CPM Report on technical, operational and regulatory/procedural matters to be considered by the 2003 World Radiocommunication Conference

GENEVA, 2002

PREFACE

This CPM Report to the 2003 World Radiocommunication Conference (WRC-03) was prepared in response to Resolution 1156 of the ITU Council to assist those who will be involved in the preparations for and deliberations at WRC-03. The Report was prepared and approved by the CPM at its second meeting, 18 - 29 November 2002. The Report is structured to generally follow the topics of the WRC-03 Agenda and its contents follow the outline approved by the first meeting of the CPM which was held during the week following WRC-2000. A cross-reference list is provided to facilitate finding specific topics within the framework of the WRC-03 Agenda. This Report comprises seven Chapters and one Annex**.**

The Report represents the best information on technical, operational and regulatory/procedural issues relevant to the WRC-03 Agenda available at the time of its preparation and should provide a good basis for the discussions at the Conference.

Robert W. Jones
Director Radiocommunication Bureau

Cross-reference between the WRC-03 agenda items and the chapters of the CPM Report

WRC-03 agenda item		Section of the CPM Report to WRC-03
1.	on the basis of proposals from administrations and the Report of the Conference Preparatory Meeting, taking account of the results of WRC-2000, and with due regard to the requirements of existing and future services in the bands under consideration, to consider and take appropriate action with respect to the following items:	
1.1	requests from administrations to delete their country footnotes or to have their country name deleted from footnotes, if no longer required, in accordance with Resolution **26 (Rev.WRC-97)**	Not in scope of CPM
1.2	to review and take action, as required, on No. **5.134** and related Resolutions **517 (Rev.WRC-97)** and **537 (WRC-97)** and Recommendations **515 (Rev.WRC-97)**, **517 (Rev.WRC-2000)**, **519 (WARC-92)** and Appendix **S11**, in the light of the studies and actions set out therein, having particular regard to the advancement of new modulation techniques, including digital techniques, capable of providing an optimum balance between sound quality, bandwidth and circuit reliability in the use of the HF bands allocated to the broadcasting service	Chapter 5, § 5.1
1.3	to consider identification of globally/regionally harmonized bands, to the extent practicable, for the implementation of future advanced solutions to meet the needs of public protection agencies, including those dealing with emergency situations and disaster relief, and to make regulatory provisions, as necessary, taking into account Resolution **645 (WRC-2000)**	Chapter 2, § 2.1
1.4	to consider the results of studies related to Resolution **114 (WRC-95)**, dealing with the use of the band 5 091-5 150 MHz by the fixed-satellite service (Earth-to-space) (limited to non-GSO MSS feeder links), and review the allocations to the aeronautical radionavigation service and the fixed-satellite service in the band 5 091-5 150 MHz	Chapter 1, § 1.1
1.5	to consider, in accordance with Resolution **736 (WRC-2000)**, regulatory provisions and spectrum requirements for new and additional allocations to the mobile, fixed, Earth exploration-satellite and space research services, and to review the status of the radiolocation service in the frequency range 5 150-5 725 MHz, with a view to upgrading it, taking into account the results of ITU-R studies	Chapter 2, § 2.2
1.6	to consider regulatory measures to protect feeder links (Earth-to-space) for the mobile-satellite service which operate in the band 5 150-5 250 MHz, taking into account the latest ITU-R Recommendations (for example, Recommendations ITU-R S.1426, ITU-R S.1427 and ITU-R M.1454)	Chapter 2, § 2.3
1.7	to consider issues concerning the amateur and amateur-satellite services:	Chapter 5, § 5.2
1.7.1	possible revision of Article **25**	Chapter 5, § 5.2.1
1.7.2	review of the provisions of Article **19** concerning the formation of call signs in the amateur services in order to provide flexibility for administrations	Chapter 5, § 5.2.2
1.7.3	review of the terms and definitions of Article **1** to the extent required as a consequence of changes made in Article **25**	Chapter 5, § 5.2.3
1.8	to consider issues related to unwanted emissions:	Chapter 6, § 6.1
1.8.1	consideration of the results of studies regarding the boundary between spurious and out-of-band emissions, with a view to including the boundary in Appendix **3**	Chapter 6, § 6.1.1
1.8.2	consideration of the results of studies, and proposal of any regulatory measures regarding the protection of passive services from unwanted emissions, in particular from space service transmissions, in response to *recommends* 5 and 6 of Recommendation **66 (Rev.WRC-2000)**	Chapter 6, § 6.1.2

1.9	to consider Appendix **13** and Resolution **331 (Rev.WRC-97)** with a view to their deletion and, if appropriate, to consider related changes to Chapter SVII and other provisions of the Radio Regulations, as necessary, taking into account the continued transition to and introduction of the Global Maritime Distress and Safety System (GMDSS)	Chapter 5, § 5.3
1.10	to consider the results of studies, and take necessary actions, relating to:	Chapter 5, § 5.4
1.10.1	exhaustion of the maritime mobile service identity numbering resource (Resolution **344 (WRC-97)**)	Chapter 5, § 5.4.1
1.10.2	shore-to-ship distress communication priorities (Resolution **348 (WRC-97)**)	Chapter 5, § 5.4.2
1.11	to consider possible extension of the allocation to the mobile-satellite service (Earth-to-space) on a secondary basis in the band 14-14.5 GHz to permit operation of the aeronautical mobile-satellite service as stipulated in Resolution **216 (Rev.WRC-2000)**	Chapter 2, § 2.4
1.12	to consider allocations and regulatory issues related to the space science services in accordance with Resolution **723 (Rev.WRC-2000)** and to review all Earth exploration-satellite service and space research service allocations between 35 and 38 GHz, taking into account Resolution **730 (WRC-2000)**	Chapter 2, § 2.5
	Resolution **723 (Rev.WRC-2000),** *resolves 1*	Chapter 2, § 2.5.1
	Resolution **723 (Rev.WRC-2000),** *resolves 2*	Chapter 2, § 2.5.3
	Resolution **723 (Rev.WRC-2000),** *resolves 3*	Chapter 2, § 2.5.3
	Resolution **723 (Rev.WRC-2000),** *resolves 4*	Chapter 2, § 2.5.4
	Resolution **730 (WRC-2000)**	Chapter 2, § 2.5.5
1.13	to consider regulatory provisions and possible identification of existing frequency allocations for services which may be used by high altitude platform stations, taking into account No. **5.543A** and the results of the ITU-R studies conducted in accordance with Resolutions **122 (Rev.WRC-2000)** and **734 (WRC-2000)**	Chapter 4, § 4.1
1.14	to consider measures to address harmful interference in the bands allocated to the maritime mobile and aeronautical mobile (R) services, taking into account Resolutions **207 (Rev.WRC-2000)** and **350 (WRC-2000)**, and to review the frequency and channel arrangements in the maritime MF and HF bands concerning the use of new digital technology, also taking into account Resolution **347 (WRC-97)**	Chapter 5, § 5.5
1.15	to review the results of studies concerning the radionavigation-satellite service in accordance with Resolutions **604 (WRC-2000)**, **605 (WRC-2000)** and **606 (WRC-2000)**	Chapter 1, § 1.2
	Resolutions **604 (WRC-2000)**	Chapter 1, § 1.2.1
	Resolutions **605 (WRC-2000)**	Chapter 1, § 1.2.2
	Resolutions **606 (WRC-2000)**	Chapter 1, § 1.2.3
1.16	to consider allocations on a worldwide basis for feeder links in bands around 1.4 GHz to the non-GSO MSS with service links operating below 1 GHz, taking into account the results of ITU-R studies conducted in response to Resolution **127 (Rev.WRC-2000)**, provided that due recognition is given to the passive services, taking into account No. **5.340**	Chapter 2, § 2.6
1.17	to consider upgrading the allocation to the radiolocation service in the frequency range 2 900-3 100 MHz to primary	Chapter 1, § 1.3
1.18	to consider a primary allocation to the fixed service in the band 17.3-17.7 GHz for Region 1, taking into account the primary allocations to various services in all three Regions	Chapter 4, § 4.2
1.19	to consider regulatory provisions to avoid misapplication of the non-GSO FSS single-entry limits in Article **22** based on the results of ITU-R studies carried out in accordance with Resolution **135 (WRC-2000)**	Chapter 3, § 3.1

1.20	to consider additional allocations on a worldwide basis for the non-GSO MSS with service links operating below 1 GHz, in accordance with Resolution **214 (Rev.WRC-2000)**	Chapter 2, § 2.7
1.21	to consider progress of the ITU-R studies concerning the technical and regulatory requirements of terrestrial wireless interactive multimedia applications, in accordance with Resolution **737 (WRC-2000)**, with a view to facilitating global harmonization	Chapter 7, § 7.1
1.22	to consider progress of ITU-R studies concerning future development of IMT-2000 and systems beyond IMT-2000, in accordance with Resolution **228 (WRC-2000)**	Chapter 7, § 7.2
1.23	to consider realignment of the allocations to the amateur, amateur-satellite and broadcasting services around 7 MHz on a worldwide basis, taking into account Recommendation **718 (WARC-92)** "Alignment of allocations in the 7 MHz band allocated to the amateur service"	Chapter 5, § 5.6
1.24	to review the usage of the band 13.75-14 GHz, in accordance with Resolution **733 (WRC-2000)**, with a view to addressing sharing conditions	Chapter 1, § 1.4
1.25	to consider, with a view to global harmonization to the greatest extent possible, having due regard to not constraining the development of other services, and in particular of the fixed service and broadcasting-satellite service, regulatory provisions and possible identification of spectrum for high-density systems in the fixed-satellite service above 17.3 GHz, focusing particularly on frequency bands above 19.7 GHz	Chapter 4, § 4.3
1.26	to consider the provisions under which earth stations located on board vessels could operate in fixed-satellite service networks, taking into account the ITU-R studies in response to Resolution **82 (WRC-2000)**	Chapter 4, § 4.4
1.27	to review, in accordance with Resolutions **540 (WRC-2000)** and **735 (WRC-2000)**, the ITU-R studies requested in those Resolutions, and modify, as appropriate, the relevant regulatory procedures and associated sharing criteria contained in Appendices **30** and **30A** and in the associated provisions	Chapter 3, § 3.2
1.28	to permit the use of the band 108-117.975 MHz for the transmission of radionavigation satellite differential correction signals by ICAO standard ground-based systems	Chapter 1, § 1.5
1.29	to consider the results of studies related to Resolutions **136 (WRC-2000)** and **78 (WRC-2000)** dealing with sharing between non-GSO and GSO systems	Chapter 3, § 3.3
1.30	to consider possible changes to the procedures for the advance publication, coordination and notification of satellite networks in response to Resolution **86** (Minneapolis, 1998)	Chapter 3, § 3.4
1.31	to consider the additional allocations to the mobile-satellite service in the 1-3 GHz band, in accordance with Resolutions **226 (WRC-2000)** and **227 (WRC-2000)**	Chapter 2, § 2.8
1.32	to consider technical and regulatory provisions concerning the band 37.5-43.5 GHz, in accordance with Resolutions **128 (Rev.WRC-2000)** and **84 (WRC-2000)**	Chapter 4, § 4.5
1.33	to review and revise technical, operational and regulatory provisions, including provisional limits in relation to the operation of high altitude platform stations within IMT-2000 in the bands referred to in No. **5.388**, in response to Resolution **221 (WRC-2000)**	Chapter 2, § 2.9
1.34	to review the results of studies in response to Resolution **539 (WRC-2000)** concerning threshold values for non-GSO BSS (sound) in the band 2 630-2 655 MHz, and to take actions as required	Chapter 3, § 3.5
1.35	to consider the report of the Director of the Radiocommunication Bureau on the results of the analysis in accordance with Resolution **53 (Rev.WRC-2000)** and take appropriate action	Chapter 3, § 3.6
1.36	to examine the adequacy of the frequency allocations for HF broadcasting from about 4 MHz to 10 MHz, taking into account the seasonal planning procedures adopted by WRC-97	Chapter 5, § 5.7
1.37	to consider the regulatory and technical provisions for satellite networks using highly elliptical orbits	Chapter 3, § 3.7

1.38	to consider provision of up to 6 MHz of frequency spectrum to the Earth exploration-satellite service (active) in the frequency band 420-470 MHz, in accordance with Resolution **727 (Rev.WRC-2000)**	Chapter 2, § 2.10
1.39	to examine the spectrum requirements in the fixed-satellite service bands below 17 GHz for telemetry, tracking and telecommand of fixed-satellite service networks operating with service links in the frequency bands above 17 GHz	Chapter 3, § 3.8
2.	to examine the revised ITU-R Recommendations incorporated by reference in the Radio Regulations communicated by the Radiocommunication Assembly, in accordance with Resolution **28 (Rev.WRC-2000)**, and to decide whether or not to update the corresponding references in the Radio Regulations, in accordance with principles contained in the Annex to Resolution **27 (Rev.WRC-2000)**	Chapter 6, § 6.2
3.	to consider such consequential changes and amendments to the Radio Regulations as may be necessitated by the decisions of the conference	Not in scope of CPM
4.	in accordance with Resolution **95 (Rev.WRC-2000)**, to review the resolutions and recommendations of previous conferences with a view to their possible revision, replacement or abrogation	Chapter 6, § 6.3
5.	to review, and take appropriate action on, the report from the Radiocommunication Assembly submitted in accordance with Nos. 135 and 136 of the Convention	Not in scope of CPM
6.	to identify those items requiring urgent action by the radiocommunication study groups in preparation for the next world radiocommunication conference	Not in scope of CPM
7	in accordance with Article 7 of the Convention:	
7.1	to consider and approve the Report of the Director of the Radiocommunication Bureau on the activities of the Radiocommunication Sector since WRC-2000, including on any difficulties or inconsistencies encountered in the application of the Radio Regulations, and action in response to Resolution **80** (**Rev.WRC-2000**)	Chapter 6, § 6.4
7.2	to recommend to the Council items for inclusion in the agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, taking into account Resolution **801 (WRC-2000)**	Chapter 7, § 7.3

List of the abbreviations

App.	Appendix
Art.	Article
BR	Radiocommunication Bureau
DNR	Draft new Recommendation
DRR	Draft revised Recommendation
GSO	Geostationary
non-GSO	non-geostationary
Rec.	Recommendation
Res.	Resolution
RR	Radio Regulations

AMS	aeronautical mobile service
AMSS	aeronautical mobile-satellite service
ARNS	aeronautical radionavigation service
ARNSS	aeronautical radionavigation-satellite service
BS	broadcasting service
BSS	broadcasting-satellite service
EESS	Earth exploration-satellite service
FS	fixed service
FSS	fixed-satellite service
ISS	inter-satellite service
LMS	land mobile service
LMSS	land mobile-satellite service
MetAids	meteorological aids service
MetSat	meteorological-satellite service
MMS	maritime mobile service
MMSS	maritime mobile-satellite service
MRNS	maritime radionavigation service
MRNSS	maritime radionavigation-satellite service
MS	mobile service
MSS	mobile-satellite service
RAS	radio astronomy service
RDS	radiodetermination service
RDSS	radiodetermination-satellite service
RLS	radiolocation service
RLSS	radiolocation-satellite service
RNS	radionavigation service
RNSS	radionavigation-satellite service
SOS	space operation service
SRS	space research service

CPM Report to WRC-03

CONTENTS

* See Volume II

I Introduction to the CPM Report to WRC-03

This CPM Report to WRC-03 is provided to assist the ITU Member States and the Radiocommunication Sector Members who will be involved in the preparations of the 2003 World Radiocommunication Conference. It represents the best information on technical, operational and regulatory/procedural issues relevant to the WRC-03 agenda, available at the time of its preparation.

I.1 Origin and purpose of CPM-02

At its 2000 session, the ITU Council, in Resolution 1156, resolved to convene a World Radiocommunication Conference (WRC-03) from 9 June to 4 July 2003 and established the agenda on the basis of Resolution 800 (WRC-2000). At its 2002 session the Council modified its resolution with regard to the venue without changing the agenda itself (see Appendix I.1). The Plenipotentiary Conference, Marrakesh, 2002, in its Resolution COM 6/5 confirmed the dates of WRC-03 and resolved that it will be convened in Geneva (Switzerland).

The 2000 Radiocommunication Assembly by its Resolution ITU-R 2-3 re-confirmed that preparatory studies for a WRC are to be carried out by a Conference Preparatory Meeting (CPM) and appointed Mr. E. George (Germany) as the Chairman of CPM-02, Ms. V. Rawat (Canada) and Mr. M. Ghazal (Lebanon) as the Vice-Chairmen.

All administrations of the ITU Member States and the Radiocommunication Sector Members were invited to participate in the preparation of the CPM Report to WRC-03.

I.2 Organization of the ITU-R preparation for the conference

The organization of the conference preparatory work is shown in Figure I-1.

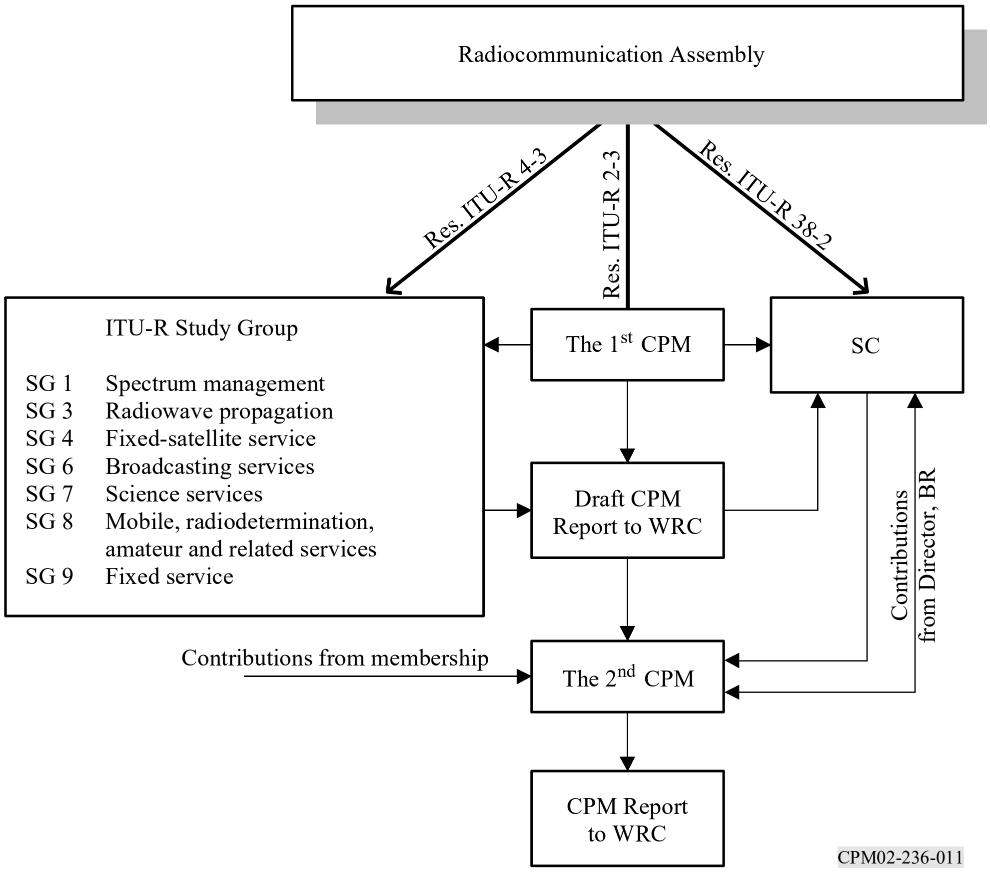
On the basis of contributions from administrations, the Radiocommunication Study Groups, the Special Committee, and other sources concerning the technical, operational and regulatory and procedural matters to be considered by radiocommunication conferences, the CPM prepares a consolidated report for such conferences, (see Resolution ITU-R 2-3).

The first Conference Preparatory Meeting (Istanbul, 7-8 June 2000) organized preparatory studies for WRC-03 and identified studies for the following WRC. A structure for the CPM Report to WRC-03 was agreed together with a preparatory process, working procedures and a chapter structure. The meeting appointed a Rapporteur for each chapter to assist the Chairman in managing the development and flow of draft report contributions.

The meeting also decided that all appropriate regulatory and procedural studies on relevant agenda items would be carried out by the Special Committee on Regulatory/Procedural matters (SCRPM), activated by WRC-2000 in accordance with Resolution ITU-R 38-2, on the basis of proposals from the membership of the ITU and the relevant ITU-R Study Groups and their Working Parties, Task Groups and Joint Task Groups. According to Resolution ITU-R 38-2 the results of the studies shall be submitted as contributions to the work of the CPM in preparing its report to the relevant WRC.

FIGURE 1-1

Organization of the ITU-R conference preparatory work



The ITU-R preparations for WRC-03 were concentrated in the following groups (listed in the order of the Study Groups):

Study Group 1 chaired by Mr. R. Mayher (USA), TG 1/7 chaired by Mr. W. Baan (the Netherlands) and Mr. S. Doiron (USA), WP 1A chaired by Mr. T. Jeacock (UK);

Study Group 3 chaired by Mr. D.G. Cole (Australia) provided technical support on propagation matters where needed.

Study Group 4 chaired by Mr. Y. Ito (Japan), WP 4A chaired by Mr. A.G. Reed (UK), WP 4-9S chaired by Mr. W. Rummler (USA), JTG 4-7-8 chaired by Ms. H. Fauve-Buresi (France);

Study Group 6 chaired by Mr. A. Magenta (Italy), WP 6E chaired by Mr. L. Olson (USA), WP 6S chaired by Mr. R. Zeitoun (Canada);

Study Group 7 chaired by Mr. R.M. Taylor (USA), WP 7B chaired by Mrs. S. Taylor (USA), WP 7C chaired by Mr. E. Marelli (ESA), WP 7D chaired by Mr. M.Ohishi (Japan), WP 7E chaired by Mr. J. Miller (USA), JTG 4-7-8-9 chaired by Mr. J. Zuzek (USA);

Study Group 8 chaired by Mr. C. van Diepenbeek (the Netherlands), WP 8A chaired by Mr. S. Towaij (Canada), WP 8B chaired by Mr. R.L. Swanson (USA), WP 8D chaired by Mr. T. Mizuike (Japan), WP 8F chaired by Mr. S. Blust (USA);

Study Group 9 chaired by Mr. V. Minkin (Russia), WP 9B and JTG 1-6-8-9 chaired by Mr. A. Hashimoto (Japan), WP 9D chaired by Ms. K. Medley (USA).

The Special Committee on Regulatory/Procedural Matters chaired by Mr. F. Rancy (France) provided the regulatory and procedural texts.

I.3 Preparation of the CPM Report to WRC-03

A draft CPM Report had been prepared by the Chapter Rapporteurs and the Chairmen of the relevant SGs, TGs and WPs on the basis of contributions from the relevant groups. The work was coordinated by Mr. E. George (Germany), Chairman of CPM-02. Staff of the Radiocommunication Bureau provided the required assistance. The draft CPM Report was distributed to all Member States and to of the Radiocommunication Sector Members as Document CPM 02-2/1.

The CPM-02 met in Geneva from 18 to 29 November 2002 under the chairmanship of Mr. E. George (Germany) to consider the draft CPM Report (Document CPM 02-2/1) together with the SCPRM Report (Document CPM02-2/2), contributions from the ITU membership and additional material submitted by the Radiocommunication Bureau.

About 1 000 participants represented 88 Member States and 80 Radiocommunication Sector Members, including international organizations.

176 contributions including the draft CPM Report (Document CPM02-2/1) and the SCPRM Report (Document CPM02-2/2) were submitted for consideration by the CPM-02.

At CPM-02 the contributions were attributed to Working Groups 1 – 7 for preparation of the final text for each Chapter according to the following adopted structure.

Chairman, CPM-02	E. George (Germany)
Vice-Chairman, CPM-02	V. Rawat (Canada)
Vice-Chairman, CPM-02	M. Ghazal (Lebanon)
Secretary, CPM-02	A. Nalbandian (ITU BR)

WG	Topic	Rapporteur	SCRPM Assistant	BR Secretary
WG 1	**RNS, RNSS. RLS issues** (Chapter 1)	V. Meens (France)	Mr. S. Sayeenathan (India)	A. Matas
WG 2	**MS/MSS and** **SSS** (Chapter 2)	A. Jamieson (New Zealand) M. Gaudreau (Cananda)	Mr. S. Sayeenathan (India) Mr. K. Kosaka (Japan)	C. Langtry
WG 3	**FSS and BSS issues** (Chapter 3)	D. Jansky (USA)	Mr. E. Davison (USA) Mr. J. Chartier (France)	J. Li
WG 4	**FS, FSS and HAPS** (Chapter 4)	M. Dreis (Germany)	Mr. E. Davison (USA) Mr. K. Kosaka (Japan)	L. Casado
WG 5	**MF and HF bands** (Chapter 5)	D. Messer (USA)	Mr. F. Williams (USA)	N. Vassiliev
WG 6	**Other matters** (Chapter 6, Introduction)	N. Kisrawi (Syria)	Mr. F. Williams (USA)	P. Lundborg
WG 7	**Future work programme** (Chapter 7)	V. Rawat (Canada)		D. Schuster

Editorial Group

F. Sillard (France)	French
L. Barclay (UK)	English
C. Menéndez (Spain)	Spanish
F. Lagrana (BR Secretary)	

Editorial work was carried out in order to align the CPM Report in the French, English and Spanish languages.

The meeting was successful in approving the CPM Report to WRC-03.

I.4 Presentation and structure of the Report

The Report is structured to follow the topics of the WRC-03 Agenda. Its outline was developed and approved by the first CPM at its meeting in June 2000. A cross-reference list is provided to facilitate finding specific topics within the framework of the WRC-03 agenda.

The Report comprises seven Chapters and an Annex.

Chapter 1 contains material relating to the RNS, RNSS and RLS (Agenda items 1.4, 1.15, 1.17, 1.24, 1.28).

Chapter 2 contains material relating to the MS, MSS and SSS (Agenda items 1.3, 1.5, 1.6, 1.11, 1.12, 1.16, 1.20, 1.31, 1.33, 1.38).

Chapter 3 covers the issues concerning FSS and BSS (Agenda items 1.19, 1.27, 1.29, 1.30, 1.34, 1.35, 1.37, 1.39).

Chapter 4 contains material relating to the FS and FSS and HAPS (Agenda items 1.13, 1.18, 1.25, 1.26, 1.32)

Chapter 5 contains material relating to the MMS, AS and ASS, and BS in MF and HF bands (Agenda items 1.2, 1.7, 1.9, 1.10, 1.14, 1.23, 1.36)

Chapter 6 contains material relating to spurious emissions (Agenda item 1.8). It also contains information for action by WRC-03 on the revised ITU-R Recommendations incorporated by reference in the Radio Regulations in accordance with Resolution **28 (Rev.WRC-2000)** (Agenda item 2), on Resolutions and Recommendations pertaining to issues arising from consideration of Resolution **95 (Rev.WRC-2000)** (Agenda item 4) and on the activities of the Radiocommunication Sector since WRC-2000 (Agenda item 7.1).

Chapter 7 contains material relating to the future work programme (Agenda items 1.21, 1.22, 7.2)

The Annex contains a list of the ITU-R Recommendations including certain draft new and revised Recommendations which are referred to in the text of this Report. The final version of this list reflecting the decisions of the 2003 Radiocommunication Assembly will be prepared by the Radiocommunication Bureau and made available to the 2003 World Radiocommunication Conference.

NOTE: The following indicators have been used throughout the text:

***** this indicates the end of the new or revised RR provision;

######### this indicates the end of the section or subsection.

APPENDIX I.1

RESOLUTION 1156 (MODIFIED)

Agenda for the World Radiocommunication Conference (WRC-03)

The Council,

noting

that Resolution 800 of the World Radiocommunication Conference (Istanbul, 2000):

a) resolved to recommend to the Council that a world radiocommunication conference be held in 2003 for a period of four weeks;

b) recommended its agenda, and invited the Council to finalize the agenda and arrange for the convening of WRC-03 and to initiate as soon as possible the necessary consultation with Member States,

resolves

to convene a World Radiocommunication Conference (WRC-03) in Caracas (Venezuela) from 9 June to 4 July 2003 with the following agenda:

1 on the basis of proposals from administrations and the Report of the Conference Preparatory Meeting, taking account of the results of WRC-2000, and with due regard to the requirements of existing and future services in the bands under consideration, to consider and take appropriate action with respect to the following items:

1.1 requests from administrations to delete their country footnotes or to have their country name deleted from footnotes, if no longer required, in accordance with Resolution **26 (Rev.WRC-97)**;

1.2 to review and take action, as required, on No.-**5.134** and related Resolutions **517 (Rev.WRC-97)** and **537 (WRC-97)** and Recommendations **515 (Rev.WRC-97)**, **517 (HFBC-87)**, **519 (WARC-92)** and Appendix **11**, in the light of the studies and actions set out therein, having particular regard to the advancement of new modulation techniques, including digital techniques, capable of providing an optimum balance between sound quality, bandwidth and circuit reliability in the use of the HF bands allocated to the broadcasting service;

1.3 to consider identification of globally/regionally harmonized bands, to the extent practicable, for the implementation of future advanced solutions to meet the needs of public protection agencies, including those dealing with emergency situations and disaster relief, and to make regulatory provisions, as necessary, taking into account Resolution **645 (WRC-2000)**;

1.4 to consider the results of studies related to Resolution **114 (WRC-95)**, dealing with the use of the band 5 091-5 150 MHz by the fixed-satellite service (Earth-to-space) (limited to non-GSO MSS feeder links), and review the allocations to the aeronautical radionavigation service and the fixed-satellite service in the band 5 091-5 150 MHz;

1.5 to consider, in accordance with Resolution **736 (WRC-2000)**, regulatory provisions and spectrum requirements for new and additional allocations to the mobile, fixed, Earth exploration-satellite and space research services, and to review the status of the radiolocation service in the frequency range 5 150-5 725 MHz, with a view to upgrading it, taking into account the results of ITU-R studies;

1.6 to consider regulatory measures to protect feeder links (Earth-to-space) for the mobile-satellite service which operate in the band 5 150-5 250 MHz, taking into account the latest ITU-R Recommendations (for example, Recommendations ITU-R S.1426, ITU-R S.1427 and ITU-R M.1454);

1.7 to consider issues concerning the amateur and amateur-satellite services:

1.7.1 possible revision of Article **25**;

1.7.2 review of the provisions of Article **19** concerning the formation of call signs in the amateur services in order to provide flexibility for administrations;

1.7.3 review of the terms and definitions of Article **1** to the extent required as a consequence of changes made in Article **25**;

1.8 to consider issues related to unwanted emissions:

1.8.1 consideration of the results of studies regarding the boundary between spurious and out-of-band emissions, with a view to including the boundary in Appendix **3**;

1.8.2 consideration of the results of studies, and proposal of any regulatory measures regarding the protection of passive services from unwanted emissions, in particular from space service transmissions, in response to *recommends* 5 and 6 of Recommendation **66 (Rev.WRC-2000)**;

1.9 to consider Appendix **13** and Resolution **331 (Rev.WRC-97)** with a view to their deletion and, if appropriate, to consider related changes to Chapter SVII and other provisions of the Radio Regulations, as necessary, taking into account the continued transition to and introduction of the Global Maritime Distress and Safety System (GMDSS);

1.10 to consider the results of studies, and take necessary actions, relating to:

1.10.1 exhaustion of the maritime mobile service identity numbering resource (Resolution **344 (WRC-97)**);

1.10.2 shore-to-ship distress communication priorities (Resolution **348 (WRC-97)**);

1.11 to consider possible extension of the allocation to the mobile-satellite service (Earth-to-space) on a secondary basis in the band 14-14.5 GHz to permit operation of the aeronautical mobile-satellite service as stipulated in Resolution **216 (Rev.WRC-2000)**;

1.12 to consider allocations and regulatory issues related to the space science services in accordance with Resolution **723 (Rev.WRC-2000)** and to review all Earth exploration-satellite service and space research service allocations between 35 and 38 GHz, taking into account Resolution **730 (WRC-2000)**;

1.13 to consider regulatory provisions and possible identification of existing frequency allocations for services which may be used by high altitude platform stations, taking into account No. **5.543A** and the results of the ITU-R studies conducted in accordance with Resolutions **122 (Rev.WRC-2000)** and **734 (WRC-2000)**;

1.14 to consider measures to address harmful interference in the bands allocated to the maritime mobile and aeronautical mobile (R) services, taking into account Resolutions **207 (Rev.WRC-2000)** and **350 (WRC-2000)**, and to review the frequency and channel arrangements in the maritime MF and HF bands concerning the use of new digital technology, also taking into account Resolution **347 (WRC-97)**;

1.15 to review the results of studies concerning the radionavigation-satellite service in accordance with Resolutions **604 (WRC-2000)**, **605 (WRC-2000)** and **606 (WRC-2000)**;

1.16 to consider allocations on a worldwide basis for feeder links in bands around 1.4 GHz to the non-GSO MSS with service links operating below 1 GHz, taking into account the results of ITU-R studies conducted in response to Resolution **127 (Rev.WRC-2000)**, provided that due recognition is given to the passive services, taking into account No. **5.340**;

1.17 to consider upgrading the allocation to the radiolocation service in the frequency range 2 900-3 100 MHz to primary;

1.18 to consider a primary allocation to the fixed service in the band 17.3-17.7 GHz for Region 1, taking into account the primary allocations to various services in all three Regions;

1.19 to consider regulatory provisions to avoid misapplication of the non-GSO FSS single-entry limits in Article **22** based on the results of ITU-R studies carried out in accordance with Resolution **135 (WRC-2000)**;

1.20 to consider additional allocations on a worldwide basis for the non-GSO MSS with service links operating below 1 GHz, in accordance with Resolution **214 (Rev.WRC-2000)**;

1.21 to consider progress of the ITU-R studies concerning the technical and regulatory requirements of terrestrial wireless interactive multimedia applications, in accordance with Resolution **737 (WRC-2000)**, with a view to facilitating global harmonization;

1.22 to consider progress of ITU-R studies concerning future development of IMT-2000 and systems beyond IMT-2000, in accordance with Resolution **228 (WRC-2000)**;

1.23 to consider realignment of the allocations to the amateur, amateur-satellite and broadcasting services around 7 MHz on a worldwide basis, taking into account Recommendation **718 (WARC-92)**;

1.24 to review the usage of the band 13.75-14 GHz, in accordance with Resolution **733 (WRC-2000)**, with a view to addressing sharing conditions;

1.25 to consider, with a view to global harmonization to the greatest extent possible, having due regard to not constraining the development of other services, and in particular of the fixed service and the broadcasting-satellite service, regulatory provisions and possible identification of spectrum for high-density systems in the fixed-satellite service above 17.3 GHz, focusing particularly on frequency bands above 19.7 GHz;

1.26 to consider the provisions under which earth stations located on board vessels could operate in fixed-satellite service networks, taking into account the ITU-R studies in response to Resolution **82 (WRC-2000)**;

1.27 to review, in accordance with Resolutions **540 (WRC-2000)** and **735 (WRC-2000)**, the ITU-R studies requested in those resolutions, and modify, as appropriate, the relevant regulatory procedures and associated sharing criteria contained in Appendices **30** and **30A** and in the associated provisions;

1.28 to permit the use of the band 108-117.975 MHz for the transmission of radionavigation satellite differential correction signals by ICAO standard ground-based systems;

1.29 to consider the results of studies related to Resolutions **136 (WRC-2000)** and **78 (WRC-2000)** dealing with sharing between non-GSO and GSO systems;

1.30 to consider possible changes to the procedures for the advance publication, coordination and notification of satellite networks in response to Resolution **86** (Minneapolis, 1998);

1.31 to consider the additional allocations to the mobile-satellite service in the 1-3 GHz band, in accordance with Resolutions **226 (WRC-2000)** and **227 (WRC-2000)**;

1.32 to consider technical and regulatory provisions concerning the band 37.5-43.5 GHz, in accordance with Resolutions **128 (Rev.WRC-2000)** and **84 (WRC-2000)**;

1.33 to review and revise technical, operational and regulatory provisions, including provisional limits in relation to the operation of high altitude platform stations within IMT-2000 in the bands referred to in No. **5.388A**, in response to Resolution **221 (WRC-2000)**;

1.34 to review the results of studies in response to Resolution **539 (WRC-2000)** concerning threshold values for non-GSO BSS (sound) in the band 2 630-2 655 MHz, and to take actions as required;

1.35 to consider the report of the Director of the Radiocommunication Bureau on the results of the analysis in accordance with Resolution **53 (Rev.WRC-2000)** and take appropriate action;

1.36 to examine the adequacy of the frequency allocations for HF broadcasting from about 4 MHz to 10 MHz, taking into account the seasonal planning procedures adopted by WRC-97;

1.37 to consider the regulatory and technical provisions for satellite networks using highly elliptical orbits;

1.38 to consider provision of up to 6 MHz of frequency spectrum to the Earth exploration-satellite service (active) in the frequency band 420-470 MHz, in accordance with Resolution **727 (Rev.WRC-2000)**;

1.39 to examine the spectrum requirements in the fixed-satellite service bands below 17 GHz for telemetry, tracking and telecommand of fixed-satellite service networks operating with service links in the frequency bands above 17 GHz;

2 to examine the revised ITU-R Recommendations incorporated by reference in the Radio Regulations communicated by the Radiocommunication Assembly, in accordance with Resolution **28 (Rev.WRC-2000)**, and to decide whether or not to update the corresponding references in the Radio Regulations, in accordance with principles contained in the Annex to Resolution **27 (Rev.WRC-2000)**;

3 to consider such consequential changes and amendments to the Radio Regulations as may be necessitated by the decisions of the conference;

4 in accordance with Resolution **95 (Rev.WRC-2000)**, to review the resolutions and recommendations of previous conferences with a view to their possible revision, replacement or abrogation;

5 to review, and take appropriate action on, the report from the Radiocommunication Assembly submitted in accordance with Nos. 135 and 136 of the Convention;

6 to identify those items requiring urgent action by the radiocommunication study groups in preparation for the next world radiocommunication conference;

7 in accordance with Article 7 of the Convention:

7.1 to consider and approve the Report of the Director of the Radiocommunication Bureau on the activities of the Radiocommunication Sector since WRC-2000, including on any difficulties or inconsistencies encountered in the application of the Radio Regulations, and action in response to Resolution **80** (**Rev.WRC-2000**);

7.2 to recommend to the Council items for inclusion in the agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, taking into account Resolution **801 (WRC-2000)**,

instructs the Director of the Radiocommunication Bureau

to make the necessary arrangements to convene the Conference Preparatory Meeting and to prepare a report to WRC-03,

instructs the Secretary-General

1 to make all the necessary arrangements, in agreement with the Director of the Radiocommunication Bureau, for the convening of the Conference;

2 to communicate this resolution to international and regional organizations concerned.

CPM Report to WRC-03

CONTENTS

* See volume I

CHAPTER 1

Radionavigation, radionavigation-satellite and radiolocation services

(WRC-03 agenda items 1.4, 1.15, 1.17, 1.24, 1.28)

CONTENTS

1.1 Agenda item 1.4

"to consider the results of studies related to Resolution **114 (WRC-95)**, dealing with the use of the band 5 091-5 150 MHz by the fixed-satellite service (Earth-to-space) (limited to non-GSO MSS feeder links), and review the allocations to the aeronautical radionavigation service and the fixed-satellite service in the band 5 091-5 150 MHz"

1.1.1 Summary of technical and operational studies including a list of relevant ITU-R Recommendations

At WRC-95, the FSS was granted co-primary status along with the ARNS in the 5 150-5 250 MHz band for the use of feeder uplinks for non-GSO MSS systems (No. **5.447A**). The frequency band 5 000-5 250 MHz is allocated on a global basis to the ARNS. The FSS is allocated on a primary basis (Earth-to-space) in the band 5 150-5 250 MHz for the use of feeder uplinks for non-GSO MSS systems (No. **5.447A**). In addition, the 5 091-5 150 MHz band was allocated on a co-primary basis to the FSS for non-GSO MSS feeder uplinks under No. **5.444A** and Resolution **114 (WRC-95)**. Resolution **114 (WRC-95)** requested ITU-R to study issues concerning sharing between ARNS and feeder links to MSS (Earth-to-space) in the band 5 091-5 150 MHz and to report results of the studies to WRC-03. The use of this band by microwave landing systems (MLS) and MSS feeder links is subject to footnotes No. **5.444** and No. **5.444A**.

The dates contained in No. **5.444A** were developed on the basis of information provided by administrations on the short-term development requirements for use of the band 5 091-5 150 MHz by the FSS. No further studies have been presented since WRC-95 to assess the future need for this band by the FSS.

Currently, only the 5 030-5 150 MHz portion has a defined ARNS attribution; namely the MLS under article No. **5.444** as modified by WRC-2000, with only the 5 030-5 091 MHz portion containing defined MLS channels. ICAO has identified the band 5 091-5 150 MHz for expansion for MLS. Results of current studies in ICAO have demonstrated that there is uncertainty of the prospective spectrum requirements for MLS for Cat II and Cat III precision approaches and landings in relation to the services that can be offered by the GNSS system. As a result, most of these MLS requirements are expected to be met in the band 5 030-5 091 MHz. Until these uncertainties have been fully addressed, the band 5 091-5 150 MHz must remain available for MLS purposes. The current radio regulatory mechanism, with an extension of the date 2010 to 2018, would meet the current aviation requirements. A further review of the allocations in this band at a future WRC (about 2010) would be necessary. It should be noted that there are also other requirements for emerging ARNS systems to be accommodated in this band. The aviation community is also exploring other applications in the 5 091-5 150 MHz band, and defining uses for the 5 150-5 250 MHz band, including perhaps provision of non-safety wideband wireless application at airports.

Two MSS systems have implemented spacecraft tracking and control operations. One system (LEO-D) has begun commercial service using the 5 091-5 250 MHz band for transmitting both user-generated telecommunications traffic and telecommand signals, from gateway earth stations to the non-GSO spacecraft. Spacecraft tracking and control operations began in the 5 091-5 250 MHz band with the launch of the first LEO-D satellite on 14 February 1998. Six gateway stations in Argentina, France, Korea, South Africa and the United States carry both command and control operations traffic and user-generated traffic. In addition, thirteen other gateway stations worldwide have been added to the network to carry user traffic. Another system (LEO-F) uses the band 5 150-5 250 MHz to support launch and service operations. That system operates eleven gateways in Australia, Brazil, Chile, Germany, India, Indonesia, Korea, Mexico, South Africa, United Arab Emirates, and United States.

Sharing between FSS and MLS is covered by Recommendation ITU-R S.1342.

Two current aviation safety objectives are to provide more information to the pilot/cockpit, and to reduce runway incursions. A proposed application in the band 5 091-5 150 MHz, the Airport Network and Location Equipment (ANLE), would address both of those goals.

In its most basic form, ANLE is a high integrity, wireless local area network (LAN) that would provide aeronautical radionavigation and safety communications for the airport area, combined with a connected grid of distributed sensors. The wireless LAN would provide the cockpit with access to appropriate information via a high-bandwidth internet-like connection. The grid of distributed sensors would use those same transmissions to derive a 3-dimensional picture of the aircraft terminal, which could then be broadcast via the same data link to provide all users with situational awareness of the airport surface. Adding simple transmitters to other surface-movement vehicles would allow for the development of a high-fidelity complete picture of the airport surface environment. The feasibility of such a wideband system in the band 5 091-5 150 MHz is currently being assessed. The International Air Transport Association (IATA) is considering a system called Airport Vehicle Position System (AVPS) to meet the ANLE requirement. The AVPS is intended to monitor surface movements, reduce runway incursion and increase airport security.

No ITU-R study is currently available for the sharing between these aeronautical applications and already allocated services. ANLE provides both radionavigation signals and communication information and the proper allocation(s) under which ANLE should operate is under study. A feasibility trial of an AVPS has been conducted in one country using adaptive wireless networks. The trial showed that the system provided aircraft and vehicles with the ability to navigate with a higher level of accuracy around the airport.

1.1.2 Analysis of the results of studies

Existing MLS operating in the band 5 030-5 091 MHz and non-GSO MSS feeder link stations operating in the band 5 091-5 250 MHz are able to function without interference, based upon the application of the coordination procedures in Recommendation ITU-R S.1342 and the operating experience gained to date. Future deployment of both MLS and non-GSO MSS facilities should be possible through coordination under Recommendation ITU-R S.1342. The common use of the 5 091-5 150 MHz band by both MLS and non-GSO MSS stations is dependent upon the extent of future deployment of these systems and the characteristics of new ARNS systems. Administrations need to investigate the continuing usage of the 5 091-5 150 MHz band by ARNS and the FSS for non-GSO MSS feeder links to determine if changes in the existing Radio Regulations covering this band are necessary.

In order to ensure a complete coverage of its service area, the initial implementation of at least one MSS system needed the use of the entire 5 091-5 250 MHz band, this being the reason for the short-term allocation to the FSS made by WRC-95. In this system, there is a one-to-one mapping between each of the frequency-division-multiplexed feeder-link radio-frequency channels and a corresponding spot-beam in the downlink service band. The removal of any frequency channel in the feeder uplink would prevent the transmission of the corresponding spot beam in the service downlink and therefore would restrict the operation of this MSS system in its initial implementation. Therefore changing feeder link assignments of the initial implementation of this MSS system below 5 150 MHz is neither expected nor would it be feasible to replace them by assignments in frequencies above 5 150 MHz.

Information presented to ITU-R in preparation for WRC-95 anticipated that future implementations of FSS systems (either new systems or the evolution of current systems) would be more spectrally efficient than those initially implemented and would be designed to operate within the band 5 150-5 250 MHz only. The time limitations placed on the status of the allocation to the FSS below 5 150 MHz relative to that of the ARNS were intended to permit the rapid deployment of the initial implementation of FSS systems and allow sufficient time for more spectrally efficient systems to be designed and implemented. No information has been provided to ITU-R to suggest that this situation has changed. However, it is apparent that the planned transition to more spectrally efficient FSS systems is taking longer than originally anticipated.

Recommendation ITU-R S.1342 provides a methodology to trigger coordination between ARNS systems (specifically MLS) operating in the band 5 030-5 091 MHz and non-GSO MSS feeder-link stations operating in the adjacent band 5091-5150 MHz. No interference has been reported by administrations that have used this methodology.

Nevertheless, this coordination process has been eased by the fact that MLS stations have been implemented effectively in the band 5 030-5 091 MHz. Therefore, the possibility of sharing between MLS of the ARNS and fixed earth stations operating feeder links in the MSS could be dependant on the future use of the 5 091-5 150 MHz band by MLS.

It is expected that if the gateway stations for the two MSS systems currently operating develop as planned, then the number of gateway stations implemented worldwide will be approximately 65.

1.1.3 Methods to satisfy the agenda item and their advantages and disadvantages

1.1.3.1 Method A

No change to Nos. **5.444** and **5.444A** and revise Resolution **114 (WRC-95)**

Advantages:

- The modification to Resolution **114** would only be to change the dates that studies would be completed. The dates could be changed to "a future competent WRC".
- Future systems in both the ARNS and the FSS could be taken into account in order to improve the evaluation of the sharing conditions between these services.

Disadvantages:

- Agenda item 1.4 will not be satisfied.

1.1.3.2 Method B

Revise Nos. **5.444** and **5.444A** and suppress Resolution **114 (WRC-95)**

The only modification to the footnotes would be to remove reference to Resolution **114**.

Advantages:

This would maintain the current relationship between the ARNS and FSS that has resulted in successful coordination between the two services. Suppression of the resolution would end the call for studies that are not necessary.

Disadvantages:

Suppression of the resolution would eliminate an existing mechanism for addressing sharing studies between new ARNS systems and MSS feeder links.

1.1.3.3 Method C

Suppress Resolution **114 (WRC-95)** and revise No. **5.444** by removing reference to Resolution **114**, and revise No. **5.444A** by removing the first condition extending the time-frames that the FSS (Earth-to-space) may remain primary in the last two conditions to allow the FSS transition above 5 150 MHz.

Advantages:

- Agenda item 1.4 will be addressed taking into account the present requirements of FSS in the band 5 091-5 250 MHz.
- Future ARNS requirements (MLS) will be addressed.

Disadvantages:

Suppression of the resolution would eliminate an existing mechanism for addressing sharing studies between new ARNS systems and MSS feeder links.

1.1.3.4 Method D

Change the dates 2008 and 2010 in No. **5.444A** to 2016 and 2018 respectively, and revise Resolution **114 (WRC-95)** accordingly, also changing WRC-01 to a future competent WRC prior to 2018 in *instructs ITU-R* 2 of that Resolution. *Instructs ITU-R* 1 of that Resolution needs to be modified according to the example given under method A. As a consequence, modify No. **5.444** to make reference to the new Resolution **114 (Rev.WRC-03)** as opposed to Resolution **114 (WRC-95)**.

Advantages:

- The modifications to No. **5.444A** and Resolution **114** would only be to change the dates contained therein.
- A future competent conference prior to 2018 would allow time for required information to be obtained, and time for decisions to be available before 2018. Future development of both ARNS and the FSS could be taken into account in order to improve the evaluation of the sharing conditions between these services.

Disadvantages:

- Agenda item 1.4 will not be satisfied.

1.1.4 Regulatory and procedural considerations

1.1.4.1 Method A

The following example is a possible modification to Resolution **114 (WRC-95)**.

MOD

RESOLUTION 114 (REV.WRC-03)

Use of the band 5 091-5 150 MHz by the fixed-satellite service (Earth-to-space) (limited to feeder links of the non-geostationary mobile-satellite service)

The World Radiocommunication Conference (Geneva, 2003),

considering

a) the current allocation of the frequency band 5 000-5 250 MHz to the aeronautical radionavigation service;

b) the requirements of both the aeronautical radionavigation and the fixed-satellite (Earth-to-space) (limited to feeder links of non-geostationary (non-GSO) mobile-satellite systems) services in the above-mentioned band,

recognizing

a) that precedence must be given to the microwave landing system (MLS) in accordance with No. **5.444** of the Radio Regulations and to other international standard systems of the aeronautical radionavigation service in the frequency band 5 000-5 150 MHz;

b) that, in accordance with Annex 10 of the Convention of the International Civil Aviation Organization (ICAO), it may be necessary to use the frequency band 5 091-5 150 MHz for the MLS if its requirements cannot be satisfied in the frequency band 5 030-5 091 MHz;

c) that the fixed-satellite service providing feeder links for non-GSO mobile-satellite services will need access to the frequency band 5 091-5 150 MHz in the short term, in order to accommodate already identified requirements,

noting

a) the necessary evolution of the current MLS and of other international standard systems in the aeronautical radionavigation service implementation plans;

b) the small number of fixed-satellite service stations to be considered;

c) the development of new systems that will provide supplemental navigation information integral to the aeronautical radionavigation service will reduce runway incursions, increase airport security and provide a high-fidelity complete picture of the airport surface environment,

resolves

1 that administrations authorizing stations providing feeder links for non-GSO mobile-satellite systems in the frequency band 5 091-5 150 MHz shall ensure that they do not cause harmful interference to stations of the aeronautical radionavigation service;

2 that the allocation to the aeronautical radionavigation service and the fixed-satellite service in the frequency band 5 091-5 150 MHz should be reviewed at a future competent conference,

urges administrations

1 when authorizing stations of the aeronautical radionavigation service, to assign frequencies giving priority to the band below 5 091 MHz;

2 when assigning frequencies in the band 5 091-5 150 MHz before 1 January 2010 to stations of the aeronautical radionavigation service or to stations of the fixed-satellite service providing feeder links of the non-GSO mobile-satellite service (Earth-to-space), to take all practicable steps to avoid mutual interference between them,

instructs ITU-R

1 to study in the appropriate time frame the technical and operational issues relating to sharing of this band between the aeronautical radionavigation service and the fixed-satellite service providing feeder links of the non-GSO mobile-satellite service (Earth-to-space);

2 to bring the results of these studies to the attention of a future competent conference,

invites

1 ICAO to further review, within the same time-frame, detailed spectrum requirements and planning for international standard aeronautical radionavigation systems in the above-mentioned band;

2 all members of the Radiocommunication Sector, and especially ICAO, to participate actively in such studies,

requests the Secretary-General

to bring this Resolution to the attention of ICAO.

1.1.4.2 Method B

The only modification to Nos. **5.444** and **5.444A** would be to remove reference to Resolution **114** and suppress Resolution **114**.

1.1.4.3 Method C

It would be necessary to suppress Resolution **114 (WRC-95)** and modify Nos. **5.444** and **5.444A** as proposed in the following example.

MOD

5.444 The band 5 030-5 150 MHz is to be used for the operation of the international standard system (microwave landing system) for precision approach and landing. The requirements of this system shall take precedence over other uses of this band. For the use of this band, No. **5.444A** applies.

MOD

5.444A *Additional allocation:* the band 5 091-5 150 MHz is also allocated to the fixed-satellite service (Earth-to-space) on a primary basis. This allocation is limited to feeder links of non-geostationary mobile-satellite systems and is subject to coordination under No. **9.11A**.

In the band 5 091-5 150 MHz, the following conditions also apply:

– prior to 1 January 2018, the requirements of existing and planned international standard systems for the aeronautical radionavigation service which cannot be met in the 5 000-5 091 MHz band, shall take precedence over other uses of this band;

- after 1 January 2008, no new assignments shall be made to stations providing feeder links of non-geostationary mobile-satellite systems;
- after 1 January 2018, the fixed-satellite service will become secondary to the aeronautical radionavigation service.

1.1.4.4 Method D

The only regulatory changes necessary would be to change the dates 2008 and 2010 in No. **5.444A** and Resolution **114** to 2016 and 2018 respectively, and change the reference of WRC-01 in Resolution **114** to a future competent conference prior to 2018. *Resolves* 1 of Resolution **114** would be deleted, because it is not required once the normal date for bringing the Final Acts of WRC-95 into force is passed. As a consequence, modify No. **5.444** to make reference to the new Resolution **114 (Rev.WRC-03)** as opposed to Resolution **114 (WRC-95)**.

#########

1.2 Agenda item 1.15

"to review the results of studies concerning the radionavigation-satellite service in accordance with Resolutions **604 (WRC-2000)**, **605 (WRC-2000)** and **606 (WRC-2000)**"

1.2.1 Resolution 605 (WRC-2000), band 1 164-1 215 MHz

"Use of the frequency band 1 164-1 215 MHz by systems of the radionavigation-satellite service (space-to-Earth)"

1.2.1.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Relevant RR provisions: No. **5.328A**

Relevant ITU-R Recommendations: DNR ITU-R M.[RNSS1] and M.[RNSS2].

Studies have been carried out by ITU-R in response to Resolution **605 (WRC-2000)**. Among the studies conducted are an assessment of the impact of RNSS into ARNS receivers, an assessment of the impact of ARNS into RNSS receivers, and a determination of whether there is a need for an aggregate epfd limit to ensure the protection of ARNS receivers (combined with a methodology to derive the aggregate equivalent pfd from all RNSS systems in the bands 1 164-1 215 MHz).

1.2.1.2 Analysis of the results of studies

ITU-R conducted studies on the overall compatibility between planned RNSS and current ARNS systems.

1.2.1.2.1 Impact of RNSS into ARNS receivers

An aggregate equivalent pfd by all RNSS transmissions that is less than or equal to -121.5 dB(W/m^2) in any 1 MHz in the 1 164-1 215 MHz band should be sufficient to protect ARNS receivers from harmful interference. This value was derived using an agreed analytic methodology (see DNR ITU-R M.[RNSS1]).

In addition, DNR ITU-R M.[RNSS2] provides the methodologies to be used in order to determine the compliance of RNSS systems with the aggregate protection criterion.

1.2.1.2.2 Impact of ARNS into RNSS receivers

Regarding the impact of current ARNS systems on RNSS receivers and taking into account RNSS receiver characteristics described in ITU-R, a two-step analysis was performed: the first step consists of a theoretical simulation based on worst-case assumptions, the second step is based on flight measurements.

The first step demonstrated that RNSS receivers used on board aircraft may experience a significant increase in the noise level at high altitude when exposed to a large number of ARNS (DME/TACAN) ground beacons within their receiver passband. The capacity for wideband RNSS receivers (20 MHz) to operate at all altitudes would depend on the minimum wanted wideband RNSS signal power.

The second step corresponding to the flight environment measurements in the 1 164-1 215 MHz band over Europe (worst case over the world), has shown by comparison that the simulation tool provides quite realistic results of the RF environment.

However, based on current ARNS (DME/TACAN) system characteristics, several mitigation techniques have been explored to avoid any harmful interference from these ARNS systems to the RNSS systems. Therefore, the RNSS receiver architecture can be designed to operate in the same band as ARNS (DME/TACAN), while not claiming protection as required in No. **5.328A**.

1.2.1.3 Method to satisfy the agenda item

Aggregate protection criterion for ARNS incorporated into the Radio Regulations with compliance to be assured by administrations.

This method mandates the provision of aggregate interference protection to the ARNS at the level identified in ITU-R studies, regardless of the number of RNSS systems operating in the band. It commits enforcement of the requirement to those administrations that operate or intend to operate RNSS systems. The aggregate protection criterion for ARNS would be specified in a Resolution (an epfd of -121.5 dB(W/m^2) in any 1 MHz of the 1 164-1 215 MHz band) that leaves to administrations the obligation to assure that protection is provided.

This method would manage the total amount of interference caused by these systems through the collaborative agreement on the part of administrations proposing and operating the RNSS systems, and there would be no additional regulatory task for the BR to validate compliance with the protection criterion.

There would be a need for coordination between RNSS administrations having GSO/non-GSO networks under Article **9**, and associated transitional measures, that would entail discussion between RNSS operators. This process would commence at an early point in the implementation of the system.

There would also be a need for consultation among RNSS administrations under the provisions of the proposed new resolution and associated provisions in the Radio Regulations to ensure that the aggregate protection criterion is met. Since RNSS operators should know sufficiently in advance the conditions under which their systems would operate, the consultations should be open to any administration having sent complete coordination or notification information to the Radiocommunication Bureau. However, only "real" systems should be included in the calculations. A mechanism needs to be put into place to determine which systems are "real" for purposes of participating in the calculations.

RNSS administrations would send the results of the aggregate protection criterion calculation to the BR for publication. This publication could take the form of a simple notification that agreement was reached or, alternatively, could be in a form that would also permit any administration to verify compliance with the aggregate protection criterion.

In addition, the method includes a provision that would prohibit any single RNSS system from using up the entire interference allowance for all RNSS systems, to ensure the equitable sharing of the available aggregate interference allowance. Agreement has yet to be reached as to whether this provision should take the form of single-entry limits or of a provision in a Resolution.

It is acknowledged that it would be difficult for systems already put into service to modify their characteristics to allow for the entry of new systems, if required as a result of the consultations, and that the aggregate interference allowance is a finite resource.

The method also addresses the Radio Regulations Board's (RRB) concerns about having multiple inconsistent regulations applicable to the same band.

ICAO was invited to, and did, participate in the ITU-R studies that led to the development of this approach.

1.2.1.4 Regulatory and procedural considerations

The existing No. **5.328A** to the allocation 1 164-1 215 MHz contains a double, and thereby potentially confusing provision for the protection of DME (i.e. "shall not cause harmful interference" and "shall not exceed a pfd"). RRB discussions have indicated that such double provisions create confusion. In order to eliminate this confusion, the footnote would be modified to remove the "shall not cause harmful interference" reference, and to retain the "shall not claim protection" reference and state additionally that provision of No. **5.43A** does not apply. In addition, the provisional pfd value would be removed and be replaced with a reference to a new Resolution containing the aggregate epfd limit.

Non-GSO RNSS systems would be made subject to Article **9** coordination obligations with respect to each other and with GSO RNSS systems (Nos. **9.12** and **9.12A**), and GSO RNSS systems would be required to coordinate with non-GSO RNSS systems under No. **9.13.** It is noted that GSO RNSS systems are already obliged to coordinate with each other under No. **9.7**.

Finally, development of this multi-step approach would enable WRC-03 to suppress Resolution **605 (WRC-2000)**.

Examples of how to implement the method described above are included in Annex 1.2.1-1. Each of the examples, as a whole, achieves the principles of the method. The examples differ from each other slightly in the approach they take to achieve the principles of the method.

From a regulatory point of view, one of the unresolved issues of the method described in Section 1.2.1.3 concerns the regulatory implementation of the mechanism that is needed to determine which systems will be considered as "real" for purposes of participating in the calculations. Examples 1 and 3 take the approach that this mechanism should be in the form of milestones that are included in an annex to the resolution containing the aggregate protection criterion. An approach was suggested within ITU-R in order to alleviate regulatory concerns associated with the milestone approach. This approach, described in Example 2, would give the responsibility to develop such a "realness" mechanism directly to the consultation meeting. Under this approach administrations, in compliance with the special arrangements referenced in Article 42 of the ITU Constitution, shall establish, at the consultation meeting, mechanisms to ensure that only real systems are taken into account in the calculation of the aggregate epfd.

Example 1

Example 1 takes the following general approach:

- Modification of No. **5.328A** as described above. In addition, the footnote would also be modified to specify that use of the band 1 164-1 215 MHz by the RNSS (space-to-Earth) is subject to the application of the provisions of Nos. **9.12**, **9.12A**, and **9.13**; and to specify that the provisions of new No. **21.18** apply.
- Addition of a new section to Article **21** (No. **21.18**) that incorporates new Resolution **[RNSS 1.2.1-1]** into the Radio Regulations.
- Adoption of new Resolution **[RNSS 1.2.1-1]** that applies to all RNSS systems for which coordination or notification information, as appropriate, was received after 2 June 2000, and states that all RNSS systems together shall not exceed the aggregate epfd level of −121.5 dB(W/m^2) in any 1 MHz of the 1 164-1 215 MHz band. The Resolution also provides milestone criteria as a mechanism for determining the RNSS systems entitled to engage in the apportioning of the aggregate interference allowance among themselves. However, all administrations having notified RNSS networks/systems in this frequency band should attend the consultations. Administrations participating in this consultation process should meet on a regular basis (e.g. yearly), the first to be held within six months of the end of WRC-03 by any administration with a filed RNSS system. The Resolution directs that the results of aggregate sharing determinations be communicated to the Bureau (which would publish the results for information). The new Resolution may also include a provision that prohibits any single RNSS system from using up the entire interference allowance for all RNSS systems. There should be no priority in sharing the aggregate epfd value between RNSS networks/systems in this frequency band.
- Suppression of Resolution **605 (WRC-2000)**.

Example 2

Example 2 takes the following general approach:

- Modification of No. **5.328A** as described above. In addition, the footnote would also be modified to specify that use of the band 1 164-1 215 MHz by the RNSS is subject to the application of the provisions of Nos. **9.12**, **9.12A**, and **9.13**, and include a reference to a new Resolution containing the aggregate epfd limit.
- Adoption of new Resolution **[RNSS 1.2.1-2]** that applies to all RNSS systems for which coordination or notification information, as appropriate, was received after 2 June 2000, and states that all RNSS systems together shall not exceed the aggregate epfd level of −121.5 dB(W/m^2) in any 1 MHz of the 1 164-1 215 MHz band. This new Resolution states that all administrations subject to the Resolution shall take all necessary steps, including by means of appropriate modifications to their systems or networks, to ensure that the aggregate interference into ARNS systems caused by such RNSS systems or networks operating in these frequency bands does not exceed the level of the aggregate protection criterion.
- Equitable access to spectrum would be ensured through a set of two "per-satellite" pfd limits incorporated in Article **21** and applicable as of 3 June 2000. These limits are derived from the aggregate limit, and answer to the double concern of ensuring access to the resource to a certain amount of RNSS systems while not constraining these systems (considering the current design of planned systems). A first "per-satellite" pfd limit in

51 MHz of –118 dB(W/(m^2 · 51 MHz)) would ensure that a single system does not take more than a certain percentage of the total "power x frequency" resource (20%, leaving enough resource for at least 5 constellations similar to Galileo, GLONASS or GPS, i.e. about 150 satellites). A second limit "per-satellite" pfd limit in 1 MHz of –129 dB(W/(m^2 · MHz)) would ensure that a wideband signal of a given system may overlap with any narrow-band signal of another system. For both "per-satellite" pfd limits, the values stated for application were presented to ITU-R, but were not agreed.

- Transparency of the consultation process would be ensured through publication for information by BR in the International Frequency Information Circular of all RNSS characteristics used for verifying compliance with the aggregate epfd limit, as well as of the calculated aggregate epfd.
- A second Resolution **[RNSS 1.2.1-3]** would contain transitional measures for Article **9** coordination between RNSS systems for which coordination or notification information was received after 2 June 2000 and before the end of WRC-03. The objective is to ensure that "per satellite" limits proposed for inclusion in Article **21** will apply as of 3 June 2000, and to put back into order the coordination queue, including re-publication by BR of the coordination/notification data as coordination information.
- Suppression of Resolution **605 (WRC-2000)**.

Example 3

Example 3 has the same overall structure as Example 1. It differs, however, in the manner in which the allocation is presented in Article **5** (table as opposed to footnote) and also in the details of the example milestones. It also adds some elements similar to Example 2 to include the idea of transitional measures. It contains a footnote **5.328A**, Resolution **[RNSS-1.2.1-4] (WRC-03)**, Resolution **[RNSS-1.2.1-5] (WRC-03)**, and reference to consequential changes to RR Appendix **4**.

ANNEX 1.2.1-1

Examples of how to implement the method described in Section 1.2.1.3

A Example 1

The following is Example 1 of the package of regulatory provisions that would allow the method under Section 1.2.1.3 to be implemented:

1 Modify No. **5.328A** to remove the aggregate power flux-density limit and the "shall not cause harmful interference" provision, but specify in the footnote both that RNSS systems shall not claim protection from ARNS systems (with No. **5.43A** not being applicable), and that the provisions of new Resolution **[RNSS 1.2.1-1] (WRC-03)** shall apply. In addition, the regulation would include references to a new provision in Article **21** (see No. 2 below) and to the formal coordination obligations of Nos. **9.12, 9.12A,** and **9.13**. No. **5.328A**, modified in this fashion, would read as follows:

MOD

5.328A *Additional allocation:* the band 1 164-1 215 MHz is also allocated to the radionavigation-satellite service (space-to-Earth) (space-to-space) on a primary basis. Stations in the radionavigation-satellite service in the band 1 164-1 215 MHz shall operate in accordance with the provisions of Resolution **[RNSS 1.2.1-1] (WRC-03)** and shall not claim protection from stations in the aeronautical-radionavigation service. No. **5.43A** does not apply. Use of the band 1

164-1 215 MHz by the radionavigation-satellite service is subject to the application of the provisions of Nos. **9.12**, **9.12A**, and **9.13**. The provisions of No. **21.18** apply.

*****

2 Include in the Radio Regulations (perhaps in a new Section of Article **21**) a provision that makes mandatory the collective obligation of administrations operating RNSS systems at 1 164-1 215 MHz to ensure that the aggregate protection criterion from *resolves* 1 of Resolution **[RNSS 1.2.1-1]** (see No. 4 below) is not exceeded, as well as the requirement to reduce emissions if administrations operating ARNS systems identify excess emission levels. The provision could read as follows:

ADD

Section VI – Protection of aeronautical radionavigation service systems from aggregate emissions of space stations of radionavigation-satellite service systems in the 1 164-1 215 MHz band

21.18 § 7 Administrations operating or planning to operate radionavigation-satellite service systems or networks in the 1 164-1 215 MHz frequency band, for which complete coordination or notification information, as appropriate, was received by the Bureau after 2 June 2000, shall, in accordance with *resolves* 2 of Resolution **[RNSS 1.2.1-1] (WRC-03)**, take all necessary steps to ensure that the actual aggregate interference into aeronautical radionavigation service systems caused by such RNSS systems or networks operating co-frequency in these frequency bands does not exceed the equivalent power flux-density level shown in *resolves* 1 of Resolution **[RNSS 1.2.1-1] (WRC-03)**.

*****

3 Modify Table 5-1 of Appendix **5** to specify an overlapping band as a coordination threshold under Article No. **9.7** in the band 1 164-1 215 MHz.

*****

4 Adopt Resolution **[RNSS 1.2.1-1] (WRC-03)**, which could take the following form:

RESOLUTION [RNSS 1.2.1-1] (WRC-03)

Protection of aeronautical radionavigation service systems from the equivalent power flux-density produced by radionavigation-satellite service networks and systems in the 1 164-1 215 MHz frequency band

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that the band 960-1 215 MHz is allocated on a primary basis to the aeronautical radionavigation service (ARNS) in all Regions;

b) that the band 1 164-1 215 MHz is also allocated on a primary basis to the radionavigation-satellite service (RNSS), subject to the condition in No. **5.328A** that operation of RNSS systems shall be in accordance with this Resolution;

c) that protection of the ARNS from harmful interference can be achieved if the value of the equivalent power flux-density (epfd) produced by all the space stations of all RNSS systems in the band referred to in *considering a)* does not exceed the level of −121.5 dB(W/m^2) in any 1 MHz band;

d) that WRC-2000 adopted Resolution **605 (WRC-2000)** to provide for implementation of a provisional aggregate power flux-density limit during the period between WRC-2000 and WRC-03, and requested ITU-R studies on the need for an aggregate pfd limit, and revision, if necessary, of the provisional pfd limit given in No. **5.328A**;

e) that only a limited number of RNSS systems are expected to be deployed in the 1 164-1 215 MHz band, and only a few of these systems at most would have overlapping frequencies;

f) that ARNS systems can be protected without placing undue constraints on the development and operation of RNSS systems in this band;

g) that to achieve the objectives in *considering f)*, administrations operating RNSS systems will need to agree cooperatively through consultation meetings to achieve the level of protection for ARNS systems that is stated in *considering c)*;

h) that it may be appropriate for representatives of administrations operating ARNS systems to be involved in determinations made pursuant to *considering g)*,

resolves

1 that, in order to protect ARNS systems, administrations shall ensure, without validation by the Radiocommunication Bureau pursuant either to No. **11.31** or **9.35** of the Radio Regulations, that the equivalent power flux density level produced by all space stations of all RNSS systems does not exceed the level –121.5 dB(W/m^2) in any 1 MHz band;

2 that administrations operating or planning to operate in the 1 164-1 215 MHz frequency band RNSS systems or networks for which complete coordination or notification information, as appropriate, was received by the Radiocommunication Bureau after 2 June 2000, in collaboration, shall take all necessary steps, including by means of appropriate modifications to their systems or networks, to ensure that the aggregate interference into ARNS systems caused by such RNSS systems or networks operating co-frequency in these frequency bands does not exceed the level of the aggregate protection criterion given in *resolves* 1 above;

3 that administrations, in carrying out their obligations under *resolves* 1 and 2 above, shall take into account only those RNSS systems with frequency assignments in the band 1164-1215 MHz that have met all of the milestones listed in the Annex to this Resolution through appropriate information provided to the consultation meetings referred to in *considering g)*;

4 that no single RNSS system shall be permitted to use up the entire interference allowance specified in *resolves* 1 above in any 1 MHz of the 1 164-1 215 MHz band;

5 that administrations participating in this process of epfd calculation should hold consultation meetings on a regular basis (e.g. yearly);

6 that administrations shall communicate to the Bureau the results of any aggregate sharing determinations made in application of *resolves* 2 above, without regard to whether such determinations result in any modifications to the published characteristics of their respective systems or networks;

7 that administrations operating ARNS systems in the 1 164-1 215 MHz band should participate, as appropriate, in discussions and determinations relating to the resolves above.

ANNEX TO RESOLUTION [RNSS 1.2.1-1] (WRC-03)

Milestone criteria

1 Submission of appropriate ITU Advance Publication, and Coordination or Notification documentation.

2 Entry into satellite manufacturing or procurement agreement:

The RNSS system or network operator should possess clear evidence of a binding agreement for the manufacture or procurement of its satellites. The agreement should identify the contract milestones leading to the completion of manufacture or procurement of satellites required for the service provision. The Notifying Administration is responsible for authenticating the evidence of agreement and providing such evidence to other interested administrations in furtherance of its obligations under this Resolution.

3 Entry into satellite launch agreement:

The RNSS system or network operator should possess clear evidence of a binding agreement to launch its satellites. The agreement should identify the launch date, launch site, and launch service provider. The Notifying Administration is responsible for authenticating the evidence of agreement and providing such evidence to other interested administrations in furtherance of its obligations under this Resolution.

B Example 2

The following is Example 2 of the package of regulatory provisions that would allow the method under Section 1.2.1.3 to be implemented:

1 Modify the Table of Frequency Allocations to include radionavigation-satellite (space-to-Earth) (space-to-space).

2 Modify No. **5.328A** to incorporate the reference of Articles Nos. **9.12**, **9.12A**, **9.13**, specify that No. **5.43A** does not apply and specify in the footnote that the provisions of new Resolutions **[RNSS 1.2.1-2] (WRC-03)** and **[RNSS 1.2.1-3] (WRC-03)** shall apply.

MOD

5.328A Stations in the radionavigation-satellite service shall not claim protection from stations of the aeronautical-radionavigation service in the band 960-1 215 MHz. No. **5.43A** does not apply. The use of the band 1 164-1 215 MHz by the radionavigation-satellite service is subject to the application of the provisions of Nos. **9.12**, **9.12A**, **9.13**, Resolution **[RNSS 1.2.1-2] (WRC-03)** and Resolution **[RNSS 1.2.1-3] (WRC-03)**.

3 Modify Article **21** to incorporate the limits per system.

4 Modify Table 5-1 of Appendix **5** to specify an overlapping band as a coordination threshold under Article No. **9.7** in the band 1 164-1 215 MHz.

RESOLUTION [RNSS 1.2.1-2] (WRC-03)

Protection of systems in the aeronautical radionavigation service from the maximum aggregate equivalent power flux-density produced by multiple radionavigation-satellite service systems in the band 1 164-1 215 MHz

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that the band 960-1 215 MHz is allocated on a primary basis to the aeronautical-radionavigation service (ARNS) in all Regions;

b) that WRC-2000 (Istanbul) decided to allocate the band 1 164-1 215 MHz to the radionavigation-satellite service (space-to-Earth) (space-to-space), and adopted a provisional limit on the aggregate power flux-density produced by all the space stations within RNSS at the Earth's surface of −115 dB(W/m^2) in any 1 MHz band for all angles of arrival;

c) that this conference has revised the limit referred to in *considering b)*, to ensure protection of ARNS systems operating in the 1 164-1 215 MHz range from the aggregate interference produced by all space stations within RNSS;

d) that this conference has approved and inserted in Article **21** limits –118 dB(W/(m^2 · 51 MHz) and –129 dB(W/(m^2 · MHz))) on the power flux-density produced by each RNSS space station in the band 1 164-1 215 MHz, with the aim to ensure equitable access by RNSS systems to the spectrum resource;

e) that this conference has decided to require coordination between RNSS systems under Nos. **9.12**, **9.12A**, **9.13**,

recognizing

a) that only a few RNSS systems are expected to be deployed in this band, and it is unlikely that more than two systems will have overlapping frequencies;

b) that the decision of this conference to require coordination between RNSS systems in the band 1 164-1 215 MHz under Nos. **9.12**, **9.12A** and **9.13** in addition to **9.7** will ensure that a dialogue will take place between administrations operating or planning to operate RNSS systems on overlapping frequencies in the band 1 164-1 215 MHz,

resolves

1 that the level of –121.5 dB(W/(m^2 · MHz)) for the aggregate equivalent power flux-density (epfd) applying for all the space stations within all RNSS systems, taking into account the reference worst case DME antenna characteristics described in Annex 2 of Recommendation ITU-R M.[RNSS2], is adequate to ensure the protection of the ARNS in the band 1 164-1 215 MHz;

2 that administrations operating or planning to operate RNSS systems in the band 1 164-1 215 MHz, for which coordination or notification information, as appropriate, was received after 2 June 2000, individually or in collaboration, shall take all necessary steps, including, if necessary, by means of appropriate modifications to their systems, to ensure that the aggregate interference into ARNS systems caused by such RNSS systems does not exceed the level specified in *resolves* 1;

3 that administrations, in developing agreements to carry out their obligations under *resolves* 1 and 2 above, shall establish mechanisms to ensure that only "real" systems are taken into account in the calculation of the aggregate epfd;

4 that administrations participating in this process of epfd calculation should meet on a regular basis (e.g. yearly);

5 that the methodology contained in Recommendation ITU-R M.[RNSS2] shall be used by administrations for calculating the aggregate epfd produced by all the space stations within all RNSS systems in the band 1 164-1 215 MHz;

6 that administrations shall send to the Bureau for publication in the International Frequency Information Circular all RNSS characteristics listed in the Annex to this Resolution used when applying the methodology referred to in *resolves* 5, as well as the calculated aggregate epfd.

Annex to Resolution [RNSS 1.2.1-2] (WRC-03)

List of RNSS system characteristics and format of the result of the aggregate epfd calculation to be provided to the BR for publication for information

I RNSS systems characteristics

I-1 RNSS ITU publication reference

RNSS network name	ITU Publication reference
	AR11/A/....
	API/A/....
	AR11/C/....
	CR/C/....

I-2 Non-GSO satellite system constellation parameters

For each non-GSO satellite system, the following constellation parameters should be provided to BR for publication for information:

N: number of space stations of the non-GSO system

K: number of orbital planes

h: satellite altitude above the Earth (km)

I: inclination angle of the orbital plane above the Equator (degrees)

Satellite index I	**RAAN** $\Omega_{i,0}$ **(degrees)**	**Argument of latitude** $E_{i,0}$ **(degrees)**
1	...	...
2	...	...
...	...	...
N	...	...

I-3 GSO satellite system longitude

For each GSO satellite system, the satellite longitude should be provided to BR for publication for information follows:

$LonGSO_i$: longitude of each of the GSO satellites (degrees)

I-4 Maximum non-GSO space station pfd versus the elevation angle at the Earth's surface (worst 1 MHz)

For the non-GSO satellite system space stations, the maximum pfd in the worst 1 MHz versus elevation angle should be provided to the BR for publication for information in a table format as follows:

Elevation angle (each 1°)	pfd ($dBW/m^2/MHz$)
–4	pfd (–4°)
–3	pfd (–3°)
…	…
…	…
90	pfd (–90°)

I-5 Maximum GSO space station pfd versus latitude and longitude at the Earth's surface (worst 1 MHz)

For each GSO satellite system space station, the maximum pfd in the worst 1 MHz, defined as the 1 MHz in which the pfd of the signal is maximum versus latitude and longitude should be provided to BR for publication for information in a table format as follows:

Latitude (each 1°)	0	1	…	360
Longitude (each 1°)	**Maximum pfd dBW/m^2 in worst 1 MHz**			
–90	Pfd (0,–90)	…	…	…
–89	…	…	…	…
…	…	…	…	…
…	…	…	…	…
90	…	…	…	pfd (360,90)

I-6 GSO/non-GSO satellite system spectrum

For each GSO and non-GSO satellite system, the level of spectrum emission in each 1 MHz relative to the spectrum value at the worst 1 MHz of the whole band (1 164-1 215 MHz) should also be provided to BR for publication for information.

II Results of the aggregate epfd calculation in the worst 1 MHz of the 1 164-1 215 MHz band

Maximum epfd in dBW/m^2 in any 1 MHz in the range 1 164-1 215 MHz.

RESOLUTION [RNSS 1.2.1-3] (WRC-03)

Transitional measures for coordination between RNSS systems in the band 1 164-1 215 MHz

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that WRC-2000 (Istanbul) decided to allocate the band 1 164-1 215 MHz to the radionavigation-satellite service (space-to-Earth) (space-to-space);

b) that this conference has approved and inserted in Article **21** limits on the power flux-density produced by each RNSS space station in the band 1 164-1 215 MHz, with the aim to ensure equitable access by RNSS systems to the spectrum resource;

c) that this conference has decided to apply bandwidth overlap as the only criterion for the identification of coordination requirements under No. **9.7** between RNSS GSO networks in this frequency band;

d) that this conference has decided to require coordination of all RNSS systems under Nos. **9.12**, **9.12A**, **9.13**,

resolves

1 that the limits referred to in *considering b)* shall apply to RNSS systems as of 3 June 2000;

2 that as of 3 June 2000, the provisions of Nos. **9.7**, **9.12**, **9.12A** and **9.13** shall apply to any frequency assignment of a RNSS system in the band 1 164-1 215 MHz with bandwidth overlap as the only criterion to determine that coordination is required;

3 that complete coordination or notification information, as appropriate, for RNSS systems in the band 1 164-1 215 MHz received by the Bureau before [end WRC-03] shall be considered as from their date of receipt as complete coordination information under Nos. **9.7**, **9.12**, **9.12A** or **9.13**, as appropriate,

instructs the Director of the Radiocommunication Bureau

1 as of the end of WRC-03, to review all findings on RNSS systems in the band 1 164-1 215 MHz for which complete coordination or notification information, as appropriate, has been received as of 3 June 2000;2 as of the end of WRC-03, for each RNSS system covered by *resolves* 3 above, to publish the relevant special section in an International Frequency Information Circular.

C Example 3

The following is Example 3 of the package of regulatory provisions that would allow the method under Section 1.2.1.3 to be implemented:

This example is similar to Example 1, except for variations in some areas:

1 In Example 3, the allocation table is modified as shown below, instead of having the allocation shown as an "additional allocation" in a footnote.

MOD

ARTICLE 5

890-1 260 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
960-1 164	AERONAUTICAL RADIONAVIGATION 5.328	
1 164-1 215	AERONAUTICAL RADIONAVIGATION 5.328 RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) MOD 5.328A	

2 The example milestones are slightly different from those in Example 1, and a new resolution similar to the one in Example 2 is included to consider transitional measures.

MOD

5.328A Stations in the radionavigation-satellite service in the band 1 164-1 215 MHz shall operate in accordance with the provisions of Resolutions [**RNSS-1.2.1-4] (WRC-03)** and **[RNSS-1.2.1-5] (WRC-03)** and shall not claim protection from stations in the aeronautical-radionavigation service. **No. 5.43A** does not apply. Use of the band 1 164-1 215 MHz by the radionavigation-satellite service is subject to the application of the provisions of Nos. **9.12**, **9.12A**, and **9.13**. The provisions of **No. 21.18** apply.

*****

3 Modify Table 5-1 of Appendix **5** to specify an overlapping band as a coordination threshold under Article No. **9.7** in the band 1 164-1 215 MHz.

*****

4 Include in the Radio Regulations (perhaps in a new Section of Article **21**) a provision that makes mandatory the collective obligation of administrations operating RNSS systems at 1 164-1 215 MHz to ensure that the aggregate protection criterion from *resolves* 1 of Resolution **[RNSS 1.2.1-4]** (see No. 5 below) is not exceeded, as well as the requirement to reduce emissions if administrations operating ARNS systems identify excess emission levels. The provision could read as follows:

ADD

Section VI – Protection of aeronautical radionavigation service systems from aggregate emissions of space stations of radionavigation-satellite service systems in the 1 164-1 215 MHz band

21.18 § 7 Administrations operating or planning to operate radionavigation-satellite service systems or networks in the 1 164-1 215 MHz frequency band, for which complete coordination or notification information, as appropriate, was received by the Bureau after 2 June 2000, shall, in accordance with *resolves* 2 of Resolution **[RNSS 1.2.1-4] (WRC-03)**, take all necessary steps to ensure that the actual aggregate interference into aeronautical radionavigation service systems caused by such RNSS systems or networks operating co-frequency in these frequency bands does not exceed the equivalent power flux-density level shown in *resolves* 1 of Resolution **[RNSS 1.2.1-4] (WRC-03)**.

*****

5 Adopt Resolution **[RNSS 1.2.1-4] (WRC-03)**, which could take the following form:

ADD

RESOLUTION [RNSS 1.2.1-4] (WRC-03)

Protection of aeronautical radionavigation service systems from the equivalent power flux-density produced by radionavigation-satellite service networks and systems in the 1 164-1 215 MHz frequency band

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that the band 960-1 215 MHz is allocated on a primary basis to the aeronautical radionavigation service (ARNS) in all Regions;

b) that the band 1 164-1 215 MHz is also allocated on a primary basis to the radionavigation-satellite service (RNSS), subject to the condition in No. **5.328A** that operation of RNSS systems shall be in accordance with this Resolution;

c) that protection of the ARNS from harmful interference can be achieved if the value of the equivalent power flux-density (epfd) produced by all the space stations of all RNSS systems in the band referred to in *considering a)* does not exceed the level of −121.5 dB(W/m^2) in any 1 MHz band;

d) that WRC-2000 adopted Resolution **605 (WRC-2000)** to provide for implementation of a provisional aggregate power flux-density limit during the period between WRC-2000 and WRC-03, and requested ITU-R studies on the need for an aggregate pfd limit, and revision, if necessary, of the provisional pfd limit given in No. **5.328A**;

e) that only a limited number of RNSS systems are expected to be deployed in the 1 164-1 215 MHz band, and only a few of these systems at most would have overlapping frequencies;

f) that ARNS systems can be protected without placing undue constraints on the development and operation of RNSS systems in this band;

g) that to achieve the objectives in *considering f)*, administrations operating RNSS systems will need to agree cooperatively through consultation meetings to achieve the level of protection for ARNS systems that is stated in *considering c)*;

h) that it may be appropriate for representatives of administrations operating ARNS systems to be involved in determinations made pursuant to *considering g)*,

resolves

1 that, in order to protect ARNS systems, administrations shall ensure, without validation by the Radiocommunication Bureau* pursuant either to No. **11.31** or **9.35** of the Radio Regulations, that the equivalent pfd level produced by all space stations of all RNSS systems does not exceed the level, –121.5 dB(W/m^2) in any 1 MHz band;

2 that administrations operating or planning to operate in the 1 164-1 215 MHz frequency band RNSS systems or networks for which complete coordination or notification information, as appropriate, was received by the Radiocommunication Bureau after 2 June 2000, in collaboration, shall take all necessary steps, including by means of appropriate modifications to their systems or networks, to ensure that the aggregate interference into ARNS systems caused by such RNSS systems or networks operating co-frequency in these frequency bands is shared equitably among the systems identified in *resolves* 4 and does not exceed the level of the aggregate protection criterion given in *resolves* 1 above;

3 that there shall be no priority in sharing the aggregate epfd value among RNSS systems/networks in this frequency band;

4 that administrations, in carrying out their obligations under *resolves* 1, 2 and 3 above, shall take into account only those RNSS systems with frequency assignments in the band 1 164-1 215 MHz that have met all of the milestones listed in the Annex to this Resolution through appropriate information provided by the consultation meetings referred to in *considering g)*;

5 that no single RNSS system shall be permitted to use up the entire interference allowance specified in *resolves* 1 above in any 1 MHz of the 1 164-1 215 MHz band;

6 that administrations participating in this process of epfd calculation should hold consultation meetings on a regular basis (e.g. yearly);

7 that administrations shall communicate to the Bureau the results of any aggregate sharing determinations made in application of *resolves* 2 above, without regard to whether such determinations result in any modifications to the published characteristics of their respective systems or networks;

8 that administrations operating ARNS systems in the 1 164-1 215 MHz band should participate, as appropriate, in discussions and determinations relating to the resolves above;

9 that the methodologies contained in draft new Recommendation ITU-R M.[RNSS2] shall be used by administrations for calculating the aggregate epfd produced by all the space stations within all RNSS systems in the band 1 164-1 215 MHz.

---

* Some administrations proposed to delete the words "without validation by the Radiocommunication Bureau" because they believe the Bureau has a role to play in this validation as mentioned in *resolves* 7 of this Resolution.

ANNEX TO RESOLUTION [RNSS 1.2.1-4] (WRC-03)

Milestone criteria

1 Submission of appropriate ITU Advance Publication, and Coordination or Notification documentation.

2 Entry into satellite manufacturing or procurement agreement, and entry into satellite launch agreement:

The RNSS system or network operator should possess clear evidence of a binding agreement for the manufacture or procurement of its satellites agreement, and entry into satellite launch agreement. The agreement should identify the contract milestones leading to the completion of manufacture or procurement of satellites required for the service provision and identify the launch date, launch site and launch service provider. The Notifying Administration is responsible for authenticating the evidence of agreement and providing such evidence to other interested administrations in furtherance of its obligations under this Resolution.

3 In lieu of satellite manufacturing and launch agreements, clear evidence of guaranteed funding arrangements for the project would be accepted. The Notifying Administration is responsible for authenticating the evidence of the financial commitment and for providing such evidence to other interested administrations in furtherance of its obligations under this Resolution.

*****

6 Adopt Resolution **[RNSS 1.2.1-5] (WRC-03)**, which could take the following form:

ADD

RESOLUTION [RNSS 1.2.1-5] (WRC-03)

Transitional measures for coordination between RNSS systems in the band 1 164-1 215 MHz

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that WRC-2000 (Istanbul) decided to allocate the band 1 164-1 215 MHz to the radionavigation-satellite service (space-to-Earth) (space-to-space);

b) that this conference has decided to apply bandwidth overlap as the only criterion for the identification of coordination requirements under No. **9.7** between RNSS GSO networks in this frequency band;

c) that this conference has decided to require coordination of all RNSS systems under Articles Nos. **9.12**, **9.12A**, **9.13**,

resolves

1 that as of 3 June 2000, the provisions of Articles Nos. **9.7**, **9.12**, **9.12A** and **9.13** shall apply to any frequency assignment of a RNSS system in the band 1 164-1 215 MHz with bandwidth overlap as the only criterion to determine that coordination is required;

2 that complete coordination or notification information, as appropriate, for RNSS systems in the band 1 164-1 215 MHz received by the Bureau [before end WRC-03][1] shall be considered as complete coordination information under Articles Nos. **9.7**, **9.12**, **9.12A** or **9.13**, as appropriate,

instructs the Director of the Radiocommunication Bureau

as of the end of WRC-03, for each RNSS system covered by *resolves* 2 above, to publish the relevant special section in an International Frequency Information Circular.

*****

7

APPENDIX 4 (WRC-2000)

ANNEX 2A

A.17c Compliance with aggregate power flux-density limits

Consequential changes to this part of the RR Appendix 4 are required to incorporate the changes in No. **5.328A** and to include the concept of epfd.

#########

1.2.2 Resolution 606 (WRC-2000), band 1 215-1 300 MHz

"Use of the frequency band 1 215-1 300 MHz by systems of the radionavigation-satellite service (space-to-Earth)"

1.2.2.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Relevant ITU-R Recommendations: M.1463, M.1461, M.1317, M.1088, M.1227 and M.1477.

Studies have been carried out by ITU-R in response to Resolution **606 (WRC-2000)**. Among the studies conducted are:

1) a worst-case study, assuming that the RNSS signal is continuously received in the main beam of the radar system;
2) a statistical study, taking into account models of real satellite constellations;
3) studies which try to explain the current situation, as stipulated in *considering b)* of Resolution **606 (WRC-2000)**;
4) studies including the mitigation techniques used by radiolocation and radionavigation services.

The GPS, an RNSS system which operates on 1 227.6 MHz (24 MHz bandwidth, designated as the "L2" signal), has been in operation in the band 1 215-1 260 MHz since 1978. It provides positioning and navigation services from space. Currently, this signal provides precision RNSS applications in

[1] This date may need to include additional time after WRC-03 in order to allow for BR to receive complete coordination information for the systems for which advanced publication information has already been received.

high productivity applications, such as machine guidance, construction, agriculture, and mining. In addition, the GLONASS has been also operating in the frequency band 1 215-1 260 MHz since 1982. It currently operates in the band 1 240.89-1 256.7975 MHz. This system also provides precision positioning and navigation services from space.

Furthermore, these systems are used for ionospheric correction by many users. These signals have been transmitted at their current power levels for over 12 years and have not caused any reports of interference to other users of the band.

A modernization of the GPS and GLONASS systems is now under way, including new and improved signals for civil and commercial applications, in the 1 215-1 260 MHz range. These signals are expected to provide enhanced accuracy, and dual frequency application, as well as improving the capabilities of existing applications.

1.2.2.2 Analysis of the results of studies

Based upon the results in ex-CCIR Report 766-2 (1990) and over 12 years of operational experience by the GPS system in the frequency range 1 215-1 240 MHz and over 10 years of operational experience by the GLONASS system in the frequency range 1 240-1 260 MHz, current RNSS signals have successfully demonstrated co-primary sharing between this radionavigation-satellite service systems and radars in the band 1 215-1 260 MHz. Operational experience with current GPS and GLONASS system characteristics in the 1 215-1 260 MHz band, has not led to any reports of harmful interference being caused to existing radar systems.

The frequency band 1 270-1 295 MHz is indicated, among others, in Resolution **217 (WRC-97)** for administrations to implement wind profiler radars in the radiolocation service. The characteristics of these radars, as used in ITU-R studies, are stated in Recommendations ITU-R M.1227 and M.1463.

As RNSS system characteristics are expected to evolve and new systems are planned, analyses, along with testing, are being conducted to determine the impact of a more powerful RNSS space-to-Earth signal on radar systems in the 1 215-1 300 MHz band. In order to ensure that radar systems are protected from more powerful RNSS space-to-Earth emissions, it may be necessary to identify a maximum pfd value for such RNSS emissions, although a technical basis for such a pfd value has yet to be completed. However, any such pfd value should take into proper account the operational experience with RNSS systems which exceed protection requirements based on the existing Recommendations currently applicable to radar systems, while leading to no reports of harmful interference.

Several analyses were performed as follows.

1.2.2.2.1 A worst-case study: RNSS signal received in the main beam of the radar system

A study was performed using Recommendations ITU-R M.1463 and M.1461, which provide respectively the characteristics and protection criteria of the radar systems. This study is based on a worst-case assumption, which corresponds to a satellite in the radar main beam and a protection criterion of I/N of –6 dB.

The study shows that, with these assumptions, current RNSS systems do not meet the protection criteria of Recommendation ITU-R M.1461. This seems in contradiction with the current situation, reported in *considering b)* of Resolution **606 (WRC-2000)**: "in the band 1 215-1 260 MHz radionavigation-satellite service (space-to-Earth) systems have been successfully operated for a considerable time in a band used by radars."

1.2.2.2.2 Statistical studies

The study mentioned in Section 1.2.2.2.1 based on current recommendations, was not able to explain the current and past situation (no interference with radars since the implementation of

RNSS systems (around 1989)). Additional studies performed were based on statistical approaches (the RNSS satellite is not always in the main beam of the radar).

The statistical studies show that the present RNSS systems exceed the protection criteria of radar systems in short but frequent periods of time corresponding overall to a small portion of the time. However, no statistical criterion for the amount of time that the protection criteria of radar systems may be exceeded has been elaborated within the ITU-R.

1.2.2.2.3 An explanation of the current and past situations on sharing between radars and RNSS in the band 1 215-1 260 MHz

The studies on the operational impact of RNSS systems into radar systems showed that the degradation of radar performance may not be operationally noticeable, even when the required protection criterion in relevant ITU-R recommendations dealing with radar protection in this band is exceeded, in particular due to the fact that this criterion is only defined for worst cases and does not take into account any statistical aspect, particularly, with respect to the signal-to-noise performance of the radar. However, there is no agreement on the statistical approach to be taken.

The main conclusions of the studies presented to the ITU-R are the following:

- The current protection criterion given in Recommendations ITU-R M.1461 and M.1463 may need to be revised in order for realistic conclusions to be reached on the operational impacts of sharing between radar systems and RNSS in the band 1 215-1 300 MHz. This matter is under study within the ITU-R.
- The current sharing experience shows that the maximum pfd level of transmissions from RNSS satellites currently in operation is acceptable to at least some radars in portions of the band 1 215-1 260 MHz, since no cases of harmful interference have been reported by operators of those radars which operate co-frequency. The calculated maximum pfd level of transmission for existing RNSS systems is –133 dB(W/(m^2 · MHz)), based on Recommendation ITU-R M.1317. Some administrations have planned RNSS systems that have a future requirement which will result in a pfd level higher than –133 dB(W/(m^2 · MHz)) into the 1 215-1 260 MHz band.

Initially, ITU-R indicated that "a few administrations successfully use radar systems co-frequency with existing RNSS systems in the 1 215-1 260 MHz band, without any spectrum management techniques" and "the same sharing conditions should be applied in the whole 1 215-1 300 MHz range". Subsequently, ITU-R sent Circular Letter CA/102, inquiring of administrations about experiences of sharing between RNSS systems and radiolocation/radionavigation systems in the 1 215-1 260 MHz band.

The 15 responses to the Questionnaire sent to administrations in Circular Letter CA/102 show that, in the band 1 215-1 260 MHz:

- a rather large number of radars are used in this frequency band in different countries, although six countries having responded do not operate any radar in the frequency band;
- air traffic control radars largely operate above 1 240 MHz;
- radars operate in this band without specific procedure of spectrum management. Most radars use frequency diversity signal processing and other techniques not intended to facilitate sharing with RNSS;
- one administration conducted operational tests and those tests showed no noticeable interference.

Based on the studies presented in ITU-R and the responses to the questionnaire CA/102 on the frequency band 1 215-1 260 MHz, the conclusion could be drawn that sharing between RNSS systems and at least some radars is feasible without causing harmful interference. Furthermore, there is difficulty in drawing a firm conclusion in response to Resolution **606**. Further studies are under way which may assist in satisfying this WRC-03 agenda item.

1.2.2.3 Methods to satisfy the agenda item and their advantages and disadvantages

1.2.2.3.1 Method A1

No pfd limit in the band 1 215-1 300 MHz; no change to the RR.

Under this method, no pfd limits would be included in the Radio Regulations for the protection of radiolocation/radionavigation systems, based on the fact the no interference have been reported between the RNSS (space-to-Earth) and systems in the radiolocation/radionavigation services (some of which may have had to utilize interference mitigation techniques) in the 1 215-1 260 MHz band. However, ITU-R has not concluded that the characteristics of existing RNSS systems are providing sufficient protection to the radionavigation and radiolocation service.

Advantages:

- The designers of RNSS systems would have freedom to develop new or improved systems, and there would be no need to develop additional regulatory provisions. Any harmful interference concerns would continue to be managed using existing RR (Article **15**).
- No additional burden to the ones expressed in the disadvantages would be imposed on the Bureau because it would be up to the administrations operating RNSS systems to resolve problems, if any arise.

Disadvantages:

- RNSS systems may evolve to employ more powerful signal levels, which may require the implementation of interference mitigation techniques by radar operators in order to avoid harmful interference to certain radiolocation radar systems, as indicated in ex-CCIR Report 766-2 (1990).
- RNSS systems may evolve to employ more powerful signal levels, and thus may need to make modifications to their systems in order to avoid causing harmful interference to certain radionavigation radar systems, as indicated in ex-CCIR Report 766-2 (1990).
- The designers of RNSS systems will have no information on how to take into account the current regulatory protection of the radionavigation service (i.e. how to avoid causing harmful interference to the radionavigation service).
- The radars of the radiolocation service are not included in No. **5.329**, which provides protection of the radionavigation service from harmful interference.
- If application of Article **15** is required, harmful interference already is being caused. This is unacceptable to a safety service.
- Application of Article **15**'s harmful interference provisions represents a burden to both administrations and the Radiocommunication Bureau.

1.2.2.3.2 Method A2

No pfd limit in the band 1215-1300 MHz; modification of No. **5.329**, consistent with *resolves* 1 of Resolution 606 (WRC-2000).

a) Modify existing No. **5.329** to extend the protection from harmful interference afforded to the radionavigation service so that it includes the protection of the radiolocation and the aeronautical radionavigation service authorized under No. **5.334**.

b) Adopt a Resolution [Method A2] (no example text included) retaining the requirement of *resolves* 1 of Resolution **606 (WRC-2000)** "that no additional constraints shall be placed on radionavigation-satellite service (space-to-Earth) systems operating in the band 1 215-1 260 MHz," and requesting ITU-R to finalize studies and prepare appropriate Recommendations to facilitate implementation of provisions in the modified No. **5.329**.

Advantages:

- The designers of RNSS systems would have freedom to develop new or improved systems (including operational and technological changes) without the need to further change the Radio Regulations. Any harmful interference concerns would continue to be managed using the existing Radio Regulations (Article **15**).
- No additional burden to the ones expressed in the disadvantages would be imposed on the Bureau because it would be up to the administrations operating RNSS systems to resolve problems, if any arise.
- Radars of the radiolocation service, which have many characteristics in common with the radionavigation service, would be protected.
- Resolution [Method A2] would ensure that the obligations on the RNSS would be consistent with *resolves* 1 of Resolution **606**.

Disadvantages:

- The ITU-R will be required to conduct studies, which identify ways to ensure that harmful interference from the RNSS into the radars and radiocommunication services is avoided.
- If application of Article **15** is required, harmful interference already is being caused. This is unacceptable to a safety service.
- Application of Article **15**'s harmful interference provisions represents a burden to both administrations and the Radiocommunication Bureau.
- RNSS systems would have the additional (although perhaps not significant) burden of protecting radiolocation service systems, which have many characteristics in common with radionavigation service systems.

1.2.2.3.3 Method B

pfd limit in the band 1 215-1 300 MHz, consistent with *considering b)* and *resolves* 1 of Resolution **606 (WRC-2000).**

A single entry RNSS space station pfd limit in the 1 215-1 300 MHz frequency band to protect the radiolocation and radionavigation services would be specified in the Radio Regulations. A pfd limit of –133 dB(W/(m^2 · MHz)) is proposed for consideration. However, the ITU-R has not concluded which pfd value is sufficient to protect the RNS and RLS. The proposed pfd limit is based on a calculation of the maximum pfd level using the characteristics for the existing RNSS system described in Recommendation ITU-R M.1317. The implementation of this method should be consistent with *resolves* 1 of Resolution **606**, which states "that no additional constraints shall be placed on RNSS (space-to-Earth) systems operating in the band 1 215-1 260 MHz."

Advantages:

- If the pfd limit is sufficient, the required protection of the RLS and RNS from the interference produced by the RNSS systems in the 1 215-1 300 MHz frequency band would be ensured.
- The designers of RNSS systems will know in advance the maximum level of pfd that is needed to protect radars.

- No additional constraints are placed on existing RNSS satellites in the band 1 215-1 260 MHz (in accordance with *considering b)* and *resolves* 1 of Resolution **606 (WRC-2000)**).

Disadvantages:

- Development and modernization of RNSS systems would be unnecessarily restricted in the band 1 215-1 300 MHz if a pfd limit that is too low is imposed.
- ITU-R has not reached final conclusion on which pfd value is sufficient to protect radars or on the operational impact of the proposed value or on the potentially required mitigation techniques.
- If the pfd value is not sufficient to protect radars, modification of existing radars would be required in the frequency band 1 215-1 300 MHz in addition to development and implementation of specific techniques for mitigating harmful interference caused by new RNSS systems.
- A pfd limit, even if sufficient to protect current radars, could also restrict the development of future radar systems.

1.2.2.3.4 Method C

pfd limit in one portion of the band 1 215-1 300 MHz and no pfd limit in the other portion of the band 1 215-1 300 MHz, consistent with *considering b)* and *resolves* 1 of Resolution **606 (WRC-2000)**

A single entry RNSS space station pfd limit in the one portion of the 1 215-1 300 MHz frequency band would be imposed to protect the radiolocation and radionavigation services and would be specified in the Radio Regulations, and there would be no pfd limit imposed in the other portion of the 1 215-1 300 MHz band. A pfd limit of –161 dB(W/(m^2 · MHz)) has been proposed for consideration in the portion of the band where a pfd limit would be imposed. The proposed pfd limit is based on the worst-case analysis and the application of Recommendation ITU-R M.1463 (which applies to the band 1 215-1 400 MHz) and Recommendation ITU-R M.1461. However, the ITU-R has not concluded which pfd value is necessary to protect the radionavigation and radiolocation services from RNSS emissions. The implementation of this method should be consistent with *resolves* 1 of Resolution **606** (**WRC-2000**), which states "that no additional constraints shall be placed on RNSS (space-to-Earth) systems operating in the band 1 215-1 260 MHz".

Advantages:

- Protection of the radiolocation/radionavigation services from the interference produced by the new or modified RNSS systems is provided in the portion of the band with the pfd limit.
- If the band without the pfd limit encompasses the bands with operating RNSS (space-to-Earth) systems, no further consideration of how to ensure consistency with *resolves* 1 of Resolution **606** would be needed.

Disadvantages:

- All of the disadvantages of Method A1 apply to the portion of the band with no pfd limit.
- Development and modification of RNSS systems would be prevented in the portion of the band with the pfd limit, given the very low proposed pfd limit of –161 dB(W/(m^2 · MHz)). This would lead to a situation where RNSS systems planning to operate in the portion of the band with the limit would be significantly disadvantaged with respect to RNSS systems in the portion of the band without the limit.

- ITU-R has not reached a final conclusion on which pfd value is necessary to protect radars, taking into account operational impact of proposed RNSS emissions and mitigation techniques.
- RNSS and radar systems in the 1 215-1 300 MHz band would be subject to differing regulatory constraints dependent solely on which portion of the band they operate.
- One of the principles upon which this method is based is that some radionavigation radars currently avoid operating within the band 1 215-1 260 MHz, to avoid the risk of harmful interference by existing RNSS systems which significantly exceed the pfd level of -161 dB(W/(m^2 · MHz)). If such radars were to be introduced in this band, and in fact be harmfully interfered with, existing RNSS systems would not practically comply with No. **5.329** and would be under the obligation to reduce their power if any administration quoted in No. **5.331** wished to operate such radionavigation radars within the band 1 215-1 260 MHz.
- If the same sharing conditions between RNSS and radars were to be applied in the whole 1 215-1 300 MHz band, as initially concluded by the ITU-R, there would be no reason why a pfd limit could not be applied equally to all portions of the band 1 215-1 300 MHz.

Other considerations

The meaning of *resolves* 1 of Resolution **606** is unclear. As a result, it is not possible to determine at this time whether specifying additional constraints under Methods B or C on future developments of existing RNSS systems is in contradiction, or not, with *resolves* 1 of Resolution **606 (WRC-2000))**.

1.2.2.4 Regulatory and procedural considerations

The only changes to the Radio Regulations needed to implement Method A1 would be consequential (modification of a footnote to delete reference to Resolution **606 (WRC-2000))**. Implementation of Method A2 would require modification of No. **5.329** and a new resolution as described in Section 1.2.2.3 above. An example of how No. **5.329** could be modified under this method is as follows:

MOD

5.329 Use of the radionavigation-satellite service in the band 1 215-1 300 MHz shall be subject to the condition that no harmful interference is caused to, and no protection is claimed from, the radionavigation service authorized under No. **5.331,** the aeronautical radionavigation service authorized under No. **5.334**, and the radiolocation service. See also Resolution **~~6~~ [Method A2]** (**WRC-03**).

*****

Methods B and C could be implemented by modifications to No. **5.329** of the Radio Regulations and addition of the pfd limits in Table **21-4** of Article **21**. Under Method B, the "harmful interference" provision of No. **5.329** could be removed (No. **5.43A** would be stated not to apply in this case) and the "shall not claim protection" provision of No. **5.329** could, if appropriate, be extended to the radiolocation service.

#########

1.2.3 Resolution 604 (WRC-2000), band 5 010-5 030 MHz

"Studies on compatibility between the radionavigation-satellite service (space-to-Earth) operating in the frequency band 5 010-5 030 MHz and the radio astronomy service operating in the band 4 990-5 000 MHz"

1.2.3.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Relevant ITU-R Recommendations: RA.769-1; RA.1513 and M.1583.

During WRC-2000, the band 5 010-5 030 MHz was allocated to the RNSS (space-to-Earth) (space-to-space) on a primary basis. Due to the fact that unwanted emissions from space stations of the RNSS in the frequency band 5 010-5 030 MHz may cause interference to the RAS operating in the nearby band 4 990-5 000 MHz, No. **5.443B** was added. This footnote specifies that the aggregate power flux-density produced in the 4 990-5 000 MHz band by all space stations within any RNSS (space-to-Earth) system operating in the 5 010-5 030 MHz band shall not exceed the provisional value of –171 dB(W/m^2) in a 10 MHz band at any radio astronomy observatory site for more than 2% of the time.

This value of –171 dB(W/m^2) in a 10 MHz band comes from Table 1 of Recommendation ITU-R RA.769-1. This Recommendation, however, does not define explicitly the percentage of time for which this level applies in case of non-GSO systems. The revision of Recommendation ITU-R RA.1513 defines that, over the sky, for elevations higher than the minimum operating elevation angle of the radio telescope, the epfd threshold level limit defined in Recommendation ITU-R RA.769-1 should not be exceeded for more than 2% of the time.

This provisional pfd level and percentage of time criteria needed to be reviewed by using an appropriate methodology to conduct compatibility studies between non-GSO systems and radio astronomy sites. ITU-R has developed such methodology, based on the epfd concept, to assess the unwanted emission levels from RNSS systems at radio astronomy sites (see Recommendation ITU-R M.1583).

1.2.3.2 Analysis of the results of studies

The studies can be divided into two parts:

- the assessment of unwanted emission levels (aggregate power levels) produced by space stations of a RNSS (space-to-Earth) system. This relates to the above-mentioned methodology requested by Resolution **604**;
- the definition, if needed, of adequate protection criteria for the RAS. This relates to the reviewing of the provisional pfd limit of No. **5.443B** as requested by Resolution **604**.

Two cases need to be considered depending on the type of RNSS systems which may cause interference to the RAS:

1) *For GSO satellite systems:*

- The assessment of pfd levels produced by GSO satellite networks presents no difficulty.
- The RAS protection criteria with regard to unwanted emissions from space service transmissions are based on the pfd value, which is given in Table 1 of Recommendation ITU-R RA.769-1.

2) *For non-GSO satellite systems:*

- The methodology requested in Resolution **604** to calculate the aggregate unwanted power levels has been developed within ITU-R, and can be found in Recommendation ITU-R M.1583. This Recommendation takes into account operational characteristics of the radio astronomy station (e.g. minimum operational elevation angle).
- The definition of specific protection criteria for the radio astronomy service with regard to non-GSO constellations has been made through revision of Recommendations ITU-R RA.769-1 and RA.1513 (taking into account the type of observation conducted at the radio

astronomy station). This allows for the definition of an epfd limit associated to a percentage of time.

A study which was an example of application of these two Recommendations for a given RNSS system showed that protection of the radio astronomy service in the band 4 990-5 000 MHz could be achieved through adequate technical measures, i.e. that the provisional aggregate pfd value indicated in No. **5.443B** could be met by non-GSO RNSS systems operating in the band 5 010-5 030 MHz.

1.2.3.3 Methods to satisfy the agenda item and their advantages and disadvantages

Modification of No. **5.443B** as proposed for consideration in § 1.2.3.4. Mention of a new Resolution (Resolution **[RNSS 1.2.3-1]**) in the footnote to clarify the application of the pfd/epfd limits.

Advantage:

Allows the deployment of RNSS systems in the band 5 010-5 030 MHz without causing interference detrimental to the RAS in the band 4 990-5 000 MHz.

Disadvantage:

Radio astronomy stations notified after RNSS stations may not be protected.

1.2.3.4 Regulatory and procedural considerations

Modification of No. **5.443B** could be done as shown in the example given below.

Both No. **5.443B** as adopted by WRC-2000 and *resolves* 1 and 2 of Resolution [RNSS 1.2.3-1] state that the pfd and epfd limits apply at any radio astronomy station (i.e. not at the whole Earth surface and for all angles of arrival).

Modification to RR Appendix **4** would be required to insert additional characteristics of the radio astronomy stations, specifically the type of observation and the minimum operating elevation angle of the antenna.

Modification to RR Appendix **4 (§ A.17a)** would also be required in order to assess the compliance of RNSS systems received as of end WRC-03 with the pfd or epfd limits given in *resolves* 1 and 2 in Resolution [RNSS 1.2.3-1].

ANNEX

Example of regulatory provision

MOD

5.443B *Additional allocation:* The band 5 010-5 030 MHz is also allocated to the radionavigation-satellite service (space-to-Earth) (space-to-space) on a primary basis. In order not to cause harmful interference to the microwave landing system operating above 5 030 MHz, the aggregate power flux-density produced at the Earth's surface in the band 5 030-5 150 MHz by all the space stations within any radionavigation-satellite service system (space-to-Earth) operating in the band 5 010-5 030 MHz shall not exceed –124.5 dB(W/m^2) in a 150 kHz band. In order not to cause interference to the radio astronomy service in the band 4 990-5 000 MHz, radionavigation-satellite service systems operating in the band 5 010-5 030 MHz shall comply with the limits in the band 4 990-5 000 MHz defined in Resolution **[RNSS 1.2.3-1] (WRC-03)**.*NOTE – The following Resolution is intended to clarify the application of the pfd/epfd limits, and to define the assumptions to be made for epfd calculations.*

ADD

RESOLUTION [RNSS 1.2.3-1] (WRC-03)

Protection of the radio astronomy service in the band 4 990-5 000 MHz from unwanted emissions of the radionavigation-satellite service (space-to-Earth) operating in the frequency band 5 010-5 030 MHz

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that unwanted emissions from space stations of the radionavigation-satellite service (RNSS) operating in the frequency band 5 010-5 030 MHz may cause interference to the radio astronomy service (RAS) in the band 4 990-5 000 MHz;

b) that WRC-2000 (Istanbul) decided to introduce a provisional power flux-density (pfd) limit in the band 4 990-5 000 MHz to protect the RAS, and invited ITU-R to conduct studies to review this limit;

c) that protection requirements for the RAS are given in Recommendations ITU-R RA.769-1 and ITU-R RA.1513, and are different for GSO and non-GSO satellite systems,

noting

a) that ITU-R has developed Recommendation ITU-R M.1583 providing a methodology for interference calculations between non-GSO MSS or RNSS satellite systems and radio astronomy telescope sites, and containing in its Annex 2 a model of radiotelescope antenna pattern;

b) that all studies related to the protection of the radio astronomy service in the band 4 990-5 000 MHz are made using a reference radiotelescope antenna with a maximum gain of 74 dBi (a diameter of 100 m),

resolves

1 that in order not to cause interference to the radio astronomy service in the band 4 990-5 000 MHz, the power flux-density produced in this band by any GSO RNSS network operating in the 5 010-5 030 MHz band shall not exceed −171 dB(W/m^2) in a 10 MHz band at any radio astronomy station;

2 that in order not to cause interference to the radio astronomy service in the band 4 990-5 000 MHz, over the sky, for elevations higher than the operating elevation angle θ_{min}[*] specified for the radio telescope, the equivalent power flux-density (epfd) produced in this band by all space stations within any non-GSO RNSS system operating in the 5 010-5 030 MHz band shall not exceed –245 dB(W/m^2) in a 10 MHz band at any radio astronomy station for more than 2% of the

[*] Until adoption of a definition of θ_{min} by the ITU, and publication of notified radio astronomy observatory data, a value of 5° may be assumed in appropriate calculations.

time, using a reference antenna with one of the beam patterns described in Annex 2 of Recommendation ITU-R M.1583 and a maximum gain of 74 dBi;

3 that administrations planning to operate a GSO or a non-GSO RNSS system in the band 5 010-5 030 MHz, for which complete coordination or notification information, as appropriate, has been received by the Bureau after 2 June 2000, shall send to the Radiocommunication Bureau the value of the maximum level of pfd as referred to in *resolves* 1 or the value of the maximum level of epfd as referred to in *resolves* 2, as appropriate,

instructs the Radiocommunication Bureau

as of the end of WRC-03, to review all RNSS systems for which complete coordination or notification information, as appropriate, has been received by the Bureau before the end of WRC-03 for the band 5 010-5 030 MHz, and, if appropriate, to revise its findings regarding compliance with No. **5.443B**, taking into account additional information received under *resolves* 3.

#########

1.3 Agenda item 1.17

"to consider upgrading the allocation to the radiolocation service in the frequency range 2 900-3 100 MHz to primary"

1.3.1 Summary of technical and operational studies including a list of relevant ITU-R Recommendations

Since WARC-79, at which 452 MHz of spectrum below 6 GHz allocated to the RLS was either removed or downgraded to secondary status, needs for radiolocation spectrum below 6 GHz have increased. This has been due to changes in requirements, missions, and technology that are driving a need for wider bandwidth to pick smaller and less reflective targets out of background clutter, and because of the unique propagation properties below 6 GHz. Over the years, the radiolocation service has been demonstrated to be compatible in bands where aeronautical and maritime radionavigation radars operate.

The RLS, while recognizing the special needs of RNS, noted in No. **4.10**, has, in a number of countries and at sea, a long successful history of sharing the band 2 900-3 100 MHz with radionavigation systems as they have evolved over many years.

Relevant Recommendations ITU-R: M.1313, M.1372, M.1460, M.1464.

Radiolocation radars, including those documented in Recommendation ITU-R M.1460, have operated in the 2 900-3 100 MHz band for decades and this use is compatible with the use of the same band by systems operating in the RNS. Similarly, weather radars, which resemble radiolocation radars in their beam scanning, have operated successfully in close proximity with aeronautical navigation radars in the 2 700-2 900 MHz band.

Draft new Report ITU-R M.[COMPAT] describes tests in which signals representative of radiolocation radars were applied to representative maritime radionavigation radars to assess their interference rejection capabilities.

1.3.2 Analysis of the results of studies

Studies have shown that compatibility between radiolocation radars and radionavigation radars has been achieved through the implementation of interference suppression/rejection circuitry as described in DRR ITU-R M.1372, which identifies many signal-processing features provided in radiolocation and radionavigation radars that mitigate pulsed interference from other radars.

The compatibility testing documented in the draft new Report ITU-R M.[COMPAT] showed that no interference was experienced by the maritime radionavigation radars from emissions of a radiolocation radar, primarily due the interference suppression circuitry/signal processing.

1.3.3 Methods to satisfy the agenda item and their advantages and disadvantages

1.3.3.1 Method A

Upgrade the radiolocation service to primary and add a new footnote.

Upgrade the RLS to a primary allocation in the band 2 900-3 100 MHz with a footnote to the Table of Frequency Allocations indicating that the RLS shall not cause harmful interference to, nor claim protection from or constrain the use and development of, the RNS.

Advantages:

- Provides a primary allocation to the radiolocation service, contiguous with the existing band 3 100-3 400 MHz, with sufficient bandwidth to meet today's requirement for improved radar target imaging resolution and less-reflective target detection against a clutter environment.
- Assures long-term operating and development environment for radiolocation systems.
- Provide primary allocation to the radiolocation service at frequencies in the vicinity of 3 GHz as needed to meet radar operational requirements while explicitly protecting the radionavigation service.
- Restores primary allocation to the radiolocation service at frequencies in the vicinity of 3 GHz as needed to meet radar operational requirements.
- The band in the vicinity of 3 GHz provides for medium-long range detection of relatively small targets from mobile platforms.
- Indicates that the radiolocation service should not cause harmful interference to nor claim protection from the radionavigation service.

Disadvantages:

- May constrain the development or deployment of radiolocation systems.

1.3.3.2 Method B

Upgrade the radiolocation service to a primary status in the band 2 900-3 100 MHz.

Advantages:

- Provides a primary allocation to the radiolocation service, contiguous with the existing band 3 100-3 400 MHz, with sufficient bandwidth to meet today's requirement for improved radar target imaging resolution and less-reflective target detection against a clutter environment.
- Assures long-term operating and development environment for radiolocation systems.
- Provides a solution to existing and foreseeable requirements of the radiolocation service without the undue added regulatory burden of an additional footnote while protecting the radionavigation service, recognizing that the latter service is afforded special measures by Member States to ensure freedom from harmful interference under No. **4.10.**
- Restores primary allocation to the radiolocation service at frequencies in the vicinity of 3 GHz as needed to meet radar operational requirements.
- The band in the vicinity of 3 GHz band provides for medium-long range detection of relatively small targets from mobile platforms.

Disadvantages:

- The upgrade to co-primary status without a footnote does not clearly indicate that the RLS should not cause harmful interference to nor claim protection from the RNS.
- The upgrade to co-primary without a footnote could preclude the use of certain types of navigation safety systems, particularly in the future.

1.3.4 Regulatory and procedural considerations

The following footnote could be adopted if Method A is selected:

ADD

5.AAA In the band 2 900-3 100 MHz, stations in the radiolocation service shall not cause harmful interference to, nor claim protection from or constrain the development of the radionavigation service.

*****

NOTE - Some administrations and the BR indicated that the inclusion of the expression “or constrain the development of”gives rise to some difficulties in the application of the RR”.

No regulatory provision is required for Method B.

No. **4.10** provides guidance to administrations in the assignment and use of frequencies in the radionavigation and other safety services.

#########

1.4 Agenda item 1.24

"to review the usage of the band 13.75-14 GHz, in accordance with Resolution **733 (WRC-2000)**, with a view to addressing sharing conditions"

1.4.1 Summary of technical and operational studies including a list of relevant ITU-R Recommendations

Relevant ITU-R Recommendations: P.452, S.465, SA.510-2, S.524, P.526, S.580, S.728, SA.1018, S.1068, SA.1071, SA.1155, SA.1414, S.1428, M.1461, and DNR ITU-R M.[RAD.CHARZ].

1.4.1.1 Sharing between RLS and FSS

WARC-92 allocated the band 13.75-14 GHz to FSS (Earth-to-space) under conditions, which were reviewed by WRC-95 and WRC-2000 and are specified in Nos. **5.502**, **5.503** and **5.503A.** These conditions as far as they relate to GSO FSS result from ITU-R studies conducted in the 1992-1995 time-frame and summarized in Recommendations ITU-R SA.1071, S.1068 and S.1069. They were adopted by WRC-95 and amended by WRC-2000 in relation to non-GSO FSS. During the 2000-2002 study period additional technical data was made available and allowed more accurate technical analysis. Any changes to the footnotes should ensure an appropriate balance between all the services involved.

The studies considered that the current constraint on FSS use of the band to earth stations with antennas no smaller than 4.5 m in diameter had been imposed with a view to limiting the number of FSS earth stations likely to be deployed, and thus limiting the interference to radar terminals. Noting also the desire of the FSS community to operate earth station antennas having diameters smaller than 4.5 m, it was agreed that other ways of protecting the radiolocation service would be needed if the dish size constraint should be relaxed or removed. Possibilities studied in this regard, which might be employed individually or in combination, were identified as a) zones where FSS earth stations would not normally be deployed, b) the imposition of pfd limits and c) the imposition of off-axis e.i.r.p. density limits more stringent than the 14/11 GHz band limits in Recommendations ITU-R S.524 and S.728.

In addition one study assessed the impact to FSS links of an increase in radiolocation station radiated e.i.r.p. to 65 dBW below 2° elevation, while retaining the existing constraint of 59 dBW above 2° elevation. Results of this study showed no significant increase in the interference compared to the existing condition at the FSS satellite receiver.

1.4.1.2 Sharing between SRS and FSS

In addition to the points above the 13.75-14 GHz band is used by the SRS for feeder links and service links of a global data relay satellite network. SRS currently operates over a bandwidth of 10 MHz from 13.770-13.780 GHz to fully achieve the international science/exploration objectives and to safely manage and control on board International Space Station (ISS) and space shuttle equipment/modules in accordance with No. **5.503**. This is a continuing requirement that is satisfied under existing sharing conditions where the FSS earth station antenna diameter is maintained at 4.5 m or above. Also in accordance with No. **5.503** only 6 MHz of this bandwidth is protected, from 13.772 to 13.778 GHz. Taking into account Resolution **733** *considering g)*, should smaller FSS earth station antenna diameters within GSO networks be introduced into the 13.75-14 GHz band, then it will be necessary to expand the protection of these SRS operations over the 10 MHz band centred on 13.775 GHz.

A number of ITU-R studies on the sharing between SRS and FSS in the band 13.772-13.778 GHz were performed over the last decade. These studies derived current sharing conditions based on a SRS link margin degradation of 0.4 dB for no more than 0.1% of the time for a single orbit considering a population of 32 FSS earth stations operating within GSO networks over the Atlantic Ocean Region.

1.4.2 Analysis of the results of technical and operational studies

It was agreed that all studies addressing radiolocation protection would also apply to radionavigation, which is also allocated in the band 13.75-14 GHz by No. **5.501**.

Studies assessed the impact of a reduction of the minimum FSS earth station antenna size on the use of radiolocation in the band and an assessment of operational and regulatory measures that would ensure that a reduction in antenna size and consequential increase in the number of FSS earth stations do not lead to harmful interference to radar receivers.

Other studies assessed the sharing conditions between FSS earth stations of all diameters and SRS systems (e.g. space shuttle and ISS) in the bands 13.772 -13.778 GHz and 13.77-13.78 GHz.

Consideration was also given to the possible impact on the EESS allocated in the band on a secondary basis.

1.4.2.1 Sharing between RLS and FSS

Studies focused on the impact on radiolocation of the relaxation of the current 4.5 m minimum antenna size for FSS earth stations. Studies performed agreed that the expected increase in the number of FSS earth stations, which would result from the relaxation of this constraint, would increase the probability of interference into radiolocation. In the case of maritime/land mobile radiolocation/FSS sharing studies, although many of the parameters were agreed some differences in deployment scenarios and assumptions occurred.

Other studies focused on the impact on FSS earth station deployment, in particular in coastal areas, to ensure an assumed protection of maritime radiolocation devices. The results show that there is a clear impact on the coastal deployment of the FSS earth stations.

1.4.2.1.1 Protection of fixed radiolocation stations from FSS earth stations

It was noted that Table 7 of Appendix **7** of the RR, which would be used to determine the need for coordination of an FSS earth station with fixed radiolocation stations at specified points, does not currently include parameters for radiolocation stations in the 13.75-14 GHz band. The studies considered that it would be more appropriate to include in Table 7 of Appendix **7** the relevant values to protect ground based radiolocation stations located at fixed points. Suitable values for fixed radiolocation stations in the band 13.75-14 GHz have been suggested and will be considered in the framework of updating Appendix **7**. This approach is irrespective of the FSS earth station antenna diameter.

1.4.2.1.2 Protection of maritime and land mobile radiolocation stations from FSS earth station interference

a) Protection criterion and proposed sharing criterion for maritime and land mobile radars

Interference into radiolocation systems was assessed in term of a decrease in probability of detection, which leads to a decrease in radar range and/or target tracking ability. Taking into account these factors, the studies concluded that the appropriate criterion to ensure the protection of maritime and land mobile radars would be a I/N of –6 dB, corresponding to an interference power level of –133 dBW in a bandwidth of 10 MHz at the receive output flange of a radar antenna.

A proposed sharing criterion to satisfy the above radiolocation protection level for FSS earth stations with a diameter less than 4.5 m, would be a single entry interfering pfd level of:

for maritime radar: X dB(W/(m^2 · 10 MHz)) not to be exceeded for more than Y% of the time produced at 36 m above sea level at the normal baseline (low water mark) as defined in UN Convention on the Law Of the Sea 1982.

for land mobile radar: X dB(W/(m^2 · 10 MHz)) not to be exceeded for more than Y% of the time produced 3 m above ground at the border.

For X and Y, two views were considered:

- An X value of –126 dB(W/(m^2 · 10 MHz)) at the normal baseline or land border as appropriate, would protect all radiolocation configurations to the agreed –6 dB I/N recommended level for Radiolocation in ITU-R M.1461. Any value for X higher than this will exceed the ITU-R recommended interference protection criteria and cause unacceptable interference. The pfd level of –126 dB(W/(m^2 · 10 MHz)) causes a 5.4% range loss for the most sensitive configuration of radiolocation stations. With the aim to reach an appropriate balance of constraints for both radiolocation and FSS, the radiolocation service in this band can accept a 0.01% of time value for Y at the –126 dB(W/(m^2 · 10 MHz)) level.
- A distinction between the probability of exceedance of a given –6 dB I/N threshold as calculated at a given location using ITU-R propagation models and the actual occurrence of an exceedance of –6 dB I/N threshold at an operating radiolocation site which is considered to be much lower. In addition radiolocation stations have been considered to be protected only when at some distance from the baseline. Based on this approach, values were considered in the range of –105.2 dB(W/(m^2 · 10 MHz)) for 1% of time (this pfd corresponds to an I/N of 0 dB, an I/N of –6 dB would be exceeded for a larger percentage of time) and –113.2 dB(W/(m^2 · 10 MHz)) for 0.5% of the time with the aim to reach an appropriate balance of constraints for both radiolocation and FSS.

Percentages of time are calculated using the ITU-R appropriate propagation model.

Some administrations are of the opinion that the measurement point of the pfd shall be determined by the concerned administration operating the FSS earth station in which case the values of X and Y should be adapted accordingly. Some other administrations believe that the measuring point of the pfd must be determined consistently by all administrations for it to be effective.

b) Conclusions of the studies on sharing between FSS and maritime and land mobile radars

Based on representative deployment scenarios of FSS earth stations with antenna diameters between 1.2 m and 4.5 m and on the protection and sharing criteria described in a), studies were conducted which lead to the areas of general agreement listed below.

1) The level of interference at the input to the radar receivers is a function of FSS earth station locations, deployment density, e.i.r.p., and the radar antenna pattern.

2) 4.5 metre or larger diameter FSS earth stations, currently allowed, may cause interference into radiolocation systems; however due to the low numbers of FSS earth stations deployed, this situation is acceptable to the radiolocation service.

3) For all sizes of FSS earth station antennas, in the absence of mitigation techniques the –6 dB I/N radar threshold would be exceeded for certain distances between the FSS earth stations and land or ship radar terminals.

4) The separation distance at which FSS interference exceeds the radiolocation –6 dB I/N interference threshold is a function of FSS and radiolocation platform antenna heights, the bearings of the FSS earth stations (assuming equal e.i.r.p. levels), FSS e.i.r.p., FSS aggregate effects, the radar antenna pattern, the terrain profile, and the mitigation techniques used by the FSS.

5) Natural or artificial site shielding cannot be considered in determining general sharing criteria, but may be used as a mitigation technique on a case-by-case basis in order to meet the sharing criteria. Limiting the area of deployment of FSS earth stations can also be considered as a way to limit interference into radiolocation.

6) Coordination as defined in the RR cannot be used as a method for resolving interference between FSS earth stations and mobile radiolocation stations irrespective of FSS earth station antenna diameter.

7) In certain cases mitigation techniques are required, to permit FSS earth stations to utilize smaller than 4.5 m dish sizes, to avoid harmful interference to radiolocation systems.

8) Interference mitigation techniques are not currently available for use by maritime radiolocation systems.

9) Line-of-sight paths between FSS earth stations and radiolocation receiver platforms provide the predominant source of interference. Non line-of-sight FSS earth stations may add to the interference.

10) Irrespective of its source, interference into radiolocation systems results in all or a combination of the following factors: a decrease in probability of detection, decrease in radar range, decrease in radar resolution and/or target tracking ability.

11) The activity factor for FSS earth stations has a significant impact on sharing conditions between FSS and radiolocation systems.

12) Limitation of off-axis e.i.r.p. density for FSS earth stations would reduce interference to the ship/land-based radars but would not be sufficient by itself to protect these radars in all cases.

13) Realistic worst-case FSS characteristics and modelling should be utilized when deriving a sharing arrangement. It would be reasonable to take into account the probability of occurrence of the worst case of interference if it can be determined.

14) There would be a need to develop recommendations which would deal with verification of compliance with pfd constraints on FSS earth stations.

15) In order for FSS to meet pfd limits at the normal baseline, deployment of FSS earth stations will be impeded in the coastal areas, the size of which depends on the FSS earth station characteristics, the local terrain and on the values of X and Y.

16) The determination of X and Y has to take into account the probability of interference from two or more terminals located near each other and that are simultaneously transmitting within a 10 MHz band.

17) Studies did not consider transmitting earth stations that employed uplink power control.

However the following points were not agreed upon:

1) Using probability of interference into 10 radars vs. 1 radar. Consideration of a realistic ship deployment which involves multiple co-located radiolocation devices. In such a case, the probability of interference is increased over that experienced by a single radiolocation device.

2) Probabilistic modelling of radar rotation.

3) A significant percent of coast lines are likely to have steadily rising terrain profiles providing possible line of sight propagation path over a large distance. No correlation was done between these high terrain configurations and the probability of presence of FSS earth stations.

1.4.2.1.3 Protection of FSS satellite receivers from maritime radiolocation stations

Interference into FSS satellite receivers was assessed in terms of a difference of interference power received at the FSS Satellite using the current radiolocation antenna configuration (10° elevation beamwidth, beam centre at 4.5° elevation) and a second antenna configuration with the beam centred at 0° and a reduced elevation beamwidth of 2.5°. The increase in antenna gain results in an e.i.r.p. increase at the output of the antenna. Due to a longer propagation path and propagation losses and the increased angle of incidence between the radiolocation transmit beam and the satellite receive beam results showed no increase in interference power at the satellite receiver. The change between the antenna types result in an increased sensitivity of radiolocation device to FSS interference.

1.4.2.1.4 Protection of aeronautical radiolocation stations from FSS earth stations

Based on the studies below, the following additional agreements were reached:

1) Airborne radiolocation technical characteristics create a unique sharing situation which limits the available mitigation techniques.

2) An FSS earth station pfd for sharing with airborne radiolocation systems is not possible due to the airborne radiolocation unique technical characteristics.

3) A limit on the off-axis e.i.r.p. density of FSS earth stations having antenna diameters down to 1.2 m would be sufficient to limit interference into airborne radars to levels comparable to those under the current regulatory situation for the studied scenario.

The ITU-R studies focused on comparing the impact, into an airborne radar, of signals coming from many FSS earth stations having a diameter less than 4.5 m, with the impact of signals coming from a smaller number of FSS earth stations compliant with the current regulations (4.5 m in diameter).

The interference into airborne radar flying over the territory of one country was simulated, with FSS earth stations located close to the border, but in the territories of adjacent countries. The transmit power of the 4.5 m earth stations was taken as representative of the current situation (79 dB(W/10 MHz)). The transmit power of the FSS earth stations having a diameter less than 4.5 m, was adjusted to correspond to the maximum e.i.r.p. density level specified in Recommendation ITU-R S.728. In both cases, the earth station antenna radiation patterns used in the simulations were those contained in Recommendation ITU-R S.1428, which characterizes interference sweeping through the side lobes.

The number of FSS earth stations was calculated so as to use the entire spectrum resource available from 15 GSO satellites in the same 10 MHz band. Two scenarios were therefore assessed: a first scenario representing the situation under the current regulations, with 30 earth stations using 4.5 m antennas and a bandwidth of 10 MHz per station, and a second scenario under a possible future regulatory situation, with 150 FSS earth stations using 1.2 m antennas and a bandwidth of 2 MHz per station.

The results of the simulations showed that the interference caused into the airborne radar by many FSS earth stations with 1.2 m antennas was more damaging to the radar operation than the impact of a small number of larger FSS earth stations, because the 1.2 m FSS earth stations interference resulted in a significant reduction in the range of the radar (up to 45%) in many directions, whereas the smaller number of 4.5 m earth stations result in a larger reduction in range (up to 65%), but in only a few directions.

More specifically, it was found that the average range loss of the radar was about 25% in the scenario with 4.5 m antennas, and about 35% in the scenario with 1.2 m antennas. Increasing the number of FSS earth stations having a diameter less than 4.5 m by reducing the bandwidth per station resulted in an average range loss asymptotic to 36%.

The conclusion of the study was that, with an e.i.r.p. restriction to levels 4 dB below the off-axis e.i.r.p. density specified for VSATs in Recommendation ITU-R S.728, the average range loss would be the same in both scenarios, irrespective of the number of small FSS earth stations and their diameter. These results apply to both static and dynamic simulations.

It was found that main beam coupling between the radiolocation antenna and the FSS earth station antennas was not a factor in this scenario. Avoiding such coupling would require that FSS earth stations irrespective of their diameter, require exclusion zones of a maximum of 70 km. The exact size of this exclusion zone would depend, among other factors, on the satellite link elevation and on the aircraft typical operating altitude.

1.4.2.1.5 Analysis of interference from radiolocation into GSO FSS space stations

Interference into GSO FSS satellites from radars was assessed in terms of a decrease in the data rate of satellite links.

It was shown that the existing conditions of No. **5.502** still allow for significant interference level at the GSO FSS space station. Encoding techniques currently used in FSS systems allow FSS links to be operated in this environment.

The radar operating parameters (power level, pulse repetition frequency and duty cycle) are decisive for designing the satellite links in order to avoid correlation between the satellite frame/encoding rate and the radar PRF and duty cycle. There is a need to include FSS and radiolocation parameters in ITU-R Recommendations, which would assist in defining the interference environment for FSS.

1.4.2.2 Sharing between FSS and SRS

a) Interference from earth stations of GSO FSS networks to SRS space stations

Studies have been performed to analyse the impact of the interference from GSO FSS earth stations with antenna diameters of 4.5 m and smaller into low-orbiting user SRS satellites operating in a data relay satellite network, taking into account the expected increase in the number of FSS earth stations.

Recent ITU-R studies were conducted assessing sharing criteria between the SRS and FSS in the 13.77-13.78 GHz band. The SRS transmission links examined were from data relay satellite networks to receivers such as ISS and space shuttle. The studies were based on two relaxations of the interference protection of the SRS data relay satellite forward links: higher interference threshold (based on an I/N of –6 dB), and a reduced link availability based on the average interference threshold exceedance calculated over 200 orbits rather than the single orbit worst case. The simulations performed for these studies considered the deployment of FSS antennas with diameters of 4.5 m and smaller. E.i.r.p. density masks were produced based partially on simulation of FSS earth station deployment.

b) Interference from FSS earth stations to SRS earth stations

SRS earth stations are adequately protected by coordination given the data available in RR Appendix **7**.

1.4.2.3 Analysis of studies relating to the interfering environment of the EESS

The frequency band 13.75-14 GHz is used on a secondary basis by non-GSO systems in the Earth exploration-satellite service (non-GSO EESS).

The study on possible implications on the operation of EESS systems of revising the limits to FSS earth stations on EESS systems included:

a) an analysis of increasing the areas within which an interference to a non-GSO space station in the EESS would exceed the current performance requirement in the event that earth stations smaller than 4.5 m in diameter are operated with e.i.r.p. between 50 and 60 dBW per 1 MHz;

b) evaluation in the increase of the probability of harmful interference to the EESS due to a growth in the number of FSS earth stations with antenna diameter smaller than 4.5 m and transmitting between 50 and 60 dBW per 1 MHz e.i.r.p.

It was concluded from this analysis of the evaluation of potential interference that reviewing the limits on FSS earth stations in the band 13.75-14 GHz contained in No. **5.502** may lead to an increase in the probability of harmful interference to altimeters potentially resulting in impeding their operation. This may be mitigated by an improvement in the off axis e.i.r.p. density of earth station antennas and consideration of minimum elevation angle for earth station antennas. These considerations should be accounted for in the limitations being expressed for FSS-SRS/RLS sharing.

As a secondary service no protection is required for the EESS in the context of the current regulations.

1.4.3 Methods to satisfy the agenda item and their advantages and disadvantages

It should be noted that in the current regulatory framework, the sharing conditions between the services allocated on a primary basis in the 13.75-14 GHz band are essentially described by the limits contained in Nos. **5.502** and **5. 503**. Since any change in the limits on the FSS in No. **5.502** would also affect the sharing situation between FSS and SRS, it is not possible to address these two footnotes independently, hence only three methods have been identified to satisfy the agenda item.

1.4.3.1 Method A

No change to the current regulations and associated sharing criteria in Nos. **5.502** and **5.503.**

Advantages:

- The delicate balance between the services in the band 13.75-14 GHz, as established by WARC-92 modified by WRC-95 and WRC-2000, in Nos. **5.502** and **5.503**, would be maintained. Since these footnotes indirectly limit the number of FSS earth stations deployed in the band, the protection they provide to Radiolocation and Space Research would be adequate.
- No additional regulatory burden is placed upon administrations.

Disadvantages:

- No protection is afforded to Radiolocation other than limiting the number of interference sources.
- FSS development would continue to be unduly constrained by the minimum size of 4.5 m in diameter in this band.

1.4.3.2 Method B

Relaxation of the current limit on the FSS antenna size, with additional regulatory provisions and increase in the protected bandwidth of SRS.

In order to maintain the delicate balance between the services involved, this method is based on reducing the current limit on the minimum antenna size to 1.2 m and by adding technical conditions, which would adequately manage the interference caused by FSS earth stations into Radiolocation and SRS stations:

- Off-axis e.i.r.p. density limits to manage the interference into airborne radars, based on a 4 dB tightening of Recommendation ITU-R S.728, and specified in the Radio Regulations on a mandatory basis.
- A single entry pfd limit (specified in the RR on a mandatory basis but not subject to compliance verification by the BR):

  for maritime radar X dB(W/(m^2 · 10 MHz)) not to be exceeded for more than Y% of the time produced at 36 m above sea level at the normal baseline as defined in UN Convention on the Law Of the Sea 1982.

  for land mobile radar, X dB(W/(m^2 · 10 MHz)) not to be exceeded for more than Y% of the time produced 3 m above ground at the border of a neighbouring country deploying land mobile radar in this band.
- Table 7 of RR Appendix **7**, would be updated in order to determine the need for coordination of an FSS earth station with radiolocation stations at specified fixed points, as part of the procedure of No. **9.17**.
- To maintain the current protection of SRS operations, the on-axis e.i.r.p. limit in the 6 MHz bandwidth contained in No. **5.503** would be made a function of the FSS antenna diameter, f(D) where D is the FSS earth station antenna diameter. In addition the protected bandwidth would be extended to 10 MHz centred on 13.775 GHz.
- 6 dB relaxation of the limit on the e.i.r.p. level averaged over 1s on radiolocation emission at elevation angles below 2°.

Advantages:

- FSS development would no longer be constrained to use only earth station antennas larger than 4.5 m. This would grant relaxation of the current limit to 1.2 m with the addition of appropriate limits to ensure the protection of the other services, thus leaving greater flexibility.
- A quantified protection from each individual FSS earth station is afforded to Radiolocation systems.
- Relaxation of the constraints on the radiolocation emission.
- SRS is assured a managed interference environment in the wider protected bandwidth.

Disadvantages:

- Administrations wishing to deploy FSS earth stations will have to ensure that the pfd limits are met, which is likely to include some territorial constraints.
- Future earth station antennas equal to or greater than 4.5 m could be limited in their deployment in coastal areas, which currently is not the case.
- Depending on the values of X and Y, the terrain and the size of the country, there will be cases where a country as a whole could be excluded from implementing FSS service in this band.
- There is a need to develop ITU-R Recommendations which would deal with verification of compliance with pfd constraints on FSS earth stations.
- SRS will have to accept a performance degradation as a result of the relaxed sharing criterion used to derive the e.i.r.p. mask.

Some administrations are of the opinion that the measurement point of the pfd shall be determined by the concerned administration operating the FSS earth station in which case the values of X and Y should be adapted accordingly. Some other administrations believe that the measuring point of the pfd must be determined consistently by all administrations for it to be effective.

1.4.3.3 Method C

- Suppression of footnote **5.502** and extension of the SRS bandwidth defined in the current No. **5.503** to 10 MHz bandwidth 13.770-13.780 GHz.
- For those administrations that wish to retain the limitation on FSS earth station antennas size for protection of the RLS/RNS, a country footnote similar in language to the current No. **5.502** could replace this footnote.
- Table 7 of RR Appendix **7**, would be updated in order to determine the need for coordination of an FSS earth station with fixed radiolocation stations at specified points, as part of the procedure of No. **9.17**.

Advantages:

- Administrations would be enabled to regulate usage of this band according to their own preferences and determine their own preferred methods for protection of the services in the band.
- In some countries, FSS development would no longer be constrained to use only earth station antennas equal to or greater than 4.5 m.
- Uplink spectrum in the 13.75-14 GHz band will be available for FSS with more flexibility than under the current **5.502** footnote. The current imbalance between downlink and uplink spectrum for FSS in the 10-14 GHz range would be reduced particularly in Region 3.

- The increased flexibility of uplink spectrum usage at 13.75-14 GHz would ease the pressure to migrate into operations at higher frequencies, which will be particularly advantageous for countries in zones with high rainfall, owing to attenuation constraints.
- SRS will be given access to more spectrum.

Disadvantages:

- This method does not provide an internationally consistent protection method for radiolocation thus requiring country by country consultation for radiolocation operators noting that international coordination under the ITU Regulations is not a suitable mechanism to establish a shared use of this band between FSS and mobile radiolocation stations. This country by country process may unduly constrain the radiolocation operation.
- In absence of adequate regulatory mechanisms, this method will create a potential for increased interference to the radiolocation service and will create an uncertainty in the level of protection offered to the globally allocated radiolocation service.
- No protection will be offered to FSS space receivers.
- There could be a regulatory burden on the administrations.
- SRS will not have a managed interference environment.
- SRS will have to accept performance degradation.
- Operation of secondary EESS could eventually be precluded.
- The effects of implementing this method cannot be confidently predicted as it has not been studied in detail by ITU-R. As an example this method would allow deployment of FSS earth stations antenna diameters below 1.2 m, the effect of which on other services has not been studied per Resolution **733**.
- The exact regulatory mechanisms need to be further developed for international protection of the radiolocation.

1.4.4 Regulatory and procedural considerations

Since Method **A** described in § 1.4.3 above does not require any regulatory or procedural changes, this Section only addresses the regulatory and procedural aspects relating to Methods **B and C**.

1.4.4.1 Regulatory and procedural considerations for Method B

1.4.4.1.1 Sharing between FSS and RLS

a) Current regulatory/procedural situation

It was noted that, pursuant to No. **11.14**, frequency assignments to ship stations and to mobile stations of other services shall not be notified under Article **11**. It was also noted that, pursuant to No. **11.20**, in the frequency band 13.75-14 GHz, which is allocated to FSS and RLS with equal rights, radiolocation stations located within the coordination area of an FSS earth station can only be notified through individual notices, i.e. at specified fixed points. This situation appears to preclude the possibility of taking into account, within the coordination of an FSS earth station under No. **9.17**, the protection of mobile radiolocation stations, which by nature, may be located at any geographical point.

The studies therefore concluded that the application of No. **9.17** would be possible only in respect of radiolocation stations located at fixed, predetermined, geographical points, which excludes land, maritime and aeronautical mobile radiolocation stations. Also, since **9.17** is a coordination procedure between administrations on the territories of which the earth station and the radiolocation station are located, it could not be carried out with maritime or aeronautical radiolocation stations.

b) Possible regulatory solutions for radiolocation stations located at specified fixed points

Table 7 of RR Appendix **7**, which would be used to determine the need for coordination of an FSS earth station with radiolocation stations located at specified fixed points, does not currently include parameters for radiolocation stations in the 13.75-14 GHz band. The studies considered that it would be more appropriate to include, in Table 7 of RR Appendix **7,** the relevant values to protect ground based radiolocation stations located at fixed points. Suitable values have been suggested and will be considered in the framework of updating RR Appendix **7** under agenda item 7.1.

c) Possible regulatory solutions for mobile radiolocation stations

The ITU-R studies concluded that, since the protection of mobile radiolocation stations cannot be effected by the coordination procedure of No. **9.17**, other regulatory measures would be needed for that purpose.

The ITU-R studies noted that, currently, the protection of mobile radiolocation stations was obtained only through the limitation of the number of FSS earth stations resulting from the minimum antenna diameter to 4.5 m.

For the protection of airborne radiolocation stations, as shown in § 1.4.2.1.3, the ITU-R studies have concluded that in situation where main beam coupling between the radiolocation antenna and the FSS earth station can be avoided, a reduction of 4 dB from the off-axis e.i.r.p. density levels currently specified for VSATs in Recommendation ITU-R S.728 would maintain the current interference situation caused by 4.5 m antennas into airborne radiolocation receivers, in a scenario where the airborne receiver is flying within one country and the interfering FSS earth stations are located in the neighbouring countries. Such limits may be implemented from a regulatory point of view, as shown in the following example of a possible addition to Section III of RR Article **21:**

ADD

21.XX In the band 13.75-14 GHz, the level of e.i.r.p. emitted by an earth station of a GSO FSS network shall not exceed the following values:

Angle off-axis	*Maximum e.i.r.p. in any 1 MHz band*
$2° \leq \varphi \leq 7°$	$43 - 25 \log \varphi$ dBW
$7° < \varphi \leq 9.2°$	22 dBW
$9.2° < \varphi \leq 48°$	$46 - 25 \log \varphi$ dBW
$\varphi > 48°$	4 dBW

These limits do not apply to FSS earth stations brought into service prior to WRC-03.

*****

To avoid situations where main beam coupling between the stations of both services could happen, additional regulatory provisions may be required such as exclusion zones. Further studies are needed to define a possible regulatory implementation.

For the protection of maritime and land mobile radiolocation stations, the off-axis e.i.r.p. density limits mentioned above would improve the interference environment in which the radiolocation systems would operate. However they would not be sufficient by themselves to ensure the protection of RLS in all cases. The proposed method to implement the protection of maritime and land mobile RLS systems, as described in section 1.4.3 b), would rely on pfd limits. From a regulatory point of view, this may be implemented by modifying No. **5.502** as in the following example:

MOD

5.502 In the band 13.75-14 GHz, an earth station of a geostationary fixed-satellite service network shall have a minimum antenna diameter of 1.2 m and an earth station of a non-geostationary fixed satellite service system shall have a minimum antenna diameter of 4.5 m. In addition the e.i.r.p., averaged over one second, radiated by a station in the radiolocation or radionavigation services shall not exceed 59 dBW above 2° elevation and 65 dBW below. An administration planning to use FSS earth stations in a geostationary network in this band shall ensure that the single entry power flux-density produced by any earth station operating within its territory does not exceed:

> X dB(W/(m^2 · 10 MHz)) not to be exceeded for more than Y% of the time produced at 36 m above sea level at the normal baseline as defined in UN Convention on the Law Of the Sea 1982.
>
> X dB(W/(m^2 · 10 MHz)) not to be exceeded for more than Y% of the time produced 3 m above ground at the border of a neighbouring country deploying land mobile radar in this band.

*****

Comments:

– The suppression of the last two sentences of the current footnote No. 5.502 takes into account the fact that the 59/65 dBW limit on radiolocation average e.i.r.p. is intended to protect FSS space stations. Hence no complaint for harmful interference can be made as long as these limits are met by radiolocation stations.

– The suppression of the provision relating to the FSS earth station e.i.r.p. levels of 85 dBW and 68 dBW results from the fact that this provision has no regulatory implication. These levels are reflected in Recommendation ITU-R S.1068.

– Transitional arrangements need to be developed to ensure consistency with current regulatory provisions.

– The proposed regulatory text only covers Method B for a pfd limit measured at the normal baseline. If a different measurement point were to be included for some administrations additional regulatory text would have to be defined.

d) Protection of FSS receive space stations

The ITU-R studies have concluded that the e.i.r.p. limits included in the example modification of No. **5.502** given in c) radiated by radiolocation stations require further technical, operational and regulatory studies to ensure that correlation between the radiolocation pulse repetition frequency and duty cycle and the FSS frame/coding rate do not occur in future operational designs of these systems different from those currently implemented.

1.4.4.1.2 Sharing between FSS to SRS

The on-axis e.i.r.p. density limit on FSS earth stations addressed in § 1.4.2.2 above would replace the current limit in No. **5.503** and would be a mandatory one, i.e. subject to examination by the Bureau under No. **11.31.** This could be done by modifying the relevant part of No. **5.503** as shown in the following example:

MOD

5.503 In the band 13.75-14 GHz, geostationary space stations in the space research service for which information for advance publication has been received by the Bureau prior to 31 January 1992 shall operate on an equal basis with stations in the fixed-satellite service; after that date, new geostationary space stations in the space research service will operate on a secondary basis. Until those geostationary space stations in the space research service for which information for advance publication has been received by the Bureau prior to 31 January 1992 cease to operate in this band:

– the e.i.r.p. density of emissions from any earth station in the fixed-satellite service operating with a space station in geostationary-satellite orbit shall not exceed 4.7D + 28 dBW/40 kHz, where D is the fixed-satellite service earth station antenna diameter (m) from 13.770 to 13.780 GHz for earth station diameters equal to or greater than 1.2 m and less than 4.5 m;

  49.2 + 20 log(D/4.5) dBW/40 kHz, where D is the fixed-satellite service earth station antenna diameter (m) from 13.770 to 13.780 GHz for earth station diameters equal to or greater than 4.5 m and less than 31.9 m;

  66.2 dBW/40 kHz for any fixed-satellite service earth station emission in the band 13.770-13.780 GHz for antenna diameters (m) equal to or greater than 31.9 m;

  for any fixed satellite service earth station antenna diameter (m) a maximum e.i.r.p. spectral density of 56.2 dBW/4 kHz for narrow-band (less than 40 kHz of necessary bandwidth) fixed-satellite service earth station emissions in the band 13.770-13.780 GHz;

– the e.i.r.p. density of emissions from any earth station in the fixed-satellite service operating with a space station in non-geostationary-satellite orbit shall not exceed 51 dBW in the 6 MHz band from 13.772 to 13.778 GHz.

Automatic power control may be used to increase the e.i.r.p. density in these frequency ranges to compensate for rain attenuation, to the extent that the power flux-density at the fixed-satellite service space station does not exceed the value resulting from use by an earth station of an e.i.r.p. meeting the above limits, in clear-sky conditions. (WRC-2000)

1.4.4.1.3 Regulatory and procedural considerations relating to EESS

Since most provisions of No. **5.503A** related to EESS and FSS operation with equal status have expired, it may be possible to reflect the remaining provisions by introducing in the table of allocation a secondary allocation to EESS and consequently to suppress No. **5.503A**.

1.4.4.2 Regulatory and procedural considerations for Method C

Implementation of Method C would require changes to at least No. **5.502** and No. **5.503**.

#########

1.5 Agenda item 1.28

"to permit the use of the band 108-117.975 MHz for the transmission of radionavigation satellite differential correction signals by ICAO standard ground-based systems"

1.5.1 Summary of technical and operational studies including a list of relevant ITU-R Recommendations

A new aviation requirement has emerged for the transmission of augmentation data for the Global Navigation Satellite Service (GNSS) to be used by aircraft receivers to satisfy the stringent accuracy and integrity requirements for GNSS applications such that they can be used for precision approach and landing. This new Ground-Based Augmentation System (GBAS) is planned to operate in the frequency band 108-117.975 MHz. The systems, that currently use this band, are ILS and VOR.

ICAO has also developed international standards for a surveillance system in which data derived from navigation systems on board an aircraft are transmitted over a data link to other aircraft and to air traffic control. This system supports navigation and surveillance functions and is intended to operate in the frequency bands 108-117.975 MHz and 117.975-137 MHz.

Compatibility of the new navigation and surveillance systems with FM broadcasting stations will be secured by ensuring that the new systems do not cause interference to the reception of FM broadcasting signals or impose constraints to the BS, operating in the band at about 87-108 MHz. These concerns have already been addressed during the development of GBAS, and no new protection requirements beyond that provided for ILS/VOR are needed with GBAS implementation. Compatibility of the surveillance systems with FM broadcasting has not yet been fully addressed.

Digital sound broadcasting systems have been designed to operate in the frequency band at about 87-108 MHz (see Recommendation BS.1114). At least one administration is planning to introduce such a system in this band. No compatibility studies within ITU-R have been conducted between these systems and the existing and additional aeronautical systems in the band 108-117.975 MHz*.

1.5.2 Analysis of the results of studies

The band 108-117.975 MHz is currently allocated to the ARNS. The new navigation and surveillance applications envisaged for implementation in this band do not fall within the definition of a RNS (i.e., using the propagation properties of radio waves) and that an amendment to the allocation of this band is required. An appropriate additional allocation would, therefore, need to be made to allow for these systems to operate in the band 108-117.975 MHz. Without making an allocation to a specific aeronautical service, the preferred way would be to permit the use of this band by ICAO standard systems that support air navigation and surveillance functions through the addition of a footnote to this band. ICAO is establishing standards, which will ensure compatibility between these systems and the ICAO standard ILS/VOR systems. These compatibility Standard and Recommended Practices will be incorporated, with the necessary Guidance Material, in Annex 10 to the ICAO Convention.

1.5.3 Methods to satisfy the agenda item and their advantages and disadvantages

1.5.3.1 Method A

Adopt a footnote that will permit the use of the band 108-117.975 MHz on a global basis for the transmission of radionavigation satellite differential correction signals by international aeronautical standard ground-based systems.

Introduce an agenda item for WRC-07, which addresses expanded aeronautical surveillance applications in the band 108-117.975 MHz.

Advantages:

- Facilitates the global implementation of GBAS
- No further consideration of issues relating to the compatibility between FM broadcasting and ground to air data links supporting air navigation functions, such as GBAS, is required.
- This would allow additional time to address FM broadcasting compatibility requirements of the surveillance systems and to reach an agreement with the broadcasting community.

* The Arab administrations recognized that the handling of the Agenda item by ITU-R has gone beyond its original by including a newly proposed ICAO surveillance system.

Disadvantages:

- Implementation of ICAO standard systems for surveillance applications in this band will be delayed until after WRC-07.
- An additional agenda item for WRC-07 would need to be introduced.
- Does not consider the impact of introducing digital sound broadcasting in the band at about 87-108 MHz.

1.5.3.2 Method B

Adopt a footnote that will permit the use of the band 108-117.975 MHz on a global basis by ICAO standard systems that support navigation and surveillance functions through a data link on the condition that priority and protection be given to the ARNS. This footnote would reference a Resolution **[Method B]** , which lays down the minimum criteria for such systems operating in this band in terms of compatibility requirements with and the protection of the broadcasting service. To ensure that compatibility with the broadcasting service does not become an issue at WRC-03, and that Recommendation ITU-R SM.1009 does not have to be revised prior to implementation of the new aeronautical systems, operation of the new systems should be limited to frequencies above 112 MHz. Based on previous studies and experience with applying Recommendation ITU-R SM.1009 (given that the ICAO immunity specification for the new receivers exceeds current standards for ILS/VOR), this guardband is sufficient to ensure that interaction between the services involved can be discounted. The frequency limitation is not significant in operational terms, because the part of the band below 112 MHz will remain heavily occupied by ILS systems for a considerable period of time, plus there is no immediate need to operate the new systems below 112 MHz.

The situation between 108 and 112 MHz does however require more study to assess and resolve any compatibility problems. The entire frequency band 108-117.975 MHz would then be made available to the new aeronautical applications, following the ITU-R studies and, if necessary, the endorsement of these studies by a future competent WRC.

Advantages:

- A footnote in the Radio Regulations, referencing a Resolution, will facilitate the global introduction of current and future internationally standardised GNSS augmentation systems and automatic dependent surveillance while not constraining current/planned FM broadcasting.
- No immediate review of compatibility issues by WRC-03 is required. Frequencies above 112 MHz can be used for these new aeronautical systems in accordance with the WRC-03 Final Acts, while use of the range 108-112 MHz can wait upon the outcome of ITU-R studies.
- No future changes to footnotes would be necessary.
- Introduction of International Standardised GNSS augmentation and surveillance applications would not be delayed due to the time constraints of re-opening the table of allocations at a future WRC.
- The broadcasting community would be continuously assured of no additional adverse effects to FM broadcasting services in the band below 108 MHz.

Disadvantages:

- Consideration of surveillance systems in the band 108-117.975 MHz is not an element of this agenda item for WRC-03.
- Insufficient time to assess all compatibility issues between the broadcasting service and aeronautical services.

- Does not consider the impact of introducing digital sound broadcasting in the band at about 87-108 MHz.

1.5.3.3 Method C

Adopt a footnote that will permit the use of the band 108-117.975 MHz on a global basis by ICAO standard systems that support navigation and surveillance functions, through a data link, on the condition that priority and protection be given to the aeronautical radionavigation service.

Advantages:

- Does not delay the introduction of either GNSS augmentation or surveillance applications.
- No further consideration of issues relating to the compatibility between FM broadcasting and the data links supporting air navigation functions, such as GBAS, is required.

Disadvantages:

- Studies with respect to the impact of the surveillance applications on FM broadcasting in the lower adjacent band will not be completed by WRC-03.
- Does not consider the impact of introducing digital sound broadcasting in the band at about 87-108 MHz.

1.5.4 Regulatory and procedural considerations

1.5.4.1 Method A

Introduce a new provision into Article 5 of the Radio Regulations that might read as follows:

ADD

5.AAA The band 108-117.975 MHz also may be used to transmit supplementary navigational information, using internationally standardized ground based augmentation systems in support of aeronautical navigation functions.

*****

NOTE – The conference will determine under which service the stations referred to in No. **5.AAA** should operate

1.5.4.2 Method B

Introduce a new provision in Article **5** of the Radio Regulations along the lines of the example text shown below, together with a new WRC-03 resolution, which would condition the immediate and future use of the band.

ADD

5.BBB The band 108-117.975 MHz may also be used by international aeronautical standard systems to transmit navigational information in support of air navigation and surveillance functions in accordance with recognized international aviation standards. Such use shall be in accordance with Resolution **[Method B]** and shall not cause harmful interference to nor claim protection from stations operating in the aeronautical radionavigation service, which operate in accordance with international aeronautical standards.

Example text of Resolution **[Method B]** is given in Annex [METHOD B-1.28] to Chapter 1.

1.5.4.3 Method C

Introduce a new provision into Article **5** of the Radio Regulations that might read as follows:

ADD

5.CCC The band 108-117.975 MHz may be used by international aeronautical standard systems supporting navigation and surveillance functions. Such use shall not cause harmful interference to nor claim protection from international standard systems operating in the aeronautical radionavigation service.

ANNEX [METHOD B–1.28]

ADD

RESOLUTION [METHOD B] (WRC-03)

Use of the band 108-117.975 MHz by aeronautical services other than the aeronautical radionavigation service

The World Radiocommunication Conference (Geneva, 2003),

considering

a) the current allocation of the frequency band 108-117.975 MHz to the aeronautical radionavigation service;

b) the requirements of the broadcasting service operating in the frequency band at about 87-108 MHz;

c) the need for the aeronautical community to provide additional services in order to enhance navigation and surveillance systems through a communication datalink,

recognizing

a) that precedence must be given to the aeronautical radionavigation service operating in the frequency band 108-117.975 MHz;

b) that, in accordance with Annex 10 of the Convention of the International Civil Aviation Organization (ICAO), all aeronautical systems must meet Standards and Recommended Practices (SARPs) requirements;

c) that within ITU-R, compatibility criteria between the broadcast service operating in the frequency band at about 87-108 MHz and the aeronautical radionavigation service operating in the frequency band 108-117.975 MHz already exist as indicated in Recommendation ITU-R SM.1009;

d) that all compatibility issues between FM broadcasting systems and ICAO standard ground-based systems for the transmission of radionavigation-satellite differential correction signals have been addressed,

noting

a) that aeronautical systems are converging towards a communication datalink environment to support aeronautical navigation and surveillance functions, which need to be accommodated in existing radio spectrum;

b) that no compatibility criteria currently exist between the broadcast service operating in the frequency band at about 87-108 MHz and the planned additional aeronautical services in the adjacent band 108-117.975 MHz using airborne transmission;

c) that studies by ICAO have confirmed that the planned additional aeronautical systems are compatible with the existing use of the adjacent band 108-117.975 MHz,

resolves

1 that the provisions of this Resolution and of No. **5.[BBB]** shall enter into force on [4 July 2003];

2 that any additional aeronautical systems planned to operate in the frequency band 108-117.975 MHz shall, as a minimum, meet the FM broadcast immunity requirements contained in Annex 10 of the Convention of the International Civil Aviation Organization (ICAO) for existing aeronautical radionavigation systems operating in this frequency band;

3 that additional aeronautical systems operating in the band 108-117.975 MHz shall place no additional constraints on current and planned stations the broadcast service operating in the band at about 87-108 MHz;

4 that frequencies below 112 MHz shall not be used for these new aeronautical systems until all compatibility issues with the lower adjacent frequency band at about 87-108 MHz, have been considered,

invites ITU-R

1 to study any compatibility issues between the broadcast service and new aeronautical services that may arise from the introduction of these new services and to develop new or revised ITU-R recommendations as appropriate;

2 to bring the results of these studies, if necessary, to the attention of a future competent WRC to determine any further action required,

requests the Secretary-General

to bring this Resolution to the attention of ICAO.

CHAPTER 2

Mobile, mobile-satellite and space science services

(WRC-03 agenda items 1.3, 1.5, 1.6, 1.11, 1.12, 1.16, 1.20, 1.31, 1.33, 1.38)

CONTENTS

2.1 Agenda item 1.3

"to consider identification of globally/regionally harmonized bands, to the extent practicable, for the implementation of future advanced solutions to meet the needs of public protection agencies, including those dealing with emergency situations and disaster relief, and to make regulatory provisions, as necessary, taking into account Resolution **645 (WRC-2000)**"

2.1.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

2.1.1.1 Introduction to public protection and disaster relief

WRC-2000 considered the benefits of globally/regionally harmonized frequency bands for future advanced solutions for public protection and disaster relief (PPDR) and an increasing need for interoperability and inter-working between security and emergency networks, both nationally and for cross-border operations, in emergency situations and disaster relief. Resolution **645 (WRC-2000)** invited the ITU-R to study the identification of possible harmonized bands for future advanced solutions for PPDR and the development of a resolution identifying the technical and operational basis for global cross-border circulation of radiocommunication equipment in emergency and disaster relief situations.

Terminology for public protection and for disaster relief

There are terminology differences between administrations and regions in the scope and specific meaning of PPDR. For the purpose of discussing this agenda item, the following terms have been taken from draft new Report ITU-R M.[PPDR]:

Public protection radiocommunication: Radiocommunication used by responsible agencies and organizations dealing with maintenance of law and order, protection of life and property, and emergency situations.

Disaster relief radiocommunication: Radiocommunication used by agencies and organizations dealing with a serious disruption of the functioning of society, posing a significant, widespread threat to human life, health, property or the environment, whether caused by accident, nature or human activity, and whether developing suddenly or as a result of complex, long-term processes.

2.1.1.2 Spectrum vision for public protection and disaster relief applications

2.1.1.2.1 Administrations' views on public protection and disaster relief

There are a number of views concerning the focus and treatment of public protection versus disaster relief within this agenda item. Administrations have different amounts of overlap between the jurisdiction and responsibilities of their agencies and organizations. Therefore, the view(s) of some administrations is that public protection and disaster relief should be treated separately for this agenda item since they each have unique requirements. The views of others are that they can be considered together because the same agencies are involved to a large extent in both activities.

View A:

Public protection, including those dealing with disaster relief

Many administrations interpret the agenda item literally as focusing on the identification of spectrum for public protection agencies. Public protection activities are related to day-to-day activities and are planned and conducted within national borders. However, public protection agencies are also likely to participate in disaster relief activities and will usually be the first responders on the scene in a disaster relief event. While acknowledging that planning for public protection is a national responsibility, many administrations see significant long-term benefits in harmonization of spectrum for public protection, viz., increased spectrum efficiencies, reducing the need for periodic band replanning as systems are replaced, reducing the consequent disruption to other spectrum users, better economies of scale, market stimulation and focus for manufacturers and a favourable basis upon which interoperability and operational efficiency will evolve. Identification of spectrum in the Radio Regulations, similar to what has been done for IMT-2000, is intended to send a message to manufacturers on where to focus future equipment development. Harmonization of public protection will also help in meeting the needs of disaster relief.

View B:

Separation of public protection from disaster relief

A number of administrations believe that some aspects of disaster relief activities, by their nature, have different requirements regarding spectrum availability. It is recognized that public protection agencies and organizations will be the first on the scene in a disaster relief event. Moreover, it is generally acknowledged that public protection activities are routine day-to-day operations and are conducted for the most part within respective national borders using public protection assets of the nation. Therefore, some administrations view spectrum planning for these agencies and organizations as a national matter. Furthermore, it is recognized by some that harmonized spectrum for national public protection could benefit from economies of scale but this does not require provision in the Radio Regulations. On the other hand, disaster relief activities may involve an international relief effort from other administrations. Hence, spectrum requirements for these activities are not needed on a continuous daily basis and are not as easily quantifiable but may require immediate and potentially dramatic increase in spectrum access in response to a disaster. Therefore, consideration for globally harmonized spectrum for disaster relief activities is supported. Furthermore, some administrations are of the opinion that commercially operated systems using spectrum already identified may play a role in disaster relief support. For these reasons, these administrations believe that public protection and disaster relief require separation in the consideration of this agenda item.

2.1.1.2.2 Aspects of the use of disaster relief radiocommunication

In their disaster relief activities, international humanitarian organizations, such as the International Committee of the Red Cross, the International Federation of Red Cross and Red Crescent Societies and United Nation agencies, rely heavily on extensive private HF and VHF/UHF radio and satellite networks, especially where normal telecommunication services are interrupted, overloaded or unavailable. For efficient and autonomous conduct of their humanitarian activities, it is crucial for these organizations to be able to operate their own wireless networks independent from networks operated by governments or government agencies.

The use of radiocommunication services in the context of international humanitarian assistance is facilitated by the *Working Group on Emergency Telecommunications (WGET), which is also known as the Reference Group on Telecommunications of the Inter-agency Standing Committee on Humanitarian Affairs (IASC)*.

Emergency management agencies and relief organizations use Amateur Service for assistance in emergency communications during disasters. Likewise, mobile-satellite communications, with their reliable, transportable terminals are used in emergency and disaster communications. In the future, other developing systems such as High Altitude Platform Stations (HAPS) may also play an important role in providing communications capabilities over a relatively large area for complementing PPDR communications.

It should also be noted that the Telecommunication Development Bureau (BDT) of ITU has recently published a handbook on disaster communications. While taking into account all telecommunication networks and services the handbook draws attention to the special capabilities of radiocommunication services. The handbook is in three parts; Part 1 provides a framework for policy-makers and planners, Part 2 is intended for those with operational responsibilities in disaster communications, while Part 3 covers technical matters.

It should be further noted commercial mobile systems are readily available and can be deployed rapidly in a disaster situation. By the year 2010, more than 1.7 billion mobile subscribers are anticipated. This will allow a large number of people in the world to be engaged in PPDR reporting activities.

The capabilities of these other radio systems to provide alternative communications should be considered.

2.1.1.2.3 Existing frequency bands designated for PPDR within countries

Based upon an ITU-R survey of PPDR communications conducted in the 2000-2003 study period from over 40 ITU members and international organizations, the summarized comments noted that existing bands in use are as follows:

a) There is little uniformity as regards the frequency bands that are used for PPDR use in different countries.

b) While in most countries the bands used for public protection are the same as those used for disaster relief, in some countries separate bands are used.

c) Many administrations have designated one or more frequency bands for narrow-band PPDR operations. It should be noted that only particular sub-bands of the frequency ranges or parts thereof listed below are utilized in an exclusive manner for PPDR radiocommunications: 3-30, 68-88, 138-144, 148-174, 380-400 MHz (including CEPT designation of 380-385/390-395 MHz), 400-430, 440-470,764-776,794-806, and 806-869 MHz (including CITEL designation of 821-824/866-869 MHz). One administration has designated PPDR spectrum for wideband and broadband applications.

2.1.1.2.4 Views on spectrum harmonization for PPDR

In the responses to the ITU-R survey of PPDR communications, a number of administrations have supported in principle the idea of providing harmonized frequency bands on a national and international level. Some of these views are as follows:

a) With regard to disaster relief, a number of countries prefer to have a common band so that use in all places is possible during the disaster. It is believed that relief teams can be much more effective if their systems operate on a common frequency band and the equipment used is based upon recognized radio compatibility characteristics and standards, and conform to common air-interface standards.

b) A number of countries have indicated the following needs and benefits of global/regional harmonization:

   i) Identification of sufficient harmonized spectrum for PPDR is a key public policy need.

   ii) Regional/global spectrum harmonization enhances cross-border coordination and assistance for a proper multinational response to a large disaster (such as large-scale earthquake and flood), crime or emergency incident, by facilitating radiocommunication between the dispatched teams and accepting agencies.

iii) Spectrum harmonization could reinforce the benefits of open standards, open technologies and radio compatibility and will help to reduce the cost of product development which may result in lower prices for PPDR users.

iv) Harmonization of spectrum could also facilitate interoperability between public protection and disaster relief agencies and organizations and provide a competitive market place.

c) Some administrations have noted that a limited extent of regional harmonization exists already and that activities are under way to further this harmonization.

d) Some administrations have questioned the need for further global/regional harmonization.

2.1.1.2.5 Future advanced solutions for PPDR

Radiocommunication in support of PPDR activities cover a range of radiocommunication services such as fixed, mobile, amateur and satellite. Typically, narrow-band technologies are used for PPDR radiocommunication within the terrestrial mobile service, while wideband and broadband technologies are finding PPDR applications within all services.

Narrow-band digital networks have been and will be introduced in an increasing number of countries while wideband and broadband technologies for PPDR are being developed. Reference to these technologies is starting to appear in regional standardization bodies.

The three radiocommunication scenarios, that is narrow-band, wideband and broadband, will develop to operate in an integrated manner to serve different needs in term of functionalities and geographic coverage for PPDR applications. Detailed information on the envisioned applications can be found in draft new Report ITU-R M.[PPDR]. In summary, the current understandings of these scenarios as they relate to PPDR are as follows:

a) Narrow-band

To provide PPDR narrow-band applications, the trend is to implement wide area networks including digital trunked radio networks providing digital voice and low speed data applications (e.g. pre-defined status messages, data transmissions of forms and messages, access to databases). Report ITU-R M.2014 lists a number of technologies, with typical channel bandwidths up to 25 kHz, that are currently used to deliver narrow-band PPDR applications.

b) Wideband

It is expected that the wideband technologies will carry data rates of several hundred kilobits per second (e.g. in the range of 384-500 kbit/s). Since it is expected that networks and future technologies may require higher data rates, a whole new class of applications including: wireless transmission of large blocks of data, video and Internet protocol-based connections in mobile PPDR communications systems may be introduced.

Systems for wideband applications to support PPDR activities are under development in various standards organizations. Many of these developments are referenced in Reports ITU-R M.2014, M.1457, and M.1073, with channel bandwidths dependent on the use of spectrally efficient technologies.

c) Broadband

Broadband technology could be seen as a natural evolutionary trend from wideband. Broadband applications enable an entirely new level of functionality with additional capacity to support higher speed data and higher resolution images.

Systems for broadband applications to support PPDR activities could typically be tailored to service localized areas (1 km^2 or less) providing voice, high speed data, high quality digital real time video and multimedia (indicative data rates in range of 1-100 Mbit/s) with channel bandwidths dependant on use of spectrally efficient technologies. Examples of possible applications are described in more detail in draft new Report ITU-R M.[PPDR].

Finally, it should be noted that various standards organizations are studying requirements for broadband PPDR applications. Report ITU-R M.2014 lists some of these activities, including Project MESA.

2.1.1.2.6 Interoperability techniques and technology solutions for PPDR

Interoperability techniques and advanced technologies may assist in providing support for bandwidth and interoperability. The variety of interoperability techniques and advanced technologies currently available may satisfy some PPDR requirements. Spectrum harmonization combined with these interoperability techniques and future advanced technologies may lessen the amount of global/regional spectrum as required by individual administrations for implementing their domestic PPDR applications. A few of these interoperability techniques and advanced technology solutions are detailed in draft new Report ITU-R M.[PPDR].

Some PPDR agencies and amateur radio groups use HF narrow-band systems including the use of data modes of operation as well as voice. Other technologies such as digital voice, high-speed data and video are in early implementations either using terrestrial or satellite network services.

2.1.1.3 Technical and operational issues

In order to provide effective communications, PPDR agencies and organizations need to fulfil a set of objectives and requirements that include interoperability, reliability, functionality, security in operations and fast call set-up[1] in each area of operation. Considering that the radiocommunication needs of PPDR agencies and organizations are growing, future advanced solutions used by PPDR agencies and organizations will require higher data rates, real-time video and multimedia. Draft new Report ITU-R M.[PPDR] among other items, defines objectives and requirements for the implementation of advanced solutions to meet the future needs of PPDR agencies and organizations. It provides a set of objectives, describes envisioned applications and the system design characteristics to be considered in order to satisfy the operational needs of PPDR agencies and organizations.

The requirements for PPDR radiocommunication should take into account the operating environments applicable to PPDR applications. User requirements are expected to lead to future advanced solutions for PPDR. The eventual accessibility of PPDR applications will also depend on various factors. These include cost, national regulations and laws, the nature of the PPDR mandate and the needs of the area to be served.

Radiocommunication in support of PPDR activities aim to achieve general objectives within the context of the maintenance of law and order, protection of life and property, response to emergency and disaster situations and coordinated rescue and relief operations. In addition, radiocommunication in support of PPDR operations aim to achieve operational objectives such as enabling communications management to be controlled (fully or in part) by PPDR agencies and organizations, in particular, for instant/dynamic reconfiguration changes, dispatch group (talk group) configuration, guaranteed access including priority levels and pre-emption (to over ride other users). It is important that communications through the system/network or those that are independent of the network such as Direct Mode Operation (DMO), simplex radio and push to talk are also available.

[1] Fast call set-up indicates reducing the response time to access the particular network.

Radiocommunication in support of PPDR activities needs to be available to support highly reliable operations on a continuous basis (i.e. 24 hours × 365 days/year). Providing coverage of the relevant jurisdiction and/or operation of the PPDR agency or organization whether it be national, provincial/state or at the local level is extremely important. PPDR radiocommunication is also usually required to provide reliable indoor and outdoor coverage of remote areas, and coverage of underground or inaccessible areas (e.g. tunnels, building basements).

The ITU-R survey also revealed concerns by administrations about appropriate levels of interference protection, the free circulation of equipment for international disaster relief, and logistic planning and preparedness.

2.1.1.4 Relevant ITU studies

Relevant Recommendations ITU-R: F.1105, M.1036 and DNR ITU-R M.[DR.RCIRC].

DN Report ITU-R M.[PPDR] "Objectives and requirements for PPDR radiocommunication", Recommendation ITU-D 13, "Effective utilization of the amateur services in disaster mitigation and relief operations" and the ITU "Disaster communications handbook for developing countries" also related to this matter.

2.1.2 Analysis of the results of studies

Studies have been undertaken in the ITU-R and the results of these studies are contained in draft new Report ITU-R M.[PPDR]. An understanding of the technical and operational issues impacting PPDR agencies and organizations has been achieved, as reflected in previous sections. However, it is the view of some administrations that further studies are required, particularly in the areas of the promotion of interoperability, regional/global roaming, equipment sharing, streamlined coordination, and economies of scale.

2.1.2.1 Agreements on PPDR radiocommunication

Many countries have formal or informal agreements with neighbouring countries concerning use of frequency bands designated for PPDR. Many countries have also signed the ITU/UN International Convention on the Provision of Telecommunications Resources for Disaster Mitigation and Relief Operation (the Tampere Convention). This framework covers the trans-border use of radiocommunication by all partners in international humanitarian assistance. Other agreements which are also relevant include ERC Decision (96) 01 regarding the harmonized frequency bands for emergency services, CITEL PCC.III/Resolution 28 (VI-96) recommendation regarding the harmonized frequency bands for public protection and IARU Memorandum of Understanding with the UN Office for the Coordination of Humanitarian Affairs (OCHA) concerning communications for disaster relief.

2.1.2.2 Spectrum requirements for PPDR

2.1.2.2.1 Objectives

The ITU-R has progressed work on the studies seeking to identify globally/regionally harmonized bands for the implementation of future advanced solutions to meet the needs of public protection agencies, including those dealing with emergency situations and disaster relief. Specifically, the ITU-R has progressed on the studies of the requirements for PPDR, contained in Annex 1 of draft new Report ITU-R M.[PPDR], which will assist in determining spectrum requirements for PPDR.

Many administrations see significant benefits for identifying harmonized spectrum for PPDR applications. These benefits could include among others, economies of scale, consolidation of duplicated infrastructure, improved spectrum efficiency, potential for interoperability, and improved operational effectiveness. These administrations envision basing their domestic planning on the internationally harmonized bands. It is believed that identifying harmonized spectrum will provide advice to manufacturers for design purposes. The amount to be identified should be based on the highest demand, most dense/urban environment. Within the globally/regionally harmonized band(s), administrations would be flexible in the amount of spectrum they want to use domestically. The identification of spectrum is viewed as providing a long-term migration opportunity to accommodate future operational needs. In this respect, globally/regionally harmonized band(s) could also support international disaster relief, however, the amount of spectrum identified is not intended to represent the amount of spectrum that should be harmonized internationally for this aspect.

The objective for other administrations is to identify globally/regionally harmonized spectrum to assist and promote interoperability of equipment internationally. This would facilitate cross-border public protection operations and effective international response to emergency and disaster relief situations when required. However, when public protection assets are invited across borders, only an agreement between those administrations involved is required. The focus therefore, should be placed on the spectrum requirements for international public protection and disaster relief. Further studies may be required to define these international spectrum requirements.

2.1.2.2.2 Methodologies for estimating PPDR spectrum needs

Administrations have used various methodologies to estimate the spectrum requirements for PPDR to the year 2010. Some administrations have used the generic methodology given in Recommendation ITU-R M.1390. This methodology and its variants are described in greater detail in Annex 4 of the draft new Report ITU-R M.[PPDR]. Other administrations have chosen alternative methodologies as described below.

2.1.2.2.2.1 Methodology based on Recommendation ITU-R M.1390

Some administrations used the generic methodology given in Recommendation ITU-R M.1390. This methodology was developed to calculate spectrum requirements for IMT-2000 and it can be used for any land mobile application by selection of appropriate input data. For these studies, the values for the input parameters were chosen to reflect the particular terrestrial mobile PPDR applications envisioned around the year 2010. Some administrations also chose to use a variant of this methodology to represent a generic city analysis.

Validity of Recommendation ITU-R M.1390 methodology for PPDR applications

A study of the validity of the results predicted by this methodology was done by inputting the parameters of a working narrow-band PPDR system into the calculator and confirming that the amount of spectrum it predicted was the same as that actually used by the system. This is particularly important in relation to the selection of the most sensitive parameters, including cell radius/frequency reuse and the number of users. Although not validated by actual measurement, the model is appropriate for estimating the wideband and broadband requirements as long as the input parameters are carefully considered and applied.

Sensitivity/parametric analysis

A sensitivity analysis of the result of spectrum calculations has been made. Considering the highest demand, most dense/urban environment the statistical analysis yielded a probable maximum upper limit of 200 MHz (narrow-band: 40 MHz, wideband: 90 MHz, broadband: 70 MHz).

2.1.2.2.2.2 Other methodologies

Other administrations have chosen alternative methodologies in their estimation. These alternative methodologies include an open and deliberative rulemaking process involving an ongoing and evolving monitoring and assessment of service needs and the consideration of input from public protection agencies and organizations, related associations, equipment manufacturers, and others based on domestic needs. This process also includes determining the availability of frequencies and sharing study with other systems.

2.1.2.3 Summary of the studies for PPDR spectrum required by the year 2010

A summary of the results of spectrum estimates for various PPDR radiocommunication applications (narrow-band, wideband, broadband), is given below in Table 2.1-1. Some administrations are of the view that further studies should address in detail differences in public protection and disaster relief spectrum requirements, including those of many developing countries, for national and international operations, in urban and rural areas, and should take into account capabilities of existing systems. It is envisioned that advanced solutions will be developed to serve different needs in terms of functionalities and geographic coverage for these scenarios.

NOTE – This table has been developed by ITU-R based on contributions provided by member administrations and discussions in the ITU-R meetings.

TABLE 2.1-1

Results of spectrum estimates for PPDR radiocommunication scenarios*

Location	**Methodology used**	**Spectrum estimates**			**Total**
		Narrow-band	**Wideband**	**Broadband**	
Large City A, Asia Pacific (High Demand, Urban Environment, Low PPDR Density)	Rec. ITU-R M.1390	52 MHz	3 MHz	48 MHz	103 MHz
Large City B, Asia Pacific (High Demand, Urban Environment, Low PPDR Density)	Rec. ITU-R M.1390	24 MHz	5 MHz	32 MHz	61 MHz
Large City, Asia Pacific (High Demand, Urban Environment, High PPDR Density)	Rec. ITU-R M.1390	40 MHz	70 MHz	60 MHz	170 MHz
Large City, America (High Demand, Urban Environment, Low PPDR Density)	Rec. ITU-R M.1390	46 MHz	39 MHz	50 MHz	136 MHz
Large City, Europe (High Demand, Urban Environment, Low PPDR Density)	Other	17 MHz	33 MHz**	-	-
Medium City, Europe (High Demand, Urban Environment, Low PPDR Density)	Rec. ITU-R M.1390	21 MHz	22 MHz	39 MHz	82 MHz
Medium City, Europe (Medium Demand, Urban Environment, Low PPDR Density)	Rec. ITU-R M.1390	12 MHz	11 MHz	39 MHz	62 MHz
Industrial District, Europe (Medium Demand, Suburban Environment, Low PPDR	Rec. ITU-R M.1390	3 MHz	3 MHz	39 MHz	45 MHz

Density)					
Asia Pacific	Other	15 MHz***	-	-	-
North America***	Other	35 MHz	12 MHz	50 MHz	97 MHz

* These estimates are from individual administrations.

** The estimate is based on a particular scenario.

*** The data reflects the current allocation(s) for one administration.

There are several reasons for the wide range of spectrum estimates in Table 2.1-1. First, the studies done in obtaining these results showed that the spectrum estimates are very sensitive to the density and the penetration rates assumed. Second, the spectrum calculations, while representative, cover different operating scenarios. For example, one administration based its spectrum estimates on the most dense/urban environment. Another administration chose to examine the amount of spectrum required in a typical medium sized city.

Many administrations do not envisage having physically separate networks supporting both domestic public protection and disaster relief activities. Therefore, the results incorporate both public protection and disaster relief spectrum requirements. Other countries may decide to calculate separate public protection and disaster relief spectrum requirements.

An analysis was performed to provide a generic example of the relationship between the different PPDR user categories and demographic population density in urban areas. This approach shows the optimum PPDR spectrum requirement based on demographics and population. That is, the amount of PPDR spectrum requirement based on the normalized number of PPDR users in a city based on its demographics and population size. This analysis assumed a non-uniform frequency reuse pattern that did not reuse frequencies in the suburban areas immediately adjacent to the urban area.

The analysis concluded that most urban areas had a central urban core with a dense population. The suburban ring around the urban core contained about the same amount of population, but was about 5 to 20 times the area of the urban core. A summary of the results of spectrum estimates for this analysis is provided in Table 2.1-2. (See Annex 4 of draft new Report ITU-R M.[PPDR] for greater detail.)

TABLE 2.1-2

Results of spectrum estimates for PPDR from a generic city analysis

	Medium city (Pop. = approx. 2.5 Million)		**Large city (Pop. = approx. 8.0 Million)**	
	PPDR user density		**PPDR user density**	
	Low	High	Low	High
Narrow-band	31 MHz	44 MHz	48 MHz	67 MHz
Wideband	25 MHz	34 MHz	38 MHz	52 MHz

Based on the data from Tables 2.1-1 and 2.1-2, Table 2.1-3 shows a range of spectrum estimates for similar scenarios.[2]

TABLE 2.1-3

Estimate of spectrum required for PPDR to the year 2010

	Medium city (Pop. = approx. 2.5 Million)		**Large city (Pop. = approx. 8.0 Million)**	
	PPDR user density		**PPDR user density**	
	Low	High	Low	High
Narrow-band	12 to 31 MHz	44 MHz*	17 to 52 MHz	40 to 67 MHz
Wideband	up to 25 MHz	34 MHz*	up to 38 MHz	52 to 70 MHz
Broadband	39 MHz	-	up to 50 MHz	60 MHz
* The results were obtained from the generic city analysis only.				

The spectrum estimates in Tables 2.1-1 and 2.1-2 do not necessarily imply a need for a single contiguous block of spectrum to accommodate all applications. It may be necessary to accommodate the requirements for the various applications (narrow-band, wideband and broadband) across a number of bands. However, to achieve economies of scale, the amount of contiguous spectrum in each category (narrow-band, wideband and broadband) should be maximized to the extent possible.

The results in Tables 2.1-1 and 2.1-2 include both the current spectrum use and the estimates for the future. The spectrum estimates provided for all three categories (narrow-band, wideband and broadband) may be reduced due to a variety of inherent network designs such as cellular architecture patterns (e.g. the cell radius and trunking efficiencies), and other technologies (Annex 5 of draft new Report ITU-R M.[PPDR]).

Considering the potential for new technologies such as IMT-2000 and systems beyond and Intelligent Transportation Systems (ITS) that may support or supplement advanced PPDR applications, the spectrum estimates may also be reduced. Although commercial systems may serve as a complement to dedicated systems in support of PPDR, such use would be in response to market demands.

The use of radiocommunication services such as the fixed service, the mobile-satellite service and the amateur service may supplement PPDR operations, which may impact the amount of spectrum needed for PPDR situations. Administrations can then take this into account when deciding their own domestic arrangements. In the future, advanced technology solutions such as HAPS and RNSS systems could provide additional capabilities, even in times of disasters due to their inherent invulnerability to natural and man-made disasters.

---

[2] It is anticipated that work will continue to progress in the ITU-R to determine an estimate of the spectrum required to the year 2010 and beyond. Therefore, administrations are strongly encouraged to submit proposals to the CPM meeting with the proposed amount of spectrum required to satisfy the agenda item. The ITU-R has not yet reconciled the estimates prepared by a number of administrations to arrive at a consensus estimate.

2.1.2.4 Candidate bands

In response to the ITU-R survey, a list of potential candidate bands has been prepared. This list is attached as Annex 2.1-1.

While considering the list of candidate bands, the conference may take into account the following aspects:

1) To the extent possible, the candidate band(s) identified for use by PPDR applications could be identified from among the bands currently allocated to the fixed, mobile or mobile satellite service regionally/globally on primary or secondary basis.

2) If, however, the identified candidate bands for global/regional harmonization are not allocated to the mobile service on primary basis or is currently allocated to mobile service on a secondary basis, then a change to the Table of Frequency Allocations may need to be considered by the Conference.

3) The specific needs, especially of developing countries, for PPDR applications including interoperability of systems and services, technical and operational assistance and system availability should be met.

4) The needs of individual administrations for flexibility in applying future advanced solutions:

   a) to determine, at the national level, how much spectrum to make available to PPDR applications;

   b) to develop transitional plans appropriate to national situations and requirements;

   c) to continue the operation of all services with allocations in accordance with the Radio Regulations as required to satisfy national needs.

5) The standards and conditions of use applied to PPDR applications need to be in accordance with the relevant ITU-R Recommendations on technical and operational standards.

6) The study of suitable candidate bands for spectrum harmonization for PPDR should consider individual administration's current and planned uses of bands under consideration.

2.1.3 Methods to satisfy the agenda item and their advantages and disadvantages

With regard to the identification of globally/regionally harmonized spectrum for future advanced solutions to meet the needs of PPDR, there are several methods to satisfy agenda item 1.3.

2.1.3.1 Method A

The conference could consider listing global or regional bands for PPDR through footnotes in RR Article **5**.

Advantages:

- A footnote in the Table of Frequency Allocations would emphasize the use of these frequencies for public protection and disaster relief and could therefore, facilitate the global use of these bands for public protection and disaster relief without preventing administrations from using other bands for this purpose or to use these bands for other purposes, if they wish.
- The language used in the example footnotes would provide administrations with flexibility in making their specific allocations and the timing of the allocations.

Disadvantage:

This regulatory format for public protection and disaster relief systems compared to other mobile systems or radio services that are not footnoted in the RR could be misinterpreted as giving a different regulatory status to public protection and disaster relief compared with other uses.

2.1.3.2 Method B

The conference could consider a new Resolution or Recommendation. An example of such a Resolution is contained in Annex 2.1-2.

Advantages:

- Globally/regionally harmonized bands could be listed in a new WRC Resolution or Recommendation, without any specific identification in a footnote to the Radio Regulations.
- Different options of possible candidate bands for terrestrial public protection and disaster relief can be given in this new WRC Resolution or Recommendation.
- This method avoids misinterpretation of the regulatory status of PPDR compared with other uses in the identified band(s) by disassociating any additional spectrum identification for PPDR from the Table of Frequency Allocations.
- Different Regional proposals intended to cover the whole scope of frequency bands options with the possibility of prioritization for one or other of the bands can be noted in the text of a Resolution or Recommendation.
- Follows the approach of avoiding inclusion into the Radio Regulations of complex footnotes (as envisioned by Method **A**) for specific systems, but rather more broadly for services or applications and allows for important explanations in the Resolution or Recommendation text.

Disadvantages:

- There is the danger that the Resolution or Recommendation, if not referenced in a footnote, would be disregarded by administrations. Although it is not unique, it may be questioned whether a Resolution or Recommendation, which address a harmonization matter, is appropriate without any reference in RR Article **5**.

2.1.3.3 Method C

The conference could consider listing global or regional bands for PPDR through footnotes in RR Article **5**, with an appropriate reference to a resolution or recommendation, such as, the example given in Annex 2.1-2.

Advantages:

- A footnote in the Table of Frequency Allocations would emphasize the use of these frequencies for public protection and disaster relief and could therefore, facilitate the global use of these bands for public protection and disaster relief without preventing administrations from using other bands for this purpose or to use these bands for other purposes, if they wish.
- The language used in the example footnotes would provide administrations with flexibility in making their specific allocations and the timing of the allocations.
- This method allows important explanations to be included in the Resolution or Recommendation text.

Disadvantage:

This regulatory format for public protection and disaster relief systems compared to other mobile systems or radio services that are not footnoted in the RR could be misinterpreted as giving a different regulatory status to public protection and disaster relief compared with other systems.

2.1.3.4 Method D

No identification of global/regionally harmonized bands for PPDR but the conference could consider a new Resolution or Recommendation inviting ITU-R to conduct studies for the development of a Resolution identifying frequency bands that could be used on a global/regional basis for disaster relief operations.

Advantage:

Afford further time to address the spectrum needs for international disaster relief operations, which by some administrations is considered to be the only relevant issue of this agenda item.

Disadvantage:

This method does not respond to the need to provide globally/regionally harmonized bands for public protection.

2.1.4 Regulatory and procedural considerations

2.1.4.1 Identification of bands

For Method **A**, an example of the required footnotes could be structured as follows:

ADD

5.XXX *(Global bands for public protection and disaster relief using terrestrial services)*: The bands [...] may be used for future advanced solutions to meet the needs of public protection and disaster relief applications, on a worldwide basis, by administrations wishing to use them for such applications. Such use does not preclude the use of these bands by any application in services to which these bands are allocated and does not establish priority in the Radio Regulations. Such use also does not preclude the use of any other frequencies for public protection and disaster relief applications in accordance with the Radio Regulations.

ADD

5.YYY *(Regional bands for public protection and disaster relief using terrestrial services)*: In [Region XYZ/countries...], the bands [...] may be used for future advanced solutions to meet the needs of public protection and disaster relief applications by administrations wishing to use them for such applications. Such use does not preclude the use of these bands by any application in services to which these bands are allocated and does not establish priority in the Radio Regulations. Such use also does not preclude the use of any other frequencies for public protection and disaster relief applications in accordance with the Radio Regulations.

*****

For Method **B**, an example of a Resolution or Recommendation is provided in Annex 2.1-2.

For Method **C**, the required footnotes could be structured as the example for Method **A** with an additional sentence as follows: "The usage of these bands for public protection and disaster relief should be in accordance with Resolution **[PPDR 2.1-1]**."

For Method **D**, an example of a Resolution is provided in Annex 2.1-3.

2.1.4.2 Global cross-border circulation of radiocommunication equipment in emergency and disaster relief situations

Resolution **645** also invited the ITU-R *"to conduct studies for the development of a resolution identifying the technical and operational basis for global cross-border circulation of radiocommunication equipment in emergency and disaster relief situations,"*

In response, DNR ITU-R M.[DR.CIRC] has been developed. A possible regulatory option to encourage circulation of equipment as follows:

Draft a Resolution based on DNR ITU-R M.[DR.CIRC] "Global cross-border circulation of radiocommunication equipment in emergency and disaster relief situations". The Tampere Convention on the Provision of Telecommunications Resources for Disaster Mitigation and Relief Operations, an international treaty deposited with the United Nations Secretary-General (ICET-98, Tampere 1998) and related United Nations General Assembly Resolutions and Reports are also relevant in this regard.

ANNEX 2.1-1

Candidate bands

NOTE – This table of candidate bands has been developed by ITU-R based on contributions provided by member administrations and discussions in the ITU-R meetings. The allocation to various services indicated in the table refers to allocation on a primary basis only. Advantages and disadvantages for each candidate band for PPDR use are also listed.

Frequency band	Comments
3-30 MHz **Footnotes:** **5.132 5.149**	The band is allocated on a primary basis to several services including FS and MS. **Advantages:** • Some administrations currently use various frequencies in this band for narrow-band PPDR applications. • Good propagation in open plains or dense vegetation. • Valuable band to be kept for existing PPDR usages, i.e. humanitarian aid and disaster management. • Supports communication over short distances using near vertical incidence skywave and longer skywave paths. • Generally, some administrations use parts of these bands for government radiocommunication systems that may be suitable for PPDR applications. **Disadvantages:** • Extensive usage in this band by various services to which the band is allocated is resulting in overcrowding. • A number of sub-bands within the 3-30 MHz band are allocated globally to the aeronautical mobile (R) and the maritime mobile services. • Relatively large antennas are required. • Interference from short and long distances can be a problem. • Some administrations use parts of these bands for government radiocommunication systems that are predominantly for non-PPDR applications.

68-74.8 and 75.2-88 MHz **Footnotes:** **5.149 5.174 5.175 5.176 5.177 5.179 5.182 5.183 5.184 5.185 5.187 5.188 5.190**	The band 68-74.8 MHz is allocated on a primary basis to FS and MS in Regions 1 and 3. In Region 2, parts of this band are allocated on a primary basis to BS, FS, MS and RAS. Parts of the frequency band 75.2-88 MHz are allocated on a primary basis to FS, MS, and BS. **Advantages:** • Parts of this band are allocated to mobile services on a global or regional basis. • Various frequencies in this band are used for narrow-band PPDR applications. • Propagation in this band provides good coverage in rural and forest areas. **Disadvantages:** • Various services have allocation in this band and extensively use it. • Some administrations use parts of this band for BS (allocated on a primary basis). (It is expected that these services will be removed in the long term following conversion to digital transmission.) • There is some susceptibility to man-made noise in and around towns in this band. • Relatively large antennas are required.
138-144 MHz and 148-174 MHz **Footnotes:** **5.207 5.210 5.211 5.212 5.213 5.214**	Parts of these bands are allocated on a primary basis to FS, MS, MMS, MSS, RLS, RNSS, RAS, AMS and SRS. **Advantages:** • Good propagation to provide cost-effective coverage in rural areas. • The band 148-174 MHz is also used by maritime mobile and aeronautical mobile services for distress purposes and has the potential to provide interoperability with maritime and aeronautical communications, if needed. • In many administrations, equipment is available to support existing widely used narrow-band PPDR applications in the band 148-174 MHz. • Generally, some administrations use parts of these bands for government radiocommunication systems that may be suitable for PPDR applications. **Disadvantages:** • One administration uses the band 137-144 MHz for broadcasting services. That administration has decided that no new assignments will be made to broadcasting services in this band and expects that these services will be removed in the long term following their conversion to digital transmission. • Many CEPT administrations use the band 138-144 MHz extensively for non-PPDR government services. • Extensively used by existing services resulting in overcrowding in most cities. • Some administrations use parts of these bands for government radiocommunication systems that are predominantly for non-PPDR applications.
380-399.9 MHz **Footnotes:** **5.208A 5.209 5.220 5.222 5.224A 5.224B 5.254 5.255**	The band is allocated on a primary basis to FS and MS. **Advantages:** • Propagation in this band is suitable for cost-effective wider area coverage including both urban and rural areas. • This band is currently used or is intended to be used for narrow-band PPDR applications by many administrations in Europe and Asia. • The designation of the band 380-385/390-395 MHz for emergency services in Europe in accordance with ERC Decision (96) 01 has provided possibilities for

	interoperability, harmonized and efficient use of common spectrum with wide equipment availability. It is also noted that ERC Decision (96) 01 under *considering i)* that among NATO member administrations, there is an agreement between military and the civil authorities to accommodate the emergency services in Military frequency bands subject to certain conditions such as sharing. • In Europe, administrations use parts of these bands extensively and exclusively for government radiocommunications. • The band 385-390/395-399.9 MHz is being considered by the CEPT as a possible candidate band for PPDR harmonization noting that further negotiations with NATO member administrations are still necessary. **Disadvantages:** • This band is allocated to FS and MS and used extensively for these services. • National frequency allocations of some east European administrations do not allow them to implement ERC Decision (96) 01 since this band is used by different categories of users by these administrations. • This band is used by non-PPDR government services by some administrations in Region 2 and Region 3 and access to this band is required for interoperability among such services.
	• Some administrations use parts of these bands extensively and exclusively for government radiocommunications.
406.1-430 MHz and 440-470 MHz **Footnotes:** **5.209 5.138 5.149 5.261 5.262 5.266 5.267 5.268 5.269 5.270 5.271 5.272 5.273 5.274 5.275 5.276 5.277 5.278 5.279 5.280 5.281 5.282 5.283 5.284 5.285 5.286 5.286A 5.286B 5.286C 5.286D 5.286E 5.287 5.288 5.289 5.290**	These bands are allocated to several services including fixed, mobile, radiolocation, mobile-satellite, radio astronomy and space research services. **Advantages:** • Propagation in these bands is suitable for cost-effective wider area coverage including both urban and rural areas. • Widely used leading to wide availability of equipment. • Some administrations use parts of these bands for narrow-band PPDR applications. • Some administrations use parts of the 450-470 MHz band for existing commercial cellular systems which may be suitable for narrow-band PPDR applications. **Disadvantages:** • These bands are allocated to several radio services and are used extensively for these services and such use will continue. • These bands are widely used by civil PMR systems and therefore parts may not be available for PPDR. • Some administrations use parts of the band 420-450 MHz for high power radiolocation radars. • Some administrations use parts of the band 420-430 MHz for government services. • Some European administrations use the 440-470 MHz band extensively for civil systems and non-PPDR government applications. • Some administrations use parts of this band for existing commercial mobile systems.
746-806 MHz **Footnotes:**	The band is allocated to BS, FS and MS. **Advantages:** • In some administrations, parts of this band are currently being used for

5.149 5.291A 5.294 5.293 5.296 5.300 5.302 5.304 5.306 5.309 5.311 5.312 5.314 5.315 5.316	narrow-band PPDR applications. • One administration in Region 2 has designated 24 MHz of spectrum in the band 764-776 MHz paired with 794-806 MHz for both narrow-band and wideband public protection use. Several technical and regulatory provisions have been adopted by this administration to foster the deployment of advanced technologies. • The transition from analogue to more efficient digital television provides an opportune time to consider planning for reallocation of spectrum in this band for PPDR services. • Propagation in this band is suitable for cost-effective wider area coverage. **Disadvantages:** • Availability of this band for PPDR is dependent on transition of existing analogue broadcast operations to digital, for which there is no definite future date. • During the period of transition from analogue to digital transmissions for television services (expected to be long term), additional spectrum will be required for simulcasting analogue as well as digital television services.
	• Some administrations use parts of this band extensively for broadcasting and associated usages (e.g. wireless microphones, etc.). • Some administrations use parts of this band for government radiocommunications. • In Regions 1 and 3 BS usage of this band may be affected by decisions taken at RRC-04/05.
806-824 MHz and 851-869 MHz **Footnotes:** **5.293 5.309 5.311 5.312 5.314 5.315 5.316 5.319 5.321 5.319 5.323 5.317 5.317A 5.318 5.149 5.305 5.306 5.307 5.311 5.320 5.317A 5.319 5.321**	The band is allocated to FS, MS and BS. **Advantages:** • This band currently supports narrow-band PPDR applications. Both analogue and digital narrow-band products are readily available. • Propagation in this band is suitable for cost-effective wide-area coverage. • In Region 2, most administrations have designated the bands 821-824/866-869 MHz for public protection applications according to CITEL PCC.III/ Resolution 28 (VI-96) and do not mandate any specific technology in this band. This has provided possibilities for interoperability, harmonized and efficient use of common spectrum. • In Regions 2 and 3, portions of the 806-821/851-866 MHz band are also used for PPDR applications. • Some administrations use parts of this band for existing commercial cellular systems which could support PPDR applications. **Disadvantages:** • The band is allocated to FS, MS and BS and used extensively for these services. • Use of this band is dependent on existing analogue broadcast operations. • Incompatibility with GSM usage by some administrations may require additional filtering. • One administration uses a large part of this band for public telecom system. • In Europe, the band 862-870 MHz is widely used for short-range devices on an unlicensed basis. • Many administrations use parts of this band extensively for broadcasting and associated usages (e.g. wireless microphones, etc.).

	• Many European administrations use parts of this band for non-PPDR government usage. • Some administrations use parts of these bands exclusively and extensively for government radiocommunications. • Some administrations use parts of this band for existing commercial cellular systems.
870-876 MHz and 915-921 MHz **Footnotes:** **5.149 5.150 5.305 5.306 5.307 5.311 5.317 5.317A 5.318 5.319 5.320 5.323 5.325 5.326**	The band is allocated on a primary basis to BS, FS and MS. **Advantages:** • This band currently supports narrow-band applications. Both analogue and digital narrow-band products are readily available. • Propagation in this band is suitable for cost-effective wide area coverage including urban areas. • In Europe the bands 870-876 MHz paired with 915-921 MHz are identified for digital public trunking systems in accordance with ERC Decision (96) 04. However a review is being discussed.
	• Some administrations use parts of this band for existing commercial cellular systems (including IMT-2000), which may support or supplement PPDR applications. **Disadvantages:** • Many administrations use this band for public mobile telecom services. • Some administrations use parts of this band for existing commercial cellular systems (including IMT-2000). • Some administrations use the band 915-921 MHz for RLS on a primary basis. • The band 902-928 MHz is used for ISM applications in Region 2 countries.
4 400-4 900 MHz **Footnotes:** **5.149 5.339 5.441 5.442 5.443**	The band is allocated on a primary basis to FS, MS and FSS. **Advantages:** • Parts of this band are allocated to mobile services on a global or regional basis. • Sufficient bandwidth to support broadband applications. • Propagation is appropriate for short-range broadband systems. • Propagation provides capability for significant frequency reuse. **Disadvantages:** • No experience to date in using this band for land mobile applications. • Some administrations use this band or parts of this band extensively for non-PPDR government radiocommunication applications.

4 900-4 990 MHz **Footnotes:** **5.149 5.339 5.443**	The band is allocated on a primary basis to FS and MS. **Advantages:** • Technology/components are readily available in this band from RLANs. • Propagation is appropriate for short-range broadband systems. • Propagation provides capability for significant frequency reuse. • One administration has designated the 4 940-4 990 MHz band to be used in support of PPDR applications. **Disadvantages:** • Parts of this band are used extensively for radio astronomy. • One administration will use this band for wireless access by public telecom service providers.
5 850-5 925 MHz **Footnotes:** **5.150**	The band is allocated on primary basis to FS, FSS and MS. **Advantages:** • This band is also intended for use by TICS. • Technology/components are readily available in this band from RLANs. • Sufficient bandwidth to support broadband applications. • Propagation is appropriate for short-range broadband systems. • Propagation provides capability for significant frequency reuse.
	Disadvantages: • Parts of this band are used for ISM applications and for short-range devices. • Some administrations in Region 2 use parts of this band, either exclusively or heavily, for radiolocation. • In some administrations parts of this band are used extensively and exclusively for non-PPDR government radiocommunications. • One administration in Region 2 uses parts of this band for VSAT deployment.

ANNEX 2.1-2

Example of a RESOLUTION [PPDR 2.1-1] (WRC-03)

NOTE - This Resolution could also be redrafted as a recommendation, as appropriate.

Public Protection and Disaster Relief

The World Radiocommunication Conference (Geneva, 2003),

considering

a) the growing telecommunication needs of public agencies and organizations dealing with law and order, disaster relief and emergency response;

b) that future advanced solutions used by such public protection and disaster relief agencies and organizations will require high data rates;

c) that there is a need for interoperability and interworking between public protection and disaster relief (PPDR) networks, both nationally and for cross-border operations, in emergency situations and disaster relief;

d) the importance of the needs of public protection agencies and organizations, including those dealing with emergency situations and disaster relief for:

i) maintenance of law and order;

ii) emergency and disaster response;

iii) protection of life and property;

e) that the provision of appropriate spectrum resources to PPDR is becoming increasingly important to the maintenance of a stable and prosperous society;

f) that current PPDR applications are mostly narrow-band, including voice and low data-rate applications, typically in channel bandwidths of 25 kHz or less;

g) that although there will continue to be narrow-band requirements, many future applications will be wideband (indicative data rates in the range of 384-500 kbit/s) and/or broadband (indicative data rates in the range of 1-100 Mbit/s) with channel bandwidths dependent on the use of spectrally efficient technologies;

h) that new technologies for wideband and broadband PPDR applications are being developed in various standards organizations: in particular, a joint standardization programme (known as Mobility for Emergency and Safety Applications (MESA)) between ETSI and TIA has commenced for broadband PPDR;

i) that there is potential for new technologies such as IMT-2000 and systems beyond IMT-2000 and Intelligent Transportation Systems (ITS) which may support or supplement advanced PPDR applications;

j) that commercial systems may serve as a complement to dedicated systems in support of PPDR and that such complementary use would be in response to market demands;

k) that Resolution 98 (Minneapolis, 1998) of the Plenipotentiary Conference urges Member States to facilitate use of telecommunications for the safety and security of humanitarian personnel,

recognizing

a) the importance of interoperability in the provision of spectrum for public protection and disaster relief;

b) the benefits of globally and regionally harmonized frequency bands, such as:

i) increased potential for interoperability;

ii) a broader manufacturing base and increased volume of equipment resulting in economies of scale and expanded availability of equipment;

iii) improved spectrum management and planning;

iv) enhanced cross-border coordination;

v) improved cross-border circulation of equipment;

c) that spectrum planning for PPDR is done at the national level, taking into account the need for interoperability and benefits of harmonization with neighbouring administrations;

d) the increased benefits of cooperation between countries for the provision of effective and appropriate humanitarian assistance during disasters;

e) the special needs of developing countries, taking into account the ITU-D Handbook on disaster relief;

f) the needs of countries, particularly for developing countries, for low-cost communications equipment for public protection and disaster relief agencies and organizations;

g) that spectrum and innovative spectrum management may be required for the implementation of future advanced solutions;

h) that the trend is to increase the use of technologies based on Internet protocols;

i) that currently some bands or parts thereof below 1 GHz have been designated for exclusive use for public protection and disaster relief, specifically:

- some administrations in Region 2 have designated the bands 821-824/866-869 MHz for public protection and disaster relief use;
- harmonization, to some extent, has been achieved by some administrations in Region 1 by designating the frequency bands 380-385/390-395 MHz for emergency services;
- some administrations in Region 3 are using, plan to use, or have identified parts of the frequency bands 68-88 MHz, 138-144 MHz, 148-174 MHz, 380-399.9 MHz, 406.1-430 MHz, 440-502 MHz, 746-806 MHz, 806-824 MHz and 851-869 MHz for PPDR applications,

noting

a) that many administrations use frequency bands below 1 GHz for narrow-band PPDR applications;

b) applications requiring large coverage areas and providing good signal availability would generally be accommodated in lower frequency bands;

c) applications requiring wider bandwidths would generally be accommodated in progressively higher bands;

d) that PPDR agencies and organizations have a minimum set of requirements, including but not limited to, interoperability, secure and reliable communications, sufficient capacity to respond to emergencies, priority access in use of non-dedicated systems, fast response times, ability to handle multiple group calls and ability to cover large areas;

e) that in most administrations, PPDR applications are provided at several levels, from national down to local, and cooperation between the levels is a domestic matter which harmonized spectrum and interoperability could facilitate;

f) that, while harmonization may be one method of realizing the benefits stated above, in some countries multiple frequency bands can be a component of meeting the communication needs in disaster situations,

resolves

1 to urge administrations to use globally and regionally harmonized bands for PPDR, to the maximum extent possible*;*

2 to provide flexibility for disaster relief agencies and organizations by indicating that the identification of bands specifically for PPDR does not preclude the use of these bands by any application in services to which these bands are allocated and does not preclude the use of any other frequencies for disaster relief applications in accordance with the Radio Regulations;

3 to urge administrations, in emergency and disaster relief situations, to satisfy temporary needs for frequencies in addition to what may be normally provided for in agreements with neighbouring administrations;

4 to urge administrations to encourage PPDR agencies and organizations to utilize both existing and new technologies and solutions (satellite and terrestrial), to the extent practicable, to satisfy PPDR interoperability requirements and to further the goals of public protection and disaster relief;

5 that administrations should encourage agencies and organizations to use advanced wireless solutions for providing complementary support to PPDR agencies and organizations*,

recommends

1 that as necessary, administrations continue to work closely with their public protection and disaster relief community to further refine the identification of future spectrum requirements and possible methods to meet these requirements;

2 that administrations encourage PPDR agencies and organizations to utilize relevant ITU-R Recommendations in planning and implementing spectrum, technology and systems for public protection and disaster relief,

invites ITU-R

to conduct appropriate technical studies in support of the implementation of PPDR applications in the identified bands.

ANNEX 2.1-3

Example of a RESOLUTION [PP AND DR 2.1-2] (WRC-03)

NOTE - This Resolution could also be redrafted as a recommendation, as appropriate.

Public Protection and Disaster Relief

The World Radiocommunication Conference (Geneva, 2003),

considering

a) the growing telecommunication needs of public agencies and organizations dealing with law and order, disaster relief, emergency response and protection of life and property;

b) that there is a need for interoperability and interworking between public protection and disaster relief networks for international and cross-border operations in emergency situations;

c) that organizations, including commercial entities, are involved in providing solutions for disaster relief activities through special programmes;

d) that some features supporting public protection and disaster relief activities use commercially operated systems;

* Some administrations believe that IMT-2000 and ITS are examples of such advanced wireless solutions.

e) that commercially operated systems are already capable of partially fulfilling the needs of public protection and disaster relief, and the development of functions which will fulfil such needs is continuing;

f) that current public protection and disaster relief applications are mostly narrow-band, including voice and low data-rate applications, typically in channel bandwidths of 25 kHz or less;

g) that although there will continue to be narrow-band requirements, many future applications will be wideband (indicative data rates in the range of 384-500 kbit/s) and/or broadband (indicative data rates in the range of 1-100 Mbit/s) with channel bandwidths dependent on the use of spectrally efficient technologies;

h) that new technologies for wideband and broadband public protection and disaster relief applications are being developed in various standards organizations;

i) that there is potential for new technologies such as IMT-2000 and systems beyond IMT-2000 and Intelligent Transportation Systems (ITS) which may support or supplement advanced public protection and disaster relief applications;

j) that Resolution [36 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference] urges Member States to facilitate the use of telecommunications for the safety and security of humanitarian personnel,

recognizing

a) that public protection activities are day-to-day operations and are conducted for the most part within respective national borders using public protection assets of the nation and, as such, spectrum planning is a national matter;

b) the importance of international and cross-border interoperability in the provision of spectrum for disaster relief;

c) that spectrum planning for public protection and disaster relief is done at the national level, taking into account the need for cooperation with other administrations;

d) the special needs of developing countries, taking into account the ITU-D Handbook on disaster relief;

e) the needs of countries, particularly for developing countries, for low-cost communications equipment for public protection and disaster relief agencies and organizations;

f) that the trend is to increase the use of technologies based on Internet protocols,

noting

a) that many administrations use frequency bands below 1 GHz for narrow-band public protection and disaster relief applications;

b) that public protection and disaster relief agencies and organizations have a minimum set of requirements, including, but not limited to, interoperability, secure and reliable communications, sufficient capacity to respond to emergencies, priority access in use of non-dedicated voice and data systems, fast response times, ability to handle multiple group calls and ability to cover large areas;

c) that the identification of multiple frequency bands and use of innovative technologies can help to meet the communication needs in public protection and disaster relief situations,

resolves

1 to urge administrations to encourage public protection and disaster relief agencies and organizations to utilize both existing and new technologies and solutions (satellite and terrestrial), to

the extent practicable, to satisfy public protection and disaster relief interoperability requirements and to further the goals of public protection and disaster relief;

2 that administrations encourage agencies and organizations to use advanced wireless solutions for public protection and disaster relief operations*,

invites ITU-R

1 to conduct studies, as a matter of urgency, for the development of a resolution identifying frequency bands that could be used on a global/regional basis for disaster relief operations, taking into account existing services in these bands;

2 to conduct studies for the development of an ITU-R Recommendation on technologies to take advantages of multiple frequency bands,

instructs the Director of the Radiocommunication Bureau

to report on the results of these studies to WRC-07,

urges administrations

to participate actively in the aforementioned studies by submitting contributions to ITU-R,

recommends

that WRC-07 consider, to the extent practicable, the identification in a resolution of globally/regionally harmonized frequency bands for disaster relief.

#########

2.2 Agenda item 1.5

"to consider, in accordance with Resolution **736 (WRC-2000)**, regulatory provisions and spectrum requirements for new and additional allocations to the mobile, fixed, Earth exploration-satellite and space research services, and to review the status of the radiolocation service in the frequency range 5 150-5 725 MHz, with a view to upgrading it, taking into account the results of ITU-R studies."

2.2.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

2.2.1.1 WAS including radio local area networks (RLANs) in the mobile service

The term "Wireless Access Systems (WAS)" describes an untethered radiocommunication system, which is usually deployed in geographically limited areas (this is not a regulatory definition for WAS including RLANs). A global mobile allocation for WAS including RLANs would support the trend that people want to use the same services everywhere. Broadband RLANs are a subset of these systems and are described in the guidelines found in Recommendation ITU-R M.1450. Office or indoor environments generally have low e.i.r.p.s and very small radio cells on the order of 30-metre radius or less. Outdoor environments generally use higher e.i.r.p.s and have larger cell radius.

* Some administrations believe that IMT-2000 and ITS are examples of such advanced wireless solutions.

Typical applications include public and private wireless access offered in homes, schools, hospitals, hotels, conference centres, airports, shopping centres, etc. These types of systems may thus be considered to fall into the ITU-R categories nomadic wireless access (NWA) or mobile wireless access (MWA). Also, administrations, through national rules and policies, may choose to either license these devices or to exempt these devices from licensing.

Several administrations have started to implement WAS in this frequency band, such as 5 150-5 350 MHz in some Region 2 and Region 3 countries and 5 150-5 350 MHz and 5 470-5 725 MHz in some Region 1 and Region 3 countries. Such systems are currently operated under No. **4.4**. There is some limited operational experience of sharing between these systems and other services allocated in these bands.

Sufficient spectrum, among other factors, is a necessary condition to allow satisfactory performance in the presence of other uncoordinated users and is one of the key conditions for market acceptance for these kind of systems.

Studies show that a spectrum requirement consistent with the bands covered by Resolution **736**, *resolves* 1, is justifiable. (See PDNR M.[METHOD.NWA.SPECTRUM]).

2.2.1.2 FWA applications in the fixed service

FWA is the wireless access application in which the location of the end-user termination and the network access point to be connected are fixed and are generally characterized as systems comprised of a base station and a number of remote stations located at users' premises within the service coverage or "cell". In a cell, all the remote stations communicate to the base station only during the assigned time slot, in the case of TDMA, or accessible timings, in the case of Carrier Sense Multiple Access (CSMA), which means only one station is emitting transmit power at any instantaneous time within a cell or sector. Employment of directive antennas at both base and remote stations will enable to reduce emissions to high elevation angles.

2.2.1.3 Earth exploration-satellite service (active)

Active sensing is the measurement on board a spacecraft of signals transmitted by the sensor and then reflected, refracted or scattered by the Earth's surface or its atmosphere.

Three basic types of active sensors are addressed herein and will also be collectively referred to as spaceborne active sensors:

1) Radar scatterometers are useful for determining the roughness of large objects such as ocean waves.
2) Radio altimeters are used to determine the height of the Earth's land and ocean surfaces.
3) Imaging radars (synthetic aperture radars) are used to produce high resolution images of land and ocean surfaces.

A need has been identified to expand the bandwidth available for spaceborne altimeters and for spaceborne synthetic aperture radars (SARs) operating in EESS (active) in the 5 250-5 460 MHz band from 210 MHz to 320 MHz (5 250-5 570 MHz) in order to satisfy a requirement for the altimeter height measurements with a standard deviation of 1 to 2.5 centimetres and a SAR requirement for measurements with enhanced ground resolution of 1 metre.

The current spaceborne altimeter uses 320 MHz between 5 140 and 5 460 MHz. The use of a 320 MHz band around 5.3 GHz is essential to provide continuous measurements of the topography of the ocean surface with an unprecedented accuracy (1 to 2.5 cm) that requires simultaneous use of large bandwidths (320 MHz) around 14 GHz and 5 GHz to estimate ionospheric delay. High quality data have been collected, allowing scientists to give new significant insights into the following areas: global and regional ocean circulation, intra-seasonal to inter-annual ocean changes, mean sea level monitoring, tides, etc. Direct applications are now foreseen in the understanding of ocean coupling with the atmosphere and so in the prediction of climatic changes.

Recent El Niño monitoring and forecasting using spaceborne altimeter data highlights the essential contribution of such a mission. There are also numerous operational applications that are being developed for marine related activities, which will enable sea state forecasting in the same way that meteorologists forecast the atmosphere today.

Spaceborne SARs remote sensing technology make it possible to acquire global-scale data sets that provide unique information about the Earth's continually changing surface characteristics. A SAR mission is essential to routinely provide valuable information about the dynamic characteristics of our planet, along with broad scientific, environmental preservation, operational, and commercial utility.

The SAR imaging system is capable of addressing a wide range of Earth science SAR measurement objectives such as surface deformation, environmental management objectives such as rapid response to oil spills, operational objectives such as ice navigation, plus a broad range of commercial applications such as mapping, surveillance, forestry, agriculture, resource exploration, and land use and urban planning. The wideband SAR with a 300 MHz bandwidth, provides a higher resolution, in order to provide opportunities for additional commercial applications, such as high-resolution surface mapping and co-registration with electro-optical sensor data. For instance, it will be possible to precisely map the boundary of oil spills with the wideband SAR and compare this data with electro-optical sensor data, both of 1 m resolution.

2.2.1.4 Radiolocation service

There are numerous radar types, accomplishing various missions, operating within the radiolocation service throughout the range 5 250-5 850 MHz. There is a need for wider bandwidth to pick smaller and less reflective targets out of background clutter. DNR M.[8B-CHAR] gives the technical characteristics for several representative types of radars that can be used to assess the compatibility between radiolocation radars and systems of other services.

To provide the same regulatory protection through the whole tuning range, an upgrade of the radiolocation allocation in the band 5 350-5 650 MHz would be necessary. Noting the increased sharing requirements through the whole spectrum to accommodate all services proposed, the upgrade may also be necessary to safeguard the operation of the radars for the future.

2.2.1.5 Relevant ITU-R Recommendations

The following Recommendations are based on the results of the ITU-R studies:

Recommendations ITU-R M.1454, S.1426, S.1427, F.1399, F.1400, F.1401, F.1490, F.1499, F.1508 , SA.1166, SA.1280, M.1450, M.1461, M.1313, M.1372, DNR F.[FWA5GHz-EESS], DNR SA.[Document 7/46], DNR M.[8B-CHAR], PDNR M.[METHOD.NWA.SPECTRUM], PDNR M.[WAS5GHz EXPANSION-EESS], PDNR M.[8A-9B.RLAN.DFS].

2.2.2 Analysis of the results of studies

2.2.2.1 Resolution 736 (WRC-2000), *resolves* 1

"allocation of frequencies to the mobile service in the bands 5 150-5 350 MHz and 5 470-5 725 MHz for the implementation of WAS including RLANs."

2.2.2.1.1 Sharing between MS for WAS including RLANs and MSS feeder links in the band 5 150-5 250 MHz

Regulatory means to ensure the protection of non-GSO MSS Feeder Links from RLAN transmissions are found in Section 2.3 of this Report.

2.2.2.1.2 Sharing between MS (RLAN) and EESS (active)

Band 5 250-5 350 MHz

DNR SA.[7/46] concludes that sharing between these services is feasible with the characteristics such as those listed below applied to WAS including RLANs in the mobile service:

- Indoor deployment (giving an additional attenuation with respect to outdoor systems).
- Mean e.i.r.p. limit of 200 mW with transmit power control (TPC) to ensure a mitigation factor of at least 3 dB (or 100 mW if power control is not used).
- Randomized channel selection function, such as dynamic frequency selection (DFS)[3], associated with the channel selection mechanism to provide a uniform loading of the Wireless LAN channels across the available bandwidth in the 5 GHz range (the assumptions made in the study for a total of 330 MHz give a density of 440 transmitters per 20 MHz channel in the SAR footprint).

Further studies have shown that the mitigation factor of DFS is reduced according to the available bandwidth. For example, in the case of 20 MHz channel WAS including RLANs operating in a 200 MHz bandwidth, a reduction in the mean e.i.r.p. limit of 1.9 dB would be required to protect the EESS (active).

Furthermore, it may be noted that the above characteristics need to include a power density limit in order to protect EESS (active) from WAS transmitters that choose to use a narrower bandwidth than assumed in the studies. For example, the mean e.i.r.p. limit of 200 mW would correspond to a 10 dBm/MHz e.i.r.p. spectral density limit.

Concerns have been expressed by an administration that the characteristics listed above may not be adequate to ensure protection of the EESS (active).

Some administrations are of the view that these characteristics are the set of operational limits, which are currently agreed in ITU-R to meet the EESS protection criteria.

Some administrations are of the view that the above characteristics are the only set of limits, which meet the EESS protection criteria.

The combined technical constraints given below are an example of constraints that are under study:

1) wireless access systems including RLANs operating in the band 5 250-5 350 MHz should be limited to:
   a) a maximum transmitter power of 250 mW (24 dBm) or 11 + 10 log B dBm per transmitter, whichever power is less. (B is the 99% power bandwidth in MHz.);
   b) a maximum e.i.r.p. of 1.0 Watt (0 dBW) or -13 +10 log B dBW per transmitter, whichever power is less.

[3] Dynamic Frequency Selection (DFS) is a general term used in this Report to describe a mitigation technique that allows, amongst other functions, detection and avoidance of co-channel interference with respect to radar systems.

2) the e.i.r.p. spectral density of the emission of WAS including RLAN transmitters operating outdoors should not exceed the following values for the elevation angle θ above the local horizontal plane (of the Earth):

−13 dB(W/MHz)	for	$0° \leq \theta < 8°$
−13 – 0.716 (θ – 8) dB(W/MHz)	for	$8° \leq \theta < 40°$
−35.9 – 1.222 (θ – 40) dB(W/MHz)	for	$40° \leq \theta \leq 45°$
−42 dB(W/MHz)	for	$\theta > 45°$

Some ITU-R studies have shown that this alternative set of constraints is sufficient to protect the EESS (active) and may be practical to implement.

Some other ITU-R studies have shown that this alternative set of constraints is not adequate to protect the EESS (active), also in view of the absence of DFS and TPC interference mitigation techniques. Furthermore, another study has shown that this e.i.r.p. mask limitation may not be practically applicable to mobile devices operating on a license exempt basis.

Band 5 470-5 570 MHz

In parallel to the allocation to WAS including RLAN, the band 5 470-5 570 MHz is also being considered under *resolves* 3 of Resolution 736 for allocation to EES/SR (active) services.

Some studies have shown that sharing is possible between the mobile and EES/SR (active) services, subject to appropriate measures. In particular, studies have shown that sharing between WAS including RLAN in the mobile service and EES scatterometers/altimeters is feasible in the band 5 470-5 570 MHz. It is expected that the additional allocation for EES/SR (active) services considered under *resolves* 3 would also be used to provide additional bandwidth for wideband SARs. If this band were only used by such wideband sensors a more favourable sharing scenario would result (5 dB relaxation of the interference threshold). It is important to note that both services are seeking new allocations within this band and it may be necessary for each new service to accept necessary constraints. The two sets of constraints that could be applied are given below (see Section 2.2.4.1, **5.WAS3**):

First set of limits:

– in the band 5 470-5 725 MHz, the indoor and outdoor use of WAS including RLANs shall be restricted to a maximum mean e.i.r.p.[5] of 1 W and a mean e.i.r.p. density limit no greater than 50 mW in any 1 MHz;

– in the bands 5 470-5 725 MHz, WAS including RLANs shall implement TPC to ensure a mitigation factor of at least 3 dB on the average output power of the devices. If TPC is not implemented, the power limitations given above shall be reduced by 3 dB;

– in the bands 5 250-5 350 and 5 470-5 725 MHz, WAS including RLANs shall implement mitigation techniques such as DFS to avoid co-channel operation with other terrestrial systems, notably radar systems (see PDNR M.[8A-9B.RLAN.DFS]). The devices shall also be designed to ensure a near uniform spread of the loading across the available spectrum of the devices to improve the sharing with satellite services.

Second set of limits:

[5] "Mean power" refers here to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented.

1) that wireless access systems including RLANs operating in the band 5 470-5 570 MHz be limited to:

   a) a maximum transmitter power of 250 mW (24 dBm) or 11 +10 log B dBm per transmitter, whichever power is less. (B is the 99% power bandwidth in MHz.);

   b) a maximum e.i.r.p. of 1.0 Watt (0dBW) or -13 +10 log B dBW per transmitter, whichever power is less.

2) the e.i.r.p. spectral density of the emission of a wireless access system including RLAN transmitter operating outdoors in the band 5470-5570 MHz should not exceed the following values for the elevation angle θ above the local horizontal plane (of the Earth):

−13 dB(W/MHz)	for	$0° \leq \theta < 8°$
$-13 - 0.716 (\theta - 8)$ dB(W/MHz)	for	$8° \leq \theta < 40°$
$-35.9 - 1.222 (\theta - 40)$ dB(W/MHz)	for	$40° \leq \theta \leq 45°$
−42 dB(W/MHz)	for	$\theta > 45°$

3) In the band 5 470-5 570 MHz, wireless access systems including RLANs shall implement mitigation techniques including dynamic frequency selection (DFS) and automatic transmit power control (ATPC).

Further studies are ongoing to identify these constraints (see values contained in Recommendations ITU-R SA.1166, PDNR M.[WAS5GHz-EXPANSION-EESS]).

2.2.2.1.3 Sharing between MS for WAS including RLANs and RDS

No administrations have expressed any current or planned aeronautical radionavigation usage of the band 5 150-5 250 MHz.

The high RF level, radar density, and the sensitivity of radar in conjunction with the expected high density of WAS including RLANs would, in general, not enable WAS including RLANs and radar to operate satisfactorily on a co-channel basis in the absence of mitigation techniques.

It is noted that in the band 5 600 - 5 650 MHz, ground-based radars used for meteorological purposes are authorized to operate on a equal basis with stations of the maritime radionavigation service, per RR 5.452.

DFS is a method, which should enable co-existence in this band between WAS including RLANs and radars. TPC is another method, which could also provide additional mitigation.

The specification of the detection criteria for the DFS must take into account the characteristics of the various radar systems operation in the 5 GHz bands as given in DNR M.[8B-CHAR].

Feasibility studies indicate that WAS including RLANs require a suitable DFS mechanism. The performance of DFS depends upon detecting the use of a certain channel by radiodetermination systems and stopping WAS including RLANs operation in this RF channel in short time so that harmful interference is not received by the radiodetermination system(s). In this case it is recommended that WAS including RLANs should be introduced in the bands shared by radars, only if the WAS including RLANs are capable of detecting and avoiding the radiodetermination systems, which could be interfered by WAS including RLANs. In the case that all WAS channels are occupied by RDS system emissions above the required DFS detection threshold, DFS must ensure that the WAS systems do not transmit until channels are clear of RDS system emissions due to RDS systems vacating the area or ceasing transmissions.

WAS including RLANs need to take into account spurious emission from radars. Measured radar emission spectra show spurious emissions that are suppressed to about –42/−62 dB relative to the radar fundamental emission level in a 20 MHz bandwidth. In measurement made from hilltop over a two week period near some major metropolitan areas of the United States, relatively high spurious emission peak levels have been observed in a large portion of the 5 GHz radiodetermination spectrum.

Analysis and simulation on the efficacy of one simplified method of co-channel interference detection and avoidance known as DFS shows that in most cases the DFS detection threshold will be exceeded and therefore radars will be detected by WAS including RLANs under these conditions. Certain types of low power radar systems may receive some interference from WAS.

Further studies are ongoing in ITU-R on DFS and final results are expected before WRC-03.

Administrations may require testing to confirm the ability of interference avoidance mechanisms (e.g. DFS) to detect the radar types in this band.

In addition, WAS including RLANs will have to accept interference from radiodetermination systems.

Provided an appropriate interference mitigation mechanism is implemented, WAS including RLANs may be able to share this band with the RDS. ITU-R concluded that the same sharing conditions apply to the bands 5 250-5 350 MHz and 5 470-5 725 MHz. One administration is of the view that studies are still ongoing in the ITU-R, therefore, it is premature, at this point, to conclude that the same sharing conditions apply to the bands 5 250-5 350 MHz and 5 470-5 725 MHz.

2.2.2.1.4 Sharing between mobile and amateur, and amateur satellite service

No contribution analysing this sharing situation has been received.

2.2.2.2 Resolution 736 (WRC-2000), *resolves* 2

"a possible allocation in Region 3 to the fixed service in the band 5 250-5 350 MHz, while fully protecting the worldwide Earth exploration-satellite (active) and space research (active) services."

2.2.2.2.1 Sharing between FS (FWA) and EESS (active)/SRS (active)

In the 5 250-5 350 MHz band, various types of spaceborne synthetic aperture radars (SAR), spaceborne radar altimeters and spaceborne scatterometers are operating in the EESS (active)/SRS (active). An analysis for frequency sharing with FWA is provided in Annex 1 to DNR F.[FWA5GHz-EESS]. For the SAR, three types of spaceborne active sensors were identified and the most vulnerable one was used in the sharing analysis. The interference from FWA to the sensor should be controlled below the threshold level, i.e. I/N<–6 dB. This threshold level corresponds to –132 dB(W/20 MHz) at the receiver input of the sensor which is located 400 km above the Earth's surface and equipped with an antenna of 42.7 dBi gain towards the Earth.

This requirement imposes an e.i.r.p. restriction on FWA operations. The analysis indicates that the total e.i.r.p. of signals transmitted towards the satellite from all the FWA stations located within its footprint of 220 km^2 area needs to be less than –7.6 dB(W/20 MHz) including surface scattering effects in order to satisfy this requirement.

The analysis also showed that the interfering signals into altimeter and scatterometer receivers from FWA systems do not cause serious interruptions to these operations. Since SAR is the most sensitive against the interference from FWA, altimeter and scatterometer receivers are considered protected if SAR receivers are protected.

The total e.i.r.p. from the FWA system towards the SAR depends on transmitter power, antenna gain patterns, cell size, employment of sector antennas, frequency reuse scheme, antenna elevation angle, etc. of the FWA systems. Annex 1 to DNR F.[FWA5GHz-EESS] includes an analysis to clarify the relationship among these factors and could be used to ensure the above conditions. For FWA systems in which both the base station and remote stations transmit signals with 2 W e.i.r.p. with other parameters used in DNR F.[FWA5GHz-EESS], the maximum density of 23 FWA base stations should be allowed within an EESS SAR foot print in the case of no use of sector antennas. Administrative measures for both base and remote stations, such as license-based operation, would be required in order to control deployment density of FWA systems and thus satisfy the above condition. The main factor to be taken into consideration is the elevation angle of the FWA transmitters.

With these requirements on the FWA systems, the EESS/SRS spaceborne active sensors are protected and the sharing is feasible.

Regarding the interference from EESS/SRS to FWA, FWA systems will need to tolerate short interruptions (0.5-10 seconds) from SAR and scatterometer systems during the satellites fly over the FWA cells (once in several days).

With these constraints to FWA system deployment and operations, EESS (active)/SRS (active) and FWA in FS are considered compatible.

A study indicates that it is difficult for FWA and other WAS including RLANs to share the same frequency at the same location. Even if RLANs are operated within FWA cells, most of them would use frequency channels different from the FWA system due to RLANs CSMA/CD and DFS capabilities. Therefore, there will not be combined interference into EESS/SRS satellites from FWA and RLAN at the same frequency from the same location.

2.2.2.2.2 Sharing between FS (FWA) and RLS

Various radiolocation radar systems are operated and planned in the band 5 250-5 350 MHz. Characteristics of these systems are described in DNR M.[8B-CHAR]. When an FWA system and a radar station share the same frequency band, a certain geographical separation is necessary between FWA cells and the radar location to secure the operation of both services.

The separation distance is determined by the interference from the FWA system into the radar receiver. Criterion of I/N = −6 dB could be used for judging whether the degradation is significant or not. The interference from the radar into the FWA receiver will be higher than the other direction in terms of level. However, with signal processing schemes such as FEC employed in the FWA system, the effect of the interference could be lowered to the level that the FWA system can continue its operation. The separation distance could be shortened if the locations of FWA stations are selected so that the interference signals towards the radar are reduced due to geographical shielding effects. Other interference mitigation techniques, e.g. antenna beam tilting or offset, polarization discrimination, frequency offset, transmit timing control, etc. could also reduce the separation distance.

An example study, in which FWA stations are located at 20 m height and the radar station at 100 m height, shows that the necessary separation distance is 70-76 km depending on the geographical shielding effect.

If the radar is of a moving nature, e.g. a ship-based radar or an airborne radar, the area in which the operation of a FWA system is allowed needs to be determined examining the effect of the exclusion zone that also moves with the radar. Protection of the radar operation would need to be confirmed by national administrative procedures to allow the operation of the FWA system. Frequency sharing between the radiolocation service and the fixed service is feasible as long as the operation of the radiolocation service is secured by administrative confirmation.

2.2.2.2.3 Sharing between FS (FWA) and MS (WAS including RLANs)

As explained in subsection 2.2.2.2.1, an ITU-R study has shown that it is difficult for FWA and RLANs to share the same frequency at the same location. When an FWA system and RLANs are operated in the adjacent areas at the same frequency, the interference from RLANs into the FWA system would be more significant than the other direction. According to this study based on the assumption of indoor RLAN deployment, operation of indoor RLANs will not be significantly affected if the RLANs are operated outside the FWA cells, or at locations more than about 1 km away from the nearest FWA base station, while an RLAN operated at the same frequency within 3 km of an FWA base station may affect the operation of the FWA base station. When there are multiple interfering RLANs observed by the FWA base station, the separation distance required will be greater.

2.2.2.3 Resolution 736 (WRC-2000), *resolves* 3

"additional primary allocations for the Earth exploration-satellite service (active) and space research service (active) in the frequency range 5 460-5 570 MHz."

ITU-R developed technical characteristics and performance and interference criteria for active spaceborne sensors. Similarly, technical characteristics and performance and interference criteria were developed for radiolocation/radionavigation radars. In order to ensure compatibility, sensor designs need to respect the interference criteria established for radiolocation systems in the frequency range between 1 and 10 GHz and to select design parameters to mitigate potential interference from terrestrial radars to the sensors (as detailed in Recommendation ITU-R SA.1280).

Spaceborne altimeters have operated in the 5 140-5 460 MHz band. Spaceborne scatterometers and spaceborne synthetic aperture radars have operated in the band 5 250-5 350 MHz. Operational experience gained over a period of more than 20 years shows that active spaceborne sensors and radionavigation and radiolocation systems have operated in common frequency bands with no record of identified instances of harmful interference to either the active spaceborne sensors or to the radionavigation and radiolocation systems.

Wideband signal altimeters and SARs are the type of spaceborne active sensors that are expected to operate in the band 5 460-5 570 MHz.

2.2.2.3.1 Sharing between EESS (active) and ARNS in the band 5 460-5 470 MHz

An analysis assessing potential interference from spaceborne altimeters into airborne weather radars operating in the aeronautical radionavigation service in the band 5 460-5 470 MHz has been performed. The results of this analysis indicate that spaceborne altimeters will not cause undue degradation to the performance of aeronautical radionavigation service systems.

An analysis assessing potential interference from airborne weather radars into spaceborne altimeters has been performed and the results indicate that spaceborne altimeters can operate in the presence of emissions from airborne weather radars operating in the aeronautical radionavigation service. Thus, it may be concluded that spaceborne altimeters and aeronautical radionavigation service systems are compatible.

An analysis assessing potential interference from spaceborne SARs into airborne weather radars operating in the aeronautical radionavigation service has been performed. The results of this analysis indicate that spaceborne SARs will not cause undue degradation to the performance of the aeronautical radionavigation service systems for the most likely case of side-lobe to side-lobe antenna coupling. The mainbeam to side-lobe coupling event duration is only 0.25-0.5 seconds as the spacecraft passes by.

An analysis assessing interference from airborne weather radars into spaceborne SARs has been performed and the results indicate that spaceborne SARs can operate in the presence of emissions from airborne weather radars operating in the aeronautical radionavigation service for the likely case of side-lobe to side-lobe coupling. The side-lobe to main-lobe coupling event lasts only 0.25-0.5 seconds as the spacecraft passes by. The SAR would point at a specific location no more than once in several days. Based on the analysis performed, it can be concluded that spaceborne SARs and airborne weather radars are compatible in the 5 460-5 470 MHz band.

2.2.2.3.2 Sharing between EESS (active) and MRNS service in the band 5 470-5 570 MHz

A study has been performed on sharing between altimeters and SARs and the maritime radionavigation service. It is concluded from this study that the radars can suffer interference from spaceborne altimeters and SARs but that the length of the interference is of the order of a few seconds when the maritime radionavigation radar enters the main lobe of the spaceborne altimeter or SAR. This kind of configuration has been statistically estimated for such kind of radar over a complete altimeter cycle (less than ten days). The total of interference events can then be considered as negligible.

The same study also concluded that the altimeter or SAR would not suffer from interference due to maritime radionavigation radars.

Altimeters and SARs operating in the band 5 460-5 570 MHz can operate satisfactorily without causing harmful interference to maritime radionavigation radars and without suffering harmful interference from them.

2.2.2.3.3 Sharing between EESS (active) and MS (RLANs) service in the 5 470-5 570 MHz band

See section 2.2.2.1.2.

2.2.2.3.4 Sharing between EESS (active) and RLS in the band 5 460-5 570 MHz

See section 2.2.2.4.1.

2.2.2.4 Resolution 736 (WRC-2000), *resolves* 4

"a review, with a view to upgrading, of the status of frequency allocations to the radiolocation service in the frequency range 5 350-5 650 MHz."

2.2.2.4.1 Sharing between EESS (active) and RLS in the bands 5 350-5 460 MHz and 5 460-5 570 MHz

Spaceborne altimeters have operated in the 5 140-5 460 MHz band. Spaceborne scatterometers and spaceborne synthetic aperture radars have operated in the band 5 250-5 350 MHz. Operational experience gained over a period of more than 20 years shows that active spaceborne sensors and radionavigation and radiolocation systems have operated in common frequency bands with no record of identified instances of harmful interference to either the active spaceborne sensors or to the radionavigation and radiolocation systems. This successful sharing has been based upon sensor employment of mitigation techniques found in Recommendation ITU-R SA.1280. In order to ensure continued compatibility, sensor designs need to respect the interference criteria established for radiolocation systems in the frequency range between 1 and 10 GHz and to select design parameters to mitigate potential interference from terrestrial radars to the sensors (as detailed in Recommendation ITU-R SA.1280).

5 350-5 460 MHz band

The ITU-R has examined the feasibility of operation of altimeters and SARs in 5 350-5 470 MHz bands. Studies indicate that compatibility exists in the 5 350-5 460 MHz band with both radiolocation systems and aeronautical radionavigation systems.

The ITU-R has determined that, for the sensors and radiolocation/radionavigation systems that have been analysed, compatibility exists in the band 5 350-5 460 MHz.

5 460-5 570 MHz band

For radiolocation systems in the band 5 460-5 570 MHz with characteristics similar to those in the band 5 250-5 460 MHz, the conclusion that active spaceborne sensors and radiolocation systems are compatible also applies to this band.

2.2.2.4.2 Sharing between RLS and ARNS in the 5 350-5 470 MHz band, RNS in the 5 460-5 470 MHz band and MRNS in the 5 470-5 650 MHz band

Operational experience gained over a period of more than 20 years shows that radionavigation and radiolocation systems have operated in common frequency bands with no record of identified instances of harmful interference to the radionavigation or radiolocation systems. To provide the same regulatory protection through the whole tuning range an upgrade of the radiolocation allocation in the bands 5 350-5 650 MHz is necessary. Noting the increased sharing requirements through the whole spectrum to accommodate all services proposed, the upgrade is also necessary to safeguard the operation of the radars for the future.

These radars are compatible for several reasons such as pulse discrimination capability within radar systems as well as the scanning of the antenna beams, which limits main-beam couplings.

2.2.2.4.3 Sharing between MS (RLAN) and RLS in the 5 470-5 650 MHz band

See section 2.2.2.1.3.

2.2.3 Methods to satisfy the agenda item and their advantages and disadvantages

Many of the issues being dealt with under this agenda item are inter-related. Therefore it is important to consider the allocations being sought in the 5 150-5 725 MHz together, balancing the needs of all services under consideration.

2.2.3.1 Resolution 736 (WRC-2000), *resolves* 1

Studies conducted within ITU-R have identified that mitigation techniques such as DFS and TPC need to be implemented as a minimum requirement to achieve interference mitigation in the bands 5 250-5 350 and 5 470-5 725 MHz.

For the 5 150-5 350 and 5 470-5 725 MHz bands, the following methods should be considered:

2.2.3.1.1 Method A

Propose a primary global allocation to the mobile service in the bands 5 150-5 350 MHz and 5 470-5 725 MHz limited to WAS including RLANs with appropriate footnotes and/or Resolutions to ensure protection of the existing services. These footnotes and/or Resolutions should incorporate technical requirements ensuring the above protection including mitigation techniques which are still under study within ITU-R. In addition WAS including RLANs, are proposed to not claim protection from the RDS, EESS (active), SRS (active) and from MSS feeder links in the relevant bands.

Advantages:

- Sufficient spectrum to implement WAS including RLANs is provided to meet the requirement based on the studies (see Section 2.2.1.1) while safeguarding the interests of the RDS, FSS, EESS and SRS through the implementation of mitigation techniques such as DFS and TPC, and appropriate operational restrictions and technical limits.
- A sufficient amount of spectrum allocated to the mobile service for the use of WAS including RLANs will enable channel spreading across the bands concerned and facilitate sharing with all space services.

- The mobile service for the use of WAS including RLANs would be protected from other possible future allocations in the concerned bands.

Disadvantages:

- May constrain future development of radiodetermination systems in these bands.
- There is no definition of WAS or RLANs, in the Radio Regulations.
- In the band 5 470-5 570 MHz, additional constraints may need to be placed on EESS (active) for which an allocation is being considered.

2.2.3.1.2 Method B

Propose a secondary global allocation to the mobile service in the bands 5 150-5 350 MHz and 5 470-5 725 MHz limited to WAS including RLANs with appropriate footnotes and/or Resolutions to ensure protection of the existing services. These footnotes and/or Resolutions should incorporate technical requirements ensuring the above protection including mitigation techniques.

Advantages:

- This method provides an allocation for the mobile service.
- This method provides regulatory recognition for WAS including RLANs.
- Protection of the existing primary services is maintained through the implementation of appropriate operational restrictions, technical limits and mitigation techniques and furthermore, WAS including RLANs, could not claim protection from these services.
- A sufficient amount of spectrum allocated to the mobile service for the use of WAS including RLANs will enable channel spreading across the bands concerned and facilitate sharing with space services.

Disadvantages:

- This method may discourage the development of WAS including RLANs relative to a primary allocation.
- While providing secondary regulatory status, the mobile service would have no protection from new primary services in the band.
- New types of systems operating on primary basis may later set additional limits for WAS including RLANs.
- If placing limits on secondary services is not permissible, then this method would not ensure protection of the primary services.
- There is no definition of WAS including RLANs in the Radio Regulations.

2.2.3.1.3 Method C

No global allocation for the mobile service.

Advantages:

- Existing situation for current systems is maintained.
- Afford further time to address sharing issues if studies are not complete regarding the necessary technical limits, operational constraints and mitigation techniques to protect the existing primary services.

Disadvantages:

- No regulatory or allocation status is given to the mobile service.

- This method does not respond to the need to provide globally harmonized spectrum for WAS including RLANs as stated in *considering* a) of Resolution **736 (WRC-2000)**. Furthermore, some administrations are of the view that by not providing the allocation needed for WAS, including RLANs, this method may encourage operation under No. **4.4**, administrations may permit licence-exempt use without the benefit of mitigation techniques specified by ITU, and interference may result from aggregate effects from a large number of devices for which no single administration is responsible, remedial action could therefore be difficult to achieve, particularly in the case of satellite systems.

2.2.3.1.4 Method D

Propose a primary global allocation to the mobile service in the bands 5 150-5 350 MHz limited to WAS including RLANs with appropriate footnotes and/or Resolutions to ensure protection of the existing services. These footnotes and/or Resolutions should incorporate technical requirements ensuring the above protection including mitigation techniques, which are still under study within ITU-R. In addition WAS including RLANs are proposed to not claim protection from the RDS, EESS (active), SRS (active) and from MSS feeder links in the relevant bands.

Propose a resolution to continue consideration of the 5 470-5 725 MHz band for WRC-07. Unresolved issues of Resolution 736 could also be included in this resolution.

Advantages:

- Some spectrum to begin initial implementation of WAS including RLANs is provided while safeguarding the interests of the RDS, FSS, EESS and SRS through the implementation of mitigation techniques such as DFS and TPC, and appropriate operational restrictions and technical limits are defined in footnotes and/or Resolutions incorporating technical requirements ensuring the above.
- Would allow additional time to confirm the effectiveness of the proposed interference mitigation technique (DFS) to ensure protection of existing services.

Disadvantages:

- This method does not fully respond to the need for globally harmonized spectrum for WAS including RLANs (i.e. it excludes the 5 470-5 725 MHz band) as stated in *considering a)* of Resolution 736 (WRC-2000).
- Given that only 200 MHz is proposed, this method may limit the full deployment of WAS including RLANs, e.g. through insufficient spectrum for dense deployments, lack of channels for functionality of DFS and possible restriction to indoor use only in the band 5 150-5 350 MHz, in some or all countries depending on the decisions of WRC-03.
- Although there are some administrations who consider that the same sharing conditions between WAS including RLAN and radiodetermination systems apply in the 5 250-5 350 and 5 470-5 725 MHz bands, this method treats the two bands differently.
- Some administrations are of the view that by not providing the allocation needed for WAS, including RLANs, in the band 5 470-5 725 MHz, this method may encourage operation under No. 4.4. In 5 470-5 725 MHz, administrations may permit licence-exempt use without the benefit of mitigation techniques specified by ITU.
- This method will increase the loading of devices across the band 5 150-5 350 MHz and therefore may increase the aggregate interference to the existing services (FSS and, depending on the DFS mitigation factor, EESS) in this band.
- There is no definition of WAS or RLANs, in the Radio Regulations.

- If an allocation to the space science services is provided for in the 5 470-5 570 MHz band at WRC-03, this may prejudice a possible allocation to the mobile service in the band 5 470-5 725 MHz at WRC-07 noting that ITU-R studies have shown that sharing between WAS including RLANs and the EESS is only feasible with constraints on both services.

2.2.3.2 Resolution 736 (WRC-2000), *resolves* 2

2.2.3.2.1 Method A

Propose a primary allocation to the fixed service in Region 3 in the band 5 250-5 350 MHz. The use should be limited to FWA systems subject to the compliance with draft new Recommendation F.[FWA5GHz-EESS]. In addition FWA are proposed to not claim protection from the RDS, EES (active), and SR (active) services, although EES (active) and SR (active) are not subject to 5.43A. Future system implementation in the RDS, EES (active) and SR (active) services should not require more restrictive sharing conditions on FWA.

Advantage:

Spectrum will be available to FWA systems. If an allocation is also provided to the MS in *resolves* 1, flexibility will be provided for each administration in Region 3 to select mobile WAS and/or FWA.

Disadvantage:

Some technical or operational arrangements at the national level may be necessary, if this band is used also for wireless access systems including RLANs in the mobile service, because it is difficult for FWA and wireless access systems including RLANs to operate on a co-frequency, co-location basis.

2.2.3.2.2 Method B

Propose a primary allocation to the fixed service for specific countries in Region 3 in the band 5 250-5 350 MHz. The use should be limited to FWA systems subject to the compliance with draft new Recommendation F.[FWA5GHz-EESS]. In addition FWA are proposed to not claim protection from the RDS, EES (active), and SR (active) services, although EES (active) and SR (active) are not subject to 5.43A. Future system implementation in the RDS, EES (active) and SR (active) services should not require more restrictive sharing conditions on FWA.

Advantage:

This method would allow the implementation of FWA systems in specific countries in Region 3 with minimum interference potential to the existing services due to the limited usage in terms of geographical areas.

Disadvantage:

Some technical or operational arrangements at the national level may be necessary, especially if this band is used also for wireless access systems including RLANs in the mobile service, because it is difficult for FWA and wireless access systems including RLANs to operate on a co-frequency, co-location basis. This disadvantage is, however, limited to the countries in the footnote.

2.2.3.2.3 Method C

Propose a secondary allocation to the fixed service in Region 3 in the band 5 250-5 350 MHz. The use should be limited to FWA systems subject to the compliance with draft new Recommendation F.[FWA5GHz-EESS].

Advantage:

- This method provides an allocation for the fixed service.

Disadvantage:

This method may discourage the development of FWA systems.

2.2.3.2.4 Method D

No allocation for the fixed service.

Advantage:

Existing situation for current systems is maintained.

Disadvantages:

- This method does not respond to the need to provide spectrum in Region 3 for fixed wireless access systems as stated in *considering b)* of Resolution **736 (WRC-2000)**.
- Some administrations are of the view that by not providing the allocation needed for FWA, this method may encourage operation under No. **4.4** by individual administrations and interference may result from aggregate effects from a large number of devices for which no single administration is responsible. Remedial action could therefore be difficult to achieve, particularly with respect to protection of satellite systems.

2.2.3.3 Resolution 736 (WRC-2000), *resolves* 3

2.2.3.3.1 Method A

Propose a primary allocation for the Earth exploration-satellite (active) and space research (active) services in the frequency band 5 460-5 570 MHz since compatibility exists with the radiolocation and the radionavigation services. To ensure successful sharing with existing radiodetermination services, design constraints and mitigation techniques in Recommendation ITU-R SA.1280 should be taken into account.

In addition, it should be noted that WRC-03 will consider the allocation of frequencies to the mobile service in the bands 5 150-5 350 MHz and 5 470-5 725 MHz for the implementation of wireless access systems including RLANs, hence the compatibility between the EESS and wireless access systems will also need to be considered.

Advantages:

- It would provide sufficient contiguous spectrum for deployment of high resolution sensors, given the current primary allocation to the EESS (active) in the adjacent band 5 250-5 460 MHz.
- Future wideband sensors would not be required to operate under No. **4.4**.

Disadvantages:

- Constraints may need to be placed on wireless access systems including RLAN for which the mobile allocation is being considered.
- If Method D is selected under *resolves* **1**, an allocation to the space science services in the band 5 470-5 570 MHz at WRC-03 may prejudice a possible allocation to the mobile service in the band 5 470-5 725 MHz at WRC-07, noting that ITU-R studies have shown that sharing between WAS including RLANs and the EESS is only feasible with constraints on both services.

2.2.3.3.2 Method B

No allocation for EESS in the band 5 460-5 570 MHz.

Advantages:

- The existing situation for current primary services is maintained.
- If Method D is selected under *resolves* **1** and no EESS allocation is provided, this will not prejudice a possible allocation to the mobile service in the band 5 470-5 725 MHz at WRC-07, noting that ITU-R studies have shown that sharing between WAS including RLANs and the EESS is only feasible with constraints on both services.

Disadvantages:

- Does not fulfil the requirement to extend the EESS allocation.
- Some administrations are of the view that by not providing allocation needed for EESS (active)/SRS (active), this method may encourage operation under No. **4.4**.

2.2.3.4 Resolution 736 (WRC-2000), *resolves* 4

2.2.3.4.1 Method A

Upgrade the radiolocation service to primary in the band 5 350-5 650 MHz. In addition, a provision could be considered that the radiolocation service should not claim protection from the existing primary radionavigation service, except as per 5.452.

Advantages:

- Provides primary allocation to the radiolocation service at frequencies in the vicinity of 5 GHz as needed to meet radar operation requirements while protecting the radionavigation service.
- The radiolocation service has a primary allocation in the band 5 350-5 650 MHz without constraints to the existing primary EESS allocation.
- The continued interference-free operation of the radiolocation service is ensured.
- Regarding the proposed primary allocation to the mobile service in the band 5 470-5 650 MHz the upgrade of the radiolocation service to primary status is a consequential change to allow restrictions to be imposed on the primary mobile service like DFS.
- Provides a primary allocation to the radiolocation service, contiguous with existing 5 250-5 350 MHz and 5 650-5 850 MHz bands, with sufficient bandwidth to meet current and future requirements for radiolocation.

Disadvantages:

- The mobile service will be required to protect, and not claim protection from the radiolocation service.
- This method may restrict certain applications in the mobile service.

2.2.3.4.2 Method B

Upgrade the radiolocation service in the band 5 350-5 470 MHz to primary status. No upgrade for the radiolocation service in the band 5 470-5 650 MHz.

Advantages:

- The existing situation for current systems in 5 470-5 650 MHz is maintained.

- Provides primary allocation to the radiolocation service at frequencies in the vicinity of 5 GHz as needed to meet radar operation requirements while protecting the radionavigation service.

Disadvantages:

- Does not fulfil the requirements of *resolves* **4** for the upgrade of the radiolocation service in the band 5 470-5 650 MHz.
- Does not provide appropriate protection of radiolocation systems to meet the changes in requirements, missions, and technology that are driving a need for wider bandwidth to pick smaller and less reflective targets out of background clutter.
- While maintaining secondary regulatory status, the radiolocation service would have no protection from new primary or secondary services in the band.

2.2.4 Regulatory and procedural considerations

2.2.4.1 Resolution 736 (WRC-2000), *resolves* 1

Methods A and B

Studies for allocations to the mobile service in the bands 5 150-5 350 MHz and 5 470-5 725 MHz have been limited to WAS including RLANs type devices only. Any allocation to the mobile service should be limited to WAS including RLANs only.

Due to the sharing with existing services in the bands 5 150-5 350 MHz and 5 470-5 725 MHz, technical limits and mitigation techniques will need to be applied to the mobile service. These constraints are seen as necessary requirements to any mobile allocations for WAS including RLANs.

If Method A or B is utilized under § 2.2.4.1 then a footnote should be added (No. **5.WAS1, 5.WAS2** and **5.WAS3**) to permit the mobile service to operate in the bands 5 150-5 350 MHz and 5 470-5 725 MHz. Examples of such footnotes for individual bands are as follows:

5 150-5 250 MHz

ADD

5.WAS1 Use of the 5 150-5 250 MHz band by the mobile service is limited to those applications described in Recommendation ITU-R M.1450-1 for WAS, including RLANs, which will be operated in accordance with the conditions below:

– in the 5 150-5 250 MHz band, the use of WAS, including RLANs, shall be restricted to indoor use with a mean e.i.r.p. limit of 200 mW and a mean[4] e.i.r.p. density limit no greater than 10 mW in any 1 MHz band.

Some administrations are of the view that the following text should also be included in the above footnote:

> WAS, including RLANs, must neither cause harmful interference to, nor claim protection from, nor otherwise impose constraints on operation or development of the existing services.

*****

Conditions related to the protection of the FSS service in this band are found in Recommendations ITU-R M.1454, S.1426 and S.1427.

Any footnote developed under WRC-03 Agenda item 1.5 must be reconciled with those suggested under WRC-03 Agenda item 1.6 that are shown in section 2.3 of this CPM Report.

5 250-5 350 MHz

ADD

5.WAS2 Use of the 5 250-5 350 MHz band by the mobile service is limited to those applications described in Recommendation ITU-R M.1450-1 for WAS, including RLANs, which will be operated in accordance with the conditions below:

Some administrations are of the view that the following text should also be included in the above footnote:

> WAS, including RLANs, must neither cause harmful interference to, nor claim protection from, nor otherwise impose constraints on operation or development of the existing services.

*****

Examples of conditions, as discussed in details in § 2.2.2.1.2 (EESS) and § 2.2.2.1.3 (RDS) are given below:

First set of limits:

– in the 5 250-5 350 MHz band, the use of WAS, including RLANs, shall be restricted to indoor use with a mean e.i.r.p.[4] limit of 200 mW and a mean e.i.r.p. density limit no greater than 10 mW in any 1 MHz band;

– in the band 5 250-5 350 MHz, WAS, including RLANs, shall implement transmitter power control (TPC) to ensure a mitigation factor of at least 3 dB on the average output power. If TPC is not implemented, the power limits given above shall be reduced by 3 dB;

– in the bands 5 250-5 350 and 5 470-5 725 MHz, WAS, including RLANs, shall implement mitigation techniques such as DFS to avoid co-channel operation with other terrestrial systems, notably radar systems (see PDNR ITU-R M.[8A-9B.RLAN.DFS]). The devices shall also be designed to ensure a near uniform spread of the loading of the devices across the available spectrum to improve the sharing with satellite services.

Second set of limits:

1) that wireless access systems, including RLANs, operating in the band 5 250-5 350 MHz be limited to:

   a) a maximum transmitter power of 250 mW (24 dBm) or 11 +10 log B dBm per transmitter, whichever value is lower (B is the 99% power bandwidth in MHz);

   b) a maximum e.i.r.p. of 1.0 Watt (0 dBW) or –13 +10 log B dBW per transmitter, whichever value is lower;

2) the e.i.r.p. spectral density of the emission of a wireless access system, including RLAN, transmitter operating outdoors should not exceed the following values for the elevation angle θ above the local horizontal plane of the Earth:

−13 dB(W/MHz)	for	$0° \leq \theta < 8°$
−13 – 0.716 (θ – 8) dB(W/MHz)	for	$8° \leq \theta < 40°$
−35.9 – 1.222 (θ – 40) dB(W/MHz)	for	$40° \leq \theta \leq 45°$
−42 dB(W/MHz)	for	$\theta > 45°$

[4] "Mean power" refers here to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented.

3) mitigation techniques such as DFS shall be implemented to address potential interference to radars operating in 5 250-5 350 MHz (under study in ITU-R, see PDNR ITU-R M.[8A-9B.RLAN.DFS]

5 470-5 725 MHz

ADD

5.WAS3 Use of the 5 470-5 725 MHz band by the mobile service is limited to those applications described in Recommendation ITU-R M.1450-1 for wireless access systems, including RLANs, which will be operated in accordance with the conditions below.

Some administrations are of the view that the following text should also be included in the above footnote:

> WAS, including RLANs, must neither cause harmful interference to, nor claim protection from, nor otherwise impose constraints on operation or development of the existing services.

*****

Examples of conditions, as discussed in detail in § 2.2.2.1.2 (EESS) and § 2.2.2.1.3 (RDS) are given below:

First set of limits:

– in the band 5 470-5 725 MHz, the indoor and outdoor use of WAS, including RLANs, shall be restricted to a mean e.i.r.p.[5] limit of 1 W and a mean e.i.r.p. density limit no greater than 50 mW in any 1 MHz;

– in the band 5 470-5 725 MHz, WAS, including RLANs, shall implement transmitter power control (TPC) to ensure a mitigation factor of at least 3 dB on the average output power of the devices. If TPC is not implemented, the power limits given above shall be reduced by 3 dB;

– in the bands 5 250-5 350 and 5 470-5 725 MHz, WAS, including RLANs, shall implement mitigation techniques such as DFS to avoid co-channel operation with other terrestrial systems, notably radar systems (see PDNR ITU-R M.[8A-9B.RLAN.DFS]). The devices shall also be designed to ensure a near uniform spread of the loading across the available spectrum of the devices to improve the sharing with satellite services.

Second set of limits:

1) that wireless access systems, including RLANs, operating in the band 5 470-5 570 MHz be limited to:

   a) a maximum transmitter power of 250 mW (24 dBm) or 11 +10 log B dBm per transmitter, whichever value is lower (B is the 99% power bandwidth in MHz);

   b) a maximum e.i.r.p. of 1.0 Watt (0 dBW) or –13 +10 log B dBW per transmitter, whichever value is lower;

2) the e.i.r.p. spectral density of the emission of a wireless access system, including RLAN, transmitter operating outdoors in the band 5 470-5 570 MHz should not exceed the following values for the elevation angle θ above the local horizontal plane of the Earth:

   –13 dB(W/MHz) for $0° \leq \theta < 8°$

[5] "Mean power" refers here to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented.

$-13 - 0.716 (\theta - 8)$ dB(W/MHz)	for	$8° \leq$	$\theta < 40°$
$-35.9 - 1.222 (\theta - 40)$ dB(W/MHz)	for	$40° \leq$	$\theta \leq 45°$
-42 dB(W/MHz)	for		$\theta > 45°$

3) wireless access systems, including RLANs, operating in the bands 5 570-5 725 MHz be limited to a maximum e.i.r.p. of 1.0 Watt (0 dBW) or –13 + 10 log B dBW per transmitter, whichever value is lower;

4) in the band 5 470-5 725 MHz, wireless access systems including RLANs shall implement mitigation techniques including dynamic frequency selection (DFS) and automatic transmit power control (TPC).

With respect to all bands listed above:

Methods A and D

In addition, WAS, including RLANs, in the mobile service must not claim protection from the existing primary services and RDS. This point should be included in the footnote. If appropriate limits and mitigation techniques are implemented (e.g. DFS, TPC), then the provisions of No. **5.43A** may not be necessary.

One administration is of the view that the following footnote should be applied:

ADD

5.WAS4 Stations in the mobile service shall not cause interference to and must accept interference from stations in the radiolocation, Earth exploration-satellite and space research (active) services. Mobile devices utilizing these bands shall operate only if equipped with an automated interference mitigation technique that meets the minimum standards as defined in Resolution [to be developed]. Technical requirements for DFS include adherence to the following criteria:

1) DFS detection threshold of –67 dBm.

2) DFS integration period of less than 1 microsecond.

3) Channel move time of 10 seconds.

4) Channel availability check time of 60 seconds.

5) Channel non-occupancy period of 30 minutes.

Method B

The footnotes described above are equally applicable to Method B noting if only a secondary allocation to EESS were to be granted, or if the radiolocation service is not upgraded to primary, some administrations suggested that the following text is also required in the relevant footnotes:

WAS including RLANs must neither cause harmful interference to, nor claim protection from, nor otherwise impose constraints on operation or development of the existing services.

NOTE – For a number of countries there is already a primary allocation to the mobile service by No. **5.447**.

2.2.4.2 Resolution 736 (WRC-2000), *resolves* 2

Any allocation to the FS in the bands 5 250-5 350 MHz for Region 3 should be limited to fixed WAS only.

If Method A or C is used under section 2.2.4.2, then the following example footnote (No. **5.FWA1**) could be used:

ADD

5.FWA1 The use of the frequency band 5 250-5 350 MHz by the fixed service is permitted in Region 3 only for fixed wireless access systems subject to compliance with DNR ITU-R F.[FWA5GHz-EESS]. In addition, FWA shall not claim protection from the RDS, EESS (active), and SRS (active), although EESS (active) and SRS (active) are not subject to No. **5.43A**. Future system implementation in the RDS, EESS (active) and SRS (active) services shall not require more restrictive sharing conditions on FWA.

*****

If Method B is used under section 2.2.4.2 then the following example footnote (No. **5.FWA2**) could be used:

ADD

5.FWA2 *Additional allocation:* The band 5 250-5 350 MHz is also allocated to the fixed service on a primary basis in the following countries in Region 3 [name of countries]. The use of this band by the fixed service is permitted only for fixed wireless access systems subject to compliance with draft new Recommendation F.[FWA5GHz-EESS]. In addition FWA shall not claim protection from the RDS, EESS (active), and SRS (active), although EESS (active) and SRS (active) are not subject to 5.43A. Future system implementation in the RDS, EESS (active) and SRS (active) services shall not require more restrictive sharing conditions on FWA.

*****

2.2.4.3 Resolution 736 (WRC-2000), *resolves* 3

Since the sharing situation between EESS (active) and the RNS in the bands 5 350-5 460 MHz and 5 460-5 570 MHz are identical, an extension of the application of No. **5.448B** would be required up to 5 570 MHz. Such a modified footnote could be as the following example:

MOD

5.448B The earth exploration-satellite (active) service operating in the band 5 350-5 570 MHz shall not cause harmful interference to, or constrain the use and development of, the radionavigation service.

*****

Regarding the sharing between EESS (active) and the RLS, it should be noted that consideration is being given to the proposed upgrade of the RLS in the band 5 350-5 650 MHz under *resolves* **4** of Resolution **736**.

A possible extension of No. **5.448A** above 5 350 MHz is not required, because it would give a more favourable status to a former secondary service (i.e. radiolocation in case of a successful upgrade) vis-à-vis an already primary service in the 5 350-5 460 MHz band (i.e. EESS).

Furthermore, since the sharing situation between the EESS (active) and the RLS is similar below and above 5 350 MHz, WRC-03 could also consider the suppression of No. **5.448A**, since the conclusion on the operational experience and sharing situation between the EESS (active) and the RLS stated above applies equally to the band 5 250-5 350 MHz. Removal of No. **5.448A** would give EESS (active) a more favourable regulatory status without constraining the development and deployment of the radiolocation service.

2.2.4.4 Resolution 736 (WRC-2000), *resolves* 4

Sharing between the RLS and the EESS (active)/SRS (active)

Since the sharing situation in the bands above and below 5 460 MHz is identical, no specific footnote is required which would put any constraints on the development and deployment of either of the two services in the band 5 460-5 570 MHz.

The text given in § 2.2.4.3 with respect to No. **5.448A** also applies here.

Sharing between RLS and RNS

The conference should consider a footnote to provide protection of current and future safety-of-life systems in the RNS from the RLS in the 5 350-5 650 MHz band.

#########

2.3 Agenda item 1.6

"to consider regulatory measures to protect feeder links (Earth-to-space) for the mobile-satellite service which operate in the band 5 150-5 250 MHz, taking into account the latest ITU-R Recommendations (for example, Recommendations ITU-R S.1426, ITU-R S.1427 and ITU-R M.1454)"

2.3.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

2.3.1.1 Summary of ITU-R Recommendations on this topic

This agenda item addresses the provision of regulatory measures to protect MSS feeder links operating in the band 5 150-5 250 MHz, in view of the use of this band by RLAN applications. It has to be noted that a possible new allocation to the mobile service in this band for RLAN applications is dealt with under WRC-03 agenda item 1.5.

If additional bands are made available for RLANs at WRC-03 under agenda item 1.5, the aggregate effect of RLAN transmissions on the non-GSO MSS feeder links will be mitigated by the spread of the RLAN devices over a larger amount of spectrum.

This sharing between RLANs and MSS feeder links was studied in ITU-R leading to the development of Recommendations ITU-R M.1454, S.1427 and S.1426 defining the operational restrictions for RLANs and protection measures of the MSS feeder links. These Recommendations provide guidance on e.i.r.p. density, operational restrictions, pfd levels and the methodology for assessing interference from RLANs into non-GSO MSS feeder links.

Recommendation ITU-R M.1454 *recommends*:

1) administrations should ensure that the mean e.i.r.p. density limit of RLANs or other wireless access transmitter devices operating in the band 5 150-5 250 MHz should be no greater than 10 mW in any 1 MHz (or equivalently 0.04 mW in any 4 kHz) per transmitter (Notes 1, 2 and 3);
2) administrations should take measures to ensure that RLANs or other wireless access transmitters are operated indoors in the bands 5 150-5 250 MHz;
3) for the protection of MSS feeder links, the pfd level of total RLAN interference observed at the victim satellite receiver, for satellites using full earth coverage antennas, should be no greater than the pfd levels specified in Recommendation ITU-R S.1426. A lower pfd level should be used as a trigger for administrations to take actions to protect non-GSO MSS feeder links from aggregate RLAN interference (Notes 4 and 5);

4) administrations should consider the implementation of mitigation techniques to further reduce interference into FSS systems from RLANs (see Note 6).

Note 4: details *recommends* 3, proposing, on a provisional basis, a pfd trigger level 3 dB below that in draft new Recommendation ITU-R S.1426, further study being required.

Recommendation ITU-R S.1426 *recommends*:

1) RLANs sharing the same frequency bands with non-GSO feeder links in the FSS should be designed in such a manner that their aggregate RLAN power flux-density be limited to $-148 - 20 \log_{10}(h_{SAT}/1\,414)$ dB(W/(m^2 · 4 kHz)), at the FSS satellite orbit for spacecraft using full earth coverage receive antennas and where h_{SAT} is the altitude of the satellite (km).

Note 1: details the meaning of the term "aggregate": the interference to the satellite receiving beam is to be calculated from all of the RLANs within the field of view of the non-GSO satellite receiving beam.

Note 2: indicates the need of further studies for non-GSO spacecraft with multiple narrow spot beams.

Recommendation ITU-R S.1427 *recommends*:

1) the assessment of interference from RLAN emissions to non-GSO MSS satellite feeder-link receivers, operating in the band 5 150-5 250 MHz, should be based on the increase ($\Delta T_{satellite}$) in satellite noise temperature ($T_{satellite}$);

2) in order to ensure adequate protection for the non-GSO MSS feeder links from RLAN emissions in the band 5 150-5 250 MHz the aggregate $\Delta T_{satellite}/T_{satellite}$ should be no more than 3%.

Note 1 indicates the need for further studies to evaluate the impact of long-term interference due to RLANs into the non-GSO MSS feeder links in terms of the reduction in non-GSO MSS system capacity, and sets a provisional tolerable reduction in capacity of 1%.

Note 2 is identical to Note 1 to Recommendation ITU-R S.1426 given above.

2.3.1.2 Summary of technical and operational studies

Studies in progress concerning building entry (or shielding) loss indicate an average building shielding loss of 15 dB at frequencies near 5 GHz. There are substantial variations in this loss value with respect not only to building type and construction, but also as a function of propagation path elevation and azimuth and floor level, as also evident in more extensive data collected at lower frequencies. Existing sharing studies make use of a more conservative average loss value of 10 dB.

There is a possibility that RLAN transmitters could proliferate until a critical point where the aggregate interference to a MSS feeder link could reach the pfd levels of Recommendation ITU-R S.1426. This assumption leads to further discussions on how to insert a reference to this latter Recommendation in the RR (Note 4 of Recommendation ITU-R M.1454), if possible or necessary.

In order to meaningfully insert pfd levels on the operation of RLANs such as those proposed in Recommendation ITU-R S.1426 in the Radio Regulations, two main issues are to be resolved:

- how to determine that the pfd levels have been reached or are close to being reached;
- what action to take when these pfd levels have been reached.

ITU-R discussions indicate that there may be technical challenges in measuring the aggregate interference level at the satellite. One possibility that has been suggested is to determine the pfd at the satellite by comparing the increase in noise level of an unoccupied satellite channel or in guardbands in the forward path, making the measurement at the Earth's surface. It has been recognized that it would be difficult to determine the source of small increases in the satellite uplink noise level because of the other sources of noise, such as intra-system and inter-system interference, which would have to be distinguished from the RLAN emissions. Such measurements could involve cooperative efforts between multiple non-GSO satellite operators. It has also been noted that the accuracy needed for assessing the levels in Recommendation ITU-R S.1426 may not be achieved by current high performance measurement tools.

There may be a need for administrations to be able to verify the results of such a measurement independently.

It appears also difficult to estimate the number of RLANs in use and to calculate the interference level. One way suggested to accomplish this would be to monitor the manufactured and deployed number of RLAN devices by the relevant RLAN manufacturers in each country of interest. One possibility would be for sellers of license-exempt radio devices to return numbers sold to their National Regulatory Authority on an annual basis, and that this data could be provided to the ITU Radiocommunication Bureau. Some administrations indicated that they would not monitor the number of equipments sold by multiple manufacturers into a global market, and that it would already be difficult to know how much equipment was actually in use. All this would lead to uncertainty sources in prediction.

Also, since RLAN interference into non-GSO MSS satellite receivers involves large areas that can encompass several countries, it would be difficult to apportion the number of RLANs between all the administrations involved. If this apportionment was possible to some extent, it would not provide neutral and equitable means to establish the responsibility of one or even a small group of administrations for the interference caused to the non-GSO MSS feeder links, as long as each administration would be only partly responsible for the aggregate interference, and it would be difficult to justify at what point the portion of responsibility is sufficient for it to be necessary for the administration to take corrective action. That is why the regulatory solutions would necessarily require the cooperation of all the administrations involved.

However, if the pfd level is approached, this would require a huge number of RLANs[6] to be in use and it is expected that there would be a general awareness of the RLAN deployment, thus supporting prediction models.

2.3.2 Analysis of the results of studies

The guidance provided in the three Recommendations described above is the result of ITU-R studies undertaken in ITU-R during the study period of 1998-2000. It was concluded that these measures were needed to protect the non-GSO MSS feeder links from interference caused by RLANs in the band 5 150-5 250 MHz.

The context of the sharing set by these three ITU-R Recommendations distinguishes two separate types of constraint, in order to support the protection of the non-GSO MSS feeder links:

- the emission and utilization limits of the RLANs, proposed by Recommendation ITU-R M.1454 *recommends* 1 and 2. This constitutes a first important step in providing protection for non-GSO MSS feeder links;

---

[6] Calculations under different assumptions produce different numbers of RLAN devices necessary to reach the levels in Recommendation ITU-R S.1426. These numbers range from just under one million to tens of millions in the field of view of the MSS satellite, e.g. for LEO-F, 1/3 of the surface of the Earth.

- an aggregate pfd level due to emissions from RLANs in the footprint of each satellite receiver such as those proposed by Recommendations ITU-R S.1426 and M.1454, leading to ITU-R action for developing and adoption of regulatory solutions before the growth of RLANs in that region reaches the critical stage.

As discussed above, there may be difficulties in determining the level of interference and therefore to apply the second type of constraint.

2.3.3 Methods to satisfy the agenda item and their advantages and disadvantages

2.3.3.1 Method A

Insert the transmission limits and indoor usage restrictions (Rec. ITU-R M.1454) on the RLANs in the RR and add a Resolution inviting the continuation of work in the ITU on further regulatory and technical mechanisms to ensure that aggregate interference will not increase to a detrimental level.

Advantages:

- Setting limits on the RLAN transmitting power and indoor utilization is easy to implement and the control of these restrictions can be implemented by each administration.
- This solution provides a level of protection to the non-GSO MSS feeder links and encourages the continuation of ITU-R studies to address the issue of aggregate interference within a realistic time-frame.

Disadvantages:

In case of an explosive growth of RLANs, this solution may not offer sufficient protection to the non-GSO MSS community in the period between the identification of the excess aggregate interference into the non-GSO MSS satellite feeder links and the completion of the requested ITU-R studies.

2.3.3.2 Method B

Insert the transmission limits and indoor usage restrictions (Rec. ITU-R M.1454) on the RLANs in the RR, and insert an aggregate pfd level at the satellite receiver with an associated WRC Resolution that establishes actions to be taken if it is shown by administrations to be exceeded.

Advantages:

This solution provides an improved level of protection to the non-GSO MSS satellites from RLAN interference provided that it is possible to verify the compliance with the pfd level.

Disadvantages:

- For technical reasons, the measurement or calculation of a pfd level at a satellite receiver may be difficult and result in uncertainties. Furthermore, there is no generally accepted measurement procedure.
- The responsibility for ensuring compliance with aggregate pfd levels would not be with individual administrations but for a group of administrations in the coverage area, whose individual responsibility would be difficult to apportion in an equitable manner.
- It may not be possible for all administrations to check the measurements performed by the operators, therefore some administrations would not be able to verify the results obtained by those making measurements. The Radio Regulations texts are mandatory and thus it should be possible to check all the requirements in an unambiguous, neutral and reproducible manner, with recognized tools.

• In the case of an explosive growth of RLANs, this solution may not offer sufficient protection to the non-GSO MSS community in the period between the identification of the problem and its resolution.

2.3.4 Regulatory and procedural considerations

For both solutions, the Radio Regulations could be modified in one of two ways: direct incorporation or incorporation by reference.

2.3.4.1 Method A

Some possible modifications to the Radio Regulations are provided as examples for the two alternative incorporation methods with regard to the incorporation of the transmission and usage limits on RLANs in the Radio Regulations.

In addition, a Resolution related to further work on regulatory and technical mechanisms has to be developed in order to address the aggregate interference from RLANs. An example Resolution [RLAN 2.3-1] is given in Section 2.3.4.1.3.

2.3.4.1.1 Direct incorporation

Add the following to Article **5**:

ADD

5.447XX1 In the band 5 150-5 250 MHz, the mobile service for implementation of WAS, including RLANs, shall be operated in accordance with the following conditions:

i) deployment of WAS, including RLANs, shall be restricted to indoor use only;

ii) the maximum e.i.r.p. density of any WAS station, including RLAN stations, shall not exceed –20 dBW (10 mW) in any 1 MHz band (or equivalently –44 dBW (0.04 mW) in any 4 kHz band);

*****

2.3.4.1.2 Incorporation by reference

Add the following to Article **5**:

ADD

5.447XX2 In the band 5 150-5 250 MHz, the mobile service for implementation of WAS, including RLANs, shall be operated in accordance with *recommends* 1 and 2 of Recommendation ITU-R M.1454.

2.3.4.1.3 Example of a Resolution for Method A

RESOLUTION [RLAN 2.3-1] (WRC-03)

Provisions to protect feeder links of non-geostationary satellite systems in the mobile-satellite service in the 5 150-5 250 MHz band

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that the FSS (Earth-to-space) is allocated worldwide on a primary basis in the band 5 150-5 250 MHz, this allocation being limited to feeder links of non-geostationary-satellite systems in the mobile-satellite service (No. **5.447A**);

b) that the band 5 150-5 250 MHz is also allocated to the mobile service, on a primary basis, in some countries (No. **5.447**, WRC-2000)[7] subject to agreement obtained under **9.21**, and that this allocation is already planned for use by RLANs[8] in Europe on a co-primary basis;

c) that RLAN devices are planned to be distributed on an unlicensed basis and to comply with the restrictions stated in No. **5.447XX**;

d) that the interference from a single RLAN device complying with the operational restrictions above will not on its own cause any unacceptable increase in the noise level at the satellite;

e) that the MSS satellite receivers may experience an unacceptable effect due to the aggregate interference from these RLAN devices, especially in the case of a prolific growth in the number of these RLAN devices;

f) that the aggregate effect will be due to the global deployment of RLAN devices and that it may not be possible to apportion the cause of the effect between individual administrations,

recognizing

a) that a means is required to prevent the aggregate interference from the worldwide deployment of RLANs from becoming detrimental to the feeder links of non-geostationary-satellite systems in the mobile-satellite service;

b) that an aggregate pfd level has been developed in Recommendation ITU-R S.1426;

c) that there is a degree of uncertainty in the means to measure or calculate the aggregate pfd level specified in Recommendation ITU-R S.1426,

resolves to invite ITU-R

to continue work on regulatory and technical procedures in order to address the aggregate interference from a possible prolific growth in the number of RLAN devices.

2.3.4.2 Method B

Some possible modifications to the Radio Regulations are provided as examples for the two alternate incorporation methods.

2.3.4.2.1 Direct incorporation

Add the following to Article **5** (the following example uses the aggregate pfd levels contained in Recommendation ITU-R S.1426 and these values would need to be substituted if other pfd levels were adopted):

ADD

5.447XX3 In the band 5 150-5 250 MHz, the mobile service for implementation of WAS, including RLANs, shall be operated in accordance with the following conditions:

i) deployment of WAS, including RLANs, shall be restricted to indoor use only;

ii) the maximum e.i.r.p. density of any WAS stations, including RLAN stations, shall not exceed –20 dBW (10 mW) in any 1 MHz band (or equivalently –44 dBW (0.04 mW) in any 4 kHz band);

---

[7] This allocation may be changed to reflect the outcome of agenda item 1.5 and Resolution **736**.

[8] This term may have to be replaced by the appropriate terminology in the Radio Regulations and will need to take account of the outcome of agenda item 1.5.

iii) The following aggregate power flux-density limit due to the emissions of all WAS stations, including RLAN stations, within the satellite receiving beam at any non-GSO satellite that is operating in accordance with the Radio Regulations and in particular with Articles **5**, **9** and **11** thereof, shall be applied in accordance with the provisions of Resolution **[RLAN2.3-2]**:

$-124 - 20 \log 10 (\mathbf{h}_{SAT} /1\,414)$ dB(W/(m^2 · 1 MHz)), or equivalently:

$-148 - 20 \log 10 (\mathbf{h}_{SAT}/1\,414)$ dB(W/(m^2 · 4 kHz)), at the FSS satellite orbit and where $\mathbf{h}_{SAT}$ is the altitude of the satellite (km).

*****

The band 5 150-5 250 MHz is required for continued operation of feeder links of non-GSO MSS. This footnote would ensure protection to the operation of non-GSO MSS feeder links in accordance with the provisions of Recommendations ITU-R **S.1426**, **S.1427** and **M.1454**. The compliance with the aggregate pfd level is not subject to verification by BR, but rather is left to individual administrations and MSS operators per Resolution **[RLAN 2.3-2]**. The aggregate pfd levels are verified for non-GSO MSS feeder-link satellites that are in operation. Should the levels exceed or be close to exceeding the pfd levels contained in No. **5.447XX**, remedial actions could be taken at the next WRC.

2.3.4.2.2 Incorporation by reference

Add the following to Article **5** (if other pfd levels than those in Recommendation ITU-R S.1426 were selected, incorporation by reference of this solution would not be valid):

ADD

5.447XX4 In the band 5 150-5 250 MHz, the mobile service for implementation of WAS, including RLANs, shall be operated in accordance with *recommends* 1 and 2 of Recommendation ITU-R M.1454, and *recommends* 1 of Recommendation ITU-R S.1426 shall be applied in accordance with Resolution **[RLAN 2.3-2]**.

2.3.4.2.3 Example of a Resolution for Method B

RESOLUTION [RLAN 2.3-2] (WRC-03)

Determination of aggregate power flux-density levels caused by stations of the mobile service operating in the band 5 150-5 250 MHz at the orbit of non-GSO FSS satellites used for feeder links of the mobile-satellite service

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that this conference adopted an allocation of the band 5 150-5 250 MHz to the mobile service for wireless access systems (WAS), including radio local area networks (RLANs);

b) that FSS (Earth-to-space) is allocated worldwide on a primary basis in the band 5 150-5 250 MHz, this allocation being limited to feeder links of non-geostationary-satellite systems in the mobile-satellite service (No. **5.447A**);

c) that there is a need for continued operation of non-GSO FSS systems used for feeder links in the mobile-satellite service in this band;

d) that results of studies in ITU-R indicate that sharing in the band 5 150-5 250 MHz between wireless access systems, including RLANs, and the FSS is feasible under specified conditions;

e) that interference from a single wireless access system, including RLANs, within the footprint of the non-GSO FSS satellite, will not cause any perceivable increase in the noise level at the satellite;

f) that in many countries, these RLAN devices will operate on a non-licensed basis;

g) that very large numbers of wireless access system, including RLAN, transmitters are expected to be deployed in individual countries, and can result in global deployment of such devices;

h) that current non-GSO FSS systems employ large beams covering as much as one third of the Earth's surface to provide feeder links in the mobile-satellite service;

i) that the interference caused by very large numbers of transmitters in the mobile service which individually meet the emission limits contained in No. **5.447XX** can cause impairment to the non-GSO FSS feeder-link transmissions due to the aggregate level of interference at the satellite,

recognizing

a) that maximum power flux-density levels have been developed in Recommendations ITU-R **M.1454** and **S.1426** and have been incorporated in No. **5.447XX**;

b) the difficulty for the Radiocommunication Bureau to assess whether such levels have been exceeded due to the manner in which RLAN devices are deployed;

c) that means may exist to measure or calculate the aggregate power flux-density levels caused by very large numbers of wireless access system including RLAN, transmitters at the non-GSO FSS satellite used to provide feeder links in the mobile-satellite service to a precision sufficient for determining whether those in No. **5.447XX** have been or are close to being exceeded,

resolves

1 to encourage administrations, with the assistance of operators of non-GSO FSS systems providing feeder links in the mobile-satellite service, cooperate to determine the aggregate power flux-density levels caused by stations of the wireless access systems, including RLANs, in the mobile service using ITU-R Recommendations where appropriate;

2 that a future competent conference should review the findings made in *resolves* 1, with a view to taking appropriate action, including reviewing the allocation and/or emission limits contained in No. **5.447XX**, should the aggregate power flux-density limits be exceeded,

encourages

1 administrations to cooperate to the maximum extent practicable in tracking the number of mobile service transmitters deployed within the territory of their respective countries to facilitate the determination of the aggregate power flux-density levels at the satellite providing feeder links for non-geostationary-satellite systems in the mobile-satellite service;

2 administrations and operators to provide the results of their measurements and/or calculations made in accordance with *resolves* 1 to ITU-R in a timely manner,

invites ITU-R

to continue developing methods for calculating and measuring aggregate power flux-density levels at non-GSO FSS satellites caused by wireless access system, including RLAN, transmitters operating in the band 5 150-5 250 MHz.

#########

2.4 Agenda item 1.11

"to consider possible extension of the allocation to the mobile-satellite service (Earth-to-space) on a secondary basis in the band 14-14.5 GHz to permit operation of the aeronautical mobile-satellite service as stipulated in Resolution **216 (Rev.WRC-2000)**"

2.4.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Relevant ITU-R Recommendations: S.728-1, RA.611, RA.769, RA.1513, SA.510, SA.1155, SA.1414; F.758, F.1094, F.1245 and DNR M.[AMSS].

2.4.1.1 Introduction

AMSS in the 14-14.5 GHz band is being proposed to meet a growing demand for two-way broadband communications by passengers and operators of commercial aircraft.

All or parts of the band 14-14.5 GHz are allocated on a primary basis to the FSS (Earth-to-space), RNS, and FS and MS (except aeronautical mobile service). Secondary services allocated in all or parts of the band include: MSS (Earth-to-space) (except AMSS), SRS, RAS, and RNSS. To achieve the objective of Resolution **216 (Rev.WRC-2000)**, studies were carried out to assess "the feasibility of sharing the band 14-14.5 GHz between the services referred to in *considering c)* and the aeronautical mobile-satellite service, with the latter service on a secondary basis." In addition, studies were carried out by the ITU-R with systems operating in secondary allocations in the band using available data as well as that obtained as a result of an Administrative Circular (CA/91).

Liaison statements among the concerned working parties exchanged information on the technical characteristics of the terminals of these services, as well as on analytical methodologies for, and results of, compatibility/sharing analyses. In addition, an Administrative Circular (CA/91) was sent by the Director of the BR requesting administrations to provide information on certain types of their use of the band 14-14.5 GHz, for which there were a limited number of replies.

2.4.1.2 Compatibility with services having primary allocations in the band 14-14.5 GHz

2.4.1.2.1 Fixed-satellite service (FSS) (14-14.5 GHz)

One central factor in the design of the planned AMSS network used for the FSS compatibility studies, is that the 14 GHz transmissions from the aircraft earth stations (AES) would be received by space station facilities that were coordinated with adjacent satellites. A second central design factor of the AMSS system is that the individual AES transmissions would be under the positive control of a network control and monitoring centre (NCMC), which would limit the aggregate off-axis, co-frequency, e.i.r.p. levels from multiple AES at adjacent satellites to (or below) those levels that have been accepted by other satellites, including, *inter alia*, effects of antenna pattern variations and pointing stability.

The AMSS networks will need rigorous protocols to control the operation of AES to be within the agreed limits. These controls include: entry of AES into the network; authorization for the AES to transmit; authorization to change transmit power/data rates and frequency assignment; and the ability to terminate AES transmissions. An NCMC must manage AES transmission levels within ranges both on an individual and on an aggregate (per transponder) basis.

Taking into account the planned AMSS networks in the 14-14.5 GHz band, studies were conducted to determine the feasibility of operating in the band on a secondary basis with the FSS.

The compatibility study with the FSS was begun by constructing a Monte Carlo simulation of a planned AMSS network, including the ability to evaluate the impact of transmissions from adding AES, and sources of random errors and inherent latencies for each co-frequency AES in the system. Running over 100 000 trials of the simulation determined that the NCMC could control the aggregate off-axis e.i.r.p. levels to those of Recommendation ITU-R S.728-1 for both 2º and 3º GSO satellite spacing to a 99.99% confidence level. This analysis verified that it was feasible to control the aggregate off-axis e.i.r.p. density levels from an AMSS network to be no greater than that of coordinated VSATs, as characterized in Recommendation ITU-R S.728-1.

Another study examined whether the cumulative interference from an AMSS network would cause harmful interference to non-GSO space station receivers.

2.4.1.2.2 Radionavigation service (RNS) (14-14.3 GHz)

There are no records in the ITU Master Register indicating use of the radionavigation allocation in the 14-14.3 GHz band by any administration. No additional information was obtained on radionavigation use of the band as a result of enquiries within the ITU-R and the BR Administrative Circular (CA/91). Consideration of compatibility matters has not revealed a problem in the use of this band by AMSS with respect to RNS.

2.4.1.2.3 Fixed service (FS) (14.4-14.5 GHz); (Regions 1 and 3: 14.3-14.4 GHz); (5.505: 14-14.3 GHz); (5.508: 14.25-14.3 GHz)

In the 14-14.5 GHz range, the FS is allocated on a primary basis in the band 14-14.3 GHz by No. **5.505**, in the band 14.25-14.3 GHz by No. **5.508**, in the band 14.3-14.4 GHz in Regions 1 and 3 and in the band 14.4-14.5 GHz in all three Regions.

Technical feasibility studies were performed by a number of administrations to determine whether planned AMSS networks could operate without causing harmful interference to the fixed service systems operating in the 14-14.5 GHz band.

These studies analysed the interference from planned AMSS networks by determining a pfd mask or e.i.r.p. mask that would not cause harmful interference to the systems in the FS. This was achieved by setting up a model of air traffic routes and fixed service receivers. The aggregate levels of interference into the fixed service networks due to emissions from planned AMSS networks were then calculated. The air traffic scenario was based upon the air traffic routes over the United Kingdom, Australia, France and Russia. Some studies used actual traffic routes with random variations in the time of arrival of the aircraft and deviation of the aircraft flight from the selected route. Other studies used worst-case scenarios in which deterministic air traffic routes were along the main beam region of the fixed service station. Aggregate levels of interference were calculated as a function of time and I/N exceedence curves were presented to describe the long-term and short-term levels of interference caused by the chosen air traffic scenario, pfd or e.i.r.p. mask and aircraft altitudes. As far as interference from the planned AMSS networks is concerned, it was agreed that the following interference assessment levels should apply:

- Long-term

  I/N = –20 dB to be exceeded for no more than 20% of time or an FDP (Fractional Degradation in Performance) not to exceed 1%.

- Short-term

A permissible interference level of –125 dB(W/MHz) not to be exceeded.

A pfd mask to protect the FS was developed on the basis of the assessment levels given above.

2.4.1.2.4 Mobile service (MS) (except aeronautical mobile) (14.4-14.5 GHz); (Regions 1 and 3: 14.3-14.4 GHz); (5.509: 14.25-14.3 GHz)

There are no records in the ITU Master Register indicating any use of the MS allocation in the band. No additional information was obtained on mobile service use of the band as a result of inquiries within the ITU-R, nor as a result of the BR Administrative Circular (CA/91).

However, based on information received in the course of conducting studies with the FS, it was learned that the band is used by some administrations for electronic news gathering (ENG) (the service is termed temporary-fixed by some administrations). Since ENG is considered by some administrations as a mobile service, and the system aspects of ENG are similar to those of the FS, the methodology recommended for AMSS studies with the FS was employed for such MS studies using ENG network characteristics.

2.4.1.3 Compatibility with services having secondary allocations in the band 14-14.5 GHz

2.4.1.3.1 Radio astronomy service (RAS) (14.47-14.5 GHz)

The RAS systems operate at relatively few sites around the world and uses antennas with a gain greater than 65 dBi. The radio astronomy observations in this band are important, but at some observatories, observations are carried out only for a small fraction of the time.

Sharing studies were performed using two alternative methodologies to determine if sharing between the RAS and the AMSS networks would be feasible in the 14-14.5 GHz band.

a) One study applied the Recommendation ITU-R RA.769 pfd level of –221 dB(W/($m^2 \cdot$ Hz)) to the AES emissions and derived the required AES pfd values to protect the RAS receiver.

b) The second study used the simulation methodology developed for sharing studies between non-GSO satellite systems and the RAS. This methodology, developed in Recommendation ITU-R M.1583, consists in a division of the sky into cells of approximately equal solid angles and in calculation of the epfd generated by all aircraft for each cell, averaged over time slots of 2 000 seconds. This methodology also assumes worst-case assumptions for the AMSS interference environment. Temporal statistics are obtained by performing a sufficient number of trials, randomly changing the RA station antenna pointing direction within a cell and the position of aircraft from one trial to another. The study showed that, above a 5° elevation angle, the epfd limit of –303 dB(W/($m^2 \cdot$ Hz)) (derived from Recommendation ITU-R RA.769 and the RAS antenna peak gain) was exceeded for less than 2% of the time (this criterion comes from Recommendation ITU-R RA.1513).

2.4.1.3.2 Space research service (SRS) (14-14.3 GHz) and (14.4-14.47 GHz)

Sharing studies were performed to determine if it is feasible for AES in the AMSS to share the 14-14.3 GHz and 14.4-14.47 GHz bands with the SRS on a secondary basis. Data relay satellite (DRS) networks use earth stations in the SRS at a very few sites in the world. These studies showed that the use of AMSS in this band is feasible.

2.4.1.3.3 Radionavigation-satellite service (RNSS) (14.3-14.4 GHz)

There are no records in the ITU Master Register indicating any use of the RNSS allocation in the 14.3-14.4 GHz band. Nor is there any record in any BR list of a prior Advance Publication Information (per No. **9.1**) by an administration for use of the band by RNSS. Nor was any information on proposed RNSS use of the band provided by administrations in response to the BR

Administrative Circular (CA/91). Consideration of sharing matters has not revealed a problem on the use of this band by AMSS with respect to the RNSS.

2.4.1.3.4 Mobile-satellite service (MSS) (except AMSS) (14.0-14.5 GHz)

MSS (except AMSS) systems, in the 14-14.5 GHz band, are operational in all three ITU Regions. Through the data reported in response to CA/91, it was learned that MSS use of the 14-14.5 GHz band requires that the MSS systems operate such that the aggregate, off-axis e.i.r.p. of all co-frequency transmissions is within the limits set by the administrations wherein these systems are employed. These limits have been based on the principles of, and closely related to, the limits developed during the adoption of Recommendation ITU-R S.728-1, as is appropriate for the satellite spacing environment. Since these existing MSS networks have a secondary status, they must accept interference from primary users of the band, but can claim protection against harmful interference from users of new secondary allocations, such as the AMSS.

A study was conducted to determine the ability of a planned AMSS network to share the band 14-14.5 GHz with an operational MSS network. The study concluded that sharing is feasible.

2.4.2 Analysis of the results of studies

On the basis of information available from the ITU-R studies, it has been demonstrated that it is feasible for appropriately designed AMSS networks to be operated on a secondary basis in the band 14-14.5 GHz without causing harmful interference to primary services in the band. Additional studies have shown the feasibility of AMSS sharing with services employing secondary allocations in the band.

2.4.2.1 Analysis of studies involving the primary allocations in the band

2.4.2.1.1 Fixed-satellite service

The studies show that an AMSS system operating on a secondary basis can compatibly operate with the FSS in the 14-14.5 GHz frequency band, provided aggregate co-frequency AES emissions in the direction of adjacent satellites are limited to levels that are equal to or less than the levels that have been accepted by other satellite networks. These conclusions apply equally to GSO and non-GSO FSS.

In addition, DNR ITU-R M.[AMSS] provides guidance to system designers and licensing administrations regarding technical and operating parameters of AMSS networks in the band 14-14.5 GHz needed to permit operation of AMSS networks with the FSS in the band.

2.4.2.1.2 Radionavigation service

Based on the information available, AMSS use of this band does not present any difficulty.

2.4.2.1.3 Fixed service

A general conclusion of the studies was that the dominant interference effect occurs as a result of an aircraft flying through the main beam of an FS antenna producing short-term interference and also significantly influencing the long-term FDP.

Results of the interference analyses have concluded that the following pfd mask applied to the AES of an AMSS network would adequately protect the fixed service networks in the band 14-14.5 GHz:

$$\text{pfd} = -132 + 0.5*\theta \quad \text{dB(W/m}^2\text{) in 1 MHz} \quad \text{for } \theta \leq 40°$$

$$\text{pfd} = -112 \quad \text{dB(W/m}^2\text{) in 1 MHz} \quad \text{for } 40 < \theta \leq 90°$$

Where θ is the angle of arrival, measured in degrees.

FS protection could also be ensured by a consistent e.i.r.p. mask, which can be derived for any given altitude from the above pfd mask using the conversion formula in Annex 2 of DNR ITU-R M.[AMSS]. Simplification of the resulting e.i.r.p. mask could also be considered.

2.4.2.1.4 Mobile service

Since there are no known mobile service systems using this allocation, a sharing analysis was accomplished employing characteristics of ENG systems that do use the allocation. These studies showed that the use of AMSS in this band is feasible, based on the information available.

2.4.2.2 Analysis of studies involving secondary allocations in the band

2.4.2.2.1 Radio astronomy service

Based on the studies described in § 2.4.1.3.1, both of which came to the same conclusion, it was concluded that sharing is feasible between the AMSS networks and the RAS in the 14-14.5 GHz band, provided that the following conditions are met:

1) AMSS Channels in the 14.47-14.5 GHz band

   a) AMSS stations do not transmit in the 14.47-14.5 GHz band within line-of-sight of radio astronomy stations operating within this band;

   or,

   b) if an AMSS operator intends to operate co-frequency within the visibility of the RA station, a specific agreement with the RA station will be needed to ensure that AMSS AES will meet the requirements of Recommendations ITU-R RA.769 and RA.1513 within the 14.47-14.5 GHz band during observations. When practicable, this may include advance information to AMSS operators regarding observation schedules.

2) AMSS channels in the 14-14.47 GHz band

   All AES transmitters on channels in the 14-14.47 GHz band, within line of sight of radio astronomy stations during radio astronomy observations have emissions in the band 14.47-14.5 GHz such that they meet the levels given in Recommendation ITU-R RA.769. Results from studies show that the following AES pfd levels in the band 14.47-14.5 GHz are sufficient, with some margin, to meet the RAS power flux-density levels in Recommendation ITU-R RA.769, i.e.:

$$\text{pfd} = -190 + 0.5*\theta \quad \text{dB(W/m}^2\text{) in 150 kHz for } \theta \le 10°$$

$$\text{pfd} = -185 \quad \text{dB(W/m}^2\text{) in 150 kHz for } 10° < \theta \le 90°$$

   Where θ is the angle of arrival, measured in degrees.

Such AES pfd levels in the band 14.47-14.5 GHz may be achieved by the AMSS operators through a combination of reduced AES signal power, sharp filtering, maintaining adequate frequency separation, or enhanced AES antenna performance.

2.4.2.2.2 Space research service

Based on the studies described in section 2.4.1.3.2, it was concluded that it is feasible for the AMSS to share with the space research service in the 14-14.3 GHz and 14.4-14.47 GHz bands, and that sharing can be accomplished through coordination as per RR Article **9**. It was determined that the main mechanism for interference occurs when an AES transmits in or near the main beam of the SRS antenna. In such a situation, coordination between the two networks is the most appropriate method for ensuring compatibility. The studies indicated that the coordination agreements between AMSS and space research networks can be developed based on controlling the emissions levels of the AES and, in severe cases, may require cessation of AES emissions in the frequency band used by the SRS networks when operating in the vicinity of the space research earth station. Specifics of the agreements will vary based on the characteristics of the individual SRS sites and the AMSS networks. Such emission restrictions are feasible for the AMSS.

2.4.2.2.3 Radionavigation-satellite service

Since there are no RNSS systems using, or proposing to use this secondary allocation, use of the band by AMSS is feasible.

2.4.2.2.4 Mobile-satellite service (except AMSS)

Analyses confirmed that interference protection margins make it feasible for AMSS and MSS (except AMSS) networks to share the band 14-14.5 GHz, both on a secondary basis, when they employ co-frequency transponders on adjacent satellites.

2.4.3 Methods to satisfy the agenda item and their advantages and disadvantages

Each of the regulatory and procedural alternatives that could be used for satisfying the agenda item to provide for the secondary AMSS allocation in the band 14-14.5 GHz requires removal from the existing MSS allocation of the phrase "*except aeronautical mobile-satellite*". Each alternative is presented below, along with the advantages and disadvantages of each.

The Arab Administrations stated their reservations with regard to all the methods proposed under this agenda item.

2.4.3.1 Method A

Remove the restriction **"*except aeronautical mobile-satellite*"** from the Table of Frequency Allocations in Article **5** for the MSS in the frequency band 14-14.5 GHz.

Under this option the phrase "*except aeronautical mobile-satellite*" would be removed from the secondary MSS allocation for 14-14.5 GHz in the Table of Frequency Allocations. No further modifications of the RR to protect other services from harmful interference would need to be incorporated.

Advantage:

Some administrations believe that compliance with the existing provisions of the RR would be sufficient. This is the simplest approach for satisfying the agenda item as the regulatory status of a secondary service and related procedures are well defined in the Radio Regulations. Since the service is to be secondary, it is obliged to protect all primary services and pre-existing systems of secondary services can claim protection from harmful interference, and also the AMSS must accept harmful interference from primary services and pre-existing secondary services.

Disadvantage:

The compatibility/sharing conditions that were identified by the ITU-R as contained in DNR ITU-R M.[AMSS] for protecting certain other services will not be explicitly referred to in the RR. In this case the application of DNR ITU-R M.[AMSS] and/or other criteria is left to administrations to satisfy the requirements to protect other services. Hence, some administrations believe that the protection of primary terrestrial and pre-existing systems of secondary services is not ensured as it may be difficult to detect and localize the interference source, and this may not allow administrations to intervene to make interferers cease their transmissions. Some administrations believe that even in the case where the interferer would be determined, it would be necessary to justify and negotiate the level of harmful interference.

2.4.3.2 Method B

Remove ***"except aeronautical mobile-satellite"*** from the Table of Frequency Allocations in Article **5** and add a footnote that incorporates by reference ITU-R Recommendation DNR ITU-R M.[AMSS].

Advantages:

Some administrations believe that this would ensure the appropriate protection of the fixed service and the radio astronomy service by enforcing the necessary limitations in the RR. For the convenience of licensing authorities, the compatibility/sharing conditions for protecting certain other services will be explicitly referenced and that this would be of assistance to administrations. Including limits in the RR identifies to AMSS operators clear operating guidelines relative to other services.

Disadvantages:

Some administrations believe that this might not be consistent with the principle that adding footnotes to the Radio Regulations or referring to additional ITU-R Recommendations in them should be avoided where possible, and that inclusion of limits in the RR for the protection of primary services from interference caused by the secondary service would not be consistent with the current status of secondary services and could be interpreted ambiguously by Administrations. Changes in Recommendations incorporated by reference into the RR must be approved by a competent WRC.

2.4.4 Regulatory and procedural considerations

In Method A, there are no consequential RR procedural changes or additions required. Existing regulatory procedures are adequate to deal with the modification to Article **5**. The modification is to remove the restriction "*except aeronautical mobile-satellite*" from the Table of Frequency Allocations in Article **5** for MSS in the frequency band 14-14.5 GHz.

In Method B, the modification is to remove the restriction "*except aeronautical mobile-satellite*" from the Table of Frequency Allocations in Article **5** for MSS in the frequency band 14-14.5 GHz and there would be regulatory or procedural changes required. This would be achieved by adding a footnote to Article **5** of the RR that incorporates by reference DNR ITU-R M.[AMSS], and by way of example, this footnote could read:

ADD

5.AMSS In the band 14-14.5 GHz, aircraft earth stations in the aeronautical mobile-satellite service shall operate in accordance with the provisions of Annex 1 of DNR ITU-R M.[AMSS]. The pfd limits in Annex 1 may be exceeded on the territory of any country whose administration has so agreed.

*****

It is worth noting that the latter sentence of this example footnote is consistent with No. **21.17**, which applies to pfd limits as described in Table 21-4.

Under Method B, even though the AMSS complies with the limits, in no way should it detract from being a secondary service, and therefore in the event it causes harmful interference, it will have to immediately eliminate the harmful interference.

For Methods A and B the case of the protection of other secondary services is addressed in DNR ITU-R M.[AMSS].

For Methods A and B in order to use AMSS on a secondary basis in the frequency band 14-14.5 GHz, a request for coordination of the AMSS network is to be submitted to the BR. Under Article 9, this leads to the publication of a Special Section of the BR International Frequency Information Circular (BR IFIC). This publication is to initiate the coordination procedure for the AMSS network where the class of station is matched for the space station and earth station, and the space station and earth station have the same category of allocation. This publication could take the form of a new AMSS network or the modification of an existing network to include the AMSS operations. Any earth station other than that published with the above-mentioned new Special Section (aeronautical mobile-satellite service with secondary allocation) must have the characteristics within the limits of those published by the Bureau or it should have to undergo the coordination procedure of Article 9. These actions could therefore be done within the existing procedures of the Radio Regulations.

With regard to the notification of earth stations pertaining to the AMSS, in addition to that included in the publication procedure referred to in the previous paragraph, some administrations were of the opinion that there would be three possible courses of action:

a) using the current provisions of Article 9 (No. 9.7 and other relevant provisions) or;

b) modifying the relevant part of the Rules of Procedure relating to No. 11.32 or;

c) a new provision (No. 9.7C), the wording of which would indicate that the required coordination needs to be effected by the administration responsible for the AMSS with respect to space services of other administrations whose services are likely to be affected. This coordination requirement should be identified by the Bureau and carried out by AMSS administrations using Appendix 8 criteria.

Under Methods A and B, WRC-03 may consider suppression of Resolution **216 (Rev.WRC-2000)**.

Some administrations are of the view that, in addition, since no further action by the Conference is needed to implement this proposal, it can be provisionally applied from the end of WRC-03 by including the appropriate provisions in Article 59. Such action will hasten the establishment of the aeronautical mobile-satellite service in this frequency band to meet the growing demand for broadband communications to provide data transmission service for aircraft.

Some other administrations are of the view that the decisions on the date of implementation is outside the mandate of CPM.

#########

2.5 Agenda item 1.12

"to consider allocations and regulatory issues related to the space science services in accordance with Resolution **723 (Rev.WRC-2000)** and to review all Earth exploration-satellite service and space research service allocations between 35 and 38 GHz, taking into account Resolution **730 (WRC-2000)**"

2.5.1 Resolution 723 (Rev.WRC-2000), *resolves* 1

"provision of up to 3 MHz of frequency spectrum for the implementation of telecommand links in the space research and space operations services in the frequency range 100 MHz to 1 GHz"

2.5.1.1 Summary of technical and operational studies, and relevant ITU-R Recommendations

Sharing scenarios from 100 MHz to 1 GHz have been considered. Recent detailed sharing studies have been conducted in the band 235-328.6 MHz.

Relevant Recommendations ITU-R: SA.363-5, SA.364-5, SA.609-1, SA.1017, SM.1448 and DNR SA.[Doc. 7/62].

2.5.1.2 Analysis of the results of studies

In the range between 100 MHz to 1 GHz, the SRS and SOS have a combined primary allocation of 3.9 MHz and a combined secondary allocation of 10.35 MHz in the space-to-Earth direction, but only a combined 2.4 MHz in the Earth-to-space direction for telecommand links.

Sharing conditions in the range 100 MHz to 1 GHz have not been agreed. However, to accommodate existing telecommand systems in certain countries where the band 257-262 MHz has already been used successfully for many years, it may be possible to identify 3 MHz within the band 257-262 MHz. Systems operating in accordance with the RR might experience occasional interference from other systems based on a coordination distance of the order of 400 km as derived from the aeronautical mobile case.

2.5.1.3 Methods to satisfy the agenda item and their advantages and disadvantages

2.5.1.3.1 Method A

No change.

Advantages:

No impact on existing systems operating in accordance with the RR.

Disadvantages:

Spectrum for telecommand links in the space research and space operations services in the frequency range 100 MHz to 1 GHz will not be provided, and the imbalance between space-to-Earth and Earth-to-space directions will continue to exist.

2.5.1.3.2 Method B

Consider the allocation of up to 3 MHz of spectrum for telecommand links (Earth-to-space) for the space research and space operations services in the 257-262 MHz band with conditions to minimize the possibility of interference to systems operating in accordance with the RR

Advantages:

- Provides up to 3 MHz of allocation in certain countries for telecommand links.
- The existing spectrum for the space-to-Earth and Earth-to-space directions will be balanced.

Disadvantages:

Occasional interference may occur to systems operating in accordance with the RR.

2.5.1.4 Regulatory and procedural considerations

Method A

None required.

Method B

The existing telecommand systems could be accommodated by the addition of a footnote to RR Article **5**. For example, the footnote could read:

ADD

5.XXX *Additional allocation:* In [countries], the band [257-262] MHz is also allocated to the space research and space operation services (Earth-to-space) on a primary basis. The coordination distance for earth stations of these services is 400 km.

2.5.2 Resolution 723 (Rev.WRC-2000), *resolves* 2

"to consider incorporating in the Table of Frequency Allocations the existing primary allocation to the space research service in the band 7 145-7 235 MHz under No. **5.460**"

2.5.2.1 Summary of technical and operational studies, and relevant ITU-R Recommendations

The 7 145-7 235 MHz band is allocated on a primary basis to the FS, the MS and by No. **5.460**, to the SRS (Earth-to-space), with a segment of the band restricted to deep space. The footnoted SRS primary allocation is subject to agreement obtained under No. **9.21**. The companion SRS downlink band, 8 400-8 500 MHz, is allocated on a primary basis in the Table of Frequency Allocations. This pair of bands is used on a worldwide basis for cross-support of near-Earth and deep space missions in accordance with international agreements concluded between a number of space agencies. The footnote calling for agreement under No. **9.21** was originally applied at WARC-71 because the coordination parameters necessary for earth station coordination were not agreed at that time. In the time since this footnote was adopted, RR Appendix **7** has been modified and now contains all of the necessary coordination parameters for transmitting earth stations for the space research service in the 7 145-7 235 MHz band. Therefore, the premise behind requiring agreement under No. **9.21** no longer exists.

Relevant Recommendations ITU-R: SA.609-1; SA.364-5; SA.1016 and SA.1157.

2.5.2.2 Analysis of the results of studies

Since WRC-2000 revised Appendix **7** to include space research station parameters and coordination methodologies for the 7 145-7 235 MHz band into the Radio Regulations and since coordination under No. **9.17** is mandatory, coordination under No. **9.21** is an additional burden on administrations, which is no longer necessary. Therefore, it is practicable, without affecting the protection afforded the fixed and mobile services, to provide a worldwide primary status in the band 7 145-7 235 MHz, while maintaining the restriction to deep space in the part of band 7 145-7 190 MHz.

Since the space research service allocation in the band 7 145-7 190 MHz is limited to deep space applications and the band 7 190-7 235 MHz is not used nor currently planned for use by GSO satellites in the space research service, there is no need to apply the provisions of No. **21.2** and Table **21-1** to the bands. Even in the unlikely case of a GSO SRS mission, there will be no requirement for orbital avoidance to be placed on terrestrial services. The provisions of No. **21.3** should be applied in the band 7 145-7 235 MHz to minimize the possibility of interference to space research satellites.

The appropriate provisions of Sections III and IV of Article **21** should be applied to SRS earth stations in the band 7 145-7 235 MHz to facilitate sharing with the fixed and mobile services.

2.5.2.3 Methods to satisfy the agenda item and their advantages and disadvantages

Method

In RR Article **5** add to the Table of Frequency Allocations a primary allocation to the SRS (Earth-to-space) in the bands 7 145-7 190 MHz (deep space) and 7 190-7 235 MHz. Modify No. **5.460** to delete the reference to No. **9.21** in the band 7 145-7 235 MHz. Retain the restriction to indicate that no emissions to deep space are permitted in the sub-band 7 190-7 235 MHz. Add to No. **5.460** the provision that GSO satellites in the SRS shall not claim protection from FS and MS, and No. **5.43A** does not apply.

Advantages:

- Satisfies *resolves* 2 of Resolution **723** with respect to deep space and non-deep space applications within the space research service.
- Eliminates the need for stations in the space research service to seek coordination under No. **9.21** prior to operation.
- Does not affect operating characteristics for transmit stations in the fixed and mobile services.
- Assures continued availability of access to these bands for space research.

Disadvantages:

None.

2.5.2.4 Regulatory and procedural considerations

Add to the Table of Frequency Allocations in RR Article **5** a primary allocation to the SRS (Earth-to-space) in the bands 7 145-7 190 MHz (deep space) and 7 190-7 235 MHz. No protection shall be claimed by SRS GSO satellites from FS and MS. Include the band 7 145-7 235 MHz in RR Table **21-2** and indicate that only Nos. **21.3** and **21.5** apply. The space research service allocation in the band 7 145-7 190 MHz will continue to be limited to the use of deep space applications.

Example of a possible modification to footnote No. 5.460

MOD

5.460 The use of the band 7 145-7 190 MHz by the space research service (Earth-to-space) is restricted to deep space; no emissions to deep space shall be effected in the band 7 190-7 235 MHz. Geostationary satellites in the space research service operating in the band 7 190-7 235 MHz shall not claim protection from the fixed and mobile services and No. **5.43A** shall not apply.

Example of a possible addition to Table 21-2

Frequency band	Service	Limit as specified in Nos.
7 145-7 235 MHz	Space research	**21.3** and **21.5**

The appropriate provisions of Sections III and IV of RR Article **21** should be applied to space research service earth stations in the band 7 145-7 235 MHz to facilitate sharing with the fixed and mobile services.

#########

2.5.3 Resolution 723 (Rev.WRC-2000), *resolves* 3

"to review the allocations to the space research service (deep space) (space-to-Earth) and the inter satellite service, taking into account the coexistence of these two services in the frequency range 32-32.3 GHz, with a view to facilitating satisfactory operation of these services"

2.5.3.1 Summary of technical and operational studies, and relevant ITU-R Recommendations

The band 31.8-32.3 GHz is allocated worldwide to the SRS (deep space) (space-to-Earth) with the 32-32.3 GHz segment shared with the ISS on a primary basis. The FS and RNS are also allocated worldwide on a primary basis. No. **5.548** states that in designing systems for the 31.8-32.3 GHz band, including the 32-32.3 GHz segment shared between the inter-satellite and the SRS (deep space), administrations shall take all necessary measures to prevent harmful interference between the services.

Sharing studies concerning bands used for deep-space research, including sharing with the ISS in the 32 GHz band, are summarized in Recommendation ITU-R SA.1016. The feasibility of sharing was assessed for ISS systems using GSO-GSO links, GSO-non-GSO links and non-GSO-non-GSO links. In all three cases, it was concluded on the basis of an inability to satisfy the protection criteria of Recommendation ITU-R SA.1157 for practical ISS links employing transmitting antennas conforming to Recommendation ITU-R S.672, that sharing between the ISS and the SRS (deep space) (space-to-Earth) in the 32-32.3 GHz band (see section 2.5 of Annex 1 in Recommendation ITU-R SA.1016) is not feasible. Interference caused by ISS links were in excess of 55 dB greater than the protection criteria given in Recommendation ITU-R SA.1157 and no techniques were identified to mitigate against such an excessive amount of interference.

Relevant Recommendations ITU-R: SA.509; SA.1014; SA.1016; SA.1157; S.672 and S.1151.

2.5.3.2 Analysis of the results of studies

Studies summarized in Recommendation ITU-R SA.1016 have concluded that sharing between the SRS (deep space) (space-to-Earth) and the ISS in the 32-32.3 GHz band may not be practicable due to the onerous sharing conditions and the absence of practical mitigation techniques. This conclusion is based on: interference to SRS (deep space) Earth stations that is in excess of 55 dB greater than the protection criteria given in Recommendation ITU-R SA.1157; and, the absence of practical mitigation techniques to reduce the interference to an acceptable level.

2.5.3.3 Methods to satisfy the agenda item and their advantages and disadvantages

Method

Delete the ISS allocation in the 32-32.3 GHz band.

Advantages:

Deletion of the allocation would ensure the reception of deep-space transmissions at the SRS deep-space earth stations without unacceptable interference.

Disadvantages:

The existing ISS allocation bandwidth of 1 000 MHz will be reduced to 700 MHz.

2.5.3.4 Regulatory and procedural considerations

Delete the ISS allocation in the 32-32.3 GHz band in RR Article **5**. Also, consequential revisions to No. **5.548** are required. Note that there is also a country footnote, No. **5.547C**, that may be affected by the decisions of the conference.

#########

2.5.4 Resolution 723 (Rev.WRC-2000), *resolves* 4

"to review existing allocations to space science services near 15 GHz and 26 GHz, with a view to accommodating wideband space-to-Earth space research applications"

2.5.4.1 Summary of technical and operational studies, and relevant ITU-R Recommendations

An allocation is needed to support planned high data rate space research missions requiring large bandwidths for high capacity transmission links. Satellites for these missions will carry telescopes and/or other passive instruments to measure phenomenon such as the Earth's magnetosphere and solar flares.

An ITU-R study considered the spectrum requirements associated with the current plans of international space agencies to implement high data rate space research missions with data rate requirements up to 1 Gbps or higher. These missions will be limited in number with an estimated three to five satellites per year worldwide, and will generally be in polar or inclined equatorial orbit with some at geostationary altitudes, some in highly elliptical orbits, and still others at the L1 or L2 libration points. Frequency bands being considered include the 14.8-15.35 GHz band, which is currently allocated on a primary basis to the FS and the MS, and on a secondary basis to SRS, and the 25.5-27.0 GHz band which is allocated on a primary basis to the FS, ISS, MS and the EESS.

This ITU-R study concluded that each band has its own set of particular advantages for satisfying a broad range of stated future SRS mission requirements from the viewpoint of technical, schedule, and cost considerations. The 26 GHz band is most desirable for high data rate SRS missions operating in high inclination orbits due to the possible sharing of ground station resources with EESS missions operating in that band. Similarly, the 15 GHz band is most desirable for high data rate SRS missions operating in low-to-mid inclination orbits, geostationary orbits, and L1/L2 libration points due to the possible sharing of ground station resources located at low-to-mid latitude Deep Space Network and US National Radio Astronomy Observatory sites. Also, an existing data relay satellite network provides added flexibility to SRS missions by providing full coverage backup support in the 15 GHz band, and partial coverage backup support in the 26 GHz band. Where a 15 GHz infrastructure is not available, the 26 GHz could also be used for some of the above applications.

Studies have been performed in both bands 14.8-15.35 GHz and 25.5-27 GHz to evaluate the feasibility of using these bands for SRS (space-to-Earth) wideband applications.

Relevant ITU-R Recommendations: SA.364, F.758, SA.1024, SA.1155 and SA.1344.

The results of the sharing studies for the band 14.8-15.35 GHz may be found in DNR ITU-R SA.[15SHAR], and for the band 25.5-27.0 GHz may be found in DNR ITU-R SA.[26SHAR].

2.5.4.2 Analysis of the results of studies

2.5.4.2.1 Frequency band 14.8-15.35 GHz

Results of simulations of the probabilistic interference from SRS, based on assumed deployment of 24 satellites in geostationary orbit, into digital point-to-point FS systems show that the same pfd limits applicable in the band 10.7-11.7 GHz are necessary to protect the fixed service in the band 14.8-15.35 GHz. In any 1 MHz band, these limits are:

1)	-126	dB (W/m^2)	for	$0° < \delta \leq 5°$
	$-126 + (\delta - 5)/2$	dB (W/m^2)	for	$5° < \delta \leq 25°$
	-116	dB (W/m^2)	for	$25° < \delta \leq 90°$

where δ is the angle of arrival above the horizontal plane (degrees).

These pfd limits should permit operation of the 400 Mbit/s space-to-Earth SRS links as required. However, as the fixed service has not been required to implement orbit avoidance in this band, some existing FS links could be adversely impacted with an I/N of up to +16 dB if antennas of these stations are aligned with specific SRS GSO orbit locations with co-channel emissions.

Results of simulation studies carried out by ITU-R of interference from SRS non-GSO satellite systems into FS P-P systems show that sharing between these services is feasible in the band 14.8-15.35 GHz using pfd limits 2 dB higher than those applicable to the band 10.7-11.7 GHz. In any 1 MHz band, these limits are:

2)	–124	dB (W/m^2)	for	$0° \leq \delta \leq 5°$
	–124 + (δ–5)/2	dB (W/m^2)	for	$5° < \delta \leq 25°$
	–114	dB (W/m^2)	for	$25° < \delta \leq 90°$

where δ is the angle of arrival above the horizontal plane (degrees).

The pfd limits in 1) and 2) above are applied to GSO and non-GSO satellites, respectively, under assumed free-space propagation conditions.

Protection of SRS receiving earth stations from the emissions of fixed systems with the characteristics given in Recommendation ITU-R F.758 may be realized at separation distances as small as 18 km to 30 km under favourable conditions and at distances from 160 km to greater than 300 km for less favourable conditions. These distances were determined for mode (1) propagation for an inland great-circle path over smooth Earth (zone A2) using the methodology in Appendix 7. These separation distances will decrease significantly when account is taken of such factors as frequency channelization plans, average antenna gains, varying elevation angles, natural site shielding, terrain clutter and other terrain features.

DNR ITU-R SA.[15SHAR] shows that an existing data relay satellite network would be protected from the emissions of the example low-orbiting satellites and geostationary satellites, and that the separation distance between a receiving geostationary data relay satellite and a transmitting geostationary SRS satellite could be as little as 12 km (equivalent to an orbital separation of less than 0.02 degrees). Additionally a minimum protection margin of +23 dB existed for the near-antipodal case of geostationary SRS satellite emissions in the direction of a receiving data relay satellite. Similar results were found for the case of a low-orbiting SRS satellite transmitting in the space-to-Earth direction that is located within the main beam of the receiving antenna of the data relay satellite. In this case, the margin of the interference with respect to the protection criteria given in Recommendation ITU-R SA.1155 was +22 dB.

There are no known SRS (passive) or EESS (passive) systems using the 15.20-15.35 GHz band under the provisions of No. **5.339**.

2.5.4.2.2 Frequency band 25.5-27 GHz

The existing pfd limits given in Table 21-4 for the band 25.5-27.0 GHz provide protection of P-P and P-MP fixed service systems from space-to-Earth emissions of low-orbiting satellites and geostationary satellites to receiving earth stations in the space research service. In any 1 MHz band, these limits are:

–115	dB(W/m^2)	for	$0° < \delta \leq 5°$
–115 + (δ – 5)/2	dB(W/m^2)	for	$5° < \delta \leq 25°$
–105	dB(W/m^2)	for	$25° < \delta \leq 90°$

where δ is the angle of arrival above the horizontal plane (degrees).

The pfd limits above are applied to GSO and non-GSO satellites under assumed free-space propagation conditions.

Protection of SRS receiving earth stations from the emissions of P-P and P-MP fixed systems with the characteristics given in Recommendation ITU-R F.758 may be realized at separation distances less than 20 km under favourable conditions. Separation distances less than 150 km for P-P systems and less than 65 km for P-MP for less favourable conditions may be required. These distances were determined for mode (1) propagation for an inland great-circle path over smooth Earth (zone A2). These separation distances will decrease significantly when account is taken of such factors as frequency channelization plans, average antenna gains, varying elevation angles, natural site shielding, terrain clutter and other terrain features. However, it is noted that the addition of an allocation to the SRS would introduce further constraints when coordinating with FS systems.

DNR ITU-R SA.[26SHAR] shows that data relay satellite networks operating in the ISS would be protected from the emissions of the example SRS low-orbiting satellites and geostationary satellites, and that the separation distance between a receiving geostationary data relay satellite and a transmitting geostationary SRS satellite could be as little as 7 km (equivalent to an orbital separation of less than 0.01 degrees). Additionally a minimum protection margin of +23.7 dB existed for the near-antipodal case of geostationary SRS satellite emissions in the direction of a receiving data relay satellite. Similar results were found for the case of a low-orbiting SRS satellite transmitting in the space-to-Earth direction that is located within the main beam of the receiving antenna of the data relay satellite. In this case, the margin of the interference with respect to the protection criteria given in Recommendation ITU-R SA.1155 was +22 dB.

In view of the envisaged use of the same infrastructure for EESS and SRS, it is expected that coordination between these two services will not result in any constraints for the EESS.

2.5.4.3 Methods to satisfy the agenda item and their advantages and disadvantages

2.5.4.3.1 Frequency band 14.8-15.35 GHz

2.5.4.3.1.1 Method A

Upgrade the allocation to the space research service in the band 14.8-15.35 GHz to primary with the space-to-Earth directional indicator. The SRS will be subject to the power flux-density limits given in 1) and 2) of § 2.5.4.2.1 for GSO and non-GSO satellites, respectively. Add space-to-space and Earth-to-space directional indicators to the existing secondary SRS allocation in the band 14.8-15.35 GHz.

Advantages:

- Provides a primary allocation to the SRS of 550 MHz for space-to-Earth wide band applications.
- Improving the status of SRS (space-to-Earth) protects the SRS from the results of possible future allocations.
- Maintains and enhances current infrastructure investments.

Disadvantages:

- The requirement to coordinate with a small number of SRS receiving earth stations imposes a new constraint on the development of the fixed service.
- The fixed service has not implemented orbital avoidance in this band since, currently, there are no requirements to share this band with a space service on a co-primary basis. Consequently, some existing FS links, if aligned with specific GSO orbit locations occupied by satellites with co-channel emissions, could be adversely impacted. For example, I/N values of up to +16 dB for boresight coupling may be experienced.

- Potential decrease in the operating margin of FS links due to interference from the emissions of geostationary and low-orbiting SRS satellites.
- For their own protection, new stations in the fixed service may be required to avoid pointing towards the GSO orbit.

2.5.4.3.1.2 Method B

Upgrade the allocation to the space research service in the band 14.8-15.35 GHz to primary but limit the applications to space-to-Earth non-GSO operation, subject to the second set of pfd limits given in § 2.5.4.2.1. Retain all other aspects of the SRS on a secondary basis.

Advantages:

- Provides a primary allocation to the SRS of 550 MHz for non-GSO space-to-Earth wide band applications.
- Improving the status of non-GSO SRS (space-to-Earth) protects the non-GSO SRS from the results of possible future allocations.
- Maintains and enhances current infrastructure investments.
- Obviates the need for the fixed service to avoid the GSO orbit.

Disadvantages:

- Does not provide a primary allocation status to SRS GSO operation.
- The requirement to coordinate with a small number of SRS receiving earth stations imposes a new constraint on the development of the fixed service.

2.5.4.3.1.3 Method C

No change to the Radio Regulations.

Advantages:

No impact on existing services.

Disadvantages:

Does not provide the desired level of protection to the SRS.

2.5.4.3.2 Frequency band 25.5-27 GHz

Method

Add a primary allocation to the SRS (space-to-Earth) in the Table of Frequency Allocations. Add the space research service (space-to-Earth) to No. **5.536A.** Add the SRS (space-to-Earth) to RR Table 21-4 for the band 25.5-27.0 GHz, subject to the pfd limits in § 2.5.4.2.2.

Advantages:

- Provides a primary allocation to the SRS of 1 500 MHz for space-to-Earth wide band applications.
- Limited impact on existing services using the band.

Disadvantages:

None in view of RR No. **5.536A**.

2.5.4.4 Regulatory and procedural considerations

2.5.4.4.1 Frequency band 14.8-15.35 GHz

Method A

In the band 14.8-15.35 GHz, add a primary allocation to the SRS (space-to-Earth) in the Table of Frequency Allocations. Add space-to-space and Earth-to-space directional indicators to the existing secondary allocation to the SRS in the band 14.8-15.35 GHz. Add the two sets of pfd limits detailed under § 2.5.4.2.1 to RR Table 21-4. The first set would be applicable to GSO SRS satellites and the second set would be applicable to non-GSO SRS satellites. Add characteristics of SRS earth stations to Table 8 of Appendix **7** for use in coordination.

Method B

In the band 14.8-15.35 GHz add a primary allocation to the SRS (space-to-Earth) limited to non-GSO applications in the Table of Frequency Allocations. Retain all other aspects of the SRS on a secondary basis in the Table of Frequency Allocations. Add the second set of pfd limits detailed under § 2.5.4.2.1 to RR Table 21-4 for non-GSO SRS (space-to-Earth). Add characteristics of non-GSO SRS earth stations to Table 8 of Appendix **7** for use in coordination.

Method C

None.

2.5.4.4.2 Frequency band 25.5-27 GHz

Method

Add a primary allocation in the band 25.5-27.0 GHz to the SRS (space-to-Earth) in the Table of Frequency Allocations. Amend No. **5.536A** to include SRS earth stations and associate the amended footnote with the SRS allocation in the Table of Frequency Allocations. Add SRS (space-to-Earth) to RR Table **21-4** in the band 25.5-27.0 GHz with the pfd values given in § 2.5.4.2.2.

NOTE - Consequential suppression of Resolution 723 could be considered by WRC-03 following successful conclusion of work on all the *resolves*.

#########

2.5.5 Review of all EESS and SRS allocations between 35 and 38 GHz, taking into account Resolution 730 (WRC-2000)

2.5.5.1 EESS (active) and SRS (active) in the band 35.5-36 GHz

Resolution **730 (WRC-2000)** *resolves*:

1 to invite ITU-R to study sharing between spaceborne precipitation radars and other services in the band 35.5-35.6 GHz;

2 to recommend that WRC-03 review the results of those studies and consider the removal of the restriction currently contained in No. **5.551A** on spaceborne precipitation radars operating in the Earth exploration-satellite service in the band 35.5-35.6 GHz.

2.5.5.1.1 Summary of technical and operational studies, and relevant ITU-R Recommendations

The band 35.5-36 GHz is allocated on the primary basis to the EESS (active) and SRS (active). Prior to WRC-97, precipitation radars in the EESS (active) operated on a primary basis in the band 35.5-35.6 GHz under the provisions of No. **S5.551 (SUP WRC-97)**. This 100 MHz band is used by precipitation radars located on spacecraft. WRC-97 decided to allocate the band 35.5-36 GHz to both the EESS (active) and SRS (active), but with the provisions contained in No. **5.551A**.

List of relevant Recommendations: ITU-R SA.577, SA.1166, DNR SA.[35GHz-EESS(active)] and DNR M.[8B-33GHz].

2.5.5.1.2 Analysis of the results of studies

ITU-R studies have shown that sharing between spaceborne active sensors and radiolocation systems in the band 35.5-36 GHz is feasible, as indicated in § 5.7.2.1 of Chapter 5 of the CPM-97 Report. The ITU-R, which studied compatibility between spaceborne active sensors and other services prior to WRC-97, noted that in the band 33.4-36 GHz, compatibility analysis between spaceborne altimeters and scatterometers, and terrestrial radars in the radiolocation service indicated that interference from these spaceborne active sensors into the radiolocation systems would not exceed the interference criteria for terrestrial radiolocation systems. The ITU-R also examined the compatibility between active sensors and radiolocation systems from the aspect of potential interference from these radiolocation systems into altimeters and scatterometers and concluded that interference into these sensors would not exceed their interference criteria. Based on these studies, CPM-97 concluded that compatibility between known spaceborne active sensors and radiolocation systems in the 33.4-36 GHz band existed and that an allocation of 500 MHz in this frequency range should be made. Therefore, there was no technical reason behind applying No. **5.551A** for the EESS (active) and SRS (active) in the 35.5-36 GHz band.

Since WRC-97 further studies have been undertaken in the ITU-R on sharing in the band 35.5-36 GHz between spaceborne synthetic aperture radars (SAR) and radiolocation systems, and spaceborne precipitation radars and radiolocation systems. These studies resulted in DNR ITU-R SA.[35GHz-EESS(active)] which concludes that sharing between all types of active spaceborne sensors and radiolocation systems is feasible provided that the pfd generated by any EESS/SRS (active) spaceborne sensor at the Earth's surface for angles greater than 0.8° from the beam centre does not exceed the limit of -73.3 dBW/m^2 in any 2 GHz band. ITU-R studies have shown there are no compatibility issues between spaceborne active sensors and systems in the fixed and MetAids service in the 35.5-36 GHz band.

2.5.5.1.3 Methods to satisfy the agenda item and their advantages and disadvantages

2.5.5.1.3.1 Method A

Delete the band 35.5-35.6 GHz from No. **5.551A**, which currently covers the entire band between 35.5-36 GHz. This would restore the regulatory situation that existed prior to WRC-97 in the band 35.5-35.6 GHz.

Advantages:

Systems in the EESS (active) and SRS (active) can again use 100 MHz (in the 35.5-35.6 GHz band) without the unnecessary constraints of No. **5.551A**.

Disadvantages:

This method maintains the unnecessary constraints of No. **5.551A** on the EESS (active) and SRS (active) in the 35.6-36 GHz band.

2.5.5.1.3.2 Method B

Replace No. **5.551A** with a footnote limiting the mean power flux-density at the Earth's surface from spaceborne active sensors operating in the EESS (active) and SRS (active) systems in the band 35.5-36 GHz, generated at an angle greater than 0.8 degrees from the beam center to -73.3 dBW/m^2 in any 2 GHz band.

Advantages:

- This would allow the deployment of current and planned EESS (active) and SRS (active) systems without undue constraint.
- This would ensure protection of other services to which this band is allocated.

Disadvantages:

Constraints may be placed on the future development of EESS (active) and SRS (active) in the 35.5-36 GHz band.

2.5.5.1.3.3 Method C

Suppress No. **5.551A**.

Advantages:

This would eliminate the restriction on the EESS (active) and SRS (active) in the entire 35.5-36 GHz band.

Disadvantages:

RLS systems and FS and MS systems in countries mentioned in No. **5.549** may not be protected from future EESS (active) or SRS (active) systems if those future systems use higher power levels than current and planned systems.

2.5.5.1.4 Regulatory and procedural considerations

Method A would require modification of No. **5.551A** to exclude the band 35.5-35.6 GHz, which was not subject to the unnecessary constraints prior to WRC-97.

Method B would require replacement of No. **5.551A** by a new footnote to limit the peak power emissions of EESS (active) and SRS (active) in the 35.5-36 GHz band, such as:

"**5.XXX** In the band 35.5-36.0 GHz, the mean power flux-density generated by any EESS/SRS (active) spaceborne sensor at the Earth's surface for any angle greater than 0.8 degrees from the beam centre shall not exceed -73.3 dB(W/m^2) in any 2 GHz band."

(NOTE - One administration sought to include additional words in this draft footnote advocating the removal of the right of protection for the EESS/SRS (active) from interference from the radiolocation service.)

Method C would require no additional regulatory provisions beyond simple suppression of No. **5.551A.**

NOTE - Consequential suppression of Resolution 730 could be considered by WRC-03.

#########

2.5.5.2 EESS (passive) in the band 36-37 GHz

2.5.5.2.1 Summary of technical and operational studies, and relevant ITU-R Recommendations

The band 36-37 GHz is allocated on a primary basis to the EESS (passive) and space research service (passive). The band is also allocated on a primary basis to the fixed and mobile services. The sub-band 36.43-36.5 GHz is also used by the radio astronomy service for spectral line observations as noted under No. **5.149**.

Relevant Recommendations ITU-R: SA.1029-1 and F.758-2.

2.5.5.2.2 Analysis of the results of studies

With respect to the EESS (passive) and SRS (passive) allocations in the band 36-37 GHz, data taken in this band contributes to the estimate of total vapour, total cloud liquid water, sea surface wind speed, sea surface temperature, sea ice extent, snow depth and soil moisture content. These parameters are derived from measurements near 7, 10.7, 18.7, 23.8, 50.3, 52.8 and 89 GHz in combination with measurements in the 36-37 GHz band. There have been no changes in the requirements for the passive sensing allocation in the 36-37 GHz band, nor have there been any changes in the sharing conditions in this band that would warrant any allocation changes to the EESS (passive) and SRS (passive).

However, the anticipated introduction of active systems into this band, without agreed sharing criteria between the active and passive services, could seriously jeopardize the success of these important scientific programmes, and consequently impact the measurements made in the bands 7, 10.7, 18.7, 23.8, 50.3, 52.8 and 89 GHz.

Based upon preliminary studies conducted so far, the deployment of a limited number of fixed stations operating at the maximum power given in Recommendation ITU-R F.758 may cause unacceptable interference to a passive sensor. Taking into account the scattering effect, the interference level may be increased. Land area measurements would be degraded rather than ocean measurements. If passive services were to be protected to the levels of Recommendation ITU-R SA.1029-1, in order to meet the data availability requirements specified in this Recommendation, it may be necessary to limit the deployment of the fixed and mobile services.

2.5.5.2.3 Methods to satisfy the agenda item and their advantages and disadvantages

2.5.5.2.3.1 Method A

Make no change to the RR and continue urgent sharing studies under normal ITU-R activities.

Advantages:

No impact on terrestrial services.

Disadvantages:

- Important scientific data from current space missions may be lost.
- Planning of future missions is inhibited by the lack of knowledge of terrestrial systems deployment, until ITU-R sharing studies are completed.

2.5.5.2.3.2 Method B

In order to protect the operation of EESS (passive) and space research service (passive) systems, urge administrations to limit the deployment of terrestrial service systems in the band 36-37 GHz and to define sharing criteria between the active and passive services in this band for possible inclusion in the Radio Regulations at the next WRC.

Advantages:

- Would provide a provisional operational environment to all services in the band until the time of establishment of appropriate sharing criteria between the active and passive services.

Disadvantages:

This may limit the deployment of fixed and mobile stations in this band.

2.5.5.2.4 Regulatory and procedural considerations

For **Method A**, no change to the RR would be needed.

For **Method B**, it may be necessary to develop a resolution in order to urge administrations to limit the deployment of active systems in the band 36-37 GHz and to define sharing criteria between active and passive service using this band, in time for WRC-07.

Example of a Resolution

ADD

Resolution XXX (WRC-03)

Use of the frequency band 36-37 GHz

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that the frequency band 36-37 GHz is allocated to the Earth exploration-satellite (passive) service and to the space research service (passive) on a primary basis;

b) that the frequency band 36-37 GHz is allocated to the fixed service and to the mobile service on a primary basis;

c) that the Earth exploration-satellite (passive) service protection criteria are contained in Recommendation ITU-R SA.1029;

d) that Recommendation ITU-R F.758-2 provides characteristics of FS point-to-multipoint systems operating in the band 36-37 GHz, but does not provide information on characteristics of FS point-to-point systems operating in this band;

e) that the band 36-37 GHz is not available for high-density applications in the fixed service (see No. **5.547**);

f) that the EESS (passive) operating in the band 36-37 GHz may be interfered by the emissions of systems of active services,

recognizing

1 that EESS (passive) systems may experience harmful interference if a high density of fixed-service stations is deployed in the band 36-37 GHz;

2 that sharing criteria between EESS (passive) and FS systems need to be defined in the band 36-37 GHz,

resolves

1 to invite ITU-R to conduct sharing analyses between passive services and the fixed and mobile services in the band 36-37 GHz in order to define appropriate sharing criteria;

2 to recommend that WRC-07 review the results of the studies and consider the inclusion of the sharing criteria within the RR,

urges administrations

1 to provide characteristics of active systems (fixed and mobile services) operating in the band 36-37 GHz;

2 to avoid deploying a high density of stations in the fixed and mobile services in the band 36-37 GHz.

#########

2.5.5.3 SRS (space-to-Earth) in the band 37-38 GHz

2.5.5.3.1 Summary of technical and operational studies, and relevant ITU-R Recommendations

The band 37-38 GHz is allocated on a primary basis to the SRS (space-to-Earth). The band is also allocated on a primary basis to the fixed and mobile services. The sub-band 37.5-38 GHz is also allocated on a primary basis to the fixed-satellite service (space-to-Earth).

Relevant Recommendations ITU-R: SA.1017, SA.1396 and SA.1344.

2.5.5.3.2 Analysis of the results of studies

With respect to the SRS (space-to-Earth) allocation in the band 37-38 GHz, there have been no changes in the requirements for this allocation, nor have there been any changes in the sharing conditions in this band that would warrant any allocation changes to the SRS (space-to-Earth). However, there are ongoing ITU-R studies examining the sharing situation between the SRS (space-to-Earth) and the FSS (space-to-Earth) with a view towards establishing appropriate sharing conditions between the two services in the 37.5-38 GHz band.

2.5.5.3.3 Methods to satisfy the agenda item and their advantages and disadvantages

Method

Make no change to the SRS (space-to-Earth) allocation in the band 37-38 GHz and continue studies under normal ITU-R activities.

Advantages:

- No impact on other services operating in the band.
- Allow administrations to get data from space research instruments operating in this band.

Disadvantages:

None.

2.5.5.3.4 Regulatory and procedural considerations

None.

#########

2.6 Agenda item 1.16

"to consider allocations on a worldwide basis for feeder links in bands around 1.4 GHz to the non-GSO MSS with service links operating below 1 GHz, taking into account the results of ITU-R studies conducted in response to Resolution **127 (Rev.WRC-2000)**, provided that due recognition is given to the passive services, taking into account No. **5.340**"

2.6.1 Uplink allocation in the band 1 390-1 393 MHz

Spectrum requirements

A total of 1.525 MHz (space-to-Earth) and 1.9 MHz (Earth-to-space) are presently allocated on a worldwide primary basis to the MSS below 1 GHz. In addition, 2 MHz (Earth-to-space) in Region 2 is allocated to the MSS below 1 GHz. Some individual countries have additional allocations (Earth-to-space) for the MSS below 1 GHz, appearing in footnotes. These bands are allocated and used for both MSS feeder links and service links. In the preparation of WRC-97 and WRC-2000 views were expressed that additional spectrum may be required for MSS feeder links to alleviate spectrum congestion in the service links. There are many non-GSO MSS networks at frequencies below l GHz at some state of coordination under No. **9.11A**, and also many non-GSO MSS networks at the advance publication stage. *Considering b)* of Resolution **214 (Rev.WRC-2000)** indicated that, "in order to meet projected MSS requirements below 1 GHz, a range of an additional 7 to 10 MHz will be required in the near future", although "a number of these systems may not be implemented for reasons not connected with spectrum availability".

During WRC-03 preparation, no evidence of spectrum congestion of MSS service links below 1 GHz has been shown in ITU-R. Furthermore, many administrations are of the opinion that the experience of MSS below 1 GHz has demonstrated that the growth of the traffic could be accommodated in the existing frequency bands without requirement for an additional allocation.

It has to be noted that several frequency bands are already allocated in upper frequency bands (for example 5 091-5 250 MHz) for non-GSO MSS feeder links and could provide an alternative solution for feeder links of MSS systems with service links below 1 GHz.

2.6.1.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Relevant Recommendations: ITU-R SA.1029, F.1242 and RA.769.

2.6.1.1.1 EESS (passive)

Regarding the impact on EESS (passive), Recommendation ITU-R SA.1029 contains the acceptable interference levels and related data availability criteria to the bands 1 370-1 400 MHz and 1 400-1 427 MHz. The acceptable interference power is −171 dBW in a reference bandwidth of 27 MHz. Several ITU-R studies have shown that use of the band 1 390-1 393 MHz for MSS uplinks would, in the worst case, require out-of-band emission attenuation between 108 and 128 dB. A recent contribution submitted by two administrations to ITU-R containing a preliminary study indicated that by limiting MSS earth station antenna side-lobe e.i.r.p. and attenuating the unwanted emissions of the earth station transmitters by 110 dB, in the band 1 400-1 427 MHz, protection of EESS (passive) can be provided. Theoretical analysis indicates that reduction of out-of-band and spurious emissions beyond the typical ITU-R levels could be achieved to assist in protecting the sensitive science services in the band 1 400-1 427 MHz by an appropriate combination of modulation techniques, filters and amplifier design. However the additional tests and measurements of emissions from equipment having the characteristics, performance and reliability of equipment that would be used in operational MSS systems, taking into account effects such as long-term shift of oscillators and their phase noise, amplifier thermal noise, amplifier non-linearity, local oscillator phase noise and Doppler effects to achieve the required attenuation have not yet been carried out as required by Resolution 127. Without confirmation by the above tests and measurements, an allocation close to the passive band 1 400-1 427 MHz is not considered by ITU-R as allowing sufficient protection to the EESS (passive).

Further studies conducted within the ITU-R have shown that, even with very advanced design, the filter rejection capability of passive sensors is limited to around 80 dB for a spectral separation of 7 MHz whereas between 94 and 101 dB will be required. A further reduction of the sensor bandwidth caused by even more extensive filtering is not feasible. Results of a preliminary study recently contributed to ITU-R indicate that emission limits on NVNG MSS earth stations combined with the EESS (passive) filter rejection capabilities are able to provide the required protection to EESS (passive) from MSS feeder uplinks in the band 1 390-1 393 MHz. However, this conclusion was not agreed by any of the relevant ITU-R working parties. The current filter design would require a spectral separation of up to 20 MHz taking into account acceptable insertion loss and hardware complexity.

Another important consideration is the secondary allocation to EESS (passive) in the band 1 370-1 400 MHz under No. **5.339**. Use of this band is made under the current interference environment given the currently allocated services. Although having a secondary status, EESS (passive) plans continued use of the band, which should be taken into account. Operation of MSS feeder links in the band 1 390-1 393 MHz would cause a level of interference that would preclude passive sensor operations in the 1 370-1 400 MHz band in large areas where MSS earth stations are within the field of view of EESS (passive) sensors.

2.6.1.1.2 Radio astronomy service

Protection of the radio astronomy service (RAS) stations is an important consideration for the deployment of MSS feeder uplinks in the 1 390-1 393 MHz band. The 1 330-1 400 MHz band is used by the RAS for observations of the red-shifted hydrogen (HI) line and No. **5.149** urges administrations to take all practicable steps to protect the RAS from harmful interference. Loss of access to this band would prevent scientists from access to critical information through observations that are carried out at a number of radio astronomy stations worldwide. Detrimental interference to radio astronomy stations observing in the 1 330-1 400 MHz or 1 400-1 427 MHz bands from MSS uplink transmissions operating in the band 1 390-1 393 MHz can be prevented by a combination of geographic location, protection (i.e. exclusion) zones around radio astronomy stations, and appropriate attenuation of unwanted emissions which may be readily achievable for the limited number of MSS feeder-link stations that would be implemented. However, to date no technical studies have been carried out concerning required separation distances between potential locations of MSS feeder uplink stations operating in the band 1 390-1 393 MHz in relation to existing RAS stations observing in the bands 1 330-1 400 MHz or 1 400-1 427 MHz.

2.6.1.1.3 Radiolocation service and radionavigation service

The radiolocation service has a primary allocation in the band 1 350-1 400 MHz. Systems in the radionavigation service are also continuing to operate in several countries in all Regions. Coordination between terrestrial stations of the radiolocation service and a limited number of MSS feeder-link earth stations could be done by applying international coordination procedures.

2.6.1.1.4 Fixed service

The band 1 350-1 400 MHz is allocated in Region 1 to the FS. Coordination between FS terrestrial stations and MSS feeder-link earth stations could be done by applying international coordination procedures. The number of MSS feeder-link stations is small, which lessens the coordination effort required.

Two of the three FS channelling plans defined in this frequency band by Recommendation ITU-R F.1242 overlap with the potential candidate for an MSS frequency allocation. The first one is pairing the band 1 427-1 452 MHz with 1 492-1 517 MHz. The second one is based on the pairing of the band 1 375-1 400 MHz with 1 427-1 452 MHz, with a duplex spacing of 52 MHz.

For countries using this second frequency arrangement, it can be noted that the candidate frequencies for the MSS feeder links are not aligned. As a consequence, this will increase the coordination effort by requiring to take into account about twice as many FS stations (stations being interfered with being different from interfering stations) for the coordination as compared to a choice of the frequencies that align with the fixed service plan. A solution would be to select an allocation for MSS feeder links in line with the FS channel plan. This could in addition increase the frequency separation between the downlink and the passive allocations in the 1 400-1 427 MHz band.

2.6.1.2 Analysis of the results of studies

2.6.1.2.1 EESS (passive)

Studies within ITU-R concluded that use of the band 1 390-1 393 MHz for MSS uplinks would require out-of-band emission attenuation between 108 and 128 dB to be implemented by the MSS transmitter, which is practically very difficult to achieve. Regarding the EESS (passive) receiver, the required filter rejection of 94 to 101 dB on-board the passive sensor satellite cannot be met with a spectral separation of only 7 MHz. A further reduction of the sensor bandwidth caused by even more extensive filtering is not feasible because of sensitivity requirements. A spectral separation of up to 20 MHz would be required. Operations of passive sensors having a secondary allocation in the band 1 370-1 400 MHz would be precluded from continuing by an MSS allocation in the band 1 390-1 393 MHz in large areas where MSS earth stations are within the field of view of EESS (passive) sensors. These studies did not take into account any additional degradation of data availability due to MSS.

One preliminary study recently contributed to ITU-R has shown that taking into account data availability requirements can result in the proposed MSS feeder links protecting the EESS (passive), while providing a data availability that exceeds the current requirement of 0.99 and a possible requirement of 0.999. However, this conclusion was not agreed by any of the relevant ITU-R working parties.

2.6.1.2.2 Other services

ITU-R has concluded that a new allocation would result in additional coordination and/or establishment of exclusion zones with radio astronomy stations, radiolocation stations and fixed and mobile stations.

2.6.2 Downlink allocations in the band 1 429-1 432 MHz

2.6.2.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Relevant Recommendations: ITU-R SA.1029, F.1242, RA.769 and RA.1513.

2.6.2.1.1 Earth exploration-satellite service (passive)

Regarding the impact on EESS (passive), Recommendation ITU-R SA.1029 contains the acceptable interference levels and related time excess criteria. The acceptable interference power is −171 dBW in a reference bandwidth of 27 MHz and the related time excess criteria is 0.99 to be distributed to all relevant services causing interference. Studies have shown that use of the band 1 429-1 432 MHz for MSS downlinks requires an out-of-band attenuation of up to 73 dB. A recent study proposes emission limits on MSS illumination and demonstrates that these proposed limits and the proposed attenuation of out-of-band and spurious emissions may protect EESS (passive). Further studies conducted within the ITU-R have shown that, even with very advanced design, the filter rejection capability of passive sensors is limited to around 40 dB for a spectral separation of 3 MHz whereas between 52 and 56 dB will be required. These study results were obtained for the case of main beam to main beam coupling, which rarely occurs during EESS data gathering operations but could occur during sensor system calibrations. Only at a spectral separation in excess of 6 MHz could the required rejection level be achieved based on acceptable insertion loss and filter complexity.

A recent preliminary study showed that, when the EESS sensor system antenna pointing as used in data gathering operations is taken into account, the protection criteria for EESS (passive) sensor systems is met with large positive margins using the filter performance of current sensor system receivers. However, this conclusion was not agreed by any of the relevant ITU-R working parties.

2.6.2.1.2 Radio astronomy service

Resolution **127 (WRC-2000)** focuses on the 1 429-1 432 MHz band as the candidate band to be allocated for space-to-Earth feeder links to the non-GSO MSS, with service links operating below 1 GHz. This band is very close to the 1 400-1 427 MHz exclusive passive band, used by the RAS for observations of the 1 420 MHz spectral line of neutral hydrogen. Recommendation ITU-R RA.769, Tables 1 and 2, list the detrimental interference levels for the RAS in the 1 400-1 427 MHz band. They are given as -180 dB(W/m^2) in the entire 27 MHz band (1 400-1 427 MHz) for continuum observations, and as -196 dB(W/m^2) in a 20 kHz band for spectral line observations.

Recommendation ITU-R RA.1513 specifies 2% of time as the maximum data loss allowable to the RAS in any one band from any one system, and 5% of time as the maximum total loss of data in any one band from all sources.

Studies have shown that to meet the RAS continuum observation protection criteria in the 1 400-1 427 MHz band an attenuation of 67 dB would be required for the unwanted emission of a single downlink transmitter providing -152 dB (W/(m$^2 \cdot$ 4 kHz)) in-band spectral power flux-density, under the assumption of a flat spectrum over the 27 MHz. In addition, in order to meet the RAS spectral line observation protection criteria in the 1 400-1 427 MHz band, spurious artefacts of this transmitter should be attenuated by 51 dB in any 20 kHz portion of the band.

In order to define limits on the aggregate interference from a non-GSO constellation into radio astronomy frequency bands, the epfd concept has been adopted by ITU-R. The methodology of the calculation is described in Recommendation ITU-R M.[NGSO/RA]. Based on the epfd concept, as defined in Article **22**, the requirements on the aggregate unwanted emissions of a non-GSO constellation into the band 1 400-1 427 MHz could be stated as:

1) An epfd limit of -243 dB(W/m^2) in 27 MHz for 98% of the time at each radio astronomy station for continuum observations.

2) An epfd limit of -259 dB(W/m^2) in 20 kHz for 98% of the time at each radio astronomy station for spectral line observations.

The above values are based on a main beam gain of 63 dBi, for a 100 m diameter radio astronomy antenna. When considering epfd levels for the largest radio astronomy antenna in use (305 m diameter), a main beam gain of 73 dBi should be used to calculate the epfd limit.

Studies show that these levels might be met using emerging technologies, but the use of such large attenuations is not customary and has not been demonstrated. Given the importance of this band for the passive services, Resolution **127** states that it is necessary to conduct additional tests and measurements on transmissions from systems having the characteristics, performance and reliability of equipment, that would be used in operational systems, to validate theoretical analyses, taking into account effects such as long-term shift of oscillators and their phase noise, amplifier thermal noise, amplifier non-linearity, local oscillator phase noise and Doppler effects, and that such tests should be completed prior to WRC-03. No such studies have been submitted to ITU-R.

2.6.2.1.3 Fixed and mobile services

The band 1 427-1 452 MHz is allocated in all Regions to both fixed service and mobile service (except aeronautical mobile in the band 1 427-1 429 MHz in all Regions and in the band 1 429-1 452 MHz in Region 1). However, No. **5.342** provides an additional allocation for aeronautical mobile service (limited to aeronautical telemetry) in eight Region 1 countries above 1 429 MHz.

Coordination between terrestrial stations of the fixed service and MSS feeder-link earth stations would require international coordination procedures. The number of MSS feeder-link stations is expected to be small which would reduce the coordination effort required.

Two of the three FS channelling plans defined in this frequency band by Recommendation ITU-R F.1242 overlap with the candidate MSS frequency bands considered under agenda item 1.16. The first one is pairing the band 1 427-1 452 MHz with 1 492-1 517 MHz. The second one is based on the pairing of the band 1 375-1 400 MHz with 1 427-1 452 MHz, with a duplex spacing of 52 MHz.

For countries using this second frequency arrangement, it can be noted that the candidate frequencies for the MSS feeder links are not aligned. As a consequence, this will increase the coordination effort by requiring to take into account about twice as many FS stations (stations being interfered with being different from interfering stations) for the coordination as compared to a choice of the frequencies that align with the fixed service plan. A solution would be to select an allocation for MSS feeder links in line with the FS channel plan. This could in addition increase the frequency separation between the downlink and the passive allocations in the 1 400-1 427 MHz band.

The band 1 427-1 452 MHz is of particular importance in many countries as this band is used intensively for low capacity long haul radio relays, including some security applications. The FS does not share this band with space services and has evolved its applications globally, primarily low cost rural, point-to-multipoint systems in developing and developed countries, without this constraint. Therefore, protection of fixed service in this frequency band needs particular attention. In addition, pfd limits are preferred for the non-GSO MSS feeder-link space segment to remove the need for any coordination with the fixed service.

Several administrations use the band 1 429-1 453 MHz for a digital cellular land mobile telecommunication system in the mobile service. The service needs to be protected from harmful interference caused by the proposed space-to-Earth feeder links of non-GSO MSS.

2.6.2.2 Analysis of the result of studies

2.6.2.2.1 Earth exploration-satellite service (passive)

Should an allocation be made, an out-of-band emission attenuation of 73 dB to be implemented by the MSS transmitter would be required to protect the EESS (passive). Regarding the EESS (passive) receiver, the required filter rejection of 52 to 56 dB on-board the passive sensor satellite cannot be met with a spectral separation of only 3 MHz. A further reduction of the sensor bandwidth caused by even more extensive filtering is not feasible because of sensitivity requirements. A spectral separation in excess of 6 MHz would be required.

2.6.2.2.2 Radio astronomy service

The following limits would ensure the protection of all but the most sensitive radio astronomy stations from unwanted emission of the non-GSO MSS feeder links space stations:

1) An epfd limit of –243 dB(W/m^2) in a 27 MHz bandwidth for 98% of the *time* at each radio astronomy station for continuum observation.

2) An epfd limit of –259 dB(W/m^2) in any 20 kHz bandwidth within the 1 400 MHz to 1 427 MHz band, for 98% of the *time* at each radio astronomy station for spectral line observation.

The above values are based on a main beam gain of 63 dBi, for a 100 m diameter radio astronomy antenna. When considering epfd levels for the largest radio astronomy antennas in use (305 m diameter), a main beam gain of 73 dBi should be used to calculate the epfd limit.

2.6.2.2.3 Fixed service

Results of sharing studies within ITU-R have concluded that the following pfd limits applied to non-GSO MSS feeder links should be adequate to protect the fixed service in the 1.4 GHz band:

-140	dB(W/m^2 in 1 MHz)	for $\theta \leq 5°$
$-140 + 0.5 (\theta - 5)$	dB(W/m^2 in 1 MHz)	for $5° < \theta \leq 25°$
-130	dB(W/m^2 in 1 MHz)	for $25° < \theta \leq 90°$

where:

θ: angle of arrival above the horizontal plane (degrees).

These pfd limits are to be applied under assumed free-space propagation conditions. Also, any new allocation should be aligned with a fixed service pairing arrangement in order to ease coordination.

2.6.3 Methods to satisfy the agenda item and their advantages and disadvantages

2.6.3.1 Method A1

Make an allocation to the MSS for feeder uplinks in the band 1 390-1 393 MHz with the necessary protection for currently allocated services.

Advantages:

Provides additional spectrum for feeder links for non-GSO MSS systems with service links below 1 GHz.

Disadvantages:

Protection of EESS (passive) in the band 1 400-1 427 MHz requires attenuation of unwanted emission levels of up to 128 dB on the MSS transmitter side. The possibility of achieving these high out-of-band attenuation levels has not yet been demonstrated. The EESS (passive) receiver may have to increase its band-pass filter rejection up to 101 dB, which is considered not feasible because of further reduction of available sensor bandwidth and insertion losses. A spectral separation of up to 20 MHz would be required. Use of the EESS (passive) secondary allocation in the band 1 370-1 400 MHz would be precluded due to in-band interference in large areas where MSS earth stations are within the field of view of EESS (passive) sensors. Sufficient geographical separation is required between MSS feeder-link earth stations and stations of other services (RAS, RLS, FS and MS). Continued access to the 1 330-1 400 MHz band by the RAS may be constrained, although further studies are required.

2.6.3.2 Method A2

Make no allocation to the MSS in the band 1 390-1 393 MHz.

Advantages:

No impact on existing services.

Disadvantages:

Does not provide any additional spectrum for feeder links for non-GSO MSS systems with service links below 1 GHz.

2.6.3.3 Method B1

Make an allocation to the MSS for feeder downlinks in the band 1 429-1 432 MHz with the necessary protection for currently allocated services (epfd limits for protection of the radio astronomy and pfd limits for the protection of fixed and mobile services).

Advantages:

Provides additional spectrum for feeder links for non-GSO MSS systems with service links below 1 GHz.

Disadvantages:

Protection of EESS (passive) in the band 1 400-1 427 MHz requires attenuation of unwanted emission levels of up to 73 dB on-board the MSS satellite or slightly lower levels if combined with limits on the MSS satellite e.i.r.p. In addition, the EESS (passive) receiver would have to increase its band-pass filter rejection up to 56 dB, to maintain protection during the rarely occurring case of main beam to main beam coupling. This level of filtering is considered not feasible because of further reduction of available sensor bandwidth and insertion losses. Protection of the RAS in the band 1 400-1 427 MHz requires attenuation of unwanted emission levels of up to 85 dB.

2.6.3.4 Method B2

Make no allocation to the MSS in the band 1 429-1 432 MHz.

Advantages:

No impact on existing services.

Disadvantages:

Does not provide any additional spectrum for feeder links for non-GSO MSS systems with service links below 1 GHz.

2.6.4 Regulatory and procedural considerations

Methods A1 and B1 would require modification of Article **5** for a new allocation.

Further modification of Articles **5** and/or **21** may be necessary to define pfd and epfd limits.

Unwanted emission levels may have to be specified for the MSS transmitters in appropriate footnotes of the Radio Regulations.

The conference may consider suppression of Resolution **127 (Rev.WRC-2000)**.

#########

2.7 Agenda item 1.20

"to consider additional allocations on a worldwide basis for the non-GSO MSS with service links operating below 1 GHz, in accordance with Resolution **214 (Rev.WRC-2000)**"

2.7.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Spectrum requirements

A total of l.525 MHz (space-to-Earth) and l.9 MHz (Earth-to-space) are presently allocated on a worldwide primary basis to the MSS below l GHz and 300 kHz (Earth-to-space) is allocated for land MSS on a worldwide primary basis. An additional 151.5 MHz may be used subject to the agreement obtained under No. **9.21**, which would make it difficult. In addition, 2 MHz (Earth-to-space) in Region 2 is allocated to the MSS below 1 GHz. Some individual countries have additional allocations (Earth-to-space) for the MSS below l GHz, appearing in footnotes. These allocations are for both the MSS service links and feeder links.

There are many non-GSO MSS networks at frequencies below l GHz at some state of coordination under No. **9.11A**, and also many non-GSO MSS networks at the advance publication stage.

Considering b) of Resolution 214 (Rev.WRC-2000) indicated that, "in order to meet projected MSS requirements below 1 GHz, a range of an additional 7 to 10 MHz will be required in the near future" although "a number of these systems may not be implemented for reasons not connected with spectrum availability. During WRC-03 preparation, no evidence of spectrum congestion of MSS service links below 1 GHz has been shown in ITU-R. Furthermore, many administrations are of the opinion that the experience of MSS below 1 GHz has demonstrated that the growth of the traffic could be accommodated in the existing frequency bands without a requirement for an additional allocation.

2.7.1.1 Sharing between non-GSO MSS Earth-to-space links and the land mobile and the fixed services in the band 450-470 MHz

There are many kinds of terrestrial systems operating in the band 450-470 MHz which have varied technical and operational requirements (such as density distributions, necessary C/(N + I) ratios and antenna heights). Therefore, at this time, it might be difficult to provide single value protection or sharing criteria applicable to all such systems. ITU-R conducted sharing studies relevant to possible additional Earth-to-space allocations to the non-GSO MSS with a view on a variety of scenarios that were examined with differing technical characteristics for systems in the mobile service and for systems in the mobile-satellite service.

2.7.1.1.1 Sharing between non-GSO MSS Earth-to-space links and the land mobile service

Several studies have been carried out using the statistical simulation model in Recommendation ITU-R M.1039, Annex 3, to determine the probability of interference between narrow-band, FDMA non-GSO MSS Earth-to-space links and land mobile service in the bands 450-470 MHz. In most studies the non-GSO MSS systems have been modelled using MSS networks with 48 satellites, and in one study 81 satellites were used. Both of these MSS networks are defined in Recommendation ITU-R M.1184. The MES antenna heights used in the studies were 1.5 m and 3 m, and MES data rates used were up to 9.6 kbit/s. The mobile earth stations were uniformly distributed over the land area within the satellite beam (12 million km^2). Certain operational constraints, such as MES transmission duration and transmission duty cycle limitations were used for the non-GSO MSS networks in the studies.

The studies assumed the following characteristics for various land mobile systems:

- An analogue, frequency modulation system (or digitally modulated, binary-FSK system); a vertically polarized antenna having 0 dBi gain towards the satellite; 10 m^2 antenna height product; minimum received signal power assumed to be −140 dBW; and channel bandwidths of 6.25, 12.5 and 25.0 kHz.
- Analogue FM or digital modulation; 5 dBi antenna gain toward the horizon; 200 m antenna height resulting in an antenna height product of 600 m^2; C/(I + N) of 17 dB and channel bandwidths of 16 and 25 kHz.
- Digital modulation, 25 kHz channel spacing, 1.5 m mobile antenna height with 45 dBm transmitter power, and 50 m base station antenna height with 40 dBm transmitter power. The second system used digital modulation, 6.25 kHz channel spacing, 2 m mobile antenna height with a maximum of 38.5 dBm transmitter power, and 200 m base station antenna height with 48 dBm transmitter power. The analogue systems used 12.5 kHz channel spacing, 1.5 m mobile antenna height with 38 dBm transmitter power, and 50 m base station antenna height with 38 dBm transmitter power. The threshold of interference in both cases was a carrier-to-interference ratio less than 19 dB.

The different scenarios studied included MSS uplinks sharing with digital or analogue MS systems only. In addition two different scenarios of a mixed analogue/digital MS system environment were examined:

- a geographically mixed environment where analogue and digital MS systems operate in the same frequency band but in different geographical areas; and
- a mixed environment in different frequency band segments where analogue and digital MS systems in the same area operate in different parts of the frequency band shared with the MES uplinks.

For the range of parameters studied, the modelled probabilities of interference into a single terrestrial link were between 0.003% and 0.1%. The greatest probability of interference in the results (0.1%) may be viewed (for a 99% availability/1% unavailability MS channel) as a reduction of availability from 99% to 98.9% and a corresponding change in unavailability of 1% increased to only 1.1%. These studies did not address the network aspects of the land mobile service.

Further studies were performed using the analytical method in Annex 1 of Recommendation ITU-R M.1039 to estimate the probability of interference from the non-GSO MSS FDMA narrow-band uplinks into the MS mobile and base station receivers in the band 450-470 MHz. Applications of the MS systems support public safety and broadcast programme production. The non-GSO MSS network has Earth-to-space links from mobile earth stations with antenna heights of 1.5 m. The technical characteristics of the MS systems are those of systems operating in an Asian region. The antenna height of mobile stations is typically 1.5 m and the effective antenna heights of base stations vary from 37.5 m to 300 m. Due to the greater antenna height the base stations would suffer more serious interference than the mobile stations in most cases.

The calculation shows an interference probability of 19% to mobile wireless systems for broadcasting utilities, which is considered unacceptable.

It was found that the probabilities of interference depend in large measure on the assumed distribution of MES in the service area. In the above studies, the MES terminals are distributed in an area of 33 thousand km^2 considering the actual operation area.

Further consideration was made regarding low-power (1 mW) systems which are operated in the 450 MHz band in Region 3 for voice communication in construction sites, power plants, etc, where interference to the systems can endanger the users. Considering that the receiving signal level of the wireless systems is about –100 dBm and the transmitting power level of MSS earth stations is about 3 watts, separation distances required between two systems would be large. Thus co-frequency sharing with MSS systems is impractical.

None of the studies were conducted with the use of a dynamic channel activity assignment system (DCAAS), as described in Annex 4 of Recommendation ITU-R M.1039, in the MSS network. In an operational MSS system with DCAAS, used to detect and to avoid active MS channels, the probability of interference may be lower than the values calculated in this study. However, low power devices may be of insufficient power for detection by the satellite, thus rendering DCAAS ineffective.

2.7.1.1.2 Sharing studies between non-GSO MSS Earth-to-space links and the fixed service

Studies were not conducted to demonstrate that fixed service and non-GSO MSS Earth-to-space links can share the same frequency band in the frequency bands around 460 MHz.

2.7.2 Analysis of results of studies

Studies have been conducted by the ITU-R with respect to co-frequency sharing between narrow-band, FDMA MSS uplinks and mobile service systems. Some studies showed low probabilities of interference to the mobile service, but others for example where low power MS systems were used resulted in significantly higher interference probabilities. This difference is caused by the differing technical parameters of MS and MSS systems and the models used in the studies.

Sharing studies did not consider sharing between narrow-band, FDMA MSS uplinks and fixed service. In addition, there are other specific cases that have not been studied, such as the network aspects of the land mobile service.

2.7.3 Methods to satisfy the agenda item and their advantages and disadvantages

No additional allocation to accommodate the MSS below 1 GHz.

Advantage:

Fully protects the existing services below 1 GHz.

Disadvantage:

Does not provide additional MSS spectrum.

2.7.4 Regulatory and procedural considerations

With no additional allocations, no changes are required to the existing Article **5** of the Radio Regulations.

The Conference may consider the suppression of Resolution **214 (Rev.WRC-2000)**.

#########

2.8 Agenda item 1.31

"to consider the additional allocations to the mobile-satellite service in the 1-3 GHz band, in accordance with Resolutions **226 (WRC-2000)** and **227 (WRC-2000)**"

2.8.1 Resolution 226 (WRC-2000)

"Sharing studies for, and possible additional allocations to, the mobile-satellite service (space-to-Earth) in the 1-3 GHz range, including consideration of the band 1 518-1 525 MHz"

2.8.1.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

2.8.1.1.1 Sharing with aeronautical mobile telemetry (AMT) systems

Recommendation ITU-R M.1459 provides the framework for conducting sharing studies between aeronautical mobile telemetry systems and the mobile satellite service. Recommendation ITU-R M.1459 was approved in 2000 and contains the pfd values to protect AMT systems applicable to GSO MSS systems. Recommendation ITU-R M.1459 takes into account a range of AMT systems with different characteristics and considers a variety of sharing scenarios, including worst-case sharing scenarios, which resulted in very stringent protection criteria for AMT systems. Recommendation ITU-R M.1459 also defines a number of mitigation techniques that may facilitate sharing and acknowledges the need for further studies on this sharing matter.

The AMT systems considered in the Recommendation and operating in the 1 518-1 525 MHz band are representative of the systems operating in the USA. Flight testing in the USA is also performed on behalf of a number of other administrations. Flight testing carried out in the USA uses the band 1 435-1 525 MHz and has priority over other uses by the mobile service.

Recommendation ITU-R M.1459, *considering p*), states "that telemetry stations in the aeronautical mobile service have a wide range of characteristics and some may have less stringent protection criteria values than those contained in the recommends". AMT systems operating in the band 1 518-1 525 MHz in the countries listed in No. **5.342** significantly differ from the characteristics given in Recommendation ITU-R M.1459. The frequency band concerned is used for the radio links for transmitting command signals to deliver telemetry data from a test aircraft. The value of pfd equal to −140 dB(W/m^2) in a 4 kHz bandwidth should be considered as the permissible level of interference to protect the considered type of AMT systems operating in the band 1 518-1 525 MHz in the countries listed in No. **5.342**. This value of permissible pfd level is based on the results of theoretical and experimental studies.

Other studies submitted within the ITU-R addressed the implementation of particular interference mitigation techniques described in Recommendation ITU-R M.1459 that, if practical, would allow MSS systems to exceed the pfd levels in this Recommendation without causing harmful interference to the aeronautical mobile telemetry systems.

Relevant RR provisions: Nos. **5.342**, **5.343**, **5.344**, **5.348**, and **5.348A**.

2.8.1.1.2 Sharing with the fixed service

Regarding sharing with the fixed service, Recommendations ITU-R M.1141 and M.1142 contain coordination pfd threshold values applicable to non-GSO MSS and GSO MSS respectively.

Some administrations have deployed point-to-multipoint systems operating below 1 520 MHz. These systems are deployed over large areas and provide services to isolated and remote communities. These administrations believe that these systems may be impacted by interference from MSS, considering the engineering and economic challenges associated with their deployment scenario.

2.8.1.1.3 Sharing with the mobile service

ITU-R studies have been conducted regarding sharing between MSS and mobile systems that operate in Japan.

2.8.1.2 Analysis of the results of studies

Sharing studies have been conducted with regard to a possible MSS downlink allocation in Regions 1 and 3 in the band 1 518-1 525 MHz.

2.8.1.2.1 Sharing with AMT

Nos. **5.342** and **5.344** provide an allocation to AMT systems in this band in a number of countries. AMT systems operate in this band in a number of countries. A small number of these countries manufacture the majority of the world's aircraft.

Studies submitted to the ITU-R indicate that the pfd values in Recommendation ITU-R M.1459 are consistent with the characteristics of AMT systems operating in one country in Region 2. These pfd values are the following (in any 4 kHz):

-181.0 dB(W/m^2)	for $0° \le \alpha \le 4°$
$-193.0 + 20 \log \alpha$ dB(W/m^2)	for $4° < \alpha \le 20°$
$-213.3 + 35.6 \log \alpha$ dB(W/m^2)	for $20° < \alpha \le 60°$
-150.0 dB(W/m^2)	for $60° < \alpha \le 90°$

A number of studies have been considered with regard to these values. All studies have agreed that, if GSO MSS systems were limited to these values for a particular territory, operation of MSS systems within that territory would not be possible.

Another study submitted to the ITU-R provided a pfd level equal to −144.4 dB(W/m^2) in a 4 kHz bandwidth to be considered as the protection level for aeronautical telemetry systems operating in the band 1 518-1 525 MHz in the countries in Region 1, that is those listed in No. **5.342**. In this theoretical study the worst-case interference approach were used. As a result it leads to overestimation of the protection requirements of aeronautical telemetry systems. At next stage of this study the more realistic approach was implemented, involving experimental evaluation of protection requirements for the aeronautical mobile telemetry systems. The result of experimental study show that, for the protection of aeronautical telemetry systems operating in the band 1 518-1 525 MHz in the countries listed in No. **5.342**, a pfd level equal to –140 dB(W/m^2) in a 4 kHz bandwidth needs to be applied to the MSS systems in this band. This pfd level would allow co-coverage operation of many types of MSS systems. Studies submitted to ITU-R did not indicate any deployment of AMT systems in Region 3. From the above information, it is concluded with respect to AMT, that operation of MSS in the band 1 518-1 525 MHz in Regions 1 and 3 is technically feasible.

The sharing studies regarding AMT systems conforming to the characteristics of Recommendation ITU-R M.1459 present diverse and sometimes conflicting views, and these different views are discussed below.

a) Several administrations' view of the sharing studies

Studies submitted to the ITU-R indicate that, in the band 1 518-1 525 MHz, only one administration operates AMT systems with characteristics consistent with Recommendation ITU-R M.1459. Such AMT systems operate in the band 1 435-1 525 MHz in that administration.

Studies have shown that, if the pfd values given in Recommendation ITU-R M.1459 are applied throughout the USA (including Alaska, Hawaii and Puerto Rico), MSS operation from 30% of orbital locations is possible. This value increases to about 42% if the pfd values are limited to the continental USA only.

Recommendation ITU-R M.1459 states that the analysis leading to the pfd levels given in the Recommendation represents a worst-case scenario and a number of interference mitigation techniques are listed in Annex 2 of the Recommendation to enhance the sharing. Studies have explored some of these mitigation techniques and have shown that the Recommendation ITU-R M.1459 pfd levels could be relaxed significantly by implementation of these techniques while still maintaining sufficient protection of the AMT systems.

Studies have concluded that around 25 dB antenna discrimination is available from aeronautical telemetry stations with site diversity, i.e. with the implementation of site diversity, the pfd levels (in a 4 kHz bandwidth) of Recommendation ITU-R M.1459 can be relaxed for high elevation angles as shown below.

-181.0 dB(W/m^2)	for $0° \leq \alpha \leq 4°$
$-190.75 + 2.44\alpha$ dB(W/m^2)	for $4° < \alpha \leq 20°$
$-188.3 + 35.6 \log(\alpha)$ dB(W/m^2)	for $20° < \alpha \leq 60°$
-125.0 dB(W/m^2)	for $60° < \alpha \leq 90°$

There would be no "keep-out" zones for aircraft using the AMT service because, at those satellite elevation angles at which site diversity is ineffective, the unmitigated pfd values of Recommendation ITU-R M.1459 are applied. This new set of pfd levels allows satisfactory non-co-coverage operation of GSO MSS satellites that are visible from AMT service areas at 15 degrees satellite elevation or more, without causing interference to the AMT service. These pfd levels would allow MSS operation from about 55% of GSO orbital locations if applied to continental USA. With these pfd levels, co-coverage sharing between AMT and MSS is also possible for GSO MSS satellites operating above 40 degrees elevation to low antenna gain mobile earth stations (MES). For MSS systems using high antenna gain MES, co-coverage operation at lower elevation angles would be possible. The studies have also shown that the MSS will have high service availability in the presence of interference from AMT systems.

Studies submitted to ITU-R provided extensive information on satellite antenna side lobe performance characteristics of currently operational and planned MSS systems. The studies showed that MSS systems are capable of providing antenna discrimination levels in the range of 20-25 dB. The studies also concluded that station keeping of MSS satellites would not adversely impact the sharing feasibility especially with those MSS systems implementing digital beam forming mechanism. Electronic beam steering by regular updates of the satellite beam coefficients allows MSS satellites to have high inclination angles while accurately maintaining the satellite footprint on the ground. This would ensure that MSS systems comply with the necessary pfd limits.

In another study the sharing scenario between the two services has been analysed, considering implementation of other mitigation techniques. This analysis has shown that MSS operation is potentially possible from all orbital locations if the following pfd values are applied to the USA (in a 4 kHz bandwidth):

-156 dB(W/m^2)	for	$0° \leq \alpha \leq 4°$
$-156.4 + 0.111\alpha$ dB(W/m^2)	for	$4° < \alpha \leq 60°$
-150 dB(W/m^2)	for	$60° < \alpha \leq 90°$

Applying these pfd values could reduce the available airspace at some AMT stations operating in the USA and this loss would have to be overcome by mitigation. As an example of one of the many mitigation techniques available, the criterion described in Recommendation ITU-R M.1459 can be met by increasing the AMT system carrier power by 1 dB. This figure reduces to 0.38 dB if there is no interference from fixed service stations to consider.

At some AMT stations where the receiving antenna points close to the geostationary arc for long periods, additional mitigation is required. An example of another mitigation technique is to use frequency avoidance. With this method, those AMT stations requiring additional mitigation would be assigned frequencies, which are not constrained by MSS operations. Of the total primary allocation to AMT systems, 7.8% would be constrained by MSS, leaving 92.2% of the available band for use in this mitigation technique.

In summary, an MSS allocation in the band 1 518-1 525 MHz is feasible, while protecting AMT systems. Without the use of any mitigation techniques by the AMT systems, the MSS would be able to use about 30% of the geostationary orbit. However, there are practical mitigation techniques that would lead to a more equitable sharing of the spectrum between AMT and MSS downlinks. The pfd values needed to protect AMT systems depend on the choice of mitigation techniques.

b) Another view of the sharing studies

Studies submitted to the ITU-R show, in accordance with Recommendation ITU-R M.1459, that GSO MSS and aeronautical mobile telemetry are fundamentally incompatible under co-coverage scenarios, and that sharing is not feasible without causing harmful interference to AMT operations. AMT systems use low-gain transmit antennas (~2 dBi) and high gain (30 dBi) receive antennas. GSO MSS satellites use extremely high gain (~40 dBi) downlink antennas and mobile earth stations use low-gain (~2 dBi) receive antennas. This fundamental asymmetry in the competing links precludes sharing if an MSS satellite is within line of sight of an AMT ground station and exceeds the protection levels in Recommendation ITU-R M.1459. Without meeting the protection levels in Recommendation ITU-R M.1459, GSO MSS satellites in Region 1 and 3 visible to AMT ground stations in Region 2 will interfere with AMT operations.

Some mitigation techniques proposed in the ITU-R studies impose impractical or unrealistic constraints on AMT. Using site diversity, for example, results in unacceptable "keep-out" zones within the test ranges. Some test ranges could become unusable in this band if GSO MSS satellites, operating at these frequencies and visible to the test ranges, are deployed. Relocation of flight test air space is not possible because the air space and spectrum in use at existing ranges is already congested. In addition, safety considerations, i.e. not flying over populated areas or in commercial airspace, prevent relocation of existing fight test air space. Indeed, harmful interference will occur for main lobe to main lobe conjunction between MSS satellites and AMT ground antennas, and for some main lobe to side lobe and side lobe to side lobe conjunctions. Specific scenarios will require further evaluation.

Other proposed mitigation techniques, such as the use of post-processing to recover lost data, are already in use. Error correction is currently used in the coding of digital flight test data prior to transmission, and proposed additional error correction will require increased spectrum, which is not available. In any event, the maximum performance advantage of such techniques is minimal (~5 dB) with respect to the overall interference deficit. Depending on modulation techniques and channel fading characteristics, the improvement would be less.

In addition, the sharing studies need to address other detailed technical issues that could impact sharing feasibility. For instance, more definitive information about MSS antenna side lobes and orbit station-keeping would be useful. It is noted that station keeping tolerances are already cited in the ITU Radio Regulations. The failure to address these issues underscores the incompleteness of existing sharing studies. Moreover, sharing studies have failed to address the escalating complexity of the "keep-out" zones that will result as additional MSS satellites are placed into orbit within view of AMT ground stations. The studies have not taken into account the aggregate effect of multiple MSS satellite systems with differing satellite designs. Finally, consideration of I/N margins, with respect to permissible levels used in sharing situations with other services, should be considered.

Range safety considerations are critical in the AMT context and must not be compromised by implementation of impractical sharing methods.

Note that the characteristics of a given telemetry system generally do not vary with frequency over the band 1 435 -1 525 MHz.

c) Common views with respect to sharing between MSS and AMT

In spite of the views reflected in a) and b) above, ITU-R has agreed that the use of the band 1 518-1 525 MHz by the MSS is feasible although the application of Recommendation ITU-R M.1459 pfd values would limit the MSS operation to 30% of the geostationary arc. However, this limitation in the GSO arc allows MSS to provide its services in Region 1 and 3 and sufficiently protect the AMT systems operating in Region 2 in conformance with Recommendation ITU-R M.1459.

Considering the recent information made available to ITU-R on the existing and future planned operations of AMT systems in the USA, a few specific AMT sites would require a pfd protection value of –155 dBW/m^2 per 4 kHz as a lower bound. This will allow MSS downlink operation from 45% of the GSO arc in spite of application of Recommendation ITU-R M.1459 pfd values to the geographic region where there are flight test ranges in continental United States.

The MSS downlink operation would be possible from any orbital location within the following ranges of the geostationary orbit:

– 7° E to 157° E and 112° W to 100° W (these values may be affected by satellite parameters such as orbital inclination).

2.8.1.2.2 Sharing with other mobile services

In the territory of Japan, the following pfd coordination threshold applies: –150 dB(W/m^2) in a 4 kHz bandwidth at all angles of arrival as specified in Appendix **5**. Recent ITU-R studies have recognized that this value continues to be applicable. MSS service could be provided outside the territory of Japan and a surrounding area while meeting this pfd value in Japan.

2.8.1.2.3 Sharing with the FS

Recommendations ITU-R M.1141 and M.1142 recommend the following pfd threshold values for non-GSO and GSO MSS systems to protect FS systems:

pfd per space station at angle of arrival δ (degrees) (dB(W/m^2) in a 1 MHz bandwidth)	-128	for $0° \le \delta < 5°$
	$-128 + 0.5\ (\delta - 5)$	for $5° \le \delta < 25°$
	-118	for $25° \le \delta \le 90°$

These values are currently included in RR Appendix **5**. Both recommendations were approved in 1997. Studies conducted since 1997 have confirmed that these pfd values provide adequate protection to FS systems from GSO MSS space stations. These pfd values will allow co-coverage sharing with some MSS systems.

2.8.1.3 Methods to satisfy the agenda item and their advantages and disadvantages

2.8.1.3.1 Method A

Make a primary MSS (space-to-Earth) allocation in Regions 1 and 3 in the band 1 518-1 525 MHz. Protection of other services in the band would be ensured through the following provisions:

- pfd coordination thresholds consistent with Recommendation ITU-R M.1459 to protect AMT systems operating in the USA. These thresholds can be relaxed by the application of a number of mitigation techniques;
- a pfd level of −140 dB(W/m^2) in a 4 kHz bandwidth as a permissible level to protect AMT systems operating in the countries listed in No. **5.342**;
- pfd coordination thresholds given in Recommendations ITU-R M.1141 and M.1142, as already provided in Appendix **5**, to ensure protection of FS systems;
- a pfd coordination threshold of −150 dB(W/m^2) in a 4 kHz bandwidth, as already provided in Appendix **5**, to protect mobile services in Japan.

The existing MSS allocation in Region 2 in the range 1 492-1 518 MHz could be suppressed.

WRC-03 may consider the suppression or modification of Resolution **226 (WRC-2000)**.

Advantages:

- An additional global allocation would be available to the MSS.
- The need for additional MSS spectrum in the vicinity of the existing 1.5 GHz allocations, recognized in Resolution **226**, would be met.
- The new allocation would alleviate the MSS spectrum congestion.
- The new allocation is contiguous to the existing L-band MSS allocations, enabling speedy and less complex implementation of new networks using both the existing and the new allocation.
- The constraints on MSS required for protection of existing services would be acceptable, especially with the use of interference mitigation techniques.

- With the implementation of this method, all services operating in the band would be protected.
- The suppression of the Region 2 MSS allocation in the band 1 492-1 518 MHz would leave AMT systems unconstrained by MSS below 1 518 MHz.

Disadvantages:

- If the MSS were limited to the pfd limits in Recommendation ITU-R M.1459 without mitigation, then MSS systems would be constrained to a limited part of the geostationary orbit, in order to avoid causing harmful interference to AMT systems in the USA.
- There is no agreement on the use of the proposed mitigation techniques.
- Proposed mitigation techniques may not be practicable at some sites due to existing constraints and range safety concerns on AMT operations in the USA.

2.8.1.3.2 Method B

Make a primary MSS (space-to-Earth) allocation in Regions 1 and 3 in the band 1 518-1 525 MHz. Protection of other services in the band would be ensured through the following provisions:

- pfd limits consistent with Recommendation ITU-R M.1459 to protect AMT systems operating in continental United States west of 71° W. A pfd limit of −155 dB (W/m^2) in a 4 kHz bandwidth to protect AMT systems operating in Alaska, Hawaii and Puerto Rico;
- a pfd level of −140 dB(W/m^2) in a 4 kHz bandwidth as a permissible level to protect AMT systems operating in the countries listed in No. **5.342**;
- pfd coordination thresholds given in Recommendations ITU-R M.1141 and M.1142, as already provided in Appendix **5**, to ensure protection of FS systems;
- a pfd coordination threshold of −150 dB(W/m^2) in a 4 kHz bandwidth, as already provided in Appendix **5**, to protect mobile services in Japan.

The existing MSS allocation in Region 2 in the range 1 492-1 518 MHz could be suppressed.

WRC-03 may consider the suppression or modification of Resolution **226 (WRC-2000)**.

Advantages:

- An additional global allocation would be available to the MSS.
- The need for additional MSS spectrum in the vicinity of the existing 1.5 GHz allocations, recognized in Resolution **226**, would be met.
- The new allocation would reduce the MSS spectrum congestion.
- The new allocation is contiguous to the existing L-band MSS allocations, enabling speedy and less complex implementation of new networks using both the existing and the new allocation.
- The constraints on MSS required for protection of existing services would be acceptable.
- With the implementation of this method, all services operating in the band would be protected.
- The suppression of the Region 2 MSS allocation in the band 1 492-1 518 MHz would leave AMT systems unconstrained by MSS below 1 518 MHz.

Disadvantages:

- MSS systems would be constrained to 45% of the geostationary orbit, in order to avoid causing harmful interference to AMT systems in the USA. The usable orbital locations for MSS are defined within the GSO arc ranges (7 E to 157 E) and (112 W to 100 W).

2.8.1.3.3 Method C

No MSS allocation in Regions 1 and 3 in the 1 518-1 525 MHz band. It may be appropriate to suppress the MSS allocation in Region 2. WRC-03 may consider the suppression or modification of Resolution **226**.

Advantages:

- There would be no effect on existing services.
- AMT systems are not further constrained.
- AMT operators would not be required to change their operational practices.

Disadvantages:

- The need for additional MSS spectrum in the vicinity of the existing 1.5 GHz allocations, recognized in Resolution 226, would not be met.
- New allocations to the MSS would have to be found in other bands.
- If additional MSS allocations were made in non-contiguous bands, the implementation of new networks using both existing and new spectrum would be delayed and become more complex.

2.8.1.3.4 Method D

Make a primary MSS (space-to-Earth) allocation in Regions 1 and 3 in the band 1 520-1 525 MHz. This would align the MSS allocation across all three Regions in this band. Protection of other services in the band would be ensured through the same provisions suggested under Method A in § 2.8.1.3.1. As with Method A, the MSS allocation below 1 520 MHz in Region 2 could be suppressed.

WRC-03 may consider the suppression or modification of Resolution **226**.

Advantages:

- An additional global allocation would be available to the MSS.
- The new allocation would partially alleviate the MSS spectrum congestion.
- The new allocation is contiguous to the existing L-band MSS allocations, enabling speedy and less complex implementation of new networks using both the existing and the new allocation.
- The constraints on MSS required for protection of existing services would be acceptable, especially with the use of interference mitigation techniques.
- With the implementation of this method, all services operating in the band would be protected.
- The performance of point-to-multipoint systems operating below 1 520 MHz would not be affected.
- The suppression of the Region 2 MSS allocation in the band 1 492-1 520 MHz would leave AMT systems unconstrained by MSS below 1 520 MHz.

Disadvantages:

- If the MSS were limited to the pfd limits in Recommendation ITU-R M.1459 without mitigation, then MSS systems would be constrained to a limited part of the geostationary orbit, in order to avoid causing harmful interference to AMT systems in the USA.
- There is no agreement on the use of the proposed mitigation techniques.
- The need for 2 × 7 MHz of additional MSS spectrum in the vicinity of the existing 1.5 GHz allocations, recognized in Resolution 226, would not be met.
- Proposed mitigation techniques may not be practicable at some sites due to existing constraints and range safety concerns on AMT operations in the USA.

2.8.1.3.5 Consideration of other bands

Current use of the band 1 492-1 517 MHz

The 1 492-1 517 MHz band is extensively used in some administrations by subscriber radio systems in the FS in a point-to-multipoint deployment mode. The subscriber radio systems provides basic communications directly to subscribers in rural and remote areas and is therefore constrained with respect to station siting and pointing. A central hub station serves several subscribers via either single hop or repeatered connections. System costs, particularly those associated with individual subscriber links, are a major consideration and must be kept to an absolute minimum.

Worst-case exposure studies by the ITU-R demonstrate that co-frequency, co-coverage operation between the GSO MSS (space-to-Earth) and the FS would not be possible.

Recent probabilistic interference studies by ITU-R have shown that point-to-point systems and subscriber radio system repeater stations would be adequately protected by the current RR Appendix **5** pfd trigger levels. However, subscriber radio systems (point-to-multipoint) hub and subscriber stations in the 1 492-1 517 MHz band will be subject to excessive interference from GSO MSS satellites if the present pfd trigger levels in Appendix **5** were applied.

One study employed the latest FS point-to-multipoint system parameters from the draft revision of Recommendation ITU-R F.758-2 and the most recent antenna patterns as modelled in Recommendation ITU-R F.1336-1, which addresses point-to-multipoint systems specifically. The study concluded that the Appendix **5** pfd trigger levels must be reduced by 7 dB in the band 1 492-1 517 MHz in order to protect 90% of subscriber stations of the point-to-multipoint systems considered to an I/N level of −6 dB. This is a relaxed criterion from the fixed service interference objective of I/N = −10 dB at all stations. No viable mitigation techniques have been identified to ease the required pfd reduction.

2.8.1.4 Regulatory and procedural considerations

If Method A is adopted, the following regulatory changes could be considered:

- Modify Article **5** appropriately to include a primary allocation for MSS (space-to-Earth) in the 1 518-1 525 MHz band in Regions 1 and 3.
- Retain the existing primary allocation for MSS (space-to-Earth) in the 1 518-1 525 MHz band in Region 2.
- Suppress the existing primary allocation for MSS (space-to-Earth) in the 1 492-1 518 MHz band in Region 2.
- Modify Appendix **5** to apply the pfd levels referred to under this method to protect AMT, mobile services in Japan, and the FS.

If Method B is adopted, similar regulatory changes as with Method A could be considered, except that in lieu of pfd coordination thresholds to protect AMT in Appendix **5**, pfd limits would be inserted in Article 21.

If Method C is adopted, there would be no allocation made to MSS in the band 1 518-1 525 MHz in Regions 1 and 3. The existing MSS allocation in the 1 492-1 525 MHz band in Region 2 may also be suppressed.

If Method D is adopted, similar regulatory changes as with Method A could be considered, but instead applicable to the band 1 520-1 525 MHz.

If Method B is adopted, the following change to Article 21 could be considered.

TABLE **21-4**

Frequency band	**Service***	**Limit in dB(W/m²) for angle of arrival (δ) above the horizontal plane**			**Reference bandwidth**
		0°-5°	**5°-25°**	**25°-90°**	

1 518-1 525 MHz (Applicable to the territory of the United States in Region 2 between the longitudes 71° W and 125° W)	Mobile-satellite (space-to-Earth)	0° ≤ δ ≤ 4°	4° < δ ≤ 20°	20° < δ ≤ 60°	60° < δ ≤ 90°	4 kHz
		–181.0	–193.0 + 20 log δ	–213.3 + 35.6 log(δ)	–150.0	

1 518-1 525 MHz (Applicable to all other territory of the United States in Region 2)	Mobile-satellite (space-to-Earth)	0° ≤ δ ≤ 43.4°	43.4° < δ ≤ 60°	60° < δ ≤ 90°	4 kHz
		–155.0	–213.3 + 35.6 log δ	–150.0	

#########

2.8.2 Resolution 227 (WRC-2000)

"Sharing studies for, and possible additional allocations to, the mobile-satellite service (Earth-to-space) in the 1-3 GHz range, including consideration of the band 1 683-1 690 MHz"

Resolution 227 invites ITU-R to assess, with the participation of WMO, the current and future spectrum requirements of the MetAids service in the band 1 683-1 690 MHz, taking into account improved characteristics, and the MetSat service in the band 1 683-1 690 MHz, taking into account future developments. Resolution 227 also resolves that in the event that studies of the specific frequency band 1 683-1 690 MHz lead to an unsatisfactory conclusion, to carry out studies in order to recommend alternative MSS (Earth-to-space) frequency bands in the 1-3 GHz range.

ITU-R has considered frequency sharing between MetAids and MSS (Earth-to-space) in the band 1 668.4-1 700 MHz. This had led to a proposed revision of Recommendation ITU-R SA.1264.

ITU-R has also considered frequency sharing between the MetSat (space-to-Earth) service and the MSS (Earth-to-space) in the band 1 670-1 710 MHz, including sharing with GVAR/S-VISSR MetSat earth stations which operate in the range 1 683-1 690 MHz. These studies have led to a proposed revision of Recommendation ITU-R SA.1158.

Studies submitted prior to WRC-2000 concluded that sharing between MetAids and MSS in the bands 1 675-1 683 MHz and between MetSat and MSS in the band 1 690-1 710 MHz is considered not feasible as reflected in Resolution **227**.

2.8.2.1 Band 1 683-1 690 MHz

The band 1 683-1 690 MHz is allocated on a primary basis to the MetAids, the MetSat (space-to-Earth), the fixed, and the mobile services in all three Regions and to the mobile-satellite service in Region 2.

2.8.2.1.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

ITU-R has conducted several studies regarding separation distances required between MSS and MetSat earth stations considering in particular GVAR/S-VISSR earth stations. The studies have been based on a range of MSS system characteristics and a range of different deployment scenarios of MetSat Main and GVAR/S-VISSR stations. An attempt was made to avoid best and worst-case assumptions by considering system and shielding assumptions ranging from favourable to unfavourable conditions. The studies revealed that shielding conditions had the most significant impact on the required separation distances. The following results were obtained for a range of MSS system parameters where the terms "favourable, typical and unfavourable" refer primarily to the MetSat deployment and shielding conditions. The lower separation distances are mainly due to favourable MSS parameters whereas the higher separation distances are obtained for unfavourable MSS parameters:

	MetSat main stations: favourable-unfav. MSS	GVAR/S-VISSR stations: favourable-unfav. MSS parameters
Favourable conditions:	< 20-35 km	20-100 km
Typical conditions:	< 20-45 km	35-300 km
Unfavourable conditions:	75-320 km	70-370 km

At this point in time, GVAR MetSat stations are mostly deployed in many Region 2 countries and S-VISSR MetSat stations are mostly deployed in many Region 3 countries. In Region 1 countries there are a few MetSat GVAR/S-VISSR stations. More than 15 MetSat Main stations are deployed throughout all three Regions. It is expected that the MetSat service will make more extensive use of this band in the future. However, there are also transportable GVAR/S-VISSR stations in Regions 2 and 3. Exclusion zones are required but cannot be practically established around transportable earth stations that may be periodically relocated.

ITU-R has also reviewed the studies regarding MetAids use of the band 1 683-1 690 MHz and concluded that the relatively few MetAids systems operated in the band 1 683-1 690 MHz can be concentrated in the range 1 675-1 683 MHz if sufficient time for transition is provided.

Relevant Recommendations ITU-R: SA.1264 and SA.1158.

2.8.2.1.2 Analysis of sharing studies

a) Sharing between MSS and MetAids

Sharing studies indicate that co-channel sharing between MetAids and MSS in the band 1 675-1 683 MHz is not feasible due to unacceptable levels of interference to both systems. Studies also indicate that time-sharing between MetAids and MSS is also not feasible due to the operational nature of both services. The band 1 683-1 690 MHz is also allocated to the MetSat service on a co-primary basis. Studies and operational experience have shown that co-frequency sharing between MetAids and MetSat downlinks is not feasible. Therefore, MetAids operations are mainly concentrated in the range 1 675-1 683 MHz in many parts of the world (Regions 2 and 3) to avoid interference to GVAR/S-VISSR (also see section b) below) MetSat downlinks. WMO has identified future requirements for narrow-band MetAids operations as 1 675-1 683 MHz. However some administrations continue to use wideband systems that should not exceed a requirement of 12 MHz, which is consistent with national spectrum availability in those countries. In reviewing the available study results, an MSS allocation in the band 1 683-1 690 MHz will most affect MetAids operations in ITU Region 1 in those locations where the limited number of MetSat stations does not prevent their use in 1 683-1 690 MHz.

b) Sharing between MSS and MetSat

Sharing the band 1 683-1 690 MHz would require the establishment of geographical separation between MSS earth stations and co-frequency MetSat stations. There are currently more than 15 main earth stations operated in all three Regions and more than 400 registered data user stations operated mostly in Regions 2 and 3, with some also in Region 1. The number of registered data user stations is increasing and the actual number of existing stations is expected to be in excess of 1 000. The studies concluded that, even though feasible in some areas of the world, implementation of sharing would be subject to such practical constraints and limitations for the MSS that it should not be considered suitable for providing MSS spectrum on a global basis.

Appendix **7** contains the methodology and parameters to determine the coordination area for mobile earth stations with respect to MetSat earth stations. The coordination area is the service area of the mobile earth stations extended by the coordination distance. For operation of MSS in the territory of one administration, it would be necessary to coordinate with MetSat stations operated by other administrations if the MetSat earth station is located within the coordination area of the MSS terminals. The available study results show that for the most favourable climatic zone, A2, the required coordination distances are often in excess of several hundred kilometres and would cause a coordination burden for the MSS noting the number of MetSat stations indicated above. The extent of the coordination burden would depend on the number and location of MetSat stations affected. The problem increases for coastal areas where coordination distances above 1 000 km could be required in a few cases. Coordination would also be required between MSS and MetSat earth stations within the territory of a given administration but would be a domestic rather than an international matter.

In addition to the coordination requirement, available studies have concluded that the actual required separation distances are typically 70-105 km, but can be up to 400 kilometres. This would in some cases cause large service areas not being available to the MSS; rendering typical features of this service such as global or regional coverage as well as unrestricted mobility, unavailable without the use of selectable frequency agility. Resolution **227** also recognizes that the use of the data user stations is on the increase and given the implications of No. **5.377**, this would mean an unpredictable risk for any MSS operator to lose service areas in addition to those unavailable today. As an additional system requirement, the MES locations would have to be determined with sufficient accuracy to comply with the required separation distances. However, there are current operational MSS systems that implement spot beam configurations (150-300 spot beams), frequency reuse and position determination capabilities. In combination with spectrum availability outside of the band 1 683-1 690 MHz, selectable frequency agility would increase the possibility of sharing this band between the MSS and MetSat.

In addition to in-band interference in the band 1 683-1 690 MHz, the problem of adjacent band interference to thousands of meteorological earth stations operating in the band 1 690-1 698 MHz requires either a guardband below 1 690 MHz or a limitation of out-of-band emissions. Studies have shown that the out-of-band emission limits contained in Recommendation ITU-R M.1480 (and proposed revisions to this Recommendation), if extended to MESs operating in 1 683-1 690 MHz, would be adequate to protect MetSat earth stations operating above 1 690 MHz. However, further study may be required.

Assuming the band 1 670-1 675 MHz would be allocated to the MSS, finding an additional 2 MHz of spectrum in the range 1 683-1 690 MHz would be difficult on a global basis. In the range 1 683-1 688 MHz, service areas in many countries, in particular Region 2, will be constrained by current and future GVAR operations and not available where transportable MetSat earth stations are deployed. In the range 1 688-1 690 MHz, in all Region 2 countries, GVARs do not operate and hence there are few constraints on sharing and sharing may be feasible depending on final conclusions regarding the necessity of guardbands. Around 1 687 MHz, up to 6 MHz are not available in major parts of Region 3 due to S-VISSR operations. In countries where few MetSat earth stations are deployed, it is likely to be possible to identify additional spectrum which could be used for the MSS with minor constraints. MSS systems would have to be sufficiently flexible to use frequencies available at each earth station location, taking into account future deployment of MetSat stations.

With regard to sharing between MSS space stations and MetSat space stations, ITU-R studies have shown that sharing between MetSat space stations and MSS space stations is feasible except for some very close GSO constellations.

2.8.2.2 Alternative frequency bands in response to Resolution 227

Due to the sharing difficulties between the MSS and MetSat service in the band 1 683-1 690 MHz in Regions 2 and 3, ITU-R studied the band 1 670-1 675 MHz as an alternative band for an MSS allocation. To meet the requirements of MSS (2 × 7 MHz) as identified within CPM-99 and Resolution 227 (WRC-2000), preliminary studies were undertaken regarding sharing in the band 1 668-1 670 MHz. The band 1 670-1 675 MHz is allocated to meteorological aids, fixed, meteorological-satellite (space-to-Earth) and mobile services on a primary basis. The mobile service is intended for aeronautical public correspondence (through No. **5.380**). The band 1 668.4-1 670 MHz is allocated to radio astronomy, meteorological aids, and the fixed and mobile services on a primary basis. The band 1 668-1 668.4 MHz is allocated to the radioastronomy and the space research service (passive) on a primary basis, and to the fixed and mobile services on a secondary basis. The adjacent band, 1 660-1 668 MHz has a primary allocation to the radio astronomy service.

2.8.2.2.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Sharing between the relatively few MetSat main earth stations and MSS uplinks in the band 1 670-1 675 MHz is feasible provided the MSS protect the few MetSat main earth stations through the use of exclusion zones and position determination. Sharing between the MSS earth stations and the MetAids service is feasible if protection is provided to MetAids operations in those countries where there is a continuing requirement to use 1 670-1 675 MHz. However, sharing between MetAids and MSS space stations is not feasible if the MSS space station antenna coverage area and the area used by MetAids coincide. Providing protection to MetAids systems operating in the few countries requiring use of 1 670-1 675 MHz may limit MSS use within those countries and in neighbouring countries. The relevant ITU-R Recommendations are SA.1264 and SA.1158.

Studies into the effect of unwanted emissions from MESs into radio astronomy stations operating in the band 1 660-1 670 MHz have been conducted, taking into account Recommendation ITU-R M.1480 (and proposed revisions to this Recommendation), and Recommendation ITU-R RA.769. The studies estimated the separation distances required between MESs and radio astronomy stations.

Preliminary studies have been conducted with regard to sharing between the mobile-satellite service and the radio astronomy service in the band 1 668-1 670 MHz, taking into account Recommendations ITU-R M.1184, ITU-R RA.769 and ITU-R RA.1513. The studies estimated the separation distance required between MESs and radio astronomy stations. However, further study is required.

2.8.2.2.2 Analysis of sharing studies

a) Sharing between MSS and MetAids

Although co-channel sharing between MetAids and MSS is not feasible due to mutual interference, in most countries there is a low use or no use of the band 1 670-1 675 MHz for MetAids operations which allows for sharing based on geographical separation. Globally, the majority of MetAids operations are concentrated in the frequency range 1 675-1 683 MHz. A survey of band usage indicates that MetAids frequency requirements can be satisfied with the spectrum available above 1 675 MHz. Most of those countries using 1 670-1 675 MHz for MetAids operations can transfer operations to 1 675-1 683 MHz over a period. There are a few countries operating MetAids systems that will continue to require use of the band 1 670-1 675 MHz where sharing may not be feasible.

b) Sharing between MSS and MetSat

Sharing is feasible in the band 1 670-1 675 MHz if an appropriate separation distance is maintained at all times between the few MetSat main earth stations and mobile earth stations, as determined pursuant to coordination under No. **9.17A**. The mobile earth stations locations will have to be determined with sufficient accuracy to ensure the required separation distances are maintained. The use of mobile earth stations in this band would therefore be subject to the ability of MSS systems to respect these separation distances through location determination capabilities.

c) Sharing between MSS and MS

With regard to Aeronautical Public Correspondence, ITU-R studies indicated that no systems are currently implemented and no future plans exist for implementation of such systems in this band. The band was intended for use on the ground-to-air link. Based on the indications that this band will no longer be required for APC, MSS sharing with APC in this band does not present any difficulty. MSS sharing with other applications of the mobile service has not been studied in the band 1 670-1 675 MHz as system characteristics were not available.

d) Adjacent band compatibility and co-frequency sharing between MSS and RAS

The radio astronomy service is allocated on a primary basis in the band 1 660-1 670 MHz. Both continuum and spectral line observations are carried out in the band. Two spectral lines of the hydroxyl radical (OH) are observed in this band: their rest frequencies are 1 665.402 MHz and 1 667.359 MHz (see Recommendation ITU-R RA.314). The associated protection criteria are given in Recommendations ITU-R RA.769 and ITU-R RA.1513.

Studies have been conducted regarding unwanted and in-band emissions for mobile earth stations into radio astronomy receivers operating below 1 670 MHz.

d1) Mobile-satellite service mobile earth stations and radio astronomy service operating in adjacent bands

Taking the unwanted emission limits of Recommendation ITU-R M.1480 as a guide for the level of unwanted emissions for MESs operating above 1 670 MHz, separation distances in the range of about 20 to 58 km are required to meet the protection criteria of Recommendations ITU-R RA.769 and RA.1513. Hence, exclusion zones would be required with regard to radio astronomy stations operating in the band 1 660-1 670 MHz. In practice, these should be defined on a case-by-case basis, taking into account the appropriate characteristics of the radio astronomy station, the surrounding terrain and the characteristics of the MSS system operating in the band 1 670-1 675 MHz. MESs operating in the 1 670-1 675 MHz frequency range would have to be able to determine their location with sufficient accuracy to avoid operating in these zones in this frequency range. From these results it can be concluded that adjacent band operations are feasible.

d2) Mobile-satellite service mobile earth stations and radio astronomy service operating in the shared band 1 668-1 670 MHz

To ensure the protection of radio astronomy stations, it would be necessary to set up exclusion zones around each of them. MESs operating in the 1 668-1 670 MHz frequency range would have to be able to determine their location with sufficient accuracy to avoid operating in these zones in this frequency range.

Preliminary studies indicated that, taking the emission limits of Recommendation ITU-R M.1184 as a guide for the in-band emission levels of MESs operating in the band 1 668-1 670 MHz, separation distances of the order of 500 km are required to meet the protection criteria of Recommendations ITU-R RA.769 and ITU-R RA.1513. These results require further validation within ITU-R. Due to the small number of radio astronomy stations using this band all around the world, coordination is thus felt to be manageable in large parts of the world.

e) Sharing between mobile-satellite service and fixed service

No studies have been submitted during the current study cycle regarding sharing between MSS and FS in the band 1 670-1 675 MHz in response to Resolution 227. Some studies are available with regard to sharing between MSS and FS in the range 1-3 GHz leading to recommendations, including Recommendations ITU-R M.1141, M.1142, and M.1143.

f) Sharing between mobile-satellite service and space research (passive)

No studies have been conducted between the space research (passive) service and the mobile-satellite service in 1 668-1 668.4 MHz.

2.8.2.3 Methods to satisfy the agenda item and their advantages and disadvantages

2.8.2.3.1 Method A

A primary worldwide MSS (Earth-to-space) allocation would be created in the band 1 670-1 675 MHz, with the necessary protection of existing services in the band, and protection of the radio astronomy service in the band 1 660-1 670 MHz.

Since MSS operations may not be possible in countries that continue to use the band 1 670-1 675 MHz for MetAids operations, the Conference could consider curtailing the long-term use of the band for MetAids (Refer to section 2.8.2.2.2a)). As a consequence of making a worldwide MSS allocation at 1 670-1 675 MHz, the Conference may further consider aligning the Region 2 MSS allocation by suppressing the allocations in all or parts of the band 1 675-1 710 MHz taking into account in particular the conclusions of Recommendations ITU-R SA.1264 for the sub-band 1 675-1 683 MHz and SA.1158 for the sub-band 1 690-1 710 MHz. In addition, the status of the current mobile allocation will need consideration.

Advantages:

The MSS would be provided additional spectrum. Protection of the few MetSat main earth stations and radio astronomy stations in the adjacent band will place little constraint on the MSS. Subject to limited sharing constraints with MetSat, MetAids, fixed and mobile services, a global allocation would be available to the MSS (Earth-to-space).

Disadvantages:

This allocation would be limited to 5 MHz. MSS operations may not be possible in those countries that continue to use the band 1 670-1 675 MHz for MetAids operations (Refer to section 2.8.2.2.2a)).

2.8.2.3.2 Method B

In addition to the 5 MHz of spectrum identified in Method A, an additional allocation, with spectrum of about 2 MHz, could be created in other bands in the vicinity of the existing allocations around 1.6 GHz taking into consideration the conclusions of studies. Since an isolated allocation of 2 MHz would be less attractive for MSS, and sharing with MetAids above 1 675 MHz is not feasible, a possible allocation to MSS in the band 1 668-1 675 MHz could be considered with the necessary protection of existing services in the band and protection of RAS in the band 1 660-1 668 MHz.

Advantages:

The spectrum requirement of a total of 7 MHz would be met.

A contiguous MSS allocation of 7 MHz would be achieved.

Subject to the results of the sharing studies, existing services operating in the band 1 668-1 670 MHz would be protected.

Disadvantages:

The requirement to protect existing services may result in constraints to MSS.

2.8.2.3.3 Method C

A worldwide MSS allocation would be created in the band 1 683-1 690 MHz, taking into account that WRC-2000 confirmed the requirement for continued protection of MetSat and MetAids services under No. **5.377**.

As a consequence of making a worldwide MSS allocation at 1 683-1 690 MHz, the Conference may consider aligning the Region 2 MSS allocation by suppressing the allocations in parts of the band 1 675-1 710 MHz taking into account in particular the conclusions of Rec. ITU-R SA.1264 for the sub-band 1 675-1 683 MHz and ITU-R SA.1158 for the sub-band 1 690-1 710 MHz.

Advantages:

The MSS would be allocated additional spectrum.

Disadvantages:

In many countries, MSS operations would be restricted by the operation of a large and increasing number of MetSat earth stations including transportable stations. Protection of existing and future MetSat earth stations would result in a significant coordination burden. The required separation distances would make large areas not available for the MSS. Coordination with transportable

MetSat earth stations is not practicable. The constraint of No. **5.377** renders this band barely usable for MSS earth stations. Future deployment of MetSat earth stations would result in further reduction of MSS service areas. The whole 7 MHz MSS allocation would not be usable on a global basis.

2.8.2.3.4 Method D

This option is to make no additional allocations within the range 1 670-1 710 MHz to accommodate the MSS.

Advantages:

This option would ensure no impact to existing services.

Disadvantages:

The spectrum requirements for MSS would not be met in this frequency band.

2.8.2.4 Regulatory and procedural considerations

a) Regarding Method A, if a worldwide allocation is made in the band 1 670-1 675 MHz, stations in the MSS shall be subject to coordination. It would be necessary to require coordination under No. **9.11A** for MSS in this band. An example footnote could be: "**5.QQQ** The mobile-satellite service using the band 1 670-1 675 MHz shall be subject to coordination under No. **9.11A**."

Coordination between earth stations in bidirectionally allocated bands is currently provided through No. **9.17A**. However, this provision is limited to specific earth stations and may therefore require modification (or an alternative provision) to permit coordination of typical MESs, which may also be considered under agenda item 1.30.

One administration believes that provisions may be required to protect existing and planned MetAids stations.

To cover sharing with MetAids, the following footnote could be considered: "**5.UUU** In the band 1 670-1 675 MHz, administrations are encouraged to implement no new systems in the MetAids service and to take all practicable steps to migrate existing meteorological aids service operations from this band."

Moreover, in order to protect the radio astronomy service from unwanted emissions of MES operating in the 1 670-1 675 MHz band, it would be necessary to ensure that unwanted emission levels falling into the radio astronomy band 1 660-1 670 MHz are limited to the levels given in Recommendations ITU-R RA.769 and ITU-R RA.1513. An example of footnote could be: "**5.XXX** Mobile earth stations operating in the band 1 670-1 675 MHz shall not cause harmful interference to stations in the radio astronomy service operating in the band 1 660-1 670 MHz. The threshold levels of interference detrimental to the radio astronomy service are given in Recommendations ITU-R RA.769 and ITU-R RA.1513." It should be noted that this footnote could introduce constraints on the existing MESs from future RAS stations.

Some administrations consider that regulatory provisions will be required to ensure sharing with and protection of fixed and mobile services. Some administrations consider that application of Article **21** for sharing with MSS space stations should be considered.

b) Regarding Method B, the regulatory measures given under Method A apply, and with an additional allocation in the 1 668-1 670 MHz band, it would also be necessary to set up coordination under No. **9.11A** for MSS in this band. The example footnote given above for the protection of RAS could be extended to the 1 668-1 675 MHz band. Additional regulatory measures could be needed to ensure the protection of the space research (passive) service in the band 1 660.5-1 668.4 MHz.

As an alternative example footnote, and if it is considered necessary to ensure no constraints on new radio astronomy stations from MSS in the band 1 668-1 670 MHz only, the MSS could be placed on a secondary basis with respect to the radio astronomy service by adding the band 1 668-1 670 MHz to footnote **5.376A**.

c) Regarding Method C, if a worldwide MSS allocation is made in the band 1 683-1 690 MHz, protection of the incumbent MetSat and MetAids services could be ensured by the application of No. **5.377**, which would require revision to reflect the actual band limits of the MSS allocation, protection of MSS space stations which are deployed prior to new MetSat space stations at orbital locations different from ones already used, and other regulatory measures. In addition, a proper footnote could be required for which the following text could be considered:

"Mobile-satellite systems using the 1 683-1 690 MHz band shall not cause harmful interference to earth stations of the meteorological-satellite service and No. **5.43** shall not apply. To avoid causing harmful interference, mobile earth stations shall not operate, except on a non-interfering signalling channel, within the zones around the meteorological earth stations defined in the coordination process. The mobile-satellite system shall have position determination capabilities to ensure compliance with this provision."

Appropriate regulatory provisions may be required to ensure protection of MetSat user stations operating above 1 690 MHz from out-of-band emissions from MESs operating in the range 1 683-1 690 MHz.

d) Regarding all four methods WRC-03 may consider modification or suppression of Resolution **227**.

#########

2.9 Agenda item 1.33

"to review and revise technical, operational and regulatory provisions, including provisional limits in relation to the operation of high altitude platform stations within IMT-2000 in the bands referred to in No. **5.388A**, in response to Resolution **221 (WRC-2000)**"

2.9.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Provisions for operation of HAPS were originally made at WRC-97, for HAPS providing FS operations in the 47.2-47.5 GHz and 47.9-48.2 GHz bands (No. **5.552A**). A definition of HAPS (No. **1.66A**) was also added to the RR. The use of HAPS as base stations within terrestrial IMT-2000 was approved at WRC-2000, resulting in provisions to facilitate this being added to the RR (No. **5.388A**). Resolution **221 (WRC-2000)** includes provisional co-channel and out-of-band pfd limits for HAPS operation, for the protection of other stations either sharing the same band or operating in adjacent bands.

Relevant Recommendations ITU-R: M.1456, and DNR M.[IMT-HAPSINT].

2.9.1.1 Protection of other IMT-2000 stations from co-channel interference from HAPS operating as an IMT-2000 base station

Based on updated information on typical noise figure of IMT-2000 mobile stations, the protection requirement of other IMT-2000 mobile stations operating co-frequency has been revised.

No interference to other IMT-2000 base stations can occur providing that HAPS operating as base stations have the same direction of transmission.

2.9.1.2 Review and, if necessary, revision of the provisional pfd thresholds

The –117 dB (W/(m^2 · MHz)) threshold is appropriate to protect other IMT-2000 mobile stations from co-channel interference.

2.9.1.3 Protection of non-IMT-2000 stations from co-channel interference from a HAPS downlink operating as an IMT-2000 base station

One study concluded that the present pfd thresholds exceed the interference allowance limits for pre-IMT-2000 PCS mobile-to-base link in a co-channel environment and proposes that the provisional co-channel pfd threshold in *resolves* 1.1 of Resolution 221 be revised. It is to be noted though that this is an issue concerning the protection from co-channel interference of certain stations in some neighbouring countries in Region 2. It is proposed that any proposed revisions related to this issue should be limited to this particular case and to the Region in question. Sharing studies have been carried out regarding the impact of the provisional pfd levels in *resolves* 1.1 of Resolution 221 on the operation of second generation PCS and on the operation of MMDS.

2.9.1.4 Protection of fixed stations from co-channel interference from HAPS operating as an IMT-2000 base station

With no studies to the contrary, the existing thresholds are deemed appropriate to protect the fixed service from co-channel interference.

2.9.1.5 Protection of fixed stations in adjacent bands from HAPS operating as an IMT-2000 base station

With no studies to the contrary, the existing thresholds are deemed appropriate to protect the fixed service from adjacent-channel interference.

2.9.2 Analysis of the results of studies

The study regarding sharing considerations between HAPS providing IMT-2000 and other non-IMT 2000 systems operating in the same bands or adjacent bands responds to the need to analyse and proposes changes to provisional pfd thresholds as specified in Resolution 221 to protect some stations operating in these bands in the fixed and mobile services.

This subject has been extensively studied for over five years and Recommendation ITU-R M.1456 was based on the results of such studies. Since the last Conference, one further study has been completed which suggests that, in certain countries in Region 2 for particular services, namely PCS and MMDS, the provisional pfd thresholds may not adequately meet system design allowances for interference for pre IMT-2000 PCS. The studies suggest that only for this particular system, the present value exceed the interference allowance limits for pre-IMT-2000 PCS mobile-to-base link in a co-channel environment and propose that the provisional co-channel pfd threshold in *resolves* 1 a) of Resolution 221 be revised.

Another study has shown that a limited relaxation (by 4.5dB) of the pfd threshold could be afforded for the specific case of the protection of other IMT-2000 mobile stations from HAPS base stations. The protection of other IMT-2000 base stations from HAPS base stations can be ensured through appropriate provisions requesting HAPS operating as an IMT-2000 base station to transmit in the frequency bands 2110-2170 in Regions 1 and 3 and 2110-2160 in Region 2. Since an IMT-2000 mobile station has the same characteristics (as defined in Recommendation ITU-R M.1457) whether it is communicating with a HAPS base station or with another IMT-2000 base station, no specific study regarding mobile stations communicating with a HAPS is needed.

2.9.3 Methods to satisfy the agenda item and their advantages and disadvantages

In order to adequately protect MMDS in some neighbouring countries in Region 2 in the band 2 150-2 160 MHz from co-channel interference, a HAPS operating as a base station to provide IMT-2000 shall not exceed the following co-channel pfd at the Earth's surface outside an administration's borders unless agreed otherwise by the administration of the affected neighbouring country:

– -127 dB(W/(m$^2 \cdot$ MHz)) for angles of arrival (θ) less than 7° above the horizontal plane;

– $-127+ 0.666\ (\theta - 7)$ dB(W/(m$^2\cdot$MHz)) for angles of arrival between 7° and 22° above the horizontal plane; and

– -117 dB(W/(m$^2 \cdot$ MHz)) for angles of arrival between 22° and 90° above the horizontal plane.

It is to be noted that the above is an issue concerning the protection from co-channel interference of certain stations in some neighbouring countries in Region 2 only.

Although Resolution **221 (WRC-2000)** was inviting ITU-R to study regulatory provisions to allow co-ordination, ITU-R has concluded that seeking agreement from a neighbouring country does not require the development of a specific procedure. However, clarification of Resolution 221(WRC-2000) is needed to specify the method for the Bureau to check the conformity. Some administrations also noted that an ITU-R Recommendation providing technical guidance should be developed to facilitate consideration with neighbouring administrations. Some administrations consider that there is a need to have regulatory procedures for coordination and registration of HAPS.

2.9.4 Regulatory and procedural considerations

In order to enable the Bureau to check the conformity with pfd limits defined in Resolution 221, several provisions are needed:

- Modification of Article 11 to have an explicit obligation of notification of HAPS stations.
- Insertion in Appendix 4 of a new characteristic applying to HAPS operating in accordance with No. 5.388A on the compliance with the limits of Resolution 221.

Some administrations consider that further technical studies should be conducted in ITU-R under the revised version of Resolution 221. Some administrations consider that there is a need to have regulatory proceduces in Articles **9** and **11** for coordinating HAPS with affected administrations prior to notification of HAPS.

Example of draft modifications to Resolution 221 (WRC-2000)

Use of high altitude platform stations as IMT-2000 base stations in the bands 1 885-1 980 MHz, 2 010-2 025 MHz and 2 110-2 170 MHz in Regions 1 and 3 and 1 885-1 980 MHz and 2 110-2 160 MHz in Region 2

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that the bands 1 885-2 025 MHz and 2 110-2 200 MHz are identified in No. **5.388** as intended for use on a worldwide basis for IMT-2000, including the bands 1 980-2 010 MHz and 2 170-2 200 MHz for both the terrestrial and the satellite component of IMT-2000;

b) that a high altitude platform station (HAPS) is defined in No. **1.66A** as "a station located on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the Earth";

c) that HAPS may offer a new means of providing IMT-2000 services with minimal network infrastructure as they are capable of providing service to a large footprint together with a dense coverage;

d) that the use of HAPS as base stations within the terrestrial component of IMT-2000 is optional for administrations, and that such use should not have any priority over other terrestrial IMT-2000 use;

e) that in accordance with No. **5.388** and Resolution **212 (Rev.WRC-97**), administrations may use the bands identified for IMT-2000, including the bands referred to in this Resolution, for stations of other primary services to which they are allocated;

f) that these bands are allocated to the fixed and mobile services on a co-primary basis;

g) that, in accordance with No. **5.388A**, HAPS may be used as base stations within the terrestrial component of IMT-2000 in the bands 1 885-1 980 MHz, 2 010-2 025 MHz and 2 110-2 170 MHz in Regions 1 and 3 and 1 885-1 980 MHz and 2 110-2 160 MHz in Region 2; the use by IMT-2000 applications using HAPS as base stations does not preclude the use of these bands by any station in the services to which they are allocated and does not establish priority in the Radio Regulations;

h) that ITU-R has studied sharing between HAPS and other stations within IMT-2000, has considered compatibility of HAPS within IMT-2000 with some services having allocations in the adjacent bands, and has established Recommendation ITU-R M.1456;

that radio interfaces of IMT-2000 HAPS are compliant with Recommendation ITU-R M.1457;

j) that ITU-R has addressed sharing between systems using HAPS and some existing systems, particularly PCS (personal communications system), MMDS (multichannel multipoint distribution system) and systems in the fixed service, which are currently operating in some countries in the bands 1 885-2 025 MHz and 2 110-2 200 MHz;

k) that HAPS stations are intended to transmit in the band 2 110-2 170 MHz in Regions 1 and 3 and in the band 2 110-2 160 MHz in Region 2,

resolves

1 that:

1.1 for the purpose of protecting IMT-2000 mobile stations in neighbouring countries from co-channel interference, a HAPS operating as an IMT-2000 base station shall not exceed a co-channel power-flux density (pfd) of -117 dB (W/(m^2 · MHz)) at the Earth's surface outside a country's borders unless explicit agreement of the affected administration is provided at the time of the notification of the HAPS station:

pfd1.2 a HAPS operating as an IMT-2000 base station shall not transmit outside the frequency bands 2110-2170 MHz in Regions 1 and 3 and 2110-2160 MHz in Region 2.

1.3 In Region 2, for the purpose of protecting MMDS stations in some neighbouring countries in the band 2 150-2 160 MHz from co-channel interference, a HAPS operating as an IMT-2000 base station shall not exceed the following co-channel power-flux density (pfd) at the Earth's surface outside a country's borders unless explicit agreement of the affected administration is provided at the time of the notification of the HAPS station:

–127 dB(W/(m^2 · MHz)) for angles of arrival (θ) less than 7° above the horizontal plane;

– –127 + 0.666 (θ – 7) dB(W/(m^2 · MHz)) for angles of arrival between 7° and 22° above the horizontal plane; and

– –117 dB(W/(m^2 · MHz)) for angles of arrival between 22° and 90° above the horizontal plane;

1.4 a HAPS operating as a IMT-2000 base station, in order to protect fixed stations from interference, shall not exceed the following limits of out-of-band power-flux density (pfd) at the Earth's surface in the bands 2 025-2 110 MHz:

– –165 dB(W/(m^2 · MHz)) for angles of arrival (θ) less than 5° above the horizontal plane;

– –165 + 1.75 (θ– 5) dB(W/(m^2 · MHz)) for angles of arrival between 5° and 25° above the horizontal plane; and

– –130 dB(W/(m^2 · MHz)) for angles of arrival between 25° and 90° above the horizontal plane;

2 that all the limits in this resolution shall apply to all HAPS stations operating in accordance with No. 5.388A as of 1 January 2002;

3 that administrations wishing to implement HAPS within a terrestrial IMT-2000 system shall comply with the following:

3.1 for the purpose of protecting IMT-2000 stations operating in neighbouring countries from co-channel interference, a HAPS operating as a base station within IMT-2000 shall use antennas that comply with the following antenna pattern:

$G(\psi) = G_m - 3(\psi/\psi_b)^2$ dBi for $0° \le \psi \le \psi_1$

$G(\psi) = G_m + L_N$ dBi for $\psi_1 < \psi \le \psi_2$

$G(\psi) = X - 60 \log(\psi)$ dBi for $\psi_2 < \psi \le \psi_3$

$G(\psi) = L_F$ dBi for $\psi_3 < \psi \le 90°$

where:

$G(\psi)$: gain at the angle ψ from the main beam direction (dBi)

G_m : maximum gain in the main lobe (dBi)

ψ_b : one-half of the 3 dB beamwidth in the plane considered (3 dB below G_m) (degrees)

L_N : near side-lobe level in dB relative to the peak gain required by the system design, and has a maximum value of –25 dB

L_F : far side-lobe level, G_m – 73 dBi

$\psi_1 = \psi_b \sqrt{-L_N/3}$ degrees

$\psi_2 = 3.745\ \psi_b$ degrees

$X = G_m + L_N + 60 \log(\psi_2)$ dBi

$\psi_3 = 10^{(X-L_F)/60}$ degrees

The 3 dB beamwidth ($2\psi_b$) is again estimated by:

$(\psi_b)^2 = 7\,442/(10^{0.1 G_m})$ degrees^2

where G_m is the peak aperture gain (dBi);

3.2 for the purpose of protecting mobile earth stations within the satellite component of IMT-2000 from interference, a HAPS operating as an IMT-2000base station , shall not exceed an out-of-band pfd of –165 dB(W/(m^2 · 4 kHz)) at the Earth's surface in the bands 2 160-2 200 MHz in Region 2 and 2 170-2 200 MHz in Regions 1 and 3;

invites ITU-R

to develop an ITU-R Recommendation providing technical guidance to facilitate consideration with neighbouring administrations.

instructs the Bureau

to review the findings made under No. **11.31** with respect to the conformity of HAPS stations operating in accordance with No. **5.388A**, and notified to the Bureau after 1 January 2002.

#########

2.10 Agenda item 1.38

"to consider provision of up to 6 MHz of frequency spectrum to the Earth exploration-satellite service (active) in the frequency band 420-470 MHz, in accordance with Resolution **727 (Rev.WRC-2000)**"

2.10.1 Summary of technical and operational studies

Relevant Recommendations ITU-R SA.577, SA.1166, SA.1260, M.1462, M.1174, F.758, M.1042, F.1108 and ITU-D 13[1].

2.10.2 Analysis of the results of studies

Recommendation ITU-R SA.577 establishes requirements for the operation of spaceborne synthetic aperture radars (SAR) at a frequency near 400 MHz to measure soil moisture, tropical biomass, Antarctic ice thickness and for documentation of geological history and climate change. SARs at these frequencies can provide data that are unattainable by any other means.

Active spaceborne sensors can be used to enable the monitoring of forests. The need for assessment and systematic observations of forest cover and the extent and rate of forest degradation in tropical and temperate regions was strongly expressed in Agenda 21 of the United Nations Conference on Economic Development (UNCED) in 1992. Studies have confirmed that 6 MHz of spectrum is still required to satisfy mission objectives.

2.10.2.1 Sharing with the amateur and amateur-satellite services

In the band 430-440 MHz, amateur services have allocations on a co-primary basis in Region 1 and on a secondary basis in Regions 2 and 3 (except in countries listed in No. **5.278**, where it is primary). Further, in accordance with No. **5.282** the amateur-satellite service may operate in part of

[1] Recommendation ITU-D 13 "Effective utilization of the amateur services in disaster mitigation and relief operations".

this band (435-438 MHz) subject to not causing harmful interference to other services operating in accordance with the Radio Regulations.

Administrations may wish to consider the important role that the amateur services play in the provision of disaster communications, especially in developing countries. This role is recognized by Resolution **644 (WRC-97)**, Recommendations ITU-R M.1042, ITU-D 13 and elsewhere. Amateur radiotelephone repeaters in the band 430-440 MHz are used for disaster communications. Amateur radio operators are active in all parts of the world, even Antarctica.

There would likely be periods where SAR transmissions would have some impact on reception by amateur services. However, SARs and the amateur services can coexist as long as the technical and operational constraints given in DRR ITU-R SA.1260 are met by the EESS (active).

2.10.2.2 Sharing with radiolocation service

Airborne, shipborne, and land-based radars operate in the frequency band 420-450 MHz. Studies prior to WRC-97 concentrated on the very large aperture antenna radar systems used for space object tracking in the band 420-450 MHz. Studies since WRC-97 have included consideration of the compatibility of spaceborne SARs with the other types of radars operating in the band 420-450 MHz.

The ITU-R has determined that there is a potential for unacceptable interference from spaceborne SARs to a limited number (around ten worldwide) of land-based space object tracking radars operating in the frequency band 420-450 MHz if a SAR is within line-of-sight of the land-based radars. It has been determined that the degree of compatibility is highly dependent upon the characteristics (and associated mission) of the spaceborne SARs, and that a spaceborne SAR intended for certain missions can be designed such that the compatibility situation is considerably improved. Field testing may be required on a case-by-case-basis to confirm compatibility with specific systems.

The ITU-R has concluded that, taking into account the SAR processing gain, the interference to SARs caused by airborne, shipborne, and land-based radars is acceptable.

Operation by geographical separation (that is, spaceborne SAR operation beyond line-of-sight to the land-based radars) has been studied. Observation of significant portions of the land mass in the northern hemisphere will be denied to the spaceborne sensors under such a restriction. However, it does appear that if the SARs are limited to operations beyond line-of-sight of land-based radars an appreciable portion of the tropical forests or Antarctic ice sheets can still be observed, which are primary missions for active sensors at these frequencies.

Studies of the compatibility of spaceborne SARs with airborne and shipborne radars have produced results that are quite similar to those for the land-based radars: a potential for significant interference (i.e. with regard to the likelihood and duration of interference events) exists for some of the SARs studied, but that the potential is highly dependent upon the characteristics of the SARs (orbits, transmitter power, antenna side-lobe characteristics). SAR design and operation in compliance with DRR ITU-R SA.1260 would greatly improve compatibility.

The band 420-460 MHz is also allocated on a secondary basis to the aeronautical radionavigation service limited to the use of radio altimeters in countries listed in No. **5.271**. While there may be close similarities between airborne radars in the radiolocation service and radio altimeters operating in the aeronautical radionavigation service, the ITU-R could not determine the potential impact from EESS (active) sensors on these aeronautical radionavigation systems due to the lack of technical information on these radio altimeters.

In addition to the radars that operate in the 420-450 MHz band as addressed in the preceding paragraphs, a radar is located in Arecibo, Puerto Rico (United States) that is used for important atmospheric research programmes. It is an upward looking radar and there is a potential for interference from and to a spaceborne SAR. There will be a need to coordinate operations of the spaceborne SAR and the Arecibo radar. Such coordination is feasible since schedules for operation of the radar are known several weeks in advance, as are the times that the SAR will be visible and its planned operations.

Wind profiler radars operate in the radiolocation service in the range 440-450 MHz unless compatibility cannot be achieved with existing services, in which case the bands 420-435 MHz and 438-440 MHz could be considered for use by wind profiler radars in accordance with Resolution **217 (WRC-97)**. Operation in separate frequency bands may be necessary for spaceborne SARs and wind profiler radars in order to preclude interference to the SARs.

2.10.2.3 Sharing with fixed and mobile services

The frequency ranges 410-430 MHz and 440-470 MHz are allocated to the fixed and mobile services on a primary basis in all three Regions. The frequency range 430-440 MHz is allocated to the fixed service in over 40 countries on a primary basis.

DNR ITU-R F.[Doc. 9/47] gives channel arrangements for digital radio systems operating in the frequency range 406.1-450 MHz. General guidance on the performance characteristics of FS systems in the band 420-470 MHz are available in DRR ITU-R F.758.

The FS protection criteria to be applied is a fractional degradation of performance (FDP) of 10% (which is equivalent to I/N = −10 dB in case of permanent interference) from a primary service, and 1% FDP (equivalent to I/N = −20 dB in case of permanent interference) from a secondary service. Pfd derived from this criterion should not be exceeded. DRR ITU-R F.758 provides the receiver thermal noise as −143 dBW in 3.5 MHz IF bandwidth.

A design of some low power, low-side lobe, spaceborne SARs has been considered that may produce power flux-densities at the surface of the Earth lower than the levels imposed in frequency bands near 400 MHz allocated to the fixed and mobile services in order to protect fixed and mobile operations.

In the range 450-470 MHz, interference to land mobile receivers used for special applications is unacceptable if any interruption occurs, even for a brief period of time, as the interference could impact protection of life and property. It is essential that the pfd of any interference to the land mobile service from EESS be less than the level specified in Table 1 of the annex to DRR ITU-R SA.1260.

The maritime mobile service may use some frequencies within the band 457-467 MHz for on-board communications stations (No. **5.287**). Receiver characteristics are similar to those of land mobile equipment listed in Recommendation ITU-R M.1174-1.

2.10.2.4 Sharing with space operation service (range safety command receivers)

Range safety command receivers are used to send arm, destruct, and safe commands to an airborne missile or drone, as well as to launch vehicles. Terrestrial missile and drone operations are accomplished at all flight altitudes (from just above ground level up to maximum flight altitudes). Commands to space launch vehicles may need to be sent from nearly ground level (just after lift-off) up or approaching early parking orbit altitudes of 100 km or so (e.g. to send a final "safe" command).

Studies conducted within the ITU-R have demonstrated the potential for interference from spaceborne SARs operating in the EESS into launch vehicle range safety command receivers. Considering the safety implications of interference into range safety command receivers from SARs operating in the EESS, co-frequency sharing is not feasible during a launch window. Such receivers operate in the band 449.75-450.25 MHz (No. **5.286**), as well as at frequencies in the ranges 420-430 MHz and 440-450 MHz with a 600 kHz bandwidth in the United States, and, in the band 433.75-434.25 MHz in India on a primary basis and certain countries in Region 2 on a secondary basis (No. **5.281**). Compatibility could be achieved by frequency avoidance or other interference avoidance measures.

2.10.3 Methods to satisfy the agenda item and their advantages and disadvantages

2.10.3.1 Method A

Allocation to EESS (active) with operational and technical regulatory constraints.

Two options can be considered for Method A. One indicates an exact band inside the range 420-470 MHz, the other does not indicate an exact band but leaves to WRC-03 the identification of the band.

2.10.3.1.1 Method A1

Allocate the band 432-438 MHz to EESS (active), based on the technical and operational constraints contained in DRR ITU-R SA.1260.

Advantage:

This would allow observation of significant tropical biomass or thickness of the Antarctic ice sheet and could avoid unacceptable interference to radiolocation, fixed, and mobile services.

Disadvantage:

The amateur services may suffer some interference in some areas, although within the limits established in relevant ITU-R Recommendations.

2.10.3.1.2 Method A2

Allocate 6 MHz to EESS (active) within the range 420-470 MHz, based on the technical and operational constraints contained in DRR ITU-R SA.1260.

Advantage:

This would allow observation of significant tropical biomass or thickness of the Antarctic ice sheet.

Disadvantage:

Depending on the exact band selected, some other radio services may suffer unacceptable interference.

2.10.3.2 Method B

Make no allocation to EESS (active) in the range 420-470 MHz.

Advantage:

No impact on existing services.

Disadvantage:

Without an allocation to EESS (active) in the 420-470 MHz range, important measurements needed for the systematic observation of forest cover, Antarctic ice thickness and desert moisture would not be possible using active spaceborne sensors.

2.10.4 Regulatory and procedural considerations

If an allocation to the Earth exploration-satellite (active) service is made in the 420-470 MHz frequency range, regulatory provisions based on DRR ITU-R SA.1260 will be needed to ensure protection of existing allocated services.

The following example footnote associated to the allocation in Article 5 could be considered:

5.XXX *The use of the band 4XX – 4YY MHz by the Earth exploration-satellite (active) service sensors shall be in accordance with Draft revision Recommendation ITU-R SA.1260 (Doc. 7/69).*

CHAPTER 3

Issues concerning fixed-satellite and broadcasting-satellite services

(WRC-03 agenda items 1.19, 1.27, 1.29, 1.30, 1.34, 1.35, 1.37, 1.39)

CONTENTS

Page

3.1 Agenda item 1.19

"to consider regulatory provisions to avoid misapplication of the non-GSO FSS single-entry limits in Article **22** based on the results of ITU-R studies carried out in accordance with Resolution **135 (WRC-2000)**"

3.1.1 Summary of technical and operational studies

WRC-2000 established in Article **22** single-entry epfd limits to be met by non-GSO FSS systems in certain parts of the frequency range 10.7-30.0 GHz to protect GSO FSS and GSO BSS networks.

The verification of conformance with the single entry epfd limits contained in Tables **22-1** to **22-3** (inclusive) of Article **22** forms an important part of the regulatory examination of any notice for a non-GSO FSS system, performed by the Radiocommunication Bureau under No. **11.31**, as referenced in Sections 2.6 to 2.6.6 of the Rules of Procedure.

Thus, the only reason for misapplication of these single entry epfd limits by artificially splitting or combining non-GSO FSS systems, will be to lower the epfd levels and therefore to get a favourable finding status as a result of this regulatory examination.

3.1.2 Analysis of the results of studies

The regulatory examination of any notice for stations in space services performed by BR under No. **11.31** includes, *inter alia*, conformity with mandatory provisions in Articles **21** and **22**, most of which deal with pfd which could be misapplied by artificially splitting and combining systems.

Furthermore, a limit, similar to those given in Table **22-3**, applicable to non-GSO FSS systems is contained in No. **22.5A** also, but that has not attracted any such concerns on possible misapplication.

The problem covered by agenda item 1.19 is not new or specific to certain non-GSO FSS systems.

3.1.3 Method to satisfy this agenda item

The problem raised by Resolution **135** (**WRC-2000**) is not new or specific to certain non-GSO FSS systems. No difficulties have been experienced so far with similar limits, which could be similarly misapplied. The current Radio Regulations are adequate.

No further studies are required therefore insofar as *"invite ITU-R"* section of Resolution **135** (**WRC-2000**) is concerned the Resolution may be suppressed.

3.1.4 Regulatory and procedural considerations

No further specific regulatory action is required.

#########

3.2 Agenda item 1.27

"to review, in accordance with Resolutions **540 (WRC-2000)** and **735 (WRC-2000)**, the ITU-R studies requested in those resolutions, and modify, as appropriate, the relevant regulatory procedures and associated sharing criteria contained in Appendices **30** and **30A** and in the associated provisions"

Resolution **540 (WRC-2000)**

Application and study of the regulatory procedures and associated sharing criteria contained in Appendices **30** and **30A** and in the associated provisions of Articles **9** and **11**.

Resolution **735 (WRC-2000)**

Sharing procedures and criteria between receiving earth stations in the broadcasting-satellite service and transmitting earth stations or terrestrial stations in frequency bands allocated to the broadcasting-satellite service and the fixed-satellite service (Earth-to-space) or to terrestrial services.

3.2.1 Introduction and summary

3.2.1.1 Scope of invited studies

Resolution **540 (WRC-2000)** invited the ITU-R to undertake, as a matter of urgency, additional studies and complete them by WRC-03 on the sharing criteria in Annexes 1, 3, 4 and 6 to Appendix **30** and Annexes 1 and 4 to Appendix **30A,** except for:

- the sharing criteria in Annex 1 to Appendix 30 that identify whether terrestrial services may be affected by BSS (*considering b)*); and
- the replacement for the method that was contained in Section 3 of Annex 4 to Appendix 30; namely, the method contained in Appendix S7 (*considering c)*),

taking into account

- that the sharing criteria in Appendices **30** and **30A** should provide appropriate protection to the BSS, FSS and terrestrial services whilst not unduly constraining the services involved (*considering g)*);
- that, worldwide, in various sub-bands of the frequency range 11.7-12.7 GHz, FSS networks as well as BSS networks are in operation, and others will be operated in the near future and, consequently, difficulties may be experienced in modifying their characteristics (*considering h)*);
- that there are differing geographic situations between the ITU Regions and that this may have an impact on the sharing criteria … (*recognizing* a)),

i) In addition to studying the sharing criteria, Resolution 540 invited the ITU-R to undertake additional studies of the changes made by WRC-2000 to the regulatory procedures contained in:

   a) Articles 4 and 5 to Appendices **30** and **30A** with a view to establishing a list of additional uses for Regions 1 and 3 and providing for its implementation, including the implications of §§ 4.1.18 - 4.1.20 on the assignments in conformity with the Plan;

   b) Articles 6 and 7 to Appendices **30** and **30A**, including related modifications to Articles **S9** and **S11** and the associated provisions of Appendix **5**,

   with a view to ensuring consistency among these provisions, as appropriate, taking into account that WRC-2000 also revised the regulatory procedures contained in Appendices **30** and **30A**, and the associated provisions in Articles **9** and **11** and associated Appendices.

ii) Like Resolution 540, Resolution **735 (WRC-2000)** also invited the ITU-R to study both sharing criteria and sharing procedures; but only those related to the coordination required by the WRC-2000 revision of No. **9.19** of terrestrial transmitters and/or transmitting earth stations with BSS earth stations in both planned and unplanned frequency bands that are shared among these services.

3.2.1.2 Summary

The results of the studies of sharing criteria under both Resolutions **540 (WRC-2000)** and **735 (WRC-2000)** are presented in § 3.2.2 below. The results of the corresponding studies of the regulatory procedures are presented in § 3.2.3.

Some administrations are strongly of the view that any action on sharing criteria referred to in § 3.2.2 should remain in abeyance until the question is resolved, of whether or not Nos. **4.1.18**, **4.1.18*bis*** and network grouping should be deleted.

Tables 3.2-8 and 3.2-9 were prepared by the Rapporteur for Chapter 3 of the draft CPM Report to provide a compact overview of the results of the ITU-R studies invited in support of WRC-03 agenda item 1.27. (These tables are to be considered at CPM02-2, November 2002.)

Table 3.2-8 characterizes the sharing criteria contained in each of the five Annexes to Appendix **30** that were identified for ITU-R study in Resolutions **540** and **735** and indicates possible WRC-03 actions based on the results of these studies. In particular, columns 2 to 5 of the table indicate, in each case, the pair of services and the frequency band(s) involved, describe the type of limits used to trigger coordination, and indicate the pertinent provision of the regulatory procedures. Column 6 indicates the possible WRC actions and Column 7 identifies the subsection of section 3.2 where the details of the studies are presented. Column 7 also highlighted cases where no studies were undertaken.

Notes to the table explain cases where additional studies are required, or decisions are to be taken, before revised sharing criteria can be agreed.

In the same manner, Table 3.2-9 summarizes the results of the ITU-R studies on the sharing criteria contained in the Annexes of Appendix **30A**.

3.2.2 Sharing criteria

3.2.2.1 Technical assumptions for reviewing the sharing criteria in Appendix 30

Resolution **540** invited study, *inter alia*, of Annex 6 to Appendix **30**, titled "Criteria for sharing between services". This Annex includes data on the protection ratio requirements for sharing between various transmissions and services in the BSS bands, an FSS reference antenna diameter for calculating interference from BSS space stations into the FSS, and data on the use of energy dispersal in the BSS. However, Annex 6 provides data only on systems using analogue transmission and has not been revised since it was written at WRC-77. As a result, it is largely irrelevant to the review of sharing criteria for current and future digital BSS and FSS systems.

Annex 6 could be maintained for historical purposes with a new title and the addition of a note explaining its role in establishing the original WARC–77 Plan and the associated sharing criteria. However, it is considered essential that there be an Annex to Appendix **30** that reflects the results of current ITU-R studies on the technical bases for the sharing criteria to be adopted by WRC-03.

These studies focused on the antenna patterns, transmission characteristics (antenna sizes and associated noise temperatures) and the protection levels that these criteria are intended to provide to the services involved.

a) Reference antenna patterns

The ITU-R studies considered the reference antenna patterns currently applicable for the protection of FSS or BSS in the Radio Regulations (Annex 3 to Appendix **8**, Section 3 of Annex 3 to Appendix **7**, Figures 7, 7*bis*, and 8 of Annex 5 to Appendix **30**) and in the relevant ITU-R Recommendations S.465-5, S.580-5 and BO.1213.

The studies included a review of the measurement data collected in the 1999-2000 time frame on small aperture receive earth station antennas ranging in size from 45 cm to 150 cm for the purpose of developing a suitable antenna pattern for protection of the BSS from interference received from non-GSO FSS systems (see Recommendation ITU-R BO.1443 and Report ITU-R BO.2029). Detailed analysis was performed on the measurement data relevant to the GSO-GSO sharing situation, including not only the data for the 0° scan plane, corresponding approximately to the GSO orbital plane, but also data for the 22.5º and 157.5º offset scan planes. The studies also included recent additional measurements provided by administrations on small BSS antennas and on small FSS antennas used simultaneously for transmission and reception.

Comparison of these data to the Recommendation ITU-R BO.1213 reference pattern indicated that more than 99% of the side lobe data complied with the Recommendation ITU-R BO.1213 pattern. On this basis, it could be concluded that the antenna reference patterns specified in the following Recommendation and Radio Regulations would serve as a basis to develop appropriate pfd masks for the protection of FSS and BSS:

- Recommendation ITU-R BO.1213 for FSS or BSS antennas with diameters between 45 cm and 240 cm.
- Recommendation ITU-R S.580-5, with 29-25logθ side lobe envelope, complemented in the main lobe by Annex 3 to Appendix **8** for FSS earth station antennas with diameters greater than 240 cm, which is equivalent to Section 3 of Annex 3 to Appendix **7** (WRC-2000).

Additional ITU-R studies, which are based on the results of two independent sets of measurements carried out by Canada and France for duplex feed antennas ranging from 0.75m to 1.2 m, confirm the above conclusions.

b) Antenna sizes and noise temperatures

It was concluded that any pfd mask intended for the protection of FSS or BSS needs to reflect current and future uses in the FSS or in the BSS, including the assignments using the nominal parameters of the Plans, and modifications of assignments of the Region 2 Plan and Region 1 and 3 lists in accordance to Article 4 of Appendices **30** and **30A**.

Table 3.2-1 provides the range of FSS or BSS receive antennas and associated noise temperatures which have been considered appropriate for this purpose. These are the same as retained by WRC-2000 in adopting the pfd mask contained in the Annex to Resolution **540 (WRC-2000)**. The total system receive noise temperature was calculated from the receive earth station noise temperature (which includes the antenna temperature, the receive amplifier temperature and the noise increase resulting from feeder losses), and adding 2 dB for all other sources of noise (uplink noise, GSO interference, cross polarization isolation and frequency reuse interference). Implicit in Table 3.2-1 is the fact that, as a result of the convergence between the technical parameters of BSS and FSS for smaller antennas, both services can be assumed to have the same characteristics in the common range of antenna diameters (0.45 m to 2.4 m).

TABLE 3.2-1

Range of antenna sizes and noise temperatures considered for the protection of FSS and for the protection of BSS in addition to nominal assignments in the Plans

Receive earth station antenna diameter (m)	0.45*	0.60	0.80	1.20	2.4	5.0	8.0	11.0
Receive earth station noise temperature (K)	110	110	125	150	150	200	250	250
Total link noise temperature (K)	174	174	198	238	238	317	396	396
* The inclusion of the 45 cm diameter in the range of antennas to be protected has not been agreed in all cases (see Table 3.2-3), since Regions 1 and 3 BSS Plan is based on 60 cm antennas, and since the use of smaller antennas in the FSS is generally constrained by the use of 2 or 3° orbital spacing.								

c) Protection criteria

ΔT/T approach

This approach determines an allowable interfering pfd limit (pfd_{all}) by specifying an allowable percentage increase in the receive link noise temperature due to interference. It is an attractive approach as it requires a minimum number of system parameters to be specified and is particularly appropriate in the case of digital systems where interference is noise-like in terms of its impact on system performance. The allowable interfering pfd is given by:

$$pfd_{all}(\theta) = 10Log(\Delta T/T) + 10Log(kT\ b_{rf}) + G_m - G_a(\varphi)$$

where:

$pfd_{all}(\theta)$ = allowable level of interfering pfd for an orbital separation of θ degrees

$\Delta T/T$ = allowable relative increase in receiver link noise

k = Boltzmann's constant (1.38×10^{-23} watt·sec/°K)

T = Total link noise temperature (K; see Table 3.2-1)

b_{rf} = Reference bandwidth (27 MHz in Regions 1 and 3; 24 MHz in Region 2)

G_m = Gain of a 1 m^2 effective aperture (dBi/m^2)

$G_a(\varphi)$ = Receive antenna gain (dBi) for topocentric angle φ

φ = Topocentric angle (in degrees) between interfering and wanted satellites (see Annex 1 of Appendix 8 of the Radio Regulations)

Note that for a specified ($\Delta T/T$), b_{rf} and T the allowable interfering pfd is only a function of the earth station receive antenna gain which is a function of satellite orbital separation. Furthermore in these studies, it was assumed that $\varphi = 1.1\ \theta$.

The approach that was taken at WRC-2000 when developing the pfd mask in the Annex to Resolution **540 (WRC-2000)** to protect the FSS from BSS in another Region was to determine the pfd levels required to provide a maximum of 4% relative noise increase ($\Delta T/T$) into the range of representative FSS earth station antennas given in Table 3.2-1 above, assuming however antenna diagrams as per Annex 3 of Appendix 8.

C/I (Protection Ratio) approach

This approach determines an allowable interfering pfd_{all} level based on meeting a Protection Ratio (PR) objective, which translates into a Carrier-to-Interference ratio (C/I), at the receiver. This Protection Ratio, when combined with the Carrier-to-total Noise $(C/N)_T$, determines the quality of the received television signal which was one of the fundamental criteria when the BSS Plans were developed. The approach is useful for establishing allowable interference levels in systems where interference does not have the same impact as noise on the signal quality such as the case of analogue television transmission. The allowable interfering pfd level (pfd_{all}) can be determined from the following equations:

$$(C/I) = PR$$

$$pfd_{all}(\theta) = pfd_W - PR + D_a(\varphi)$$

where:

PR	=	protection ratio required to meet picture quality objective (dB)
$pfd_{all}(\theta)$	=	allowable interfering pfd at orbital separation of θ degrees
pfd_W	=	wanted signal pfd
$D_a(\varphi)$	=	receive antenna discrimination (dB) for off-axis angle φ
φ	=	topocentric angle between interfering and wanted satellites (see Annex 1 of Appendix 8 of the Radio Regulations)

This approach was taken at WARC-77 and later at RARC-83 for establishing the BSS Plans. It was also used in developing the pfd masks included in Annexes 4 and 1 to Appendix **30** to protect the BSS in one Region from the FSS or BSS in another Region respectively, assuming a single entry C/I criterion equal to the nominal C/(N+I) aggregate level in the Plan, plus 5 dB, assuming a nominal assignment in Regions 1 and 3 BSS Plan (e.g. a wanted pfd of –103 dB(W/(m^2 · 27 MHz)) and a 90 cm antenna with a pattern as given in Figure 7 of Appendix **30**).

The same approach was adopted by WRC-2000 when developing the pfd mask, which is now in Section 1 of Annex 1 of Appendix **30**, to protect the BSS Plan and List in Regions 1 and 3 from new assignments in the Regions 1 and 3 List. In adopting this approach, WRC-2000 took into account the changes which had occurred since 1977 in the characteristics of the Plan, i.e. a reduced C/(N+I) aggregate level, a reduced wanted pfd of –108 dB(W/(m^2 · 27 MHz)), a reduced antenna diameter (60 cm) and an improved antenna radiation pattern as given in Figure 7*bis* of Annex 5 to Appendix **30** (also Recommendation ITU-R BO.1213). This pfd mask also takes into account a range of BSS antenna sizes from 60 cm to 240 cm, under the assumption that the satellite e.i.r.p. is adjusted so that the link quality is the same for all diameters. Table 3.2-2 provides a summary of the nominal parameters of the Plans including, for Region 2, subsequent modifications to the Plans, with the associated protection requirements used under this approach.

TABLE 3.2-2

Summary of nominal characteristics and co-channel C/I protection requirements in Appendix 30 (using Annex 6 of Appendix 30 (WRC-2000)*

	Regions 1 and 3 WARC-77 Plan, individual reception	**Regions 1 and 3 WARC-77 Plan, community reception**	**Regions 1 and 3 "new" Plan (WRC-2000) (digital to digital interference)**	**Region 2 Plan (Original) (Overall protection)**	**Region 2 Plan Modifications (Overall protection)**
BSS receive antenna diam (m)	0.9	1.8	0.6	1.0	0.45 to 2.4
BSS receive antenna pattern	Fig. 7 of Annex 5 of App. **30**	Fig. 7 of Annex 5 of App. **30**	Fig. 7*bis* of Annex 5 of App. **30**	Fig. 8 of Annex 5 of App. **30**	Fig. 7*bis* of Annex 5 of App. **30**
Pfd wanted dB(W/m^2)	–103	–111	–108	–107	–116 to –107
Bandwidth (MHz)	27	27	27	24	24
C/I aggregate (dB)	31	31	21	28	28
C/I single entry[1] required (dB)	36	36	26	33	33

[1] The $(C/I)_{single\ entry}$ parameter was used mainly as a planning tool in synthesizing the Plans and is not necessarily an appropriate criterion to consider for modifying the assignments in accordance to Article 4.

* Other values of parameters can also occur in the assignments of Appendix **30.**

Approach selected

The ITU-R studies concluded that either approach used by WRC-2000 (ΔT/T or C/I) may be used in arriving at suitable pfd masks to protect the BSS or the FSS, also taking into account the need to extend these two approaches to cover a range of advanced digital modulations and coding rates that may be used in the future for both BSS and FSS. These studies also concluded that the ΔT/T approach, using a 6% noise increase criterion for the range of antennas provided in Table 3.2-1, would be appropriate, and that it led to results very similar to those of the C/I approach, taking into account advanced digital modulations.

Assessment of the aggregate interference

Both approaches considered above rely on a single-entry criterion. Concern was expressed during the studies that these approaches may not provide sufficient protection against potentially unlimited aggregation of interference from multiple networks, each being allowed to produce the specified single-entry level, in particular for large orbital separations corresponding to the plateau region of the masks, e.g. greater than 10°, where most of interferers are expected to be located.

One way of addressing this concern would be the use of an aggregate interference criterion, such as the criterion used in Annex 1 of Appendix **30** to protect Region 2 Plan assignments from proposed modifications to that Plan or to protect Regions 1 and 3 Plan assignments from proposed additions/modifications to the Regions 1 and 3 List. This criterion is based on limiting the degradation caused to the Equivalent Protection Margin (EPM) for Regions 1 and 3, or to the Overall Equivalent Protection Margin (OEPM) for Region 2. Although this may be suited for the protection of the BSS within the same Regional Plan (i.e. intra-Plan protection), it raises difficulties for inter-Plan, or inter-service application, due to its complexity, its time-varying nature and the use of different protection criteria for intra-Plan protection of assignments.

Another way of addressing the concerns in respect of the aggregate interference is to limit the single-entry interference allowance for large orbital separations. This approach was the basis for the WRC-2000 decision to limit the pfd mask included in the Annex to Resolution **540 (WRC-2000)** to a plateau of –111 dB(W/($m^2 \cdot 27$ MHz)) and –115 dB(W/($m^2 \cdot 27$ MHz)), for the protection of the FSS in Region 2 and in Region 3 respectively, against BSS interference. However, a plateau limit of –103.6 dB(W/($m^2 \cdot 27$ MHz)) was also adopted by WRC-2000 in Section 1 of Annex 1 of Appendix **30 (WRC-2000)**, for the protection of Regions 1 and 3 BSS Plan assignments against new or modified entries in the List.

Further detailed studies concluded that this plateau of –103.6 dB(W/($m^2 \cdot 27$ MHz)) should provide sufficient protection against aggregation of interference by multiple networks, for both BSS and FSS considering that, for satellite orbital separations greater than 15º, this value provides a 5 to 10 dB margin for practically all antennas of 45 cm diameter or greater.

3.2.2.2 Appendix 30 Criteria for intra-Regional BSS - BSS Sharing

This section concerns BSS/BSS sharing between assignments:

A. within the Regions 1 and 3 Plan,

B. of the Regions 1 and 3 Plan and the Regions 1 and 3 List,

C. within the Region 2 Plan.

The current criteria for these intra-service sharing situations are specified in various sections of the Annexes of Appendix **30**, as follows:

a) Section 2 of Annex 1 to Appendix 30 provides the criterion for case C, specifying an OEPM degradation threshold limit of 0.25 dB, for the protection of BSS assignments within the Region 2 Plan against proposed modifications of that Plan.

There was a consensus among Region 2 administrations participating in the ITU-R studies, that the current OEPM degradation limit of 0.25 dB was appropriate and should be maintained.

It was considered that there would be a need, in the case where a BSS assignment in the Region 2 Plan contained in Appendix **30** is used in conjunction with a feeder-link assignment which is not using the 17.3-17.8 GHz band subject to Appendix **30A**, to calculate the OEPM degradation by assuming no degradation due to the feeder link (i.e. the OEPM would consist only of the downlink EPM). It was also considered that this issue is a conference issue and is outside the mandate of Study Groups.

b) Section 1 of Annex 1 to Appendix 30, as revised by WRC-2000, provides the criteria for cases A and B:

- the pfd cannot exceed –103.6 dB(W/($m^2 \cdot 27$ MHz))
- an administration is considered affected if the minimum orbital spacing is less than 9° and if the EPM degradation exceeds 0.45 dB and the pfd within the service area exceeds the following values (for the protection of digital transmissions):

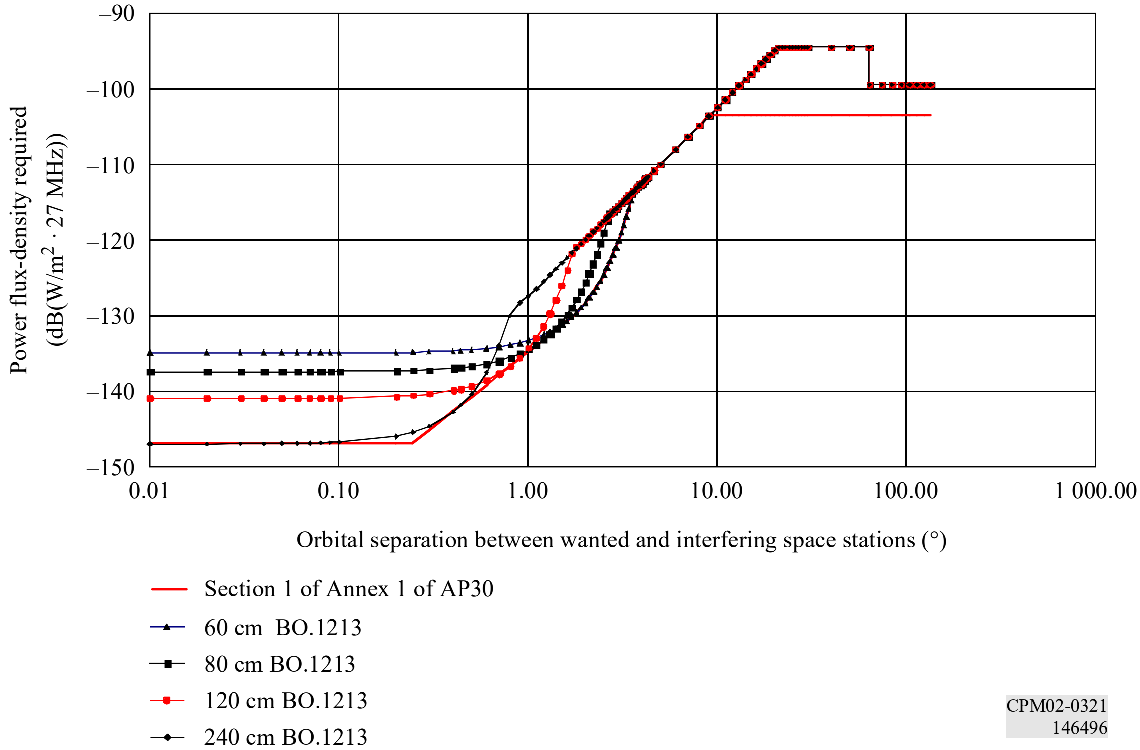
-147	dB(W/($m^2 \cdot 27$ MHz))	for	$0° \leq \theta < 0.245°$
$-134.8 + 20 \log \theta$	dB(W/($m^2 \cdot 27$ MHz))	for	$0.245° \leq \theta < 1.7°$
$-135 + 1.66\,\theta^2$	dB(W/($m^2 \cdot 27$ MHz))	for	$1.7° \leq \theta < 3.6°$

$-127.5 + 25 \log \theta$ dB(W/(m^2 · 27 MHz)) for 3.6° $\leq \theta < 9°$

This pfd mask is shown in Figure 3.2-1. It was generated at WRC-2000 with the aim of protecting the nominal characteristics of the Regions 1 and 3 Plan, as well as a range of antennas from 60 cm to 240 cm, that may be used for community reception or for assignments in the Regions 1 and 3 List.

FIGURE 3.2-1

Protection requirements for 60 cm to 240 cm antennas
(*C/I* requirement = 27 dB, reference –108 dB(W/m² · 27 MHz), 60 cm)*



* In this figure and subsequent figures, the actual mask in each case is the lower bound of the group of curves.

The protection of these antennas is based on the assumption that the wanted pfd is reduced dB per dB with increasing receive antenna gain, in such a way that the performance of the link is maintained constant corresponding to that using the nominal Plan transmission parameters; hence the protection criterion is the same, i.e. a C/I single- entry of 27 dB[1]. The permissible interfering pfd limit is calculated with the same formula in all cases:

$$\text{Interfering pfd limit } (\theta) = \text{pfd wanted} - 27 + \Delta G\ (\theta)$$

Where ΔG (θ) is the off-axis angular discrimination for the corresponding topocentric angle for the antenna size considered, assumed to be compliant with Recommendation ITU-R BO.1213 (or Figure 7*bis* of Annex 5 of Appendix **30**).

In adopting the mask contained in Section 1 of Annex 1 of Appendix **30 (Rev.WRC-2000)**, the following objectives were considered:

[1] This value of 27 dB was taken at WRC-2000 under the assumption of a wanted aggregate downlink C/I of 22 dB, which was subsequently modified by WRC-2000, to 21 dB.

- to avoid providing assignments in the List with a protection level different from that of the Plan. The main concern was that the use of non-standard parameters for assignments included in the List may unduly constrain the entry into the List of future assignments, even if the former assignments have obtained all the agreements necessary to enter in the List. In particular, it was agreed not to protect antennas smaller than 60 cm;
- to avoid unnecessary coordinations by limiting the range of orbital separations in which coordination may be required. This was accomplished by limiting the maximum value of pfd of –103.6 dB(W/(m^2 · 27 MHz)) which corresponds to the value of the pfd mask in Section 1 of Annex 1 to Appendix **30 (Rev.WRC-2000)** for the orbital separation of 9°. Selecting this value ensures that in all cases the interference outside the 9° arc will not exceeed the permissible values, hence no coordination is required outside this arc;
- in order to maintain efficient use of spectrum, an off-axis antenna gain pattern corresponding to that specified in Recommendation ITU-R BO.1213 was adopted;
- in order to avoid entries in the List that would prevent the use of the same orbital position by future entrants, a maximum antenna diameter was used. The value of 2.4 m was selected for consistency with the mask in Annex 4 to Appendix **30**, which uses the same on-axis pfd level of –147 dB(W/(m^2 · 27 MHz)). This does not preclude the use of larger antennas, but only means they will be protected only to this level;
- in order to avoid entries in the List that would prevent the use of adjacent orbital locations, the protection of antenna sizes smaller than 60 cm was avoided. This does not preclude the use of smaller antennas, but only means they will be protected only to the level afforded to the 60 cm antenna.

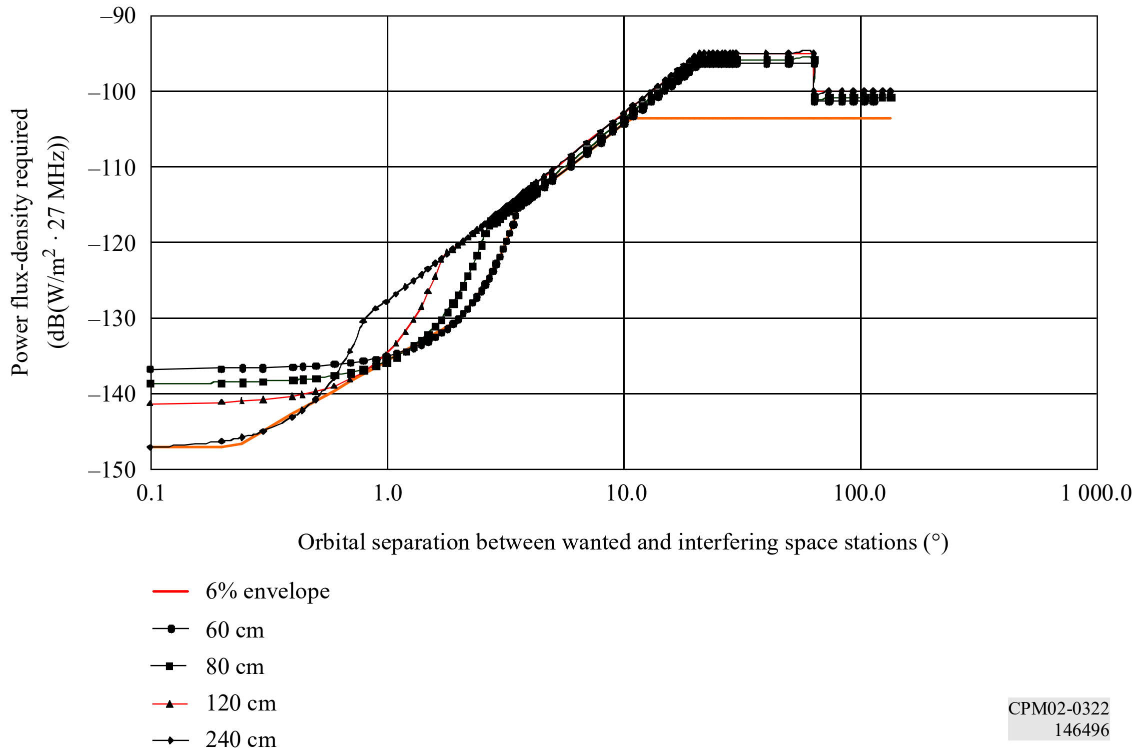
Concern was expressed during WRC-2000 that the way in which the pfd mask of Section 1 of Annex 1 of Appendix **30 (Rev.WRC-2000)** was developed, i.e. scaling down the BSS pfd requirement from a reference set corresponding to a satellite e.i.r.p. of 56 dBW and a receive antenna of 60 cm, may not be adequate, since current systems use 60 cm with e.i.r.p. levels close to 50 dBW.

Discussions carried out by the ITU-R since WRC-2000 have shown that adequate protection may be given to assignments in the List by adopting the pfd mask given in Section 3.2.2.3 a) (BSS protection), which is based on a 6% noise increase criterion, and on the protection of a range of antennas from 60 cm to 240 cm associated to receive noise temperatures given in Table 3.2-1.

Figure 3.2-2 illustrates that this mask is the envelope of pfd masks corresponding to various antenna diameters.

FIGURE 3.2-2

**pfd masks corresponding to a 6% noise increase
(BO.1213 pattern)**

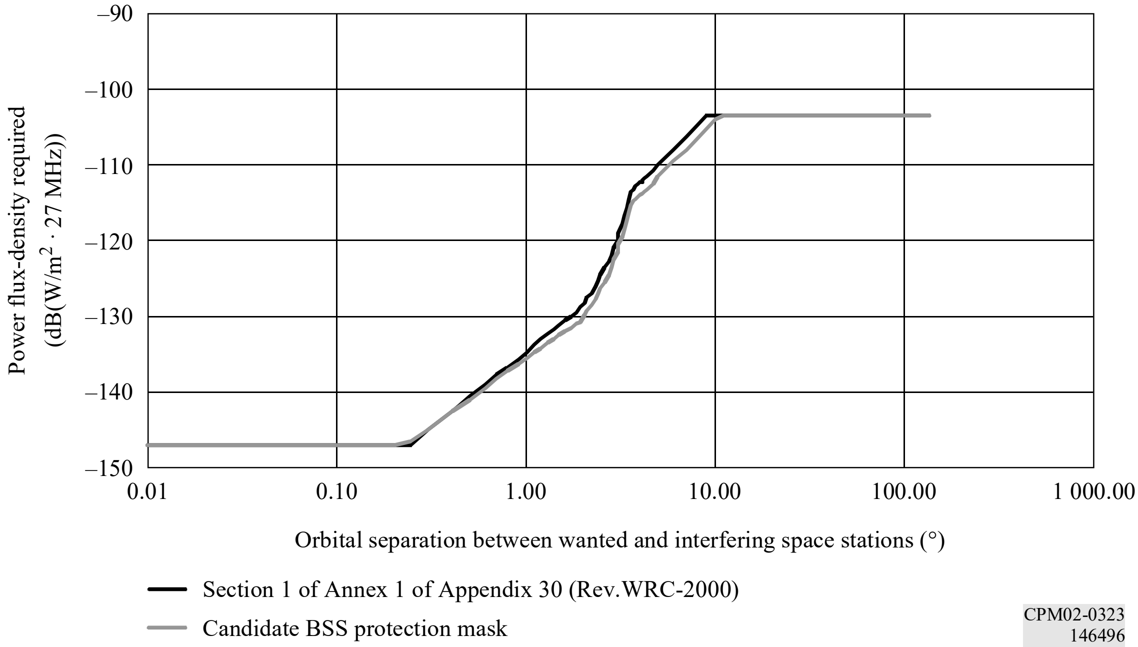


As can be seen from Figure 3.2-3, which compares the masks in Figures 3.2-1 and 3.2-2, the pfd mask under consideration provides up to 1.7 dB better protection to the nominal assignments in the Plan (60 cm antenna, –108 dB(W/(m^2 · 27 MHz)) wanted pfd) than the pfd mask adopted by WRC-2000 in Section 1 of Annex 1 to Appendix **30 (WRC-2000)**. It could therefore be advantageous to adopt this mask as a replacement for that in Section 1 of Annex 1 of Appendix **30**.

Some countries in Region 3 also consider that the protection of 45 cm antennas for the BSS is necessary, because of the large number of such antennas currently deployed in these countries. This could be incorporated in the above mask as indicated in the equations given section 3.2.2.3 b) (BSS protection) and shown in Figure 3.2-5, based on a 6% noise increase and Recommendation ITU-R BO.1213 antenna pattern.

FIGURE 3.2-3

Comparison of current and candidate pfd masks protection of BSS for Regions 1



3.2.2.3 Appendix 30 criteria for interregional sharing

The current criteria for interregional sharing in Appendix **30** are specified in various sections of the Annexes to Appendix **30**:

a) Annex 1, Section 3 specifies a pfd mask for the protection of the BSS subject to one of the Regional Plans from BSS Plan modifications or proposed new or modified assignments in the List in another Region (interregional sharing between planned bands including the 12.5–12.7 GHz band sharing between Region 2 plan and Region 3 un-planned band).

b) Annex 1, Section 6 (provisionally replaced by the Annex to Resolution **540 (WRC-2000)**) specifies a pfd mask for the protection of the FSS in one Region from BSS Plan modifications or proposed new or modified assignments in the List in another Region (interregional sharing between FSS downlinks and BSS).

c) Annex 1, Section 7 specifies a $\Delta T/T$ limit of 4% to protect FSS receive space stations in Region 1 from BSS Plan modifications in Region 2 (interregional sharing between FSS uplinks and BSS in the 12.5–12.7 GHz band).

d) Annex 4 specifies a pfd mask to protect the BSS in one Region from FSS or non-planned BSS in another Region (interregional sharing between BSS and FSS downlinks).

The ITU-R studies reviewed the protection criteria contained in these Sections of Appendix **30**, taking into account:

- the changes which occurred to the parameters and protection objectives of Plans since 1977;
- the need to protect BSS transmissions that may be entered in the Region 2 Plan or in the Regions 1 and 3 List, while ensuring efficient use of spectrum/orbit resources;
- that WRC-2000 requested in Resolution **540 (WRC-2000)** for the ITU-R to conduct this review considering that the sharing criteria in Appendices **30** and **30A** should provide

appropriate protection to the BSS, FSS, and terrestrial services whilst not unduly constraining the services involved;

- the desirability, in order to facilitate the coordination where Annex 4 protection levels are exceeded, to have an ITU-R Recommendation for use by administrations in their bilateral coordination, that would contain guidelines and methodology on power flux-density levels for the protection of individual BSS systems when the Annex 4 limits are exceeded. Such a Recommendation is also being developed.

  The impact of Nos. 4.1.18 and 4.1.18*bis* of Art. 4 of **AP30** and the need to avoid monopolization of orbital and spectrum resources, in particular by grouping of multiple networks on one orbital position is addressed in Section 3.2.3 and requires further study.

- with respect to the criterion in Section 7 of Annex 1 to Appendix **30**, the studies concluded that the current ΔT/T limit of 4% to protect FSS receive space stations in Region 1 against BSS Plan modifications in Region 2 could be relaxed to 6%.

With respect to the pfd masks contained in the other Sections of Appendix **30**, in view of the conclusions reported in the previous Section, possible alternatives to these pfd masks were developed, on the basis of a protection criterion of 6% noise increase, the antenna reference patterns given in Section 3.2.2.1 above, and the range of antennas and associated noise temperatures given in Table 3.2-1, as follows:

- For the protection of BSS: antenna diameters from 45/60 cm to 240 cm
- For the protection of FSS: antenna diameters from 45/60 cm to 11m.

Selection of the minimum antenna size to be included in the pfd mask

Depending on whether 45 cm or 60 cm is taken into account as the minimum antenna size, the corresponding pfd masks only differ in the range 2.0-5.0° of orbital separations, with a maximum difference of 7.2 dB for an orbital separation of 3.6° between the interfering and wanted space stations, as shown in Figure 3.2-1. Selection of the 45 cm antenna size would therefore translate into a reduction of up to 7.2 dB in permissible FSS/BSS interfering space station pfd in this range of orbital separation, compared with the selection of the 60 cm mask.

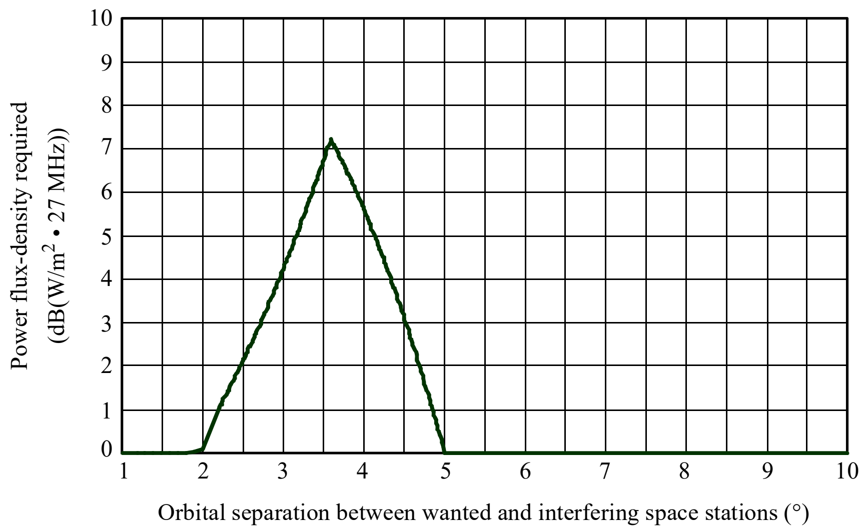
Differing views emerged as to the appropriateness of selecting 45 cm or 60 cm as the minimum size of antenna to be taken into account in deriving possible alternatives to the relevant pfd masks:

- Some administrations from Region 2 considered that the protection of the 45 cm antenna was essential for the protection of the Region 2 original BSS Plan assignments and their modifications including implemented systems where this size antenna is widely used. These administrations are also of the view that application of interregional reciprocity without an operational or technical basis may lead to unnecessary constraints on services.
- Some countries in Region 3 considered that the protection of 45 cm antennas for Region 3 BSS was necessary provided that the BSS is limited to national service area only, because the Regions 1 and 3 Plan was basically designed with 6° spacing, hence the protection of 45 cm antennas is ensured from the other assignments in the Regions 1 and 3 BSS Plan.
- Some countries in Region 3 considered that the protection of 45 cm antennas for the FSS in Region 3 was necessary. These countries also consider that the 45 cm pfd mask will satisfactorily reduce the number of "unnecessary" coordinations from the current pfd mask in Annex 1 of Appendix 30, as illustrated in Table 3.2.4 of this Report and selecting the 60 cm pfd mask would result in serious difficulties for their existing FSS networks in Region 3. These countries do not consider that interregional reciprocity should be applied.

- Some Regions 1 and 3 countries considered that the mutual protection of BSS and FSS within Regions 1 and 3 would need to be based on the 60 cm mask. Whilst recognizing that antenna sizes as small as 45 cm are currently used in some Region 3 countries, these countries noted that in practice, the protection given to these antennas either within the BSS or within the FSS was much smaller than what would be afforded by taking this size into account in the pfd mask. This is shown in Figure 3.2-2 for BSS (where going to the 45 cm mask could only increase the difference between the two curves) and in Figure 3.2-3 for FSS. These countries therefore considered that selection of the 45 cm size would make access to orbit/spectrum resources more difficult for future comers in both services, and result in less efficient use of these resources and unnecessary coordination requirements on both the FSS or the BSS. These countries also consider that interregional reciprocity should be applied.
- Some administrations of Region 1 do not agree on the principle of interregional reciprocity unless operational and technical bases for such reciprocity are identified.

FIGURE 3.2-1

Difference between the pfd masks based on 45 cm and 60 cm



CPM02-245-0322
(154983)

FIGURE 3.2-2

Example of permissible single entry C/I into assignments in the Plan (left hand) and in the List or under the Article 4 process (right-hand part) for angular separations 2-5°

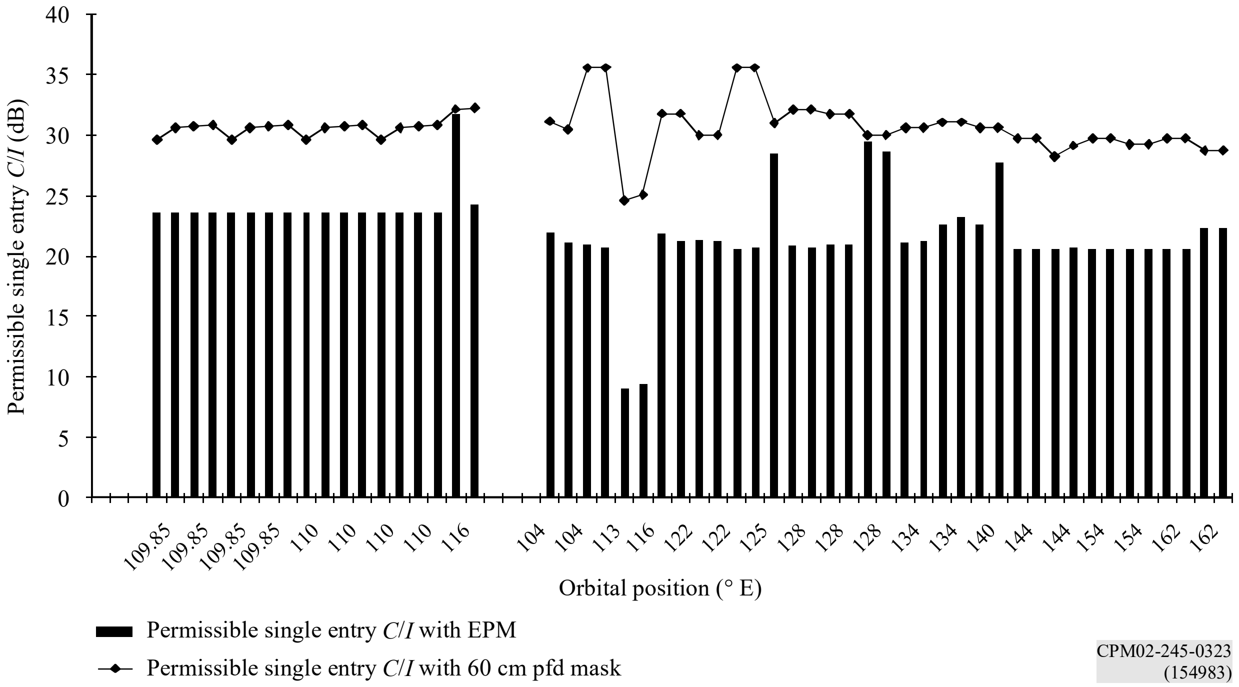
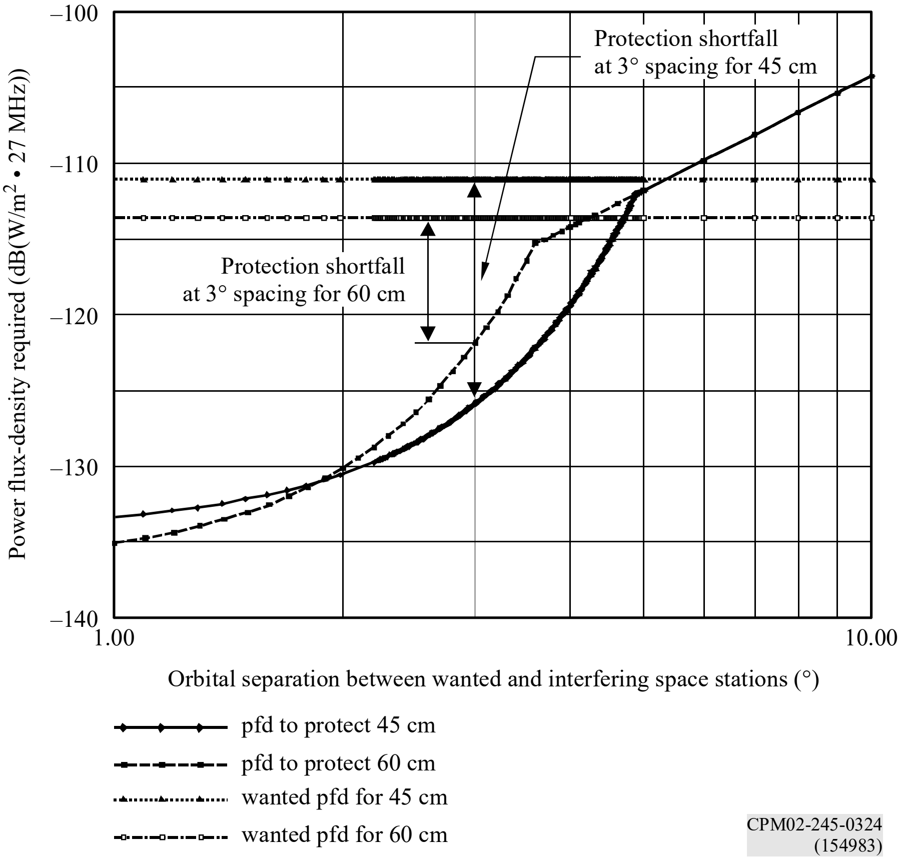


FIGURE 3.2-3

Pfd reqiured to protect 45/60 cm FSS antennas (BO1213, 6% noise increase) and to provide service to them



Another aspect to consider as a possible means of reducing the number of masks to be specified, is the sensitivity of the power flux-density limit on frequency. Considering the expression that determines the maximum allowable power flux-density (pfd_{all}) for a specified value of ($\Delta T/T$) (see Section 3.2.2.1 above) the only frequency-dependent terms are G_m, the gain of 1 m^2 effective aperture and $G_a(\varphi)$, the antenna gain in the main-lobe region only (note that the gain in the side-lobe and back-lobe regions are not frequency dependent). Hence in the main-lobe region, the frequency-dependent term cancels and pfd_{all} is independent of frequency. In the side-lobe and back-lobe regions, the pfd_{all} varies with frequency according to the G_m term. Therefore in these regions the difference in pfd_{all} between 12.2 GHz and 11.7 GHz is less than 0.4 dB. Also, considering the proposed pfd masks, this variance in pfd_{all} . only occurs in the side-lobe region of the smallest antenna being considered (i.e. between 5.0º-10.57º for the proposed 45 cm mask and between 3.59º-10.57º for the 60 cm proposed mask). For these reasons, and considering the expressed desire to converge towards a common mask, or minimum number of variations, only one frequency will be considered for generating the masks, i.e. 11.7 GHz.

Pending a decision on the minimum-size antenna that may be protected, the ITU-R studies concluded that the current pfd masks related to interregional sharing appearing in Sections 3 and 6 of Annex 1 and in Annex 4 to Appendix **30** may be replaced by one or both of the following masks (see Figures 3.2-4 and 3.2-5):

a) Proposed pfd mask for protection of BSS/FSS antennas down to 60 cm (protection: FSS antenna 0.6 m ≤ D ≤ 11 m; BSS antenna 0.6 m ≤ D ≤ 240 cm)

For FSS protection only[3]:

-158.2 dB(W/(m^2 · 27 MHz))	for	$0° \le \theta < 0.054°$
$-135.7 + 17.74 \log \theta$ dB(W/(m^2 · 27 MHz))	for	$0.054° \le \theta < 0.23°$

For FSS and BSS protection:

-147 dB(W/(m^2 · 27 MHz))	for	$0° \le \theta < 0.23°$
$-135.7 + 17.74 \log \theta$ dB(W/(m^2 · 27 MHz))	for	$0.23° \le \theta < 2.0°$
$-136.7 + 1.66\ \theta^2$ dB(W/(m^2 · 27 MHz))	for	$2.0° \le \theta < 3.59°$
$-129.2 + 25 \log \theta$ dB(W/(m^2 · 27 MHz))	for	$3.59° \le \theta < 10.57°$
-103.6 dB(W/(m^2 · 27 MHz))	for	$10.57° \le \theta$

where θ is the minimum geocentric orbital separation between the wanted and interfering space stations taking into account the respective East-West station keeping accuracies.

Figure 3.2-4 shows the proposed 60 cm FSS/BSS masks and demonstrates that it consists of the envelope of the masks required to protect a range of antenna sizes from 11 metres down to 60 cm.

b) Proposed pfd mask for protection of BSS/FSS antennas down to 45 cm (protection: FSS antenna 0.45 m ≤ D ≤ 11 m; BSS antenna 0.45m ≤ D ≤ 240 cm) For FSS protection only[3]:

-158.2 dB(W/(m^2 · 27 MHz))	for	$0° \le \theta < 0.054°$
$-135.7 + 17.74 \log \theta$ dB(W/(m^2 · 27 MHz))	for	$0.054° \le \theta < 0.23°$

For FSS and BSS protection:

-147 dB(W/(m^2 · 27 MHz))	for	$0° \le \theta < 0.23°$
$-135.7 + 17.74 \log \theta$ dB(W/(m^2 · 27 MHz))	for	$0.23° \le \theta < 1.8°$
$-134.0 + 0.89\ \theta^2$ dB(W/(m^2 · 27 MHz))	for	$1.8° \le \theta < 5.0°$
$-129.2 + 25 \log \theta$ dB(W/(m^2 · 27 MHz))	for	$5.0° \le \theta < 10.57°$
-103.6 dB(W/(m^2 · 27 MHz))	for	$10.57° \le \theta$

where θ is the minimum geocentric orbital separation between the wanted and interfering space stations taking into account the respective East-West station keeping accuracies.

---

[3] As the FSS also uses narrow-band transmissions the pfd should be expressed in units of dB(W/(m^2/40 kHz)). This requires reducing the pfd value by 10Log(27000/40) = 28.3 dB.

FIGURE 3.2-4

Proposed pfd mask for inter-regional FSS/BSS protection
(60 cm - 11 m)

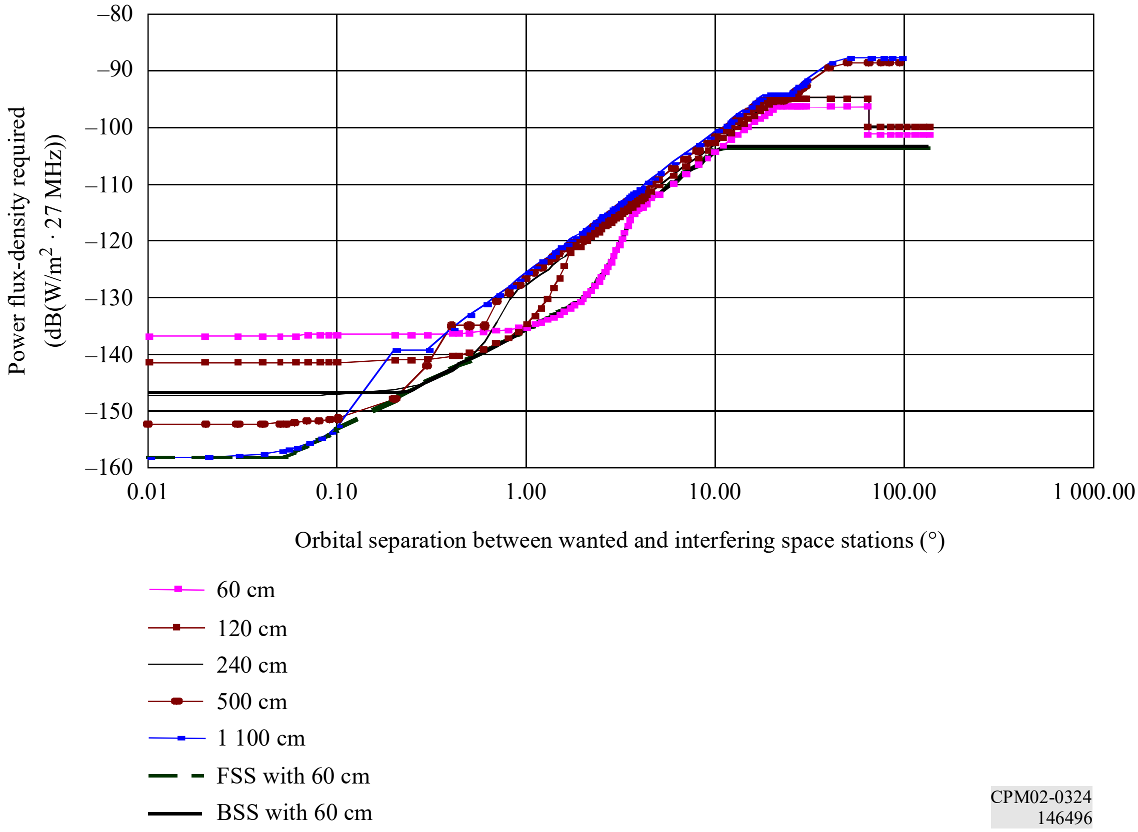


FIGURE 3.2-5

Proposed pfd mask for inter-regional FSS/BSS protection
(45 cm - 11 m)

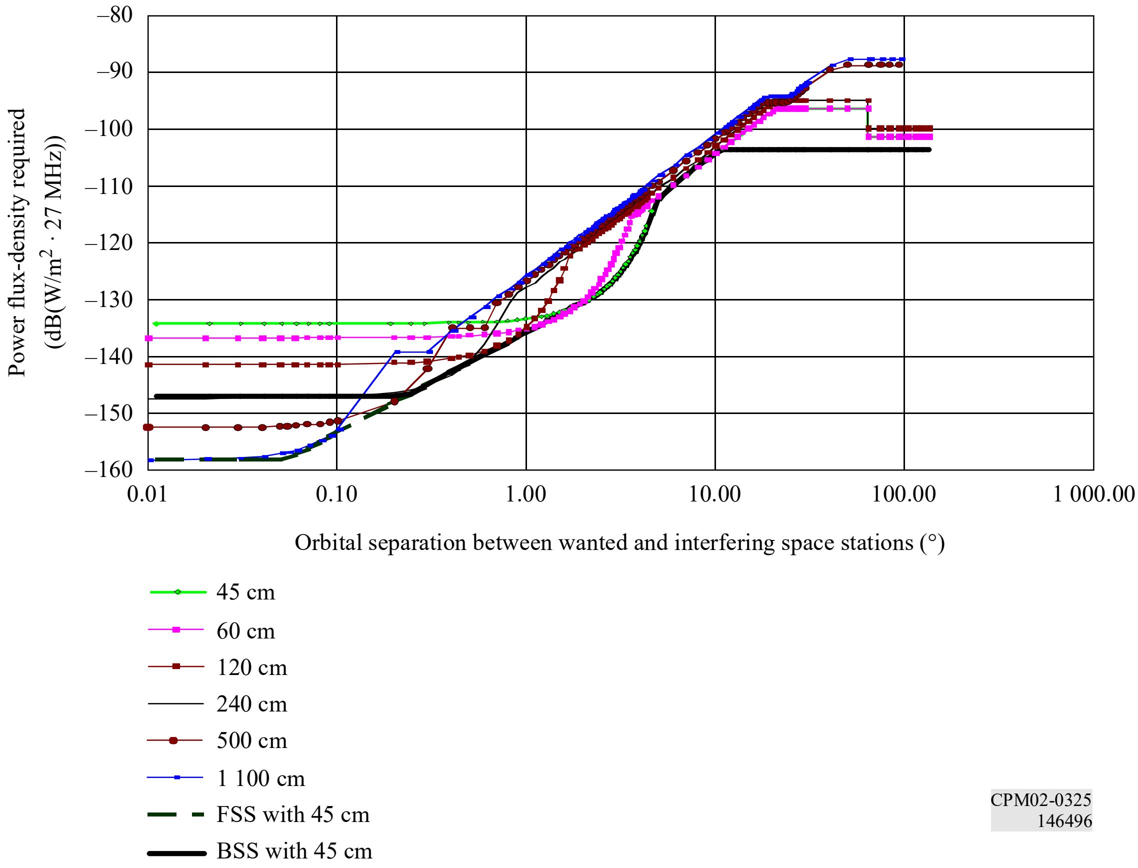


Figure 3.2-5 shows the 45 cm FSS/BSS masks and demonstrates that it consists of the envelope of the masks required to protect a range of antenna sizes from 11 metres down to 45 cm.

These proposed masks would provide for the protection of transmissions in the Regions 1 and 3 Plan, in the Regions 1 and 3 List and in the Region 2 Plan and its modifications, from interference caused by FSS or by the other Regional BSS Plan.

Also, the ITU-R studies concluded that there would be a need for grandfathering of certain types of transmissions brought into service prior to certain dates.

Some administrations are of the view that further studies are needed because the pfd mask in §§ 3.2.2.3 a) and b) only apply for a particular range of latitudes for which the assumption that "the topocentric angle is equal to 1.1 times the geocentric angle" is valid.

Some administrations considered that another possibility would be to retain the existing pfd masks in Appendix **30**, noting in particular that the current mask in Annex 4 of Appendix **30** would provide a better protection for the BSS Plan than the alternative masks proposed above. It was noted however, that this would have several disadvantages:

- Keeping the current masks for the BSS protection would, protect assignments using antennas down to 10 cm in diameter, a situation which would clearly not represent efficient use of orbit/spectrum resources and would encourage monopolization of resources by non-standard uses in the List.

- Keeping the current masks would maintain undue constraints on both the FSS and the planned and non-planned BSS, and would make the use of the assignments in conformity with the Plan very difficult for many countries. As an illustration of that, Table 3.2-1 highlights the benefit that the adoption of the proposed masks would provide on reducing the number of coordinations required in bringing the assignments of the Regions 1 and 3 Plan into service. It should be noted that this issue is also connected to agenda item 1.35.

TABLE 3.2-1

Impact of the adoption of alternative relaxed sharing criteria on the evaluation of the coordination requirements of the new Appendix 30 Plan for Regions 1 and 3 with the FSS

Sharing criteria	**Article 11 of AP 30 (current pfd masks in Annex 1 of Resolution 540) (WRC-2000)**	**Proposed pfd mask (with 45 cm FSS minimum antenna size)**	**Proposed pfd mask (with 60 cm FSS minimum antenna size)**
Number of Region 2 FSS networks identified as affected by the Regions 1 and 3 Plan (WRC-2000)	**796**	**164**	**160**
Number of Region 3 FSS networks identified as affected by the Regions 1 and 3 Plan (WRC-2000)	**2 100**	**207**	**205**

Table 3.2-2 provides the result of a similar study in the other direction of operation, i.e. from FSS and non-planned BSS into BSS Plan and the List, in order to evaluate the impact of candidate sharing criteria in terms of coordination requirements.

TABLE 3.2-2

Impact of the adoption of alternative relaxed sharing criteria on the evaluation of the coordination requirements of FSS/non-planned BSS with the Appendix 30 Plans and List

Sharing Criteria		Annex 4 of Appendix 30	Proposed pfd mask (with 45 cm BSS minimum antenna size)	Proposed pfd mask (with 60 cm BSS minimum antenna size)
R1	Number of coordinations required with BSS beams in the Region 1 Plan	4	2	2
	Number of coordinations required with BSS beams in the Region 1 List	264	198	184
	Number of coordinations required with BSS beams, whose Appendix 4 data have been published by the BR	643	543	490
R2	Number of coordinations required with BSS beams in the Region 2 Plan	519	428	N/A
	Number of coordinations required with BSS beams, whose Appendix 4 data have been published by BR	56	54	N/A
R3	Number of coordinations required with BSS beams in the Region 3 Plan	0	0	0
	Number of coordinations required with BSS beams in the Region 3 List	160	123	117
	Number of coordinations required with BSS beams, whose Appendix 4 data have been published by BR	398	360	326

The numbers of BSS beams mentioned in Table 3.2-2 represent the numbers of MSPACE beams from SPS database identified as affected by FSS networks. The same beam can be identified multiple times for coordination with different FSS networks.

245excel.xls

3.2.2.4 Appendix 30 criteria for the protection of BSS earth stations from terrestrial stations or from FSS earth stations operating in the opposite direction of transmission

Protection of receive BSS earth stations in the band 11.7-12.5 GHz against interference caused by terrestrial or FSS transmit earth stations operating in the opposite direction of transmission is ensured by No. **9.19** and its associated method for determining the need for a coordination (i.e. Annex 3 of Appendix **30**).

Considering that Appendix **7** and Annex 3 to Appendix **30** provide sharing criteria that may be reviewed and adjusted in order to cover both sharing situations (terrestrial and FSS earth station interference into BSS), Resolution **735 (WRC-2000)** invites the ITU-R to undertake, as a matter of urgency, and complete in time for consideration by WRC-03, the appropriate regulatory, operational and technical studies in the bands allocated to the BSS and the FSS (Earth-to-space) or to terrestrial services, consistent with the decisions of WRC-2000 concerning No. **9.19**, in order to enable WRC-03 to review, and if appropriate revise, the regulatory and technical sharing conditions between these services, with a view to enabling equitable access to spectrum by these services in these bands and ensure their harmonious development.

Resolution **735 (WRC-2000)** was motivated by the fact that, as originally adopted at WRC-97, No. **9.19** dealt only with the need for transmitting terrestrial stations to coordinate with respect to receiving earth stations in the unplanned BSS bands. WRC-2000 modified No. **9.19** to extend its applicability to include transmitting earth stations, as well as terrestrial stations, and to include BSS earth stations in the planned BSS bands, as well as in the unplanned bands.

Annex 3 provides the current criteria for the protection of BSS earth stations from interference caused by terrestrial stations, as specified in the Appendix **30** regulatory procedures for this type of coordination (see Section 6.2.2 of Article 6 of Appendix **30**). It provides a simple method for determining each of two relevant pfd:

a) the limiting pfd not to be exceeded at the edge of a BSS service area in order to protect the BSS earth stations located there, and

b) the interfering pfd produced at any point on the edge of the BSS service area by a given transmitting terrestrial station, under worst-case propagation conditions.

Coordination is required if the pfd calculated in b) exceeds the pfd calculated in a). The same criteria and calculation method could also be applied to determining the need for coordination of a transmitting earth station.

The pfd calculation of a) takes into account the wanted pfd of the BSS at the edge of the service area, the protection ratio between the wanted and interfering signals, the angular discrimination provided by the BSS receiver antenna radiation pattern and the polarization discrimination between the wanted and the interfering signal. These parameters were established by WARC-77 for the Regions 1 and 3 Plan and by RARC-83 for the Region 2 Plan. In order to continue to use this Annex in the framework established by WRC-2000, there is a need to update the parameters taking into account the updated Plan parameters in Regions 1 and 3, and the case of interference from FSS transmitting earth stations in the band 12.5-12.7 GHz. The pfd calculation of b) takes into account the e.i.r.p. of the terrestrial station in the direction of the point concerned on the edge of the BSS service area, and the total path loss. The propagation information for calculating the latter should also be updated to align with the most recent propagation models developed by the ITU-R.

Appendix **7 (WRC-2000**) addresses the determination of the coordination area (see No. **1.171**) around a transmitting or receiving earth station that is sharing spectrum in frequency bands between 100 MHz and 105 GHz with terrestrial radiocommunication services or with earth stations operating in the opposite direction of transmission. The coordination area represents the area surrounding an earth station sharing the same frequency band with terrestrial stations, or the area surrounding a transmitting earth station that is sharing the same bidirectionally allocated frequency band with receiving earth stations, within which the permissible level of interference may be exceeded and hence coordination is required. The coordination area is determined on the basis of known characteristics for the coordinating earth station and on conservative assumptions for the propagation path and for the system parameters for the unknown terrestrial stations, or the unknown receiving earth stations, that are sharing the same frequency band.

For the purpose of calculating the coordination area, the location of the transmitting or receiving earth station may be represented by a single point or by a service area. In the case of protecting a service area, the coordination area is determined by extending the periphery of the specified service area within which the earth stations are operating by the calculated coordination distance. In the case of interest here and with respect to transmitting terrestrial stations, Appendix 7 could be used to determine the coordination area around BSS earth stations referred to in Section 1.4.5 of Appendix **7**. In particular, ITU-R studies have shown that this method could be used as an alternative to that of Annex 3 of Appendix **30** for the identification of administrations with which coordination is to be effected or agreement sought under No. **9.19**.

Where two earth stations are operating in opposite directions of transmission it is only necessary to establish the coordination area for the transmitting earth station, as receiving earth stations will automatically be taken into consideration. Hence, a receiving earth station operating in a bidirectionally allocated frequency band will only be involved in coordination with a transmitting earth station if it is located within the transmitting earth station's coordination area. In the case of interest here and with respect to transmitting earth stations in the fixed-satellite service (Earth-to-space), Appendix **7** could also be used to determine the coordination area around these FSS earth stations.

In order to respond to Resolution **735**, the ITU-R has identified the two following options, the merits of which are discussed below:

Option 1: to maintain Annex 3 of Appendix **30** with appropriate revisions of the BSS parameters to reflect changes made to the technical parameters in the plans since Annex 3 was developed at WARC-77, but retaining the existing propagation model. This option is referred to hereafter as "**Annex 3(Rev.1)**".

ITU-R also recommends that the propagation model used in Annex 3 be updated to reflect the most recent ITU-R model. This option is referred to hereafter as "**Annex 3(Rev.2)**";

Option 2: to replace Annex 3 of Appendix **30** by use of Appendix **7** with the addition of the appropriate BSS parameters to be included in Table 8 of Annex 7 of this Appendix.

Option 1

In comparing the two types of sharing criteria, Annex 3 provides an arguably more straightforward and readily understood way for an administration to determine whether coordination is required when it wishes to deploy transmitting terrestrial or earth stations outside the BSS service area of another administration. Annex 3 is also somewhat simpler to use than Appendix **7** because it determines the need to coordinate based directly on parameters that are typically used in the coordination of BSS stations and uses BSS systems parameters that are familiar to BSS operators, e.g., power flux densities, protection ratios, angular discrimination of a receiver antenna. Therefore, if the results show that coordination is required, administrations can fully appreciate the protection being afforded and hence negotiate the appropriate values for these well-known parameters and assess the impact on system performance. In contrast, Appendix **7** parameters such as NL, Ms, and W, have not been used when the coordination process involves BSS stations.

Another positive aspect of Annex 3 is that it is wholly self-contained within Appendix **30**. This aspect has long been recognized as a positive feature since administrations are accustomed to finding all of the regulations covering use of the 12 GHz planned BSS bands in Appendix **30**. To replace Annex 3 by a reference to Appendix **7** would be to make the corresponding sharing criteria the only ones for protecting the BSS that are not available in their entirety within Appendix **30**.

If Annex 3 is maintained, the ITU-R believes that the updates to the parameters provided in Table 3.2-3 are appropriate. Also the propagation model should be updated to reflect the most recent ITU-R model.

TABLE 3.2-3

Updated Annex 3 parameters

Annex 3 Parameter	**Updated Value**
For Regions 1 and 3	
R	30 dB
P	0 dB
Fo	–108 dB(W/(m^2·27 MHz))
D	0.0025((d/λ)*φ)^2 dB for $0° \le \varphi \le \varphi_m$ G_{max}-(29–25log(φ_r)) dB for $\varphi_m \le \varphi \le \varphi_r$ G_{max}-(29–25log(φ)) dB for $\varphi_r \le \varphi \le 14.45°$ G_{max} dB for 14.45° < φ Where: φ_m = (λ/d)((G_{max}–G_1)/(0.0025))^(0.5) deg. φ_r = 95(λ/d) deg. G_{max}= 35.5 dB G_1 = 29–25logφ_r dB d = 60 cm λ = wavelength in centimetres
For Region 2	
R	30 dB
P	0 dB
Fo	–115 dB(W/(m^2·24 MHz))
D	0.0025((d/λ)*φ)^2 dB for $0° \le \varphi \le \varphi_m$ G_{max}-(29–25log(φ_r)) dB for $\varphi_m \le \varphi \le \varphi_r$ G_{max}-(29–25log(φ)) dB for $\varphi_r \le \varphi \le 14.45°$ G_{max} for 14.45° < φ dB Where: φ_m = (λ/d)((G_{max}–G_1)/(0.0025))^(0.5) deg. φ_r = 95(λ/d) deg. G_{max}=33.5 dB (45 cm)

	$G_1 = 29 - 25\log\varphi_r$ dB d = 45 cm λ = wavelength in centimetres
NOTE 1 – The proposed value for D is updated based on ITU-R BO.1213. NOTE 2 – The current values contained in Annex 3 should be maintained for the analogue BSS assignments in the Region 2 Plan which are in conformity with Appendix **30** and which have been brought into use and for which the date of bringing into use has been confirmed to the Bureau before 9 June 2003.	

Option 2

Appendix **7** takes advantage from a recent revision of propagation data (Recommendation ITU-R P.620-4) and takes account of the rain climatic zone. Thus it will provide a more accurate and realistic evaluation of the interference potential. It will also enable to correct several deficiencies identified in Annex 3 of Appendix **30** methodology (e.g. Annex 3 does not provide any criterion for short-term conditions of propagation; unexplained significant differences in propagation fading have been identified between Region 2 and Regions 1 and 3).

Replacing Annex 3 of Appendix **30** by Appendix **7** will also permit to simplify and harmonize the Radio Regulations in retaining a single methodology for determining the need for a coordination in all sharing situations. In that respect, WRC-2000 followed this direction in replacing the former Section 3 of Annex 4 to Appendix **30A** by Appendix **7** for the determination of the coordination area around a feeder-link transmitting earth station.

Table 3.2-4 provides the parameters, which have been considered appropriate by the ITU-R for this purpose. These proposed values allow higher terrestrial pfd levels than those, which would result from the application of the current Annex 3 method.

TABLE 3.2-4

BSS parameters for possible inclusion in Table 8 of Annex 7 of Appendix 7

Frequency band (GHz)		11.7-12.75	12.2-12.7	12.2-12.7
Region		R1 and 3	R2	R2
Modulation		N	A	N
p0 (%)	Percentage of the time during which the interference from all sources may exceed the permissible value	0.003	0.03	0.003
n	Number of expected entries of interference, assumed to be uncorrelated	1	1	1
p (%)	Percentage of the time during which the interference from one source may exceed the permissible value (p = p0/n)	0.003	0.03	0.003
NL (dB)	Link noise contribution	1	1	1
Ms (dB)	Link performance margin	4	7	4
W (dB)	Equivalence factor (dB) relating interference from interfering emissions to that caused by the introduction of additional thermal noise of equal power in the reference bandwidth	0	4	0
Te (K)	Thermal noise temperature of the receiving system at the output of the receiving antenna	120	120	120
B (Hz)	Reference bandwidth (bandwidth of the interfered with	2.7E+07	2.4E+07	2.4E+07

	system over which the power of the interfering emission can be averaged)			
Pr (p) (dBW in B)	Pr(p) = 10 log (k Te B) + NL + 10 log (10^(Ms/10) – 1) – W	−130.7	−131.0	−131.2
N = Digital modulation A = Analogue modulation				

Comparison of Annex 3 methodology and Appendix 7 methodology

The objective is to compare the protection provided to BSS receivers by the different methodologies used in Annex 3 and Appendix 7. First, it is necessary to find an equivalent parameter from the two methodologies to be able to perform the comparison. This section determines that equivalent parameter and shows that the parameter is independent of the specific propagation model. It also seeks to align the methodology used in Appendix 7 to be equivalent to the methodology used in Annex 3 which is based on a protection ratio criteria.

Table 3.2-5 below compares the maximum allowable interfering pfds at the coordination distance and their corresponding minimum protection ratios for six cases using Annex 3(Rev.1) and Appendix 7.

TABLE 3.2-5

Interfering pfd levels and corresponding (C/I) at BSS receiver

Region, type of path, modulation	Methodology	Interfering pfd at BSS receiver exceeded only for p% (see note) (dB(W/m^2))	(C/I) at BSS receiver ≥ (100-p)% (see note) (dB)	(C/I) at BSS receiver ≥ 99.7% of the time (dB)
R1 and R3 overland digital	Appendix 7	–87.6	15.3	29.11
	Annex 3(Rev.1)	–102.3	30	30
R1 and R3 oversea digital	Appendix 7	–87.6	15.3	24.53
	Annex 3(Rev.1)	–102.3	30	30
R2 overland analogue	Appendix 7	–84.85	21.05	29.24
	Annex 3(Rev.1)	–98.8	35	35
R2 oversea analogue	Appendix 7	–84.85	21.05	26.38
	Annex 3(Rev.1)	–98.8	35	35
R2 overland digital	Appendix 7	–87.6	6.1	19.85
	Annex 3(Rev.1)	–111.5	30	30
R2 oversea digital	Appendix 7	–87.6	6.1	15.22
	Annex 3(Rev.1)	–111.5	30	30

NOTE – In the case of Appendix 7, the value of *p*% corresponds to 0.003% for digital and 0.03% for analogue. In the case of Annex 3, the value of *p*% is 0.3%.

Table 3.2-5 contains the comparison of the interfering pfd levels at the BSS receiver, assumed to be located at the edge of the BSS service area, where the elevation angle is assumed to be 30°, that is exceeded for only *p*% of the time, using Appendix 7 and Annex 3 methodologies. This comparison is done for the three Regions using various propagation paths and for analogue and digital modulations. In the case of Appendix 7 methodology, the parameters assumed are given in Table 3.2-4 and for the case of Annex 3 in Table 3.2-3. The third column provides the resulting interfering pfd levels that are only exceeded for *p*% of the time, where *p* corresponds to 0.3% in the case of Annex 3(Rev.1) and in the case of Appendix 7, p corresponds to 0.003%(for digital modulation) and 0.03% (for analogue modulation). The fourth column gives the corresponding values of C/I that are met or exceeded for all but *p*% of the time. Finally, the fifth column shows the corresponding values of C/I with *p*% adjusted to be the same, corresponding to 0.3%. As can be seen, from the fifth column, Annex 3(Rev.1) methodology results in a higher value of protection (i.e. C/I) in all cases for the same percentage of the time.

Table 3.2-6 compares the resulting coordination distances. For digital modulation in all Regions, it is observed that Appendix 7 provides a smaller coordination distance for an oversea path as compared to Annex 3(Rev.1) and a similar or larger coordination distance as provided by Annex 3(Rev.1) for an overland path. For analogue modulation, it is observed that Appendix 7 provides a larger coordination distance for an overland path and a similar coordination distance for an oversea path. Since Appendix 7 reflects the most recent ITU-R propagation model to determine the coordination distances, it is desirable to update the propagation model in Annex 3(Rev.1) with the propagation model of Appendix 7 as recommended in the draft CPM Report.

Table 3.2-7 provides the coordination distances obtained from various cases using the Appendix 7 propagation model. Column 2 contains the coordination distances obtained by Annex 3(Rev.2) option with a value for *p*% of 0.003% (N) and 0.03% (A) (the same as proposed for use in Appendix 7). Column 3 provides the coordination distances for the Annex 3(Rev.2) option using a value for *p*% of 0.3%, which is the value used in current Annex 3 propagation model. It was stated that the mitigation factor used in Appendix 7 propagation option be set to 0. This is due to the fact that the methodology of Annex 3 is based on a known geometry between the interfering terrestrial station or transmitting earth station and the receiving BSS earth stations as well as a known interfering transmitter power. Many of the assumptions on the mitigation factor are no longer valid since in the Annex 3 approach these parameters and geometry are known. However, this may not be valid for the case of coordinating mobile terrestrial transmitters. Column 4 provides the coordination distances for the option of Annex 3(Rev.2) using a value for *p*% of 0.3% and no mitigation factor (i.e. $C_{2i} = 0$). Setting mitigation factor to 0 resulting in increase of coordination distances of up to 12% for the examples considered. However, for certain cases such as coordination distances resulting from mode 2 propagation and overseas paths, this mitigation factor has no impact on the coordination distances. Column 5 provides the option of Appendix 7 using the proposed value for *p* of 0.003% (N) and 0.03% (A). It is noted that the coordination distances for Annex 3(Rev.2) option are greater than those for Appendix 7 option for all the examples. This is consistent with the results given in Table 3.2-4, which indicates that the Annex 3(Rev.2) option provides greater protection than the Appendix 7 option.

TABLE 3.2-6

Comparison of coordination distances* with respect to Annex 3(Rev.1)

Region, type of path, modulation	Method used	Coordination distance (km)	Coord. distance % difference, w.r.t. Annex 3(Rev.1)
R1 and R3 overland digital	Appendix 7	215	0.6
	Annex 3(Rev.1)	214	
R1 and R3 oversea digital	Appendix 7	324	–46.9
	Annex 3(Rev.1)	610	
R2 overland analogue	Appendix 7	181	23.2
	Annex 3(Rev.1)	147	

R2 oversea analogue	Appendix 7	277	0.4
	Annex 3(Rev.1)	276	
R2 overland digital	Appendix 7	214	12.1
	Annex 3(Rev.1)	191	
R2 oversea Digital	Appendix 7	319	−11.1
	Annex 3(Rev.1)	359	
* It should be noted that the calculation of the coordination distances in this study are based on the spread sheet provided in Document 6S/185.			

TABLE 3.2-7

Coordination distances (km) using Appendix 7 propagation model (for different values of *p* and mitigation factor, C_{2i})

Region, type of path, modulation	**Annex 3(Rev.2) *p*%=0.003% (N); *p*%=0.03% (A)**	**Annex 3(Rev.2) *p*%=0.3%**	**Annex 3(Rev.2) *p*%=0.3% (C_{2i}=0)**	**Appendix 7 *p*%=0.003% (N); *p*%=0.03% (A)**
R1 and R3 overland digital	284	218	249	215
R1 and R3 oversea digital	434	359	359	324
R2 overland analogue	266	206	230	181
R2 oversea analogue	372	330	330	277
R2 overland digital	324	289	289	214
R2 oversea digital	493	413	413	319

3.2.2.4.1 Additional ITU-R studies

Based on studies conducted by the ITU-R on Option 1 and Option 2 approaches, the following conclusions were reached:

- the value of 0.3%, may be used for *p*, the percentage of time, in the possible updating of the propagation model of Annex 3. This corresponds to the value used in the existing propagation model of Annex 3, hence providing a consistent level of protection;
- using the parameter values proposed in the draft CPM Report for Appendix 7 and Annex 3 and a value for *p* of 0.3% in the case of Annex 3 methodology, the Annex 3 methodology provides greater protection to BSS earth stations for 99.7% of the time;
- considering that the propagation model used in Appendix 7, which is based on Recommendation ITU-R P.620-4, represents the most recent published results of ITU-R studies, it should replace the current propagation model contained in Annex 3 to Appendix 30;
- regardless of which Option is adopted, further study is required to determine the applicability of Mode (2) propagation of Appendix 7 in coordination of BSS receive earth stations;

- regardless of which Option is selected, the following scenarios should be considered to determine an appropriate value(s) for the mitigation factor for terrestrial (fixed and mobile) transmitting stations and FSS transmitting earth stations:
  – for the case of coordinating with fixed terrestrial transmit stations and FSS transmit earth stations the mitigation factor should be set to zero;
  – if the interfering transmitting and/or the receiving stations' system parameters and path geometries are unknown (e.g. coordination of a typical terrestrial mobile transmitting stations), a mitigation factor is needed to compensate for the worst-case assumptions. Appendix 7 provides a basis for calculating the mitigation factor, however, further study is required to determine its applicability for coordination of BSS stations.

3.2.2.5 Appendix 30A intra-Regional criteria for the protection of BSS feeder-link receiving space stations from BSS feeder-link transmitting earth stations

Section 3 of Annex 1 of Appendix **30A** provides the intra-Regional BSS feeder-link Plan sharing criterion for Region 2. This criterion allows a degradation of the Overall Equivalent Protection Margin (OEPM) of 0.25 dB below 0 dB, or if already negative, of no more than 0.25 dB below the resulting value from the feeder-link Plan as established by the 1983 Conference; or a modification of the assignment in accordance with this Appendix; or a new entry in the feeder-link Plan under RR Article **4**; or any agreement reached in accordance with this Appendix except for Resolution **42 (Rev.Orb-88)**. It was considered that there would be a need, in the case where a BSS assignment in the Region 2 Plan contained in Appendix **30** is used in conjunction with a feeder-link assignment which is not using the 17.3-17.8 GHz band subject to Appendix **30A**, to calculate the OEPM degradation by assuming no degradation due to the feeder link (i.e. the OEPM would consist only of the downlink EPM). It was also considered that this issue is a conference issue and is outside the mandate of Study Groups.

Section 4 of Annex 1 of Appendix **30A** addresses the intra-Regional BSS feeder-link Plan sharing for Regions 1 and 3. The current combination of three sharing criteria, as adopted by WRC-2000 are provided below:

- a power flux-density limit of -76 dB(W/(m$^2 \cdot$ 27 MHz)) at any point in the GSO arc;
- an administration in Region 1 or 3 shall not be considered as being affected if the minimum orbital spacing between the wanted and interfering space stations, under worst case station-keeping conditions, is more than 9 degrees;
- an administration in Region 1 or 3 shall not be considered as affected if the effect of a proposed new or modified assignment causes its feeder-link equivalent protection margin to fall no more than 0.45 dB below 0 dB, or if already negative, no more than 0.45 dB below the value from the Regions 1 and 3 Plan and List as established by WRC-2000, or a proposed new or modified assignment to the List, or a new entry in the Regions 1 and 3 List as a result of the successful application of Article 4.

The ITU-R studies concluded that these criteria are appropriate and there is no need for modification.

3.2.2.6 Appendix 30A criteria for the protection of BSS feeder-link receiving space stations from FSS or BSS transmitting space stations or from BSS feeder-link transmitting earth stations

The sharing criteria for the protection of BSS feeder-link receiving space stations from FSS/BSS transmitting space stations or from BSS feeder-link earth stations are contained in the following four sections of Appendix **30A**:

- Annex 1 Section 5 provides Appendix **30A** BSS feeder-link limits to protect a frequency assignment in the bands 17.3-18.1 GHz (Regions 1 and 3) and 17.3-17.8 GHz (Region 2) to a receiving space station in the FSS (Earth-to-space).
- Annex 1 Section 6 provides Appendix **30A** BSS feeder-link limits to protect a frequency assignment in the band 17.8-18.1 GHz (Region 2) to a receiving feeder-link space station in the FSS (Earth-to-space).
- Annex 4 Section 1 provides threshold values for determining when coordination is required between transmitting space stations in the FSS or the BSS and a receiving space station in the feeder-link Plans in the frequency bands 17.3-18.1 GHz (Regions 1 and 3) and 17.3-17.8 GHz (Region 2).
- Annex 4 Section 2 provides threshold values for determining when coordination is required between transmitting feeder-link earth stations in the FSS in Region 2 and a receiving space station in the Regions 1 and 3 feeder-link Plan or List in the frequency band 17.8-18.1 GHz.

The increase in noise temperature criterion ranges in value from a $\Delta T/T$ of 3% in Annex 1 to 4% in Annex 4. These criteria result in modifications to the feeder-link Plans providing slightly more protection to the unplanned services.

A recent ITU-R study provided interference analyses and discussion of the equatorial limb geometry necessary for dealing with transmitting Region 2 BSS satellites interfering with receiving Regions 1 and 3 BSS feeder-link satellites in the 17.3-17.8 GHz band. This case is currently covered by Annex 4, Section 1 as described above. These studies, which have resulted in a draft new Recommendation, have shown that for the cases studied, the interference from transmitting BSS space stations in Region 2 into a receiving space station in the Regions 1 and 3 feeder-link Plan resulted in a $\Delta T/T$ of less than 4% (assuming a system noise temperature of 600 K), and are therefore consistent with the criterion contained in Annex 4.

The ITU-R agreed that it would be useful to harmonize the inter-Regional criteria contained in Annex 1 and Annex 4 of Appendix **30A**. The ITU-R considers that it may be appropriate to relax each of the four criteria mentioned in this section. However, further study is required to determine a baseline satellite system noise temperature and an allowed $\Delta T/T$ increase that would be equitable for all Regions.

3.2.3 Regulatory/procedural aspects

3.2.3.1 Review of §§ 4.1.18 to 4.1.20 of Appendices 30 and 30A

3.2.3.1.1 Review of these provisions with respect to Regions 1 and 3

In reviewing paragraphs 4.1.18 to 4.1.20 of Appendices **30** and **30A** (Regions 1 and 3), the following options were identified:

1) to suppress §§ 4.1.18 to 4.1.20 of Appendices **30** and **30A**;
2) to maintain §§ 4.1.18 to 4.1.20 of Appendices **30** and **30A** without any change;
3) to maintain §§ 4.1.18 to 4.1.20 of Appendices **30** and **30A** with additional provisions in order to satisfactorily protect assignments in the Plan or in the List.

The rationale for these options and the reasons provided by administrations are reported hereafter.

Views expressed in support of Option 1

Background

WRC-2000, Istanbul/Turkey, in revising the Regions 1 and 3 downlink and feeder link of Appendices **30** and **30A**, introduced and incorporated several new and modified paragraphs, including §§ 4.1.18 to 4.1.20, in Section 4.1 of the above-mentioned Appendices. These paragraphs were included at the request of few European administrations to counterbalance the addition of, in general, five new channels for each Region 1 administration and seven new channels for each Region 3 administration. However, other administrations likewise added two more paragraphs, namely 4.1.24 and 4.1.25, on one hand to complement the previously-mentioned paragraphs and, on the other hand to inject, to some extent, the concept of de-monopolization of the spectrum utilization in the domain of these Appendices.

The incorporation of the above-mentioned paragraphs was done on the last day on which the draft revised Plans and List were presented to the Conference without leaving the Conference time to carefully examine the consequence of the application of some of the above-mentioned four paragraphs.

Administrations of Regions 1 and 3, in particular those of the developing countries of these Regions, who have reluctantly accepted the inclusion of paragraphs 4.1.18, 4.1.18*bis* and 4.1.20, later on found considerable difficulties if these paragraphs were to be implemented. These difficulties are highlighted below.

Origin of RR 11.41

In order to understand the issue, it might be useful to analyse how the case was evolved. The concept of paragraph 4.1.18 of the above Appendices is taken from that of provision 11.41 of Article 11 of non-planned services. It is worthwhile to mention the origin of RR 11.41, in order to better understand the situation. In application of relevant provisions of Articles 9 and 11 of the Radio Regulations with respect to the non-planned services, should administration "B", in application of the above-mentioned Articles, not succeed to complete the required coordination procedure with respect to administration "A", who has successfully completed the relevant procedures of these Articles before administration "B" and recorded in the Master Register with Favourable Finding(s), notifies to the Bureau its assignments. The Bureau, in applying the relevant provisions of Article 11, would return the assignments in question to administration "B" on the grounds that coordination is not successfully completed. Administration "B" could then resubmit the assignments requesting the Bureau to examine them under RR 11.32A and/or RR 11.33, as appropriate. Should the results of the Bureau's examination be unfavourable, the assignments would be returned again to administration "B". Should administration "B" decide to resubmit the assignments in question again, it has to apply RR 11.41, in insisting upon its reconsideration. The Bureau shall enter the assignments provisionally in the Master Register with the indication of those administrations whose assignments were the basis of the unfavourable finding. The entry shall be changed from provisional to definitive recording in the Master Register only if the Bureau is informed that the new assignments have been in use together with the assignments, which were the basis of the unfavourable finding, for at least four months without any complaint of harmful interference being made. It should be noted that the above approach seems to be logical as it prevents that recorded assignments not yet brought into use block other assignments being brought into use be recorded in the Master Register, and thus being protected by subsequent assignments. The above arrangement is coupled with provision RR 11.42, which stipulates, "Should harmful interference be caused by an assignment recorded under No. 11.41 to any recorded assignment which was the basis of the unfavourable finding, the station using the frequency assignments recorded under No. 11.41 shall, upon receipt of advice thereof, immediately eliminate this harmful interference". The concept of the latter provision is similar to that of 4.1.20.

*Situation in Appendices **30** and **30A***

The way that the interference analysis is functioning in these Appendices is based on the cumulative effects of the interference on the existing assignments that consist of those already calculated plus the effect of an incoming assignment. In other words, there is no longer the one-to-one basis between the existing interfered assignment and the incoming interfering assignment. This is due to the fact that the Equivalent Protection Margin (EPM) is based on the cumulative effects of the aggregation of all interferences on an existing assignment. On the other hand, should the EPM value be reduced beyond certain level, as result of several interfering signals/assignments, that interfered assignment(s) whose EPM is degraded beyond a certain level, would no longer be identified as affected by the subsequent incoming assignment(s).

In this addition, the concept of harmful interference referred to in non-planned services is different from the concept of not causing interference above a certain level due to the fact that the harmful interference is a subjective issue whereas the permitted or acceptable interference is an objective matter, thus one which is used in case of non-planned services cannot be used for cases of Appendices **30**/**30A**.Discussion

Now, let us go back to the issue of how paragraphs 4.1.18 to 4.1.20 will be applied to the assignments of Appendices **30** and **30A**. First of all, as far as the number of interfering cases is concerned the situation is different in case of the Plan, on the one hand, and in case of the List, and other services covered by the Appendices **30** and **30A** frequency bands. In case of the Plan, the number of interfering cases which could apply paragraphs 4.1.18 to 4.1.20 are limited to three, whereas the number of interfering cases which could apply these paragraphs with respect to the List and other services using the frequency bands of these Appendices are unlimited. This is an important matter to be carefully taken into account. A quick review of these paragraphs reveals the following.

With respect to their application to the Plan, a maximum of three interferences are allowed. In this case either one or all three interferences, which may come from one administration, or several administrations would reduce or degrade the EPM of the Plan's assignment(s). It may also degrade the assignment which was the basis of the disagreements to the extent that they would no longer be identified as affected by the subsequent incoming assignment(s), which put the assignment which was the basis of the disagreements in a position that its actual EPM would be degraded more and more without being demonstrated. It would therefore deprive the assignment which was the basis of the disagreement(s) to comment on its affected assignment(s). This would result that the Plan's assignment(s) although remain in the file or the Radio Regulation but with only the nominative existence and not a real value.

Moreover, once the victim Plan assignments are to be brought into use, in case that those three interferences which were the origin of degrading the EPM have to eliminate the interference as foreseen by paragraph 4.1.20, the administration responsible for the Plan's/assignment which was the basis of the disagreement does not know to which of these three interfering sources this administration should refer, as it is affected by the cumulative effect of these three interfering assignments (their aggregate effects) and not necessarily by their individual (single-entry effect). That administration would be stuck in the middle of nowhere. In case that its EPM was degraded to lower level than be identified as affected, even if these three sources of interference collectively and positively cooperate with each other and reduce the interferences to the acceptable level (which is almost improbable), the Plan's assignments still would suffer from the interference of those non-identified sources which caused interference to that assignment which was the basis of the disagreements as they were not identified by the Bureau as interfering sources due to the very low level of EPM.

It would be interesting to know whether or not the concept of eliminating interference has even been used. If yes, when, by whom, in relation with which networks? And if it is used, how an administration could eliminate the interference without closing down a particular transponder or without any, in orbit process modifications, since, the degree of such in-orbit process modification is very limited? In addition, there would be some negative consequence of such an in orbit process modification, from the viewpoint of customer requirements. Moreover, what guarantee will be given that, in real time, such an action would be taken by the notifying administration of the interfering assignments?

In other words, all these arrangements would remain to be theoretical and non-implementable.

It is very doubtful and impractical that any of the interfering operational BSS satellites, all of a sudden, could reduce its interference to the victim BSS Plan, due to the fact that there would be some operational constrains and consequences.

As for the assignments in the List, taking into account that the number of interferences is unlimited, the situation is worse and even catastrophic than what was explained in the above in case of the Plan assignments.

It should be noted that those administrations that are supporting the application of paragraphs 4.1.18 to 4.1.20, they know that the negative consequences of this application would also involve them in one way or another. In other words, the safety measures that they established in relation to the Plan's assignments to help them, now would cause more damage to their assignments in the List than those caused to the assignments of other administrations in the Plan. This is the fact that they have failed to realize when these administrations supported the inclusion of 4.1.18 and 4.1.20 in Article 4 of both Appendices.

For these reasons, some administrations are of the strong belief that paragraphs 4.1.18 to 4.1.20 of Article 4 of both Appendices must be suppressed.

Views expressed in support of Option 2

Some administrations were of the view that the provisions of 4.1.18 to 4.1.20 of AP30 and AP30A shall be retained in the Radio Regulations. These administrations are of the view that these provisions as well as the provisions 4.1.24 and 4.1.25 were an integral part of the compromise prior to the replanning of the BSS that took place during WRC-2000. Without infringing the individual administration's rights to protection of the Plan assignments these provisions provide a procedure for notification of frequency assignments in the AP30/AP30A bands in line with the procedure in the unplanned services. It is understood that, in applying provision 4.1.18, the reference situation of the assignment which is the basis of the disagreement shall not be updated in entering the proposed new network into the List, and the assignment against which 4.1.18 was used will thus retain their EPM and their original protection for subsequent modifications. Furthermore, the concept of "not causing harmful interference" has existed in the Radio Regulations for many years and has been applied by several conferences without problem. It should further be noted that any administration operating a satellite under 4.1.18-4.1.20 is obliged to follow the provisions in the Radio Regulations and shall immediately eliminate harmful interference caused to the assignment, recorded in the Master Register, that was the basis for disagreement, whenever this is brought into use. This clearly identifies the assignments entered into the List under 4.1.18 as having a lower status than the other entries in the Plan and the List. Similar provisions have been applied in the RR in the unplanned services and for other services for many years without any disadvantages experienced. Therefore the procedures of 4.1.18-4.1.20 ensure that the integrity of the Plan is guaranteed.

An assignment against which 4.1.18 is used will retain its original protection with the above measures. This will be the case regardless of how many times 4.1.18 is used. There is therefore no need to have a limitation on the number of times these provisions may be applied.

Views expressed in support of Option 3

In order to solve the concerns expressed by administrations of Region 1 and Region 3, in particular developing countries, on the provisions contained in Nos. 4.1.18 to 4.1.20 of Appendices **30** and **30A** (reported under Option 1), it is proposed to implement the following solutions.

Unlike in the case of non-planned services, when §§ 4.1.18 to 4.1.20 of Appendices **30** and **30A** are applied in respect of an assignment in the Plan or in the List, it may take many years before the assignment which was the basis of the disagreement is brought in service. This means that throughout this period, the Bureau will have to continue to protect the affected assignment to the level that it would have if its EPM was not degraded by more than the permissible level. This may be done by adding a new symbol in M-space to the effect that the EPM does not take into account the unaccepted excess interference into the assignment which was the basis of the disagreement in the Plan or in the List. However, the EPM should take into account the interference from these assignments which were the basis of the disagreement in the Plan or in the List into the assignment for which No. 4.1.18 is applied.

There appears to be a significant discontinuity between the protection which is afforded by the initial part of the procedure (if a given interference level, generally a pfd level, is exceeded, agreement must be sought), and the type of protection which is given in case of disagreement (no harmful interference shall be caused, i.e. the BSS space station shall not seriously degrade, obstruct, or repeatedly interrupt the affected service"). The procedure starts by offering a clear, quantified and verifiable level of protection, but when this level is exceeded, and this excess has not been accepted, it is replaced by a level of protection which is loose, non-quantified, subject to interpretation, not verifiable in practice, and in any case much less protective than at the beginning of the procedure. This is compounded by the fact that harmful interference may result from the addition of several interfering sources, thus diluting the responsibility of the administrations which may be the source of the harmful interference. A possible solution to this problem may be to replace the words "cause harmful interference" by the words "exceed the levels given in Annex 1" in the provisions of §§ 4.1.18 to 4.1.20. This would mean that, once any of the assignments which was the basis of a disagreement is brought into service in conformity with the applicable provisions of the Radio Regulations, and a complaint for unacceptable interference is received, the characteristics of the interfering assignment recorded in the List after application of § 4.1.18, and which is the cause for this unacceptable interference has to be modified so that no excess interference is caused to the assignment which was the basis of the disagreement. If this is not the case, the assignment in question would be deleted from the List.

Limiting to three the number applications of § 4.1.18 appears to lead to a difference of treatment between the administrations which apply the procedure at the early stage and subsequent ones. If the solution proposed above is applied, this difficulty would disappear since there would be no need for such a limitation.

Further study is required for the implementation of Option 3.

3.2.3.1.2 Review of these provisions with respect to Region 2

Although paragraphs 4.1.18 to 4.1.20 and other associated paragraphs in the way they appear in Appendices **30** and **30A** might be interpreted by some administrations that they are equally applicable to Region 2, it is to be noted that the intent of WRC-2000 was not to affect the integrity of Region 2 services (see Resolutions 524 (WRC-92), 531 (WRC-95) and 532 (WRC-97).

3.2.3.2 Application of the grouping concept for one orbital location in Appendices 30 and 30A with respect to Regions 1 and 3

In reviewing the grouping concept as applied for one orbital location in Regions 1 and 3, the following options were identified:

A) to suppress the grouping concept for one orbital location in Appendices **30** and **30A** for Regions 1 and 3;

B) to maintain the grouping concept for one orbital location in Appendices **30** and **30A** for Regions 1 and 3 as it is applied today;

C) to maintain the grouping concept for one orbital location in Appendices **30** and **30A** for Regions 1 and 3, but to limit the maximum number of networks in the group.

The rationale for these options and the reasons provided by administrations are reported hereafter.

Views expressed in support of Option A

Network grouping means that a given administration submits to the Bureau several networks on a given orbital position but asks the Bureau to group them together.

Apart from those groups which are currently contained in the Appendices as a result of the decisions of previous Conferences, there are no regulatory provisions to allow that type of grouping application. In a simple language, the concept of grouping is that all grouped networks will be protected by the incoming assignments or networks, whereas the interference from the members of the group to other assignments outside the group would be the worst interference of any of the networks and not the combined interferences of all networks.

This necessitates that the grouped networks should not operate simultaneously, i.e. they could operate individually. This means that the responsible administration of these grouped networks establishes the maximum flexibility for itself to operate any of the grouped networks it so wishes. However, this flexibility is at the expense of the inflexibility of other administrations. Moreover, the consequence of this grouping of networks is some sort of warehousing of the spectrum which is in total contradiction with the very principle of Article 44 of the Constitution and paragraph 3.3 of the Appendices.

For these reasons, some administrations are of the strong belief that the Rules of Procedure currently allowing the use of network grouping must be suppressed.

Views expressed in support of Option B

The protection of assignments in the Plan and the List against new entries in the List is based upon aggregate C/I (EPM) levels or degradation. If an administration requires to modify some characteristics of its assignment in the Plan or List, e.g. antenna diameter or modulation technique, a modification under Article 4 of AP30 and/or AP30A is required. Such a modification will capture an alternative way to operate the same capacity and thus cannot be operated simultaneously with the original assignment as these between themselves are incompatible. Such modifications are crucial for any administration that wants to be able to consider modification of some of the technical parameters of its assignment in the Plan or the List prior to, or after bringing this into use.

However, if interference is calculated between these assignments in updating the reference situation, this would lead to an over-conservative assessment of the interference inflicted upon other assignments in the Plan or List, as only one assignment will be active at any given time. More seriously, in calculating interference between these assignments, there will be a strong calculated interference between these networks that will totally dominate their EPM. Again, since the assignments will not be active at the same time, this interference is not real. Nevertheless, protection of these assignments is based upon degradation of the EPM, and with this artificial interference calculated between the assignment and its modification, any new modification can have a very high single entry C/I into these before degrading the aggregate C/I by more than the trigger limits.

For this reason, for an administration to be able to modify the technical characteristics of its assignment in the Plan or the List and retain protection for its assignment, interference cannot be calculated between them. The grouping of the assignments is the way this is achieved in the current Radio Regulations. In calculation of interference into the Plan and the List, by grouping assignments, interference is only calculated from the worst and interference is not calculated between the assignments, giving an accurate description of the actual operation.

It is noted that grouping a modification request under Article 4 with an existing entry in the Plan or the List, or with another modification request, in no way relieves administrations from the responsibility to ensure full protection from this new entry to all assignments in the Plan or the List. As such, assignments entered into the List, grouped with other assignments will have absolutely no impact on any assignment in the Plan or List. This will be the case, regardless of how many networks are grouped together. Any entry into the List, grouped or not grouped, will have an impact upon the flexibility of administrations to successfully coordinate subsequent modification requests under Article 4. This, however, is not a quality of the grouping concept and is completely in line with the "first come first served" principle, in line with coordination in the unplanned bands, as adopted for Article 4 modifications.

For these reasons, grouping of networks in one orbital location is a necessity to enable administrations to modify the technical parameters of their assignments in the Plan or List. Application of this concept will have no impact upon any assignment in the Plan or the List. Such grouping therefore needs to, and should, be retained.

Views expressed in support of Option C

Because of the aggregate EPM criteria used in Appendices **30** and **30A**, multiple filings in one orbital location could result in loss of protection for assignments involved. The grouping of multiple networks at the same orbital location could alleviate this difficulty and enable administrations to implement assignments of the BSS Plan or additional use more flexible.

However, there is a concern that usage of the grouping concept could unduly complicate access to spectrum resources for new administrations wanting to coordinate capacity in Region 1 or 3 to go into the List. There may therefore be merit in limiting the maximum number of networks that can go into a group as well as limiting the number of groups in one orbit location. Specific care has to be given to the definition of the "number of networks" as well as the definition of the "number of groups". Further studies are required to understand the mechanisms leading to the constraints that the grouping concept is intended to alleviate, in particular as a result of the use of the aggregate protection criteria (EPM degradation) and to determine the appropriate limits for number of networks in a group as well as number of groups at a given orbital location.

3.2.3.3 Sharing criteria in Annexes 1, 3, 4 and 6 to Appendix 30 and Annexes 1 and 4 to Appendix 30A

Section 3.2.2 of the CPM Report presents the results of ITU-R studies in response to Resolutions 540 (WRC-2000) and 735 (WRC-2000) with respect to sharing criteria between services in the band 11.7-12.7 GHz. Attachments 1 to 5 to this chapter are proposing draft examples of possible modification of Annexes 1, 3, 4 and 6 to Appendix **30** and Annexes 1 and 4 to Appendix **30A**, should WRC-03 decide to modify the sharing criteria of these annexes in accordance with the proposals developed in the draft CPM Report.

These draft examples take into account the experiences of BR in applying the Radio Regulations, including the difficulties and inconsistencies encountered in the application of the relevant provisions.

Generally speaking every effort should be made to avoid retroactive action as this would result in some degree of uncertainty in application of a given provision or use of a given service. It would also increase the workload of the administrations and the Bureau. Moreover, it is required to indicate the availability of the calculation method and the corresponding software to be applied by the administrations and the Bureau.

Concerning the draft example provided for Annex 6 to Appendix **30**, doubts were expressed by some administrations concerning the receive earth station noise temperature and total link noise temperature being identical for antenna having different diameters, in particular when the antenna diameters are doubled, the noise temperatures remain unchanged.

3.2.3.4 Use of BSS feeder-link assignments for GSO FSS (Earth-to-space) in the bands 14.5-14.8 GHz and 17.3-18.1 GHz

No. **5.492** authorizes the use by FSS (space-to-Earth) transmissions of BSS assignments which are in conformity with the appropriate regional Plan or included in the Regions 1 and 3 List in Appendix **30**, provided that such transmissions do not cause more interference, or require more protection from interference, than the BSS transmissions operating in conformity with the Plan or the List, as appropriate.

The conformity of an assignment with this provision is verified by the Bureau at the time of notification of the assignment, under paragraph 5.2.1 *d)* of Article 5 of Appendix **30**. ITU-R has studied the technical criteria under which such use satisfies the conditions stated in this provision (see Recommendation ITU-R BO.1373-1), which provides to the Bureau the necessary tools to verify that this provision is correctly applied.

However, No. **5.492** does not constitute an allocation to the FSS (space-to-Earth), but establishes conditions under which an assignment in the BSS allocation may be used for FSS transmissions. Consequently, when this provision is applied by an administration, the assignment which is made remains a BSS assignment from the point of view of the Radio Regulations.

Nos. **5.510** and **5.516** limit the use of the bands 14.5-14.8 GHz and 17.3-18.1 GHz by GSO FSS (Earth-to-space) to BSS feeder links.

The conformity of an assignment with one of these provisions is examined under Article 5 of Appendix **30A** from the point of view of its conformity with the Plan or List, as appropriate, and therefore may be used only if they do not cause more interference, nor require more protection than the BSS feeder links transmissions operating in conformity with the Plan or the List, as appropriate.

The conference may wish to further clarify and review where appropriate the possibility of using the bands 14.5-14.8 GHz and 17.3-18.1 GHz (Earth-to-space) for GSO FSS transmissions other than BSS feeder links. Two options were identified:

Option 1

Addition of two new footnotes to explicitly cover the possibility of using the bands 14.5-14.8 GHz and 17.3-18.1 GHz (Earth-to-space) for GSO FSS transmissions other than BSS feeder links, and revision of paragraph 5.2.1 *d)* of Article 5 of Appendix **30A** accordingly. Example of regulatory texts is given hereafter:

ADD

5.510A In the band 14.5-14.8 GHz, assignments to feeder-link stations which are in conformity with the appropriate regional Plan or included in the Regions 1 and 3 List in Appendix **30A** may also be used for transmissions in the fixed-satellite service (Earth-to-space), other than feeder links for the broadcasting-satellite service, provided that such transmissions do not cause more interference or require more protection from interference, than the feeder-link transmissions operating in conformity with the Plan or the List, as appropriate.

5.516A In the band 17.3-18.1 GHz, assignments to feeder-link stations which are in conformity with the appropriate regional Plan or included in the Regions 1 and 3 List in Appendix **30A** may also be used for transmissions in the fixed-satellite service (Earth-to-space), other than feeder links for the broadcasting-satellite service, provided that such transmissions do not cause more interference or require more protection from interference, than the feeder-link transmissions operating in conformity with the Plan or the List, as appropriate.

An example of a possible revision of paragraph 5.2.1 *d)* of Article 5 of Appendix **30A** is given below:

MOD

5.2.1

d) with respect to its conformity with the appropriate Regional feeder-link Plan or the Regions 1 and 3 feeder-link Lists, however, having characteristics differing from those in this Plan or in the Regions 1 and 3 feeder-link Lists in one or more of the following aspects:

- use of a reduced e.i.r.p.,
- use of a reduced coverage area entirely situated within the coverage area appearing in the Plan or in the Regions 1 and 3 feeder-link Lists,
- use of other modulating signals in accordance with the provisions of § 3.1.3 to Annex 5 of Appendix **30**,
- use of the assignment for transmission in the fixed-satellite service in accordance with Nos. **5.510A** and **5.516A**,
- in the case of Region 2, use of an orbital position under the conditions specified in § B of Annex 7 to Appendix **30**,
- in the case of Regions 1 and 3, use of an orbital position under the conditions specified in § 3.15 of Annex 3[12]

Recommendation ITU-R BO.1373-1 would need to be updated in order to provide to the Bureau the necessary complementary tools to verify that this provision is correctly applied.

It was also noted that, with respect to the coordination of a transmit FSS earth station with a receive FSS earth station or a terrestrial station, the current procedure of Appendix **30A** applicable to BSS feeder-link earth stations continues to apply.

Option 2

No change to the Radio Regulations.

3.2.3.5 5.2.1 *d)* of Article 5 of Appendix 30

It should be clarified that, as a general principle, any changes to the Plans and List assignments under Article 5 are not protected in application of Article 4.

It is also proposed to clarify that when administrations are implementing satellite networks under Article 5, the pfd limit may be exceeded on the territory of the notifying administration, as long as the pfd of the original Plan assignments at each test point of that assignment is not exceeded. It is to be noted that, under such conditions, the assignments for which the pfd exceed should in no way require more protection than that afforded to them under application of Article 4 or under the Plan and List.

An example of possible modification to Article 5 of Appendix **30** is given hereafter.

[12] The Bureau shall also apply this provision to § 5.2.1 *d)* of Appendix **30** for Regions 1 and 3.

MOD

ARTICLE 5

Notification, examination and recording in the Master International Frequency Register of frequency assignments to space stations in the broadcasting-satellite service[2]

MOD
5.2.1

d) with respect to its conformity with the appropriate Regional Plan or the Regions 1 and 3 List, however, having characteristics differing from those in the appropriate Regional Plan or in the Regions 1 and 3 List, in one or more of the following aspects:

- use of a reduced e.i.r.p.,
- use of a reduced coverage area entirely situated within the coverage area appearing in the appropriate Regional Plan or in the Regions 1 and 3 List,
- use of other modulating signals in accordance with the provisions of § 3.1.3 of Annex 5,
- use of the assignment for transmission in the fixed-satellite service in accordance with No. **5.492**,
- in the case of Region 2, use of an orbital position under the conditions specified in § B of Annex 7;
- in the case of the notification of the Plan, the pfd limit of –103.6 dB(W/m^2/27 MHz) given in Section 1 of Annex 1 to Appendix **30** may be exceeded on the territory of the notifying administration under the condition that the pfd on all the test points of the satellite networks in question are equal or below those of the associated Plan assignments; *or*

3.2.3.6 Other provisions of Appendices 30 and 30A

In reviewing the Preliminary Report of BR to WRC-03 under agenda item 7.1 (part dealing with the experiences of BR in applying the Radio Regulations, including the difficulties and inconsistencies encountered in the application of the relevant provisions), the Special Committee and the CPM reached the following conclusions and agreed on draft examples of possible modification of Appendices **30** and **30A** which are provided in Attachments 6 and 7 to this Chapter.

3.2.3.6.1 Annex 2A to Appendix 4

Recommendation ITU-R BO.1293-1 which is referred to in § 3.4 of Annex 5 to Appendix **30** and § 3.3 of Annex 3 to Appendix **30A** was updated by ITU-R on 30 April 2002. In Annex 3 of that new Recommendation the calculation of protection masks requires two additional parameters in addition to those currently in Appendix 4, namely, the relative levels of the first and second side lobes of digitally-modulated 12 GHz BSS transmit signals and the side lobe attenuation resulting from post-high power amplifier filtering.

Administrations may wish to consider reviewing Appendix 4 along one of the following approaches:

[2] As a general principle, any changes to the Plans and List assignments under Article 5 are not protected in application of Article 4.

1) to delete current items C.9 b)9 and C.9 b)10 taking into account that Annex 3 of Recommendation ITU-R BO.1293-2 applies to bilateral coordination between administrations;

2) to include in Appendix 4, Annex 2A, item C.9 b) the above-mentioned parameters (i.e. the relative levels of the first and second side lobes of digitally-modulated 12 GHz BSS transmit signals and the side lobe attenuation resulting from post-high power amplifier filtering) on a non-mandatory basis, and make current items C9b9 and C9b10 non-mandatory, taking into account that Annex 3 of Recommendation ITU-R BO.1293-2 applies to bilateral coordination between administrations;

3) to include in Appendix 4, Annex 2A, item C.9 b) the above-mentioned parameters on a mandatory basis.

3.2.3.6.2 Article 2 of Appendices 30 and 30A

WRC-2000 added to Article 2 of Appendices **30** and **30A** a new § 2.2 which stipulates the conditions to use the guardbands of the Plans in those Appendices in order to provide space operations functions in accordance with No. 1.23 in support of GSO satellite networks in the BSS.

It is proposed to include additional text in § 2.2 of Article 2 of Appendices **30** and **30A** in order to clarify that:

– no API is required for such assignments, the coordination procedure under No. 9.7 is initiated by the submission of the coordination data;

– the applicable time limit for bringing into use those assignments is the same as for the planned BSS/feeder-link assignments, i.e. eight years counted from the date of receipt by the Bureau of the complete Appendix 4 information (plus a possible extension as indicated in Resolution 533).

3.2.3.6.3 Publication of comments under § 4.1.10 or § 4.2.14 of Article 4 of Appendices 30 and 30A

Contrary to the situation in Article 9 of the RR (see No. 9.53A), there is no specific provision in Article 4 of Appendices **30** and **30A** referring to the need for the Bureau to publish, upon expiry of the deadline for comments under § 4.1.10 or § 4.2.14 of Article 4, the list of administrations having submitted their disagreement or other valid comments within the four-month regulatory period stipulated in the above-mentioned paragraphs.

In order to provide to administrations a clear picture of the coordination requirements and to avoid any uncertainties in that respect, it is proposed to include additional text in § 4.1.10 and § 4.2.14 of Article 4 of Appendices **30** and **30A**, or new provisions in that article, as appropriate.

3.2.3.6.4 Resolution 42 (Rev.Orb-88)

It is proposed to align §§ 2 to 5 of the Annex to Resolution 42 (Rev.Orb-88) with the decisions established at WRC-2000, namely:

– inclusion of appropriate references to the Regions 1 and 3 Lists;

– replacement of references to Annex 2 to Appendices **30/30A** by references to Appendix 4 of the RR;

– inclusion of appropriate references to Article 4 submissions received by the Bureau;

– deletion or replacement of references to some former provisions of Articles 4 and 7 and Annex 1 of Appendices **30/30A** by the appropriate current ones;

– deletion of §§ 5.2 c) and 5.2 d) due to the fact that WRC-2000 has excluded from the procedure of Article 4 of Appendix **30A** the coordination of the transmitting feeder-link earth stations with respect to receiving earth stations operating in the opposite direction of transmission, as well as with respect to terrestrial stations.

3.2.3.6.5 Resolution 49 (Rev.WRC-2000)

Resolves 2 of Resolution 49 (Rev.WRC-2000) defines the deadlines before which "the complete due diligence information in accordance with Annex 2 to this Resolution" shall be submitted to the Bureau.

In the case of satellite networks received by the Bureau under the coordination procedure of Article 4 of Appendices **30/30A** before 22 November 1997, the applicable deadline defined in accordance with *resolves* 2 of Resolution 49 (Rev.WRC-2000) is the earliest date between 21 November 2003 and the expiry of the date afforded for the coordination of the satellite network before bringing it into use (i.e. eight years counted from the date of receipt of the complete Annex 2 to Appendices **30/30A** information).

It was noted that, for a satellite network submitted for coordination under Article 4 of Appendices **30/30A** and received by the Bureau from 22 November 1995 up to 21 November 1997 inclusive, the regulatory period afforded for submission of due diligence information would be less than eight years.

This situation, which might not have been intended, creates therefore some inconsistencies between the period afforded for submission of due diligence information of satellite networks received by the Bureau from 22 November 1995 up to 21 November 1997 inclusive and that afforded for other satellite networks.

In view of the above, administrations may wish to consider a possible revision of *resolves* 2 of Resolution 49 (Rev.WRC-2000).

3.2.3.6.6 §§ 4.1.10 and 4.2.14 of Article 4 of Appendices 30 and 30A

Considering the adverse effect of a no-reply within the four-month period for comments following the Part A publication of a network under Article 4 of Appendices **30** or **30A**, which means a tacit agreement, the RRB has adopted an appropriate Rule of Procedure (see Rule of Procedure relating to § 4.1.10) instructing the Bureau to send reminder telegrams 30 days before the expiry of the above four-month period.

Since this course of action has been implemented for a long time, it is proposed to convert this Rule of Procedure into regulatory provisions in §§ 4.1.10 and 4.2.14 of Article 4 of Appendices **30** and **30A**.

3.2.3.6.7 § 4.2.11 of Article 4 of Appendices 30 and 30A

Administrations of Region 2 may wish to consider the deletion of § 4.2.11 of Article 4 of Appendices **30** and **30A** since the purposes of these provisions are already covered under § 4.2.3 of Appendix **30** or § 4.2.2 of Appendix **30A** and under § 4.2.10 of both Appendices.

3.2.3.6.8 § 5.3.1 of Article 5 of Appendices 30 and 30A

The modification of the date of bringing into use which is possible under § 5.3.1 of Article 5 of Appendices **30** and **30A** is limited by a deadline defined by the period of eight years counted from the date of receipt by the Bureau of complete Appendix 4 information plus a possible extension as indicated in Resolution 533 (Rev.WRC-2000). This limitation is not reflected in the RR but in a Rule of Procedure.

In view of the above, it is proposed to revise § 5.3.1 of Article 5 of Appendices **30** and **30A** by adding a footnote after the word "modify" in this provision referring to the regulatory period defined in § 4.1.3 or § 4.2.6 of Article 4 of these Appendices.

3.2.3.6.9 Title and §§ 5.1.3, 5.1.4, 5.1.5 and 5.2.1 f) of Article 5 of Appendix 30A

In revising the Appendix **30A** feeder-link Plans for Regions 1 and 3, WRC-2000 has excluded from the procedure of Article 4 of that Appendix the coordination of the transmitting feeder-link earth stations with respect to receiving earth stations operating in the opposite direction of transmission, as well as with respect to terrestrial stations. This coordination should now be undertaken by the notifying administration directly with the other concerned administrations with respect to terrestrial stations and receiving earth stations operating in the opposite direction of transmission, in accordance with the relevant/corresponding provisions of Article 9 of the RR.

As a consequence, as of 2 June 2000, notification of assignments to transmitting feeder-link earth stations included in the Region 2 feeder-link Plan following successful application of Article 4, or included in the Regions 1 and 3 feeder-link List, shall be effected applying the provisions of Article 11.

With respect to the notification of frequency assignments to transmitting feeder-link earth stations, the application of Article 5 as of 2 June 2000, should be strictly limited to the assignments of the Plans.

In view of the above, administrations may wish to consider the possible revision of the title of Article 5 of Appendix **30A** and its associated footnote.Administrations are also invited to clarify the notification of assignments to transmitting feeder-link earth stations, when agreements have already been obtained through the former Article 4 procedure.

One administration expressed the view that notification of frequency assignments of the Plans to transmitting feeder-link earth stations could be done on a service area basis, and not on a station by station basis. However, careful studies are required for the implementation of this latter approach.

3.2.3.6.10 Orbital positions for Regions 1 and 3 Plan (Section 3.15 of Annex 3 of Appendix 30A)

In revising the Regions 1 and 3 Plans, WRC-2000 used orbital positions shifted by 0.2° from some nominal positions as a means to resolve the interference excess identified during the replanning studies in the feeder-link Plans at both 14 and 17 GHz[2]. This was never understood as corresponding to the Region 2 cluster concept.

Therefore, the use of an orbital position not coincident with that appearing in the Regions 1 and 3 Plan(s) or the List(s) would require, as other major changes of the characteristics, to seek the agreement of the administrations having assignments identified as affected by this change.

In view of the above, it is proposed to consider the deletion of the last indent of § 5.2.1 d) of Article 5 of Appendix **30A**. Administrations are also invited to review Section 3.15 of Annex 3 of Appendix **30A** in order to provide appropriate description of orbital positions in the Regions 1 and 3 feeder-link Plan.

3.2.3.7 Review of the provisions of footnote No. 5.491

As the procedures relating to sharing between the planned broadcasting-satellite service in the 12 GHz band and other services are being reviewed in this agenda item, WRC-03 may want to review the provisions of footnote No. **5.491**, which address the particular situation of the allocation

---

[2] For further details, see Section 8.3 of Corrigendum 1 to Document WRC-2000/34.

to the fixed-satellite service (space-to-Earth) in Region 3 in respect of the planned broadcasting-satellite service and terrestrial services. This footnote currently reads as follows:

5.491 *Additional allocation:* in Region 3, the band 12.2-12.5 GHz is also allocated to the fixed-satellite service (space-to-Earth) on a primary basis. The power flux-density limits in Table **21-4** of Article **21** shall apply to this frequency band. The introduction of the service in relation to the broadcasting-satellite service in Region 1 shall follow the procedures specified in Article 7 of Appendix **30**, with the applicable frequency band extended to cover 12.2-12.5 GHz. (WRC-2000)

This footnote therefore entails several regulatory provisions:

a) it allocates, on a primary basis, the band 12.2-12.5 GHz to the fixed-satellite service (space-to-Earth) in Region 3;

b) it refers to the applicable limits in Table **21-4**;

c) it refers to the applicable provisions of Article 7 of Appendix **30**, with the applicable frequency band extended to cover 12.2-12.5 GHz, in relation to the broadcasting-satellite service in Region 1.

Provision b) is not necessary, since the limits in Table **21-4** always apply, irrespective of whether or not they are called by a footnote in Article **5**.

Provision c) is no longer necessary, since Article 7 has been modified by WRC-2000 in order to cover this particular provision, and Article 7 therefore applies, whether or not it is called by this footnote.

If WRC-03 decided to suppress the provisions under b) and c) above, provision a), hence the entire footnote, may be reflected in the Table of Article **5** itself, as a primary Table allocation to the fixed-satellite service (space-to-Earth) in Region 3 in the band 12.2-12.5 GHz. In such a case, footnote No. **5.491** may therefore be suppressed, in line with Resolution **26** (Rev. WRC-97).

WRC-03 may consider the following example modifications to the Radio Regulations which intend to implement the conclusions stated above.

SUP

5.491 *Additional allocation:* in Region 3, the band 12.2-12.5 GHz is also allocated to the fixed-satellite service (space-to-Earth) on a primary basis. The power flux-density limits in Table **21-4** of Article **21** shall apply to this frequency band. The introduction of the service in relation to the broadcasting-satellite service in Region 1 shall follow the procedures specified in Article 7 of Appendix **30**, with the applicable frequency band extended to cover 12.2-12.5 GHz. (WRC-2000)

MOD

11.7-14.25 GHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td rowspan="3">11.7-12.5
FIXED
BROADCASTING
BROADCASTING-SATELLITE
MOBILE except aeronautical mobile
5.487 5.487A 5.492</td><td>11.7-12.1
FIXED 5.486
FIXED-SATELLITE (space-to-Earth) 5.484A
Mobile except aeronautical mobile
5.485 5.488</td><td rowspan="2">11.7-12.2
FIXED
MOBILE except aeronautical mobile
BROADCASTING
BROADCASTING-SATELLITE
5.487 5.487A 5.492</td></tr>
<tr><td>12.1-12.2
FIXED-SATELLITE (space-to-Earth) 5.484A
5.485 5.488 5.489</td></tr>
<tr><td rowspan="2">12.2-12.7
FIXED
MOBILE except aeronautical mobile
BROADCASTING
BROADCASTING-SATELLITE
5.487A 5.488 5.490 5.492</td><td>12.2-12.5
FIXED
FIXED-SATELLITE (space-to-Earth)
MOBILE except aeronautical mobile
BROADCASTING
5.484A 5.487</td></tr>
<tr><td rowspan="2">12.5-12.75
FIXED-SATELLITE (space-to-Earth) 5.484A (Earth-to-space)
5.494 5.495 5.496</td><td rowspan="2">12.5-12.75
FIXED
FIXED-SATELLITE (space-to-Earth) 5.484A
MOBILE except aeronautical mobile
BROADCASTING-SATELLITE 5.493</td></tr>
<tr><td>12.7-12.75
FIXED
FIXED-SATELLITE (Earth-to-space)
MOBILE except aeronautical mobile</td></tr>
</table>

TABLE 3.2-8

Sharing criteria in Annexes 1, 3, 4, 6 and 7 to Appendix 30

Criteria in	**Protected service(s) and bands (GHz)**	**Interfering service**	**Type of limit**	**Associated procedures**	**Possible action**	**CPM text**
1	**2**	**3**	**4**	**5**	**6**	**7**
Annex 1 Sec. 1	Assignments in R1 and 3 BSS Plan or List and new or mod assignments in the R1 and 3 BSS List (11.7-12.5 in R1 and 11.7-12.2 in R3)	Proposed new or modified assignments in R1 and 3 BSS List	Hard pfd limit + Coord arc + pfd(θ) + Δ epm↓ (θ=space station separation)	Art 4, § 4.1.1a) or b)	R1: Replace pfd(θ) limit with BSS protection equations of § 3.2.2.3a) R3: **See Note 4**	Sec. 3.2.2.2b)
Annex 1 Sec. 2	Assignments in Region 2 BSS Plan (12.2-12.7)	Proposed new or modified assignments in R2 BSS Plan	Δ oepm	Art 4, § 4.2.3c)	NOC	Sec. 3.2.2.2a)
Annex 1 Sec. 3	Assignments in Region 2 BSS Plan (12.2-12.5)	Proposed new or modified assignments in R1 and 3 List	pfd(θ); (θ=space station separation)	Art 4, § 4.1.1c)	Replace with BSS protection equations of § 3.2.2.3b)	Sec. 3.2.2.3
	BSS Plan in R1 (12.2-12.5) and unplanned BSS in R3 (12.5-12.7)	Proposed new or modified assignments in R2 Plan		Art 4, § 4.2.3a) or b) or f)	R1: Replace with BSS protection equations of § 3.2.2.3b) R3: **See Note 4**	Sec. 3.2.2.3
Annex 1 Sec. 4	Terrestrial services in R1, 2 or 3 (11.7-12.7)	Proposed new or modified assignments in R2 Plan or R1 and 3 List	Δ pfd + pfd(θ); (θ=angle of arrival)	Art 4, § 4.1.1d) Art 4, § 4.2.3d)	NOC	**No study** per Res. 540 *invites* 1
Annex 1 Sec. 6	FSS↓ in R2 (11.7-12.2) and in R3 (12.2-12.5)	Proposed new or modified assignments in R1 and 3 List	Δ pfd + pfd(θ) (θ=space station separation) Note 1	Art 4, § 4.1.1e) or 4.2.3e)	R1: Replace pfd(θ) with FSS protection equations of § 3.2.2.3a) R2 and 3: **See Note 5**	Sec. 3.2.2.3
	FSS↓ in R1 (12.5-12.7) and R3 (12.2-12.7)	Proposed new or modified assignments in R2 Plan		Art 4, § 4.2.3e)		Sec. 3.2.2.3
Annex 1 Sec. 7	FSS↑ in R1 (12.5-12.7)	Proposed modification to R2 Plan	ΔT/T	Art 4, § 4.2.3e)	Change ΔT/T from 4% to 6%	Sec. 3.2.2.3

Annex 3	BSS receiving earth stations in R1 (11.7-12.5), R2 (12.2-12.7), and R3 (11.7-12.2)	Terrestrial stations and FSS↑ earth stations **Note 7**	pfd at edge of BSS service area	Art 6, § 6.2.2	Retain Annex 3 but with new parameters or replace with App. 7 including new BSS parameters	Sec. 3.2.2.4
Annex 4	R1 and 3 BSS Plan	FSS↓ or unplanned BSS in R2 (11.7-12.2 GHz)	pfd(θ) (θ=space station separation)	Art 7, § 7.1 and 7.2	R1: Replace with BSS protection equations of § 3.2.2.3a)	Sec. 3.2.2.3
	R2 BSS Plan	FSS↓ or unplanned BSS in R1 (12.5-12.7 GHz) and R3 (12.2-12.7 GHz)			R2: Replace with BSS protection equations of § 3.2.2.3b) R3: **See Note 4**	Sec. 3.2.2.3
Annex 6 **Note 2**	BSS	BSS, FSS, FS, BS	C/I	Not explicitly referenced in Articles 4 - 7 of Annex 30	Replace with new Annex 6 using text from § 3.2.2.1 **See Note 3**	Sec. 3.2.2.1
	FSS	BSS, FSS	C/I, N			
	FS	BSS	N			
	BS	BSS	C/I			
Annex 7 **§ A3)**	FSS in R2 (11.7-12.2)	BSS in R1	Orbital position		NOC	**No study** **See Note 6**

TABLE 3.2-9

Sharing criteria in Annexes 1 and 4 to Appendix 30A

Criteria in	Protected service(s) and bands (GHz)	Interfering service	Type of limit	Associated procedures	Possible action	CPM text
1	**2**	**3**	**4**	**5**	**6**	**7**
Annex 1 **Sec. 3**	R2 FL Plan (17.3-17.8)	Proposed modification to R2 FL Plan	Δ oepm	Art 4, § 4.2.2c)	NOC	Sec. 3.2.2.5
Annex 1 **Sec. 4**	R1 and 3 FL Plan or FL List or modifications to FL List	Proposed modification to R1 and 3 FL List	Hard pfd + coord arc + ΔFLepm	Art 4, § 4.1.1a) or § 4.1.1b)	NOC	
Annex 1 **Sec. 5**	FSS↑ in R1 and 3 (17.3-18.1) or R2 (17.3-17.8)	Proposed modification to R1 snf 3 FL List or R2 FL Plan	ΔT/T (3%) **Note 8**	Art 4, § 4.2.2a) or § 4.2.2b)	Increase ΔT/T to a common value to be determined by further study	Sec. 3.2.2.6
Annex 1 **Sec. 6**	Unplanned BSS FL in R2 (17.8-18.1)	Proposed modification to R1 and 3 FL List	ΔT/T (3%) **Note 8**	Art 4, § 4.1.1c)		

Annex 4 Sec. 1	R1 and 3 FL Plan (17.3-18.1) or R2 FL Plan (17.3-17.8)	FSS↓ or BSS	ΔT/T (4%) **Note 8**	Art 7, § 7.1	**Note 8**	
Annex 4 Sec. 2	BSS FL in R1 and 3 Plan or List (17.8-18.1)	Unplanned BSS FL in R2	ΔT/T (3%) **Note 8**	Art 7, § 7.1		

Note 1 – Until § 6 of Annex 1 to Appendix **30** is modified by WRC-03, the pfd limits appearing in the Annex to Resolution **540 (WRC-2000)** shall be applied in place of the –138 dB(W/(m^2 · 27 MHz)) and –160 dB(W/(m^2 · 4 kHz)) criteria appearing in the third paragraph of § 6 of Annex 1 to Appendix **30**.

Note 2 – Annex 6 to Appendix **30** in the 2001 Edition of the Radio Regulations provides a table showing the protection requirements that were assumed at WARC-77 as a basis for developing sharing criteria among the indicated combinations of protected and interfering services assuming the use of analog signals (TV/FM, FDM/FM, TV/VSB, 4φ-PSK) appropriate to those services at the time. Annex 6 also suggests the diameter, gain, and efficiency of a reference FSS earth station used at WARC-77 in calculating interference from BSS space stations, and provides data on the BSS use of energy dispersal.

Note 3 – If desired for historical reasons, a note similar to Note 2 above should be added as a footnote to the title of the new Annex 6.

Note 4 – Requires decision on minimum diameter of BSS antenna to be protected in Region 3. If 60 cm, replace pfd(θ) with BSS protection equations of § 3.2.2.3a); if 45 cm, replace pfd(θ) with BSS protection equations of § 3.2.2.3b).

Note 5 – Requires decision on minimum diameter of FSS antenna to be protected in Region 3. If 60 cm, replace pfd(θ) with FSS protection equations of § 3.2.2.3a); if 45 cm, replace pfd(θ) with FSS protection equations of § 3.2.2.3b).

Note 6 – *Invites the ITU-R* 3 of Resolution **540 (WRC-2000)** invited study of the limitations of § A3 of Annex **7** to Appendix 30 in the context of any changes to the sharing criteria studied by the ITU-R. The responsible Working Party and its Special Rapporteur Group received no responses to this invitation, implying that the proposed changes to the sharing criteria did not warrant changing the § A3 limitations.

Note 7 – Both Res. **540** and Res. **735** invite study of the criteria for this sharing case. The latter Resolution emphasizes sharing in the bands consistent with the decisions of WRC-2000 on No. **9.19**.

Note 8 – ΔT/T is calculated in accordance with the method of Appendix 8 except that the maximum power densities per Hertz averaged over the worst 1 MHz are replaced by power densities per Hertz averaged over the total RF bandwidth of the feeder-link carriers. The further study leading to the new value of ΔT/T should include specification of the reference antenna pattern to be used in lieu of that in Annex III to Appendix **8**.

ATTACHMENT 1 TO SECTION 3.2 OF CHAPTER 3

DRAFT EXAMPLE OF POSSIBLE MODIFICATION OF ANNEX 1 OF APPENDIX 30

MOD

ANNEX 1 (WRC-2000)

Limits for determining whether a service of an administration is affected by a proposed modification to the Region 2 Plan or by a proposed new or modified assignment in the Regions 1 and 3 List or when it is necessary under this Appendix to seek the agreement of any other administration[14]

(See Article 4)

1 Limits for the interference into frequency assignments in conformity with the Regions 1 and 3 Plan or with the Regions 1 and 3 List or into new or modified assignments in the Regions 1 and 3 List

Under assumed free-space propagation conditions, the power flux-density of a proposed new or modified assignment in the List shall not exceed the value of –103.6 dB(W/(m^2 · 27 MHz)).

With respect to § 4.1.1 *a)* or *b)* of Article 4, an administration in Region 1 or 3 is considered by the Bureau as being affected if the minimum orbital spacing between the wanted and interfering space stations, under worst-case station-keeping conditions, is less than 9°.

However, an administration is considered as not being affected if either of the following two conditions are met:

a) under assumed free-space propagation conditions, the power flux-density at any test point within the service area associated with any of its frequency assignments in the Plan or in the List or for which the procedure of Article 4 has been initiated, does not exceed the following values:[15]

{Editorial note: pfd mask. See Section 3.2.2.3 of the CPM Report}

---

[14] With respect to this Annex, except for Section 2, the limits relate to the power flux-density which would be obtained assuming free-space propagation conditions.

With respect to Section 2 of this Annex, the limit specified relates to the overall equivalent protection margin calculated in accordance with § 2.2.4 of Annex 5.

[15] For the protection of analogue assignments brought in service before 17 October 1997, the following values shall be used until 1 January 2015:

–147 dB(W/(m^2 · 27 MHz)) for $0° \leq \theta < 0.44°$

–138 + 25 log θ dB(W/(m^2 · 27 MHz)) for $0.44° \leq \theta < 9°$.

b) the effect of the proposed new or modified assignments in the List is that the equivalent downlink protection margin[16] corresponding to a test point of its assignment in the Regions 1 and 3 Plan or List, or for which the procedure of Article 4 has been initiated, including cumulative effect of any previous modification to the List or any previous agreement, does not fall more than 0.45 dB below 0 dB or, if already negative, more than 0.45 dB below the value resulting from:

– the Regions 1 and 3 Plan and List as established by WRC-2000; *or*

– a proposed new or modified assignment to the List in accordance with this Appendix; *or*

– a new entry in the Regions 1 and 3 List as a result of successful application of Article 4 procedures.

NOTE – In performing the calculation, the effect at the receiver input of all the co-channel and adjacent-channel signals is expressed in terms of one equivalent co-channel interfering signal. This value is usually expressed in decibels.

NOC

2 Limits to the change in the overall equivalent protection margin for frequency assignments in conformity with the Region 2 Plan

MOD

3 Limits to the change in the power flux-density to protect the broadcasting-satellite service in Regions 1 and 2 in the band 12.2-12.5 GHz and in Region 3 in the band 12.5-12.7 GHz

With respect to § 4.1.1 *c)* of Article 4, an administration in Region 2 is considered as being affected if the proposed new or modified assignment in the Regions 1 and 3 List would result in exceeding the power flux-densities given below, at any test point in the service area of its overlapping frequency assignments.

With respect to § 4.2.3 *a)*, 4.2.3 *b)* or 4.2.3 *f)* of Article 4, as appropriate, an administration in Region 1 or 3 is considered as being affected if the proposed modification to the Region 2 Plan would result in exceeding the power flux-densities given below, at any test point in the service area of its overlapping frequency assignments.

{Editorial note: pfd mask. See Section 3.2.2.3 of the CPM Report}

NOC

4 Limits to the power flux-density to protect the terrestrial services of other administrations[18, 19, 20]

5 (Not used.)

MOD

[16] For the definition of the equivalent protection margin, see § 3.4 of Annex 5.

[18] See § 3.18 of Annex 5.

[19] In the band 12.5-12.7 GHz in Region 1, these limits are applicable only to the territory of administrations mentioned in Nos. **5.494** and **5.496**.

[20] See Resolution **34**.

6 Limits to the change in the power flux-density of assignments in the Regions 1 and 3 Plan or List to protect the fixed-satellite service (space-to-Earth) in the band 11.7-12.2 GHz in Region 2 or in the band 12.2-12.5 GHz in Region 3, and of assignments in the Region 2 Plan to protect the fixed-satellite service (space-to-Earth) in the band 12.5-12.7 GHz in Region 1 and in the band 12.2-12.7 GHz in Region 3

With respect to § 4.1.1 *e)* of Article 4, an administration is considered as being affected if the proposed new or modified assignment in the Regions 1 and 3 List would result in an increase in the power flux-density over any portion of the service area of its overlapping frequency assignments in the fixed-satellite service in Region 2 or Region 3 of 0.25 dB or more above that resulting from the frequency assignments in the Plan or List for Regions 1 and 3 as established by WRC-2000.

With respect to § 4.2.3 *e)*, an administration is considered as being affected if the proposed modification to the Region 2 Plan would result in an increase in the power flux-density over any portion of the service area of its overlapping frequency assignments in the fixed-satellite service in Region 1 or 3 of 0.25 dB or more above that resulting from the frequency assignments in the Region 2 Plan at the time of entry into force of the Final Acts of the 1985 Conference.

With respect to § 4.1.1 *e)* or § 4.2.3 *e)* of Article 4, an administration is considered as not being affected if the proposed new or modified assignment in the Regions 1 and 3 List, or if a proposed modification to the Region 2 Plan, gives a power flux-density anywhere over any portion of the service area of its overlapping frequency assignments in the fixed-satellite service in Region 1, 2 or 3 of less than:

For interference caused by Regions 1 and 3 BSS to Region 2 FSS (space-to-Earth in the band 11.7-12.2 GHz):

{Editorial note: pfd mask. See Section 3.2.2.3 of the CPM Report}

For interference caused by Region 1 BSS to Region 3 FSS (space-to-Earth in the band 12.2-12.5 GHz), or interference caused by Region 2 BSS to Regions 1 and 3 FSS (space-to-Earth in the band 12.5-12.7 GHz in Region 1 and in the band 12.2-12.7 GHz in Region 3):

{Editorial note: pfd mask. See Section 3.2.2.3 of the CPM Report}

MOD

7 Limits to the change in equivalent noise temperature to protect the fixed-satellite service (Earth-to-space) in Region 1 from modifications to the Region 2 Plan in the band 12.5-12.7 GHz

With respect to § 4.2.3 *e)* of Article 4, an administration of Region 1 is considered as being affected if the proposed modification to the Region 2 Plan would result in:

– the value of $\Delta T/T$ resulting from the proposed modification is greater than the value of $\Delta T/T$ resulting from the assignment in the Region 2 Plan as of the date of entry into force of the Final Acts of the 1985 Conference; *and*

– the value of $\Delta T/T$ resulting from the proposed modification exceeds [6%],

using the method of Appendix **8** (Case II).

ATTACHMENT 2 TO SECTION 3.2 OF CHAPTER 3

Example of possible modification of Annex 3 of Appendix 30

MOD

ANNEX 3

Method for determining the limiting interfering power flux-density at the edge of a broadcasting-satellite service area in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) and for calculating the power flux-density produced there by a terrestrial station, or a transmitting earth station in the fixed-satellite service in the band 12.5-12.7 GHz

1 General

1.1 This Annex describes a method of calculating the interference potential from terrestrial transmitters or transmitting earth stations in the fixed-satellite service to broadcasting-satellite receivers.

1.2 The method is in two parts:

a) the calculation of the maximum permissible interfering power flux-density at the edge of the broadcasting-satellite service area concerned;

b) the calculation of the likely power flux-density produced at any point on the edge of the service area by the terrestrial transmitter or the transmitting earth station in the fixed-satellite service of another administration.

1.3 The interference potential of the terrestrial transmitters or the transmitting earth stations in the fixed-satellite service must be considered case by case; the power flux-density produced by each terrestrial transmitter or transmitting earth station is compared to the limiting power flux-density at any point on the edge of the service area of a broadcasting-satellite station of another administration. If, for a given transmitter, the value of the power flux-density produced is lower than the value of the limiting power flux-density at any point on the edge of the service area, the interference caused to the broadcasting-satellite service by this transmitter is considered to be lower than the permissible value and no coordination is required between administrations before the terrestrial station or the transmitting earth station is brought into use. Where this is not the case, coordination and more precise calculations derived from a mutually agreed basis are necessary.

1.4 It is emphasized that, should the calculation described in this Annex indicate that the maximum permissible power flux-density is exceeded, it does not necessarily preclude the introduction of the terrestrial or the fixed-satellite service since the calculations are necessarily based on worst-case assumptions for:

a) the nature of the terrain of the interference path;

b) the off-beam discrimination on the broadcasting-satellite receiving installations;

c) the necessary protection ratios for the broadcasting-satellite service;

d) the type of reception in the broadcasting-satellite service, i.e., assuming individual reception, this being more critical than community reception for the angles of elevation concerned;

e) the value of power flux-density to be protected in the broadcasting-satellite service;

f) the propagation conditions between the interfering station or earth station and the broadcasting-satellite service area.

2 Limit of power flux-density

2.1 General

The limiting power flux-density not to be exceeded at the edge of the service area in order to protect the broadcasting-satellite service of an administration is given by the formula:

$$F = F_0 - R + D + P \tag{1}$$

where:

F: the maximum permissible interfering power flux-density (dB(W/m^2)) within the necessary bandwidth of the broadcasting-satellite;

F_0: the wanted power flux-density (dB(W/m^2)) at the edge of the service area;

R: the protection ratio (dB) between the wanted and interfering signals;

D: angular discrimination (dB) provided by the radiation pattern of the broadcasting-satellite receiver antenna;

P: polarization discrimination (dB) between the wanted and interfering signals.

2.2 Wanted power flux-density (F_0)

The value of F_0 is equal to:

For the Regions 1 and 3 Plan and List (WRC-2000), and digital assignments in the Region 2 Plan:

a) –108 dB(W/m^2) in 27 MHz for service areas in Regions 1 and 3, and

b) –115 dB(W/m^2) in 24 MHz, as well as in 27 MHz with respect to the cases mentioned in the footnote to Section 3.8 of Annex 5 concerning the necessary bandwidth in Region 2.

For the analogue BSS assignments in the Region 2 Plan:

–107 dB(W/m^2) for 24 MHz, as well as for 27 MHz with respect to the cases mentioned in the footnote to Section 3.8 of Annex 5 concerning the necessary bandwidth in Region 2.

2.3 Protection ratio (*R*)

2.3.1 For digital BSS assignments, the single entry protection ratio is equal to 30 dB.

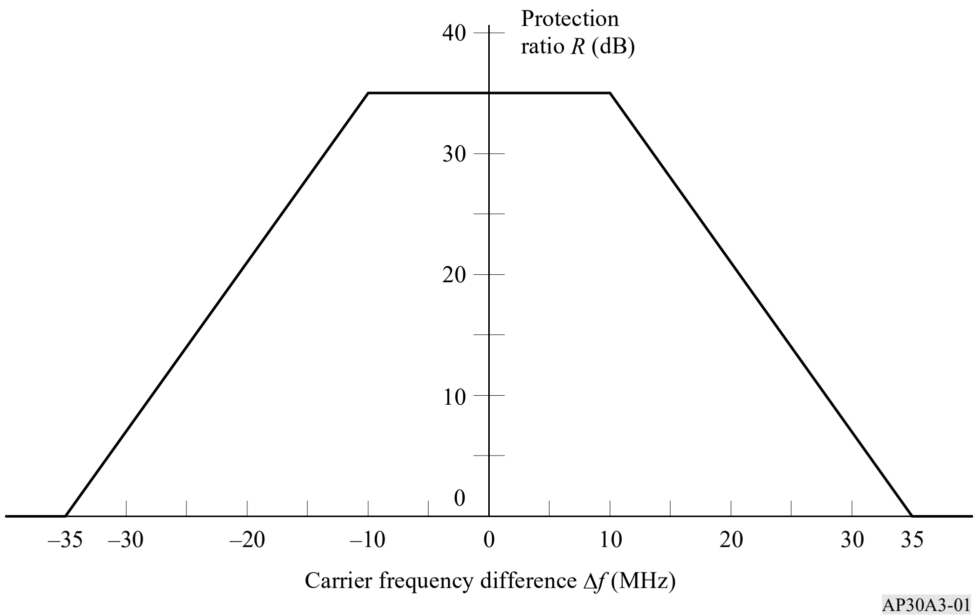
2.3.2 For the analogue BSS assignments in the Region 2 Plan and for BSS assignments in Regions 1 and 3 Plan and List which have been notified in conforming with the Plans and List of AP30 and brought into use and for which the date of bringing into use has been confirmed to the Bureau before [9 June 2003], the single entry protection ratio against all types of transmissions, with the exception of amplitude-modulation multichannel television systems, is 35 dB for carrier frequency differences between the wanted and interfering signals of up to ±10 MHz, decreasing linearly from 35 dB to 0 dB for carrier frequency differences between 10 MHz and 35 MHz, and is 0 dB for frequency differences in excess of 35 MHz (see Fig. 1). For amplitude-modulation multichannel television systems which produce high peaks of power flux-density spread over a wide range of their necessary bandwidth, the protection ratio *R* is 35 dB and is independent of the carrier frequency difference.

2.3.3 The carrier frequency difference should be determined by reference to the frequency assignments in the broadcasting-satellite Plan or, in the case of assignments not contained within a plan, by reference to the characteristics of the proposed or operational system.

2.3.4 A signal from a terrestrial station or a transmitting earth station in the fixed-satellite service should be considered only if its necessary bandwidth overlaps the necessary bandwidth of the broadcasting-satellite assignment.

FIGURE 1

Protection ratio (*R*) (dB) for a broadcasting-satellite signal against a single entry of interference from a terrestrial service (except for AM multichannel TV system)



2.4 Angular discrimination (*D*)

Regions 1 and 3:

2.4.1 The value of *D* to be assumed in equation (1) is derived from the following equations:

$$\begin{aligned}
D &= 0.0025((d/\lambda)*\varphi)\hat{}2 && \text{dB} && \text{for } 0° \le \varphi \le \varphi_m \\
D &= G_{max}-(29-25\log(\varphi_r)) && \text{dB} && \text{for } \varphi_m \le \varphi \le \varphi_r \\
D &= G_{max}-(29-25\log(\varphi)) && \text{dB} && \text{for } \varphi_r \le \varphi \le 14.45° \\
D &= G_{max} && \text{dB} && \text{for } 14.45° < \varphi
\end{aligned} \qquad (2)$$

where:

φ is the angle of elevation for the broadcasting-satellite system

φ_m = $(\lambda/d)((G_{max}–G_1)/(0.0025))$^(0.5) deg.

φ_r = $95(\lambda/d)$ deg.

G_{max} = 35.5 dB

G_1 = $29–25\log\varphi_r$ dB

d = 60 cm

λ is the wavelength in centimetres at [12.2] GHz.

Region 2:

2.4.2 For the digital BSS assignments in the Region 2 Plan the value of *D* to be assumed in equation (1) is derived from the following equations:

$D = 0.0025((d/\lambda)*\varphi)^2$ dB for $0° < \varphi < \varphi_m$

$D = G_{max}-(29–25\log(\varphi_r))$ dB for $\varphi_m < \varphi < \varphi_r$

$D = G_{max}-(29–25\log(\varphi))$ dB for $\varphi_r < \varphi < 14.45°$

$D = G_{max}$ dB for $14.45° < \varphi$

where:

φ is the angle of elevation for the broadcasting-satellite system

$\varphi_m = (\lambda/d)((G_{max}–G_1)/(0.0025))^{(0.5)}$ deg.

$\varphi_r = 95(\lambda/d)$ deg.

$G_{max} = 33.5$ dB

$G_1 = 29–25\log\varphi_r$ dB

$d = 45$ cm

λ = wavelength in centimetres at [12.2] GHz.

2.4.3 For the analogue BSS assignments in the Region 2 Plan *D* in dB should be derived from the expression (3) below where φ is the elevation angle for the proposed or operational broadcasting-satellite system for the broadcasting-satellite service area concerned.

NOTE 1 – If more than one value of φ is specified for a particular service area, the appropriate value of φ should be used for each section of the edge of the service area under consideration.

$$\begin{aligned}
D &= 0 && \text{dB for } 0° \leq \varphi \leq 0.43° \\
D &= 4.15\,\varphi^2 && \text{dB for } 0.43° < \varphi \leq 1.92° \\
D &= 8.24 + 25\log\varphi && \text{dB for } 1.92° < \varphi \leq 25° \\
D &= 43.2 && \text{dB for } \varphi > 25°
\end{aligned} \qquad (3)$$

NOTE 2 – For the graphical determination of *D,* when calculated by equation (3) above, see Fig. 3.

2.5 Polarization discrimination (*P*)

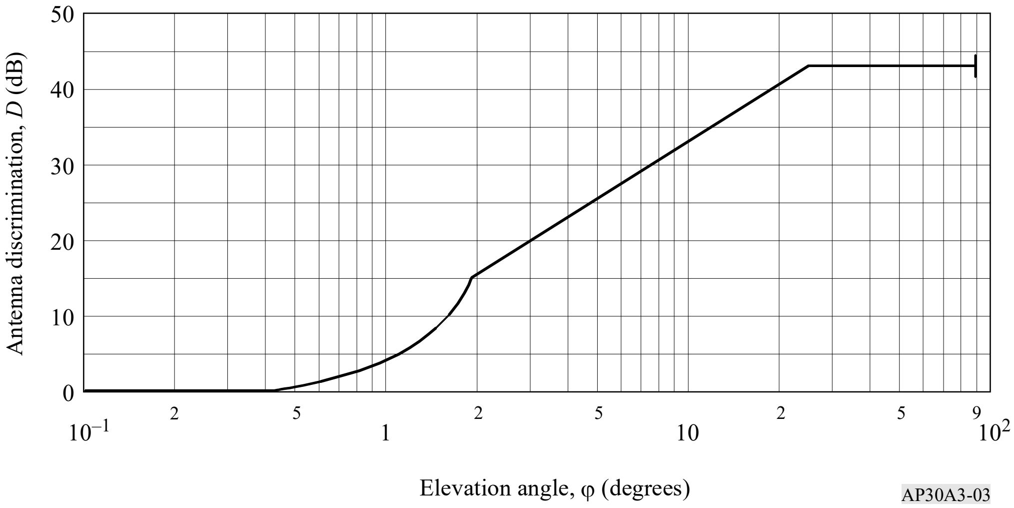
The value of *P* is equal to:

a) 3 dB when the interfering service uses linear polarization and the broadcasting-satellite service uses circular polarization or vice versa;

b) 0 dB when the interfering service and the broadcasting-satellite service both use circular or both use linear polarization.

FIGURE 3

Discrimination *D* (dB) of broadcasting-satellite receiver antenna as a function of satellite elevation angle



3 Power flux-density produced by a terrestrial station or a transmitting earth station (F_p)

The power flux-density F_p (dB(W/m^2)) produced at any point on the edge of the service area by the terrestrial station or the transmitting earth station is determined from the following formula:

$$F_p = E - A + [43] \tag{4}$$

where:

E: the equivalent isotropically radiated power (dBW) of the terrestrial station or the transmitting earth station in the direction of the point concerned on the edge of the service area;

A: the total path loss (dB);

Constant of [43] dB: the gain of a 1 m^2 aperture antenna at [12.2] GHz.

3.1 Evaluation of path loss *A* for a terrestrial station or a transmitting earth station at the edge of the service area of the broadcasting satellite

This section provides the propagation model to use for determining the minimum path loss between the interfering terrestrial transmitter or transmit earth station and the edge of the BSS service area. The calculations assume a frequency of [12.2] GHz for the interfering signal. References are made to the appropriate sections of Appendix 7 that describe the model in more detail.

3.1.1 Propagation Mode 1 (Appendix 7: § 4 , § 1 of Annex 1, § 3 of Annex 1)

3.1.1.1 Ducting Model

Distance-independent part of the losses (dB) for ducting

For BSS earth stations, no additional protection can be assumed to be available from the earth station horizon elevation angle, i.e. A_h, the total site shielding attenuation, is 0 dB.

Reduction in attenuation arising from direct coupling into over-sea ducts (dB):

$$A_c = \frac{-6}{(1 + d_c)}$$

where d_c (km) is the distance from a land based earth station to the coast in the direction being considered. d_c is zero in other circumstances.

Distance-independent part of the losses (dB) for ducting:

$$A_1 = 140.35 + A_c$$

Distance-dependent part of the losses (dB) for ducting

Specific attenuation due to gaseous absorption (dB/km):

$$\gamma_g = 7.507 \times 10^{-3} + 1.104 \times 10^{-2}\left(\frac{d_t}{d_i}\right) + 1.551 \times 10^{-2}\left(1 - \frac{d_t}{d_i}\right)$$

where:

d_t (km): aggregate land distance, Zone A1 + Zone A2, along the path

d_i (km): path length considered, it lies within the range between a minimum calculated distance and a maximum calculated distance, which are given in § 4.2 and § 4.3 of Appendix 7.

Values for zone-dependent parameters:

$$\tau = 1 - \exp\left[-\left(4.12 \times 10^{-4} (d_{lm})^{2.41}\right)\right]$$

where:

d_{lm} (km): longest continuous inland distance, Zone A2, along the path considered.

$$\mu_1 = \left[10^{\frac{-d_{tm}}{16-6.6\tau}} + \left[10^{-(0.496+0.354\tau)}\right]^5\right]^{0.2}$$

where:

d_{tm} (km): longest continuous land (i.e. inland + coastal) distance, Zone A1 + Zone A2 along the path considered.

μ_1 limited to $\mu_1 \le 1$.

$$\sigma = -0.6 - 8.5 \times 10^{-9} d_i^{3.1} \tau$$

σ limited to $\sigma \ge -3.4$.

$$\mu_2 = \left(2.48 \times 10^{-4} d_i^2\right)^{\sigma}$$

μ_2 limited to $\mu_2 \le 1$.

$$\mu_4 = \begin{cases} 10^{(-0.935+0.0176\zeta_r)\log\mu_1} & for \quad \zeta_r \le 70^o \\ 10^{0.3\log\mu_1} & for \quad \zeta_r \ge 70^o \end{cases}$$

where ζ_r is given in § 4.1 of Appendix 7.

Path-dependent incidence of ducting, β, and the related parameter, Γ_1:

Time dependency of the path loss:

$$\beta = \beta_e \cdot \mu_1 \cdot \mu_2 \cdot \mu_4$$

where β_e is given in § 4.1 of Appendix 7.

$$\Gamma_1 = \frac{1.076}{(2.0058 - \log\beta)^{1.012}} \exp\left[-\left(9.51 - 4.8\log\beta + 0.198(\log\beta)^2\right) \times 10^{-6} d_i^{1.13}\right]$$

The correction factor, C_{2i} (dB) is given by (see equation 52 in Annex 1 to Appendix 7):

$$C_{2i} = Z(f)(d_i - d_{\min})\tau \qquad dB$$

where Z(f) is given in § 4.4 of Appendix 7. At distances greater than 375 km the value of the correction factor C_{2i} to be applied is the value of C_{2i} at the 375 km distance.

Distance-dependent part of the losses (dB) for ducting:

$$L_5(p) = 0.138 d_i - 4.625 \times 10^{-3} d_t + (1.2 + 3.7 \times 10^{-3} d_i)\log\left(\frac{p}{\beta}\right) + 12\left(\frac{p}{\beta}\right)^{\Gamma_1} + C_{2i}$$

where p is the maximum percentage of time for which the permissible interference power may be exceeded.

Attenuation due to ducting:

$$A_{duct} = A_1 + L_5(p)$$

3.1.1.2 For the tropospheric scatter model

Distance-independent part of the losses (dB) for tropospheric scatter

$$A_2 = 212.98 + 10\varepsilon_h - 0.15 N_o - 10.1\left(-\log\left(\frac{p}{50}\right)\right)^{0.7}$$

where:

ε_h: earth station horizon elevation angle (degrees)

N_o: path centre sea level surface refractivity (§ 4.1 in the main body of Appendix 7)

Distance-dependent part of the losses (dB) for tropospheric scatter

$$L_6(p) = 20\log(d_i) + 5.73 \times 10^{-4}(112 - 15\cos(2\zeta))d_i + 0.0115 d_i + C_{2i}$$

where ζ is the latitude of the earth station's location (degree).

Total attenuation due to tropospheric scatter:

$$A_{trop} = A_2 + L_6(p)$$

Path loss for Mode 1:

$$A_{mode1} = \mathrm{Min}(A_{duct}, A_{trop})$$

3.1.2 Propagation Mode 2 (Appendix 7: § 5, Annex 5)

Distance-dependent part of the losses (dB)

$$L_r = 146.27 + 20\log r_i - 13.2\log R - G_x + A_b - 10\log R_{cv} + \Gamma_2 + L_{ar} + 7.507 \times 10^{-3} d_o + 0.0110 d_v$$

where:

r_i: path length considered, it lies within the range between a minimum calculation distance and a maximum calculation distance, which are given in § 4.1 of Appendix 7 and § 2 of Annex 2 to Appendix 7

R: rain fall rate (mm/h)

G_x: terrestrial network antenna gain (dB)

A_b: additional attenuation for the departure from Rayleigh scattering (dB)

R_{cv}: effective scatter transfer function

Γ_2: additional attenuation outside the common volume (dB)

L_{ar}: loss above the rain height (dB)

d_o: effective path length for oxygen absorption (km)

d_v: effective path length for water vapour absorption (km).

Path loss for Mode 2:

$$A_{\mathrm{mod}e2} = L_r(p) + G_r + G_t$$

where G_r is the gain (dB) of the antenna of the receiving earth station.

The minimum path loss, A_{min}, between interfering transmit site and edge of BSS service area is given by:

$$A_{min} = \mathrm{Min}\,(A_{mode1}, A_{mode2}) \quad \text{(dB)}$$

ATTACHMENT 3 TO SECTION 3.2 OF CHAPTER 3

DRAFT EXAMPLE OF POSSIBLE MODIFICATION OF ANNEX 4 OF APPENDIX 30

MOD

ANNEX 4 (WRC-2000)

Need for coordination of a transmitting space station in the fixed-satellite service or in the broadcasting-satellite service where this service is not subject to a Plan: in Region 2 (11.7-12.2 GHz) with respect to the Plan, the List or proposed new or modified assignments in the List for Regions 1 and 3, in Region 1 (12.5-12.7 GHz) and in Region 3 (12.2-12.7 GHz) with respect to the Plan or proposed modifications to the Plan for Region 2, in Region 3 (12.2-12.5 GHz) with respect to the Plan, the List or proposed new or modified assignments in the List for Region 1

(See Article 7)

With respect to §§ 7.1 and 7.2 of Article 7, coordination of a space station in the fixed-satellite service (space-to-Earth) of Region 2 is required when, under assumed free-space propagation conditions, the power flux-density over any portion of the service area of the overlapping frequency assignments in the broadcasting-satellite service of an administration in Region 1 or Region 3 exceeds the value derived from the expressions given below.

{Editorial note: pfd mask. See Section 3.2.2.3 of the CPM Report}

With respect to §§ 7.1 and 7.2 of Article 7, coordination of a space station in the fixed-satellite service (space-to-Earth) of Region 3 is required when, under assumed free-space propagation conditions, the power flux-density over any portion of the service area of the overlapping frequency assignments in the broadcasting-satellite service of an administration in Region 1 exceeds the value derived from the expressions given below:

{Editorial note: pfd mask. See Section 3.2.2.3 of the CPM Report}

With respect to §§ 7.1 and 7.2 of Article 7, coordination of a space station in the fixed-satellite service (space-to-Earth) in Region 1 or 3 or broadcasting-satellite service not subject to a Plan in Region 3 is required when, under assumed free-space propagation conditions, the power flux-density over any portion of the service area of the overlapping frequency assignments in the broadcasting-satellite service of an administration in Region 2 exceeds the value derived from the expressions given below:

{Editorial note: pfd mask. See Section 3.2.2.3 of the CPM Report}

ATTACHMENT 4 TO SECTION 3.2 OF CHAPTER 3

DRAFT EXAMPLE OF POSSIBLE MODIFICATION OF ANNEX 6 OF APPENDIX 30

ANNEX 6[39]

Criteria for sharing between services

ADD

Part A Assumptions used in deriving sharing criteria adopted by the WARC–77

NOC

Sections 1 to 3 of Annex 6

ADD

Part B Assumptions used in deriving sharing criteria adopted by WRC-03

The establishment of new sharing criteria between the fixed-satellite service and the broadcasting-satellite service has been based on the following assumptions.

1 Reference antenna patterns

1.1 For earth station antennas in the fixed-satellite service or in the broadcasting-satellite service with diameters between 45 cm and 240 cm, the gain of the side lobes is given by [Recommendation ITU-R BO.1213].

1.2 For earth station antennas in the fixed-satellite service with diameters greater than 240 cm, the gain of the side lobes is given by Recommendation ITU-R S.580-5, with 29-25log θ side-lobe envelope, complemented in the main lobe by Annex 3 to Appendix 8, which is equivalent to Section 3 of Annex 3 to Appendix 7 (WRC-2000).

2 Antenna sizes and total noise temperatures

The range of antenna sizes and total noise temperatures considered for the protection of the fixed-satellite service and the broadcasting-satellite service are given in the following table:

Receive earth station antenna diameter (m)	0.45*	0.60	0.80	1.20	2.4	5.0	8.0	11.0
Receive earth station noise temperature (K)	110	110	125	150	150	200	250	250
Total link noise temperature (K)	174	174	198	238	238	317	396	396

39 Sections 1 and 2 of Part A of this Annex are applicable when the services of Regions 1 or 3 are involved. Section 3 of Part A is applicable to all Regions.

* ***The inclusion of the 45 cm diameter in the range of antennas to be protected has not been agreed in all cases.***

The total link noise temperature was calculated from the receive earth station noise temperature (which includes the antenna temperature, the receive amplifier temperature and the noise increase resulting from feeder losses), and adding 2 dB for all other sources of noise (uplink noise, GSO interference, cross polarization isolation and frequency reuse interference).

3 Protection criteria

Pfd masks developed in Sections 1, 3 and 6 of Annex 1 and in Annex 4 to Appendix 30 to protect the fixed-satellite service and the broadcasting-satellite service have been determined by specifying to 6% the allowable relative noise increase (ΔT/T) into the range of earth station antennas given in the above table.

The allowable interfering pfd was calculated by the following expression:

$$PFD_{all}(\theta) = 10Log(\Delta T/T) + 10Log(kT\ b_{rf}) + G_m - G_a(\varphi)$$

where:

$PFD_{all}(\theta)$ = allowable level of interfering pfd for an orbital separation of θ degrees

$\Delta T/T$ = allowable relative increase in receiver link noise = 6%

k = Boltzmann's constant (1.38×10^{-23} Watt·sec/K)

T = Total link noise temperature (K; see Table in section 2 above)

b_{rf} = Reference bandwidth (27 MHz in Regions 1 and 3; 24 MHz in Region 2)

G_m = Gain of a 1 m^2 effective aperture (dBi/m^2)

$G_a(\varphi)$ = Receive antenna gain for topocentric angle of φ (dBi)

φ = Topocentric angle between interfering and wanted satellites (see Annex 1 of Appendix 8 of the Radio Regulations) (deg)

It was assumed that $\varphi = 1.1\ \theta$

4 Power flux-density to protect FSS and BSS with specific antenna diameters

The table below contains required power flux-density levels for the protection of FSS and BSS with the characteristics in Section 2 above using the criteria specified in Section 3 above.

Required power flux-density (pfd) in dB (W/m²/27 MHz) corresponding to different antenna diameters								
Orbital separation between wanted and interfering space stations	**45 cm***	**60 cm**	**80 cm**	**120 cm**	**240 cm**	**500 cm**	**800 cm**	**1 100 cm**
0°	−134.2	−136.7	−138.7	−142.2	−147.4	−152.5	−155.6	−158.2
θ>0	For any value of the orbital separation θ between the wanted and interfering space stations, the applicable pfd should be relaxed from the value corresponding to 0° orbital separation by adding the off-axis antenna discrimination, as calculated under the assumptions in Section 1 above.							

* ***The inclusion of the 45 cm diameter in the range of antennas to be protected has not been agreed in all cases.***

ATTACHMENT 5 TO SECTION 3.2 CHAPTER 3

DRAFT EXAMPLE OF POSSIBLE MODIFICATION OF ANNEXES 1 AND 4 OF APPENDIX 30A

ANNEX 1

Limits for determining whether a service of an administration is considered to be affected by a proposed modification to the Region 2 feeder-link Plan or by a proposed new or modified assignment in the Regions 1 and 3 feeder-link List or when it is necessary under this Appendix to seek the agreement of any other administration (WRC-2000)

1 (SUP - WRC-2000)

2 (SUP - WRC-2000)

NOC

3 Limits to the change in the overall equivalent protection margin with respect to frequency assignments in conformity with the Region 2 feeder-link Plan[18] (WRC-2000)

[18] With respect to § 3 the limit specified relates to the overall equivalent protection margin calculated in accordance with § 1.12 of Annex 3.

MOD

4 Limits to the interference into frequency assignments in conformity with the Regions 1 and 3 feeder-link Plan or with the Regions 1 and 3 feeder-link List or proposed new or modified assignments in the Regions 1 and 3 feeder-link List (WRC-2000)

MOD

5 Limits applicable to protect a frequency assignment in the bands 17.3-18.1 GHz (Regions 1 and 3) and 17.3-17.8 GHz (Region 2) to a receiving space station in the fixed-satellite service (Earth-to-space)

An administration in Region 1 or 3 is considered affected by a proposed modification in Region 2, with respect to § 4.2.2 *a)* or § 4.2.2 *b)* of Article 4, or an administration in Region 2 shall is considered affected by a proposed new or modified assignment in the Regions 1 and 3 feeder-link List, with respect to § 4.1.1 *c)* of Article 4, when the power flux-density arriving at the receiving space station of a broadcasting-satellite feeder-link would cause an increase in the noise temperature of the feeder-link space station which exceeds the threshold value of $\Delta T/T$ corresponding to [][x%], where $\Delta T/T$ is calculated in accordance with the method given in Appendix **8**, except that the maximum power densities per hertz averaged over the worst 1 MHz are replaced by power densities per hertz averaged over the necessary bandwidth of the feeder-link carriers. (WRC-2000)

Interim systems of Region 2 in accordance with Resolution **42 (Rev.Orb-88)** shall not be taken into consideration when applying this provision to proposed new or modified assignments in the Regions 1 and 3 feeder-link List. However, this provision shall be applied to Region 2 interim systems with respect to Regions 1 and 3 administrations in accordance with § 5.2 *b)* of Resolution **42**. (WRC-2000)

MOD

6 Limits applicable to protect a frequency assignment in the band 17.8-18.1 GHz (Region 2) to a receiving feeder-link space station in the fixed-satellite service (Earth-to-space) (WRC-2000)

With respect to § 4.1.1 *d)* of Article 4, an administration in Region 2 is considered affected by a proposed new or modified assignment in the Regions 1 and 3 feeder-link List when the power flux-density arriving at the Region 2 receiving space station of a broadcasting-satellite feeder-link would cause an increase in the noise temperature of the receiving feeder-link space station which exceeds the threshold value of $\Delta T/T$ corresponding to [][x%], where $\Delta T/T$ is calculated in accordance with the method given in Appendix **8**, except that the maximum power densities per hertz averaged over the worst 1 MHz are replaced by power densities per hertz averaged over the necessary bandwidth of the feeder-link carriers. (WRC-2000)

ANNEX 4 (WRC-2000)

Criteria for sharing between services

MOD

1 Threshold values for determining when coordination is required between transmitting space stations in the fixed-satellite service or the broadcasting-satellite service and a receiving space station in the feeder-link Plan or List, or a proposed new or modified receiving space station in the List in the frequency bands 17.3-18.1 GHz (Regions 1 and 3) and in the feeder-link Plan or a proposed modification to the Plan in the frequency band 17.3-17.8 GHz (Region 2)

With respect to § 7.1, Article 7, coordination of a transmitting space station in the fixed-satellite service or in the broadcasting-satellite service with a receiving space station in a broadcasting-satellite service feeder link in the Regions 1 and 3 feeder-link Plan or List, or a proposed new or modified receiving space station in the List, or in the Region 2 feeder-link Plan or proposed modification to the Plan is required when the power flux-density arriving at the receiving space station of a broadcasting-satellite service feeder link of another administration would cause an increase in the noise temperature of the feeder-link space station which exceeds a threshold value of $\Delta T_S / T_S$ corresponding to [][x%]. $\Delta T_S / T_S$ is calculated in accordance with Case II of the method given in Appendix **8**.

MOD

2 Threshold values for determining when coordination is required between transmitting feeder-link earth stations in the fixed-satellite service in Region 2 and a receiving space station in the Regions 1 and 3 feeder-link Plan or List or a proposed new or modified receiving space station in the List in the frequency band 17.8-18.1 GHz

With respect to § 7.1, Article 7, coordination of a transmitting feeder-link earth station in the fixed-satellite service with a receiving space station in a broadcasting-satellite feeder link in the Regions 1 and 3 feeder-link Plan or List or a proposed new or modified receiving space station in the List is required when the power flux-density arriving at the receiving space station of a broadcasting-satellite service feeder link of another administration would cause an increase in the noise temperature of the feeder-link space station which exceeds a threshold value of $\Delta T/T$ corresponding to [][x%], where $\Delta T/T$ is calculated in accordance with the method given in Appendix **8**, except that the maximum power densities per hertz averaged over the worst 1 MHz are replaced by power densities per hertz averaged over the necessary bandwidth of the feeder-link carriers.

ATTACHMENT 6 TO SECTION 3.2 CHAPTER 3

DRAFT EXAMPLE OF POSSIBLE MODIFICATION OF ARTICLES 1, 2, 4, 7, 9 AND ANNEXES 5 AND 7 OF APPENDIX 30

APPENDIX 30* (WRC-2000)

Provisions for all services and associated Plans and List for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-2000)

(See Article **9**)

TABLE OF CONTENTS

MOD

Page

ANNEXES

* The expression "frequency assignment to a space station", wherever it appears in this Appendix, shall be understood to refer to a frequency assignment associated with a given orbital position. See also Annex 7 for the orbital limitations. (WRC-2000)

ARTICLE 1 (WRC-2000)

General definitions

1.8 *Regions 1 and 3 List of additional uses (hereafter called in short the "List"):* The List of assignments for additional uses in Regions 1 and 3 as established by WRC-2000 (see Resolution 542 (WRC-2000)), as updated following the successful application of the procedure of § 4.1 of Article 4.

1.9 *Frequency assignment in conformity with the List:* Any frequency assignment which appears in the List as updated following successful application of § 4.1 of Article 4.

ARTICLE 2

Frequency bands

2.1 The provisions of this Appendix apply to the broadcasting-satellite service in the frequency bands between 11.7 GHz and 12.2 GHz in Region 3, between 11.7 GHz and 12.5 GHz in Region 1 and between 12.2 GHz and 12.7 GHz in Region 2 and to the other services to which these bands are allocated in Regions 1, 2 and 3, insofar as their relationship to the broadcasting-satellite service in these bands is concerned.

2.2 The use of the guardbands of the Plans in this Appendix, as defined in § 3.9 of Annex 5, to provide space operations functions in accordance with No. **1.23** in support of the operation of geostationary-satellite networks in the broadcasting-satellite service shall be coordinated with the BSS assignments subject to this Appendix using the provisions of Article 7. Coordination among assignments intended to provide these functions and services not subject to a Plan shall be effected using the provisions of No. **9.7** and the associated provisions of Articles **9** and **11**. Coordination of modifications to the Region 2 Plan or assignments to be included in the Regions 1 and 3 List with assignments intended to provide these functions shall be effected using § 4.1.1 *e)*, 4.2.3 *e)* or 4.2.3 *f)* as appropriate, of Article 4. (WRC-2000)

ARTICLE 4 (WRC-2000)

Procedures for modifications to the Region 2 Plan or for additional uses in Regions 1 and 3[2]

4.1 Provisions applicable to Regions 1 and 3

4.1.26 The procedure of this Article may be applied by the administration of a new ITU Member State in order to include new assignments in the List. Upon completion of the procedure, the next World Radiocommunication Conference may be requested to consider, among the assignments included in the List after the successful completion of this procedure, the inclusion in the Plan of up to 10 channels (for Region 1) and up to 12 channels (for Region 3), over the national territory of the new Member State.

---

[2] The provisions of Resolution **49 (Rev.WRC-2000)** apply.

4.2 Provisions applicable to Region 2

4.2.6 An administration intending to make a modification to the Region 2 Plan shall send to the Bureau, not earlier than eight years but preferably not later than two years before the date on which the assignment is to be brought into use, the relevant information listed in Appendix **4**. Modifications to that Plan involving additions under § 4.2.1 *b)* shall lapse if the assignment is not brought into use by that date[7bis].

ARTICLE 7 (WRC-2000)

Coordination, notification and recording in the Master International Frequency Register of frequency assignments to stations in the fixed-satellite service (space-to-Earth) in the bands 11.7-12.2 GHz (in Region 2), 12.2-12.7 GHz (in Region 3) and 12.5-12.7 GHz (in Region 1), and to stations in the broadcasting-satellite service in the band 12.5-12.7 GHz (in Region 3) when frequency assignments to broadcasting-satellite stations in the bands 11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3 are involved[11]

7.1 The provisions of No. **9.7**[12] and the associated provisions under Articles **9** and **11** are applicable in respect of frequency assignments to broadcasting-satellite stations in the bands 11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3:

a) to transmitting space stations in the fixed-satellite service in the bands 11.7-12.2 GHz (in Region 2), 12.2-12.7 GHz (in Region 3) and 12.5-12.7 GHz (in Region 1); and

b) to transmitting space stations in the broadcasting-satellite service in the band 12.5-12.7 GHz (in Region 3).

7.2 In applying the procedures referred to in § 7.1, the provisions of Appendix **5** are replaced by the following:

7.2.1 The frequency assignments to be taken into account are:

a) the assignments in conformity with the appropriate Regional Plan in Appendix **30**;

b) the assignments included in the Regions 1 and 3 List;

c) the assignments for which the procedure of Article 4 has been initiated, as from the date of receipt of the complete Appendix **4** information under § 4.1.3 or 4.2.6.

7.2.2 The criteria to be applied are those given in Annex 4.

[7bis] The provisions of Resolution **533 (Rev.WRC-2000)** apply.

[11] These provisions do not replace the procedures prescribed in Articles **9** and **11** when stations other than those in the broadcasting-satellite service subject to this Appendix are involved.

[12] The provisions of Resolution **33 (Rev.WRC-97)** are applicable to space stations in the broadcasting-satellite service for which the advance publication information or the request for coordination has been received by the Bureau prior to 1 January 1999.

ARTICLE 9

Power flux-density limits between 12.2 GHz and 12.7 GHz to protect terrestrial services in Regions 1 and 3 from interference from Region 2 broadcasting-satellite space stations

9.1 The power flux-density at the Earth's surface in Regions 1 and 3, produced by emissions from a space station in the broadcasting-satellite service in Region 2 for all conditions and for all methods of modulation shall not exceed the values given in Section 4 of Annex 1 on the territory of any country unless the administration of that country so agrees.

ANNEX 5

Technical data used in establishing the provisions and associated Plans and the Regions 1 and 3 List, which should be used for their application[22] (WRC-2000)

3.4 Protection ratio between television signals

For developing the original 1977 broadcasting-satellite service Plan for Regions 1 and 3, the following protection ratios were used[27, 28]:

– 31 dB for co-channel signals;

– 15 dB for adjacent channel signals.

[22] In revising this Annex at WRC-97 and at WRC-2000, no changes have been made to the technical data applicable to the Region 2 Plan. However, for all three Regions, it should be noted that some of the parameters of networks proposed as modifications to the Region 2 Plan and the Regions 1 and 3 List may differ from the technical data presented herein. (WRC-2000)

[27] These protection ratio values were used for the assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 27 October 1997.

[28] The equivalent protection margin M is given in dB by the formula:

$$M = -10 \log (10^{-M_1/10} + 10^{-M_2/10} + 10^{-M_3/10})$$

where M_1 is the value (dB) of the protection margin for the same channel. This is defined in the following expression where the powers are evaluated at the receiver input:

$$\frac{\text{wanted power}}{\text{sum of the co-channel interfering powers}} \text{ (dB)} - \text{co-channel protection ratio (dB)}$$

M_2 and M_3 are the values (dB) of the upper and lower adjacent-channel protection margins respectively.

The definition of the adjacent-channel protection margin is similar to that for the co-channel case except that the adjacent-channel protection ratio and the sum of the interfering powers due to emissions in the adjacent channel are considered.

For revising this Plan at WRC-97, the following aggregate downlink protection ratios were specified in Recommendation ITU-R BO.1297 for the purpose of calculating downlink equivalent protection margins[28], [29, 30]:

– 24 dB for co-channel signals;

– 16 dB for adjacent channel signals.

In revising the Regions 1 and 3 Plan at WRC-97, the following aggregate overall protection ratio values were used [] for calculating the overall co-channel and adjacent-channel protection margins as defined in §§ 1.8 and 1.9:

– 23 dB for co-channel signals;

– 15 dB for adjacent channel signals.

[]It was also specified that for the revision of the Regions 1 and 3 Plan, no overall co-channel single entry *C*/*I* should be lower than 28 dB.

However, for the assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 27 October 1997, the overall equivalent protection margins were calculated using a co-channel overall protection ratio of 30 dB and lower and upper overall adjacent channel protection ratios of 14 dB[31].

WRC-2000 adopted, for the protection of digital assignments from digital emissions, the following protection ratio values to be applied for calculation of downlink equivalent protection margins of the WRC-2000 Regions 1 and 3 Plan:

– 21 dB for co-channel signals;

– 16 dB for adjacent channel signals.

During planning at WRC-2000, these values were used for all assignments of the Regions 1 and 3 Plan and List except those for which WRC-2000 adopted different values used in the planning process[32].

Revision of the Regions 1 and 3 Plan at WRC-97 and planning at WRC-2000 were generally based on a set of reference parameters such as the average e.i.r.p., the reference earth station receiving antenna, all test points placed within the –3 dB contour, a bandwidth of 27 MHz and the predetermined value of *C*/*N*. The Regions 1 and 3 Plan as established by WRC-2000 is generally based on the use of digital modulation.

Protection masks and associated calculation methods for interference into broadcast satellite systems involving digital emissions are given in Recommendation ITU-R BO.1293-1. (WRC-2000)

---

[29] These protection ratio values were used for the assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau between 27 October 1997 and 12 May 2000. (WRC-2000)

[30] These protection ratio values were used for protection of digital and analogue assignments from analogue emissions. (WRC-2000)

[31] The overall protection margin calculation method used is based on the first formula in § 1.12 of Annex 3 to Appendix **30A**.

[32] For analogue assignments, the protection ratios adopted by WRC-97 were used (24 dB co-channel and 16 dB adjacent channel). (WRC-2000)

In Region 2, the following protection ratios have been adopted for the purpose of calculating the overall equivalent protection margin[33]:

– 28 dB for co-channel signals;

– 13.6 dB for adjacent-channel signals;

– –9.9 dB for second adjacent-channel signals.

In Region 2, as a guide for planning, the reduction in the overall *C/I* ratio due to co-channel interference in the feeder link is taken as equivalent to a degradation in the down-link co-channel *C/I* ratio of approximately 0.5 dB not exceeded for 99% of the worst month, but the feeder-link and downlink Plans are evaluated on the basis of the overall equivalent protection margin, which includes the combined downlink and feeder-link contributions.

In Region 2, an overall equivalent protection margin of 0 dB, or greater, indicates that the individual protection ratios have been met for the co-channel, the adjacent channels and the second adjacent channels.

3.9 Guardbands

3.9.1 A guardband is defined as the portion of the frequency spectrum between the edge of the allocated band and the edge of the necessary bandwidth of the emission in the nearest channel.

3.9.2 For the planning of the broadcasting-satellite service, the guardbands chosen at the 1977 Conference to protect the services in adjacent frequency bands are shown in the Table below.

Regions	Guardband at the lower edge of the band (MHz)	Guardband at the upper edge of the band (MHz)
1	14	11
2	12	12
3	14	11

For Regions 1 and 3 at WARC-77, the guardbands were derived on the assumption of analogue emissions and a maximum beam centre e.i.r.p. of 67 dBW (value relating to individual reception), and a filter roll-off of 2 dB/MHz. If smaller e.i.r.p. values are assumed, the guardbands can be reduced in width by 0.5 MHz for each decibel decrease in e.i.r.p. The degree of possible reduction also depends on improvements in technology and on the type of modulation. (WRC-2000)

3.9.3 (SUP - WRC-97)

3.9.4 The guardbands at both the lower and upper edges may be used to provide space operations functions in accordance with No. **1.23** in support of the operation of geostationary-satellite networks in the broadcasting-satellite service.

[33] The definitions in §§ 1.7, 1.8, 1.9, 1.10 and 1.11 of the Annex apply to these calculations.

ANNEX 7 (WRC-2000)

Orbital position limitations

A In applying the procedure of Article 4 for proposed modifications to the Region 2 Plan or for proposed new or modified assignments in the Regions 1 and 3 List, administrations should observe the following criteria:

1) No broadcasting satellite serving an area in Region 1 and using a frequency in the band 11.7-12.2 GHz shall occupy a nominal orbital position further west than 37.2° W or further east than 146° E.

2) No broadcasting satellite serving an area in Region 2 that involves an orbital position different from that contained in the Region 2 Plan shall occupy a nominal orbital position:

a) further east than 54° W in the band 12.5-12.7 GHz; *or*

b) further east than 44° W in the band 12.2-12.5 GHz; *or*

c) further west than 175.2° W in the band 12.2-12.7 GHz.

However, modifications necessary to resolve possible incompatibilities during the incorporation of the Regions 1 and 3 feeder-link Plan into the Radio Regulations shall be permitted.

3) The purpose of the following orbital position and e.i.r.p. limitations is to preserve access to the geostationary-satellite orbit by the Region 2 fixed-satellite service in the band 11.7-12.2 GHz. Within the orbital arc of the geostationary-satellite orbit between 37.2° W and 10° E, the orbital position associated with any proposed new or modified assignment in the Regions 1 and 3 List of additional uses shall lie within one of the portions of the orbital arc listed in Table 1. The e.i.r.p. of such assignments shall not exceed 56 dBW, except at the positions listed in Table 2.

TABLE 1

Allowable portions of the orbital arc between 37.2° W and 10° E for new or modified assignments in the Regions 1 and 3 Plan and List

Orbital position	37.2° W to 36° W	33.5° W to 32.5° W	30° W to 29° W	26° W to 24° W	20° W to 18° W	14° W to 12° W	8° W to 6° W	4° W[1]	2° W to 0°	4° E to 6° E	9° E[1]

[1] Proposed new or modified assignments in the List which involve this orbital position shall not exceed the pfd limit –138 dB(W/(m^2 · 27 MHz)) at any point in Region 2.

TABLE 2

Nominal positions in the orbital arc between 37.2° W and 10° E at which the e.i.r.p. may exceed the limit of 56 dBW

Orbital position	37° W ±0.2°	33.5° W	30° W	25° W ±0.2°	19° W ±0.2°	13° W ±0.2°	7° W ±0.2°	4° W[1]	1° W ±0.2°	5° E ±0.2°	9° E[1]

[1] Proposed new or modified assignments in the List which involve this orbital position shall not exceed the pfd limit –138 dB(W/(m^2 · 27 MHz)) at any point in Region 2.

B The Region 2 Plan is based on the grouping of the space stations in nominal orbital positions of ±0.2º from the centre of the cluster of satellites. Administrations may locate those satellites within a cluster at any orbital position within that cluster, provided they obtain the agreement of administrations having assignments to space stations in the same cluster. (See § 4.13.1 of Annex 3 to Appendix **30A**.)

ATTACHMENT 7 TO SECTION 3.2 CHAPTER 3

DRAFT EXAMPLE OF POSSIBLE MODIFICATION OF ARTICLES 1, 2, 4, 7 AND ANNEX 3 OF APPENDIX 30A

APPENDIX 30A (WRC-2000)

Provisions and associated Plans and Lists[1] for feeder links for the broadcasting-satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz[2] and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2 (WRC-2000)

TABLE OF CONTENTS

ARTICLE 1 (WRC-2000)

General definitions

1.10 *Regions 1 and 3 feeder-link Lists of additional uses (hereafter called in short the "feeder-link Lists")*: The lists of assignments for additional uses in Regions 1 and 3 as established by WRC-2000 (see Resolution 542 (WRC-2000)), as updated following the successful application of the procedure of § 4.1 of Article 4.

1.11 *Frequency assignment in conformity with the List:* Any frequency assignment which appears in the List as updated following successful application of § 4.1 of Article 4.

---

[1] *Note by the Secretariat:* The Regions 1 and 3 feeder-link Lists of additional uses are annexed to the Master International Frequency Register (see Resolution **542 (WRC-2000)**). (WRC-2000)

[2] This use of the band 14.5-14.8 GHz is reserved for countries outside Europe.

ARTICLE 2

Frequency bands

2.1 The provisions of this Appendix apply to the feeder-links in the fixed-satellite service (Earth-to-space) in the frequency bands 14.5-14.8 GHz and 17.3-18.1 GHz for the broadcasting-satellite service in Regions 1 and 3, and 17.3-17.8 GHz for the broadcasting-satellite service in Region 2 and to other services to which these bands are allocated in Regions 1, 2 and 3 so far as their relationship to the fixed-satellite service (Earth-to-space) in these bands is concerned.

2.2 The use of the guardbands of the Plans in this Appendix, as defined in § 3.1 and 4.1 of Annex 3, to provide space operations functions in accordance with No. **1.23** in support of the operation of geostationary-satellite networks broadcasting-satellite service, shall be coordinated with the BSS feeder-link assignments subject to this Appendix using the provisions of Article 7. Coordination among assignments intended to provide these functions and services not subject to a Plan shall be effected using the provisions of No. **9.7** and the associated provisions of Articles **9** and **11**. Coordination of modifications to the Region 2 feeder-link Plan or assignments to be included in the Regions 1 and 3 feeder-link Lists, with assignments intended to provide these functions shall be effected using § 4.1.1 *d)* of Article 4. (WRC-2000)

ARTICLE 4 (WRC-2000)

Procedures for modifications to the Region 2 feeder-link Plan or for additional uses in Regions 1 and 3

4.1 Provisions applicable to Regions 1 and 3

4.1.26 The procedure of this Article may be applied by the administration of a new ITU Member State in order to include new assignments in the feeder-link Lists. Upon completion of the procedure, the next world radiocommunication conference may be requested to consider, among the assignments included in the feeder-link Lists after the successful completion of this procedure, the inclusion in the Regions 1 and 3 feeder-link Plan of up to 10 channels (for Region 1) and up to 12 channels (for Region 3), over the national territory of the new Member State.

4.2 Provisions applicable to Region 2

4.2.6 An administration intending to make a modification to the Region 2 feeder-link Plan shall send to the Bureau, not earlier than eight years but preferably not later than two years before the date on which the assignment is to be brought into use, the relevant information listed in Appendix **4**. Modifications to that Plan involving additions under § 4.2.1 *b)* shall lapse if the assignment is not brought into use by that date[9bis].

[9bis] The provisions of Resolution **533 (Rev.WRC-2000)** apply.

ARTICLE 7 (WRC-2000)

Coordination, notification and recording in the Master International Frequency Register of frequency assignments to stations in the fixed-satellite service (space-to-Earth) in Regions 1, 2 and 3 in the band 17.7-18.1 GHz, to stations in the fixed-satellite service (Earth-to-space) in Region 2 in the band 17.8-18.1 GHz and to stations in the broadcasting-satellite service in Region 2 in the band 17.3-17.8 GHz when frequency assignments to feeder links for broadcasting-satellite stations in the 17.3-18.1 GHz band in Regions 1 and 3 or in the band 17.3-17.8 GHz in Region 2 are involved

Section I – Coordination of transmitting space or earth stations in the fixed-satellite service or transmitting space stations in the broadcasting-satellite service with assignments to broadcasting-satellite service feeder links

7.1 The provisions of No. **9.7**[14] and the associated provisions under Articles **9** and **11** are applicable to transmitting space stations in the fixed-satellite service in the band 17.7-18.1 GHz, to transmitting earth stations in the fixed-satellite service in Region 2 in the band 17.8-18.1 GHz and to transmitting space stations in the broadcasting-satellite service in Region 2 in the band 17.3-17.8 GHz.

7.2 In applying the procedures referred to in § 7.1, the provisions of Appendix **5** are replaced by the following:

7.2.1 The frequency assignments to be taken into account are:

a) the assignments in conformity with the appropriate Regional feeder-link Plan in Appendix **30A**;

b) the assignments included in the Regions 1 and 3 feeder-link Lists;

c) the assignments for which the procedure of Article 4 has been initiated as from the date of receipt of the complete Appendix **4** information under § 4.1.3 or 4.2.6.

7.2.2 The criteria to be applied are those given in Annex 4.

---

[14] The provisions of Resolution **33 (Rev.WRC-97)** are applicable to space stations in the broadcasting-satellite service for which the advance publication information or the request for coordination has been received by the Bureau prior to 1 January 1999.

ANNEX 3

Technical data used in establishing the provisions and associated Plans and Regions 1 and 3 feeder-link Lists, which should be used for their application[21] (WRC-2000)

3 Basic technical characteristics for Regions 1 and 3

3.1 Translation frequency and guardbands

a) 17 GHz feeder-links

The feeder-link Plan generally uses a frequency translation of 5.6 GHz between the 17 GHz feeder-link channels and the 12 GHz downlink channels. Other values of the translation frequency may be used, provided that the corresponding channels have been assigned to the space station of the administration concerned.

With the value of frequency translation between the feeder-link frequency band (17.3-18.1 GHz in Regions 1 and 3) and the downlink frequency band (11.7-12.5 GHz in Region 1 and 11.7-12.2 GHz in Region 3), the guardbands specified in § 3.9 of Annex 5 to Appendix **30** for the downlink Plan result in corresponding guardband bandwidths of 11 MHz at the upper and 14 MHz at the lower feeder-link band edges. These feeder-link guardbands may be used to provide space operations functions in accordance with No. **1.23** in support of the operation of geostationary-satellite networks in the broadcasting-satellite service.

3.8 System noise temperature

The satellite system noise temperature values generally used in the Plan at the 1988 Conference (WARC Orb-88) are 1 800 K for 17 GHz and 1 500 K for 14 GHz[32]. For revising the Regions 1 and 3 Plan at WRC-97 these values are 900 K for 17 GHz and 750 K for 14 GHz. A value of 600 K is used for the 17 GHz band in the revision of the Regions 1 and 3 Plan at WRC-2000.

4 Basic technical characteristics for Region 2

4.1 Translation frequency and guardbands

The feeder-link Plan is based on the use of a single frequency translation of 5.1 GHz between the 17 GHz feeder-link channels and the 12 GHz downlink channels. Other values of the translation frequency may be used, provided that the corresponding channels have been assigned to the space station of the administration concerned.

---

[21] In revising this Annex at WRC-97 and at WRC-2000, no changes were made to the technical data applicable to the Region 2 feeder-link Plan. However, for all three Regions it should be noted that some of the parameters of networks proposed as modifications to the Region 2 feeder-link Plan and the Regions 1 and 3 feeder-link Lists may differ from the technical data presented herein. (WRC-2000)

[32] These system temperature values are still used for assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 27 October 1997.

With a single value frequency translation between the feeder-link frequency band (17.3-17.8 GHz) and the downlink frequency band (12.2-12.7 GHz), the guard bands present in the downlink Plan result in corresponding bandwidths of 12 MHz at the upper and lower feeder-link band edges. These feeder-link guard bands may be used to provide space operations functions in accordance with No. **1.23** in support of the operation of geostationary-satellite networks in the broadcasting-satellite service.

4.6 Receiving antenna

4.6.1 Cross-section of receiving antenna beam

Planning has been based on beams of elliptical or circular cross-section. When the assignments are implemented, or when the Plan is modified, administrations may use non-elliptical or shaped beams.

If the cross-section of the receiving antenna beam is elliptical, the effective beamwidth φ_0 is a function of the angle of rotation *q* between the plane containing the satellite and the major axis of the beam cross-section and the plane in which the beamwidth is required.

The relationship between the maximum gain of an antenna and the half-power beamwidth can be derived from the expression:

$$G_m = 27\,843/ab$$

or

$$G_m \text{ (dB)} = 44.44 - 10 \log a - 10 \log b$$

where:

a and *b* are the angles (degrees) subtended at the satellite by the major and minor axes of the elliptical cross-section of the beam.

An antenna efficiency of 55% is assumed.

4.6.2 Minimum beamwidth

A minimum value of 0.6° for the half-power beamwidth of the receiving antenna has been agreed on for planning.

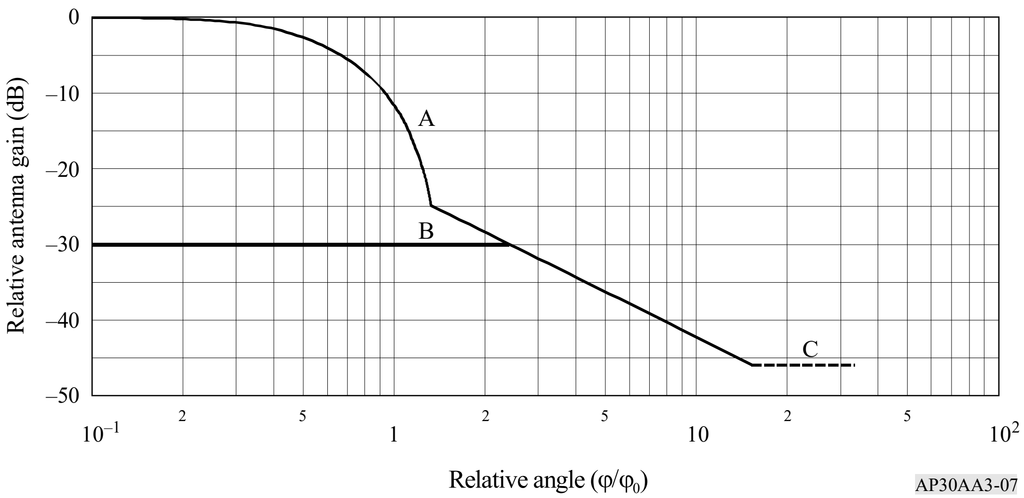
4.6.3 Reference patterns

The reference patterns for the co-polar and cross-polar components of the satellite receiving antenna used in preparing the Plan are given in Fig. 7.

Where it was necessary to reduce interference, the pattern shown in Fig. 8 was used; this use will be indicated in the Plan by an appropriate symbol. This pattern is derived from an antenna producing an elliptical beam with fast roll-off in the main lobe. Three curves for different values of φ_0 are shown as examples.

FIGURE 7

Reference patterns for co-polar and cross-polar components for satellite receiving antenna in Region 2



Curve A: co-polar component (dB relative to main beam gain)

$-12\,(\varphi/\varphi_0)^2$ for $0 \leq (\varphi/\varphi_0) \leq 1.45$

$-(22 + 20 \log (\varphi/\varphi_0))$ for $(\varphi/\varphi_0) > 1.45$

after intersection with Curve C, as Curve C.

Curve B: cross-polar component (dB relative to main beam gain)

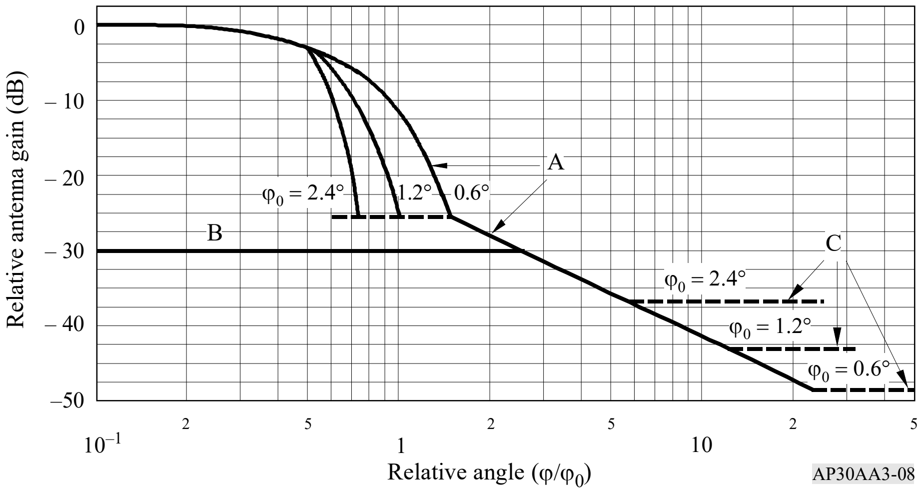
-30 for $0 \leq (\varphi/\varphi_0) \leq 2.51$

after intersection with Curve A, as Curve A.

Curve C: minus the on-axis gain (Curve C in this Figure illustrates the particular case of an antenna with an on-axis gain of 46 dBi)

FIGURE 8

Reference patterns for co-polar and cross-polar components for satellite receiving antennas with fast roll-off in the main beam for Region 2



Curve A: co-polar component (dB relative to main beam gain)

$-12\ (\varphi/\varphi_0)^2$ for $0 \leq \varphi/\varphi_0 \leq 0.5$

$-33.33\ \varphi_0^2\ (\varphi/\varphi_0 - x)^2$ for $0.5 < \varphi/\varphi_0 \leq \dfrac{0.87}{\varphi_0} + 36$

-25.23 for $\dfrac{0.87}{\varphi_0} < \varphi/\varphi_0 \leq 1.45$

$-(22 + 20 \log (\varphi/\varphi_0))$ for $\varphi/\varphi_0 > 1.45$

after intersection with Curve C, as Curve C.

Curve B: cross-polar component (dB relative to main beam gain)

-30 for $0 \leq \varphi/\varphi_0 < 2.51$

after intersection with Curve A, as Curve A.

Curve C: minus the on-axis gain (Curves A and C represent examples for three antennas having different values of φ_0 as labelled in Fig. 8. The on-axis gains of these antennas are 37, 43 and 49 dBi, respectively).

where:

φ: off-axis angle (degrees)

φ_0: dimension of the minimum ellipse fitted around the feeder-link service area in the direction of interest (degrees)

$$x = 0.5 \left(1 - \frac{0.6}{\varphi_0}\right)$$

#########

3.3 Agenda item 1.29

"to consider the results of studies related to Resolutions **136 (WRC-2000)** and **78 (WRC-2000)** dealing with sharing between non-GSO and GSO systems"

3.3.1 Resolution 136 (WRC-2000)

"Frequency sharing in the range 37.5-50.2 GHz between GSO FSS networks and non-GSO FSS systems"

3.3.1.1 Summary of technical studies, including a list of relevant ITU-R Recommendations

Both GSO FSS and non-GSO FSS systems are planned for operation within the 37.5-42.5 GHz and 47.2-50.2 GHz bands. FSS systems based on the use of new technologies associated with both GSO and non-GSO orbits are capable of providing the most isolated regions of the world with high capacity and low-cost means of communications. Although plans are to operate FSS in 3 GHz of uplink spectrum (at 47.2-50.2 GHz) and 5 GHz of downlink spectrum (37.5-42.5 GHz), most proposed FSS systems are planned to use approximately 2 GHz of spectrum in each direction for user links. Due to constraints imposed by the need to protect the fixed and other services, and resulting pfd limits, the bands 37.5-40 GHz and 42-42.5 GHz are expected to be available to the FSS (GSO and non-GSO alike) only for use by gateway/hub applications with a limited number of coordinated earth stations using large antennas. In addition, because propagation impairments are severe in the 40/50 GHz bands, most FSS systems operating in these bands are not planned to use dual polarizations.

Frequency sharing between GSO FSS networks and non-GSO FSS systems in the 37.5-50.2 GHz frequency range is currently regulated under No. **22.2**, which provides that "non-geostationary-satellite systems shall not cause unacceptable interference to geostationary-satellite systems in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations". Because there has been little or no deployment of satellite systems to date in the band 37.5-50.2 GHz, WRC-2000 concluded in Resolution **136 (WRC-2000)** that both GSO FSS and non-GSO FSS operators should be expected to exhibit flexibility in achieving the appropriate balance in the sharing environment, and urged administrations, in the application of Article **22** to their GSO and non-GSO FSS systems in this range prior to WRC-03, to seek balanced sharing arrangements. Resolution **136** invited the ITU-R to undertake the appropriate technical, operational, and regulatory studies on sharing arrangements that achieve an appropriate balance between GSO FSS networks and non-GSO FSS systems in the 37.5-50.2 GHz frequency range.

To date the ITU-R studies done specifically for the 40/50 GHz bands have been fairly limited in extent. However, in recent years a very substantial amount of work has been carried out on non-GSO/GSO sharing in bands below 30 GHz, and much of this applies at 40/50 GHz. The principal differences for the higher frequencies are the use of narrower spot-beams in greater numbers on each satellite, and the trend towards higher bit-rates, which leads to emissions and transponders of increased bandwidth. Also the increased propagation loss during bad weather leads to higher system margins and/or greater reliance on fade counter-measures such as adaptive coding.

Relevant Recommendations ITU-R: S.1323, S.1325, S.1328, S.1529, S.1557.

Information on the characteristics of both GSO and non-GSO FSS systems planned to operate in the 40/50 GHz bands can be found in the latest version of Recommendation ITU-R S.1328.

On a related matter, Recommendation ITU-R S.1557 sets forth the system parameters of GSO FSS networks and non-GSO FSS systems operating in the 50/40 GHz bands, and contains operational requirements for both types of systems.

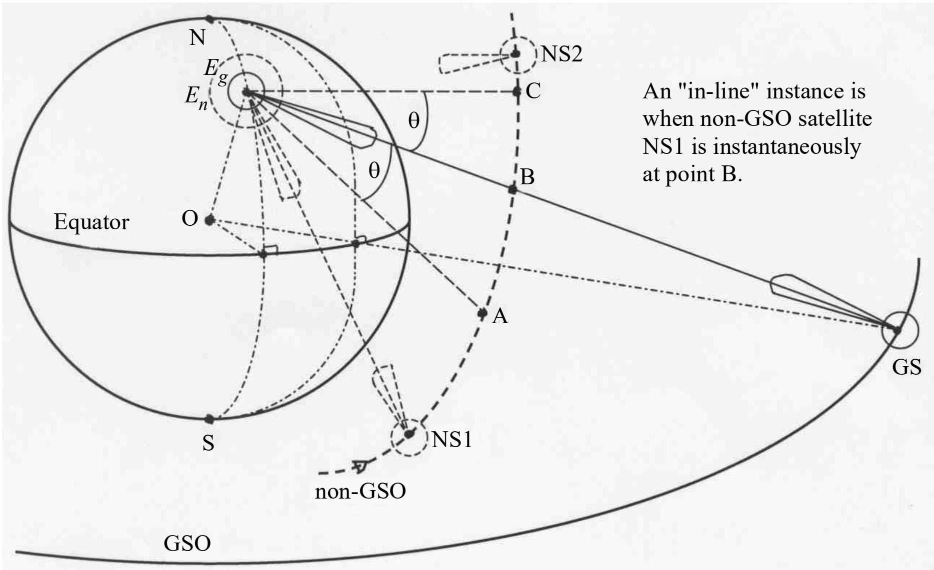
Given the system characteristics, long and short-term criteria for acceptable interference may be calculated using Recommendation ITU-R S.1323, taking into account the increased rain fade environment in the 40/50 GHz bands.

To determine whether given criteria for the interference between a GSO and a non-GSO system would be met, proprietary software packages are available which may be used based on Recommendation ITU-R S.1325 or on Recommendation ITU-R S.1529.

If no techniques are employed to avoid direct coupling between the main beams of satellites in a non-GSO system and the main beams of earth stations in a GSO system, and vice versa, during the short periods when "in-line" transitions occur, the interference in both directions, which is likely to be modest for the majority of the time, will rise sharply by many dB for short periods aggregating to small percentages of time (see Figure 3.3-1). Several possible techniques to mitigate this short-term interference have been investigated, as summarized below.

FIGURE 3.3-1

"In-line" transition



CPM02-0331
146496

NOTE – (main beam)/(near sidelobe) ratio is of the order of 30 dB for earth stations and 20 dB for satellites.

Several studies involving sharing between GSO FSS networks and non-GSO FSS systems in the frequency range 37.5-50.2 GHz have been conducted within the ITU-R. However the levels of acceptable interference for GSO FSS networks and non-GSO systems were not fully assessed. Moreover the mitigation techniques cannot be easily translated into regulatory provisions. Such provisions would require development of a set of epfd masks to protect GSO FSS networks and of off-axis e.i.r.p. density masks to protect non-GSO FSS systems.

3.3.1.2 Analysis of the results of studies

The ITU-R did not consider whether new regulatory regimes would provide a more appropriate balance between GSO FSS networks and non-GSO FSS systems than the current regime under No. **22.2**. Nevertheless the studies, which conclude that both GSO networks and non-GSO FSS systems can co-exist in this band if certain technical standards are observed, confirm that the establishment of a first-come/first-served regulatory regime in the 37.5-50.2 GHz band (i.e. the removal of No. **22.2** and application of No. **9.11A** without appropriate technical standards) would create an imbalance between GSO FSS networks and non-GSO FSS systems in this frequency range. In addition, because the studies conducted show that co-frequency sharing between GSO FSS networks and non-GSO FSS systems is feasible, imposition of band segmentation or some other form of mandatory frequency separation would also create an imbalance between GSO FSS networks and non-GSO FSS systems. In the last regard, it is noteworthy that if highly-elliptical orbit non-GSO FSS systems are introduced into the 40/50 GHz bands, GSO/non-GSO sharing on a co-frequency basis would be greatly enhanced, as highly-elliptical orbit non-GSO systems typically operate at separation angles from the GSO of the order of 40 degrees or more.

In most cases sharing between a GSO FSS network and a non-GSO FSS system of the LEO or MEO type will be feasible only if mitigation techniques to avoid main beam-to-main beam coupling of "in-line" interference are applied. Such techniques include:

3.3.1.2.1 Mitigation techniques

a) Satellite diversity or arc avoidance

An example of one form of satellite diversity is illustrated in Figure 3.3-1. When non-GSO satellite NS1, which is shown currently serving earth station En (and other earth stations within the same "cell"), reaches point A - i.e. a topocentric angle θ degrees from "in-line" transition point B - earth station En diverts its transmission and reception temporarily to satellite NS2, and NS1 temporarily switches off its transmit and receive beams which would otherwise interfere with and receive interference from the main beams of earth station E_g operating to GSO satellite GS. When satellite NS1 has moved to point C, which is θ degrees beyond point B, the operation of earth station E_n reverts to satellite EN1.

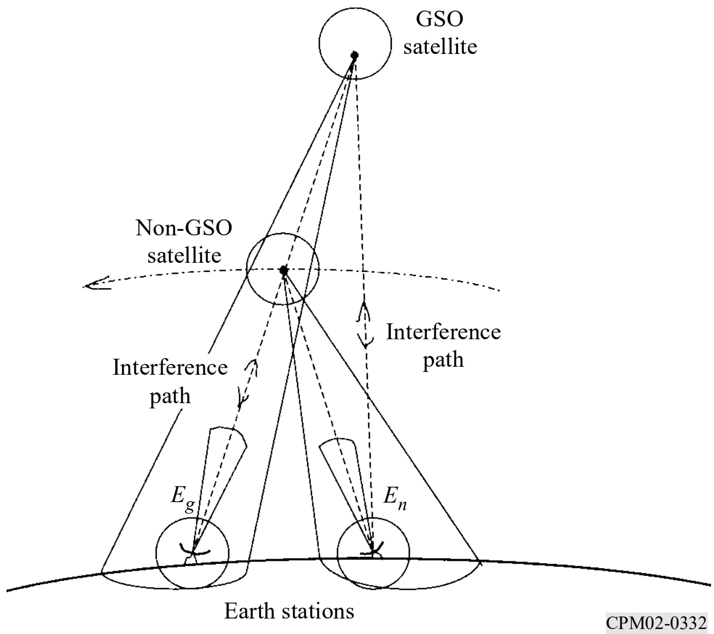
Satellite diversity or arc avoidance is the most effective of the mitigation techniques, but it requires either an increase in the number of satellites or transponders per satellite, or the reservation of some existing space-sector capacity, to accommodate the temporarily diverted traffic. Since it is not practicable to apply it to GSO systems, the burden falls on the non-GSO systems.

b) Geographical isolation between earth stations

Figure 3.3-2 shows a non-GSO satellite at an instant when it is crossing the line between a GSO satellite and one of its earth stations E_g. This is an instant of maximum interference to and from E_g because there is no transmit or receive discrimination from its antenna pattern. However, there is both transmit and receive discrimination from the antenna of the non-GSO satellite, and this mitigates the maximum levels of short-term interference in both directions.

FIGURE 3.3-2

Geographical isolation

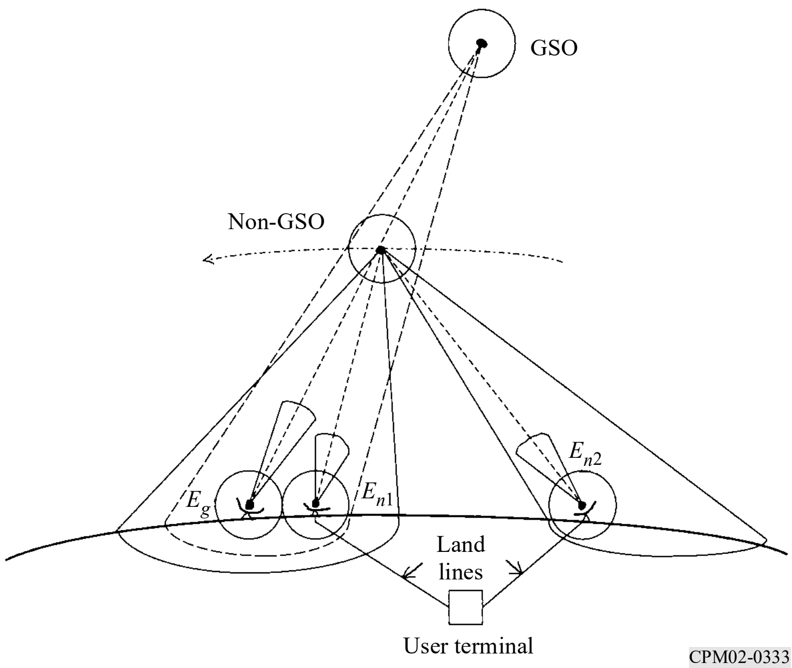


c) Site diversity

Site diversity is illustrated in Figure 3.3-3.

FIGURE 3.3-3

Site diversity



When a non-GSO satellite nears an "in-line" transition its links serving the relevant earth stations (e.g. En1) are temporarily switched to alternative earth stations (e.g. En2), via a co-frequency satellite beam illuminating a geographically separate "cell" and alternative land lines to the user terminals. Alternatively the site diversity could be implemented in the GSO network.

d) Adaptive coding

In the frequency bands concerned it is likely that some systems will employ measures to counter the significant additional propagation loss, which occurs during bad weather. For example, in a TDM or TDMA transmission it is possible to leave part of each time frame normally unallocated to traffic bursts, and to allocate this time to individual up and downlinks when they are experiencing heavy rainfall (heavy rain cells are normally relatively small in diameter). By adapting the error-correction coding in these instances maximum use of the additional time to maintain the required BER is made.

In addition to countering rain fades, it is conceptually possible to design such an adaptive coding technique so that it also counters the effect of short-term interference peaks. Since for much of the time there is no heavy rain anywhere within the coverage of a given GSO satellite beam, most non-GSO/GSO "in-line" transitions within that beam occur when the adaptive-coding is not being used to counter fades, and in principle it may therefore be used to mitigate "in-line" interference.

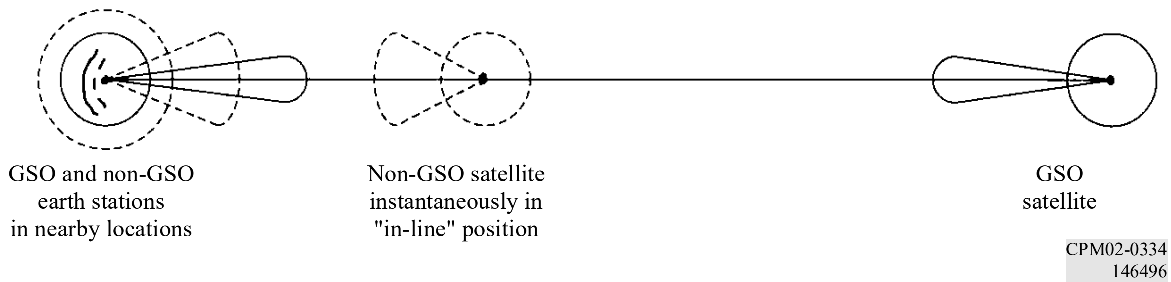
e) Link balancing

From Figure 3.3-4 it can be seen that, at an "in-line" instant, downlink interference will occur from a transmit main beam of the non-GSO satellite to the receive main beam of the GSO earth station, and also from a transmit main beam of the GSO satellite to the receive main beam of the non-GSO earth station. Similarly there will be main beam-to-main beam up-link interference from non-GSO link to GSO link and vice versa.

In general the two systems will not be designed with identical link margins, and on the downlink for example it is likely that the C/I at the instant depicted will be lower for one of the two earth stations than for the other. In principle it may be possible in many cases to ameliorate the worst interference effects by an increase in the e.i.r.p. of the more vulnerable of the two downlinks and a reduction in the e.i.r.p. of the other downlink. Such link balancing may also be applied on the up-paths.

FIGURE 3.3-4

Link balancing



f) Use of orthogonal polarizations

Under a set of conditions on antenna performance both for earth stations and for space stations, the frequency sharing between GSO FSS networks and non-GSO FSS systems would be feasible if the systems operated on opposite polarizations.

3.3.1.2.2 Sharing between GSO networks and non-GSO systems in the range 37.5-50.2 GHz

No operational studies were conducted since the actual operational parameters of both non-GSO and GSO systems that are planned to operate in the range 37.5-50.2 GHz are still unclear.

3.3.1.3 Methods to satisfy the agenda item and their advantages and disadvantages

Method

Modification of Resolution 136 to call for further studies

It is considered premature to conclude on the advantages and disadvantages of each technique described in section 3.3.1.2.1 until further studies have been accomplished. Such studies should focus on the scope of application of one or more of the interference mitigation techniques described in section 3.3.1.2.1 above or other suitable techniques. It is thus proposed to call for additional studies on this topic.

3.3.1.4 Regulatory and procedural considerations

It is considered that no modification is needed in Article **22** at this time. Implementation of the method given in section 3.3.1.3 above would involve the modification of Resolution **136 (WRC-2000)** to reflect a new date for completion of studies and action by a future conference.

An example of modified Resolution **136 (WRC-2000)** is given below.

MOD

EXAMPLE OF PROPOSED REVISION OF RESOLUTION 136 (MOD WRC-03)

Frequency sharing in the range 37.5-50.2 GHz between geostationary fixed-satellite service networks and non-geostationary fixed-satellite service systems

The World Radiocommunication Conference **(**~~Istanbul, 2000~~Geneva, 2003**)**

considering

a) that WRC-2000 made provisions for the operation of geostationary fixed-satellite service (GSO FSS) networks and non-GSO FSS systems in the 10-30 GHz frequency range;

b) that there is an emerging interest in operating GSO FSS networks and non-GSO FSS systems in the 37.5-50.2 GHz range;

c) that there is a need to provide for the orderly development and implementation of new satellite technologies in the 37.5-50.2 GHz frequency range;

d) that systems based on the use of new technologies associated with both GSO FSS networks and non-GSO FSS systems are capable of providing the most isolated regions of the world with high-capacity and low-cost means of communication;

e) that there should be equitable access to the radio frequency spectrum and orbital resources in a mutually acceptable manner that allows for new entrants in the provision of services;

f) that the Radio Regulations should be sufficiently flexible to accommodate the introduction and implementation of innovative technologies as they evolve;

g) that in the bands 37.5-50.2 GHz, where there has been little or no deployment of satellite systems to date, both GSO FSS and non-GSO FSS operators should be expected to exhibit flexibility in achieving the appropriate balance in the sharing environment~~,~~;

h) that this Conference, having considered the outcome of ITU-R studies on this subject, has decided that further studies are needed before the conditions for non-GSO FSS systems to share these bands with GSO FSS systems can reliably be determined,

resolves to urge administrations

to seek balanced sharing arrangements between GSO FSS networks and non-GSO FSS systems in the application of Article 22 to such systems in the 37.5-50.2 GHz frequency range, prior to the review by a future competent Conference of the results of the studies called for by this Resolution,

invites ITU-R

1 to undertake, as a matter of urgency, further technical, operational and regulatory studies on sharing arrangements which achieve an appropriate balance between GSO FSS networks and non-GSO FSS systems in the frequency range 37.5-50.2 GHz. Such further studies should include, but not necessarily be limited to:

a) Techniques which individually or in combination avoid, or otherwise adequately mitigate interference resulting from coupling of main beams in both directions between non-GSO FSS and GSO FSS systems at "in-line" instants. The studies should be based on the key parameters of systems firmly planned to operate in the bands concerned, and should be pursued sufficiently far to establish appropriate long-term and short-term interference criteria and to compute the time statistics of interference from non-GSO systems to GSO networks, and from GSO networks to non-GSO systems, to determine whether those criteria would be met. The computations and comparisons should be made firstly assuming no mitigation, and subsequently with each of the various mitigation techniques or combinations of mitigation techniques envisaged. The mitigation techniques thus investigated should include:

- Satellite diversity or arc avoidance.
- Geographical isolation between earth stations.
- Site diversity.
- Adaptive coding.
- Link balancing.
- Opposite polarizations for GSO and non-GSO systems.
- Other appropriate techniques, if any.

b) The development of technical, operational and regulatory guidance which would enable WRC-07 to decide whether or not to include, in the Radio Regulations, epfd limits on non-GSO FSS systems for the protection of GSO FSS networks, and off-axis e.i.r.p. density limits on earth stations in GSO FSS networks for the protection of non-GSO FSS systems, in the frequency range 37.5-50.2 GHz. Such guidance should include quantitative values for suitable epfd↓ , epfd↑ and off-axis e.i.r.p. density limits;

2 to report the results of these studies to a future competent Conference.

#########

3.3.2 Resolution 78 (WRC-2000)

"Development of procedures in case the operational or additional operational limits in Article 22 are exceeded"

3.3.2.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

The situation described in Resolution **78 (WRC-2000)** is unique in the Radio Regulations. The operational and additional operational epfd$_\downarrow$ limits were created and included in Section II of Article **22**, and left to administrations to enforce on an operational basis. The limits were requirements for non-GSO FSS systems to be accommodated in certain frequency bands. The need for procedures to facilitate the process of compliance is a very important part of the package of measures developed for this accommodation.

ITU-R has developed a set of Recommendations on identifying and quantifying (by measurement or by simulation) the interference levels generated by a non-GSO FSS system in the parts of the band 10.7-20.2 GHz covered by Resolution **78**, to aid administrations in determining whether a non-GSO FSS system is in compliance with the operational or additional operational epfd$_\downarrow$ limits contained in Section II of Article **22.**

Relevant Recommendations ITU-R: S.1527, S.1554, S.1558, and S.1592.

3.3.2.2 Analysis of the results of studies

No. **22.5I** clearly stipulates that if a non-GSO FSS system subject to the operational or additional operational epfd$_\downarrow$ limits contained in Section II of Article **22** at an operational receiving earth station within a GSO network operating in accordance with the Radio Regulations, exceeds these limits then it is a violation of No. **22.2** except as otherwise agreed between concerned administrations. In other words, exceeding the limits by such a non-GSO FSS system is, by itself, an infringement of the RR.

The RR contain provisions that can be applied when non-GSO systems exceed the operational or additional operational epfd$_\downarrow$ limits contained in No. **22.5I** (including the provisions of Section V) (Report of infringements) or VI (Procedure in case of harmful interference), as appropriate, of Article **15**).

The procedures are intended only to help a victim GSO network determine the source of interference in an environment where multiple non-GSO FSS systems are operating and to facilitate expeditious remedy of exceedances of the limits in No. **22.5I**.

ITU-R studied the options for regulatory procedures that would assist administrations that experience exceedances of the limits in No. **22.5I** at their operational GSO earth stations in determining the source of the interference and rapidly bringing the interference levels produced by such a system back into compliance with the regulations. ITU-R also considered the issue of where in the regulatory framework such a set of procedures, if deemed necessary by WRC-03, could be placed. The options considered were inclusion of the procedures facilitating compliance with the limits as an Annex to an ITU-R Recommendation to which the RR may or may not refer to (without incorporating it by reference), inclusion of the procedures facilitating compliance with the limits as an Annex to a Resolution that would be referenced exclusively in the text of the RR (No. **22.5I**) that they are to help enforce, and inclusion of the procedures in a new section of Article **15**.

3.3.2.3 Methods to satisfy this agenda item and their advantages and disadvantages

Method A1

Method A1 is to apply the existing provisions in RR Article **15** (including the provisions of Sections V - Reports of Infringements and VI - Procedure in a case of harmful interference) to the resolution of interference, including cases where non-GSO systems exceed the operational or additional operational epfd$\downarrow$ limits contained in No. **22.5I**. An ITU-R Recommendation containing a set of procedures in an Annex to the Recommendation could provide more structure for this particular case. ITU-R Recommendations referred to in § 3.3.2.1 and concerning methodologies to be used to address operational and additional operational epfd$\downarrow$ compliance also provide useful guidance to administrations and/or their GSO system operators. These methodologies should be referenced to in ITU-R Recommendation containing a set of procedure; however, there is no need to incorporate any of these Recommendations by reference in the Radio Regulations.

No change to the Radio Regulations, including Article **15** or Article **22**, would be required to implement Method A1.

Advantages:

- The provisions in Article **15** have been used successfully to resolve interference problems between all services in a variety of sharing situations. It is reasonable to expect that Article **15** could be applied successfully by administrations that experience exceedances of the limits in No. **22.5I** at their operational GSO earth stations. Lack of specific time-frames or means to identify the interference source in the Article **15** procedures has not been a barrier between cooperating administrations to resolving infringements or cases of harmful interference.
- Using the existing procedures in Sections V and VI of Article **15** could avoid an unintended imbalance of status of services and systems within the Radio Regulations.
- It avoids placing additional burden on BR for a case where administrations, rather than BR, are responsible for determining compliance with the operational or additional operational epfd$\downarrow$ limits.
- GSO earth station operators would, as contemplated by WRC-2000, have access to specific procedures that would assist them in identifying and expeditiously remedying infringement of the limits in No. **22.5I** of the Radio Regulations.
- ITU-R Recommendations are intended to give guidance and to recommend one or more procedures for a specific application, which are considered to be sufficient to serve as a basis for international cooperation.
- All the necessary material (technical and additional procedural) for remedying an infringement of No. **22.51** is referred to in a single ITU-R Recommendation.

Disadvantages:

- ITU-R Recommendations do not contain mandatory procedures (i.e. time-frames and required actions by BR) of the type that would facilitate compliance with No. **22.5I**. These types of instructions to BR are typically given in regulatory determinations made by a WRC.
- In the event that mandatory procedures are desired, reliance on Article **15**, which provides no specific time-frames, may not be sufficient to expeditiously remedy infringement of No. **22.5I**.

Method A2

This method is similar to the one proposed in Method A1, except for the following:

the ITU-R Recommendation containing a set of procedures in an Annex to the Recommendation should be referred to in No **22.5I**, but not incorporated by reference.

Advantages:

The same as for Method A1, plus

- It provides a unique entry point referred to in the appropriate place in No. **22.5I** to find all the necessary elements developed by ITU-R and that may be useful to administrations to handle such a case of interference.

Disadvantage:

The same as for Method A1.

Method B1

Method B1 is to make no change to the procedures in Sections V and VI of Article **15**. Instead, add a reference in No. **22.5I** to a new WRC resolution that contains the procedures to be used by affected GSO and non-GSO networks and systems to determine which non-GSO FSS system is responsible for exceedances and to facilitate the expeditious return to the levels required in No. **22.5I**. The procedures themselves have been developed within ITU-R, and provide administrations operating non-GSO FSS systems with an incentive to cooperate to expeditiously resolve exceedances of the operational and/or additional operational $\text{epfd}_{\downarrow}$ limits.

Advantages:

- GSO earth station operators would, as contemplated by WRC-2000, have access to measures in a WRC-03 Resolution that would assist them in identifying and expeditiously remedying exceedances of the limits in No. **22.5I**.
- The procedures are limited specifically to the unique situation in No. **22.5I** where the level of unacceptable interference is pre-determined in the Radio Regulations, and thus are suitable only for use in conjunction with that regulation.
- Limiting the use of the procedures to the specific case in No. **22.5I** could avoid an unintended imbalance of status of services and systems within the Radio Regulations.

Disadvantages:

- Places potential burden on BR for a case where administrations, rather than BR, are responsible for determining compliance with the operational or additional operational $\text{epfd}_{\downarrow}$ limits. However, if it were required to act under the procedures, the BR role would be largely limited to administrative, non-discretionary functions, which would be unnecessary if administrations cooperate to resolve the interference.
- The relationship and precedence between these procedures and those of Article **15** is unclear.
- Not using the existing procedures in Sections V and VI of Article **15** could cause an unintended imbalance of status of services and systems within the Radio Regulations.
- There is no reference to the material developed by ITU-R that may be used to quantify and identify the source(s) of an infringement of No. **22.5I**.

Method C

The procedures currently contained in Sections V and VI of Article **15**, suitably modified to address only the precise situation described in No. **22.5I**, is one method to satisfy this agenda item. (No identification has yet been made of what type of modifications of Article **15** could be considered.)

Advantage:

GSO earth station operators would have access to specific regulations that would assist them in identifying and expeditiously remedying infringement of the limits in No. **22.5I**.

Disadvantages:

- The need for procedures identified in Resolution **78** is a very narrow one that applies to a single specific case where unacceptable interference has been quantified in the Radio Regulations. Inclusion of such procedures in an article of general applicability such as Article 15 may create confusion and lead to unintended consequences.
- Modifying Article **15** for this particular case could lead to further revisions of Article **15** to address a variety of interference situations in specific terms.
- Places additional burden on BR for a case where administrations, rather than BR, are responsible for determining compliance with the operational or additional operational epfd$_{\downarrow}$ limits.

Method B2

This method is similar to that proposed above in Method A2 but with the ITU-R Recommendation to be incorporated by reference in the Radio Regulations. The only change would be the addition of a footnote to **22.5I**.

3.3.2.4 Regulatory and procedural considerations

Care should be taken to ensure that the solution to the issue raised in Resolution **78 (WRC-2000)** is no broader than absolutely necessary to address the specific and unique situation found in Section II of Article **22** generally, and in No. **22.5I** and its associated tables in particular. The provisions of Article **15** address cases of general applicability, and any modification thereto would have to take this into account. To date, no study has been done with regard to applying the procedures developed pursuant to Resolution **78** to any case other than exceedances of the operational and additional operational epfd$_{\downarrow}$ limits by non-GSO FSS systems subject to those limits.

As the objectives of having a set of procedures for this specific case are to help a victim GSO network determine the source of non-GSO FSS interference in an environment where multiple non-GSO FSS systems are operating and to facilitate the expeditious return to the required power levels, it is important that the time requirements in the procedures be as short as feasible. The time periods should strike the best balance possible between the need by affected GSO networks for expeditious remedial action and the provision of sufficient time for administrations and BR to effectively accomplish their required tasks.

Examples of the regulatory provisions that could implement the proposed Methods A1, A2 and B are given below.

Method A1

No change to the Radio Regulations, including Article **15** or Article **22**, would be required to implement Method A1, noting that a suitable ITU-R Recommendation is being developed, making reference to existing ITU-R Recommendations on the identification and measurement of interference exceeding the *operational* limits, and on the computation of interference statistics for comparison with the *additional operational* limits, and setting out detailed procedures.

Method A2

The only change to the Radio Regulations will be the addition of a footnote to No. **22.5I.**

The following is an example of such a footnote to No. **22.5I.**

ADD

22.5I.1 In addition to the procedures contained in the Radio Regulations (including the provisions of Sections V and VI of Article **15**), administrations may also use Recommendation ITU-R S.[XXX] as a guide to resolving such an infringement of No. **22.2**.

*****

Method B1

The following is an example of some of the regulatory provisions that would allow Method B1 under Section 3.3.2.3 above to be implemented:

1) Modification of No. **22.5I** to include reference to a new WRC-03 resolution containing the procedures for resolving cases of exceedances of the operational and additional operational limits:

MOD

22.5I 6) … The provisions of Resolution **XXX (WRC-03)** shall apply in the event of non-compliance with the single-entry operational and additional operational limits in Section II of Article **22** by a non-geostationary-satellite system in the fixed-satellite service that is subject to the <u>limits in Nos. **22.5C, 22.5D** and **22.5F**.</u>

Method B2

The only change would be the addition of a footnote to No. **22.5I** similar to that proposed above in Method A2 but with the ITU-R Recommendation to be incorporated by reference in the Radio Regulations. The following is an example of such a footnote.

ADD

22.5I.1 In addition to the procedures contained in the Radio Regulations (including the provisions of Sections V and VI of Article **15**), the specific procedures in Recommendation ITU-R [XXX] shall apply.

#########

3.4 Agenda item 1.30

"to consider possible changes to the procedures for the advance publication, coordination and notification of satellite networks in response to Resolution **86** (Minneapolis, 1998)"

In response to Resolution 86 (Minneapolis, 1998) ITU-R studies have progressed in four areas:

1) improvement and reformatting of Appendix 4;
2) automation of the regulatory examination for checking compliance with the RR Table of Frequency Allocations and the footnotes thereto;
3) FSS earth stations deployed in large numbers;
4) BSS frequency bands not subject to Appendix 30.

3.4.1 Modification of Appendix 4

3.4.1.1 Summary of technical and operational studies

The ITU-R has examined the structure and content of the Appendix 4 data and the format used by Member States to supply this data to the Bureau as well as the format used by the Bureau to publish this data.

3.4.1.2 Analysis of the results of studies

The results of these studies can be divided into three categories.

a) Limiting the volume of data provided under section C.8 of Appendix 4

The volume of data supplied by Member States may be reduced by limiting the data supplied under section C8a and C8c of Appendix 4 to the carriers with the maximum potential for causing interference and having the maximum sensitivity to interference, see Annex 1 to section 3.4.1. This proposal is already permitted under the current Radio Regulations but Member States are not necessarily aware that this option for supplying data is available. However, noting the Rule of Procedure on No. **9.35** agreed by the RRB at its 25th meeting, care needs to be exercised in the use of this option as the impact on the filing from an unfavourable finding, during the technical/regulatory examination, due to excess power/pfd may be more significant from the perspective of the network as the unfavourable finding would then apply to all carriers using that emission.

During the studies a number of other requests for changes to the Appendix **4** data were identified but it has been recognised that these can be resolved by extending the number of queries available in the Bureau's Space-Query software and a correspondence group will progress the work.

b) Removal of duplicated data requirements and inconsistencies from Appendix 4

The structure and contents of App. **4** requirements for space services have been examined to remove duplication and inconsistencies particularly in relation to the data presented in Annex 2B to App. **4**. The proposal is based on individually identifying each data item and Recommendation ITU-R SM.1413. Annex 2 to section 3.4.1 presents a suggested structure for Annex 2B to App. **4**.

The revised structure of App. **4** would enable duplicated data elements to be identified and removed e.g. the maximum isotropic gain for a satellite antenna is listed 6 times in App. **4** (items B3a1, B3b1, B3b2, B3g1, B3g5 and B4a). Identifying each data element simplifies the validation of data by Member States and the Bureau and the removal of the need for additional footnotes to clarify requirements would make maintenance easier. The proposal would make it possible to combine Annexes 2A and 2B into this one suggested structure.

The table notes in Annex 2 to section 3.4.1 are provided for the purpose of explaining of the changes to the data requirements and are not expected to be retained in the final version of App. **4**.

The proposed corrections of inconsistencies to the data in App. **4** are based on:

- Recommendation ITU-R SM.1413 - provides the separation of the App. **4** data into their individual elements and identifies a number of inconsistencies in the presentation of the data;
- Rules of Procedure on App. **4** - identifying inconsistencies in the identification of data elements with respect to various forms of notice and service;
- Radiocommunication Bureau Circular Letters CR/158 and CR/158c1 - identifying inconsistencies in the identification of data elements relating to the Plan bands.

In the course of studies the following issues have been identified with regard to the data contained in App. **4** and while there appear to be no technical limitations in developing a solution there may be other factors:

- the visibility arc (App. **4** data item A4A3) is not used by the Bureau and is no longer used by administrations, on that basis it could be deleted as could App. **4** data item A4A5 (the reason the visibility arc is less than the service arc);
- there is some duplication in the data requirements for the orbital parameters of non-GSO satellite systems affecting satellite systems subject to coordination as well as satellite systems not subject to coordination, Annex 3.4.1-3 contains a possible solution.

Administrations and the Special Committee may wish to consider whether there any other factors that would require this data to be retained in its present form and if there is a requirement for corresponding text in § 3.4.1.4.

c) Rationalization of presentation format for supply and publication of data

This proposal considers rationalization of the format used by Member States to supply the Appendix 4 data to the Bureau and the format used by the Bureau to publish this data. The following report is provided to the CPM for information only.

The suggested rationalization would reformat the data into a simpler structure than that now utilized by the Radiocommunication Bureau's data entry software and a simpler structure than that now published in the space Special Sections of the International Frequency Information Circular. This study is not yet completed and can be considered an effort for the longer term that would not provide an immediate impact on reducing the backlog in satellite filings if implemented. A conclusion has not been reached as to whether changes to the Regulations would be necessary to implement such an approach.

3.4.1.3 Methods to satisfy the agenda item and their advantages and disadvantages

Method A

Limiting the volume of data provided under section C.8 of Appendix **4**.

While it is understood that limiting the volume of data to be provided under section C.8 of Appendix **4** is permitted under the existing Radio Regulations, it may be appropriate to include a footnote to clarify that this option is available to Member States in the submission of satellite network filing data. Appendix **4** could be modified with text contained in Annex 1 to section 3.4.1 so that Member States can optionally decide if they want to provide a reduced set of data.

Advantage:

Clarifies the requirements of the existing Radio Regulations for Member States to have the flexibility to provide a reduced data set if they so wish, thus potentially speeding up their provision and handling of data.

Disadvantage:

The impact, on the network concerned, of an unfavourable finding during technical/regulatory examination arising from excess power/pfd may be more significant.

Method B

Removal of duplicated data requirements and inconsistencies from Appendix **4**.

To replace the text of Appendix 4 based on the text contained in Annex 3.4.1-3. The table notes in this Annex are provided for the purpose of explanation of the changes to the data requirements and are not expected to be retained in the final version of Appendix **4**.

Advantage:

To have complete and consistent Appendix **4** data available.

Disadvantage:

None.

Method C

Implementing both Method A and Method B.

Method A and Method B may be combined and used to replace the text of Appendix **4**.

Advantage:

As noted above.

Disadvantage:

As noted above.

Disadvantages of retaining the existing text of the Radio Regulations

Member States may not be aware of their rights to have flexibility in reducing the volume of data to be submitted. In addition known problems with the existing text will not be resolved.

Method D

Implement Method C and limit the information required under Section D of Annex 2A of Appendix 4.

The information currently required under Section D only affects the calculation of $\Delta T/T$ when there is an overlap in frequency on both the uplink and the downlink of the network effecting coordination. For networks having an overlap in either the uplink or the downlink, the calculation of $\Delta T/T$ ($\Delta T_s/T_s$ or $\Delta T_e/T_e$) is done independently on the uplink and the downlink and the data in Section D is not used in this case. Supplying overall link characteristics should not be mandatory for all FSS or BSS satellite networks in all frequency bands with the exception of a space radiocommunication service, in a frequency band and in a Region where the service is subject to a Plan. If Section D is revised to be non-mandatory for these cases, it will reduce the burden of filing and make processing of filings more efficient by BR. There are provisions to file such information when it is required.

Modify Section D of Annex 2A of Appendix 4 as follows:

D Overall link characteristics

"To be provided only when simple frequency-changing transponders are used on the space station onboard a geostationary satellite.

In the case of fixed-satellite service networks or broadcasting-satellite networks using the frequency bands specified in No. **9.7** (GSO/GSO) of Table 5-1 of Appendix **5**, (§ 1), 2) and 3) of the frequency band column), the data specified in this section of the Appendix is not mandatory and should not be submitted to the Bureau."

Consequential to the above revision, changes must also be made to the relevant sections of Table 5-1 of Appendix 5. The changes to Appendix 4 and Appendix 5 are shown in Annex 3.4.1-1 attached.

Concomitantly, there should be a provision included in Article 59 for this revision of Appendix 4 and Appendix 5 to provisionally enter into force as of 5 July 2003.

Advantages

Removes the mandatory requirement for the provision of information that does little to aid BR in identifying networks that may be affected as a result of the eventual bringing into use of the network that is effecting the coordination of the satellite network. Elimination of the mandatory requirement to provide overall link characteristics can significantly reduce the amount of data required when submitting Ap4 satellite network characteristics. In addition, elimination of this requirement can reduce the workload of BR and hopefully help in the effort to reduce the satellite backlog.

Disadvantages

The administration that is effecting the coordination carries a risk that the increase in the equivalent satellite link noise temperature may be greater than ΔT_e when there is a frequency overlap with potentially interfering networks on the uplink and the product of γ and ΔT_s is significant relative to ΔT_e. Also, not knowing the strapping of the network that is effecting coordination, BR and other potentially affected administrations can only calculate the effect of the interference to other networks independently on the uplinks and downlinks of those networks. The calculation of $\Delta T/T$ would have to be done on the uplink and the downlink independently just as in the case of a network with onboard processing, independently of whether or not the interfered-with network uses simple frequency changing transponders or onboard processing.

3.4.1.4 Regulatory and procedural considerations

Limiting the volume of data provided under sections C.8 and D of Appendix 4

The text contained in Annex 3.4.1-2 to section 3.4.1 could be used as the basis for updating section C.8 and the text contained in § 3.4.1.3 could be used as the basis for updating section D of Appendix **4**.

Removal of duplicated data requirements and inconsistencies from Appendix 4

The text contained in Annex 3.4.1-3 to section 3.4.1 could be used as the basis for updating Appendix **4**.

MOD

ANNEX 3.4.1-1

TABLE 5-1 (WRC-2000)

Technical conditions for coordination
(see Article **9**)

Reference of Article 9	**Case**	**Frequency bands (and Region) of the service for which coordination is sought**	**Threshold/condition**	**Calculation method**	**Remarks**
No. **9.7** GSO/GSO	A station in a satellite network using the geostationary-satellite orbit (GSO), in any space radiocommunication service, in a frequency band and in a Region where this service is not subject to a Plan, in respect of any other satellite network using that orbit, in any space radiocommunication service in a frequency band and in a Region where this service is not subject to a Plan, with the exception of the coordination between earth stations operating in the opposite direction of transmission	1) 3 400-4 200 MHz 5 725-5 850 MHz (Region 1) and 5 850-6 725 MHz 2) 10.95-11.2 GHz 11.45-11.7 GHz 11.7-12.2 GHz (Region 2) 12.2-12.5 GHz (Region 3) 12.5-12.75 GHz (Regions 1 and 3) 12.7-12.75 GHz (Region 2) and 13.75-14.5 GHz	i) Bandwidth overlap, and ii) any network in the fixed-satellite service (FSS) with a space station within an orbital arc of ± 10° of the nominal orbital position of a proposed network in the FSS i) Bandwidth overlap, and ii) any network in the FSS, or BSS, not subject to a plan with a space station within an orbital arc of ± 9° of the nominal orbital position of a proposed network in the FSS or BSS		With respect to the FSS or BSS in the bands in 1), 2) and 3), an administration may request, pursuant to No. **9.41**, to be included in requests for coordination, indicating the networks for which the value of $\Delta T/T$ calculated by the method in § 2.2.1.2 and 3.2 of Appendix **8** exceeds 6%. When the Bureau, on request by an affected administration, studies this information pursuant to No. **9.42**, the calculation method given in § 2.2.1.2 and 3.2 of Appendix **8** shall be used. With respect to the FSS or BSS in the bands in 1), 2) and 3), an administration may request, pursuant to No. **9.41**, that an administration be excluded from requests for coordination, giving as reason

TABLE 5-1 (*continued*)

Reference of Article 9	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. **9.7** GSO/GSO (*cont.*)		3) All bands above 17.3 GHz 4) All frequency bands, other than those in § 1), 2) and 3), allocated to a space service, and the bands in § 1), 2) and 3) where the radio service of the proposed network or affected networks is other than the FSS, or in the case of coordination of space stations operating in the opposite direction of transmission	i) Bandwidth overlap, and ii) any network in the FSS, or BSS, not subject to a plan with a space station within an orbital arc of ± 8° of the nominal orbital position of a proposed network in the FSS or BSS Value of $\Delta T/T$ exceeds 6%	Appendix **8**	that the network of this administration will not be affected because value of $\Delta T/T$ calculated by the method in § 2.2.1.2 and 3.2 of Appendix **8** do not exceed 6%. When the Bureau, at the request of an administration, studies this information pursuant to No. **9.42**, the calculation method given in § 2.2.1.2 and 3.2 of Appendix **8** shall be used

Annex 3.4.1-2

Example limiting the volume of data provided under Section C.8 of Appendix 4

Items in Appendix	**Advance publication of a geostationary-satellite network**	**Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9**	**Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9**	**Notification or coordination of a geostationary-satellite network (including Appendix 30B)**	**Notification or coordination of a non-geostationary-satellite network**	**Notification or coordination of an earth station**	**Notice for space stations in the broadcasting-satellite service under Appendix 30**	**Notice for feeder-link stations under Appendix 30A**	**Notice for stations in the fixed-satellite service under Appendix 30B**	**Items in Appendix**	**Radio astronomy**
C.8.a			X[1, 7,AA]	X[7,AA]	X[7,AA]	C[8,AA]				C.8.a	
C.8.b			X[1, 7]	X[7]	X[7]	X[11]				C.8.b	
C.8.c			O	X[6,AA]	X[6,AA]	X[6, 11,AA]				C.8.c	
C.8.d				X[2]	X[2]					C.8.d	
C.8.e			O	X[6]	X[6]	X[6, 11]				C.8.e	
C.8.f			X[3]							C.8.f	
C.8.g				C[4]	C[4]	C[4, 5]				C.8.g	
C.8.h							X			C.8.h	
C.8.i								X		C.8.i	
C.8.j									X	C.8.j	

New footnote AA: Member States may optionally supply, for each class of emission, only the powers related to the carriers that have the greatest sensitivity to interference and the greatest potential for causing interference.

Annex 3.4.1-3

Removal of duplicated data requirements and inconsistencies from Appendix 4

In the following table two columns have been added: the first entitled "Extra code field" that is used to identify compound data elements, this field is temporary and is not expected to be retained in the final version of Appendix 4; and, the column entitled "Data Description" containing the data descriptions from Annex 2A to Appendix 4.

New data elements are identified by the text "Not in App. 4" in column 1. Existing data elements that have been relocated within the table are identified by an appropriate existing Appendix 4 item code combined with one of the following terms "*bis*", "*ter*", or "*quinter*". Where data items have been relocated or combined, the reference code for the original location or the constituent data items are listed at the new location with each reference enclosed in square brackets. Revision marking is used to show changes to the text and a series of table notes provide the details of changes and the source of more detailed reference material. The existing footnotes to Annex 2B to Appendix 4 are separately listed, for reference, after the table notes.

Example of a rationalized structure for Appendix 4

Characteristics to be submitted for stations in the space and radio astronomy services

1		2	3	4	5	6	7	8	9	10	11	12
Items in Appendix	**Extra code field**	**Data Description**	**Advance publication of a geostationary-satellite network**	**Advance publication of a non-geostationary satellite network subject to coordination under Section II of Article 9**	**Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9**	**Notification or coordination of a geostationary satellite network (75)**	**Notification or coordination of a non-geostationary-satellite network**	**Notification or coordination of an earth station (including notification under Appendices 30A and 30B) (76)**	**Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (77)**	**Notice for a satellite network (feeder-link) under Appendix 30A (78)**	**Notice for a satellite network in the fixed satellite service under Appendix 30B (Articles 6 and 8) (75)**	**Radio astronomy**
A		**GENERAL CHARACTERISTICS TO BE PROVIDED FOR THE SATELLITE NETWORK OR THE EARTH OR RADIO ASTRONOMY STATION**										
A1		**IDENTITY OF THE SATELLITE NETWORK OR THE EARTH OR RADIO ASTRONOMY STATION**										
A1a [A1d]		Identity of a satellite network and in the case of Appendix 30B for a network not derived from the Allotment Plan.	X	X	X	X	X		X	X	X	
									(50)			
A1c [A1d]		Country and beam identification.							X (51)	X	X	
A1e		**Identity of an earth or radio astronomy station:**										
A1e1		the type of earth station (specific or typical)						X				
A1e2	a	the name by which the station is known, required if the name of the locality is not supplied;						+				+
A1e2	b	the name of the locality in which it is situated (i.e. site name), required if the name of the station is not supplied.						+ (3)				+ (3)
A1e3		**for a specific earth station or radio astronomy station:**										
A1e3 [A1e4 a]	a	the country or geographical area in which the station is located, using the symbols from the Preface to the International Frequency List;						X				X

1		2	3	4	5	6	7	8	9	10	11	12
A1e3 [A1e4 b]	b	the geographical coordinates of each transmitting or receiving antenna site constituting the earth station (longitude and latitude in degrees and minutes). For a specific earth station seconds (to an accuracy of one-tenth of a minute) are to be provided if the coordination area of the earth station overlaps the territory of another administration;						X				X
A1f [A18 4]	1	Country symbol of the notifying administration. .	X	X	X	X	X	X (59)	X	X	X	X
A1f [A18 2]	2	The country symbols of the administrations in the group submitting the information on the satellite network.	X	X	X						X	
Not in App. 4		If the notice is submitted on behalf of an intergovernmental satellite organization provide its symbol (4)	X	X	X	X	X		X	X		
A2		**DATE OF BRINGING INTO USE**										
A2a		The date (actual or foreseen, as appropriate) of bringing the frequency assignment (new or modified) into use. The date of bringing into use denotes the date at which the frequency assignment of a geostationary satellite network is brought into regular operation* to provide the published radiocommunication service with the technical parameters within the technical characteristics notified to the Bureau. Whenever the assignment is changed in any of its basic characteristics (except in the case of a change in item A.1 a), the date to be given shall be that of the latest change (actual or foreseen, as appropriate). * Pending further studies by ITU-R on the applicability of the term "regular operation" to non-geostationary satellite networks, the condition of regular operation shall be limited to geostationary satellite networks.	X	X	X	X	X	X	X	X	X	
A2b		For the case of a space station onboard a geostationary satellite, the period of validity of the frequency assignments (see Res. 4 (Rev.Orb-88)).	X			X						
A2c		The date (actual or foreseen, as appropriate) on which reception of the frequency band begins or on which any of the basic characteristics are modified.										X
A3		**OPERATING ADMINISTRATION OR AGENCY**										
A3	a	Symbols for the operating administration or agency if it is in operational control of the space station or earth station; required in the case of Appendix 30B for notification under Article 8 only.			X	X	X	X	X	X	**X** (5)	X

1		2	3	4	5	6	7	8	9	10	11	12
A3	b	Symbols for the address of the administration to which communication should be sent on urgent matters regarding interference, quality of emissions and questions referring to the technical operation of the space network or earth station (see Article **15**); required in the case of Appendix 30B, for notification under Article 8 only.	X (6)	X (6)	X	X	X	X	X	X	**X** (5)	X
A4		**ORBITAL INFORMATION**										
A4a		**For the case of a space station onboard a geostationary satellite:**										
A4a1		the nominal geographical longitude on the geostationary-satellite orbit;	X			X			X	X	X	
A4a2	a	the planned longitudinal tolerance easterly limit.				X			X	X	X (7)	
A4a2	b	the planned longitudinal tolerance westerly limit.				X			X	X	X (7)	
A4a2	c	the planned inclination excursion.				X			O (8)	O (8)	X (7)	
A4a		**In the case where a geostationary space station is intended to communicate with an earth station:**										
A4a3	a	the arc of visibility easterly limit (the arc of the geostationary-satellite orbit over which the space station is visible at a minimum angle of elevation of 10° at the Earth's surface from its associated earth stations or service areas);				X						
A4a3	b	the arc of visibility westerly limit (the arc of the geostationary-satellite orbit over which the space station is visible at a minimum angle of elevation of 10° at the Earth's surface from its associated earth stations or service areas);				X						
A4a4	a	the service arc easterly limit (the arc of the geostationary-satellite orbit within which the space station could provide the required service to its associated earth stations or service areas); required in the case of Appendix 30B, for satellite networks not derived from the Allotment Plan.				X					+ (9)	
A4a4	b	the service arc westerly limit (the arc of the geostationary-satellite orbit within which the space station could provide the required service to its associated earth stations or service areas); required in the case of Appendix 30B, for satellite networks not derived from the Allotment Plan.				X					+ (9)	
A4a5		in the event that the service arc is less than the arc of visibility, the reasons therefore.				X						
A4b		**For the case of space station(s) onboard non-geostationary satellite(s):**										
A4b1		the angle of inclination of the orbit;		X	X		X (10)					
A4b2		the period;		X	X		X (11)					
A4b3	a	the altitude in kilometres of the apogee of the space station(s);		X	X		X (11)					
A4b3	b	the altitude in kilometres of the perigee of the space station(s);		X	X		X (11)					
A4b4		the number of satellites used.		X	X		X					

1		2	3	4	5	6	7	8	9	10	11	12
Not in App. 4		Reference body code (12)		X	X		X					
A4b5		**In addition, if the stations operate in a frequency band subject to the provisions of No. 9.11A: data elements required to characterize properly the orbital statistics of non-GSO satellite systems:**										
A4b5 N_p	a	number of orbital planes;		X (14)	X (14)		X (15)					
A4b5 N_s	b	number of satellites in each orbital plane;					X					
A4b5 Ω_j	c	right ascension of the ascending node for the j-th orbital plane, measured counter-clockwise in the equatorial plane from the direction of the vernal equinox to the point where the satellite makes its South-to-North crossing of the equatorial plane ($0° \leq \Omega_j < 360°$);					X					
A4b5 i_j	d	inclination angle for the j-th orbital plane with respect to the reference plane, which is taken to be the Earth's equatorial plane ($0° \leq i_j < 180°$);					X					
A4b5 ω_i	e	initial phase angle of the i-th satellite in its orbital plane at reference time t = 0, measured from the point of the ascending node ($0° \leq \omega_i < 360°$);					X					
A4b5 α	f	semi-major axis;					X					
A4b5 e	g	eccentricity ($0 \leq e < 1$);					X					
A4b5 ω_p	h	argument of perigee, measured in the orbital plane, in the direction of motion, from the ascending node to the perigee ($0° \leq \omega_p < 360°$).					X					
A4b6		**In addition, if the stations operate in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F, data elements required to characterize properly the orbital operation of non-geostationary satellite systems:**										
A4b6a		**for each range of latitudes provide:**										
A4b6a	1	the maximum number of non-geostationary satellites transmitting with overlapping frequencies to a given location;					X (72)					
A4b6a	2	the associated start of the latitude range;					X (72)					
A4b6a	3	the associated end of the latitude range;					X (72)					
A4b6b		the minimum altitude of the space station above the surface of the Earth at which any satellite transmits;					X (72)					
A4b6c		an indicator identifying if the space station uses station-keeping to maintain a repeating ground track;					X (72)					

1		2	3	4	5	6	7	8	9	10	11	12
A4b6d		where the space station uses station-keeping to maintain a repeating ground track, the time in seconds that it takes for the constellation to return to its starting position, i.e. such that all satellites are in the same location with respect to the Earth and each other;					X (72)					
A4b6e		an indicator identifying if the space station should be modelled with a specific precession rate of the ascending node of the orbit instead of the J_2 term;					X (72)					
A4b6f		for a space station that is to be modelled with a specific precession rate of the ascending node of the orbit instead of the J_2 term, the precession rate in degrees/day, measured counter-clockwise in the equatorial plane;					X (72)					
A4b6g		the longitude of the ascending node for the j-th orbital plane, measured counter-clockwise in the equatorial plane from the Greenwich meridian to the point where the satellite orbit makes its south-to-north crossing of the equatorial plane ($0° \leq \Omega_j < 360°$); NOTE – For the evaluation of epfd a reference to a point on the Earth is used and hence the "longitude of the ascending node" is required. All satellites in the constellation should use the same reference time.					X (72)					
A4b6h	1	the time (date) at which the satellite is at the location defined by Ω_j; NOTE – For the evaluation of epfd a reference to a point on the Earth is used and hence the "longitude of the ascending node" is required. All satellites in the constellation should use the same reference time.					X (72)					
A4b6h	2	the time at which the satellite is at the location defined by Ω_j; NOTE – For the evaluation of epfd a reference to a point on the Earth is used and hence the "longitude of the ascending node" is required. All satellites in the constellation should use the same reference time.					X (72)					
A4b6i		the longitudinal tolerance of the longitude of the ascending node					X (72)					
A4b7		**In addition, if the stations operate in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F data elements required to characterize properly the performance of non-geostationary satellite systems:**										
A4b7a		the maximum number of non-geostationary satellites receiving simultaneously with overlapping frequencies from the associated earth stations within a given cell;					X (72)					
A4b7b		the average number of associated earth stations with overlapping frequencies per square kilometre within a cell;					X (72)					
A4b7c		the average distance between co-frequency cells;					X (72)					
A4b7d		**for the exclusion zone about the geostationary-satellite orbit provide:**										
A4b7d		the type of zone;					X (72)					

1		2	3	4	5	6	7	8	9	10	11	12
A4b7d	1	in the case of an exclusion zone based on topocentric angle the width of the zone in degrees.					X (72)					
A4b7d	2	in the case of an exclusion zone determined using a satellite based angle the width of the zone in degrees.					X (72)					
A4c	1	For the case of an earth station, the identity of the associated space station(s) with which communication is to be established .						X				
A4c	2	For the case of an earth station, if communication is to be established with an associated geostationary space station its orbital position.						X				
A5		**COORDINATION**										
A5		The country symbol of any administration with which coordination has been successfully effected as well as the country symbol of any administration with which coordination has been sought but not completed. For the case of an FSS earth station, not required for coordination under No. 9.7A.				X	X	X (23)	X	X	X	
Not in Ap 4		If coordination has been sought or completed provide the related provision code. For the case of an FSS earth station, not required for coordination under No. 9.7A.				X	X	X (23)	X	X	X	
A6		**AGREEMENTS**										
A6		If appropriate, the country symbol of any administration or administration representing a group of administrations with which agreement has been reached, including where the agreement is to exceed the limits prescribed in these Regulations. For the case of an FSS earth station, not required for coordination under No. 9.7A.				X	X	X (23)	X	X	X	
Not in Ap 4		If agreement has been reached provide the related provision code. For the case of an FSS earth station, not required for coordination under No. 9.7A.				X	X	X (23)	X	X	X	
A7		**EARTH OR RADIO ASTRONOMY STATION SITE CHARACTERISTICS**										
A7		**For a specific earth station:**										
A7a1		The horizon elevation angle in degrees for each azimuth around the earth station. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)		(17)		
A7a2		the distance in kilometres from the earth station to the horizon for each azimuth around the earth station.						O				
A7b [B6]		the planned minimum angle of elevation of the antenna in the direction of maximum radiation in degrees from the horizontal plane. For an earth station the minimum elevation angle should have due regard to possible inclined-orbit operation of the associated geostationary space station. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)		(17)		X

1		2	3	4	5	6	7	8	9	10	11	12
A7b-bis [B6]		The planned maximum angle of elevation of the antenna in the direction of maximum radiation in degrees from the horizontal plane.										X
A7c [B6]	1	The start azimuth for the planned range of operating azimuthal angles for the direction of maximum radiation in degrees, clockwise from True North. For an earth station the start azimuth should have due regard to possible inclined-orbit operation of the associated geostationary space station. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)				X
A7c [B6]	2	The end azimuth for the planned range of operating azimuthal angles for the direction of maximum radiation in degrees, clockwise from True North. For an earth station the start azimuth should have due regard to possible inclined-orbit operation of the associated geostationary space station. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)				X
A7d		The altitude (metres) of the antenna above mean sea level. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)		(17)		
A7e		The minimum angle of elevation of the antenna in the direction of maximum radiation in degrees from the horizontal plane for each azimuth around the earth station that is operating to associated non-geostationary space stations. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)				
		(20)										
A10		**EARTH STATION COORDINATION AREA DIAGRAMS**										
A10		The diagrams shall be drawn to an appropriate scale, indicating, for both transmission and reception, the location of the earth station and its associated coordination areas, or the coordination area related to the service area in which it is intended to operate the mobile earth station. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)				
A11	a	Regular hours of operation start time UTC (30)							X	X		
A11	b	Regular hours of operation stop time UTC (30)							X	X		
A12		**RANGE OF AUTOMATIC GAIN CONTROL**										
A12		Range of automatic gain control, expressed in dB.								X		
A13		**AS APPROPRIATE, REFERENCE TO THE SPECIAL SECTION OF THE BUREAU'S INTERNATIONAL FREQUENCY INFORMATION CIRCULAR (BR IFIC).**										
A13a		providing the advance publication special section reference information required in accordance with No. 9.1;				X	X	X				

1		2	3	4	5	6	7	8	9	10	11	12
A13b		providing the coordination special section reference information required in accordance with No. 9.7;				X	(22)	+ (38)				
A13c		providing the special section reference information required in accordance with No. 9.21;				X	X	X				
A13d		providing the coordination special section reference information required in accordance with Art. 7 of Ap. 30;				X	(22)	(24)				
A13e		providing the coordination special section reference information required in accordance with Art. 7 of Ap. 30A;				X	(22)	+ (73)				
A13f		providing the coordination special section reference information required in accordance with No. 9.11;				+ (43)	+ (43)	(24)				
A13g		providing the coordination special section reference information required in accordance with No. 9.11A;				X	X	X				
A13h		providing the special section reference information required in accordance with Article 6 of Appendix 30B.					(22)	+ (36)			+ (80)	
Not in Ap 4		providing the special section reference information required in accordance with Article 4 of Appendix 30. (84)							X			
Not in Ap 4		providing the special section reference information required in accordance with Article 4 of Appendix 30A (84)								X		
Not in Ap 4		providing the coordination special section reference information required in accordance with No. 9.7A (84)						X				
Not in Ap 4		providing the coordination special section reference information required in accordance with No. 9.7B. (84)					X					
Not in Ap 4		providing the coordination special section reference information required in accordance with No. 9.12. (84)					X					
Not in Ap 4		providing the coordination special section reference information required in accordance with No. 9.12A. (84)					X					
Not in Ap 4		providing the coordination special section reference information required in accordance with No. 9.13. (84)				X						
A14		**SPECTRUM MASKS**										
A14		**For stations operating in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F**										
A14a		**for each e.i.r.p. mask used by the non-geostationary space station provide**:										
A14a							(65)					
A14a	1	the mask identification code;					X					
A14a	2	the mask pattern defined in terms of the power in the reference bandwidth for a series of off-axis angles with respect to a specified reference point;					X					
A14a	3	the lowest frequency for which the mask is valid;					X					
A14a	4	the highest frequency for which the mask is valid;					X					
A14b		**for each associated earth station e.i.r.p. mask provide**:										
A14b							(65)					

1		2	3	4	5	6	7	8	9	10	11	12
A14b	1	the mask identification code;					X					
A14b	2	the mask pattern defined in terms of the power in the reference bandwidth for a series of off-axis angles with respect to a specified reference point;					X					
A14b	3	the lowest frequency for which the mask is valid;					X					
A14b	4	the highest frequency for which the mask is valid;					X					
A14b	5	the minimum elevation angle at which any associated earth station can transmit to a non-geostationary satellite;					X					
A14b	6	the minimum separation angle between the geostationary-satellite orbit arc and the associated earth station main beam-axis at which the associated earth station can transmit towards a non-geostationary satellite;					X					
A14c		**for each pfd mask used by the non-geostationary space station provide:**										
A14c	1	the type of mask;					X					
A14c	2	the mask identification code;					X					
A14c	3	the mask pattern of the power flux-density defined in three dimensions;					X					
A14c	4	the lowest frequency for which the mask is valid;					X					
A14c	5	the highest frequency for which the mask is valid.					X					
A15		**COMMITMENT REGARDING COMPLIANCE WITH ADDITIONAL OPERATIONAL EPFD↓ LIMITS**										
A15		For non-geostationary-satellite systems operating in the fixed-satellite service in the bands 10.7-11.7 GHz (in all Regions), 11.7-12.2 GHz (Region 2), 12.2-12.5 GHz (Region 3), and 12.5-12.75 GHz (Regions 1 and 3), a commitment that the filed for system will meet the additional operational epfd↓ limits that are specified in Table **22-4A1** under No. **22.5I**.					X					
A16		**COMMITMENT REGARDING COMPLIANCE WITH OFF-AXIS POWER LIMITATIONS**										
A16		A commitment that the associated earth stations operating with a geostationary-satellite network in the fixed-satellite service meet the off-axis power limitations given in Nos. **22.26** to **22.28** or **22.32** (as appropriate) under the conditions specified in Nos. **22.30**, **22.31** and **22.34** to **22.39**, where the earth stations are subject to those power limitations.				X						
A17		**COMPLIANCE WITH AGGREGATE POWER FLUX-DENSITY LIMITS**										
A17a	1	For satellite systems operating in the radionavigation-satellite service in the band 5 010-5 030 MHz, the aggregate power flux-density produced at the Earth's surface in the band 5 030-5 150 MHz in a 150 kHz bandwidth as defined in No. **5.443B** (60)**.**				X (61)	X					

1		2	3	4	5	6	7	8	9	10	11	12
A17a	2	For satellite systems operating in the radionavigation-satellite service in the band 5 010-5 030 MHz, the aggregate power flux-density produced at the Earth's surface in the band 4 990-5 000 MHz in a 10 MHz bandwidth, as defined in No. **5.443B** (60)**.**				X (61)	X					
A17b		For satellite systems operating in the fixed-satellite service and broadcasting-satellite service in the band 41.5-42.5 GHz the calculated aggregate power flux-density in any 1 MHz bandwidth produced at the site of a radio astronomy station for more than 2% of the time in the band 42.5-43.5 GHz, as defined in No. **5.551G**.				X (62)	X					
A17c		For satellite systems operating in the radionavigation-satellite service in the band 1 164-1 215 MHz, the calculated aggregate power flux-density produced at the Earth's surface by all the space stations within all radionavigation-satellite systems, as defined in No. **5.328A**.				X (63)	X					
A17d		For non-geostationary-satellite systems operating in the fixed-satellite service (feeder links) in the band 15.43-15.63 GHz (space-to-Earth), the aggregate power flux-density produced at the Earth's surface in the band 15.35-15.4 GHz, as defined in No. **5.511A**.					X					
A18	1	**SUB-REGIONAL SYSTEMS**: for the case of a space network submitted in accordance with Appendix **30B**, indicate the type of system (i.e. if the network is part of a sub-regional system) (26).									X	
A18	3	**SUB-REGIONAL SYSTEMS**: for the case of a space network submitted in accordance with Appendix **30B,** indicate for each participating administration, if applicable, the part of the national allotment proposed to be used to form the subregional system.(26)									X	

X - Mandatory; + Mandatory under specified conditions; O - Optional; C- Mandatory if used as a basis to effect coordination with another administration.

1		2	3	4	5	6	7	8	9	10	11	12
Items in Appendix	**Extra code field**	**Data Description**	**Advance publication of a geostationary-satellite network**	**Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9**	**Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9**	**Notification or coordination of a geostationary - satellite network (75)**	**Notification or coordination of a non-geostationary-satellite network**	**Notification or coordination of an earth station (including notification under Appendices 30A and 30B) (76)**	**Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (77)**	**Notice for a satellite network (feeder-link) under Appendix 30A (78)**	**Notice for a satellite network in the fixed satellite service under Appendix 30B (Articles 6 and 8) (75)**	**Radio astronomy**
B		**CHARACTERISTICS TO BE PROVIDED FOR EACH SATELLITE ANTENNA BEAM OR EACH EARTH OR RADIO ASTRONOMY STATION ANTENNA**										
B1		The designation of the satellite antenna beam. The designation shall be a character code, and the last character shall be an "R" for steerable or reconfigurable beams.			X	X	X	X	X	X	X	
B2		Transmission/Reception indicator. For the case of an FSS earth station, not required for coordination under No. 9.7A.			X	X	X	X (23)			X	
B3		**SPACE STATION ANTENNA CHARACTERISTICS**										
B3a1 [B3b1] [B3b2 a] [B3g1 a] [B3g5] [B4a 1]		the maximum co-polar isotropic gain (dBi). Where a steerable beam (see No. 1.191) is used, if the effective boresight area (see No. 1.175) is identical with the global or nearly global service area, the maximum antenna gain (dBi) is applicable to all points on the Earth's visible surface;			X	X	X		X	X	X	
B3a1- bis [B3g1 b]		maximum cross-polar isotropic antenna gain (dBi) in the case of beams that are not elliptical.							X	X	(21)	

1		2	3	4	5	6	7	8	9	10	11	12
B3a2 **[B3b2 b]** **[B3g5 a]**		the antenna gain contours plotted on a map of the Earth's surface, preferably in a radial projection from the satellite onto a plane perpendicular to the axis from the centre of the Earth to the satellite. For the case of a steerable beam (see No. 1.191), if the effective boresight area (see No. 1.175) is less than the global or nearly global service area, the contours are the result of moving the boresight of the steerable beam around the limit defined by the effective boresight area. The space station antenna gain contours shall be drawn as isolines of the isotropic gain, at least for –2, –4, –6, –10 and –20 dB and at 10 dB intervals thereafter, as necessary, relative to the maximum antenna gain, when any of these contours is located either totally or partially anywhere within the limit of visibility of the Earth from the given geostationary satellite. Whenever possible, the gain contours of the space station antenna should also be provided in a numerical format (e.g. equation or table). Required for the case of Aps. 30, 30A and 30B, non-elliptical beams only.				X			+	+	+	
B3a2-bis **[B3g5 b]**		cross-polar gain contours plotted on a map of the Earth's surface, preferably in a radial projection from the satellite on to a plane perpendicular to the line from the centre of the Earth to the satellite. The isotropic or absolute gain shall be indicated at each contour which corresponds to a decrease in gain of 2, 4, 6, 10 or 20 dB and thereafter at 10 dB intervals down to a value of 0 dB relative to an isotropic radiator. Whenever practicable, a numerical equation or table providing the necessary information to allow the gain contours to be plotted should be provided. Required for the case of Aps. 30, and 30A non-elliptical beams only.							+	+	(69)	
B3a2-ter **[B3e]** **[B3g4 a]** **[B4a 2]** **[B4b 2]**		the co-polar antenna radiation pattern; for non-geostationary space stations, space stations where the antenna radiation beam is directed towards another satellite and required for the case of Appendices 30, 30A and 30B elliptical beams.			X	X	X		X	X	X	
B3a2-quinter **[B3g4 g]**		the cross-polar antenna radiation pattern; required for the case of elliptical beams.							X	X	(69)	
		'										
B3c	a	The antenna gain contours of B.3 a) 2 above shall include the effect of the planned, inclination excursion.				X (27)						
B3c	b	The antenna gain contours of B.3 a) 2 above shall include the effect of the planned longitudinal tolerance.				X (27)						

1		2	3	4	5	6	7	8	9	10	11	12
B3c	c	The antenna gain contours of B.3 a) 2 above shall include the effect of the planned pointing accuracy of the antenna.				X (27)						
B3d		The pointing accuracy of the antenna.				X			X	X	X	
B3f **[B3g5 g]**		The gain of the antenna in the direction of those parts of the geostationary-satellite orbit which are not obstructed by the Earth, in the case of operation in a band allocated in the Earth-to-space direction and in the space-to-Earth direction.				X				X		
B3g		**For the case of a space station submitted in accordance with Appendix 30, Appendix 30A or Appendix 30B:**										
B3g-bis **[B3g4 f]** **[B3g5 c]**		nominal intersection of the antenna beam axis with the Earth (boresight longitude and latitude); required for the case of non-steerable beams.							X	X	X	
		(52)										
		(52)										
		(52)										
		(52)										
		(52)										
		(52)										
B3g4		**for elliptical beams:**										
B3g4	b	rotational accuracy in degrees;							X	X	X	
B3g4	c	major axis orientation in degrees anticlockwise from the Equator;							X	X	X	
B3g4	d	major axis (degrees) at the half-power beamwidth;							X	X	X	
B3g4	e	minor axis (degrees) at the half-power beamwidth;							X	X	X	
		'										
		'										
									(70)			

1		2	3	4	5	6	7	8	9	10	11	12
B4		**NON-GEOSTATIONARY SPACE STATION ANTENNA CHARACTERISTICS**										
B4b		**In the case of a space station submitted in accordance with No. 9.11A:**										
B4b	1a	orientation angle alpha of the satellite transmitting and receiving antenna beams;			(32)		X					
B4b	1b	orientation angle beta of the satellite transmitting and receiving antenna beams;			(32)		X					
B4b	3	the satellite antenna gain G(θ) as a function of elevation angle at a fixed point on the Earth;			(32)		X					
B4b	4	the spreading loss (for a non-GSO satellite) as a function of elevation angle (to be determined by equations or provided in graphical format);			(32)		X					
B4b	5a	maximum beam peak e.i.r.p./4 kHz for each beam			(32)		X					
B4b	5c	maximum beam peak e.i.r.p./1 MHz for each beam			(32)		X					
B4b	5b	average beam peak e.i.r.p./4 kHz for each beam			(32)		X					
B4b	5d	average beam peak e.i.r.p./1 MHz for each beam			(32)		X					
B4b	6	for the fixed-satellite service (space-to-Earth) in the band 6 700-7 075 MHz, calculated peak value of power flux-density produced within ±5 degrees inclination of the geostationary-satellite orbit.			(32)		X					
B5		**EARTH STATION ANTENNA CHARACTERISTICS**										
B5a		The isotropic gain (dBi) of the antenna in the direction of maximum radiation (see No. 1.160).						X				
B5b		Half-power beamwidth in degrees. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)				
B5c		Either the measured radiation pattern of the antenna or the reference radiation pattern to be used for coordination. For coordination under No. 9.7A, the reference radiation pattern is to be provided						X (53)				
B6		**RADIO ASTRONOMY STATION ANTENNA CHARACTERISTICS**										
B6	a	The antenna type and dimensions, effective area										X
		'										
		'										

1		2	3	4	5	6	7	8	9	10	11	12
Items in Appendix	**Extra code field**	**Data Description**	**Advance publication of a geostationary-satellite network**	**Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9**	**Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9**	**Notification or coordination of a geostationary-satellite network (75)**	**Notification or coordination of a non-geostationary-satellite network**	**Notification or coordination of an earth station (including notification under Appendices 30A and 30B) (76)**	**Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (77)**	**Notice for a satellite network (feeder-link) under Appendix 30A (78)**	**Notice for a satellite network in the FSS under Appendix 30B (Articles 6 and 8) (75)**	**Radio astronomy**
C		**CHARACTERISTICS TO BE PROVIDED FOR EACH GROUP OF FREQUENCY ASSIGNMENTS FOR A SATELLITE ANTENNA BEAM OR AN EARTH OR RADIO ASTRONOMY STATION ANTENNA**										
C1		**FREQUENCY RANGE**										
C1	a	The frequency range lower limit within which the carriers and the bandwidth of the emission will be located for each Earth-to-space or space-to-Earth service area, or for each space-to-space relay.	X	X	X						X	
C1	b	The frequency range upper limit within which the carriers and the bandwidth of the emission will be located for each Earth-to-space or space-to-Earth service area, or for each space-to-space relay.	X	X	X						X	
C2		**ASSIGNED FREQUENCY (FREQUENCIES)**										
C2a	1	The assigned frequency (frequencies), as defined in No. 1.148, in kHz up to 28 000 kHz inclusive, in MHz above 28 000 kHz to 10 500 MHz inclusive and in GHz above 10 500 MHz. Required for the case of Appendix 30B for notification under Article 8 only. If the basic characteristics are identical, with the exception of the assigned frequency, a list of frequency assignments may be provided.				X	X	X	X	X	X (5)	
C2a	2	Channel number							O (19)			
C2b		The centre of the frequency band observed, in kHz up to 28 000 kHz inclusive, in MHz above 28 000 kHz to 10 500 MHz inclusive and in GHz above 10 500 MHz.										X
C3		**ASSIGNED FREQUENCY BAND**										
C3a		The bandwidth of the assigned frequency band in kHz (see No. 1.147). Required for the case of Appendix 30B for notification under Article 8 only.				X	X	X	X (28)	X	X (5)	

1		2	3	4	5	6	7	8	9	10	11	12
C3b		The bandwidth of the frequency band in kHz observed by the station.										X
C4		**CLASS OF STATION(S) AND NATURE OF SERVICE**										
C4	a	The class of station using the symbols shown in the Preface to the International Frequency List.	X	X	X	X	X	X	X	X		X
C4	b	The nature of service performed, using the symbols shown in the Preface to the International Frequency List.	X	X	X	X	X	X	X	X		X
C5		**RECEIVING SYSTEM NOISE TEMPERATURE**										
C5a		In the case of a space station, the lowest total receiving system noise temperature, in kelvins, referred to the output of the receiving antenna of the space station.			X	X	X			X	X	
C5b		In the case of an earth station, the lowest total receiving system noise temperature, in kelvins, referred to the output of the receiving antenna of the earth station under clear-sky conditions. This value shall be indicated for the nominal value of the angle of elevation when the associated transmitting station is onboard a geostationary satellite and, in other cases, for the minimum value of the angle of elevation.						X				
C5c		In the case of a radio astronomy station, the overall receiving system noise temperature in kelvins, referred to the output of the receiving antenna.										X
C6		**POLARIZATION**										
C6	a	The type of polarization and, if appropriate, sense of polarization of the antenna. In the case of circular polarization, indicate the direction of polarization (see Nos. 1.154 and 1.155). In the case of a space station submitted in accordance with Appendix **30** or **30A**, this indication is to be in the direction of the boresight or the aim point or as defined in B.3 *g)* 4) and B.3 *g)* 5), respectively. For the case of an FSS earth station, not required for coordination under No. 9.7A. (34) (52)			X	X	X	X (23)	X	X		
C6	b	In the case of linear polarization, indicate the angle (in degrees) measured counter-clockwise in a plane normal to the beam axis from the equatorial plane to the electric vector of the waves as seen from the satellite. In the case of a space station submitted in accordance with Appendix **30** or **30A**, this indication is to be in the direction of the boresight or the aim point or as defined in, B.3 *g)* 4) and B.3 *g)* 5), respectively. For the case of an FSS earth station, not required for coordination under No. 9.7A. (34) (52)			X	X	X	X (23)	X	X		
C7		**CLASS OF EMISSION, NECESSARY BANDWIDTH AND DESCRIPTION OF THE TRANSMISSION**										
C7		**In accordance with Article 2 and Appendix 1:**										

1		2	3	4	5	6	7	8	9	10	11	12
C7a **[C7c 1]** **[C7c 3]** **[C7d 1]** **[C7d 3]**	1	the class of emission; and, if required for coordination only, for each carrier. Required for the case of Appendix 30B for notification under Article 8 only.			O	X	X	X	X	X	X (5)	
C7a **[C7c 2]** **[C7d 2]**	2	the necessary bandwidth; and, if required for coordination only, for each carrier. Required for the case of Appendix 30B for notification under Article 8 only.			O	X	X	X	X	X	X (5)	
C7b	1	the carrier frequency of the emission(s);			O	C	C	C				
C7b	2	the frequencies of the emission(s);			O	C	C	C				
C8		**POWER CHARACTERISTICS OF THE TRANSMISSION**										
C8a	1	The maximum value of the peak envelope power (dBW) supplied to the input of the antenna for each carrier type.			O (31) (46)	+ (46)	+ (46)	C (37)				
C8a	2	The maximum power density (dB(W/Hz))[3], averaged over the worst 4 kHz band for carriers below 15 GHz, supplied to the input of the antenna for each carrier type.			+ (31) (46)	+ (46)	+ (46)	O				
C8a	3	The maximum power density (dB(W/Hz))[3] averaged over the worst 1 MHz band for carriers above 15 GHz, supplied to the input of the antenna for each carrier type.			+ (31) (46)	+ (46)	+ (46)	O				
C8b **[C8h 1]** **[C8i 1]**	1	The total peak envelope power (dBW) supplied to the input of the antenna tenna, averaged over the worst . For coordination/notification of an Appendix 30A earth station the values shall include the maximum range of power control. For the case of an FSS earth station, not required for coordination under No. 9.7A.			O (31) (46)	+ (46)	+ (46)	X (23) (81)	X	X		
C8b **[C8h 3]** **[C8i 3]** **[C8j 3]**	2	The maximum power density (dB(W/Hz))[3] supplied to the input of the antenna, averaged over the worst 4 kHz band for carriers below 15 GHz. For coordination/notification of an Appendix 30A earth station the values shall include the maximum range of power control. For the case of an FSS earth station, not required for coordination under No. 9.7A.			+ (31) (46)	+ (46)	+ (46)	X (23) (81)	X (54)	+	X	

[3] The most recent version of Recommendation ITU-R SF.675 should be used to the extent applicable in calculating the maximum power density per Hz.

1		2	3	4	5	6	7	8	9	10	11	12
C8b [C8i 2]	3	The maximum power density (dB(W/Hz))[3] supplied to the input of the antenna averaged over the worst 1 MHz band for carriers above 15 GHz. For coordination/notification of an Appendix 30A earth station the values shall include the maximum range of power control. For the case of an FSS earth station, not required for coordination under No. 9.7A.			+ (31) (46)	+ (46)	+ (46)	X (23) (81)		+		
C8c	1	The minimum value of the peak envelope power (dBW) supplied to the input of the antenna for each carrier type. For the case of an FSS earth station, not required for coordination under No. 9.7A.			O	+ (40)	+ (40)	+ (40) (23)				
C8c	2	The minimum power density (dB(W/Hz))[3], averaged over the worst 4 kHz band for carriers below 15 GHz supplied to the input of the antenna for each carrier type. For the case of an FSS earth station, not required for coordination under No. 9.7A.			O	+ (40)	+ (40)	+ (40) (23)				
C8c	3	The minimum power density (dB(W/Hz))[3] averaged over the worst 1 MHz band for carriers above 15 GHz, supplied to the input of the antenna for each carrier type. For the case of an FSS earth station, not required for coordination under No. 9.7A.			O	+ (40)	+ (40)	+ (40) (23)				
C8c	4	Reason for absence of the minimum value of the peak envelope power (dBW) supplied to the input of the antenna for each carrier type. For the case of an FSS earth station, not required for coordination under No. 9.7A. (40)				+	+	+ (23)				
C8c	5	Reason for absence of the minimum power density supplied to the input of the antenna for each carrier type. For the case of an FSS earth station, not required for coordination under No. 9.7A. (40)				+	+	+ (23)				
C8d	1	For a space to earth or space to space link the maximum total peak envelope power (dBW) supplied to the input of the antenna for each contiguous satellite bandwidth. For a satellite transponder, this corresponds to the maximum saturated peak envelope power. (64)				X	X					
C8d	2	For a space to earth or space to space link each contiguous satellite bandwidth. For the maximum saturated peak envelope power of the satellite transponder, this corresponds to the bandwidth of each transponder. (64)				X	X					
C8e	1	The required carrier-to-noise ratio (dB), considering clear-sky operation, for each carrier type. For the case of an FSS earth station, not required for coordination under No. 9.7A.			O	+ (40)	+ (40)	+ (40) (23)				
C8e	2	Reason for absence of the carrier-to-noise ratio. For the case of an FSS earth station, not required for coordination under No. 9.7A. (40)				+	+	+ (23)				
C8f	1	For space to space the space station's nominal equivalent isotropically radiated power(s) on the beam axis. (35)			X							

1		2	3	4	5	6	7	8	9	10	11	12
C8f	2	For space to space the associated space station's nominal equivalent isotropically radiated power(s) on the beam axis. (35)			X							
C8g	1	The maximum aggregate power (dBW) of all carriers (per transponder, if applicable) supplied to the input of the transmitting associated earth station antenna or the transmitting earth station antenna. Not required for coordination of a specific earth station under No. **9.15**, **9.17** or **9.17A**. (68)				C	C	C (44)				
C8g	2	The aggregate bandwidth of all carriers (per transponder, if applicable) supplied to the input of the transmitting associated earth station antenna or the transmitting earth station antenna. Not required for coordination of a specific earth station under No. **9.15**, **9.17** or **9.17A**. (68)				C	C	C (44)				
C8g	3	The aggregate bandwidth of all carriers (per transponder, if applicable) supplied to the input of the transmitting associated earth station antenna or the transmitting earth station antenna. If this corresponds to the bandwidth of a transponder, this shall be indicated. Not required for coordination of a specific earth station under No. **9.15**, **9.17** or **9.17A**. (68)				C	C	C (44)				
C8h												
C8h									(82)			
C8h												
C8h **[C8i 4]** **[C8j 1]**	4	the maximum power density per Hz (dB(W/Hz)), averaged over the necessary bandwidth. For the case of Appendix 30A in the band 17.3-18.1 GHz only. (71)							X (74)	X	X (55)	
C8h									(82)			
C8i		**In the case of an earth station submitted in accordance with Appendix 30A:**										
		(71)										
C8i	5	range of power control, expressed in dB, above the transmitting power indicated above (if power control is used).								X		
C8j		**In the case of a space station or an earth station submitted in accordance with Appendix 30B:**										
C8j	2	the frequency below which signals whose peak-to-average ratio is less than 5 dB will be located;									X	

1		2	3	4	5	6	7	8	9	10	11	12
C9		**INFORMATION ON MODULATION CHARACTERISTICS**										
C9a		**For each carrier, according to the nature of the signal modulating the carrier and the type of modulation:**										
C9a1	a	the lowest frequencies of the baseband; in the case of a carrier frequency modulated by a frequency-division multichannel telephony baseband (FDM/FM) or by a signal that can be represented by a multichannel telephony baseband;			O	C	C					
C9a1	b	the highest frequencies of the baseband; in the case of a carrier frequency modulated by a frequency-division multichannel telephony baseband (FDM/FM) or by a signal that can be represented by a multichannel telephony baseband;			O	C	C					
C9a1	c	the r.m.s. frequency deviation of the pre-emphasis characteristic for a test tone as a function of baseband frequency in the case of a carrier frequency modulated by a frequency-division multichannel telephony baseband (FDM/FM) or by a signal that can be represented by a multichannel telephony baseband;			O	C	C					
C9a2 [C9b3]	a	the standard of the television signal; in the case of a carrier frequency modulated by a television signal: including, where appropriate, the standard used for colour;			O	C	C		X	X		
C9a2 [C9b2 a]	b	the P-P frequency deviation of the pre-emphasis characteristic; in the case of a carrier frequency modulated by a television signal:			O	C	C		X	X		
C9a2 [C9b2 b]	c	the pre-emphasis characteristic itself; in the case of a carrier frequency modulated by a television signal:			O	C	C		X	X		
C9a2 [C9b7]	d	where applicable, the characteristics of the multiplexing of the video signal with the sound signal(s) or other signals; in the case of a carrier frequency modulated by a television signal:			O	C	C		X	X		
C9a3 [C9b9 b]	a	the bit rate; in the case of a carrier phase-shift modulated by a digital signal			O	C	C		X	X		
C9a3	b	the number of phases; in the case of a carrier phase-shift modulated by a digital signal:			O	C	C					
C9a4	a	in the case of an amplitude modulated carrier (including single sideband): as precisely as possible, the nature of the modulating signal;			O	C	C					
C9a4	b	in the case of an amplitude modulated carrier (including single sideband): as precisely as possible, the kind of amplitude modulation used;			O	C	C					
C9a5		for all other types of modulation: such particulars as may be useful for an interference study.			O	C	C					

1		2	3	4	5	6	7	8	9	10	11	12
C9a6 [C9b8 a]	a	for any type of modulation, as applicable: the characteristics of energy dispersal, such as the peak-to-peak frequency deviation.			O	C	C		X	X		
C9a6 [C9b8 b]	b	for any type of modulation, as applicable: the characteristics of energy dispersal, such as the sweep frequency (kHz) of the energy dispersal waveform.			O	C	C		X	X		
C9a6 [C9b8 c]	c	for any type of modulation, as applicable: the energy dispersal waveform.			O	C	C		X	X		
C9b		**In the case of a space station submitted in accordance with Appendix 30 or the case of a space station submitted in accordance with Appendix 30A:**										
C9b1		type of modulation;							X	X		
C9b4		sound-broadcasting characteristics;							X	X		
C9b5		frequency deviation;							X	X		
C9b6		composition of the baseband;							X	X		
C9b9	a	the effective bit rate; in the case of a carrier phase-shift modulated by a digital signal:							X	X		
C9b9	c	the symbol rate; in the case of a carrier phase-shift modulated by a digital signal:							X	X		
C9b10		roll-off factor of the filter of the receiver.							X	X		
C9c	1	the type of modulation in the case of a non-geostationary space station submitted in accordance with No. 9.11A:			(32)		X					
C9c	2	the type of multiple access. In the case of a non-geostationary space station submitted in accordance with No. 9.11A,			(32)		X					
C9c	3	the spectrum mask. In the case of a non-geostationary space station submitted in accordance with No. 9.11A.			(32)		X					
C9d		**For stations operating in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F, provide:**										
C9d	1	the type of mask;			(58)		X		(56)	(56)		
C9d	2	the pfd mask identification code.			(58)		X		(56)	(56)		
C9d	3	the space station's e.i.r.p. mask identification code.			(58)		X		(56)	(56)		
C9d	4	the associated earth station's e.i.r.p. mask identification code.			(58)		X		(56)	(56)		

1		2	3	4	5	6	7	8	9	10	11	12
C10		**TYPE AND IDENTITY OF THE ASSOCIATED STATION(S)**										
C10		**The associated station may be another space station, a typical earth station of the network or a specific earth station.**										
C10a		For an associated space station, its identity.			X	X	X					
Not in App. 4		If an associated space station is in the geostationary orbit provide its nominal longitude (41)			X	X	X					
Not in App. 4		For an associated earth station, the name by which the station is known.			X	X	X			X		
Not in App. 4		Typical/Specific indicator (42)			X	X	X			X		
C10b	1	For a specific associated earth station, the identity of the earth station (i.e. site name).			X	X	X			X		
C10b	2	For a specific associated earth station, the geographical coordinates of the antenna site.			X	X	X			X		
Not in App. 4		For a specific associated earth station the country or geographical area in which the associated earth station is located, using the symbols from the Preface to the International Frequency List; (83)			X	X	X			X		
C10c		**For an associated earth station (whether specific or typical):**										
C10c1	a	the class of station using the symbols shown in the Preface to the International Frequency List;			X	X	X			(57)	(57)	
C10c1	b	the nature of service performed, using the symbols shown in the Preface to the International Frequency List;			X	X	X			(57)	(57)	
C10c2		the isotropic gain (dBi) of the antenna in the direction of maximum radiation (see No. 1.160);			X	X	X		X (28)	X	X	
C10c3		the beamwidth in degrees between the half power points (describe in detail if not symmetrical);			O	X	X		X(28)	X	X	
C10c4	a	either the measured co-polar radiation pattern of the antenna or the reference radiation pattern;			X	X	X		X (28)	X	X	
C10c4	b	either the measured cross-polar radiation pattern of the antenna or the reference radiation pattern;							X (28)	X		
C10c5		the lowest total receiving system noise temperature, in kelvins, referred to the output of the receiving antenna of the earth station under clear-sky conditions, when the associated station is a receiving earth station;			X	X	X				X	
C10c6		the antenna diameter (metres).								X		
Not in App. 4		Equivalent Antenna Diameter							X (28)			
C11		**SERVICE AREA**										

1		2	3	4	5	6	7	8	9	10	11	12
C11a [C11b] [C11c 2]	1	The service area or areas of the satellite beam on the Earth, when the associated transmitting stations are earth stations. In the case of a space station submitted in accordance with Appendix 30A or 30B, the feeder-link service area identified by a set of a maximum of twenty test points and by a service area contour on the surface of the Earth or defined by a minimum elevation angle. For advance publication of satellite networks subject to coordination, only the list of country or geographic designators or a narrative description of the service area shall be supplied.	X (49)	X (49)	X	X	X			X	X	
C11a [C11c 1]	2	The service area or areas of the satellite beam on the Earth, when the associated receiving stations are earth stations. In the case of a space station submitted in accordance with Appendix 30 or Appendix 30B, the service area identified by a set of a maximum of twenty test points and by a service area contour on the surface of the Earth or a service area defined by a minimum elevation angle (Rev.WRC-97). For advance publication of satellite networks subject to coordination, only the list of country or geographic designators or a narrative description of the service area shall be supplied.	X (49)	X (49)	X	X	X		X		X	
		twenty feeder-link test points,										
C11d		In the case of a non-geostationary space station submitted in accordance with No. 9.11A, appropriate information required to calculate the affected region due to the MSS space stations (as defined in Recommendation ITU-R M.1187).					X					
C12		**REQUIRED PROTECTION RATIO**										
C12		The minimum acceptable aggregate carrier-to-interference ratio, if less than 26 dB. The carrier-to-interference ratio is to be expressed in terms of the power averaged over the necessary bandwidth of the modulated wanted and interfering signals, assuming both the desired carrier and interfering signals have equivalent bandwidths and modulation types.									X	
C13		**CLASS OF OBSERVATIONS**										
C13		The class of observations to be taken on the frequency band shown in item C.3 b). Class A observations are those in which the sensitivity of the equipment is not a primary factor. Class B observations are those of such a nature that they can be made only with advanced low-noise receivers using the best techniques.										X
C15		**DESCRIPTION OF THE GROUP(S) REQUIRED IN THE CASE OF NON-SIMULTANEOUS EMISSIONS**										
C15		If an exclusive operation group its identification code							X	X		

1		2	3	4	5	6	7	8	9	10	11	12
Items in Appendix	**Extra code field**	**Data Description**	**Advance publication of a geostationary-satellite network**	**Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9**	**Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9**	**Notification or coordination of a geostationary-satellite network (75)**	**Notification or coordination of a non-geostationary-satellite network**	**Notification or coordination of an earth station (including notification under Appendices 30A and 30B) (76)**	**Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (77)**	**Notice for a satellite network (feeder-link) under Appendix 30A (78)**	**Notice for a satellite network in the fixed satellite service under Appendix 30B (Articles 6 and 8) (75)**	**Radio astronomy**
D		**OVERALL LINK CHARACTERISTICS**										
		To be provided only when simple frequency-changing transponders are used on the space station onboard a geostationary satellite. In the case of fixed-satellite service networks using the frequency bands specified in No. **9.7** (GSO/GSO) of Table 5-1 of Appendix **5**, (§§ 1), 2) and 3) of the frequency band column), the data specified in this section of the Appendix is not mandatory and should not be submitted to the Bureau.										
D1		**CONNECTION BETWEEN EARTH-TO-SPACE AND SPACE-TO-EARTH FREQUENCIES IN THE NETWORK**										
		To be provided only when simple frequency-changing transponders are used on the space station onboard a geostationary satellite. In the case of fixed-satellite service networks using the frequency bands specified in No. **9.7** (GSO/GSO) of Table 5-1 of Appendix **5**, (§§ 1), 2) and 3) of the frequency band column), the data specified in this section of the Appendix is not mandatory and should not be submitted to the Bureau.										
D1		The connection between uplink and downlink frequency assignments in each transponder for each intended combination of receiving and transmitting beams. Required for the case of Appendices 30 and 30A in Region 2.				X			X (28)	X (28)		
D2		**TRANSMISSION GAINS AND ASSOCIATED EQUIVALENT SATELLITE LINK NOISE TEMPERATURES**										
D2		**For each entry under D.1:**										
D2a	1	The lowest equivalent satellite link noise temperature. These values shall be indicated for the nominal value of the angle of elevation.				X						

1		2	3	4	5	6	7	8	9	10	11	12
D2a	2	The associated transmission gain of the lowest equivalent satellite link noise temperature. These values shall be indicated for the nominal value of the angle of elevation. The transmission gain is evaluated from the output of the receiving antenna of the space station to the output of the receiving antenna of the earth station.				X						
D2b	1	The values of transmission gain that correspond to the highest ratio of transmission gain to equivalent satellite link noise temperature.				X						
D2b	2	The values of associated equivalent satellite link noise temperature that corresponds to the highest ratio of transmission gain to equivalent satellite link noise temperature.				X						

Table Notes

Explanation of changes to Annexes 2A and 2B to RR Appendix 4

(1) Not used.

(2) Not used.

(3) Explanation: currently combined with the earth station antenna's name which can apply to both specific and typical antenna and shown in RR Appendix 4 as mandatory: the name of the locality only applies to a specific earth station.

(4) Addition: currently not listed in RR Appendix 4: this data item is required on the notice forms and is supplied with the notifying administration's name.

(5) Addition: currently not listed in RR Appendix 4: this data item is required for notification under Article 8 of RR Appendix 30 B - see BR Circular Letter CR/158c1.

(6) Addition: currently not listed in RR Appendix 4: the notifying administration's correspondence address is required for the special section relating to the advance publication.

(7) Addition: currently not listed in RR Appendix 4: this data item is required for RR Appendix 30B - see BR Circular Letter CR/158.

(8) Modification: currently shown as mandatory in RR Appendix 4: at WRC-97 the requirement for this data item was changed to optional.

(9) Addition: currently not listed in RR Appendix 4: this data item is required for RR Appendix 30B when the satellite network is not derived from the Allotment Plan - see BR Circular Letter CR/158.

(10) Comment: currently shown as mandatory in RR Appendix 4: this data item listed under A.4.b.1 is duplicated for non-geostationary satellites subject to No. 9.11A to the RR as the identical data is recorded under A4b5.

(11) Comment: currently shown as mandatory in RR Appendix 4: this data item is not necessary for non-geostationary satellites subject to No. 9.11A as more detailed data supplied under A4b5 makes it superfluous.

(12) Addition: currently not listed in RR Appendix 4: this data item is required on the notice forms and is used in non-geostationary satellite network filings for identifying the reference body on which the orbit characteristics are based.

(13) Not used.

(14) Addition: currently not listed in RR Appendix 4 for advance publication: this data item is required on the notice forms, including for non-geostationary networks not subject to coordination under Section II of Article 9 as they may operate in one or more orbital planes.

(15) Comment: currently not listed in RR Appendix 4 for notification of non-geostationary networks not subject to coordination under Section II of Article 9: the requirement for this data item is based on Note (14) and would then be required for confirmation of any changes from the advance publication stage.

(16) Not used.

(17) Deletion: the requirement for this data item was deleted at WRC-2000: - see BR Circular Letter CR/158c1.

(18) Not used.

(19) Modification: currently shown as mandatory in RR Appendix 4: the assigned frequency is the mandatory requirement and the channel number is only optional.

(20) Deletion: the requirement for this data item was deleted at WRC-97: - see BR Circular Letter CR/158.

(21) Modification: the requirement for cross-polar gain does not apply to Appendix 30B and the RR Appendix 4 footnote quoted in table note (69) should also apply to Ap. 4 data item B3g1 - see BR Circular Letter CR/158.

(22) Deletion: currently listed as mandatory in RR Appendix 4: the regulatory provision does not apply to non-geostationary space stations.

(23) Modification: currently listed in RR Appendix 4 with the footnote "Not required for coordination under No. 9.7A or 9.7B"; however, 9.7B applies to non-geostationary satellite systems and not to earth stations hence the footnote should read, "Not required for coordination under No. 9.7A".

(24) Deletion: currently listed as mandatory in RR Appendix 4: the regulatory provision only applies to the space station and is therefore not required for notification of earth stations.

(25) Not used.

(26) Addition: currently not listed in RR Appendix 4: this data item is required for Appendix 30B if part of a sub-regional system - see BR Circular Letter CR/158.

(27) Comment: this data item is requested to be included within the plots of antenna contours.

(28) Addition: currently not listed in RR Appendix 4: the requirement for this data item was added at WRC-97 - see BR Circular Letter CR/158.

(29) Not used.

(30) Explanation: alignment with RR Appendices 30 and 30A - see BR Circular Letter CR/158.

(31) Explanation: currently listed in RR Appendix 4 with the footnote "Only the value of maximum power density is mandatory".

(32) Deletion: currently listed in RR Appendix 4 as mandatory: this data item was inadvertently added at WRC-97 and the information to which it refers is only applicable to non-geostationary satellites subject to coordination under Section II of Article 9. The RRB have issued a Rule of Procedure that states "the Bureau, in the completeness examination of the submitted data, will disregard the requirement for the characteristics B.4.b and C.9.c in the case of the advance publication of those non-GSO satellite systems which are not subject to the coordination procedures of Section II of Article 9". Therefore it is proposed that this data should be deleted from RR Appendix 4.

(33) Not used.

(34) Comment: in Appendix 30/30A circular polarization is defined as viewed in the direction of propagation. In RR Appendix 4 Circular Polarization is defined as viewed from the satellite. In the Preface to the IFL, both circular polarization and linear polarization are quoted as viewed in the direction of propagation. This is likely to cause confusion with the possible swapping of co/cross polarization during the notification process.

(35) Explanation: currently listed in RR Appendix 4 with the footnote "For space-to-space relay only": this text is now included in the description.

(36) Modification: currently listed as mandatory in RR Appendix 4: this data item is only required for sub-regional systems.

(37) Modification: currently shown as required for coordination in RR Appendix 4 with a footnote that states "only the total peak envelope power is required for coordination under Nos. 9.15, 9.17 and 9.17A": this statement is incorrect and should refer to the maximum peak envelope power.

(38) Modification: currently listed as mandatory in RR Appendix 4: this data item is only required in specific cases (e.g. when communicating with geostationary space stations).

(39) Not used.

(40) Explanation: currently listed in RR Appendix 4 with the footnote "Required, if applicable, for the type of transmission. If not applicable, a reason why it is not applicable is required": this text is now separately listed under the respective data item.

(41) Addition: currently not listed in RR Appendix 4: this data item is required if the associated space station is in the geostationary orbit.

(42) Addition: currently not listed in RR Appendix 4: this data item is included to identify if the associated earth station is typical or specific.

(43) Modification: currently shown as mandatory in RR Appendix 4: this regulatory provision and Resolution 33 only apply to the Broadcasting-Satellite Service, where it is not subject to a plan.

(44) RR Appendix 4, footnote: "Not required for coordination under Nos. **9.15**, **9.17** or **9.17A**."

(45) Not used.

(46) RR Appendix 4, footnote: "One or the other of C.8.a or C.8.b is mandatory, but not both."

(47) Not used.

(48) Not used.

(49) RR Appendix 4, footnote: "Only the list of country or geographic designators or a narrative description of the service area shall be supplied."

(50) Deletion: currently listed as mandatory in RR Appendix 4: the Radiocommunication Bureau propose to align this data with the Appendix 30A data requirements listed in A1c - see BR Circular Letter CR/158.

(51) Addition: currently not listed in RR Appendix 4: the Radiocommunication Bureau propose to align with Appendix 30A data requirements listed in A1c - see BR Circular Letter CR/158.

(52) Deletion: currently listed with circular beams in RR Appendix 4: the Radiocommunication Bureau propose to align with non-plan services where circular beams are recognized as special form of elliptical beam - see BR Circular Letter CR/158.

(53) RR Appendix 4, footnote: "In the case of coordination under No. 9.7A, the reference radiation pattern is to be provided".

(54) Addition: currently not listed in RR Appendix 4 - deleted at WRC-2000: the Radiocommunication Bureau state this data item is still required for checking the pfd limits of Section 4 Annex 1 to RR Appendix 30 - see BR Circular Letter CR/158.

(55) Explanation: this value will be used for calculation of the C and D parameters in the case of a transmitting space station or the A and B parameters in the case of a transmitting earth station, under RR Appendix 30B, Annex 1, Section B - see BR Circular Letter CR/158.

(56) Deletion: currently listed as mandatory in the Final Acts WRC-2000: this data item only applies to non-geostationary systems and is not applicable to the BSS Plan - see BR Circular Letter CR/158.

(57) Deletion: currently listed as mandatory in RR Appendix 4: the Radiocommunication Bureau propose to align with data requirements of RR Appendices 30/30A/30B - see BR Circular Letter CR/158.

(58) Deletion: currently listed as mandatory in RR Appendix 4: this data item only applies to non-geostationary systems subject to No. 9.11A and is not applicable to non-geostationary systems not subject to Section II of Article 9 - see BR Circular Letter CR/158.

(59) Modification: currently listed in RR Appendix 4 with the following footnote "Not required for coordination under No. 9.7A or 9.7B"; this statement is incorrect as the country symbol of the notifying administration is always mandatory.

(60) Modification: In the Final Acts to WRC-2000, RR Appendix 4 references in Item A17a provision No. 5.444C, this reference is incorrect and should, instead, refer to No. 5.443B "*Additional allocation:* The band 5 010-5 030 MHz is also allocated to the radionavigation-satellite service (space-to-Earth) (space-to-space) on a primary basis. In order not to cause harmful interference to the microwave landing system operating above 5 030 MHz, the aggregate power flux-density produced at the Earth's surface in the band 5 030-5 150 MHz by all the space stations within any radionavigation-satellite service system (space-to-Earth) operating in the band 5 010-5 030 MHz shall not exceed -124.5 dB (W/m^2) in a 150 kHz band. In order not to cause harmful interference to the radio astronomy service in the band 4 990-5 000 MHz, the aggregate power flux-density produced in the 4 990-5 000 MHz band by all the space stations within any radionavigation-satellite service (space-to-Earth) system operating in the 5 010-5 030 MHz band shall not exceed the provisional value of -171 dB (W/m^2) in a 10 MHz band at any radio astronomy observatory site for more than 2% of the time. For the use of this band, Resolution **604 (WRC-2000)** applies."

(61) Addition: Neither No. 5.443B nor Resolution **604 (WRC-2000)** limit the application of this data item to non-geostationary space networks and as the pfd limits apply to out-of-band emissions it is not possible for potentially affected administrations to calculate the aggregate pfd value hence, this

data item has been added to the requirements for RNSS geostationary space networks - see BR Circular Letter CR/171.

(62) Addition: Neither No. 5.551G nor Resolution **128 (WRC-2000)** limit the application of this data item to non-geostationary space networks and as the pfd limits apply to out-of-band emissions it is not possible for potentially affected administrations to calculate the aggregate pfd value hence, this data item has been added to the requirements for FSS and BSS geostationary space networks - see BR Circular Letter CR/171.

(63) Addition: Neither No. 5.328A nor Resolution **605 (WRC-2000)** limit the application of this data item to non-geostationary space networks and as the pfd limits are aggregated across all space stations it is not possible for potentially affected administrations to calculate the aggregate pfd value hence, this data item has been added to the requirements for RNSS geostationary space networks.

(64) Explanation: currently listed in RR Appendix 4 with the footnote "For transmission from the space station only": the text has been added to the description.

(65) Deletion: there appears to be no requirement for this data item to be associated with this type of mask.

(66) Not used.

(67) Not used.

(68) Explanation: currently listed in RR Appendix 4 with the footnote "For transmission from the earth station only": the text has been added to the description.

(69) Explanation: currently listed in RR Appendix 4 with the footnote "Only information on co-polar antenna characteristics is required".

(70) Deletion: currently listed in RR Appendix 4 as mandatory: this data item used to be listed as B3g6 which only applied to Appendix 30A; at WRC-2000 it was merged into B3g5 which applies to both RR Appendix 30 and 30A however the requirement for this data item is still limited to Appendix 30A.

(71) Modification: currently listed with the RF bandwidth shown as (24 MHz For Region 2 or 27 MHz for Regions 1 and 3): however the bandwidth may not conform to these specified limits and the power density averaged over the total bandwidth is required.

(72) RR Appendix 4, footnote: "required for networks operating in the bands defined in Nos. **22.5C**, **22.5D** or **22.5F**".

(73) Modification: currently listed as mandatory in RR Appendix 4: the regulatory provision only applies to FSS earth stations operating in frequency bands in the Appendix 30A Plan.

(74) Addition: noting Table Note 71 and the introduction of strapping for Region 2 this data item may also be required for RR Appendix 30 in Region 2.

(75) Modification: Plan modification, coordination and notification for FSS systems under RR Appendix 30B are all performed using the data requirements under column 11 "Notice for a satellite network in the fixed satellite service under Appendix 30B (Articles 6 and 8)" - see BR Circular Letter CR/158c1.

(76) Modification: notification of an earth station operating in the BSS feeder-link plan or the FSS plan is performed using the data requirements under column 8 headed "Notification or coordination of an earth station (including notification under Appendices 30A and 30B)" - see BR Circular Letter CR/158c1.

(77) Modification: Plan modification, coordination and notification for BSS systems under RR Appendix 30 are all performed using the data requirements under column 9 headed "Notice for a satellite network in the broadcasting satellite service under Appendix 30" - see BR Circular Letter CR/158c1.

(78) Modification: Plan modification, coordination and notification for BSS feeder links under RR Appendix 30A are all performed using the data requirements under column 10 headed "Notice for a satellite network (feeder-link) under Appendix 30A" - see BR Circular Letter CR/158c1.

(79) Not used.

(80) Modification: noting Table Note 75, the information only relates to sub-regional systems and is now required under column 11 headed "Notice for a satellite network in the FSS under Appendix 30B (Articles 6 and 8)".

(81) Modification: for earth stations under the BSS Appendix 30A Plan these values shall include the maximum range of power control - see BR Circular Letter CR/158c1.

(82) Deletion: discussions with the BR indicate that the maximum power density over the worst 5 MHz, and the maximum power density over the worst 40 kHz are no longer required.

(83) Addition: currently not listed in RR Appendix 4: this data item is required on the notice forms.

(84) Addition: currently not listed in RR Appendix 4: this data item is required following revision of the Radio Regulations.

Existing RR Footnotes

The footnotes to Annex 2B to Appendix 4 are shown below. Following the changes to the table and its contents these footnotes are no longer required as indicated by the text in italic font. The figure in parenthesis identifies the relevant table note.

1 Only the value of maximum power density is mandatory.
The separation of the compound data elements in C8a and C8b into individual components allows the footnote to be deleted. (31)

2 For transmission from the space station only.
The text has been added to the description so the footnote could be deleted. (64)

3 For space-to-space relay only.
The text has been added to the description so the footnote could be deleted. (35)

4 For transmission from the earth station only.
The text has been added to the description so the footnote could be deleted. (68)

5 Not required for coordination under Nos. **9.15**, **9.17** or **9.17A**.
The text has been added to the description so the footnote could be deleted. (44)

6 Required, if applicable, for the type of transmission. If not applicable, a reason why it is not applicable is required.
The text of the footnote has been added to the table as a separate data element under C8c and C8e and so the footnote could be deleted. (40)

7 One or the other of C.8.a or C.8.b is mandatory, but not both.
The mandatory indicatory associated with these data elements has been changed to "+" which represents "mandatory under specified conditions" and so the footnote could be deleted. (46)

8 Only the value of total peak envelope power is required for coordination under Nos. **9.15**, **9.17** or **9.17A**.
The meaning of this text needs to be confirmed and then the description of the data could be modified so the footnote could be deleted. (37)

9 Only information on co-polar antenna characteristics is required.
The separation of the compound data elements into individual components allows the footnote to be deleted. (69)

10 Only the list of country or geographic designators or a narrative description of the service area shall be supplied.
The text has been added to the description so the footnote could be deleted. (49)

11 Not required for coordination under No. **9.7A** or **9.7B**.
The text has been added to the description so the footnote could be deleted. (23)

12 In the case of coordination under No. **9.7A**, the reference radiation pattern is to be provided.
The text has been added to the description so the footnote could be deleted. (53)

13 Required for networks operating in the bands defined in Nos. **22.5C**, **22.5D** or **22.5F**.
The text has been added to the description so the footnote could be deleted. (72)

Annex 3.4.1-4

Example of a revised structure for non-geostationary orbit parameters in Appendix 4

Characteristics to be submitted for stations in the space and radio astronomy services

1		2	3	4	5	6	7	8	9	10	11	12
Items in Appendix	**Extra code field**	**Data Description**	**Advance publication of a geostationary-satellite network**	**Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9**	**Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9**	**Notification or coordination of a geostationary - satellite network (75)**	**Notification or coordination of a non-geostationary-satellite network**	**Notification or coordination of an earth station (including notification under Appendices 30A and 30B) (76)**	**Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (77)**	**Notice for a satellite network (feeder-link) under Appendix 30A (78)**	**Notice for a satellite network in the fixed satellite service under Appendix 30B (Articles 6 and 8) (75)**	**Radio astronomy**
A4b		**For the case of space station(s) onboard non-geostationary satellite(s):**										
A4b – bis [A4b5 a]		number of orbital planes;		X (14)	X (14)		X (15)					
A4b – ter [A4b5 b]		number of satellites in each orbital plane;		X	X		X					
A4b1 [A4b5 d]		the angle of inclination of each orbital plane;		X	X		X					
		In addition for advance publication of non-geostationary satellite(s) and notification of stations not subject to coordination under Section II of Article 9.										
A4b2		the period;		X	X		X (11)					
A4b3	a	the altitude in kilometres of the apogee of the space station(s);		X	X		X (11)					
A4b3	b	the altitude in kilometres of the perigee of the space station(s);		X	X		X (11)					
Not in Ap. 4		Reference body code (12)		X	X		X					

1		2	3	4	5	6	7	8	9	10	11	12
A4b5		**In addition, if the stations operate in a frequency band subject to the provisions of No. 9.11A: data elements required to characterize properly the orbital statistics of non-GSO satellite systems:**										
A4b5 Ω_j	c	right ascension of the ascending node for the j-th orbital plane, measured counter-clockwise in the equatorial plane from the direction of the vernal equinox to the point where the satellite makes its South-to-North crossing of the equatorial plane ($0° \leq \Omega_j < 360°$);					X					
		'										
A4b5 ω_i	e	initial phase angle of the i-th satellite in its orbital plane at reference time t = 0, measured from the point of the ascending node ($0° \leq \omega_i < 360°$);					X					
A4b5 α	f	semi-major axis;					X					
A4b5 e	g	eccentricity ($0 \leq e < 1$);					X					
A4b5 ω_p	h	argument of perigee, measured in the orbital plane, in the direction of motion, from the ascending node to the perigee ($0° \leq \omega_p < 360°$).					X					
X - Mandatory; + Mandatory under specified conditions; O - Optional; C - Mandatory if used as a basis to effect coordination with another administration												

See Annex 2 for a description of the table structure and presentation.

Table Notes

Explanation of changes to Annexes 2A and 2B to RR Appendix 4

(11) Comment: currently shown as mandatory in RR Appendix 4: this data item is not necessary for non-geostationary satellites subject to No. 9.11A as more detailed data supplied under A4b5 makes it superfluous.

(12) Addition: currently not listed in RR Appendix 4: this data item is required on the notice forms and is used in non-geostationary satellite network filings for identifying the reference body on which the orbit characteristics are based.

(13) Not used.

(14) Addition: currently not listed in RR Appendix 4 for advance publication: this data item is required on the notice forms, including for non-geostationary networks not subject to coordination under Section II of Article 9 as they may operate in one or more orbital planes.

(15) Comment: currently not listed in RR Appendix 4 for notification of non-geostationary networks not subject to coordination under Section II of Article 9: the requirement for this data item is based on Note (14) and would then be required for confirmation of any changes from the advance publication stage.

#########

3.4.2 Automation of examination of space filings for compliance with RR Article 5

3.4.2.1 Summary of technical and operational studies

The ITU-R has examined automation of the regulatory examination for checking compliance with the RR Table of Frequency Allocations and the footnotes thereto.

3.4.2.2 Analysis of the results of studies

Contributions from administrations and Sector Members, as well as information provided by the Bureau, have provided sufficient material for the development of a draft Recommendation. This Recommendation contains the specification for automating the examination for compliance with the provisions of RR Article 5. These examinations are carried out by the Bureau in its processing of satellite network coordination requests and notifications, as well as by administrations in their preparation of space filings. The ITU-R work does not address specifications for automating those functions that are already implemented by existing BR software modules.

3.4.2.3 Regulatory and procedural considerations

The efforts to specify an automation of Article 5 examination do not seek to modify the Radio Regulations, but simply to automate existing manual processes. There is, therefore, no need for WRC-03 to introduce any new regulations in this regard. However, the specification contained in the draft Recommendation, and the related databases, may require systematic review and possible updating to reflect changes to Article 5 of the Radio Regulations based on Conference decisions.

#########

3.4.3 FSS earth stations deployed in large numbers

3.4.3.1 Summary of technical and operational studies

The purpose of studies is to address the regulatory situation of the FSS systems deploying large numbers of earth stations in respect of terrestrial services or earth stations operating in the opposite direction of transmission, which may involve the use of typical earth stations as opposed to specific earth stations.

3.4.3.2 Analysis of the results of studies

3.4.3.2.1 Coordination between satellite networks in co-directional frequency bands

In the framework of the coordination between satellite networks (e.g. under No. **9.7**), administrations may send notices to the Bureau relating to typical earth stations located anywhere within the service area of the satellite network. Successful coordination of the satellite network and its subsequent notification and recording in the Master Register will in this case result in the protection of these earth stations from interference caused by other satellite networks operating in the same direction of transmission. As a consequence, the protection of typical earth stations, with respect to satellite networks in co-directional frequency bands, is by the satellite network coordination, notification and recording.

3.4.3.2.2 Coordination and notification of typical FSS earth stations with respect to terrestrial services

Under the present regulatory provisions, where coordination is required, the coordination of FSS typical earth stations is generally not permitted (Nos. **9.17**, **9.17A**), and whilst this coordination can be conducted with FSS typical earth stations in some cases (No. **9.15**), the notification and recording of such FSS typical earth stations is in any case precluded by Article **11**.

3.4.3.2.3 Coordination and notification of typical MSS earth stations

Mobile earth stations are by nature typical and therefore their regulatory situation may be of interest for the development of possible provisions for typical FSS earth stations. With respect to terrestrial services, MSS earth stations may be coordinated, notified and recorded as typical earth stations. This is possible at the notification stage (Article **11**), because No. **11.17** exempts mobile earth stations from the need to be notified on the basis of specific notices, which is understood as allowing notification of typical mobile earth stations.

In respect of earth stations operating in the opposite direction of transmission, No. **9.17A** precludes the coordination of typical MSS earth stations.

3.4.3.2.4 Conclusion of the analysis

Because the status of assignment to earth stations in respect of terrestrial stations or earth stations operating in the opposite direction of transmission is derived from the application of the relevant coordination procedure (No. **8.3**), the conclusion is that, under the current regulatory provisions, where coordination among earth stations and terrestrial stations is required (i.e. Appendix 5, Table 5-1 is triggered):

- receiving FSS earth stations may not be ensured to be protected from harmful interference from terrestrial stations or earth stations operating in the opposite direction of transmission unless coordination, notification and recording are conducted for specific earth stations;
- transmitting FSS earth stations will have to take steps to eliminate harmful interference caused to existing and future terrestrial or earth stations operating in the opposite direction of transmission unless coordination, notification and recording are conducted for specific earth stations;
- the coordination, notification and recording of typical mobile earth stations is currently possible in frequency bands shared on an equal basis between the MSS and terrestrial services;

- with respect to terrestrial networks or earth stations operating in the opposite direction of transmission, protection may be achieved, in the absence of any applicable provisions in the Radio Regulations, through bilateral agreements between the administrations using typical earth stations as a basis.

Should a large number of FSS earth stations be deployed, their coordination, notification and recording as specific earth stations (i.e. on a site-by-site basis for all earth stations) may result in a rather long process.

3.4.3.3 Methods to satisfy the agenda item and their advantages and disadvantages

Method A

No change to the Radio Regulations.

Advantage:

This method would keep the current relation of sharing between FSS and terrestrial services, allowing to take due account of the actual and expected (within the next 3 years) terrestrial deployment and of the geographical situation.

Disadvantage:

Applying the procedure for specific earth stations to a large number of FSS earth stations may be a long process.

Other considerations:

It was noted, that the interfering situation between typical earth stations and mobile service deployment is not entirely different, than the interference situation between the mobile networks of the two administrations. This later situation is, however, currently handled on a bilateral basis, outside the scope of the RR.

The existing Radio Regulations **9.17**, **9.17A**, and **9.18** call for the coordination of specific stations in the FSS and FS for bands allocated above 100 MHz with equal rights to these services. Both of these services are implementing large numbers of stations in certain frequency bands and the current requirement to coordinate specific stations for these services is likely to result in a rather long process. An option in the Radio Regulations permitting, subject to the agreement of concerned administrations, the coordination of typical stations as an alternative to specific site coordination of every station for these services could help to reduce the potentially long process associated with site-by-site coordination in these cases. Possible solutions to this situation were discussed within ITU-R.

Under one concept presented, countries that are adjacent to each other and in the service area of a particular satellite network could conduct coordination on the basis of typical earth stations or typical stations when they are implementing high-density applications of the FSS and/or FS in certain specific allocations. The possibility of permitting such coordination would be introduced in Article 9 (**9.17**, **9.17A** and **9.18**) and would be conditioned upon the explicit agreement of the administrations involved. Further, under this concept, upon completion of a coordination agreement, countries involved in such coordinations would send notices to BR for annotating the satellite network notification with which the satellite earth terminals would operate, and changes would be made to Article 11 to allow the Radiocommunication Bureau to accept the notification of these agreements. Such notifications would be the responsibility of the administration on whose territory the terminals are located and which were involved in the coordination.

As related to the concept of coordination of typical stations, an alternative concept that was suggested was to consider modifying provision **9.50.1** to allow, based upon the agreement between the concerned administrations, coordination to be done on a typical basis for the FSS and FS in those cases where an administration is deploying many stations that would need to be coordinated. This would be analogous to the case in **9.50.1** where, in the absence of specific provisions in the Regulations relating to the evaluation of interference, the methods and criteria to be used can be agreed between the administrations concerned. As a second alternative concept in this area, it was suggested that some changes to Appendix 5 may allow the flexibility sought in coordinating large numbers of typical stations over a given geographical area.

During the course of discussion on this topic, it was pointed out that the notification of typical stations in relation to terrestrial stations and earth stations operating in the opposite direction of transmission could create a number of other complexities within the Radio Regulations. Given the need to resolve this situation, administrations are encouraged to consider the details of any solutions and submit relevant proposals to WRC-03.

Method B

Modifications of the Radio Regulations to provide for typical FSS earth stations a regulation similar to typical mobile earth stations. On this basis, the coordination area around these types of earth stations could be determined by a new methodology, which would be incorporated into Appendix 7.

Advantage:

This would address the need to provide protection to FSS earth stations deployed in large numbers, or to terrestrial stations as appropriate, and avoid the situation where such stations would have to be coordinated and/or notified as specific earth stations or operate on a "non-interference" or "non-protected" basis.

Disadvantages:

- This change in the provisions of the Radio Regulations would modify the current regulatory situation of band sharing between services in Article 5 of the Radio Regulations in favour of one service and may need reciprocal change for the other services so as to ensure a balanced situation.
- After an administration has coordinated, notified and recorded typical FSS earth stations, coordination of a specific terrestrial station or earth station operating in the opposite direction of transmission by a neighbouring administration is likely to be difficult. This could impose significant restriction for this administration in its terrestrial deployment, in particular with regard to mobile networks, whose stations use omni-directional antennas.
- This method is based on the provisions applicable to MSS earth stations, however, it should be noted that most uplink MSS bands are shared with terrestrial services only to a very limited extent because coordination between MSS earth stations and terrestrial services is difficult in practice.

Other considerations:

It was noted, that the interfering situation between typical earth stations and mobile service deployment is not entirely different, and may not be more constraining to the mobile service than the interference situation between the mobile networks of the two administrations. This later situation is, however, currently handled on a bilateral basis, outside the scope of the RR.

#########

3.4.4 BSS frequency bands not subject to Appendix 30

3.4.4.1 Summary of technical and operational studies

Protection of unplanned receive BSS earth stations against interference caused by terrestrial or FSS transmit earth stations operating in the opposite direction of transmission is ensured by No. **9.19** and its associated method for determining the need for a coordination (i.e. pfd limit at the edge of the BSS service area). The purpose of this study is to clarify the possibility of applying No. **9.19** to BSS receive earth stations other than on a case by case basis (i.e. using specific BSS earth stations) on BSS frequency bands not subject to Appendix **30**.

3.4.4.2 Analysis of the results of studies

The only coordination procedure where typical earth stations may be taken into account is No. **9.19**. However, No. **9.19** can only be applied to protect BSS earth stations if the symmetrical coordination procedure has been started to start establishing the rights of the BSS earth station for protection against terrestrial stations, i.e. if No. **9.17** has been started. Since No. **9.17** only refers to specific earth stations, this means No. **9.19** cannot be applied on a typical BSS earth station basis.

In all cases, at the notification stage (Article **11**), Nos. **11.22.1** and **11.22.2 specify that** individual notices of frequency assignments (i.e. notices relating to specific earth stations, as opposed to typical earth stations) are required for frequency bands allocated with equal rights

- to terrestrial and space services where coordination is required under Appendix **5**, Table 5-1;
- to space services, in the opposite direction of transmission, where coordination is required under Appendix **5**, Table 5-1.

In summary, it appears that under the present regulatory provisions, this coordination cannot be conducted with typical earth stations. In addition, the notification and recording of such typical earth stations in these cases is precluded by Article **11**.

However, in the framework of the coordination between satellite networks (e.g. under Nos. **9.7**, **9.12**, **9.12A** and **9.13**), administrations may send notices to the Bureau relating to typical earth stations located anywhere within the service area of the satellite network. Successful coordination of the satellite network and its subsequent notification and recording in the Master Register will in this case result in the protection or international recognition of these earth stations in relation to the interference they may cause to or receive from other satellite networks operating in the same direction of transmission.

3.4.4.3 Methods to satisfy the agenda item and their advantages and disadvantages

Method A

Protection/recognition of typical BSS earth stations in respect of terrestrial stations or in respect of earth stations operating in the opposite direction of transmission, may be covered, in the absence of any applicable provisions in the Radio Regulations, by bilateral agreements which may be established between the administrations concerned, on the basis of typical earth stations.

Method B

The coordination, notification and recording of typical mobile earth stations is currently possible in frequency bands shared on an equal basis between the MSS and terrestrial services. This example may offer a possible solution to the difficulties identified by ITU-R. Extending this solution to the case of BSS typical earth stations in respect to terrestrial service or in respect to FSS earth stations operating in the opposite directions of transmission requires further study.

While it is noted that such coordination of at least one MSS system was reported by the BR to have been successfully completed, it was also noted that the given example was related to a geographical location where, given the particular frequency and the sparsely populated geographical location, the number of fixed links was very limited.

The solution envisaged could be further studied, however, it was noted that the current band sharing in RR Article 5 is based on regulations allowing a balanced access to the spectrum by different services in adjacent administration's territories. As a consequence, any significant change in the provisions of the RR that would break this balanced situation in favour of one service would need reciprocal change for the other services so as to find a new balanced situation. In that respect, it was suggested that if coordination procedure with typical BSS earth stations were to be developed, the possibility for terrestrial services, and in particular for the FS, that terrestrial stations be also coordinated and notified on a typical basis be investigated.

It was noted by some administrations that Method B would not theoretically exclude the terrestrial services in a zone, from the border, inside an administration territory *A,* which is close to an administration *B* which had coordinated and notified typical BSS earth stations in its whole territory. The administration *A* could still attempt to coordinate and notify specific terrestrial stations. It was however noted that such a coordination of a specific terrestrial station with an administration *B*'s typical BSS earth station could impose significant restriction for administration A in its terrestrial deployment.

3.4.4.4 Regulatory and procedural considerations

ITU-R noted that, for the coordination of terrestrial stations or FSS transmit earth stations under No. **9.19** in respect of typical BSS earth stations, Section 1.4.5 of Appendix **7** already specifies how the coordination area method should be applied in respect of the protection of typical BSS earth stations. It was also noted however, that this provision was not currently enabled since Appendix **7** is not called by Appendix **5** in respect of No. **9.19**. Instead, Appendix **5** refers to protection of BSS earth stations by a pfd limit at the edge of the BSS service area.

3.4.5 Review of Resolution 49

3.4.5.1 Summary of technical and operational studies

The Conference Preparatory Meeting (CPM) considered input documents relating to work by the ITU-R on possible modifications to Resolution 49.

3.4.5.2 Analysis of the results of studies

The CPM reviewed Resolution 49 (WRC-2000) and expressed two views. One view was that Resolution 49 (WRC-2000) has not been efficient in addressing the problem of reservation of orbit and spectrum capacity without actual use. Another view was that sufficient time has not passed to adequately evaluate the effectiveness of this Resolution.

Two methods were identified:

Method A

No change to Resolution 49.

Method B

Modify Annex 2 to Resolution 49 so that it is clearly specified that the frequency range(s) for the frequency assignments of the satellite network that have to be provided by the administrations are the ones that are intended to be brought into use in the space station in conformity with the Radio Regulations.

MOD

ANNEX 2 TO RESOLUTION 49 (REV.WRC-2000)

A Identity of the satellite network

a) Identity of the satellite network

b) Name of the administration

c) Country symbol

d) Reference to the advance publication information or to the request for modification of the Region 2 Plan or for additional uses in Regions 1 and 3 under Appendices **30** and **30A**

e) Reference to the request for coordination (not applicable for Appendices **30** and **30A**)

f) Frequency ranges for the frequency assignments of the satellite network transponder(s) that are intended to be brought into use in conformity with the relevant time-limits included in the Radio Regulations

g) Name of the operator

h) Name of the satellite

i) Orbital characteristics.

B Spacecraft manufacturer*

a) Name of the spacecraft manufacturer

b) Date of execution of the contract

c) Contractual "delivery window"

d) Number of satellites procured.

C Launch services provider

a) Name of the launch vehicle provider

b) Date of execution of the contract

c) Launch or in-orbit delivery window

d) Name of the launch vehicle

e) Name and location of the launch facility.

3.4.5.3 Regulatory and procedural considerations

The text in §3.4.5.2 could be used as the basis for updating Resolution 49.

3.4.6 Resolution 34

3.4.6.1 Summary of technical studies

Resolution **34** contains regulatory provisions which apply to the use of the BSS in Region 3 in the band 12.5-12.75 GHz, in respect of the space and terrestrial services in all Regions.

* NOTE – In cases where a contract for satellite procurement involving the frequency assignments concerned covers more than one satellite, the relevant information shall be submitted for each satellite.

It has been considered whether the provisions contained in Resolution **34** are still necessary or whether they could be reflected in a simple way in the main body of the Radio Regulations.

3.4.6.2 Analysis of the results of studies

The band 12.5-12.75 GHz is allocated to the broadcasting-satellite service in Region 3 on a primary basis. This allocation is not subject to a Plan.

As far as terrestrial services allocated on a primary basis are concerned in Regions 1, 2 and 3:

- the band 12.5-12.75 GHz is allocated to the fixed and mobile, except aeronautical mobile, services in some countries of Region 1 listed in Nos. **5.494** and **5.496**; and
- the band 12.5-12.75 GHz is allocated to the fixed and mobile, except aeronautical mobile, services in Region 3; and
- in Region 2, the band 12.2-12.75 GHz is allocated to the fixed and mobile, except aeronautical mobile, services and the band 12.2-12.7 GHz is allocated to the broadcasting service.

The band 12.5-12.75 is also allocated to the FSS in Regions 1 and 3; the band 12.5-12.7 GHz is allocated to the planned BSS in Region 2 and the band 12.7-12.75 GHz is allocated to the FSS in Region 2.

Besides, attached to the allocation to the BSS in Region 3 in the band 12.5-12.75 GHz, No. **5.493** specifies a hard limit of –111 dB(W/(m^2·27 MHz)) on the power flux-density produced at the Earth's surface by a station in the broadcasting-satellite service in Region 3 at the edge of the service area.

Resolution **34** contains regulatory provisions which apply to the use of the BSS in Region 3 in the band 12.5-12.75 GHz, in respect of the space and terrestrial services in all Regions.

– *resolves* 1 states that, until a plan is established for this allocation, Resolution **33** (Rev.WRC-97) and Article **9** apply with respect to space stations in the BSS and in the FSS in all Regions and terrestrial services in all Regions. Hence, it is understood that when the provisions of Article **9** need to be applied, No. **9.7** applies with respect to GSO networks in the FSS and the BSS of all Regions, and No. **9.11** applies with respect to terrestrial of all Regions.

– *resolves* 2 calls for technical studies to develop appropriate provisions for the sharing between stations in the BSS service in Region 3 and space and terrestrial stations in Regions 1 and 2.

– *resolves* 3 provides criteria to be applied until the studies in *resolves* 2 are completed, in order to describe the sharing between this allocation to the BSS in Region 3 and terrestrial services in all Regions.

    - *resolves* 3.1) specifies a hard limit which is the same than the one in No. **5.493** i.e. –111 dB(W/(m^2·27 MHz)) at the edge of the service area;
    - *resolves* 3.2) specifies that the hard limits of Table **21-4**, currently applicable to the FSS in the band 12.5-12.75 GHz, also apply to this BSS allocation in the countries mentioned in Nos. **5.494** and **5.496**;
    - *resolves* 3.1) also states that *resolves* 3.2) only applies with respect to the protection of the broadcasting service; but, since the services mentioned in *resolves* 3.2) through Nos. **5.494** and **5.496** are only the fixed and the mobile services, the statement seems to have no clear meaning and two views have been suggested to interpret it. The first view is that the statement should be ignored on the basis that it is inconsistent with the

remaining part of *resolves* 3, whereas the second view is that it may be taken into account so as to disable the provisions of *resolves* 3.2). Under this latter viewpoint, it is therefore not clear why *resolves* 3.2) exists and which procedure applies with respect to the terrestrial services allocated in the Region 1 countries mentioned in Nos. **5.494** and **5.496**;

- *resolves* 3.3) specifies that these limits may be exceeded on the territory of any country provided the administration of that country has so agreed, which paraphrases No. **21.17**.

As far as the protection of terrestrial services in all Regions from the unplanned BSS in Region 3 in the band 12.5-12.75 GHz are concerned, the apparent discrepancy between *resolves* 1 and *resolves* 3 was outlined:

- *resolves* 1.2) specifies that the BSS stations apply the provisions of Resolution **33 (Rev.WRC-97)** and Article **9** with respect to terrestrial services of all Regions;
- whereas *resolves* 3.1), *resolves* 3.2) and No. **5.493** provide power-flux density hard limits.

The same situation in other bands has led to the adoption of a Rule of Procedure on No. **9.11** (see circular letter CR/181 dated 16 July 2002) stating that, in such cases, a finding resulting from the examination under No. **11.31** based on the respect of hard limits established for the sharing between BSS and terrestrial services is provided to the BSS assignment, i.e. a favourable finding if the limits are not exceeded, or an unfavourable finding otherwise.

Relying upon this conclusion, one view was emphasized that the protection of terrestrial services in all Regions from the BSS allocation in the band 12.5-12.75 GHz was assured as described hereafter:

– To protect the stations in the terrestrial services in the Region 1 countries mentioned in Nos. **5.494** and **5.496**, according to *resolves* 3.2), the limits of Table **21-4** of Article **21** apply and could be reflected in a simple way by modifying Table **21-4**. It should be noted that, as Resolution **506 (Rev.WRC-97)** precludes the operation of BSS stations in the non-geostationary-satellite orbit in the 12 GHz band, such a modification to Table **21-4** would apply only to the BSS stations in the geostationary-satellite orbit.

– Terrestrial services in Region 3 are protected by:
  - the limit of -111 dB(W/(m$^2\cdot$27 MHz)), which applies at the edge of the service area, if they are allocated in countries out of the service area of the BSS network; or
  - coordination under No. **9.11** if they are allocated in countries included in the service area of the BSS network.

– Terrestrial services in Region 2 are protected by the limit of -111 dB(W/(m$^2\cdot$27 MHz)) since Region 2 is out of any service area of a BSS network operating in Region 3.

Another view was that there is a remaining discrepancy between the provisions of the *resolves* 1 and 3 of Resolution **34** and also that, regarding terrestrial services in Region 3, the current mention of the band 12.5-12.75 GHz for Region 3 in Table **5-1** of Appendix **5** under No. **9.11** may not be clear enough to specify that it may only apply with respect to Region 3 countries included in the service area.

3.4.6.3 Methods to satisfy this agenda item

WRC-03 may wish to consider the views expressed in the previous section, that the suppression of Resolution **34** together with some modifications to the Radio Regulations might be considered. An example of modified Table **21-4** of Article **21** and Resolution **34,** which reflects one view on how to apply the provisions of Resolution **34**, is given below.

MOD

TABLE **21-4** *(continued)*

Frequency band	Service*	Limit in dB(W/m^2) for angle of arrival (δ) above the horizontal plane			Reference bandwidth
		0°-5°	5°-25°	25°-90°	
…					
12.5-12.75 GHz[7] (Region 1 countries listed in Nos. **5.494** and **5.496**)	Broadcasting-satellite (geostationary- satellite orbit)	–148	$-148 + 0.5(\delta - 5)$	–138	4 kHz
…					

SUP

RESOLUTION 34

Relating to the establishment of the broadcasting-satellite service in Region 3 in the 12.5-12.75 GHz frequency band and to sharing with space and terrestrial services in Regions 1, 2 and 3

3.4.7 Rule of Procedure on No. 9.35 provisionally adopted to reduce the backlog in the processing of satellite filings under Article 9 of the RR

3.4.7.1 Summary of activities performed in relation to the reduction of the backlog

Council-01 adopted Resolution 1182 recommending the Board to develop, as a matter of urgency, a set of Rules of Procedure, consistent with the Radio Regulations, intended to eliminate the backlog. The reason for this was the increasing backlog in the processing of satellite filings, identified already in 1994 by the Kyoto Plenipotentiary Conference in the adoption of Resolution 18. Since 1994, the issue has also been considered by WRC-97, PP-98, WRC-2000 and WGR. The problem of the backlog is still not solved and is under consideration by SATBAG (an action group of the Council, established by Council Resolution 1182, which prepares and oversees a coordinated approach for treating the complex and related factors contributing to the backlog in the Bureau's processing of satellite network filings). SATBAG will submit a report to WRC-03.

The Board adopted during its 25th meeting (3-7 December 2001) a Rule of Procedure on the suspension, within the No. **9.35** examinations, of examinations[3] other than conformity with respect to the Table of Frequency Allocations. A "qualified favourable" finding, as described in Circular Letter CR/180, is issued, which will need to be confirmed at the notification stage. The "suspended" examinations will be made in the No. **11.31** notification phase. The Board indicated that these above measures would be used on a provisional basis until further decisions by WRC-03. The Rule has been applied to those networks for which complete coordination information has been received by the Bureau on and after 1 June 1999.

The provisional adoption of the Rule of Procedure on No. **9.35** drew comments from several fora.

3.4.7.2 Analysis of the impact of the provisional application of the Rule of Procedure

The Bureau made available to the Board, at its 25th meeting, an estimate on the reduction of time requirements in the examination of a coordination request under the provisional Rules on Nos **9.35** and **9.36**. While the Bureau estimated that the adopted rules could reduce the time needed to examine a coordination request by 13.6%, (ref. Benchmark b) of Doc. RRB2001/289(Rev.1)), the Bureau also conditioned this estimate with the following potential implications of the rules if they were adopted:

– an increase of the Bureau's work pursuant to Nos **9.41/9.42** particularly due to the suspension of pfd calculation under No. **9.35**;
– transfer of work from the Bureau to administrations, having to do their own analysis;

[3] Examinations with respect to:

i) Any power limits referred to in applicable footnotes, Resolutions or Recommendations;
ii) The power limits for earth stations as specified in Nos **21.8**, **21.10**, **21.12** and **21.13**;
iii) The limits of power flux-density from space stations produced at the Earth's surface as specified in Table **21-4** (**21.16**), as well as in Tables **22-1A** to **22-1D** (**22.5C**);
iv) The limits of power flux-density from space stations produced at the geostationary orbit as specified in Nos **22.5** and **22.5A**;
v) The limits of power flux-density from earth stations produced at the GSO as specified in Table **22.2** (**22.5D**);
vi) The limits of power flux-density from space stations produced at any point in the geostationary orbit as specified in Table **22.3** (**22.5F**); and
vii) The off-axis power limits of earth stations in the fixed-satellite service specified in Nos **22.26** to **22.39**.

– possible increase of requests for assistance to the Bureau; and
– affording all the assignments in compliance with the Table of Frequency Assignments the status "qualified favourable" at the coordination stage and their potential impact on Bureau's records.

ITU-R sent a liaison statement to the SATBAG and the RRB which contrasted the regulatory situation prior to the adoption of the provisional Rule, in that, an assignment receiving unfavourable findings under No. **9.35** causes the assignment to have no regulatory right, to the "qualified favourable" status afforded to all the assignments treated pursuant to the provisional Rule and raised the following issues of concern:

– the rule shifts the backlog in processing satellite filings from the coordination stage to the notification stage;
– the analysis of conformity with the mandatory technical provisions of the Radio Regulations, instead of being done once by the Bureau on behalf of all administrations, will have to be done by any administration which wishes and even by the Bureau at a request for assistance; and
– the introduction of the status "qualified favourable" assignments under No. **9.35** raises concerns on how the Bureau will deal with the status of coordination requests at the notification stage of a network, being complicated by options available, under the rule, to administrations in pursuing the coordination and notification of their systems.

During the CPM meeting, some administrations indicated that they do not agree with these issues of concern, in that they have not been experienced in the months that the provisional Rules have been applied. Since the application of the provisional Rules as well as other factors, as the backlog at the coordination stage has started to be reduced, they are of the view that the provisional Rules are having the desired effect without any serious practical negative implications that some had predicted.

3.4.7.3 Methods to satisfy this issue and their advantages and disadvantages

The advantages and disadvantages listed hereafter have been subject to considerable discussions and not all administrations agreed to all of them.

3.4.7.3.1 Method A

WRC-03 does not endorse the provisional Rule of Procedure on No. **9.35**.

Advantages:

The advantages of not endorsing the provisional Rule on No. **9.35** would include:

– avoiding the possibility of work increase for the Bureau pursuant to Nos **9.41/9.42**, as well as due to requests for assistance;
– avoiding the characterization of all the assignments with a "qualified favourable" status at the coordination stage will maintain the credibility of Bureau generated reports, which are of critical importance to administrations;
– avoiding the situation where the work, instead of being done once by the Bureau on behalf of all administrations, will have to be done by the administrations and even by the Bureau as a result of requests for assistance;
– avoiding the transfer of the backlog problem in processing satellite filings from the coordination stage to the notification stage;

– avoiding that the number of coordination be higher because of the surplus generated by assignments that are not in conformity with the provisions of Radio Regulations;

– avoiding that administrations be required to coordinate with preceding assignments that are not in conformity with the Radio Regulations and consequently not be able to carry out in due time the higher number of required coordination to meet the regulatory time limit (5+2 years) to bring into use frequency assignments.

Disadvantages:

– Loss of the benefit of a reduction in the time required for the examination of coordination requests at the coordination stage by the Bureau.

– The time used by BR to re-examine all filings that have been processed under the provisional Rules, if so instructed by WRC-03.

– It maintains duplicate workload of BR for those filings that are notified as well as maintaining the examination of the "paper" filings that are never notified.

3.4.7.3.2 Method B*

WRC-03 incorporates the essence of the provisional Rules into the Radio Regulations, either in Article 9 or by a Resolution.

Advantages:

– This option solves the concern of some administrations about the unconstitutional aspect of the decision by the RRB, and does not necessitate the re-examination of filings processed under the provisional Rules.

– It removes duplicate workload of BR for those filings that are notified as well as removing the examination of the "paper" filings that are never notified.

– For those assignments that are never notified, any work done at the coordination phase is a wasted effort as these notices will eventually be cancelled.

– Under the present RR any excess of pfd in the examination at the coordination phase results in an unfavourable finding under No. **9.35/11.31**, resulting in the network not being protected by subsequent filings. A subsequent modification to the filing which brings the frequencies into compliance with the pfd limits will result in a new date of receipt and the need to coordinate with filings submitted between the date of the original filling and the date of the modified filing. Having no finding on these technical limits at the coordination phase results in the network being protected as of the original filing, with adequate time to seek agreement in accordance with No. **21.17** and other similar provisions or reduce the pfd prior to notification, even though it was not the main intent of the provisional Rule of Procedure.

Disadvantages:

– This could create more workload in BR.

– Possibility of work increase for the Bureau pursuant to Nos **9.41/9.42**, as well as due to requests for assistance.

– The report of examinations (see the list in footnote 1 above) by BR will not be available to administrations.

* All Arab administrations and the administration of Iran object to Method B.

– The work, instead of being done once by the Bureau on behalf of all administrations, will have to be done by any administration which wishes so and even by the Bureau as a result of requests for assistance.
– The number of coordinations is higher because of the surplus generated by assignments that are not in conformity with the provisions of Radio Regulations.
– Administrations are required to coordinate with preceding assignments that are not in conformity with the Radio Regulations and consequently may not be able to carry out in due time the higher number of required coordinations to meet the regulatory time limit (5+2 years) to bring into use frequency assignments.
– Possible increase of requests for assistance to the Bureau.
– Affording all the assignments in compliance with the Table of Frequency Assignments the status "qualified favourable" at the coordination stage and their potential impact on Bureau's records.
– By shifting the workload in processing satellite filings from the coordination stage to the notification stage, this method might simply transfer the backlog.

3.4.7.4 Regulatory and procedural considerations

Depending on how Method B is implemented, some advantages (resp. disadvantages) may be added or may disappear.

Should WRC-03 adopt Method A, it would need to instruct RRB to take necessary action. A draft Resolution to this effect is attached. Some administrations do not agree with this course of action.

DRAFT RESOLUTION

Rules of Procedure

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that the duty of the Radio Regulations Board, *inter alia*, is the approval of the Rules of Procedures in accordance with the Radio Regulations (CS94 and CS95);

b) that these Rules of Procedures shall be used by the Director and the Bureau in application of the Radio Regulations to register the assignments made by the Member States (CS95);

c) that the Board shall approve a set of Rules of Procedure to govern its own activities and those of the Bureau in the application of the Radio Regulations, to ensure the impartial, accurate and consistent processing of frequency assignment notices and to assist in the application of these Regulations (RR No. **13.12**),

having been informed

that some administrations have objected to the Rules of Procedure relating to application of No. **9.35** of the Radio Regulations adopted at the 25th meeting of the RRB (3-7 December 2001) as not being in conformity with the Radio Regulations,

noting

that in case the approved Rules of Procedure are not fully in conformity with the Radio Regulations, the findings adopted on this basis would affect the interests of administrations, *resolves to instruct the Radio Regulations Board*

1 to review the above-mentioned Rules of Procedure with the view to bringing them into full conformity with the Radio Regulations;

2 to review, where appropriate, the findings given in applying the adopted Rules of Procedure to take account of the modification of the Rules of Procedure as results of action taken under *resolves* 1 above.

########

3.5 Agenda item 1.34

"to review the results of studies in response to Resolution **539 (WRC-2000)** concerning threshold values for non-GSO BSS (sound) in the band 2 630-2 655 MHz, and to take actions as required"

3.5.1 Summary of technical and operational studies related to non-GSO BSS (sound), including a list of relevant ITU-R Recommendations

The band 2 535-2 655 MHz is additionally allocated to the broadcasting-satellite service (sound) on a primary basis in nine countries in Region 1 and 3 in accordance with the provisions of No. **5.418**. Use of the band 2 630-2 655 MHz by this service is subject to Resolution **528 (WARC-92)** and is exempt from the pfd limits indicated in RR Table 21-4 of Article **21**. At least one country has filed for a non-GSO BSS (sound) system to operate in the 2 630-2 655 MHz band and this system is expected to be operational in the near future.

The band 2 630-2 655 MHz is also allocated to the fixed and mobile services on a primary basis and WRC-2000 identified this band as an additional band for IMT-2000 per No. **5.384A**, which states "The bands, or portions of the bands, 1 710-1 885 MHz and 2 500-2 690 MHz, are identified for use by administrations wishing to implement International Mobile Telecommunications (IMT-2000) in accordance with Resolution **223 (WRC-2000)**. This identification does not preclude the use of these bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations". It is noted that this band is intended to be used for IMT-2000 systems by around the year 2010.

WRC-2000 introduced Resolution **539** for non-GSO BSS (sound) in the band 2 630-2 655 MHz (in Table 5-1 of Appendix **5** of the RR, Resolution **539** is shown as also applying as stated in the threshold condition column in the application of No. **9.11**). WRC-2000 also adopted as part of Resolution **539** limits on non-GSO BSS (sound) systems to national services (unless agreement has been reached to include the territories of other administrations in the service area) to be operated such that the minimum elevation angle over the service area is not less than 40° for the purposes of sharing with terrestrial services. The Resolution also contains the following provisional power flux-density (pfd) threshold levels for non-GSO BSS (sound) systems:

-128	dB(W/m^2 per MHz)	for $0° \leq \theta \leq 5°$
$-128+0.75(\theta-5)$	dB(W/m^2 per MHz)	for $5° \leq \theta \leq 25°$
-113	dB(W/m^2 per MHz)	for $25° \leq \theta \leq 90°$

where θ is the angle of arrival of the incident wave above the horizontal plane, in degrees.

It is noted that some administrations understand that the pfd values in Resolution **539** are thresholds to be used in the identification of administrations with which coordination is to be effected under 9.11. Other administrations are of the view that the pfd values in Resolution **539** are thresholds to be used in the identification of administrations with which the process of seeking of agreement is to be effected. In this CPM text, the phrase "pfd threshold levels" is used. See section 3.5.4.

ITU-R conducted studies regarding the appropriate satellite pfd threshold values for non-GSO BSS (sound) in Resolution **539** with a view to avoid placing undue constraints on either non-GSO BSS (sound) or terrestrial services.

Relevant ITU-R Recommendations: P.681-3, M.1036, F.1245-1, F.1336-1, BS.1114, BS.1547, BO.789, BO.1130, BO.1504, DNR ITU-R F.[9/118]* and DNR ITU-R M.[8/106].**

3.5.1.1 Non-GSO BSS (sound) system parameters

Non-GSO BSS (sound) systems envisaged for operation with high elevation angles (with a minimum of 40°) over the service area in the band 2 630-2 655 MHz in accordance with Resolution **539** are generally those employing highly elliptical orbits (HEO) in which a constellation consists of a number of satellites and only one satellite becomes active at any time, providing a continuous service. For the non-GSO BSS (sound) high availabilities are required for a viable implementation and these availabilities can only be ensured if there are high link margins. In the mobile operation envisaged for the non-GSO BSS (sound) the link margins can be reduced without impacting on availability provided high elevation angles to the satellite are maintained and this can only be achieved in medium to high latitude countries with a highly elliptical orbits type of implementation.

Users of sound broadcasting services expect and often demand very high levels of availability under all manner of reception conditions including mobile within the designated service area because this has become normal for sound broadcasting in the MF and VHF bands. In cases of large service areas, such as within all the territory within national borders, ubiquitous coverage can only be achieved via a combination of direct to user satellite and complementary terrestrial repeaters.

Non-GSO BSS (sound) system design is driven by the need to achieve an optimized balance between satellite and terrestrial repeater coverage and these in turn determine the required satellite e.i.r.p. and number of terrestrial repeaters. These elements in combination determine the total system deployment cost and hence the potential viability of the system.

For medium to high latitude countries, HEO signals can be received at high elevation angles within the service area and this significantly reduces the probability of total blockage of the satellite signal from natural or man-made obstructions in the path of the satellite signal and hence significantly increases the probability of direct reception from the satellite. Under these circumstances the desired availability can be achieved when the network is deployed with a modest number of terrestrial repeaters provided an adequate margin is provided for the satellite link to overcome partial blockage such as that introduced by foliage and certain man-made obstacles.

Operating with high elevation angles provides advantages for the operation of non-GSO BSS (sound) systems and may also reduce the impact of the non-GSO BSS (sound) on other services in the band. The ITU-R study taking into account the geographical distribution of these countries shows that, at the maximum, four active satellites may operate at the same frequency, and taking into account the geographical location of countries in Region 3 in practical terms there is an expectation that no more than three active satellite systems will operate in the same frequency sub-band. The longitudinal difference between adjacent active satellites will not be uniform. This factor has been taken into account in some of the ITU-R sharing studies.

The parameters of non-GSO BSS (sound) systems used in sharing studies are given below:

* This DNR has been objected to by five administrations at the stage of adoption in ITU-R.

** Some administrations expressed their objection to and concern regarding this DNR in ITU-R.

Orbital Parameter	
Altitude of Apogee (km)	44 640.5
Altitude of Perigee (km)	26 931.55
Orbital Inclination Angle (°)	42.5 *
Active Arc	4.5 hours before apogee to 3.5 hours after apogee
Number of Satellites	3
Number of Satellites Active at one time	1
Transmitting Parameter	
Minimum e.i.r.p. density (dB(W/Hz))	–6.3
Earth Station Receive Antenna Gain (dB)	7.0
Polarization	Circular
*NOTE – Some of the studies also considered a non-GSO BSS (sound) system with an orbital inclination angle of 50°.	

Based on the above parameters, taking into account the minimum required C/N of 6 dB including implementation loss of 1.8 dB and small link margin of 1.4 dB, a power flux-density at the surface of the Earth in the service area of non-GSO BSS (sound) systems of –110.3 (dBW/(m^2 · MHz)) is required under an ideal reception environment. Since non-GSO BSS (sound) systems are intended to operate with mobile receiving terminals, it is also necessary to consider the effects of fading depth due to shadowing by trees, etc. The effects of fading depth due to shadowing with respect to the elevation angle (70 degrees), in accordance with Recommendation ITU-R P.681-3, are estimated as 15 dB for availability objective of 97% and 7 dB for 95%. Taking into account the link power margin regarding the fading depth, the minimum required pfd levels for non-GSO BSS (sound) systems are calculated as follows:

Availability objective	Fading depth	Minimum required pfd in the non-GSO BSS (sound) service area
97%	15 dB	–95.3 dB(W/(m^2 · MHz))
95%	7 dB	–103.3 dB(W/(m^2 · MHz))

High pfd levels would provide tangible benefits in terms of increased availability and a potential reduction in the number of terrestrial repeaters, but would impose increased technical and cost constraints on the satellite component particularly for large service areas, and in these cases additional satellites must be employed.

Outside the service area, the pfd is expected to be reduced to facilitate the sharing situation with the terrestrial services of neighbouring countries. A maximum pfd mask was assumed in studies to evaluate the level of interference received by terrestrial stations. However, it should be noted that this is a worse case approach since each satellite will not be producing its pfd at the levels given in the mask for some terrestrial station locations.

3.5.1.2 IMT-2000 system parameters

Since this band has been identified for IMT-2000, most studies concerning protection of the mobile service have focused on the protection of IMT-2000. IMT-2000 is a cellular mobile telecommunication system, characterized by very high levels of Quality of Service, allowing to offer interactive and very high bit rates data communication to the end user. IMT-2000 is felt to offer very innovative and spectrum efficient telecommunication services and is recognized to take beneficial advantage from international harmonization of the spectrum and commonality of technologies.

The pfd thresholds in the frequency band 2 630-2 655 MHz are intended to protect IMT-2000 systems with a view to avoid placing undue constraints on non-GSO BSS (sound) systems in this specific frequency band. Therefore, they have to take into account the direction of the IMT-2000 link that is planned for the use of these 25 MHz. Recommendation ITU-R M.1036 on channelization plans for IMT-2000 systems is to be revised by 2004. Therefore, it is not known if this band is to be utilized for uplink (mobile station to base station links), downlink (base station to mobile station links), or both. The final determination of the direction of operation for the IMT-2000 systems may have an impact on the appropriate thresholds.

The deployment of terrestrial IMT-2000 in the 2 520-2 670 MHz band is expected to encompass urban and rural areas. Some administrations indicated their expectation that this frequency band will be first used in urban areas where there is spectrum congestion and demand for high speed mobile data services which would result in small, heavily loaded cells. It has been noted the rural areas are considered the most difficult to cover, given the low but important traffic density. Rural areas will be covered by macrocells designed for a coverage efficiency whereas urban areas will encompass every type of cell, from macro to picocells. The different types of cells may also be layered in these urban areas to better fit to capacity needs and demands: this being a particularity of IMT-2000 deployment schemes. Pico cells are designed for indoor coverage and service.

Further, it would be desirable that deployment in rural areas (which are coverage limited as opposed to traffic limited) be accommodated in lower frequency bands as coverage will decrease with increased frequency.

3.5.1.2.1 Receiver parameters for IMT-2000 mobile and base stations

The receiver parameters for mobile stations used in sharing studies are given in the following:

Receiver Noise Figure (dB)	9.0
Maximum Antenna Gain (dBi)	0.0
Polarization	Linear

The receiver parameters for base stations used in sharing studies are given in the following:

	Macro-rural	Macro-urban	Micro
Typical receiver noise figure (dB)	5.0	5.0	5.0
Maximum antenna gain (dBi)	17.0-18.0	18.0 (NOTE 1)	8.0
Antenna type	120° Sector (See NOTE 3)	120°/60° Sector (See NOTES 2 and 3)	120° Sector (See NOTE 3)
Antenna height	15.0 metres	Assume 24.0 metre building and antenna is 6 metres above top of building	Assume 24.0 metre building and antenna is 6 metres below top of building
Tilt angles (°)	2.5	6.0	6.0
Typical feeder loss (dB)	2.0	2.0	2.0
Polarization	Linear	Linear	Linear
NOTE 1 – Maximum antenna gains of 9 dBi, 13 dBi and 17 dBi have also been considered for macro-urban cells in one of the studies. NOTE 2 – The sector size is dependent on the capacity requirements for the cell. At the start of implementation of IMT-2000 systems, three 120° sectors would be used. If the particular cell needs more capacity, six 60° sectors could be used. NOTE 3 – For IMT-2000 base stations that employ multiple sector antennas in order to cover 360°, the systems are assumed to be designed such that each sector antenna will have its own receiver.			

Picocells are expected to be located in-doors, so the interference effect from satellite systems is not expected to be a factor and these systems were not taken into account in the studies.

A key IMT-2000 parameter from the viewpoint of sharing with non-GSO BSS (sound) systems is the IMT-2000 station antenna characteristics. Many contributions were made to the ITU-R on this subject. From these contributions it is clear that using IMT-2000 antennas that have good performance in terms of side-lobe suppression significantly enhances the probability of successful sharing with satellite services. Given the extended time-frame for the IMT-2000 deployment and the availability of such antennas, it was agreed that it is reasonable to conduct the sharing studies on the basis of IMT-2000 base station antennas with a performance that can reasonably be expected within the deployment period.

3.5.1.3 Fixed service system parameters

There are several types of FS systems operating in the band 2 630-2 655 MHz including point-to-point (P-P) system, point-to-multipoint (P-MP) system and electronic news gathering system (ENG). Since system characteristics of these systems are very much different, they have to be studied separately.

Details of parameters for the fixed service are given in DNR ITU-R F.[9/118].*

Fixed service system parameters important from the viewpoint of sharing with BSS (sound) systems are antenna characteristics, receiver parameters, Isat/Nth criteria and the acceptable percentage of fixed service links potentially exceeding the Isat/Nth criteria. Recommendation ITU-R F.1245 and the draft revision of Recommendation ITU-R F.1336 were used as fixed service antenna radiation patterns.

* This DNR has been objected to by five administration at the stage of adoption in ITU-R.

3.5.2 Analysis of the results of studies

The ITU-R studies concentrated on developing appropriate pfd threshold levels, which would be acceptable to both terrestrial and non-GSO BSS (sound) systems, noting that it has proven difficult so far to agree on such levels.

The ITU-R also recognized that the pfd limits in Table **21-4** of RR Article **21**, which apply to BSS systems operating in the 2 520-2 670 MHz band under No. **5.416**, provide adequate regulatory protection to existing terrestrial systems operating in the same frequency band.

3.5.2.1 Protection of terrestrial systems from non-GSO BSS (sound) systems

3.5.2.1.1 Case of IMT-2000 systems

The ITU-R studies addressed the appropriate power flux-density thresholds that would adequately protect both base and mobile stations of IMT-2000 systems with a view to avoid placing undue constraints on non-GSO BSS (sound) systems.

IMT-2000 can be deployed in different ways as already identified above. The tolerance to external interference is related to the nature of the deployment. There is agreement that the rural coverage limited FDD uplink scenario would require the most protection from non-GSO BSS (sound) systems, although protection of mobile stations may become important at high elevation angles. FDD downlinks, urban micro and picocells in either the uplink or downlink direction and TDD deployments are expected to be more tolerant to external interference, therefore, studies were focused primarily on the rural coverage limited up-link case.

3.5.2.1.1.1 Case of IMT-2000 base stations

The ITU-R reviewed several sharing studies relating to the appropriate pfd threshold levels with respect to non-GSO BSS (sound) systems sharing with IMT-2000 systems. The ITU-R was unable to agree upon one set of acceptable pfd threshold levels. The studies proposed the following two alternative pfd threshold levels for sharing between non-GSO BSS (sound) systems and the IMT-2000 uplink case that, for the masks considered, is the most susceptible to interference in the band 2 630-2 655 MHz:

A)**

-128	$\mathrm{dB(W/(m^2 \cdot MHz))}$	$0° \leq \theta \leq 5°$
$-128 + 0.75\,(\theta-5)$	$\mathrm{dB(W/(m^2 \cdot MHz))}$	$5° \leq \theta \leq 25°$
-113	$\mathrm{dB(W/(m^2 \cdot MHz))}$	$25° \leq \theta \leq 90°$

where θ is the angle of arrival of the incident wave above the horizontal plane, in degrees. It may be noted that the above thresholds are identical with the pfd thresholds given in Resolution **539 (WRC-2000)**.

**NOTE − A further study considering different angle of arrival break points and different pfd levels.

B)***

−132	dB(W/(m^2 · MHz))	0° ≤ θ ≤ 5°
−132 + 0.5 (δ−5)	dB(W/(m^2 · MHz))	5° ≤ θ ≤ 25°
−122	dB(W/(m^2 · MHz))	25° ≤ θ ≤ 90°

where θ is the angle of arrival of the incident wave above the horizontal plane, in degrees.

***NOTE − A further study resulted in pfd levels that are 2 dB higher than these values for all elevation angles and another resulted in pfd levels up to 4 dB tighter at low elevation angles and relaxed by 1 dB for high angles.

There were several different assumptions used in these studies that led to the differences in appropriate pfd masks. These assumptions and the differences are summarized below:

a) Reference radiation antenna patterns for the IMT-2000 base stations

The study that developed the levels given in **B)** used the antenna pattern for sectoral antennas that is contained in Recommendation ITU-R F.1336-1. It is noted that the pattern given in this Recommendation for sectoral antennas does not include any discrimination in the azimuth plane (i.e. the model only contains a pattern in the vertical plane, although in practice this azimuthal discrimination will occur). It is noted that further studies considered azimuthal antenna discrimination and a vertical pattern modelled with Recommendation ITU-R F.1336-1 and resulted in the pfd levels given in the note to mask **B)**. The two studies used in the development of the levels given in A) used reference antenna patterns that accounted for discrimination in the azimuth plane. It is noted that these two studies used different models for the horizontal gain pattern. One of these studies used two antenna patterns: one with the vertical pattern from Recommendation ITU-R F.1336-1 and the other with a different model for the vertical pattern. DNR [8/106]* states that the azimuth gain pattern outside the sector can be modelled as the maximum vertical gain minus 30 dB.

b) Maximum antenna gains for the IMT-2000 base stations

The studies used in the development of the levels given in **A)** assumed a mixture of maximum base station antenna gains of 8 dBi, 9 dBi, 13 dBi and 17 dBi for the base station antenna. The different antenna gains used in the analyses take into account that the implementation plan for this band has not yet been defined and the gain values correspond to all of the different possible deployment scenarios for IMT-2000 systems. The study used to develop the levels given in B) assumed a maximum base station antenna gain of 18 dBi focusing on the rural FDD uplink scenario.

c) Shaping factor "k" for the IMT-2000 base stations

Recommendation ITU-R F.1336-1 contains a shaping factor "k", which is the parameter that accounts for the vertical side-lobe levels (i.e. in the elevation plane) of the antennas. It is noted that a lower value for k indicates improved side-lobe performance. The study that developed the levels given in B) used a k value of 0.2. One of the studies used to develop the levels in A) used "k" values of 0, 0.1 and 0.2. The second study used in the development of the levels in A) used values of 0 and 0.1. It is noted that one contribution that contained measured antenna patterns for IMT-2000 base stations that have been extensively deployed concluded that a k value of 0 is appropriate. Another

* Some administrations expressed their objection to and concern regarding this DNR in ITU-R.

contribution contained measured antenna patterns for IMT-2000 base station that meet k factors of 0.4 and 0.7. Given that this is a very sensitive parameter to the studies under consideration every effort should be made to accurately model base station antennas that will be deployed in the 2008 time frame, which may use advances in antenna technology. One study has demonstrated that the "k" shaping factor may not affect the low angle pfd requirement, but does affect the high angle pfd requirement (5 dB difference in the case of k=0.0 *vs.* k=0.2).

d) I/N levels

For the development of a given pfd threshold level for the protection of IMT-2000 base stations, the studies assumed different values for the I/N criterion. It is noted that "I" is the interference due to the non-GSO BSS (sound) satellites and "N" is the thermal noise of the IMT-2000 base station receiver. The study that developed the levels given in **B)** used an I/N of –10 dB. One of the studies that developed the levels given in **A)** used an I/N criterion of –6 dB. The second study that developed the levels given in **A)** used an I/N criterion of –6 dB, but it is noted that the results were not significantly different if an I/N of –10 dB had been used due to other assumed factors. There were some discussions in the ITU-R about the need to consider the effect of satellite interference in conjunction with other sources of interference in addition to the thermal noise of the receiver, which was taken into account in some of the studies.

e) Percentage of base stations where a given I/N level is exceeded

In the assessment of the adequacy of the pfd masks for the protection of IMT-2000 uplinks, some studies presented the results as the probability that a percentage of base stations would receive I/N levels that exceeded a certain value. The studies assumed different allowable percentages of base stations where the I/N threshold could be exceeded. One of the studies that developed the levels given in **A)** used 10% as the acceptable percentage of stations where the I/N criterion could be exceeded. In this study, an I/N level of –6 dB was exceeded at 6.2% of the base stations. The other study used in the development of the levels in **A)** assumed that an acceptable percentage of base stations where the I/N criterion is exceeded is 10 to 20%. Although the study that developed the levels given in **B)** did not focus only on presenting the results using such probabilities but on an assessment of the interference levels received at base stations evenly located around the Earth, it can be noted that the I/N criterion was exceeded at certain base stations, generally representing 4% or less of base stations. One study that resulted in low angle pfd levels tighter than mask **B)** considered that no stations should exceed the I/N criterion.

f) Polarization isolation

As the non-GSO BSS (sound) satellite antennas use circular polarization and the IMT-2000 base stations use linear polarization, there may be a polarization loss that should be taken into account in the analyses. One view was that polarization losses of 1.5 dB should be included in the studies. Another view was that no/minimal polarization loss should be taken into account since the interference would arrive at elevation angles far from antenna boresight. One of the studies used to develop the levels given in **A)** assumed a polarization loss of 1.5 dB. The other three studies assumed 0 dB polarization loss.

g) Averaging and aggregating of interference into base stations

One of the studies used in the development of the levels in **A)** considered the probability that a sector antenna at given latitudes and varying longitudes and azimuth angles would experience different Isat/N levels. The other study used in the development of the levels in **A)** considered the probability that a sector antenna at different latitudes and varying antenna "k" factors and maximum antenna gains would experience different Isat/N levels. This study also looked at the situation where all of the results are averaged together. The study used in the development of the levels in **B)** which modelled the base station antenna patterns using Recommendation ITU-R F.1336-1, assessed the I/N levels received at base stations located at a given latitude for varying longitudes, and presented cumulative distributions of these results. One of the further studies related to the levels in **B)**used the same type of approach in terms of results. This further study used two methods for calculating the interference received at an IMT-2000 base station: one method assumed that all three sectors of the base station would be impacted in terms of loss of coverage to the same level as the sector that received the greatest impact; the second method assumed that the impact on the base station was a tuned average of the impact on each of the three individual sectors. It is noted that the results reported above related to this further study used the second method, as did the other study referred to in the note to mask **B**). Both methods have considered varying azimuth angles for the base stations.

h) Number of satellites assumed in the studies

The four studies used different assumptions for the number of BSS (sound) satellites.*

The first study used in the development of the levels given in **A)** assumed three different cases: seven BSS (sound) satellites equally spaced around the geostationary orbit, three satellites equally spaced around the geostationary orbit and one GSO satellite and two non-GSO satellites. The assessment of the adequacy of the pfd mask was based on the results using seven BSS (sound) satellite equally spaced around the geostationary orbit.

The second study used in the development of the levels given in **A)** considered three different cases:

- Six non-GSO systems: three of the systems have their "active arc" located in the northern hemisphere and three have their "active arc" located in the southern hemisphere. The constellations separated in longitude by 120 degrees.
- Four non-GSO systems: two of the systems have their "active arc" located in the northern hemisphere and two have their "active arc" located in the southern hemisphere. The constellations separated in longitude by 180 degrees.
- Three non-GSO systems: All have their "active arc" located in the northern hemisphere. The constellations separated in longitude by 120 degrees.

The results of this study were based on the six non-GSO system case.

The third study used to develop the mask given in **B)** investigated several cases:

- Seven satellites uniformly distributed around the geostationary orbit.
- Three satellites uniformly distributed across 40° of the geostationary orbit.
- Three satellites uniformly distributed across 100° of the geostationary orbit.
- Four non-GSO satellite systems with active arcs in the northern hemisphere uniformly distributed across 360° of longitude.

---

* These studies are for the purpose of studying sharing between non-GSO BSS (sound) systems and terrestrial systems, including also GSO BSS (sound) systems, in order to assess the environment that future terrestrial systems may experience. However, refinement of the modelling of GSO BSS (sound) is necessary to reflect the GSO BSS (sound) characteristics more accurately. Any assumptions and results of these studies may be used only for appropriate pfd levels for NGSO BSS (sound) systems and must not be considered for any purpose beyond this agenda item.

- Three non-GSO satellite systems with active arcs in the northern hemisphere uniformly distributed across 360° of longitude (two of the non-GSO systems" orbits had inclination angles of 42.5° and the other had an inclination angle of 50°).
- One non-GSO satellite system and four GSO satellites. The GSO satellites were distributed uniformly around the geostationary orbit and the non-GSO satellite was located at the midpoint between 2 of the GSO satellites (i.e. GSO longitudes were 10°, 100°, 190° and 280°. The non-GSO longitude was 50°).

A fourth study that resulted in a pfd mask 4 dB tighter at low angle and 1-3 dB more relaxed at high angle than mask **B)** considered several cases:

- Seven satellites uniformly distributed around the geostationary orbit.
- Three satellites uniformly distributed across 40° of the geostationary orbit.
- Three non-GSO satellite systems with active arcs in the northern hemisphere uniformly distributed across 360° of longitude with orbital parameters as in § 3.5.1.1.
- One non-GSO satellite system and four GSO satellites. The GSO satellites were distributed uniformly around the geostationary orbit and the non-GSO satellite was located at the midpoint between 2 of the GSO satellites (i.e. GSO longitudes were 10°, 100°, 190° and 280°. The non-GSO longitude was 50°).

3.5.2.1.1.2 Case of IMT-2000 mobile stations

For the case of the downlink from a base station to a mobile station, the ITU-R considered the results of two studies. These studies assumed an isotropic 0 dBi gain antenna and an I/N_{th} criterion of −10 dB. Considering a maximum of three visible satellites in the same frequency band, the pfd threshold value would be −120 dB(W/(m^2 · MHz)), for all elevation angles. With only two visible satellites the pfd would be –118.2 dB(W/(m^2 · MHz)). Opinions were expressed that the assumptions used in these analyses were not correct. The following text explains the questions relating to the assumptions:

The major consideration in assessing the relative sensitivity of the upstream link and the downstream link is that in the design of the downstream sufficient margin must be included to penetrate buildings and other enclosures where some mobile users may be located. Recommendation ITU-R M.1225, states that the guideline for the design of a cellular system is 95% signal availability indoors and that the structure penetration loss should be modelled as a log-normal distribution with 12 dB mean and 8 dB standard deviation. The cellular system downlink must include sufficient margin to overcome the penetration loss.

In order to maintain this indoor availability, the downlink design must include at least 20 dB of margin. The satellite signal will be attenuated by building loss, resulting in very low Isat/Nth indoors. Downlink power control is used to provide a constant QoS (Quality of Service) to the end user (mobile terminals). When a user goes from indoor to outdoor usage, the margin is reused by the base-station to be distributed over other users (some of whom also go from outdoors to indoors). This additional power may be used to compensate against interference unless the base-station is already operating at its maximum power. The impact of interference on fully loaded cells has to be further studied taking into account the impact of increased intra-cell interference and power control.

An additional consideration in studies is that the number of satellites visible to a mobile terminal will be three, a factor of 5 dB. This will only occur for a very small number of cases due to probable blockage of signals coming from different satellites by natural terrain, man-made objects and other factors. Accordingly, having more than two interfering sources is improbable.

These above considerations should be taken into account in developing the appropriate downlink pfd mask.

3.5.2.1.2 Case of fixed service systems

Based on the above considerations and DNR ITU-R F.[9/118], *the following pfd threshold levels at the surface of the Earth should apply with respect to station in the fixed service operating in the band 2 630-2 655 MHz:

-128	$\text{dB(W/(m}^2 \cdot \text{MHz))}$	$0° \le \theta < 5°$
$-128 + 0.6\,(\theta - 5)$	$\text{dB(W/(m}^2 \cdot \text{MHz))}$	$5° \le \theta < 25°$
-116	$\text{dB(W/(m}^2 \cdot \text{MHz))}$	$25° \le \theta < 35°$
$-116 + 1.5\,(\theta - 35)$	$\text{dB(W/(m}^2 \cdot \text{MHz))}$	$35° \le \theta < 37°$
-113	$\text{dB(W/(m}^2 \cdot \text{MHz))}$	$37° \le \theta < 90°$

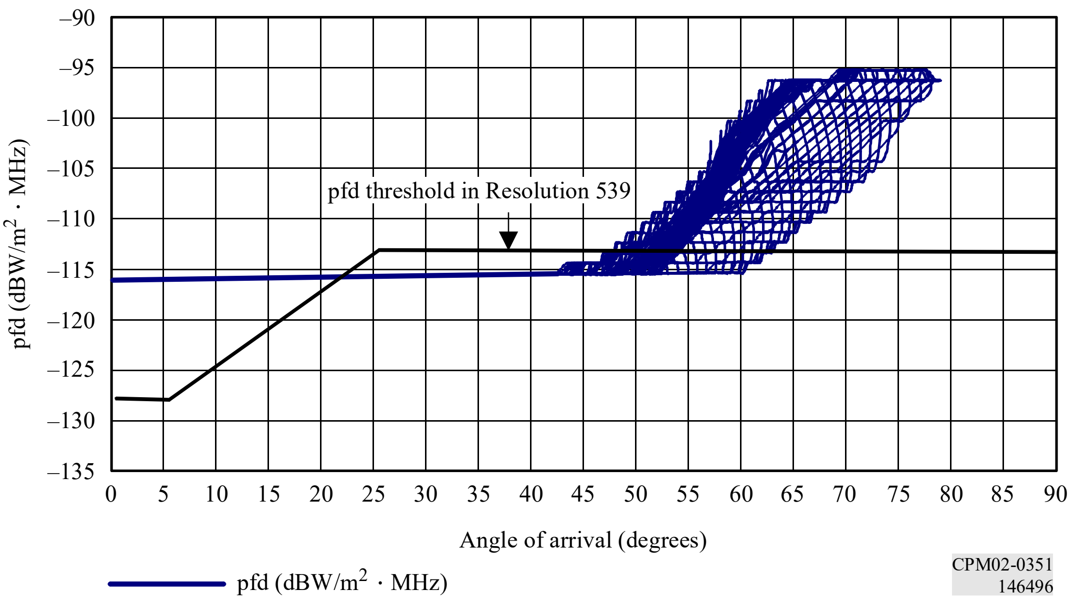
where θ is the angle of arrival of the incident wave above the horizontal plane, in degrees.

3.5.2.2 Impact on the non-GSO BSS (sound) systems

The minimum required power flux-density levels for non-GSO BSS (sound) systems within the service area are shown in § 3.5.1.1. Figures 3.5-1 and 3.5-2 show the relationship between the elevation angle over the visible surface of the Earth and the pfd produced by a non-GSO BSS (sound) system meeting availability objectives of 97% and 95%, respectively.

FIGURE 3.5-1

Relationship between the elevation angle and the pfd (availability objectives = 97%)

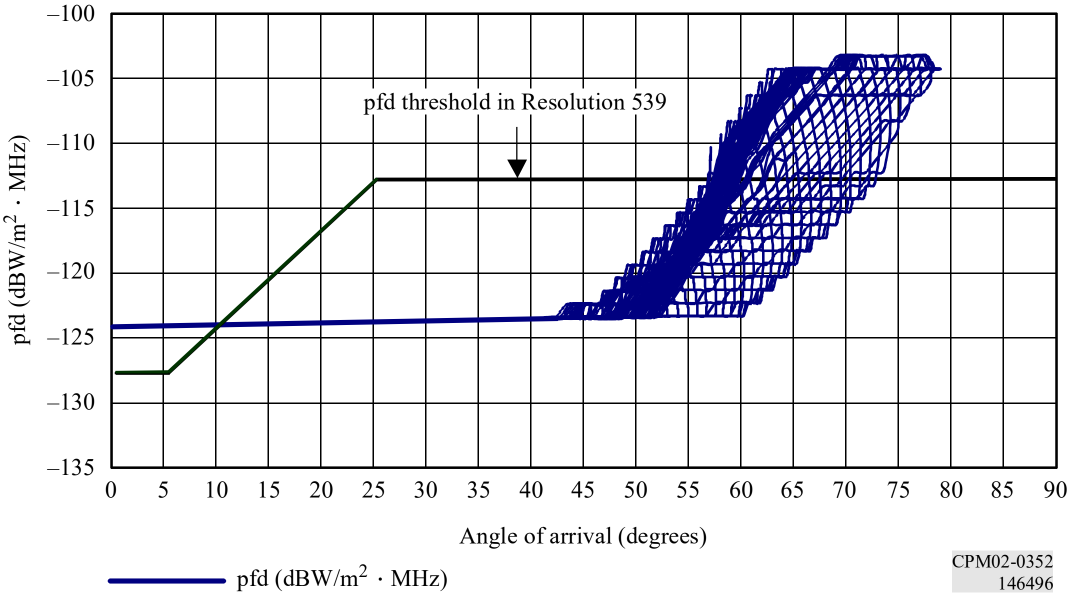


---

* This DNR has been objected to by five administrations at the stage of adoption in ITU-R.

FIGURE 3.5-2

Relationship between the elevation angle and the pfd (availability objectives = 95%)

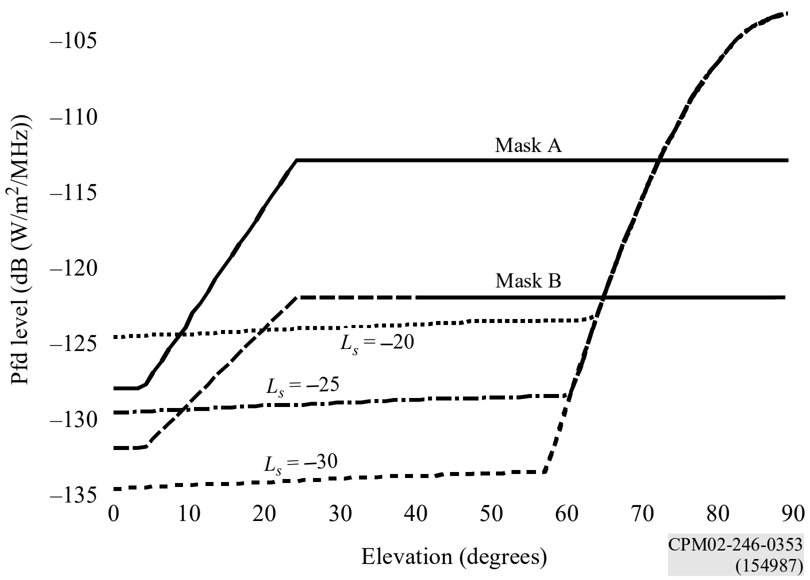


NOTE – These figures were developed using the antenna pattern information submitted in the App. 4 form for a non-GSO BSS (sound) satellite system, which only provided for side lobes that are 20 dB below the maximum gain. It is expected that the actual antenna roll-off for non-GSO BSS (sound) satellite antennas would perform better in the side lobes than the pattern submitted and therefore would improve the pfd mask.

There would be spectrum utilization advantages for both the non-GSO BSS (sound) and terrestrial services if higher performance satellite antennas with improved roll-off characteristics could be implemented in practice. Figure 3.5-3 shows examples of calculated pfd levels for a non-GSO BSS (sound) system transmitting with a maximum pfd level of –103.3 dB(W/(m^2 · MHz)) and using an antenna pattern conforming to ITU-R Recommendation S.672 with L_s parameters in the range of –20 dB to –30 dB and the relationship between these pfd levels and masks **A** and **B**.

FIGURE 3.5-3

Calculated pfd levels for non-GSO BSS (sound) satellite using Recommendation ITU-R S.672 with L_s between –20 dB and –30 dB compared to mask A and B



The impact of tightening the power flux-density levels in the low and high elevation angles would increase the area of the Earth's surface in which these levels could be exceeded (the impact in such terms would be greater at the lower elevation angles), thus increasing the number of countries identified as likely to be affected.

Depending on the maximum pfd levels produced at the surface of the Earth by the non-GSO space station at a given angle of arrival, the pfd threshold mask may or may not be practically met (see Figures 3.5-1, 3.5-2 and 3.5-3). In order to meet the pfd threshold mask at any elevation angle (or in a very limited portion of elevation angles), a non-GSO BSS (sound) system would require improved antenna side-lobe performance, and this may pose a serious challenge for the satellite manufacturers.

At this time, there is no actual implementation of practical antennas in the 2.6 GHz band on board non-GSO BSS (sound) space stations, leading to uncertainties on the actual expected roll-off performance and the degree of constraints that such threshold may cause to non-GSO BSS (sound) systems.

Studies are continuing in ITU-R in this matter. One administration emphasized that simulations of antennas performed up to now have peak envelope side lobe performance capabilities down to –25 dB at best at the lower elevation angles.

3.5.2.3 Impact on the IMT-2000 systems

In the studies, the values used for $I_{sat}/N_{thermal}$ ranged from –10 dB to –6 dB. It is appropriate to consider the potential impact of this range of $I_{sat}/N_{thermal}$ on the performance of IMT-2000 base station uplink performance. The following table presents the impact in terms of either system margin, increase in number of base stations, or signal availability.

$I_{sat}/N_{thermal}$(dB)	Reduction in system margin (dB)	Increase in number of base stations (%) (NOTE 1)		Availability loss (%) (NOTES 2 and 3)	
		IMT-2000 System Loading		EOC (NOTE 4)	Overall (NOTE 3)
		20%	50%		
		Rural	Urban		
–10	0.41	5	2.5	0.56	0.18
–6	0.97	11	5	1.38	0.46
NOTE 1 – Dependent on IMT-2000 system loading. NOTE 2 – Availability loss is Independent of IMT-2000 System Loading NOTE 3 – Based on an IMT-2000 system designed with an edge of coverage availability of 95% and an "overall" availability averaged over the cell of 98.56%. NOTE 4 – "EOC" is at the edge of coverage.					

Two studies considered the impact in terms of the increase of the number of base stations that would be required to maintain a constant quality of service over a given area for an assumed system loading. Another study considered the impact in terms of the loss of signal availability. The impact is one or the other, as given in the table, or a combination of reduced effects of each.

3.5.2.4 Impact on both, the non-GSO BSS (sound) and the IMT-2000 system

With respect to sharing between non-GSO BSS (sound) systems and IMT-2000 systems an overly conservative pfd threshold would be unnecessarily and prohibitively constraining on the development of non-GSO BSS (sound) systems, and would have the effect of inhibiting the implementation of this service. Conversely, an overly optimistic threshold would increase the risk of interference to terrestrial services.

3.5.2.5 Evaluation of the most adequate pfd thresholds

a) With respect to sharing between non-GSO BSS (sound) systems and fixed service systems, based on the above considerations and the study results described in DNR ITU-R F.[9/118], *the following pfd threshold levels at the surface of the Earth should apply with respect to station in the fixed service operating in the band 2 630-2 655 MHz:

-128	$\text{dB(W/(m}^2 \cdot \text{MHz))}$	$0° \leq \theta < 5°$
$-128 + 0.6\,(\theta-5)$	$\text{dB(W/(m}^2 \cdot \text{MHz))}$	$5° \leq \theta < 25°$
-116	$\text{dB(W/(m}^2 \cdot \text{MHz))}$	$25° \leq \theta < 35°$
$-116 + 1.5\,(\theta-35)$	$\text{dB(W/(m}^2 \cdot \text{MHz))}$	$35° \leq \theta < 37°$
-113	$\text{dB(W/(m}^2 \cdot \text{MHz))}$	$37° \leq \theta < 90°$

where θ is the angle of arrival of the incident wave above the horizontal plane, in degrees.

b) With respect to sharing between non-GSO BSS (sound) systems and IMT-2000 systems, the ITU-R was unable to develop a single set of agreed upon pfd threshold levels. Further study is required in order to develop the appropriate levels.

* This DNR has been objected to by five administrations at the stage of adoption in ITU-R.

#########

3.5.3 Methods to satisfy agenda item 1.34 for WRC-03

A number of methods have been used in the Radio Regulations to establish the regulatory regime applying to situations where transmit space stations may affect terrestrial stations, and each of these methods would provide a different degree of flexibility to non-GSO BSS (sound) systems and a different degree of protection to terrestrial networks, which takes into account the expected development of terrestrial and space services in the band when this regulatory approach was adopted for this particular case. These methods may be grouped into the following:

– Method 1: Pfd limits in Article **21**, Table **21-4**
– Method 2: Agreement seeking procedure of No. **9.21**
– Method 3: Coordination procedure of No. **9.11**
– Method 4: A procedure combining two or more of these methods

Each of the methods may be adapted to take account of the special sharing situation between non-GSO BSS (sound) and terrestrial services that applies in the band with a view to avoid placing undue constraints on any of the services, which may involve variants or adjustments to the existing regulatory implementation of these methods.

In particular, the procedures in Methods 2 and 3 may be applied with or without pfd threshold masks. Having the mask (which is the approach taken in the annexed examples) has the potential advantage of limiting the number of administrations likely to be affected.

Each of these methods, including its variations or adjustments, may be reflected in the body of the Radio Regulations in order to avoid the proliferation of new and complex procedures outside this body. Alternatively, these methods may be reflected in a modified version of Resolution **539 (WRC-2000)**, which may be easier to specify and may avoid undue complexity in the general procedure to cover a very specific case.

In order to ensure harmonious development of the greatest range of terrestrial and non-GSO BSS (sound) systems in this band, it would be appropriate to devise regulatory solutions which clarify the sharing situation, optimize the use of the spectrum and give regulatory certainty in this band.

It was agreed that acceptance of any of these methods was closely related to the values of the pfd thresholds that will be decided by WRC-03. However, if none of these methods provides an appropriate regulatory solution, the conference would need to take necessary action, as appropriate.

Method 1: Pfd limits in Article 21 with no examination under No. 9.35

Under this approach, the values of the pfd mask would be included as limits in Article **21** of the Radio Regulations, Table 21-4, and compliance of the non-GSO BSS (sound) system with these limits would be verified by the Bureau under No. **11.31**. Pursuant to No. **21.17**, these limits might be exceeded on the territory of any country whose administration has so agreed . In order for the non-GSO BSS (sound) system to continue to be protected by subsequent systems until its notification, examination of the conformity of the limits under No. **9.35** would not be performed. If all the agreements required have not been obtained at the stage of notification, the non-GSO BSS (sound) system may be operated only under the provisions of Nos **4.4** and **8.5** (not cause harmful interference nor claim protection to any assignments in conformity with the RR and immediately eliminate such interference upon receipt of advice thereof).

Advantages:

• Clear protection is given to existing and future terrestrial services if appropriate levels are selected.

- There is no need for administrations with terrestrial services to get involved in coordination activities with administrations planning to deploy non-GSO BSS (sound) systems.
- This method would allow discussions to take place until notification between the concerned administrations, without loss of rights for the non-GSO BSS (sound) with respect to third parties.

Disadvantages:

- It has been difficult so far to agree on limits to be used under this option and which would ensure adequate protection of terrestrial services and can be met by non-GSO BSS (sound) systems.
- One single administration on the territory of which the pfd is exceeded could prevent the non-GSO BSS (sound) system to be recorded with a favourable finding under **11.31** and thus be protected.
- This method, if it was applied for all angles of arrival at too stringent levels, would not be compatible with the intent of Resolution **539 (WRC-2000)**.

Method 2: Agreement seeking procedure of No. 9.21

Under this approach, the agreement seeking process of No. **9.21** would be followed, together with its associated Rules of Procedure[1]. The pfd mask adopted by WRC-03 would be used as a threshold in this process, and the Bureau would identify the administrations on the territory of which these thresholds are exceeded and publish their names together with the characteristics of the non-GSO BSS (sound) system. Among these administrations, only those having commented within four months of this publication would be considered affected. Only those assignments in conformity with the Radio Regulations and already in service or to be brought into service within three years of this publication may constitute a basis for disagreement. In case of such disagreement(s), the terrestrial administration is required to provide details of its assignments likely to be affected to the non-GSO BSS (sound) administration in order to maintain its rights. In addition, in this case, the examination by the Bureau under No. **11.31** would result in a favourable finding except in respect of the disagreeing administration(s), and the assignment to the non-GSO BSS (sound) system could be brought into service only under the conditions of No. **11.36** with respect to the services of the disagreeing administration(s), i.e. provided it does not cause harmful interference to, nor claim protection from assignments of that (these) administration(s) which are in conformity with the RR and if such interference occurs, it is immediately eliminated upon receipt of advice thereof. The assignments to the non-GSO BSS (sound) system would be protected from the date of the coordination request with respect to any subsequent assignment, except those of the disagreeing administration(s).

As a variant to this method, there would be no limitation to the period within which assignments to terrestrial stations are to be taken into account in the procedure. Also, in order to recognize the incompatibility of terrestrial services with non-GSO BSS (sound) operating in the same service area, administrations having assignments to non-GSO BSS (sound) space stations serving their territory in the overlapping bandwidth would not be considered affected. This variant could be implemented by a simple modification to Section **2** of Appendix **5**, as given in the annex.

---

[1] There would be a need to reflect these Rules of Procedure in the body of the Radio Regulations, which has not been done in the example given.

Advantages:

- This approach would ensure long term protection of terrestrial services in this band for the administrations having responded within four month of the non-GSO BSS (sound) system publication and having terrestrial services in operation or to be brought into use within three years of that publication (for the variant, the latter time limitation is removed).
- Compared with Method 1, this method would have the advantage that one single administration on the territory of which the pfd is exceeded could not prevent the non-GSO BSS (sound) system to be recorded with a favourable finding under No. **11.31** and thus be protected.
- For the variant, it would prevent administrations having non-GSO BSS (sound) systems objecting to other non-GSO BSS (sound) systems by requesting for their terrestrial services a level of protection that their own non-GSO BSS (sound) system does not provide within their own territory.

Disadvantages:

- An administration which has not commented within four months of the publication of the non-GSO BSS (sound) system would be deemed to have accepted the interference. Depending on the excess pfd radiated by the non-GSO BSS (sound) space station, this may preclude the deployment of terrestrial services in countries not equipped for timely response to such publications.
- If an administration already operates or brings into service terrestrial stations within three years of the publication of the non-GSO BSS (sound) system (or without this time limitation in case of the variant), it may object to that system and in this case, all its terrestrial stations would be protected in the future, independently from their date of bringing into use. Depending on the stringency of the mask and on the degree of excess of the pfd levels produced by the non-GSO BSS (sound) system, this may entail an element of risk, and thus make deployment of such systems difficult.

Method 3: Coordination procedure of No. 9.11

Under this method, non-GSO BSS (sound) systems would be subject to the coordination procedure of No. **9.11.** The pfd mask adopted by WRC-03 would be used as a threshold in this process, the Bureau would identify the administrations on the territory of which these limits are exceeded and publish their names together with the characteristics of the non-GSO BSS (sound) system. Among these administrations, only those having commented within four months of this publication would be considered affected. Only those terrestrial station assignments already in service or to be brought into service within three years of this publication may constitute a basis for disagreement. Pursuant to No. **9.50.2**, this time limitation of three years may be extended, but only by agreement between the administrations concerned. In case of such a disagreement, the non-GSO BSS (sound) system might be brought into service only if the Bureau has concluded that there is no probability of causing harmful interference (No. **11.32A**) or if it does not cause harmful interference to the assignments which were the basis of the disagreement and are recorded in the MIFR, and if such interference is immediately eliminated upon receipt of advice thereof (No. **11.41**).

As variants to this method, it would be possible to include an explicit agreement, or extension of the period within which assignments to terrestrial stations are to be taken into account in the procedure. This may remove some disadvantages of this method.

Advantages:

- It provides increased flexibility to implement non-GSO BSS (sound) systems.
- It encourages the administrations with terrestrial systems to cooperate with the non-GSO BSS (sound) administration.
- No. **9.11** of the Radio Regulations has been included since several decades to govern the coordination procedure of all non-planned BSS bands for both non-GSO and GSO, in application of Resolutions **507 (WARC-79)** and **528 (WARC-92)** and has been applied by administrations and the Bureau.
- No. **11.41** of the Radio Regulations has been included since several decades to be used in occasional cases in non-planned bands to avoid terrestrial or space systems assignments not yet in operation preventing a real system from being recorded in the MIFR and has helped in the area of non-planned bands in that context.

Disadvantages:

- An administration which has not commented within four months of the publication of the non-GSO BSS (sound) system would be deemed to have accepted the interference. Depending on the excess pfd radiated by the non-GSO BSS (sound) space station, this may preclude the deployment of terrestrial services in countries not equipped for timely response to such publications.
- An administration planning to deploy terrestrial stations may object to the non-GSO BSS (sound) system only on the basis of the characteristics of its terrestrial stations already in service or to be brought into service within three years of the publication of the non-GSO BSS (sound) system. However, this situation could happen in other cases in which the terrestrial service in the non-planned bands are involved and thus it is not a specificity of this very provision (No. **9.11**). Although No. **9.50.2** offers the possibility to extend this period, but only by mutual agreement, this limitation may not be compatible with the deployment of large scale terrestrial networks foreseen in the 2.6 GHz band (such as MMDS or mobile telecommunication networks), which require long-term spectrum redistribution.
- In case of disagreement, the application of No. **11.41** by the non-GSO BSS (sound) system leads to an unclear situation as to the effective level of protection given to the terrestrial services of the administration which has not agreed. This situation could occur in very occasional cases in which No. **11.41** has to be applied and thus it is not a specificity of this very provision (No. **9.11**).

Method 4: A procedure combining two or more of these methods

This method would be an appropriate combination of aspects of two or more of the above methods. The advantages and disadvantages would logically flow from the particular combination that is developed from the methods concerned. In particular, this method would have the advantage to provide more flexibility to resolve the difficulties highlighted in the three methods above.

3.5.4 Regulatory aspects

Resolution **539 (WRC-2000)** was developed in order to enable the development of non-GSO BSS (sound) systems in the band 2 630-2 655 MHz, whilst providing adequate protection to terrestrial services in this band, which was also identified by WRC-2000 for use by IMT-2000. The pfd thresholds in this Resolution have been reviewed by ITU-R, as reported in the previous sections.

Unlike the pfd limits in Article **21**, which give rise to an examination by BR with respect to the conformity of the non-GSO BSS (sound) system with No. **11.31** before publication of non-GSO

BSS (sound) system, the limits in Resolution **539 (WRC-2000)** are thresholds which are used by the Bureau to determine the administrations whose terrestrial services may be affected and from which agreement has to be sought by the non-GSO BSS (sound) administration. In contrast with the situation in the case of hard limits in Article **21**, Resolution **539 (WRC-2000)** therefore allows the non-GSO BSS (sound) system to start acquiring rights in respect of subsequent satellite or terrestrial systems, even if these thresholds are exceeded on the territories of many administrations.

The following Annexes provide possible examples of the regulatory implementation of the three specific methods described in Section 3.5.3. The development of regulatory text for Method 4 would be consequential to any decision on the type of combining of approaches from the other methods. These examples should be carefully reviewed by administrations in order that they fully reflect the methods described in Section 3.5.3 in their regulatory and procedural proposals to WRC-03.

ANNEX 1

Possible example of regulatory implementation of Method 1

(Limits in Article 21, with no examination under No. 9.35)

ARTICLE 5

Frequency allocations

MOD

5.418 *Additional allocation:* in Bangladesh, Belarus, Korea (Rep. of), India, Japan, Pakistan, Singapore, Sri Lanka and Thailand, the band 2 535-2 655 MHz is also allocated to the broadcasting-satellite service (sound) and complementary terrestrial broadcasting service on a primary basis. Such use is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (WARC-92)**. The provisions of No. **9.21** do not apply to this additional allocation and the provisions of Table **21-4** of Article 21 do not apply to GSO networks using this additional allocation. The use of this allocation by non-geostationary-satellite BSS (sound) systems is limited to national systems unless agreement has been reached to include the territories of other administrations in the service area, and to operation with a minimum elevation angle over the service area of not less than 40°.

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations[1, 2, 3, 4, 5, 6]

Sub-Section IIA – Requirement and request for coordination

MOD

9.35 *a)* examine that information with respect to its conformity with No. **11.31**[16, 16A];
(WRC-2000)

ADD

[16A] **9.35.2** When examining under No. **9.35** an assignment subject to No. **21.16.3B** with respect to its conformity with No. **11.31**, the Bureau shall identify and publish, under No. **9.38**, the names of the administrations on the territory of which the pfd limits in Table **21-4** are exceeded. Under this examination, any excess will be considered as in conformity with No. **11.31** until the assignment is examined by the Bureau under Article 11.

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section V – Limits of power flux-density from space stations

MOD

TABLE **21-4** (WRC-2000)

Frequency band	**Service***	**Limit in dB(W/m²) for angle of arrival (δ) above the horizontal plane**			**Reference bandwidth**
		0°-5°	**5°-25°**	**25°-90°**	
2 500-2 690 MHz 2 520-2 670 MHz 2 500-2 516.5 MHz (No. **5.404**)	Fixed-satellite Broadcasting-satellite[9A] Radiodetermination-satellite	–152 [9]	–152 + 0.75(δ – 5) [9]	–137 [9]	4 kHz
2 630-2 655 MHz (No. **5.418**)	Broadcasting-satellite (sound) (non-geostationary satellite orbit)	–128 [9B, 9C]	–128 + 0.75 (δ – 5) [9B, 9C]	–113 [9B, 9C]	1 MHz
2 630-2 655 MHz (No. **5.418**)	Broadcasting-satellite (sound) (non-geostationary satellite orbit)	[TBD] [9B, 9D]	[TBD] [9B, 9D]	[TBD] [9B, 9D]	1 MHz

NOC

21.17 2) The limits given in Table **21-4** may be exceeded on the territory of any country whose administration has so agreed.

ADD

[9A] **21.16.3A** These limits do not apply to the BSS (sound) allocation under No. **5.418**.

[9B] **21.16.3B** In the band 2 630-2 655 MHz, an assignment to a non-geostationary space station in the broadcasting-satellite service (sound) under No. **5.418** shall be considered in conformity with No. **11.31** if all the agreements required under No. **21.17** have been received.

9C **21.16.3C** These values apply to assignments to non-geostationary satellite systems in the broadcasting-satellite service (sound) for which complete Appendix **4** coordination or notification information, as appropriate, has been received by the Bureau after 2 June 2000 and the due diligence information has been received by the Bureau before 9 June 2003.

9D **21.16.3D** These values apply to assignments to non-geostationary satellite systems in the broadcasting-satellite service (sound) for which complete Appendix **4** coordination or notification information, as appropriate, has been received by the Bureau after 2 June 2000 and the due diligence information has been received by the Bureau after 9 June 2003.

APPENDIX 5 (WRC-2000)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

1 For the purpose of effecting coordination under Article **9**, except in the case under No. **9.21**, and for identifying the administrations with which coordination is to be effected, the frequency assignments to be taken into account are those in the same frequency band as the planned assignment, pertaining to the same service or to another service to which the band is allocated with equal rights or a higher category[1] of allocation, which might affect or be affected, as appropriate, and which are:

MOD

a) in conformity with No. **11.31**[2]; and

---

2 For the purpose of effecting coordination, an assignment for which the process of obtaining agreement under No. **9.21** has been initiated or which is subject to No. **21.16.3B**, as appropriate, is considered to be in conformity with No. **11.31** with respect to Nos. **9.21** or No. **21.16.3B,** as appropriate.

MOD

TABLE 5-1 (WRC-2000)

**Technical conditions for coordination
(see Article 9)**

Reference of Article 9	**Case**	**Frequency bands (and Region) of the service for which coordination is sought**	**Threshold/condition**	**Calculation method**	**Remarks**
...					
No. **9.11** GSO, non-GSO/ terrestrial	A space station in the broadcasting-satellite service (BSS) in any band shared on an equal primary basis with terrestrial services and where the BSS is not subject to a Plan, in respect of terrestrial services	620-790 MHz 1 452-1 492 MHz 2 310-2 360 MHz 2 535-2 655 MHz (GSO BSS (sound) in the countries mentioned in No. **5.418**)12.5-12.75 GHz (Region 3) 17.3-17.8 GHz (Region 2) 21.4-22 GHz (Region 1 and 3) 74-76 GHz	Bandwidths overlap;	Check by using the assigned frequencies and bandwidths	
...					

ANNEX 2

Possible example of regulatory implementation of Method 2

(Agreement seeking under No. 9.21)

ARTICLE 5

Frequency allocations

MOD

5.418 *Additional allocation:* in Bangladesh, Belarus, Korea (Rep. of), India, Japan, Pakistan, Singapore, Sri Lanka and Thailand, the band 2 535-2 655 MHz is also allocated to the broadcasting-satellite service (sound) and complementary terrestrial broadcasting service on a primary basis. Such use is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (WARC-92)**. The provisions of Table **21-4** of Article **21** do not apply to this additional allocation and No. **9.21** does not apply to GSO networks using this additional allocation. The use of this allocation by non-geostationary-satellite systems in the broadcasting-satellite service (sound) is subject to agreement obtained under No. **9.21** and limited to national systems unless agreement has been reached to include the territories of other administrations in the service area, and to operation with a minimum elevation angle over the service area of not less than 40°.

APPENDIX 5 (WRC-2000)*

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MOD

2 For the application of No. **9.21**, except for assignments to non-geostationary BSS (sound) space stations subject to No. **5.418**, the agreement of an administration may be required with respect to the frequency assignments in the same frequency band as the planned assignment, pertaining to the same service or to another service to which the band is allocated with equal rights or a higher category of allocation, which may affect or be affected, as appropriate, and:

ADD

2*bis* For the application of No. **9.21** to assignments to non-geostationary BSS (sound) space stations subject to No. **5.418**, the frequency assignments to be taken into account are those in the same frequency band as the planned assignment, to a terrestrial service to which the band is allocated with equal rights and are already operating in conformity with No. **11.31** or planned to be so operated in the future. However, agreement is not required from an administration having an assignment in the same service as the planned assignment, which is also subject to No. **9.21**, and for which the thresholds given in Table **5-1** are exceeded over its own territory.

---

* The modification to paragraph 2 in the introductory text of Appendix 5 applies only with respect of the implementation of the variant to Method 2 mentioned in Section 3.5.3.

MOD

TABLE 5-1 (WRC-2000)

**Technical conditions for coordination
(see Article 9)**

Reference of Article 9	**Case**	**Frequency bands (and Region) of the service for which coordination is sought**	**Threshold/condition**	**Calculation method**	**Remarks**
No. **9.11** GSO, non-GSO/ terrestrial	A space station in the broadcasting-satellite service (BSS) in any band shared on an equal primary basis with terrestrial services and where the BSS is not subject to a Plan, in respect of terrestrial services	620-790 MHz 1 452-1 492 MHz 2 310-2 360 MHz 2 535-2 655 MHz (GSO BSS (sound) in the countries mentioned in No. **5.418**) 12.5-12.75 GHz (Region 3) 17.3-17.8 GHz (Region 2) 21.4-22 GHz (Region 1 and 3) 74-76 GHz	i) Bandwidths overlap;	Check by using the assigned frequencies and bandwidths	

No. **9.21** Terrestrial, GSO, non-GSO/ terrestrial, GSO, non-GSO	A station of a service for which the requirement to obtain the agreement of other administrations is included in a footnote to the Table of Frequency Allocations referring to No. **9.21**	Band(s) indicated in the relevant footnote	Incompatibility established by the use of Appendices **7**, **8**, technical Annexes of Appendices **30** or **30A**, pfd values specified in some of the footnotes, other technical provisions of the Radio Regulations or ITU-R Recommendations, as appropriate	Methods specified in, or adapted from, Appendices **7**, **8**, **30**, **30A**, other technical provisions of the Radio Regulations or ITU-R Recommendations	
	non-GSO BSS (sound)/ terrestrial	2 535-2 655 MHz (non-GSO BSS (sound) in the countries mentioned in No. 5.418)	i) Bandwidths overlap; ii) in the band 2 630-2 655 MHz, the pfd from a non-GSO BSS (sound) space station calculated under free-space propagation conditions exceeds at any point of the territory of an administration in Regions 1, 2 or 3 the following: a) for a non-GSO BSS (sound) space station for which complete Appendix **4** coordination information, or notification information, as appropriate, has been received after 2 June 2000 and Resolution **49** information has been received by 9 June 2003, -128 dB(W/m^2/MHz) for $0° \leq \delta \leq 5°$ $-128 + 0.75(\delta - 5)$ dB(W/m^2/MHz) for $5° \leq \delta \leq 25°$ -113 dB(W/m^2/MHz) for $25° \leq \delta \leq 90°$ where δ is the angle of arrival above the horizontal plane; b) for a non-GSO BSS (sound) space station for which complete Appendix **4** coordination information, or notification information, as appropriate, has been received after 2 June 2000 and Resolution **49** information has not been received by 9 June 2003, [pfd values to be developed]	Check by using the assigned frequencies and bandwidths	

ANNEX 3

Possible example of regulatory implementation of Method 3

(Coordination under No. 9.11)

ARTICLE 5

Frequency allocations

5.418 *Additional allocation:* in Bangladesh, Belarus, Korea (Rep. of), India, Japan, Pakistan, Singapore, Sri Lanka and Thailand, the band 2 535-2 655 MHz is also allocated to the broadcasting-satellite service (sound) and complementary terrestrial broadcasting service on a primary basis. Such use is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (WARC-92)**. The provisions of No. **5.416** and Table **21-4** of Article **21**, do not apply to this additional allocation. The use of this allocation by non-geostationary-satellite systems in the broadcasting-satellite service (sound) is limited to national systems unless agreement has been reached to include the territories of other administrations in the service area, and to operation with a minimum elevation angle over the service area of not less than 40°.

APPENDIX 5 (WRC-2000)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MOD

TABLE 5-1 (WRC-2000)

Technical conditions for coordination (see Article 9)

Reference of Article 9	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. **9.11** GSO, non-GSO/ terrestrial	A space station in the broadcasting-satellite service (BSS) in any band shared on an equal primary basis with terrestrial services and where the BSS is not subject to a Plan, in respect of terrestrial services	620-790 MHz 1 452-1 492 MHz 2 310-2 360 MHz 2 535-2 655 MHz (No. **5.418**) 12.5-12.75 GHz (Region 3) 17.3-17.8 GHz (Region 2) 21.4-22 GHz (Region 1 and 3) 74-76 GHz	i) Bandwidths overlap; ii) in the band 2 630-2 655 MHz, the pfd from a non-GSO BSS (sound) space station calculated under free-space propagation conditions exceeds at any point of the territory of an administration in Regions 1, 2 or 3 the following: a) for a non-GSO BSS (sound) space station for which complete Appendix **4** coordination information, or notification information, as appropriate, has been received after 2 June 2000 and Resolution **49** information has been received by 9 June 2003,	Check by using the assigned frequencies and bandwidths	

			-128 dB(W/m^2/MHz) for $0° \leq \delta \leq 5°$ $-128 + 0.75(\delta - 5)$ dB(W/m^2/MHz) for $5° \leq \delta \leq 25°$ -113 dB(W/m^2/MHz) for $25° \leq \delta \leq 90°$ where δ is the angle of arrival above the horizontal plane; b) for a non-GSO BSS (sound) space station for which complete Appendix **4** coordination information, or notification information, as appropriate, has been received after 2 June 2000 and Resolution **49** information has not been received by 9 June 2003, [pfd values to be developed]		

#########

3.6 Agenda item 1.35

"to consider the report of the Director of the Radiocommunication Bureau on the results of the analysis in accordance with Resolution **53 (Rev.WRC-2000)** and take appropriate action"

Resolution **53 (Rev.WRC-2000)**

Updating of the "Remarks" columns in the tables of Article **9A** of Appendix **30A** and Article **11** of Appendix **30** to the Radio Regulations

In response to Resolution 53, BR has produced an initial Report. This Report to Member States of the Union is found in CR/183 dated 7 October 2002. It concerns partial implementation of Resolution 53 (Rev.WRC-2000), updating of the "Remarks" columns in the Tables of Article 9A of Appendix 30A and Article 11 of Appendix 30 to the Radio Regulations. The information made available by the Bureau in CR/183 includes compatibility analyses between R1 and R3 plans and the R2 plan, the R1 and R3 downlink plan to terrestrial services, R1 and R3 plans and FSS (including non-planned BSS), except compatibility analyses from R1 and R3 feeder-link plan earth stations to terrestrial services and FSS earth stations operating in the opposite direction. In Note 1 appearing on pages 9 and 17 of CR/183 of 7 October 2002, the Bureau has indicated that for some FSS satellite networks the relevant Rules of Procedure, including No. 9.35 (see CR/175 of 15 February 2002) have been applied*. Further reports are expected on the impact from terrestrial services, as well as other matters that may be required.

#########

3.7 Agenda item 1.37

"to consider the regulatory and technical provisions for satellite networks using highly elliptical orbits"

3.7.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

The ITU-R has been considering the sharing aspects of highly elliptical orbit (HEO) satellite systems in a number of contexts and under a number of different names in recent years.

HEO systems are a subcategory of non-GSO systems, and hence are subject to all limitations, which may apply to non-GSO systems in the RR unless otherwise specified in the RR, HEO systems could conceivably be employed in any satellite service in any frequency band allocated to that service. The technical characteristics of these systems vary considerably. The ITU-R is studying the ability of HEO systems to co-exist with other HEO systems, with other types of non-GSO systems, with GSO networks and with terrestrial systems, as well as the regulatory provisions that may be applied to HEO systems.

HEO systems are at the stage of advance publication or coordination, or have been notified in the fixed-satellite, mobile-satellite, broadcasting-satellite, inter-satellite, space operations, and space research services in frequency bands from below 225 MHz to above 64 GHz. Some of these are in operation. Various regulatory provisions apply to these systems.

The ITU-R activity to date has focused on HEO type non-GSO FSS and BSS systems in frequency bands up to 30 GHz, and thus the CPM text that follows in this section is similarly focused.

* These Rules of Procedure were contested by some administration.

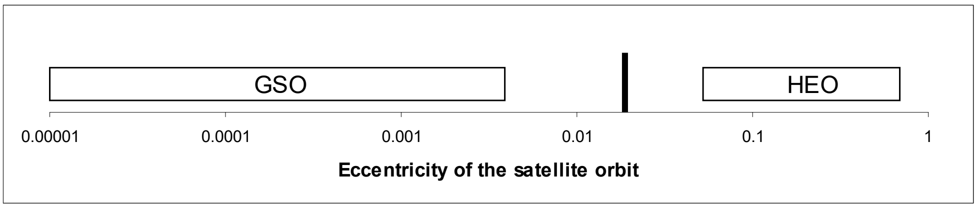
Relevant ITU-R Recommendations: S.1431, S.1560, S.1328-3, S.1593, S.1595 and DNR SF.[Hesat].

3.7.1.1 Characterization and typical examples of satellite systems using HEO

HEO systems/networks are non-GSO systems. As such, under the current Radio Regulations, a HEO satellite system is treated like any other non-GSO satellite system in the same band and service. However, they have specific characteristics, which have been considered in the ITU-R studies on this issue.

The orbits that have been considered in the ITU-R studies are:

1) an orbit with an eccentricity of at least 0.05 (see Figure below), an inclination between 35 and 145 degrees, an apogee altitude of at least 18 000 km, and a period that is the geosynchronous period (23 hours, 56 minutes) multiplied by m/n where m and n are integers (the ratio m/n may be less than, equal to, or greater than one); or
2) a circular orbit (with an eccentricity of at most 0.005), with the geosynchronous period (23 hours, 56 minutes) and an inclination between 35 and 145 degrees. The second category above has been included in the ITU-R studies because these orbits have characteristics for sharing with the GSO that are similar to HEO systems.



Each satellite in the two categories above has a repeating ground track and provides a space radiocommunication service (other than space operation services) only during a portion or portions of the orbit referred to variously as operational windows, active arcs, or high-latitude stationary arcs (all of these terms are referred to throughout Section 3.7 as "active arc"). The results discussed in the following subsections are intended to include both types of orbit categories described in the prior paragraph, unless otherwise expressly stated.

Studies in ITU-R have shown that many variations in HEO system design and operation are possible. These variations arise because HEO systems and networks have differing missions or differing optimization criteria. Examples of these variations are frequencies; space services; the size of the service area; minimum elevation angles; use of full-motion, limited-tracking, or fixed earth terminal antennas; the size of the active arcs; the number of satellites that operate simultaneously; and the number of active arcs within which a satellite operates. It is recommended that regulations not focus on a small subset or limited range of these characteristics but should be general so as to afford an opportunity for development of HEO systems.

Annex 3.7-1 contains Figures 3.7-1 to 3.7-3 that present the ground tracks of some Highly-Elliptical Orbits (HEO) satisfying the characteristics described in above.

3.7.1.2 Operational features common to HEO satellite systems

HEO systems have specific operational features, which are described hereafter.

a) **Active Arc** - Except for space operations functions, each satellite in an HEO system operates during a specific portion of its orbit. Depending on the orbit period, this portion of the orbit will recur over one or more location on the Earth. The sizes of these active arcs are a function of the particular system design. In order to provide continuous service, at least one satellite from a given HEO system will be in each active arc at all times.

b) **Repeating ground tracks** - Satellites in HEO orbits have repeating ground tracks that fix the active arcs in the sky. Depending on the size of the operational window and the number of satellites within the HEO system, this may help increase frequency reuse between separate systems using these types of orbits. The fixed operational windows in the sky may also result in near-constant look angles from the earth stations.

c) **Antennas of associated earth stations** - Depending on the band and service, earth station antennas may be more or less directional. Depending on the size of the active arc and the directionality of the antenna, the antenna's steerability may vary from full to non-steerable (Fixed).

d) **High elevation angles from HEO earth stations in medium to high latitude regions** - This allows locations that have low elevation angles to the GSO to obtain the benefits of high elevation angles.

e) **Low elevation angles for earth stations in tropical and sub-tropical regions**.

f) **Interval between handovers** - HEO satellites in the same active arcs are able to provide continuous coverage, with many hours between handovers.

g) **Angular discrimination from the geostationary-satellite orbit** - An HEO system can be designed such that there is a large angular discrimination from the geostationary-satellite orbit. For applications in which directional antennas are used and depending on the size of the operational window, this could enhance sharing between a satellite in its operational window and satellites in the geostationary-satellite orbit.

h) **Coverage area** - For certain regions of the world, in medium to high latitudes, a HEO system may serve a very large east-to-west portion of that region that could not be served by a single geostationary satellite.

3.7.2 Analysis of the results of studies

3.7.2.1 Sharing involving HEOs, other non-GSO systems, and GSO networks

The studies in ITU-R have shown that, where HEO earth stations use directional antennas, sharing between as many as nine HEO satellite systems would be possible by using similar orbit parameters and appropriate interleaving between satellites using similar orbital planes. (This conclusion is based on the assumption of an earth station antenna off-axis gain pattern of $36 - 25\mathrm{Log}(\theta)$.) See Recommendation ITU-R S.1593. This however, would require that pre-defined orbital and transmission parameters be included in the RR. Given that ITU has already received filings for a variety of different HEO system designs, it is likely that agreement on the optimum configuration would be difficult to achieve.

Since the studies previously performed by ITU-R on the sharing between inhomogeneous non-GSO satellite systems included HEOs, the use of mitigation techniques would in principle facilitate this sharing. However, the significant difference in operating altitude between HEOs and other types of non-GSO system (particularly low-Earth orbit systems) potentially increases the severity of interference during "in-line" events, and hence increases the degree of mitigation required. The use of satellite diversity as described in Recommendation ITU-R S.1431, may be difficult. Most HEOs simply are not designed to have multiple satellites with multiple beams per satellite capable of simultaneously servicing a given earth station location. See Recommendation ITU-R S.1595. Where earth stations use directional antennas, most HEO systems have the potential for sharing with GSO networks without using satellite diversity, because their inherent design ensures maintenance of large separations between active non-GSO satellites and GSO satellites. As a result, the additional spacecraft and switching strategies necessary to effect satellite diversity are not typically part of the design of HEO systems, and make its use by such systems in sharing with other types of non-GSO FSS systems (including dissimilar HEO systems) difficult.

The studies previously performed by ITU-R on the sharing between inhomogeneous non-GSO satellite systems assumed a maximum effective number of 3.5 for co-coverage, co-frequency, non-GSO systems, including HEO systems. These studies addressed the bands between 10.7 GHz and 30 GHz. In bands below 10.7 GHz, this number may be different, depending on factors such as the reduced earth station antenna discrimination, the smaller link margins and the deployment scenarios of non-GSO systems.

The ITU-R has developed a methodology for assessing the maximum interference produced by HEO systems at 6/4 GHz into GSO FSS networks (see Recommendation ITU-R S.1560). Application of this methodology shows that peak $\Delta T/T$ values produced into a representative GSO network by a particular type of HEO system at 6/4 GHz are very low (less than 1% in most cases, and always less than 2%). This methodology may also be used in other frequency bands to assess interference levels into GSO networks. However, the use of this methodology (including the $\Delta T/T$ criterion) as a basis for drawing conclusions on possible regulatory measures to protect GSO networks from non-GSO systems producing only long term interference requires further studies (see § 3.7.4.7). ITU-R has also been developing methodologies for assessing the maximum interference produced by HEO systems in the frequency band 10-31 GHz into GSO networks.

In the bands where earth stations (within HEO, other non-GSO systems or GSO networks) use antennas with small angular discrimination, the sharing potential of anyone of these systems is essential very limited.

3.7.2.2 Sharing between FSS systems using HEO satellites and the FS

ITU-R has undertaken initial sharing studies between HEO FSS systems and FS stations to develop the maximum allowable pfd at the surface of the Earth produced by FSS HEO satellites operating in the bands shared with the FS. In these studies, ITU-R recognized that HEO satellites are non-GSO satellites, but are different from the so-called low earth orbit (LEO) satellites and medium earth orbit (MEO) satellites, and that satellites in highly-elliptical orbits have the characteristics described in § 3.7.1.1. Also it was noted that in general only one satellite is active within each active window of a HEO system.

Analysis of the designs of present and future HEO FSS systems shows that, in most such systems, the maximum pfd value at the Earth's surface is produced by a HEO satellite only when it is entering to or exiting from an active window, i.e. when it is at the minimum distance from the Earth while transmitting.

In bands where the FSS is co-primary with the FS, the assessment of sharing conditions should take into account the requirements of both services on an equal basis.

3.7.2.2.1 Nature of interference into the fixed service from different types of satellite orbits

In principle, the interference produced by satellites in the GSO arc is long term in nature, but is limited to specific combinations of FS elevation and azimuth. Since the location of the GSO arc is well defined, it is possible for an FS receive station to mitigate the interference by avoiding the arc, if necessary. The interference produced by non-GSO satellites in low circular orbits is short term in nature, but occurs in a much greater number of combinations of FS elevation and azimuth. Non-GSO FSS satellites in highly-elliptical orbits may repeatedly appear within main beams of some FS antennas for significant durations of time. Unlike the GSO case, the combinations of affected FS elevation and azimuth are not limited to a single arc, but may occur in comparatively wide belts in the sky. It is not practicable for FS receive stations to avoid these belts. For some highly-inclined HEO systems this situation is potentially more critical for FS links which have approximately North/South alignments and are located in low latitude areas. In addition, at high latitudes, interference into FS side lobes is a concern.

It is recognized that equal treatment should be given to HEOs compared to other non-GSO systems. On this basis, some administrations believe that the determination of the pfd masks should be based on protection of all FS links and that interference exceeding the FS protection criteria should only be accepted in exceptional cases. Some other administrations believe that some of the pfd levels being considered based on protection of all FS links would lead to undue constraints on the development and operation of HEO systems. These other administrations consider that this would be inconsistent with the principle of equal treatment among non-GSO systems and with the fact that FSS/FS sharing in co-primary bands should be based on pfd levels that would adequately, but not fully, protect the FS.

3.7.2.2.2 Power flux-density in the 4 GHz band

One of the features of FS systems operating in the 4 GHz band is that generally they are used for point-to-point (P-P) transmission with multi-state modulation (e.g. 64-QAM) achieving high spectral efficiency. In such systems, it is a general practice to use diversity reception techniques in many hops to overcome adverse effects of multipath fading. It is noted that part of this band is also used for point-to-multipoint (P-MP) systems. Recommendations ITU-R F.1108-2 and SF.1320 recognize that long-haul FS systems are susceptible to interference from satellites and have adopted a formula to calculate fractional degradation in performance (FDP) which is used for evaluating the effects of interference to FS systems employing diversity reception techniques.

ITU-R has been studying sharing between HEO FSS satellites and the FS. The studies showed that the interference produced by the HEO systems into the FS stations depends on the number of visible active satellites and on the orbital parameters. Several studies were performed involving multiple constellations of HEO satellites in 8-hour and 12-hour orbits. For the 8-hour orbit case, one study was based on a total of 45 active HEO satellites (30 in the northern hemisphere and 15 in the southern hemisphere) in a multi-constellation environment. Other studies were based on a total of 18 or 36 active satellites (all in the northern hemisphere) that use 12-hour orbits in a multi-constellation environment. The expected number of active HEO satellites, which should be taken into account while calculating the interference into a FS station, has not been agreed.

In addition, some studies were based on a 10% allowance of FS links exceeding the required criteria (FDP = 10%), while others were based on a ~0% allowance.

Some administrations are of the view that the following existing pfd limits in Table **21-4** of RR Article **21** for FSS in the 4 GHz band are sufficient to adequately protect FS systems from HEO satellite interference:

-128	dB(W/m^2) in 1 MHz	for $0° < \theta \leq 5°$
$-128 + 0.5\ (\theta - 5)$	dB(W/m^2) in 1 MHz	for $5° < \theta \leq 25°$
-118	dB(W/m^2) in 1 MHz	for $25° < \theta \leq 90°$

On the other hand, some other administrations believe that a tightening of the current Article **21** pfd mask is necessary in order to ensure the protection of the FS, in particular with regard to low elevation angles. These administrations proposed the following pfd masks for the 3.7 to 4.2 GHz band:

Mask A

−136	dB(W/m^2) in 1 MHz	for 0° $< \theta \le 5°$
−136 + 0.5 (θ – 5)	dB(W/m^2) in 1 MHz	for 5° $< \theta \le 25°$
–126	dB(W/m^2) in 1 MHz	for 25° $< \theta \le 90°$

or Mask B

−142	dB(W/m^2) in 1 MHz	for 0° $< \theta \le 5°$
−142 + 0.9 (θ – 5)	dB(W/m^2) in 1 MHz	for 5° $< \theta \le 25°$
−124	dB(W/m^2) in 1 MHz	for 25° $< \theta \le 90°$

or Mask C

−147	dB(W/m^2) in 1 MHz	for 0° $< \theta \le 5°$
−147 + 1.15 (θ – 5)	dB(W/m^2) in 1 MHz	for 5° $< \theta \le 25°$
–124	dB(W/m^2) in 1 MHz	for 25° $< \theta \le 90°$

or Mask D

−158	dB(W/m^2) in 1 MHz	for 0° $< \theta \le 5°$
−158 + 1.65 (θ – 5)	dB(W/m^2) in 1 MHz	for 5° $< \theta \le 25°$
–125	dB(W/m^2) in 1 MHz	for 25° $< \theta \le 90°$

where θ is the arrival angle above the horizontal plane. The pfd values should be calculated under free-space propagation conditions.

In particular, it can be noted that Masks A and B are based on a 10% allowance of FS links exceeding the required criteria (FDP = 10%), while Masks C and D are based on a ~0% allowance. These latter masks (C and D) are intended by some administrations to protect the FS, which mainly operates at low elevation angles, and meet the need of high pfd level at high elevation for HEO satellites. These same administrations are of the view that current Article **21** pfd limits, as well as masks A and B, would unduly constrain existing and future FS links. Some other administrations are of the view that Masks C and D would unduly constrain the design of HEO satellites, and render HEOs impracticable in this band.

Therefore, it was agreed that further sharing studies between HEO FSS and FS systems in the frequency band 3.7 - 4.2 GHz are required, if possible before WRC-03, in order to determine whether there is a need to modify the current Article **21** limits and, if there is, to determine the relevant pfd mask that will adequately protect the FS and, at the same time, will reflect HEO FSS satellite requirements.

3.7.2.2.3 Power flux-density in the 11 GHz band

Unlike the bands below 10 GHz, usually FS systems in the 11 GHz band do not employ diversity reception techniques and, therefore, the effects of satellite interference in terms of FDP can be evaluated by averaging the interference-to-thermal noise ratio. Some sharing studies, based on a 10% or less allowance of FS links exceeding the required criteria (FDP = 10%), show that the existing pfd limits in Table **21-4** of RR Article **21** for non-GSO FSS systems are acceptable for HEO satellites, these being that the maximum pfd at the surface of the Earth by emissions of a HEO satellite should not exceed the following values:

in the band 10.7 to 11.7 GHz, in any 1 MHz band:

-126	dB(W/m^2)	for $0° < \theta \leq 5°$
$-126 + 0.5\ (\theta - 5)$	dB(W/m^2)	for $5° < \theta \leq 25°$
-116	dB(W/m^2)	for $25° < \theta \leq 90°$

in the band 11.7 to 12.7 GHz, in any 1 MHz band:

-124	dB(W/m^2)	for $0° < \theta \leq 5°$
$-124 + 0.5\ (\theta - 5)$	dB(W/m^2)	for $5° < \theta \leq 25°$
-114	dB(W/m^2)	for $25° < \theta \leq 90°$

where θ is the arrival angle above the horizontal plane. The pfd values should be calculated under free space propagation conditions.

Some other administrations noted that the same assumption concerning the interference allowance was not considered when assessing the above Article **21** pfd limits for circular orbit non-GSO satellites in the previous study period. These same administrations are of the view that these current Article **21** pfd limits would unduly constrain existing and future FS links. On this basis, they identified additional pfd masks intended to protect the FS, which mainly operates at low elevation angles, and meet the need of high pfd level at high elevation for HEO satellites. These masks would apply to the entire 10.7-12.75 GHz range, as follows:

Mask E

-147	dB(W/m^2) in 1 MHz	for $0° < \theta \leq 5°$
$-147 + 1.75\ (\theta - 5)$	dB(W/m^2) in 1 MHz	for $5° < \theta \leq 25°$
-112	dB(W/m^2) in 1 MHz	for $25° < \theta \leq 90°$

or Mask F

-149	dB(W/m^2) in 1 MHz	for $0° < \theta \leq 5°$
$-149 + 3\ (\theta - 5)$	dB(W/m^2) in 1 MHz	for $5° < \theta \leq 15°$
$-119 + 3\ (\theta - 15)/10$	dB(W/m^2) in 1 MHz	for $15° < \theta \leq 25°$
-116	dB(W/m^2) in 1 MHz	for $25° < \theta \leq 90°$

where θ is the arrival angle above the horizontal plane. The pfd values should be calculated under free space propagation conditions.

Those administrations supporting the continued application of the current Article **21** limits for non-GSO FSS systems to HEO systems are of the view that masks E and F would unduly constrain the design of HEO satellites and render HEOs impracticable in these bands.

ITU-R has not agreed on which of the masks stated above is adequate to protect the FS in the 11 GHz band from HEO satellite interference. Therefore, it was agreed that further sharing studies between HEO FSS and FS systems in the frequency band 10.7-12.75 GHz are required, if possible before WRC-03, in order to determine whether there is a need to modify the current Article **21** limits and, if there is, to determine the relevant pfd mask or masks that will adequately protect the FS and, at the same time, will reflect HEO FSS satellite requirements.

3.7.2.2.4 Power flux-density in other FSS bands shared with the FS

ITU-R studies on sharing between HEO FSS and the FS in other shared bands below 42.5 GHz have commenced.

For the 18 and 38/40 GHz bands, some Administrations are of the opinion that the current Article **21** pfd limits for non-GSO FSS are adequate to protect the FS from HEO satellite transmissions.

On the other hand, based on studies presented within ITU-R by one administration, some other administrations are of the view that tightening of the pfd limits compared to those for other non-GSO systems, mainly at low elevation angles, would be necessary in order to ensure the adequate protection of the FS.

Therefore, it was agreed that further sharing studies between HEO FSS and FS systems in the frequency bands above are required, if possible before WRC-03, in order to determine whether there is a need to modify the current Article **21** limits and, if there is, to determine the relevant pfd masks that will adequately protect the FS and, at the same time, will reflect HEO FSS satellite requirements.

3.7.2.2.5 Interference from FS systems to FSS HEO space stations

FSS systems comprised of constellations of HEO satellites may operate in the same frequency bands shared with the FS. FSS earth stations may be designed to operate at high elevation angles in medium to high latitude regions. As a consequence, satellite antenna patterns may be less sensitive in the direction of the Earth's limb and, therefore, FS stations might not need to avoid pointing at HEO satellites.

Proponents of FSS systems employing HEO satellites should be aware of the existing fixed service power limits in Nos. **21.3** and **21.5**.

3.7.2.2.6 Coordination between earth stations of FSS HEO systems and FS stations

RR Appendix **7**, which covers earth stations operating with non-GSO satellites, can be applied to the determination of coordination area for an earth station of FSS HEO systems in frequency bands shared with FS systems.

3.7.2.3 Sharing involving HEO BSS systems and terrestrial services

Analysis of results of studies of non-GSO, including HEO, BSS (sound) systems in the band 2 630-2 655 MHz are presented in Section 3.5 above, in response to WRC-03 agenda item 1.34.

The ITU-R discussions covered No. **5.311** of the Radio Regulations regarding the bringing into use of assignments to the broadcasting-satellite service in the band 620-790 MHz shared with equal rights with the broadcasting service. There are few GSO systems operating in accordance with No. **5.311**. There is no non-GSO system (HEO or not) currently operating in this band. Also, several systems (HEO and GSO) have recently been the subject of advance publications in this band. The RRB is expected to address this issue based on the conclusion of the ITU-R. The impact of such HEO systems on the broadcasting service is currently under study by ITU-R.

In relation to the pfd limits in No. **5.311** and in Recommendation **705 (WARC-79)**, ITU-R needs to determine the adequacy of these pfd limits to protect the terrestrial BS from single entry and aggregate interference caused by non-GSO HEO BSS systems and GSO BSS networks.

The use of the band 620-790 MHz by the broadcasting service in Region 1 and in a number of countries in Region 3 is subject to revision by RRC 04/05. Some administrations consider that no action should be taken regarding the sharing between HEOs and terrestrial broadcasting services until the conclusion of RRC 04/05.

The question of the protection of terrestrial services requires further study, noting that the current limits in No. **5.311** were developed as interim values. These studies are currently conducted by ITU-R and should take into account, in particular, the expected characteristics of the terrestrial and space systems in the band, the type of modulation used, the maximum number of HEO satellites that may be operated simultaneously, and the need for a single entry pfd limit and/or an aggregate pfd limit. Views were expressed that it would be inappropriate to draw conclusions regarding the form and levels of the protection criteria and their modes of application until all such information has been taken into account and the studies have been completed.

3.7.2.4 Other frequency bands and radio services

Combinations of frequency bands and radio services, other than those mentioned above, have not been studied. As a consequence, there are no analyses of results to report.

3.7.3 Methods to satisfy the agenda item

3.7.3.1 Background

Depending on the frequency band, three ways have been identified in the Radio Regulations in order to specify the regulatory framework for sharing between non-GSO (including HEO) systems and GSO networks.

- Application of No. **22.2** without specific additional regulatory provisions.
- Application of No. **22.2** with additional regulatory provisions to:
  a) quantify it (and thus clarify the status of non-GSO systems); and
  b) impose hard limits on the power radiated by non-GSO systems into GSO networks (and thus clarify the status of GSO networks).
- Replacement of No. **22.2** by coordination between GSO and non-GSO systems.

The applicability of any one of these approaches to HEO systems in any frequency band depends on the specific regulatory situation in that band, the current and expected use of the band by GSO networks and HEO systems, the possible burden on administrations and the Bureau, and the maturity of the ITU-R studies on the issue.

Some studies submitted to ITU-R concluded that, taking into account the characteristics of HEO systems, criteria and calculation methodologies different from those applied for other non-GSO systems may be applied to HEO systems to assess interference from these systems into other systems or networks.

Some administrations take the view that the intention of WRC-2000 in proposing the inclusion of this item in the agenda of WRC-03 was limited to a possible description of highly elliptical orbits and minimum regulatory provisions as a starting point which could be a way forward for further ITU-R studies and possible consideration at a future Conference. They believe that it was in no way intended that all regulatory and procedural aspects of HEOs should be addressed by ITU in one study period.

3.7.3.2 Definition of HEO systems in the Radio Regulations

Geostationary satellites and the GSO are defined in Nos. **1.189** and **1.190** of the Radio Regulations independent of use, design characteristics, radio service, frequency band, etc. Likewise, LEO and MEO are defined in Recommendation ITU-R S.673 solely in terms of their orbital characteristics. The description of HEO in Section 3.7.1.1 is the same; such a description does not and should not involve any system characteristics. This generality of description is important for HEOs since their current use is low and development should not be constrained by a description that restricts system design options. Consequently, there is no need to modify Article **1**.

3.7.3.3 Status of HEO systems in respect of GSO networks and other non-GSO systems

Satellite networks using HEOs should continue to be considered as non-GSOs, and have the same regulatory standing with regard to co-frequency GSO networks as other types of non-GSOs, such as MEOs and LEOs.

3.7.3.4 Data elements in Appendix 4

Some regulations applicable to HEO systems, as a subset of non-GSO systems, already exist in Articles **21** and **22** and Appendix **4**. It may be desirable to add/modify several data elements to Appendix **4** (mean motion; eccentricity; inclination; longitudes of apogees; arguments of perigees; active arc extents (may be specified as time relative to the time of highest latitude); the index position in each ground track (a mean anomaly at a cited epoch, from which all satellite positions are to be measured); and spacing in ground track (in mean anomaly, or alternatively, time of cited point crossing)).

If these data elements are added or modified, there should be no regulatory limitation on their values in order to allow full flexibility to the operator.

3.7.3.5 Sharing between HEO FSS systems and the fixed service

In the 3.7-4.2 GHz and 10.7-12.7 GHz bands, ITU-R studies have been carried out in order to identify appropriate maximum pfd levels for the protection of fixed service systems from interference produced by HEO FSS systems. However, ITU-R has been unable to reach a conclusion on this issue. Further study of the sharing situations in these bands is required.

3.7.4 Regulatory and procedural considerations

3.7.4.1 HEO MSS systems below 3 GHz

In the bands allocated to the MSS below 3 GHz, non-GSO and GSO MSS systems enjoy the same regulatory footing and are required to coordinate under No. **9.11A**. Thus there does not appear to be need for any regulatory change to these allocations to facilitate the introduction of HEO systems.

3.7.4.2 HEO BSS systems below 1 GHz

It was noted that, in addition to the other applicable procedures, No. **23.13** also applies to the operation of GSO BSS and non-GSO HEO BSS systems in bands below 1 GHz, and that some administrations consider that the current Rules of Procedure do not properly cover the case when an administration requests that its territory be excluded from the satellite service area in real terms.

3.7.4.2.1 Sharing between HEO BSS systems and GSO BSS systems below 1 GHz

The band 620-790 MHz is allocated to the BSS under the conditions No. **5.311**.

The use of this allocation by non-GSO BSS systems is also subject to the application of No. **22.2**, in order to protect GSO BSS systems.

Concerning the application of this provision and the relative status of HEO BSS and GSO BSS in this band, the discussions in the ITU-R lead to three different views:

a) In this band, it may be assumed that earth station antennas with no or very limited angular discrimination, will be used by GSO systems, HEO systems, and by other non-GSO systems. This means that the sharing potential of anyone of these systems is inevitably very limited and GSO systems do not provide, from this point of view, any specific advantage that would warrant any sort of priority. For this reason, it would be consistent to modify the radio regulations so that the same regulatory situation applies to all these satellite systems, i.e. to apply Nos. **9.12, 9.12A and 9.13** as a replacement for the application of No. **22.2**. It was noted that, in a similar case, coordination procedures between non-GSO systems and

GSO networks have been implemented (Nos. **5.418A, B** and **C** in the band 2 630-2 655 MHz).

b) In this band, HEO BSS systems have been allowed since WARC-71. However, no such systems have been implemented up to now. WRC-97 extended the application of No. 22.2 to protect GSO BSS networks from non-GSO systems and therefore GSO BSS systems should continue to be protected by No. **22.2**, and HEO systems should continue to protect GSO BSS networks irrespective of their date of receipt by the Bureau.

c) In this band, GSO BSS systems should continue to be protected by No. **22.2**, but there would be a need to quantify the level of interference that is considered acceptable under this provision, in order to clarify the regulatory status of both GSO networks and HEO systems in the band.

It was concluded however that, since the protection of the broadcasting-satellite service from the HEO broadcasting-satellite service is still under study in ITU-R, any decision to suppress the application of No. **22.2** in this band should be deferred until completion of the ITU-R studies.

3.7.4.2.2 Sharing between BSS systems and the broadcasting service below 1 GHz

Resolution 33 (Rev.WRC-97) on the bringing into use of space stations in the BSS, prior to the entry into force of agreements and associated plans for the BSS, resolves that for satellite networks for which the API has been received after 1 January 1999 the procedures of Article **9** shall be applied regarding the coordination procedure with terrestrial stations. Within these procedures, No. **9.11** applies to GSO and non-GSO transmit space stations in respect of terrestrial services.

No. **5.311** of the Radio Regulations indicates a pfd limit of –129 dBW/m^2 (see Rec. 705) for space stations at angles of arrival below 20° with no mention as to the orbit of the concerned BSS space station (GSO or non-GSO).

Concerning the procedures to be applied by BSS systems in order to protect the broadcasting service the following conclusions have been reached:

a) For angles of arrival below 20°, the limit of –129 dBW/m^2 per space station is a hard limit associated with examination under No. **11.31**. The value of this limit requires further study.

b) For angles of arrival above 20° the pfd mask contained in Recommendation 705 (WARC-79), possibly modified in view of the results of ITU-R studies, may be applied. Such ITU-R studies are proceeding, including consideration of possible regulatory procedures for the application of the pfd values.

3.7.4.3 Bands allocated to BSS (sound) between 1 and 3 GHz

The band 2 535-2 655 MHz is allocated to BSS (sound) in the nine countries covered by No. **5.418**, i.e. Bangladesh, Belarus, Korea (Rep. of), India, Japan, Pakistan, Singapore, Sri Lanka and Thailand.

In the sub-band 2 630-2 655 MHz, No. **22.2** no longer applies for the protection of GSO FSS or BSS networks received after 3 June 2000. The associated regulatory provisions applicable to the use of non-GSO BSS (sound) systems are specified in Nos. **5.418A, 5.418B** and **5.418C**. Application of Nos. **9.12A** and **9.13** is specified for coordinating between GSO and non-GSO in this band. No. **9.12** applies for the coordination between non-GSO systems.

The use of the other sub-band (2 535-2 630 MHz) in these nine countries is subject to the provisions of Resolution **528** (WARC-92), i.e. cannot be used by BSS sound until a planning conference has been convened.

The other bands allocated to BSS (sound) between 1 and 3 GHz are the following:

1 452-1 492 MHz in Regions 1, 2 and 3 (except in the USA)
2 310-2 360 MHz (in the countries covered by No. **5.393**, i.e. USA, India and Mexico)

In these bands, the use of BSS (sound) by GSO systems is protected from non-GSO systems by No. **22.2**, as a result of a change to this provision at WRC-97. Pursuant to Resolution **528 (WARC-92)**, the band 1 452-1 467 MHz cannot be used by BSS sound until a planning conference has been convened. This future planning conference may consider regulatory provisions to accommodate HEO systems in the 1 452-1 492 MHz, 2 310-2 360 MHz and 2 535-2 655 MHz bands.

In the band 2 310-2 360 MHz, both GSO and non-GSO systems are now operating. Its use has been successfully coordinated through the bilateral negotiation process under the current regulatory procedures, thus no further regulatory action is required. Moreover, it is noted that none of the administrations listed in No. **5.393** have expressed a need for any regulatory change with regard to GSO/non-GSO BSS (sound) sharing in the 2 310-2 360 MHz band.

In the band 1 467-1 492 MHz, consideration may be given to the introduction of non-GSO HEO systems on an equitable basis with GSO networks, for reasons similar to those given in Section 3.7.4.2 a) above. This may be done in a similar way as decided by WRC-2000 in the band 2 630-2 655 MHz in the countries covered by No. **5.418**, by replacing the application of No. **22.2** by coordination between non-GSO and GSO systems (Nos. **9.12, 9.12A** and **9.13**). Any changes to the Radio Regulations in the 1 467-1 492 MHz band should be made only after taking into account the technical and regulatory requirements of the HEO BSS (sound) systems proposed to operate in the band, operational GSO BSS (sound) networks in the band, and other allocated services.

3.7.4.4 HEO BSS (and not specifically BSS sound) or HEO FSS between 1 and 3 GHz

The following bands are allocated to the BSS or FSS between 1 and 3 GHz:

2 500-2 690 MHz	FSS (space-to-Earth) in Region 2
2 500-2 535 MHz and 2 655-2 690 MHz	FSS (space-to-Earth) in Region 3
2 520-2 670 MHz	BSS in Regions 1, 2 and 3

In these bands, No. **22.2** applies for the protection of GSO FSS and GSO BSS, with the exception of the band 2 630-2 655 MHz in the countries listed in No. **5.418**. The operation of FSS or BSS systems is limited by Nos. **5.415** and **S5.416**, to national and regional systems, subject to agreement obtained under **No. 9.21**. The power flux-density at the Earth's surface must not exceed the values given in Article **21**, Table **21-4**. These values are expected to require the use of receive earth station antennas with sufficient size to provide enough discrimination for sharing among GSO networks and HEO systems.

Two views have been expressed on this subject:

a) Facilitating the use of these bands by non-GSO HEO systems may be achieved by the adoption of sharing criteria specifying the level of acceptable interference, i.e. quantifying No. **22.2**, as was done by WRC-97 and WRC-2000 in some bands between 10.7 GHz and 30 GHz. Alternatively, No. **22.2** may be replaced by coordination between GSO networks and HEO systems, through Nos. **9.12, 9.12A** and **9.13.** This may be achieved with or without the establishment of thresholds to trigger these coordinations. In both cases, the sharing criteria could be based on epfd thresholds/limits which may be included, respectively in Article **22** or in Appendix **5**. These may be derived on the basis of a representative range of GSO transmissions (antenna sizes, patterns and system noise temperatures), a maximum effective number of non-GSO systems and an agreed upon aggregate noise increase allowance. These aspects require further studies within the ITU-R and may be the subject of a WRC-03 resolution.

b) No specific regulatory action is required. Changes to the Radio Regulations should be made on the basis of an identified need, and taking into account the technical and regulatory requirements of systems proposed to operate in the band. No requirement has been identified within the ITU-R for the use of such frequency bands for HEO BSS (non-sound) and HEO FSS and therefore such systems in the 1-3 GHz band need not be considered under this agenda item.

3.7.4.5 HEO FSS and BSS systems in bands above 3.4 GHz where No. 22.2 applies and no epfd limits are given in Article 22

In the 6/4 GHz, HEO FSS systems (i.e. MOLNYA) have been operating for the last 30 years. There is also a recent filing (USAKU-H2) for a HEO system, and this system, which has been studied in the ITU-R, is one in which transmissions to or from the non-GSO satellite are not made within 40° of the GSO as viewed from any point on the Earth's surface (see Section 3.7.2.1 above). In this frequency range, the introduction of HEO FSS systems and networks may make it desirable to adopt sharing criteria quantifying the level of acceptable interference, hence facilitating compliance by administrations operating such systems or networks with the obligations under **22.2**.

These sharing criteria could take the form of epfd limits in Article **22**. These limits may be derived on the basis of a representative range of GSO transmissions (antenna sizes, patterns and system noise temperatures), a maximum effective number of non-GSO systems and an agreed upon aggregate noise increase allowance. These aspects require further studies within the ITU-R and may be the subject of a WRC-03 resolution. Depending on the results of studies obtained in time for WRC-03, WRC-03 may consider developing appropriate changes to the relevant Radio Regulations.

No studies have been conducted by the ITU-R in bands other than the 6/4 GHz bands where No. **22.2** applies and no epfd limits are given in Article **22**. Some administrations have expressed an interest in studying sharing conditions in other frequency bands that fall within the scope of this section. At this time, however, no need has been identified for any possible changes to the Radio Regulations in conjunction with HEO systems in these bands under this agenda item.

3.7.4.6 HEO FSS, MSS and BSS systems in bands above 3.4 GHz where No. 9.11A applies

In these frequency bands non-GSO and GSO systems enjoy the same regulatory status and are required to coordinate under No. **9.11A**. Thus there does not appear to be a need for any regulatory change to these allocations to facilitate the introduction of HEO systems.

3.7.4.7 HEO FSS, MSS and BSS systems in bands above 3.4 GHz where No. 22.2 applies and epfd limits are given in Article 22

In these bands, it is possible to use for HEOs the same interference assessment methodologies, regulatory approaches and limits already developed by the ITU-R for non-GSO systems. In the frequency bands where Nos. **22.5C** and **22.5D** apply, the FSS satellite systems using highly-elliptical orbits have to meet epfd↓, epfd↑ and $epfd_{is}$ limits.

These epfd↓ limits may also be expressed as a percentage increase of the GSO network link noise temperature (ΔT/T) into a range of GSO earth station antenna diameters and associated example noise levels. In the band 10.7-12.7 GHz, the applicable long term epfd↓ limits correspond to ΔT/T levels ranging from 0.2 to 1.1%. In the band 17.8-18.6 GHz, they correspond to ΔT/T levels ranging from 1.2 to 2.3%. In the band 19.7-20.2 GHz, they correspond to ΔT/T levels ranging from 0.04 to 0.09%.

There is therefore a large variation (more than 15 dB) between long term ΔT/T allowances which correspond to the applicable limits in the various frequency bands. These long-term epfd limits were based on previous ITU-R studies and decisions taken at WRC-2000 and were based on the assumption that non-GSO systems may produce both short term and long term interference. The epfd caused by many types of HEO system into GSO networks is almost time invariant. For these HEOs, compliance with the epfd↓ validation limits is dominated by the long-term epfd↓ limits. In the 10.7-12.7 GHz band and in the 17.8-18.6 GHz band studies have shown that HEO systems having orbital inclinations greater than about 30° are generally able to meet the single-entry epfd↓ limits in No. **22.5C** and there should be no need for changes to the current epfd↓ limits in these bands.

With respect to the 19.7-20.2 GHz band, however, some administrations have stated that it is difficult for some HEO systems to meet the epfd↓ limits which currently apply in this band. Some other administrations have stated that it can be shown that the existing epfd↓ limits at 19.7-20.2 GHz can be met by some HEO systems. ITU-R has concluded that further study is required to determine if the existing epfd↓ limits are overly constraining on HEO systems in the 19.7-20.2 GHz band.

It was suggested that in order to have a more consistent treatment of HEO systems (and possibly of other non-GSO systems) across the various frequency bands, epfd↓ limits be developed in the 19.7-20.2 GHz band, based on a ΔT/T or other possible long term allowance, which would more accurately characterize the interference produced by HEO systems into GSO networks, hence would be more appropriate for HEO systems whilst providing the same overall protection to GSO networks. However, before specific values can be proposed for such limits, more studies are required in the following areas:

- The applicability or otherwise of the antenna patterns in Recommendation ITU-R S.1428 to HEO/GSO interference;
- the maximum effective number ($N_{effective}$) of HEO systems that may share the same frequency band and contribute to the interference into any given GSO network;
- the aggregate long-term allowance for the noise increase produced by all non-GSO systems (including HEO systems);
- the combined effect of interference produced into GSO networks by HEO systems and other non-GSO systems;
- the potential consequential requirement to review the current epfd limits for other non-GSO systems in the 19.7-20.2 GHz band.

Depending on the results of studies obtained in time for WRC-03, WRC-03 may consider developing appropriate changes to the relevant Radio Regulations for the band 19.7-20.2 GHz.

Concerning the use of the Earth-to-space allocations by HEO systems, the ITU-R studies concluded that the current regulatory provisions (including epfd↑ and $epfd_{is}$ limits) in the bands 13.75-14.5 GHz and 17.3 to 30 GHz provide a satisfactory sharing scheme between GSO networks and any type of non-GSO systems, including HEO systems, hence no changes are needed within the scope of this agenda item.

The coordination approach for GSO networks with very large earth station antennas adopted by WRC-2000 in **9.7A** and **9.7B** applies to all bands subject to epfd↓ limits.

3.7.4.8 Other combinations of radiocommunication services and frequency bands

Combinations of frequency bands and radiocommunication services, other than those mentioned above, have not been studied under this agenda item. It is therefore premature to identify any possible changes to the Radio Regulations in conjunction with HEO system/network use of particular combinations of frequency bands and radio services.

3.7.5 General

It is considered that, should WRC-03 decide to suppress the application of No. **22.2** and to apply Nos. **9.12**, **9.12A** and **9.13** in a particular frequency band allocated to a space service, there would be a need to specify the associated transitional arrangements, e.g. in a footnote of Article **5** or in a WRC Resolution referred to by such a footnote. In such a case, a possible example of such transitional arrangements would be the following:

ADD

5.TTT In the band XX MHz, No. **22.2** shall continue to apply to assignments to non-geostationary satellite systems in the [specified space service] for which complete notification information is considered to have been received by the Bureau prior to [day following the end of WRC-03] in respect of assignments to geostationary satellite networks in the [specified space service] for which complete coordination information is considered to have been received by the Bureau prior to [day following the end of WRC-03]. In all other cases, the use of the band XX MHz by networks or systems in the [specified space service] is subject to the application of the provisions of Nos. **9.12**, **9.12A** and **9.13**, and No. **22.2** does not apply.

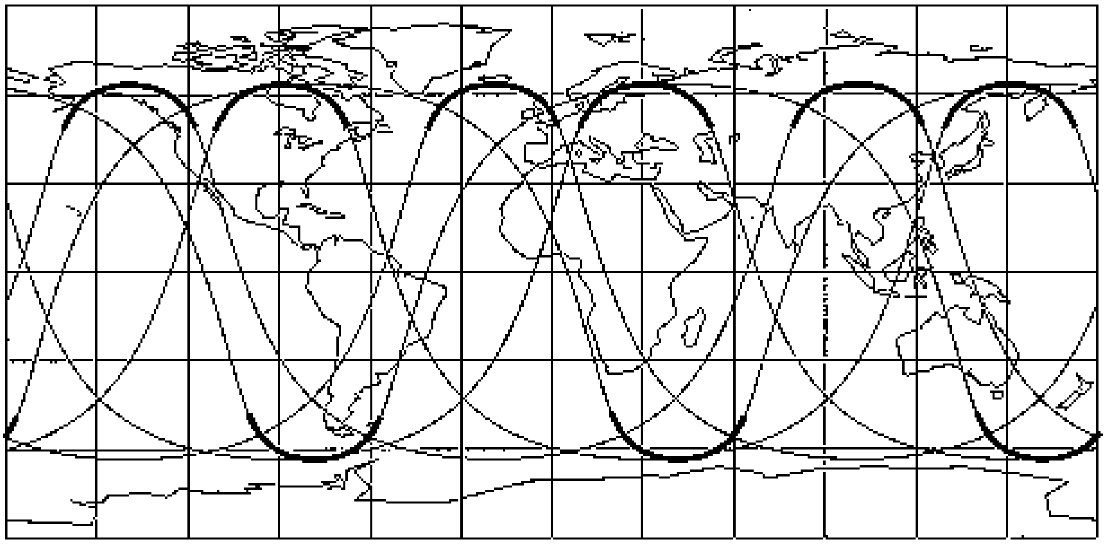
It was also considered that, should WRC-03 decide to suppress the application of No. **22.2** in a particular band, there may be other possible approaches to effect coordination between geostationary satellite networks and non-geostationary satellite systems in that band than applying Nos. **9.12**, **9.12A** and **9.13**.

Annex 3.7-1

Figures 3.7-1 to 3.7-3 present the ground track of some Highly-Elliptical Orbits (HEO) satisfying the characteristics described in Section 3.7.1 above:

FIGURE 3.7-1

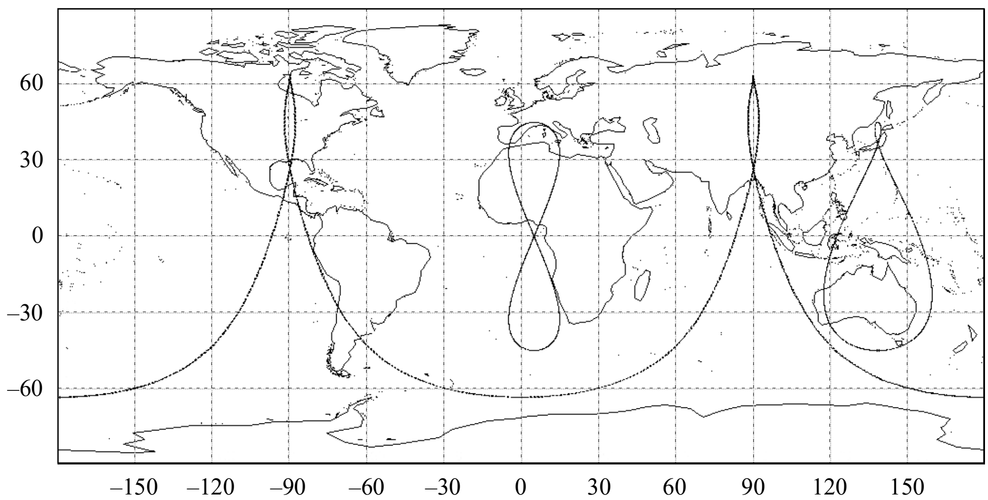
Ground tracks (two Northern Hemisphere, one Southern Hemisphere) of the USAKU-H2 sub-geosynchronous orbit system (period: 7 hours 59 minutes) (m = 1; n = 3)



CPM02-0371
146496

FIGURE 3.7-2

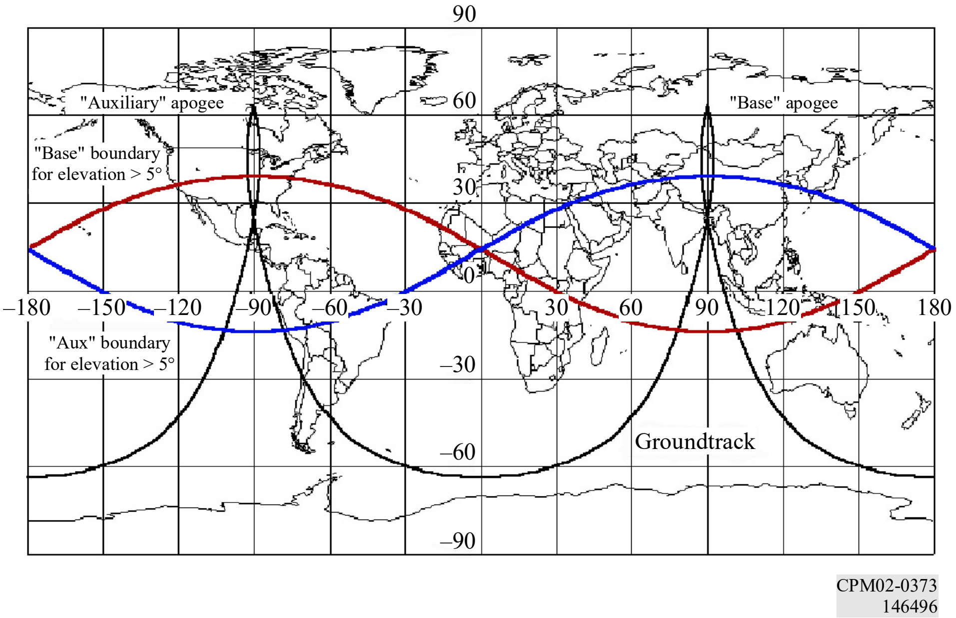
Example of a ground track of
geosynchronous elliptical orbit system (period: 23 hours and 56 minutes) (m = 1; n = 1)
geosynchronous circular orbit system (period: 23 hours and 56 minutes) (m = 1; n = 1)
super-geosynchronous sytem (period: 47 hours and 52 minutes) (m = 2; n = 1)



CPM02-0372
146496

FIGURE 3.7-3

Example of MOLNIYA orbit system (m = 1; n = 2) (period: 11 hours and 58 minutes)



Annex 3.7-2

Statement from Syria, Iran and India:

WRC-2000, in its Resolution 800, under further *resolves* 8 recommended to the Council that the additional budgetary and conference resources be provided so that 4 additional items (8.1-8.4) of that Resolution now appear on agenda item 1.36-1.39 in Resolution 1156 of the Council 2001 can be included in the agenda item for WRC-03.

When Council reviewed Resolution 800 (WRC-2000) at its 2001 session, it was stated that the inclusion of these 4 additional items in the agenda of WRC-03 would not have a great financial impact neither in budgetary terms nor in Conference resource terms.

The way ITU-R proceeding in this regard, in particular with respect to agenda item 1.37, has already had considerable amount of budgetary and meeting resources even before the matters being discussed at WRC-03.

Various ITU-R Study Groups including WPs 4A, 6S, 4-9S and other Working Parties have devoted enormous amount of time and resource to prepare draft CPM text.

At its 2002 April meeting, WP 4A spent tens of hours including Saturday and Sunday to embark upon this very broad agenda item.

Moreover, the intention of WRC-2000 of possible inclusion of this item in the agenda of WRC-03 was limited to a possible description of Highly Elliptical orbit and minimum regulatory provision as a starting point which could be a way forward for its further development and elaboration at future conference and ITU-R Study Groups.

WRC-2000 in no way intended to dwell on this very complex issue form all aspects, in all frequency bands and in every type of orbit. In no way it intended to study all regulatory and procedural aspects of HEO in one shot and by ITU-R Study Groups. The regulatory and procedural aspects of HEO are very broad, complex, multi-dimensional and are not normally within the mandate of Study Groups.

For these reasons, this administration reserves its right with respect of the inclusion of the premature text relating to regulatory matters of HEO in the draft CPM text.

#########

3.8 Agenda item 1.39

"to examine the spectrum requirements in the fixed-satellite service bands below 17 GHz for telemetry, tracking and telecommand of fixed-satellite service networks operating with service links in the frequency bands above 17 GHz"

3.8.1 Summary of technical and operational studies including a list of relevant ITU-R Recommendations

WRC-03 Agenda item 1.39 identifies the need to examine the spectrum requirements in the fixed-satellite service (FSS) service bands below 17 GHz for Telemetry, Tracking and Command (TT&C) of FSS networks operating in the frequency bands above 17 GHz. As a consequence, Question ITU-R 257/4 was revised to include the following issues:

1) What are the performance reliability criteria and objectives of TT&C subsystem operation for the FSS?

2) How do TT&C subsystems for networks using service links above 17 GHz differ from those for networks using service links below 17 GHz?

3) What is the additional coordination burden that must be taken into account in order to accommodate increased usage of spectrum in the bands below 17 GHz bands for TT&C subsystems for FSS networks with service links above 17 GHz?

4) What are the spectrum requirements for the telemetry, tracking and control of FSS satellites, both GSO and non-GSO, operating and planned to operate in the bands above 17 GHz?

3.8.1.1 Technical and operational characteristics of FSS TT&C systems

The results of a parametric analysis on some of the key elements that effect operations above 17 GHz show that it may be difficult to implement TT&C in-band for service links above 17 GHz since these operations are required to be reliable and the performance of TT&C links above 17 GHz is limited by a number of factors.

In the following parametric analysis of command uplinks and telemetry downlinks in the 30/20 GHz and the 50/40 GHz bands, a link in the 14/11-12 GHz range was used as a baseline.

On the uplink, the "threshold" pfd of the reference 11/14 GHz band satellite network was used to calculate the receive power level at the input to the command receiver on the spacecraft. This receive power level was assumed to be a constant required power level for nominal operations. The "threshold" pfd level for the 14 GHz band (reference domestic satellite network) was −90 dB(W/m²). Apart from the threshold pfd, the other parameters which were assumed to be the same across all three frequency bands were the command signal bandwidth, telemetry signal bandwidth and spacecraft transmit power, specified as 1 300 kHz, 300 kHz, and −20 dBW respectively.

The earth station transmitter power levels for the 30 GHz and 50 GHz bands were 600 W and 50 W respectively. Transmit and receive antenna gains of 52.4 dBi and 46.5 dBi were used for the 30 GHz and the 50 GHz bands respectively.

Based on a typical 11/14 GHz band link design, the availabilities achieved on the command uplinks and the telemetry downlinks for satellites are typically on the order of 99.98%. These availabilities are achieved in the 11/14 GHz band under normal operation and are used as guidelines for determining what achievable levels or performance would be acceptable in other frequency bands such as the 30/20 GHz and the 50/40 GHz bands. Note that only the "normal" mode of operation is considered in the sensitivity analysis since the performance achieved under emergency conditions is not the determining factor for TT&C links. Figure 3.8-1 shows the minimum elevation angles over which uplink command and downlink telemetry links may operate with a minimum availability of 99.98 % for rain rates ranging from a minimum of 10 mm/h to a maximum of 100 mm/h.

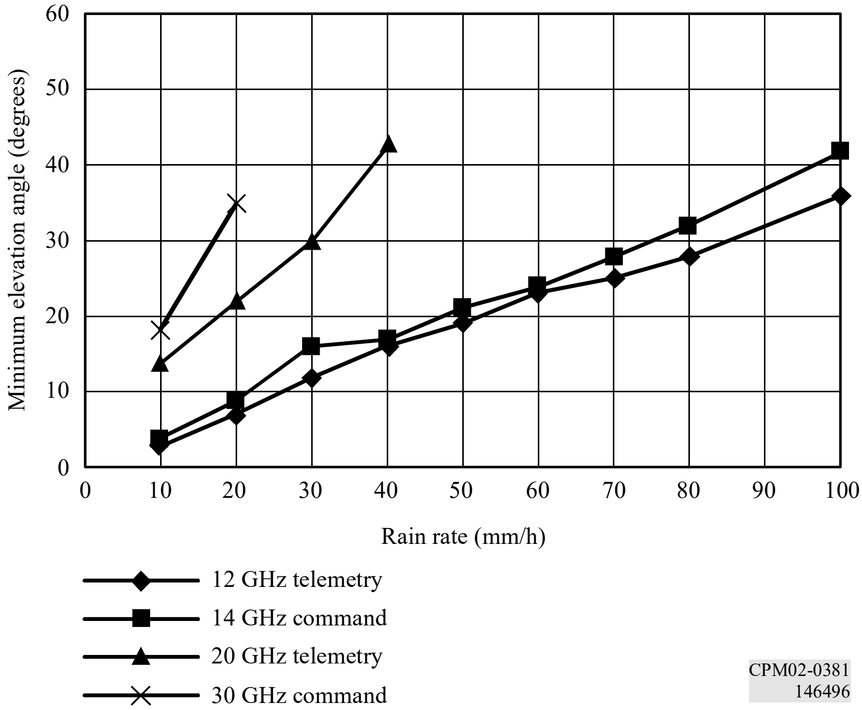
In the 40 GHz frequency band, an availability of only 99.97% could not be achieved for the lowest rain rate and elevation angle examined (10 mm/h and 60° respectively). For 50 GHz, the availability objective of 99.98% was not achieved by any rain rate or elevation angle. An availability of less than 99.9% in the best case was achieved in the 50 GHz frequency band for the command uplink.

It was concluded that there are constraints on TT&C carriers above 17 GHz to achieve availabilities greater than 99.98%, depending on the rain rate and on the elevation angle of the TT&C earth station.

FIGURE 3.8-1

Comparison of TT&C performance at 14/11-12 GHz versus frequencies above 17 GHz

Minimum elevation angle that permits an availability of 99.98% as a function of rain rate



3.8.1.2 Coordination of TT&C carriers

No specific ITU-R Recommendations specify the protection criteria for TT&C carriers. However Recommendation ITU-R BO.1505 contains coordination thresholds for space operation carriers operating in the guard-bands of the BSS Plan contained in Appendices **30** and **30A**.

3.8.1.2.1 Characteristics of TT&C carriers related to interference analysis

One study showed that the minimum and maximum power density levels of the TT&C carriers are not substantially more sensitive nor have more potential for causing interference than standard 64 kb/s QPSK 3/4 rate FEC digital carriers. In the study it was found that in the minimum TT&C carrier level case, the downlink telemetry carriers were more sensitive by approximately 5 dB, while in the case of the maximum carrier levels the uplink command carriers were generally more interference causing by about 4 dB. It should however be noted that two important considerations ease the coordination of the TT&C carriers of any two satellite networks:

a) TT&C carriers occupy a small portion of the satellite bandwidth and through appropriate frequency planning they are usually accommodated.

b) TT&C earth stations usually employ large antennas which reduce the input power requirements and interference susceptibility.

3.8.1.2.2 Coordination between communication carriers and TT&C carriers

Some operators have used a single entry criterion of $C/I > 21$ dB in intersystem coordination with other satellite networks. This criterion allows them to successfully coordinate their TT&C carriers for more than 20 years.

3.8.1.2.3 Coordination between TT&C carriers

A study used a threshold of 1 dB below the minimum sensitivity level to which a command receiver on the spacecraft can respond. This threshold was used as a basis to establish the minimum spacing of adjacent satellites. This minimum spacing is needed to ensure that under the condition where either the wanted carrier is not being transmitted or where it is severely attenuated due to a rain fade event, that the command receiver cannot be "captured" by the interfering satellite network.

The study calculated the aggregate interference from uplink earth stations transmitting to the four closest adjacent satellite networks spaced at multiples of 2° apart. Given a command receiver interference sensitivity of -125 dB(W/m^2) and an uplink antenna diameter (9 m) of the one 14/11 GHz band system analysed, the effect of varying the antenna size in increments of approximately 2 m up to a maximum of 15 m was examined to assess the impact of antenna diameter on the minimum satellite spacing.

The results of the study showed that for a 9 m uplink antenna, the spacing between satellites would have to be no less than 12° to permit frequency reuse. If the antenna size was increased to 15 m, the spacing between the satellites could be reduced to as little as 8°. Based on this fact, when both wanted and interfering command carriers are emitted with the same power levels, it leads to an aggregate C/I ratio of 52 dB.

However, based on a single entry C/I requirement of 30 dB and on the assumption that all TT&C carriers are emitted with the same power levels, another study showed that a co-frequency TT&C carrier could be reused on an adjacent satellite 3° away.

3.8.1.3 TT&C carrier bandwidths

Typically the guard-bands at the upper and lower end of the spectrum used for communications links are used for TT&C operations. Thus, only 5 to 10 MHz of spectrum uplink and downlink are usually available for pilot signals, beacons and TT&C operations. Increasing the amount of spectrum for use by TT&C operations could require some operators to incur reductions in capacity or costs associated with changing the frequency plans employed in their satellite infrastructures. Given that each command uplink occupies on the order of 1.25 MHz bandwidth, the available spectrum for in-band TT&C operations in the 14/11-12 GHz frequency band is already limited. Most GSO FSS spacecraft typically utilize two uplink command carriers, one primary and the other as backup, each may be transmitted on one or multiple polarizations. However, only one command carrier is transmitted at any given time. The allocated bandwidth of a command carrier generally ranges from 1.0 to 1.5 MHz.

Most spacecraft typically utilize two downlink telemetry channels (i.e. two carriers/frequencies) which are transmitted on one or multiple polarizations. Depending on the specific spacecraft, the telemetry information could be transmitted on one channel or simultaneously on both channels. The allocated bandwidth of a telemetry carrier generally ranges from 350 to 600 kHz.

For ranging, lower frequency sub-carriers are often included in the command channel and transmitted to the spacecraft, down-converted and retransmitted back to earth on the telemetry carrier. Therefore, in this case, no additional bandwidth is required for ranging carriers.

3.8.1.4 TT&C spectrum requirements based on satellite network filings

A review of the requests for coordination received by the Radiocommunications Bureau for assignments to the service links of satellites in the FSS primary allocations above 17 GHz, coupled with an assessment, based on the responses to Circular Letter CA/99, of the orbital spacing needed for frequency re-use by TT&C carriers, led to the following deductions:

i) To date there have been no request for assignments to FSS service links above 74 GHz, and hence this analysis examined only the FSS primary allocations between 17 and 74 GHz.

ii) Up to now about half of the FSS satellites with services above 17 GHz are designed to operate their TT&C carriers below 17 GHz.

iii) Based on the amount of spectrum currently available to the FSS the eventual number of satellites with service payloads between 17 and 74 GHz is estimated to be about twice the number with service payloads below 17 GHz.

iv) TT&C frequencies below 17 GHz can be re-used at intervals of about 3° around the GSO based on the typical antenna diameters provided in response to CA/99, the assumption that each TT&C carrier is emitted with the same power levels and a single entry C/I=30 dB.

v) Of the FSS satellites currently filed for service links above 17 GHz the maximum number per 3 degrees of the GSO is 21, and the average is about 10.

vi) The average satellite needs a bandwidth of about 4.5 MHz in an Earth-to-space band for telecommand, and about 3.3 MHz in a space-to-Earth band for telemetry.

Making the interpretation in i) and assuming that the trend in ii) continues, deductions iv), v) and vi) indicate that, to meet the TT&C needs of currently foreseen fixed-satellite services above 17 GHz the amount of spectrum required below 17 GHz is as follows:

- in heavily used parts of the GSO, $21/2 \times 4.5 \cong 47$ MHz up and $21/2 \times 3.3 \cong 35$ MHz down;
- in regions of average GSO use, $10/2 \times 4.5 \cong 22.5$ MHz up and $10/2 \times 3.3 \cong 16.5$ MHz down.

Experience suggests that the satellites in a significant proportion of the current filings will not actually be implemented, and this factor would reduce the estimates for TT&C spectrum. On the other hand, further filings for fixed-satellite services between 17 and 74 GHz and above may be expected in the future, and this would increase the estimates for TT&C spectrum. On the assumption that these two effects will be of similar magnitude, the above estimates are considered to be of the right order.

However, it should be noted that in those regions of the GSO where the bands below 17 GHz allocated to the FSS (and also those allocated to Space Operations) are heavily used it may be difficult to coordinate additional TT&C links. Some FSS bands below 17 GHz are less heavily used than others: in certain countries the bands 3 400-3 600 MHz (space-to-Earth), 5 725-5 850 MHz (Earth-to-space), 7 025-7 075 MHz (Earth-to-space), 13.75-14.0 GHz (Earth-to-space) are currently such bands.

3.8.2 Analysis of results of studies

Under the current regulatory environment, TT&C links for FSS networks may be implemented in any FSS band, and thus far have been successful in meeting their TT&C spectrum requirements within the existing 6/4 GHz, 14/10-11 GHz, and higher frequency bands. However, future TT&C requirements for satellites operating above 17 GHz might put additional constraints on the bands below 17 GHz if they do not operate in their service link bands.

It was determined that the expected TT&C spectrum requirements below 17 GHz to meet the needs of currently foreseen fixed-satellite services operating above 17 GHz would be approximately 47 MHz uplink, and 35 MHz downlink in the heavily used parts of the GSO, and approximately 22.5 MHz uplink and 16.5 MHz downlink in those parts of the GSO with average use.

Multi-band satellites operating in bands below 17 GHz and having existing TT&C systems reduce the overall need for additional TT&C spectrum for GSO FSS networks operating above 17 GHz. In addition, most GSO FSS networks operate their TT&C carriers in the guard bands at the edges of their operating bands allowing for the successful coordination of these carriers between FSS networks.

The current flexibility to accommodate these additional spectrum requirements for TT&C command uplinks in bands below or above 17 GHz should meet the needs of FSS networks in the foreseeable future.

3.8.3 Methods to satisfy the agenda item and their advantages and disadvantages

In view of the above, it is considered that no action is required to satisfy this agenda item.

3.8.4 Regulatory and procedural considerations

Based on the current use of the existing FSS allocations, the studies do not indicate that any new regulatory/procedural provisions would be required to meet the spectrum requirements for the operation of TT&C below 17 GHz for FSS systems with service links above 17 GHz. Therefore, it is considered that no regulatory or procedural action is required to satisfy this agenda item.

CHAPTER 4

Fixed and fixed-satellite services and high altitude platform systems

(WRC-03 agenda items 1.13, 1.18, 1.25, 1.26, 1.32)

CONTENTS

4.1 Agenda item 1.13

"to consider regulatory provisions and possible identification of existing frequency allocations for services which may be used by high altitude platform stations, taking into account No. **S5.543A** and the results of the ITU-R studies conducted in accordance with Resolutions **122 (Rev.WRC-2000)** and **734 (WRC-2000)**"

4.1.1 Resolution 122 (Rev.WRC-2000)

"Use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz by high altitude platform stations (HAPS) in the fixed service and by other services and the potential use of bands in the range 18-32 GHz by HAPS in the fixed service"

4.1.1.1 Summary of technical and operational studies

The ITU-R has conducted sharing and compatibility studies between systems using HAPS and the following systems/services:

a) fixed wireless access (FWA) systems in the FS in the 28 and 31 GHz bands;

b) GSO satellite systems in the FSS in the 28 GHz band;

c) the EESS (passive) in the 31 GHz band;

d) the radio astronomy service (RAS) in the 31 GHz band;

e) systems in the FS and FSS in the bands 47.2-47.5 GHz and 47.9-48.2 GHz.

Relevant Recommendations ITU-R: F.758, RA.769-1, SA.1029, S.1328-3, F.1336-1, S.1432, SF.1481-1, F.1570, SF. [HAPS-FSS METHOD] (Doc. 4-9/BL/7), F.[HAPS-MT] (Doc. 9/BL/40), F.[HAPS-FWA] (9/BL/42), F.[HAPS-RAS] (Doc. 9/BL/45), F.[9B/HAPS1] (Doc. 9/BL/41) and F.1569.

One administration has conducted studies that have not yet been submitted to ITU-R, of interference from some HAPS to FWA receivers and to FSS GSO receivers, from which it concludes that interference to the FS could be reduced by use of appropriate mitigation techniques, and that interference to the FSS could be controlled by keeping the pfd reaching the GSO are below a specific value. This administration plans on making these studies formally available in the appropriate ITU-R forum prior to WRC-03.

4.1.1.1.1 A reference model of a system using HAPS

The ITU-R has performed a basic technical examination of a proposed system using HAPS in the fixed service within the bands 27.5-28.35 GHz and 31.0-31.3 GHz, leading to Recommendation ITU-R F.1569, which establishes a reference model of a system using HAPS, including a set of performance and operational parameters. These parameters are for use in studies relating to sharing and compatibility issues in these specific bands.

The studies have also included an investigation and a feasibility study of interference mitigation measures that could be applicable for the system using HAPS in order to facilitate sharing and compatibility with other services contained in DNR ITU-R F.[HAPS-MT] (Doc. 9/BL/40). Results of the studies indicate that the mitigation schemes contained in the referenced DNR could contribute to viable solutions to interference situations.

4.1.1.1.2 Interference evaluation from FS systems using HAPS to other types of FS systems within the 27.5-28.35 GHz and 31.0-31.3 GHz bands

The ITU-R has developed interference evaluation methodologies for use between systems using HAPS in the FS and FWA systems in the FS in the bands 27.5-28.35 GHz and 31.0-31.3 GHz. Interference scenarios for two different types of FWA systems have been examined. These scenarios may be applicable within an administration and between administrations. On the basis of assumed interference criteria, the results of these studies include the expected level of interference and the required separation distance to avoid harmful levels of interference and are given in DNR ITU-R F.[HAPS-FWA] (Doc. 9/BL/42).

The studies indicate that a separation distance of 500 km may be needed in the worst case. The studies indicate that frequency sharing may only be possible if appropriate interference mitigation techniques are applied.

Applicable Recommendation - ITU-R F.758.

4.1.1.1.3 Sharing between systems using HAPS and FSS/GSO systems within the 27.5-28.35 GHz band

The ITU-R has developed a methodology for interference evaluation from the downlink (HAPS-to-ground direction) of systems using HAPS to the uplink of the GSO satellite system in the FSS within the band 27.5-28.35 GHz. The preliminary results produced by the application of this methodology were derived using the most sensitive GSO/FSS parameters in the band 27.5-28.35 GHz obtained from link budgets listed in Recommendation ITU-R S.1328-3 which may not be typical of the most sensitive GSO systems deployed in the band. The study assumed interference from a single system using HAPS, consisting of 95 airships and three identical HAPS systems with adjacent service areas, spaced 10 degrees apart in longitude, each consisting of 95 airships.

The preliminary results suggest that the aggregate interference from a single system using HAPS to a GSO satellite would represent an I/N increase of at most 1.5% at the GSO satellite. The aggregate interference increase from three identical systems using HAPS into a GSO satellite would be at most 4%. Practical and operational considerations stemming from limited elevation angles and ATPC in the downlink from HAPS may lower these levels even further. Additional studies are required in order to take into account the impact of deployments over larger geographic areas, different latitudes and different satellite antenna beam sizes.

The applicable Recommendations are ITU-R S.1432 and DNR ITU-R SF.[HAPS-FSS METHOD] (Doc. 4-9/BL/7).

4.1.1.1.4 Compatibility between systems using HAPS and EESS (passive) around the 31 GHz band

Results of ITU-R studies indicate that systems using HAPS may be compatible with EESS (passive) sensor operations in the band 31.3-31.8 GHz if the unwanted emissions from a ground station of a system using HAPS meet the level of −106 dB(W/MHz) into an antenna for an uplink to a HAPS for clear sky conditions and −100 dB(W/MHz) under rainy conditions. In case of a phased array antenna, this level constitutes the total unwanted emission power feeding all elements of the antenna sub-system. These studies show that uplinks to HAPS would have to operate under severe restrictions in order not to cause harmful interference.

The applicable Recommendations are ITU-R SA.1029 and F.1570.

4.1.1.1.5 Compatibility between systems using HAPS and RAS around the 31 GHz band

Results of ITU-R studies indicate that systems using HAPS may be compatible with RAS in the band 31.3-31.8 GHz. The studies show that the level of unwanted emissions into the antenna for an uplink to a HAPS of −106 dB(W/MHz) for clear sky conditions and −100 dB(W/MHz) for rainy conditions would result in compatibility. Appropriate separation distance between the RAS antenna and the ground stations of a system using HAPS need also to be implemented.

Applicable Recommendations: ITU-R RA.769 and DNR ITU-R[HAPS-RAS] (Doc. 9/BL/45).

4.1.1.1.6 Sharing between systems using HAPS and other types of FS systems in the bands 47.2-47.5 GHz and 47.9-48.2 GHz

The ITU-R has studied sharing between systems using HAPS and other types of FS systems in the FS in the bands 47.2-47.5 GHz and 47.9-48.2 GHz leading to a DNR ITU-R F.[9B/HAPS1] (Doc. 9/BL/41).

4.1.1.1.7 Sharing between systems using HAPS in the FS and FSS GSO systems in the bands 47.2-47.5 GHz and 47.9-48.2 GHz

The ITU-R has studied sharing between systems using HAPS in the FS and satellite systems in the GSO in the FSS in the bands 47.2-47.5 and 47.9-48.2 GHz. The results of this work are contained in Recommendation ITU-R SF.1481-1.

4.1.1.2 Analysis of results of studies relating to the agenda item

4.1.1.2.1 Interference evaluation from FS systems using HAPS to other types of FS systems in the bands 27.5-28.35 GHz and 31.0-31.3 GHz

The possibility of frequency sharing between a system using HAPS and a point-to-multipoint (P-MP) FWA system, and between a system using HAPS and a point-to-point (P-P) FWA system has been studied. The system parameters of the system using HAPS used in the calculation are based on Recommendation ITU-R F.1569. The parameters of the FWA systems are taken from typical FWA systems in the frequency bands under consideration in combination with various antenna patterns, including those given in Recommendation ITU-R F.1336-1.

DNR ITU-R F.[HAPS-FWA] (Doc. 9/BL/42) was developed evaluating interference from systems using HAPS into other types of FS systems, and based on the assumptions of a value of I/N and of the required separation distance between a ground station of a system using HAPS and an FWA station.

The results of the evaluation are summarized as follows:

a) frequency sharing between the HAPS airship and the base station of a P-MP FWA system would be possible, if the parameters of the system using HAPS are appropriately chosen and the location of the HAPS airship is adequately coordinated;

b) frequency sharing between ground stations of systems using HAPS and FWA systems will only be possible if appropriate interference mitigation techniques are applied.

In this examination, some FWA parameters such as the transmitter output power are taken from operating systems and others are from the lists in Recommendation ITU-R F.758. It is noted that the separation distance varies largely, up to 500 km, depending on geographical relationships among the HAPS airships, their ground stations and the FWA stations.

4.1.1.2.2 Sharing between systems using HAPS and FSS GSO systems in the band 27.5-28.35 GHz

Preliminary sharing studies of interference into the FSS from HAPS indicate an I/N increase of 1.5% for a single system and 4% for multiple systems having adjacent service areas. Additional studies are required within the ITU-R to assess the impact of different types of HAPS deployments and of FSS configurations to assess the compatibility between the two systems.

4.1.1.2.3 Compatibility between systems using HAPS and EESS (passive) around 31 GHz

Studies have revealed that compatibility between uplinks to HAPS and passive sensor operations may be achieved if the uplinks to HAPS are operated under severe constraints. These include filtering of unwanted emission side-lobe levels by around 90 dB, and in the inclusion of a guardband. Automatic transmit power control (ATPC) would have to be used to overcome high rain attenuation or increase system availability.

In addition, Recommendation ITU-R F.1570 was formulated to provide a methodology to evaluate the impact from uplinks to HAPS on the EESS (passive). The results of studies indicate that an unwanted emissions level of −100 dB(W/MHz) into an antenna for an uplink to a HAPS with a gain of 35 dBi will not create interference in excess of protection criteria for the passive sensors. It is noted that the required attenuation levels in excess of 90 dB are more than the unwanted emission levels currently under discussion in ITU-R, which are typically around 35 dB. The technical feasibility to achieve attenuation levels in excess of 90 dB in the band 31.3-31.8 GHz has been demonstrated by one administration by prototyping a transmitter module and making appropriate measurements. These show that the required unwanted emissions level of −106 dB(W/MHz) can be met in combination with some guardbands, typically around twice the width of the spectral main lobe. The required guardband may be smaller if the spectral main lobe is reduced. However, this guardband is also likely to increase if non-linear devices are used.

The studies also considered the impact of cumulative interference from several ground stations of systems using HAPS and concluded that the interference coming from four stations within one beam is dominant in the cumulative interference for the assumed configurations. Further study may be required regarding different system constellations as well as the aggregate interference of many systems using HAPS deployed in the territory of administrations listed in No. **5.543A** or possibly worldwide, if other administrations decide to be added to this footnote at a later stage.

The studies concluded that the specification of a single unwanted emission power density in No. **5.543A** constitutes the most suitable approach due to a minimum set of specifications, maximum flexibility for the design of a system using HAPS and full assurance of adequate protection of EESS (passive).

4.1.1.2.4 Compatibility between systems using HAPS and RAS around 31 GHz

Results of ITU-R studies provided in DNR ITU-R F.[HAPS-RAS] (Doc. 9/BL/45) have indicated that some systems using HAPS may be compatible with RAS in the band 31.3-31.8 GHz provided that:

a) appropriate interference mitigation techniques are utilized by systems using HAPS to achieve the requested level of unwanted emissions into the RAS band. The level of unwanted emission from a ground station of a system using HAPS into the 31.3-31.8 GHz band is a key parameter and −106 dB(W/MHz) for clear sky conditions and −100 dB(W/MHz) for rainy conditions are required for the compatibility;

b) the required guardband between the carrier frequency and the RAS band is implemented (40 MHz from the centre frequency of a 20 MHz bandwidth signal to the RAS band);

c) appropriate separation distances are implemented. The required separation distances depend on the minimum elevation angle of the RAS antennas and on the deployment of the ground stations of systems using HAPS.

The above evaluation of the separation distance was done assuming a minimum elevation angle of 5 degrees for the radio telescope antenna and a range of weather and propagation conditions.

4.1.1.2.5 Sharing between systems using HAPS and other types of FS systems in the bands 47.2-47.5 GHz and 47.9-48.2 GHz

The ITU-R has completed significant studies dealing with sharing between systems using HAPS and other types of FS systems in the bands 47.2-47.5 GHz and 47.9-48.2 GHz leading to DNR ITU-R F.[9B/HAPS1] (Doc. 9/BL/41).

4.1.1.2.6 Sharing between systems using HAPS in the FS and FSS GSO systems in the bands 47.2-47.5 GHz and 47.9-48.2 GHz

The ITU-R has studied sharing between systems using HAPS in the FS and satellite systems in the GSO in the FSS in the bands 47.2-47.5 and 47.9-48.2 GHz. The results of this work are contained in Recommendation ITU-R SF.1481-1, which notes that further studies could identify additional operational scenarios and mitigation techniques which could further facilitate frequency sharing.

4.1.1.2.7 Conclusion

4.1.1.2.7.1 Frequency bands 27.5-28.35 GHz and 31.0-31.3 GHz

With the exception of the FSS, the results of studies already completed indicate that the systems using HAPS could operate in the bands 27.5-28.35 GHz and 31.0-31.3 GHz without any unacceptable interference to other types of FS systems or other co-primary services (except FSS), through appropriate interference mitigation measures and taking into account the required geographical separation distance and frequency guardband. It is also confirmed that deployment of systems using HAPS in the band 31.0-31.3 GHz could operate without causing harmful interference to the passive services in the band 31.3-31.8 GHz, through appropriate interference mitigation measures.

With regard to the FSS, additional studies are required within the ITU-R to assess the impact of different types of HAPS deployments and of FSS configurations to assess the compatibility between the two systems.

4.1.1.2.7.2 Frequency bands 47.2-47.5 GHz and 47.9-48.2 GHz

Significant sharing studies in this band have been completed within ITU-R. No additional issues are considered necessary in sharing between systems using HAPS in the FS and other types of FS systems in the 48 GHz range at this time.

4.1.1.3 Methods to satisfy the agenda item

4.1.1.3.1 Frequency bands 27.5-28.35 GHz and 31.0-31.3 GHz

Identification of suitable FS bands for systems using HAPS should be in bands that are already allocated to the FS on a primary basis. The bands considered should be limited to the 27.5-28.35 GHz and 31.0-31.3 GHz bands identified in Resolution **122**.

A possible method would be the identification of bands for systems using HAPS by country footnote and limited to countries indicating a need for an additional 2 × 300 MHz identification of bands, because of difficulties with severe rain attenuation associated with the existing 2 × 300 MHz bands at 47 GHz identified for systems using HAPS.

Additionally the amount of spectrum identified for systems using HAPS in the referenced bands, 27.5-28.35 GHz and 31.0-31.3 GHz, should be consistent with the amount identified at 47 GHz (i.e. 2 × 300 MHz), unless a specific technical rationale for more spectrum is provided. Nevertheless, a different view, expressed by two administrations, states that, taken in its totality, Resolution **122** does not suggest that the spectrum bandwidth to be considered for systems using HAPS in the range 18-32 GHz should necessarily conform to the 2 × 300 MHz bands designated for this application in the 47 GHz region of the spectrum and further, that the amount of downlink spectrum in the range 27.5-28.35 GHz as is suggested in *request* 3 of that Resolution is appropriate.

The sharing and compatibility issue of a system using HAPS in the fixed service in the range 18-32 GHz with other systems or other services is divided into three issues as follows:

Issue 1: Interference from a system using HAPS to other types of FS systems sharing the same frequency bands (See sections 4.1.1.1.2 and 4.1.1.2.1.)

Issue 2: Interference from a system using HAPS to satellite systems of the FSS operating in the GSO in the 27.5-28.35 GHz (See sections 4.1.1.1.3 and 4.1.1.2.2.)

Issue 3: Compatibility of a system using HAPS with the science services (passive) having a primary allocation in the band 31.3-31.8 GHz (See sections 4.1.1.1.4, 4.1.1.1.5, 4.1.1.2.3 and 4.1.1.2.4.)

These issues are independent and can be discussed individually. Methods to solve each issue are proposed as follows:

4.1.1.3.1.1 Methods for Issue 1 (Interference from systems using HAPS to other types of FS systems)

4.1.1.3.1.1.1 Method A

Modification to RR No. **5.537A** and **5.543A** so as to contain the appropriate interference methodology, if any, from a system using HAPS to other types of FS systems or other services.

Advantages:

Interference to victim systems or services is completely controlled.

Disadvantages:

- Various criteria for different services would be specified in footnotes of the RR and may make them very complex.
- To date, no criteria have been agreed.

4.1.1.3.1.1.2 Method B

No change to RR No. **5.537A** and **5.543A**.

Advantages:

Simplest approach forward.

Disadvantages:

Bilateral agreements by administrations will be required in those sharing situations where compatibility is needed.

4.1.1.3.1.2 Methods for Issue 2 (Interference from systems using HAPS to FSS/GSO)

The identification of bands for systems using HAPS should be done in such a way as not to impact the ability to operate existing and planned FSS systems.

Method

Defer a decision on the identification of bands.

As additional studies are required within the ITU-R to assess the impact of systems using HAPS on the FSS/GSO operating in the bands proposed for consideration by agenda item 1.13, WRC-03 should consider deferring a decision on this aspect of the matter until the next WRC. Under this method, it is proposed that Resolution **122** should be revised accordingly or a new Resolution should be adopted and that an appropriate agenda item should be taken into consideration at a competent WRC.

Advantages:

More time is permitted to study and resolve one of the difficult sharing situations for use of HAPS in these bands.

Disadvantages:

Resolution **122 (Rev.WRC-2000)** is only partially satisfied.

4.1.1.3.1.3 Methods for Issue 3 (Protection of science services (passive))

4.1.1.3.1.3.1 Method A

Modification to No. **5.543A** so as to contain the operational restrictions for systems using HAPS through specification of an unwanted emission power level.

Advantages:

- Science services (passive) in the adjacent band are completely protected.
- Maximum flexibility for a system using HAPS design.

Disadvantage:

Some restrictions on implementation of systems using HAPS.

4.1.1.3.1.3.2 Method B

Modification to No. **5.543A** so as to incorporate the appropriate operational restrictions for systems using HAPS contained in ITU-R recommendations by reference.

Advantages:

Science services in the adjacent band are completely protected.

Disadvantages:

- Some restrictions on implementation of systems using HAPS.
- The set of recommendations for design of systems using HAPS is quite voluminous.
- Some guidelines in the recommendations may unduly constrain the design of systems using HAPS.

4.1.1.3.1.3.3 Method C

Maintenance of No. **5.543A** and extension of the present restriction for systems using HAPS to the conference following WRC-03.

Advantages:

Science services in the adjacent band are appropriately protected.

Disadvantages:

Resolution **122 (Rev.WRC-2000)** cannot be fulfilled.

4.1.1.3.2 Frequency bands 47.2 to 47.5 GHz and 47.9 to 48.2 GHz

Some administrations support the consideration of another method to satisfy this agenda item as described in section 4.1.1.3.3 below.

Method

All portions of Resolution **122** dealing with systems using HAPS in the frequency bands 47.2 to 47.5 GHz and 47.9 to 48.2 GHz can be suppressed. No. **5.552A** would need to be amended to remove the reference to Resolution **122** and to reference the appropriate sections of Article 9 of the Radio Regulations. Consequential changes may be required to Article 9 in order to correctly define the coordination required between the FSS and systems using HAPS.

Advantages:

Permanently entrenches the coordination regime between the fixed service using HAPS and the FSS in the Radio Regulations.

Disadvantages:

There is a need to develop a coordination procedure between systems using HAPS operating in the FS and FSS systems.

4.1.1.3.3 Method for assessment of interference from systems using HAPS and FSS in the 48 GHz band

Compatibility between the systems using HAPS and the FSS service in the 48 GHz band could be achieved by further study as noted in Recommendation ITU-R SF.1481-1.

It is recognized that there may be better methods for coordination between systems using HAPS and FSS in the 48 GHz band and initiate further studies. Resolution **122 (Rev.WRC-2000)** should be amended and an appropriate agenda item should be taken into consideration at a competent WRC.

Advantages:

- Further studies may identify better methods and additional mitigation techniques.
- More compatible operational scenarios may be identified.

Disadvantages:

This method will prolong the inability of BR to process FSS notifications (except feeder links for BSS).

4.1.1.4 Regulatory and procedural consideration

4.1.1.4.1 Operation of systems using HAPS in the fixed service in the band 31.0-31.3 GHz

In the methods described in the above sections relating to the 31 GHz band, implementation of one or more methods would require modifications to certain provisions in Article **5**.

Regarding passive services including EESS and RAS, modification of No. **5.543A** may be considered as follows:

MOD

5.543A In Bhutan, Indonesia, Iran (Islamic Republic of), Japan, Maldives, Mongolia, Myanmar, Pakistan, the Dem. People's Rep. of Korea, Sri Lanka, Thailand and Viet Nam, the allocation to the fixed service in the band 31-31.3 GHz may also be used by systems using high altitude platform stations (HAPS) in the ground-to-HAPS direction. The use of the band 31-31.3 GHz by systems using HAPS shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems or other co-primary services, taking into account No. **5.545**. Systems using HAPS in the band 31-31.3 GHz shall not cause harmful interference to the radio astronomy service having a primary allocation in the band 31.3-31.8 GHz, taking into account the protection criterion of –141 dB(W/(m^2•500 MHz)). In order to ensure the protection of satellite passive services, the level of unwanted emissions from a ground station of a system using HAPS into the band 31.3-31.8 GHz shall be limited to –106 dB (W/MHz) under a clear-sky condition, and may be increased under rainy conditions in accordance with rain attenuation, provided that effective impact on the passive services is not in excess of –100 dB (W/MHz) .

****

Furthermore, revision of Resolution **122 (Rev.WRC-2000)** may be considered to extend the time frame of the ITU-R study on the sharing issues (except compatibility studies with passive services) to the WRC-07.

The example revision of No. **5.543A** as shown here removes the limitation on the deployment of systems using HAPS to the 31.0-31.15 GHz part of the allocation to the fixed service at 31.0-31.3 GHz. Some administrations do not agree with the removal of limitation to the use of this band.

4.1.1.4.2 Operation of systems using HAPS in the fixed service in the band 47.2-47.5 GHz and 47.9-48.2 GHz

Two different views have emerged during the discussions on this topic:

Some administrations believe that the paragraph, *instructs the Director of the Radiocommunication Bureau* 2*,* of Resolution **122** should be suppressed. In this connection, these administrations are of the view that appropriate revisions to Article **9** of the Radio Regulations could be adopted which would permit coordination between systems using HAPS and the FSS in these bands. Administrations holding this view maintain that Recommendation ITU-R SF.1481-1 indicates that sufficient work has been accomplished under the auspices of Resolution **122** to permit the suppression of this "*instructs*". It is also the view of these administrations that any further required studies can be completed within the Study Group structure of the ITU-R.

Other administrations believe that, consistent with the requirements of certain parts of Recommendation ITU-R SF.1481-1, further sharing studies are required and that the provisions of Resolution **122** as they apply to this portion of the spectrum should be maintained, These administrations also recognized that ITU-R SF.1481-1 is based on the findings of already completed significant sharing studies, but they are concerned that these studies have not addressed all of the potential sharing problems that may arise in these bands. Regarding sharing between systems using HAPS and FSS systems in the 48 GHz range, the need for further studies noted above may be facilitated by amending Resolution **122 (Rev.WRC-2000)**. For example, the following modifications have been suggested:

- add a new "*considering n bis)*" that Recommendation ITU-R SF.1481-1 provides useful reference information in regard to sharing between systems using HAPS and GSO FSS but also notes that further study of operational scenarios and mitigation techniques is required, and such study would enable greater confidence in sharing the radio spectrum in the 47.2-47.5 GHz band and 47.9-48.2 GHz band, which have been designated for systems using HAPS;
- modify "*requests ITU-R* 2" to continue carry out studies on the appropriate technical sharing criteria for the situations referred to in *considering j* and *n bis* above; and
- modify "*instructs the Director of the Radiocommunication Bureau* 2" that from 22 November 1997, and pending review of the sharing studies in *considering j* and *n bis,* and review of the notification process by WRC-07, the Bureau shall accept notices in the bands 47.1-47.5 GHz and 47.9-48.2 GHz only for HAPS in the fixed service and for feeder links for the broadcasting-satellite service, shall continue to process notices for the FSS networks (except for feeder links for the broadcasting-satellite service) for which complete

information for advance publication has been received prior to 27 October 1997, and shall inform the notifying administrations accordingly.

4.1.2 Resolution 734 (WRC-2000)

"Feasibility of use by high altitude platform stations in the fixed and mobile services in the frequency bands above 3 GHz allocated exclusively for terrestrial radiocommunication"

4.1.2.1 Summary of technical and operational studies

ITU-R has examined the Table of Frequency Allocations as well as associated footnotes for bands allocated exclusively to terrestrial services in accordance with Resolution **734 (WRC-2000)**, which requests ITU-R to carry out studies for the possibility of identifying more spectrum for systems using HAPS. Table 4.1-1 shows the frequency bands, which fall under Resolution **734**.

There have been very few studies by administrations on sharing conditions and no studies on the amount of spectrum required for systems using HAPS in these bands. Without more detailed studies, it is not apparent, if any of the bands listed in Table 4.1-1 contain sufficient spectrum for operation of systems using HAPS. In addition, some of these bands are adjacent to passive service allocations and may require guardbands larger than the available spectrum.

TABLE 4.1-1

Frequency bands to be studied for possible use by systems using HAPS (RR Article 5)

Frequency band (GHz)	Bandwidth (MHz)	Table allocation		Footnote allocation	Comments and remarks
		Primary	Secondary	(small letters: secondary)	
3.30-3.332	32	RLS (all)	AS (R2, R3) FS/MS (R2)	RNS (5.430, all), FS/MS (5.429, R1, R3)	(1), (2), (3)
3.339-3.40	61	RLS (all)	A (all) FS/MS (R2)	RNS (5.430, all), FS/MS (5.429, R1, R3)	(2), (3)
4.20-4.40	200	ARNS (all)		FS (5.439, R3)	(3), (4)
4.40-4.50	100	FS/MS (all)			(5)
5.47-5.65	180	MRNS (all)	RLS	MS (5.451, R1)	(6), (3), (7)
5.725-5.83	105	RLS (all) FS (R1)	AS (all)	FS/MS (5.453, 5.455, R2, R3)	(8), (3)
7.0725-7.145	70	FS/MS (all)			(9)-(13)
7.235-7.250	15	FS/MS (all)			(9)-(13)
7.85-7.90	50	FS/MS * (all)			(14), (15)
8.50-8.55	50	RLS (all)		FS/MS (5.468, all)	(2), (3)
8.65-8.75	100	RLS (all)		FS/MS (5.468, all)	(2), (3)
9.80-9.975	175	RLS (all)	FS (all)	RNS (5.430, all), FS (5.477, R1, R3)	(16), (17), (3)
10.025-10.45	425	RLS (all) FS/MS (R1, R3)	AS (all)	FS/MS (5.480, R2)	(17), (3)
10.50-10.55	50	RLS (R2, R3) FS/MS (all)	RLS (R1)		(18), (3)
10.55-10.60	50	FS/MS * (all)	RLS (all)		(19), (15)
15.7-16.6	900	RLS (all)		FS/MS (5.512, all)	(17), (3), (20)
17.10-17.20	100	RLS (all)		FS/MS (5.512, all)	(3)
* except aeronautical mobile R1-Region 1, R2-Region 2, R3-Region 3, all-Regions 1, 2 and 3					

Comments and remarks for Table 4.1-1
(1) The band 3.332-3.339 GHz is referred to in No. **5.149** with respect to radio astronomy and does not fit with the provisions in Resolution **734**.
(2) Extensively used in all Regions by radiolocation systems.
(3) Sharing with radio astronomy, radiolocation or radionavigation is expected to be very difficult.
(4) The frequency 4.202 GHz may be used by standard frequency and time signal-satellite service (No. **5.440**).
(5) Extensively used by fixed systems and by mobile systems in Region 2 (between 4.46 and 4.50 GHz).
(6) Extensively used in all Regions by maritime and meteorological radars.
(7) WRC-03 is expected to consider new allocations to the EESS and mobile service and upgrading the radiolocation allocation under agenda item 1.5. Further sharing is expected to be difficult.
(8) Extensively used by licence-exempt wireless access systems. In addition all services must accept harmful interference from ISM.
(9) The band 7.075-7.250 GHz is related to passive microwave sensor measurement stated in No. **5.458**.
(10) 7.10-7.155 and 7.19-7.235 GHz**: Space operation No. **5.459** (** the band outside the scope of Resolution **734**).
(11) 7.145-7.235 GHz**: Space research in all Regions No. **5.460**. (** the band outside the scope of Resolution **734**).
(12) Extensively used by point-to-point fixed systems in all regions, including critical telemetry and control for utilities.
(13) Sharing is expected to be very difficult.
(14) Meteorological satellite operating in the adjacent band 7.750-7.850 GHz will require further consideration.
(15) Compatibility with systems using HAPS is expected to be very difficult.
(16) Meteorological satellite service operating in the adjacent band 9.975-10.025 GHz may require consideration.
(17) Extensively used worldwide by radiolocation systems.
(18) Extensively used by radiolocation including licence-exempt applications.
(19) Radio astronomy, EESS (passive), space research (passive) operating in the adjacent band 10.6-10.68 GHz will require further consideration.
(20) This band is also used by radionavigation (i.e. airport surface detection equipment) in one administration.

4.1.2.2 Analysis of results of studies

Since a feasibility study on systems using HAPS in the frequency range 18-32 GHz is being conducted under Resolution **122 (Rev.WRC-2000)**, the studies relating to Resolution **734 (WRC-2000)** are focusing primarily on the range 3-18 GHz.

4.1.2.2.1 General consideration of the frequency range 3-18 GHz

The technical considerations are made for the following frequency ranges taking account of frequency dependent characteristics:

1) the 3 to 7 GHz frequency range;
2) the 7 to 18 GHz frequency range.

The 3-7 GHz frequency range is suitable for achieving a highly reliable service because of very low rainfall attenuation. Since a system would need no rain margin in the link budget, the availability of higher than 99.99% could be achieved without resorting to any special techniques. This range is also suitable for a ground station of a system using HAPS using an omnidirectional antenna because of the lower propagation loss. A typical application may be systems in the mobile service.

The 7-18 GHz frequency range is susceptible to rain attenuation in the higher part of the frequency range. The link availability could be 99.99% in the lower frequency bands below about 10 GHz and 99.95% in the higher frequency bands above about 10 GHz. The propagation loss also increases when the frequency becomes higher. It might be practical to use this frequency range for a fixed service or a nomadic type service using a terminal with a directive antenna.

However, at this time it has to be noted that no band has been allocated exclusively to the FS or MS in accordance with the RR Article **5** in the 10.6 to 18 GHz range, although there are footnote allocations in this frequency range under the scope of Resolution **734**. Table 4.1-2 summarizes the above considerations.

TABLE 4.1-2

Typical application of systems using HAPS above the 3 GHz band

Frequency range	3-7 GHz	7-18 GHz
Rain attenuation	Very small	Small-moderate
Typical link availability	99.99% or higher	99.95% or higher
Possible user terminal mobility	mobile/nomadic/fixed	Nomadic/fixed

4.1.2.2.2 Frequency sharing consideration with other services

The equation of geometrically visible distance given in Recommendation ITU-R F.1501 may not be applicable for a system using HAPS operating in the frequency bands considered in Resolution **734**. It is understood that a system using HAPS could operate locally in a limited area compared with the area generally covered by GSO FSS system.

To date, only one preliminary sharing study between a system using HAPS in the FS and a FWA system in the FS has been undertaken but not completed with respect to Resolution **734** in the range 3-18 GHz.

Nevertheless, it was assumed that for most of the bands in Table 4.1-1, the sharing or compatibility with existing services will be difficult.

Interference scenarios to be considered are as follows:

a) interference between HAPS airships and terrestrial stations in other terrestrial services;

b) interference between ground stations of systems using HAPS and terrestrial stations in other terrestrial services;

c) unwanted emissions from airships and ground stations of systems using HAPS into other services utilizing the adjacent bands;

d) the effects of unwanted emissions falling within adjacent or nearby passive service bands, e.g. 10.6-10.7 GHz.

A detailed methodology to evaluate the coordination distance and sharing criteria of systems using HAPS for 3-18 GHz needs further study.

4.1.2.3 Methods to satisfy the agenda item

Method 1

To continue studies in accordance with possible revision of Resolution 734 at WRC-03 from the technical and regulatory points of view on some or all the frequency bands listed in Table 4.1-1, in particular the services and technical requirements for sharing and compatibility issues which largely depend on the frequency bands of interest.

Advantages:

- There is the possibility to continue studies on the required amount of spectrum and sharing conditions.

Disadvantages:

- Sharing studies seem to be very complex and time consuming.

Method 2

Continue studies under normal activities of ITU-R; suppress Resolution 734.

Advantages:

- Could allow a decrease of the financial constraints on BR and administrations.

Disadvantages:

- No additional identification of frequencies under Resolution 734.

4.1.2.4 Regulatory and procedural consideration

If Method 1 is adopted for implementation of systems using HAPS in the fixed and mobile services in the bands above 3 GHz that are allocated exclusively by the Table of Frequency Allocations or by footnotes for terrestrial radiocommunication, various regulatory and technical studies are required under Resolution 734 which may be revised at WRC-03 to identify the frequency bands suitable for this application. It is necessary to take into account the co-located services sharing the same band as well as passive services in adjacent bands, and their operational requirements, which differ over the bands 3-18 GHz. All the studies carried out for systems using HAPS in the bands 47/48 GHz and 28/31 GHz are considered as useful references. Further studies are required in ITU-R in order to solve the sharing issue between the FS system using HAPS and other services, and to determine the feasibility of systems using HAPS in the mobile services in the range above 3 GHz.

#########

4.2 Agenda item 1.18

"to consider a primary allocation to the fixed service in the band 17.3-17.7 GHz for Region 1, taking into account the primary allocations to various services in all three Regions"

4.2.1 Summary of technical and operational studies including a list of relevant ITU-R Recommendations

The 17.3-17.7 GHz band is allocated to the FSS (Earth-to-space) in all three Regions. The use of this allocation by GSO networks is limited to BSS feeder links and subject to the Plans in App. **30A**. In Region 2, the band 17.3-17.7 GHz is also allocated (from 1 April 2007) to BSS. There are therefore three sharing issues related to BSS to be considered possible, namely: interference from an FS station into BSS feeder-link space station receivers, interference from BSS feeder-link earth stations into FS receive stations, as well as the potential impact on BSS in Region 2.

4.2.2 Analysis of the results of studies

4.2.2.1 Interference from an FS station into BSS feeder-link space station receivers

With regard to this scenario, the situation is the same as in the adjacent band (17.7-18.1 GHz). Protection of BSS feeder-link space station receivers could be ensured by the extension of the limits currently applicable in Article 21 in the 17.7-18.1 GHz band. In applying these limits sharing between FS stations and BSS space stations would not cause difficulties for BSS feeder-link space station receivers.

4.2.2.2 Interference from BSS feeder-link earth stations into FS receive stations

The addition of an FS allocation in Region 1 would result in possible interference from Regions 1, 2 and 3 BSS feeder-link earth stations into the FS receivers. Sharing between transmit FSS earth stations and FS receivers is normally handled through the coordination under RR No. 9.17, using specific earth stations.

However, with the App. **30A** Plan the locations of the feeder-link earth stations are not pre-determined; in general, such stations can be located anywhere within the feeder-link service area, which is often coincident with the service area of the associated BSS space station.

Although the size of the area around the BSS feeder-link earth station within which this earth station may cause harmful interference to FS receivers, may vary according to the shape of the terrain and the presence of obstacles, this size may be expected to range within about 20-100 kilometres. A separation distance would become even larger when BSS feeder-link earth stations adopt power control by 5 to 10 dB in order to overcome the rain attenuation.

In order to ensure protection of Appendix **30A** Plans, no protection can be given to future FS receivers from interference caused by BSS feeder links in conformity with the Plan. Such BSS Plan feeder links can be located and operated free of constraints anywhere within the service area of the associated BSS satellite.

If FS receivers have to be protected from future BSS feeder-link earth stations in Regions 1 and 3 List, as evolving, of App. **30A**, the deployment of future/additional BSS feeder-links would be significantly constrained.

4.2.2.3 Impact on the Region 2 BSS (space-to-Earth)

In Region 2, BSS networks are expected to be deployed once the allocation comes into effect. Sharing between FS applications under a new FS allocation in Region 1 and BSS in Region 2 is feasible.

4.2.3 Methods to satisfy the agenda item

Method

Recognizing the results of the ITU-R studies carried out, no new allocation should be made to the FS in Region 1 in the band 17.3-17.7 GHz. Furthermore, the review of the actual FS use and future plans currently makes the use and interest by FS within Region 1 in the 17.3-17.7 GHz band limited. Therefore a primary allocation to the FS is not required.

NOTE - A few administrations of Region 1 were of the view that a primary allocation for the fixed service in the band 17.3-17.7 GHz in Region 1 is required.

#########

4.3 Agenda item 1.25

"to consider, with a view to global harmonization to the greatest extent possible, having due regard to not constraining the development of other services, and in particular of the fixed service and the broadcasting-satellite service, regulatory provisions and possible identification of spectrum for high-density systems in the fixed-satellite service above 17.3 GHz, focusing particularly on frequency bands above 19.7 GHz"

4.3.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

A High Density application in the FSS (HD-FSS) is one which operates on a system in the FSS, deploying a large number of ubiquitous earth stations. Satellite systems can be of any orbital type, such as GSO or non-GSO, and using any of the available technologies.

High Density applications are generally characterized as follows:

- flexible, rapid and ubiquitous deployment of earth stations (terminals);
- high frequency reuse typically through the use of satellite spot beams;
- small terminal antenna size;
- cost optimized terminals.

As a consequence of these general characteristics, it may be a rather long process to coordinate HD-FSS earth stations on an individual site-by-site basis. Because the status of assignments to earth stations in respect of terrestrial stations or earth stations operating in the opposite direction of transmission is derived from the application of the relevant coordination procedure (No. **8.3**), the conclusion is that, under the current regulatory provisions, where coordination among earth stations and terrestrial stations is required (i.e. RR Appendix **5**, Table 5-1 is triggered):

- receiving FSS earth stations may not be ensured to be protected from harmful interference from terrestrial stations or earth stations operating in the opposite direction of transmission unless coordination, notification and recording are conducted for specific earth stations;
- transmitting FSS earth stations will have to take steps to eliminate harmful interference caused to existing and future terrestrial stations or earth stations operating in the opposite direction of transmission unless coordination, notification and recording are conducted for specific earth stations;
- FSS receive/transmit earth stations are not required to be coordinated if their coordination area does not cover in whole or in part the territory of another country.

Some regulatory means may be required to facilitate coordination of FSS earth stations in certain frequency bands identified for HD-FSS deployment to allow terminals to operate on a protected basis in these bands. The feasibility and impact on other services of such means are being studied. Some administrations require HD-FSS terminals to coordinate with the FS or to operate on a non-protected basis in some FSS bands.

It is noted that access to and from rural and urban areas is necessary for the HD-FSS to ensure its economic viability.

4.3.1.1 Bands allocated to FSS (Earth-to-space)

Technical studies in the band 27.5-29.5 GHz have been carried out within the ITU-R. These studies indicate the non-practicability of the co-frequency sharing between HD-FSS earth stations and terrestrial services in the same geographical area. They have shown that transmissions from FSS terminals can cause interference into FS receivers unless a minimum separation distance is maintained. No mitigation technique has been identified in the ITU-R to allow wide-scale deployment of HD-FSS terminals that will also ensure protection of receiving FS stations in the same geographical area.

4.3.1.2 Bands allocated to FSS (space-to-Earth)

Technical studies in the band 17.7-19.3 GHz have been carried out within the ITU-R. These studies show that HD-FSS terminals can receive interference from transmitting terrestrial stations which creates areas around each transmitter where operation of HD-FSS terminals may not be possible. The size of these areas depends on the characteristics of the HD-FSS and FS systems and can be reduced by the use of mitigation techniques.

Some administrations believe that these mitigation techniques (e.g. ATPC and larger antenna size for FS or adaptive coding and spread spectrum for FSS) can be implemented by both FS and FSS, improving co-frequency sharing between HD-FSS earth stations and terrestrial services in the same geographical area.

Other administrations believe that these mitigation techniques to be applied by FS (e.g. ATPC and larger antenna size) can reduce the interference areas, but there will always remain some area around each FS transmitter where deployment of FSS terminals will not be possible. These administrations believe that mitigation techniques proposed to be applied to the FSS, while theoretically feasible, are not practicable for HD-FSS systems.

As a result of the above, it is agreed that as the number of coordinated FSS receivers grows, there will be more constraints on the deployment of FS and similarly as the number of FS transmitters grows, more of the potential service area will be lost by the FSS.

Although the specific conditions under which HD-FSS terminals will be deployed in a given geographical area may depend on the FS deployment and the practicability and effectiveness of mitigation techniques, the identification of bands for HD-FSS may not be based solely on these specific sharing conditions.

4.3.1.3 Bands currently not allocated to FSS (space-to-Earth)

Some administrations support the identification of bands which would require new allocations to FSS (space-to-Earth) and are of the view that the identification of spectrum under agenda item 1.25 does not preclude the consideration of new FSS bands and the corresponding sharing studies.

Other administrations do not support the identification of any bands for HD-FSS that are not currently allocated to the FSS, in the indicated direction. These administrations are of the view that the allocation of a band requires analysis of sharing considerations with current services while the identification of a band is assumed to be the identification of specific bands from among the bands allocated to a service.

Three bands not allocated to FSS (space-to-Earth) have also been studied for possible allocation to this service and identification for HD-FSS applications. Of these, only the bands 17.3-17.7 GHz (in Regions 1 and 3) and (parts of) 47.2-50.2 GHz are still being considered, whereas the 21.4-22 GHz band is no longer under consideration since the ITU-R has concluded that it is not feasible for that purpose.

4.3.1.3.1 Band 17.3-17.7 GHz (in Regions 1 and 3)

The 17.3-17.7 GHz band is allocated to the FSS (Earth-to-space) in all three Regions. The use of this allocation by GSO FSS networks is limited to BSS feeder links and the use of the band 17.3-18.1 GHz is subject to the Plans in Appendix **30A**. In Region 2, the band 17.3-17.7 GHz is also allocated (from 1 April 2007) to BSS. The use of the band 17.3-18.1 GHz by all of the above services is fully defined in No. **5.516**. The radiolocation service is allocated on a secondary basis in all three Regions. The band is also allocated to the fixed and mobile services on a secondary basis in the 31 countries in No. **5.514**.

There are therefore three sharing issues involving BSS or BSS feeder-link allocations as well as other sharing issues.

In relation to the possible addition of an FSS (space-to-Earth) allocation in the 17.3-17.7 GHz band, the ITU-R studies concluded the following:

Sharing between FSS transmit space stations and BSS feeder-link receive space stations would be feasible under the current provisions in the Radio Regulations applicable in the adjacent band (17.7-18.1 GHz), i.e. by extending to the band 17.3-17.7 GHz the application of Article **7** and Section 1 of Annex 4 to Appendix **30A** to protect assignments subject to Appendix **30A** Plans from GSO FSS and by extending the application of the current $epfd_{is}$ limits in Article **22** to protect Appendix **30A** Plans and the List from non-GSO FSS.

In order to ensure protection of Appendix **30A** Plans, no protection can be given to FSS receive earth stations from interference caused by assignments to BSS feeder-link earth stations previously included in the relevant Plan or in the List or for which the procedures of Article 4 of Appendix **30A** and No. **9.17A**, as appropriate, have been previously initiated. Such BSS Plan feeder links can be located anywhere within the service area of the associated BSS satellite. The procedures in Article 7 of Appendix **30A** ensure that BSS feeder-link earth stations in conformity with the Plan will be able to operate free of constraints anywhere in the service area. Feeder-link earth stations in the List will share on an equal basis with FSS receive earth stations by applying the procedure of No. **9.17A**, which involves only specific earth stations. Hence, FSS receive earth stations in the same band cannot be protected from interference that may be caused by existing or future BSS feeder-link earth stations in conformity with Appendix **30A** or the relevant BSS feeder-link Plan. However, the current procedure under No. **9.17A** also enables specific FSS receive earth stations to be protected from feeder-link earth stations in the Regions 1 and 3 List after successful application of this procedure, as currently possible in the band 17.7-18.1 GHz. Some administrations consider that this may constrain the development of future additional BSS feeder-link uses in the Regions 1 and 3 List. Other administrations consider that the potential constraint is very limited due to the possibility of applying No. **11.41** in case of disagreement from the administration of the receive FSS earth station.

Sharing between FSS (space-to-Earth) and BSS feeder links in the Regions 1 and 3 List would be feasible under the current provisions applicable in the adjacent band (17.7-18.1 GHz) since the FSS receive earth stations are specific.

Sharing between FSS (space-to-Earth) in Region 2 and BSS in Region 2 would lead to very serious constraints on the development of the BSS in that Region, hence the allocation to FSS (space-to-Earth) in Region 2 is not supported.

Sharing between FSS (space-to-Earth) in Regions 1 and 3 and BSS in Region 2, would be feasible under the current RR provisions, i.e. No. **9.7** for the coordination between GSO BSS and GSO FSS networks, and No. **22.2** for the protection of GSO BSS networks against non-GSO FSS systems or for the protection of GSO FSS networks against non-GSO BSS networks.

Sharing between FSS (space-to-Earth) in Regions 1 and 3 and non-GSO FSS in Regions 1 and 3 would be feasible under the current RR provisions applicable to the adjacent band 17.7-18.1 GHz.

Sharing between FSS (space-to-Earth) in Regions 1 and 3 and radiolocation is feasible without imposing undue constraints on either services.

Some administrations believed that the sharing situation between small FSS receive terminals in Regions 1 and 3 and radiolocation in this band may be similar to the existing situation regarding sharing between BSS (space-to-Earth) and radiolocation in Region 2.

However, further studies to compare the characteristics and availability of BSS (space-to-Earth) in Region 2 with the FSS characteristics considered to date, would be required before any conclusion can be reached on the similarities.

Sharing between FSS (space-to-Earth) in Regions 1 and 3 and the FS in Region 1, as a result of a potentially new primary allocation under agenda item 1.18, could be treated under the current provisions of the Radio Regulations applicable to the adjacent band 17.7-19.7 GHz.

Some administrations consider that the allocation of the FSS on a primary basis in Regions 1 and 3 shall not claim protection from the fixed and mobile services of the countries mentioned in No. **5.514**.

Other administrations that support new FSS allocations under this agenda item, believe that FSS (space-to-Earth) allocations in the band 17.3-17.7 GHz would be feasible under the current RR provisions without unduly constraining the fixed and mobile services (secondary) of those countries in No. **5.514**.

It was also noted that some administrations propose to use the BSS feeder-link assignments in the frequency band 17.3-18.1 GHz for GSO FSS (Earth-to-space) and to clarify this by aligning No. **5.516** with No. **5.492**. It should be noted that no consideration on the impact on the radiolocation service has been studied.

If an allocation to the FSS (space-to-Earth) were to be made in the band 17.3-17.7 GHz in Regions 1 and 3, the extension to this band of the regulatory provisions currently applicable in the band 17.7-18.4 GHz, may provide a satisfactory regulatory framework for sharing between BSS feeder links, BSS and HD-FSS (space-to-Earth), in the band 17.3-17.7 GHz, as well as in the band 17.7-18.4 GHz.

As to the new regulatory provisions that may be adopted in conjunction with the identification of any part of the band 17.3-18.4 GHz for HD-FSS use, serious concern was expressed on the possibility of modifying the current provisions under No. **9.17A** or adopting new provisions in order to allow the coordination of typical FSS receive earth stations. If such a modification was not implemented with great care in order to ensure equitable access between the services, it could severely constrain the development of future BSS feeder-link uses in the 17.3-18.4 GHz band.

This issue is also discussed under Section 3.4 (agenda Item 1.30, typical earth stations).

Some administrations objected to the proposal for an allocation to FSS (space-to-Earth) in the band 17.3-17.7 GHz.

4.3.1.3.2 Band 47.2-50.2 GHz:

Such new allocation to the FSS (space-to-Earth) leads to the following sharing and compatibility scenarios:

- sharing between FSS (space-to-Earth) and FSS (Earth-to-space),
- sharing between FSS (space-to-Earth) and FS,
- compatibility between FSS (space-to-Earth) and EESS (passive) in the band 50.2-50.4 GHz,
- compatibility between FSS (space-to-Earth) and RAS in the band 48.94-49.04 GHz.

The current status of the studies and the results of some of them are given in § 4.3.2.3.

4.3.2 Analysis of the results of studies

4.3.2.1 Possible candidate uplink bands

Table 4.3-1 gives the analysis of the results of the studies (where applicable) carried out for each bands considered for identification for HD-FSS applications in the uplink direction, providing comments and conclusions.

TABLE 4.3-1

81-86 GHz	**Conclusion:** Seems not to be usable with current technology.
50.4-51.4 GHz	**Comments:** Part of this band might be intended for use in all three Regions by some administrations for FSS other than public communication systems (e.g. national defence systems). In one country in Region 3, there is deployment of RLAN in this band. **Conclusion:** This band is not proposed for "HD-FSS" identification.
47.2-50.2 GHz	**Comments:** There are filings for "HD-FSS" type systems. The sub-band 48.2-50.2 GHz represents 2 GHz of spectrum that might be considered for "HD-FSS" use since there would be no overlap with the HAPS designated spectrum. There is some intention to use this band for FS PP links. Some FS links are already deployed in Region 1. Sharing in the same geographical area between HD-FSS transmitting earth stations and FS is generally not practicable however studies may be required. Sharing in the same geographical area may not be feasible between HAPS (intended to be used in the 47.2-47.5 and 47.9-48.2 GHz sub-bands) in the fixed service and "HD-FSS". Some discussions took place at WRC-2000 and studies are ongoing, as detailed by Resolution 122 (WRC-2000). Taking into account the possible use of HAPS in some countries in the 47.2-47.5 and 47.9-48.2 GHz sub-bands, the possible identification of these sub-bands for "HD-FSS" is limited. The band 48.94-49.04 GHz is also allocated to the radio astronomy service on a primary basis.
47.2-50.2 GHz (continued)	For information, part of this band is under study for an FSS allocation in the downlink direction (see section 4.3.2.3). **Conclusions:** Some administrations consider that the band 48.2-50.2 GHz is suitable for "HD-FSS" identification on a global basis. Other administrations consider that the 47.2-50.2 GHz band is not suitable for HD-FSS identification on a global basis.

42.5-43.5 GHz	**Comments:** This band was identified for HDFS at WRC-2000, so some sharing difficulties can be anticipated with the HD-FSS. This band is also allocated to radio astronomy, which could impose constraints on "HD-FSS" and HDFS around the radio astronomy sites. Some HDFS applications are well under way in Region 1 for the 42.5-43.5 GHz band. **Conclusion:** This band is not proposed for "HD-FSS" identification.
30-31 GHz	**Comments:** In all three Regions, the use of this band is limited by some administrations for FSS other than public communication systems (e.g. national defence systems). **Conclusion:** This band is not proposed for "HD-FSS" identification.
29.5-30 GHz	**Comments:** No primary terrestrial allocations. "HD-FSS" systems are already in development in this band. **Conclusion:** This band is suitable for "HD-FSS" identification on a global basis.
29.1-29.5 GHz	**Comments:** In Region 1, some administrations will deploy "HD-FSS" applications in the band 29.4525-29.5 GHz. In Region 2 GSO "HD-FSS" programme under development in the band 29.25-29.5 GHz. Studies may be required on the assessment of the impact of "HD-FSS" sharing with feeder links to non-GSO MSS. In Region 1, some administrations have decided to allow dense deployment of FS applications in the range 29.1-29.4525 GHz and have already begun licensing. Studies conclude that sharing is generally not practicable between FS and "HD-FSS" in the same geographical area. **Conclusions:** Part of this band is suitable for "HD-FSS" identification on a global basis. Some administrations consider that the band 29.4525-29.5 GHz is suitable for "HD-FSS" identification on a global basis. Other administrations consider that the band 29.25-29.5 GHz is suitable for "HD-FSS" identification on a global basis.

28.6-29.1 GHz	**Comments:** This entire band is designated for "HD-FSS" in some administrations in all Regions while in other administrations only a part of this band has been so designated. Some administrations in all Regions have adopted regulatory provisions limiting use of terrestrial systems in this entire band in order to facilitate its use by "HD-FSS". Some "HD-FSS" systems are already in development in this band and there are other filings for "HD-FSS" type systems. In Region 1, some administrations are intending to deploy "HD-FSS" applications in the sub-band 28.6-28.8365 GHz. Some administrations in Region 1 are intending to allow dense deployment of FS applications in the sub-band 29.0605-29.1 GHz (and have begun licensing in this band), and, on a geographical basis, dense deployment of FS or "HD-FSS" in the sub-band 28.8365-29.0605 GHz. Studies conclude that sharing is generally not practicable between FS and "HD-FSS" in the same geographical area. It is noted that in the band 28.6-29.1 GHz, footnote **5.523A** applies, providing a different set of provisions to the non-GSO FSS utilizing this band to those provisions for non-GSO FSS utilizing bands outside 28.6-29.1 GHz. **Conclusions:** Some administrations are of the view that the band 28.6-29.1 GHz is suitable for "HD-FSS" identification on a global basis. Other administrations are of the view that only the sub-band 28.6-28.8365 GHz is suitable for "HD-FSS" identification on a global basis.
27.5-28.6 GHz	**Comments:** In Region 1, some administrations are intending to deploy "HD-FSS" applications in both sub-bands 27.5-27.8285 GHz and 28.4445-28.6 GHz. In Region 2, GSO "HD-FSS" program under development in the band 28.35-28.6 GHz There are some filings for "HD-FSS" type systems in part of this band. Some administrations in Region 1 are intending to allow dense deployment of FS applications in the sub-band 28.0525-28.4445 GHz (and have begun licensing in this band), and on a geographical basis, for dense deployment of FS applications or "HD-FSS" in the sub-band 27.8285-28.0525 GHz. There are sharing studies being conducted with respect to planned HAPS deployment by administrations listed in 5.537A (Resolution 122, WRC-2000) in the sub-band 27.5-28.35 GHz with respects to FS and FSS. Studies are required to conclude focusing on this sub-band as a matter of urgency by WRC-03. In Region 2, dense deployments of FS applications (LMCS/LMDS) are currently in use in the sub-band 27.5-28.35 GHz. **Conclusions:** Part of this band is suitable for "HD-FSS" identification on a global basis. Some administrations consider that the bands 27.5-27.8285 GHz and 28.4445-28.6 GHz are suitable for "HD-FSS" identification on a global basis. Other administrations consider that the band 28.35-28.6 GHz is suitable for "HD-FSS" identification in Region 2 or on a global basis.

27-27.5 GHz	**Comments:** The FSS allocation is only in Regions 2 and 3. This band is intended for use by some administrations in Region 1 and possibly all three Regions, for FS and MS other than public communication systems (e.g. national defence systems). In Region 2, dense deployments of FS applications (LMCS/LMDS) are currently in use. **Conclusion:** This band is not proposed for "HD-FSS" identification.
24.75-25.25 GHz	**Comments:** This band is allocated to FSS only in Regions 2 and 3, and its use for feeder links of the BSS has priority over other use of the FSS (Earth-to-space) as per No. **5.535**. This band is allocated to the radionavigation service on a primary basis until 2008 in one administration in Region 3. In Region 1, dense deployments of FS applications are currently in use. **Conclusion:** This band is not proposed for "HD-FSS" identification.
19.3-19.7 GHz	**Comments:** The use of the FSS in the band 19.3-19.6 GHz in the Earth-to-space direction is limited to non-GSO MSS feeder links. In Regions 1 and 3, there is a large number of FS links already in use in this band. **Conclusion:** This band is not proposed for "HD-FSS" identification.
18.1-18.4 GHz	**Comments:** The use of FSS in this band is limited to BSS feeder links. In Regions 1 and 3, there are a large number of FS links already in use in this band. **Conclusion:** This band is not proposed for "HD-FSS" identification.
17.3-17.8 GHz	**Comments:** The use of the FSS in this band is limited to feeder links for BSS in the case of GSO FSS networks according to AP30A. Other FSS uses of the band are defined in No. 5.516. In Region 2, the FSS use of the band is limited to GSO systems only. In Region 2, an allocation to BSS comes into effect on 1 April 2007 (RR 5.517). There is an agenda item (1.18) of WRC-03 to possibly introduce in Region 1 a primary FS allocation in the 17.3-17.7 GHz sub-band. In Region 1 (in the band 17.7-17.8 GHz in CEPT countries) and 3, there are a large number of FS links already in use in this band. **Conclusion:** This band is not proposed for "HD-FSS" identification.

4.3.2.2 Possible candidate downlink bands

Table 4.3-2 gives the analysis of the results of the studies (where applicable) carried out for each band considered for identification for HD-FSS applications in the downlink direction, providing comments and conclusions.

TABLE 4.3-2

71-76 GHz	**Conclusion:** Seems not to be usable with current technology.
37.5-42.5 GHz	**Comments:** The bands 37-40 GHz and 40.5-43.5 GHz are already identified for HDFS (No. **5.547**), however, it is recognized that the band 39.5-42.0 GHz is targeted for the deployment of "HD-FSS" (No. **5.547** and Resolution 84). In Regions 1 and 3, there are a large number of FS links already in use in the sub-band 37.5-39.5 GHz. HDFS applications are well under way in some administrations for the 40.5-42.5 GHz band. Many administrations in Region 1 intend to deploy "HD-FSS" in the 39.5-40.5 GHz. In Region 2, there is deployment of HDFS links in the sub-band 38.6-40 GHz. In all Regions, the band 40.5-42-5 GHz is also allocated on a co-primary basis to the fixed, broadcasting-satellite and terrestrial broadcasting services. Any implementation of HD-FSS in this band could impose coordination constraints on BSS systems. **Conclusions:** Some administrations consider that the band 40-42 GHz is suitable for "HD-FSS" identification on a global basis. Other administrations consider that the band 39.5-40.5 GHz is suitable for "HD-FSS" identification on a global basis. Some administrations in Region 3 consider that the band 37.5–40.0 GHz is not suitable for HD-FSS allocation in this Region. At the minimum, the 40-40.5 GHz band is suitable for "HD-FSS" identification on a global basis.
20.2-21.2 GHz	**Comments:** In all three Regions, the use of this band is limited by some administrations for FSS other than public communication systems (e.g. national defence systems). **Conclusion:** This band is not proposed for "HD-FSS" identification.
19.7-20.2 GHz	**Comments:** Limited use of terrestrial services. Although not allocated on a regional basis to terrestrial services, footnote 5.524 identifies 44 administrations potentially having fixed and mobile service allocations. This footnote further states that these terrestrial uses shall not impose any limitation on the power flux-density of space stations in the fixed-satellite service, thereby not allowing terrestrial stations to claim protection from the MSS and FSS (see 5.43A). **Conclusion:** This band is suitable for "HD-FSS" identification on a global basis.

19.3-19.7 GHz	**Comments:** In addition to the reverse band allocation for the feeder link for the MSS in the E-S direction, the band 19.3-19.7 GHz in the S-E direction was also identified for use by MSS feeder links. This allocation was intended to provide a small number of gateway earth stations for the MSS systems. There are a large number of FS links already in use in this band in a number of countries in all Regions. The range 17.7-19.7 GHz is of vital importance to the FS telecommunication infrastructure, particularly in relation to the infrastructure of mobile networks, and to provide broadband service. This is due to the fact that this is the highest possible frequency band to be used to develop the FS infrastructure for mobile networks in geographic zones where the rain attenuation is high. The range 17.7-19.7 GHz is also of vital importance to the FSS in order to provide broadband service and to alleviate orbital congestion in the lower bands and because of severe rain attenuation in higher frequency bands. **Conclusion:** This band is not proposed for "HD-FSS" identification.
18.8-19.3 GHz	**Comments:** This entire band is designated for "HD-FSS" by some administrations in all Regions. Some "HD-FSS" systems are already in development in this band and there are other filings for "HD-FSS" type systems. Some administrations in all Regions have adopted regulatory provisions limiting use of terrestrial systems in this entire band in order to facilitate "HD-FSS". In some countries in Region 1, terminals in the "HD-FSS" applications will operate on a non-protected basis within their territory if they are not coordinated on a site-by-site basis. However, sharing with the FS is planned to be facilitated by the use of mitigation techniques. Some administrations are of the view that it is not appropriate to suggest the notion of "HD-FSS" operation without protection. There is a large number of FS links already in use in the band 18.8-19.3 GHz in a number of countries in all Regions. The range 17.7-19.7 GHz is of vital importance to the FS telecommunication infrastructure, particularly in relation to the infrastructure of mobile networks, and to provide broadband service. This is due to the fact that this is the highest possible frequency band to be used to develop the FS infrastructure for mobile networks in geographic zones where the rain attenuation is high. The range 17.7-19.7 GHz is also of vital importance to the FSS in order to provide broadband service and to alleviate orbital congestion in the lower bands and because of severe rain attenuation in higher frequency bands. It is noted that in the band 18.8-19.3 GHz, footnote **5.523A** applies, providing a different set of provisions to the non-GSO FSS utilizing this band to those provisions for non-GSO FSS utilizing bands outside 18.8-19.3 GHz. **Conclusions:** Some administrations consider that this band is suitable for "HD-FSS" identification on a global basis. Other administrations consider that this band is not suitable for "HD-FSS" identification on a global basis.

17.7-18.8 GHz	**Comments:** In some countries in Region 2, there are "HD-FSS" systems under development in the band 18.58-18.8 GHz. In some countries in Region 1, terminals in the "HD-FSS" applications will operate on a non-protected basis within their territory if they are not coordinated on a site-by-site basis. However, sharing with the FS is planned to be facilitated by the use of mitigation techniques. Some administrations were of the view that it is not appropriate to suggest the notion of "HD-FSS" operation without protection. There are a large number of FS links already in use in this band in some countries in all Regions. There are some filings for "HD-FSS" type systems. The range 17.7-19.7 GHz is of vital importance to the FS telecommunication infrastructure, particularly in relation to the infrastructure of mobile networks, and to provide broadband service. This is due to the fact that this is the highest possible frequency band to be used to develop the FS infrastructure for mobile networks in geographic zones where the rain attenuation is high. The range 17.7-19.7 GHz is also of vital importance to the FSS in order to provide broadband service and to alleviate orbital congestion in the lower bands and because of severe rain attenuation in higher frequency bands. In Regions 1 and 3, the band 17.7-18.1 GHz is a planned band for BSS feeder links (FSS allocation in Earth-to-space) (AP30A). The procedures in AP30A ensure that BSS feeder-link earth stations in conformity with the Plan will be able to operate free of constraints anywhere in their service area. Feeder-link earth stations in the List will share on an equal basis with FSS receive earth stations by applying the procedure of No. **9.17A**, which involves only specific earth stations. Some administrations consider that this may constrain the development of future additional BSS feeder-link uses in the Regions 1 and 3 List. Other administrations consider that the potential constraint is very limited due to the possibility of applying No. **11.41** in case of disagreement from the administration of the receive FSS earth station. In Region 2, the sub-band 17.7-17.8 GHz is a planned band for BSS feeder links (FSS allocation in Earth-to-space) (AP30A). Also as per No. **5.517**, an allocation to the BSS in the sub-band 17.3-17.8 GHz shall come into effect 1 April 2007. After this date, the FSS allocation becomes a secondary allocation thereby making it unsuitable for HD-FSS. Mitigation techniques should be studied to minimize the risk of interference from feeder links of earth stations of BSS and gateways (Earth-to-space) of non-GSO FSS in the bands where they can operate. It is moreover noted that 21.16.2 applies so as to protect the EESS (passive) and SRS (passive) in the 18.6-18.8 GHz band. **Conclusions:** Some administrations consider that the sub-band 18.58-18.8 GHz is suitable for "HD-FSS" identification in Region 2 or on a global basis. Other administrations consider that this band is not suitable for "HD-FSS" identification on a global basis.

4.3.2.3 Bands currently not allocated to FSS (space-to-Earth)

Table 4.3-3 gives the analysis of the results of the studies carried out for each bands considered for new allocation to FSS (space-to-Earth) including identification for HD-FSS applications, providing comments and conclusions.

TABLE 4.3-3

47.2-50.2 GHz	**Comments:** It is noted that many administrations plan to operate BSS feeder links and FSS uplinks (including HD-FSS uplinks) in this range. The feasibility of an FSS allocation (space-to-Earth) in this band is being studied by ITU-R. An allocation to the FSS (space-to-Earth), where feasible, would allow the identification of more downlink spectrum for HD-FSS applications than in the uplink. Results of studies carried out in ITU-R show that: • intra-system sharing in the opposite direction of transmission (i.e. using the same frequency band in both directions of transmission on the same satellite) is not a new issue for a new allocation. Passive intermodulation products have to be dealt with by administrations willing to use both the existing FSS (Earth-to-space) allocation and the possible new allocation to the FSS (space-to-Earth) on the same satellite payload; • sharing between transmitting FSS gateways and "HD-FSS" receiving terminals is feasible only if regulatory provisions are developed to indicate that there shall be no obligation on the FSS gateways to protect receiving "HD-FSS" terminals. This would constrain the deployment of the latter in a 4 to 10 km zone around the transmitting gateway stations (which are expected to be few in number) where "HD-FSS" receiving stations may suffer interference. The conclusions similarly apply for earth stations operating either with a GSO satellite or with non-GSO satellites; • sharing the same band between transmitting "HD-FSS" terminals and receiving "HD-FSS" terminals of the FSS (s-E) in the same geographical area would not be feasible The conclusion also applies for earth stations operating either with a GSO satellite or with non-GSO satellites; • sharing between two non-co-located GSO space stations operating in opposite direction of transmission in the same frequency band may be feasible. Initial studies have demonstrated that sharing under certain conditions would be feasible, however, further studies are necessary to bound the specific combinations of FSS parameters within which sharing is possible and outside of which there may be significant constraints. The current regulatory provisions (i.e. No. **9.7**) provide an appropriate regulatory framework to coordinate space stations if necessary; • further studies are required to cover the case of non-GSO space stations; • inter-service sharing between FS (excluding HAPS) and transmitting space stations in the FSS (space-to-Earth) can be ensured by appropriate pfd limits.

47.2-50.2 GHz (continued)	Based on studies, provided by one administration, the following maximum pfd levels in any 1 MHz band, -115 dB(W/m^2) for $\theta \leq 5°$ $-115 + 0.5\,(\theta - 5)$ dB(W/m^2) for $5° < \theta \leq 25°$ -105 dB(W/m^2) for $25° < \theta \leq 90°$ would ensure adequate protection of the fixed service. These studies will be further considered in ITU-R in order to confirm that these maximum pfd do not unduly constrain the FSS, and that HD-FSS systems which meet these limits are feasible. In addition, the question of the possibility of sharing with HAPS has been raised, and some further studies would be required. Moreover, further studies about the sharing between "HD-FSS" earth station receivers and FS stations would be required. • Compatibility between EESS and FSS (space-to Earth): Inter service compatibility studies between EESS (passive) in the band 50.2-50.4 GHz and FSS (space-to Earth) in the band 47.2-50.2 GHz have been initiated. However, some points still have to be addressed: • Inter-service compatibility studies between EESS (passive) in the band 50.2-50.4 GHz and FSS (space-to-Earth) in the band 47.2-50.2 GHz have been initiated. The case of interference coming into the main lobe of the EESS sensor after a scattering on the Earth's surface. ITU-R still needs to assess the scattering coefficient to be used in such a compatibility analysis. • The assumption in the study on the percentage of the power falling into the passive band was questioned. Other masks under consideration by ITU-R propose higher values. • There may be a need to consider the impact of FSS satellite operations under rainy conditions on the interference coming into EESS receiver.

47.2-50.2 GHz (continued)	• Compatibility between radio astronomy and FSS (space-to Earth): The band 48.94-49.04 GHz is also allocated to the radio astronomy service on a primary basis. Any deployment of "HD-FSS" systems should also ensure the protection of the radio astronomy sites in this band. The ITU-R has concluded that an FSS (space-to-Earth) allocation in the bands 47.5-47.9 GHz, 48.20-48.54 GHz and 49.44-50.2 GHz would be compatible with the RAS on the basis of the assumptions that the maximum satellite e.i.r.p. spectral density is –3 dBW/Hz and an appropriate out-of-band emission mask is used. **Conclusions:** Some administrations consider that the bands 47.5-47.9 GHz, 48.2-48.54 GHz and 49.44-50.2 GHz are suitable for an FSS (space-to-Earth) allocation and "HD-FSS" identification on a global basis. Other administrations consider that an FSS (space-to-Earth) allocation in these bands is not feasible because of technical constraints on the FSS in both directions of transmission and such an allocation would cause severe difficulties in the operation to EESS. Therefore these bands cannot be used to satisfy agenda item 1.25.
21.4-22.0 GHz	**Comments:** The 21.4-22.0 GHz band is currently allocated to BSS in Regions 1 and 3. This allocation is subject to future planning, in accordance with Resolution 507. Furthermore, Resolution 525 states that in Regions 1 and 3 the BSS is implemented after 1 April 2007 in order to protect the existing services and a future competent world radiocommunication conference will adopt definitive provisions. Therefore, a new FSS allocation would seriously limit the deployment of BSS networks including their future planning. **Conclusion:** This band is not proposed for "HD-FSS" identification.
17.3-17.7 GHz	**Comments:** This sub-band is part of a planned band for BSS feeder links (Earth-to-space) in all ITU Regions (APS30A) and is subject to No. **5.516**. In Region 2, as per 5.517, an allocation to the BSS in the band 17.3-17.7 GHz will come into effect 1 April 2007. There is an agenda item (1.18) of WRC-03 to possibly introduce a primary FS allocation in the 17.3-17.7 GHz sub-band. The band is also allocated in all ITU Regions to radiolocation on a secondary basis and also in the countries in No. **5.514** to the fixed and mobile services on a secondary basis. The ITU-R has undertaken a number of studies and the conclusions are documented in section 4.3.1.3.1 of the CPM text. **Conclusions:** This band is not suitable for an FSS (space-to-Earth) allocation in Region 2. Some administrations consider that this band is suitable for an FSS (space-to-Earth) allocation and "HD-FSS" identification in Regions 1 and 3. Other administrations consider that this band is not suitable for an FSS (space-to-Earth) allocation in Region 3.

4.3.3 Methods to satisfy the agenda item and their advantages and disadvantages

The candidate uplink and downlink bands for HD-FSS must be determined whether they are appropriate for HD-FSS identification within the direction of the existing allocation. A few possible candidate downlink bands that are not currently allocated in this direction were proposed by some administrations for identification for HD-FSS and this would require a new allocation to the FSS (space-to-Earth).

If a candidate band in the indicated direction is deemed appropriate for HD-FSS identification, three methods are proposed to satisfy the agenda item:

4.3.3.1 Method A

Identification of frequency bands for high-density applications in the fixed-satellite service through a WRC Resolution.

Advantages:

- Identifies the frequency bands and provides necessary explanatory text.
- Could provide the date of implementation of the HD-FSS in the Resolution.

Disadvantage:

Does not clearly indicate HD-FSS global/regional frequency bands in the Table of Frequency Allocations of the Radio Regulations.

4.3.3.2 Method B

Identification of frequency bands for high-density applications in the fixed-satellite service through a footnote No. **5. HD-FSS** in Article **5** of the Radio Regulations.

Identification of bands for HD-FSS could be analogous to identification of bands for high-density applications in the fixed service (HDFS) in No. **5.547**.

Advantage:

Provides a reference in the Table of Frequency Allocations and indicates all HD-FSS global and regional frequency bands in one or several footnotes in Article 5 of the Radio Regulations.

Disadvantage:

This regulatory format for HD-FSS applications compared to other applications that are not referred to in a footnote in the RR could be misinterpreted as giving a different regulatory status to HD-FSS compared with other applications.

4.3.3.3 Method C

Identification of frequency bands for high-density applications in the FSS through a footnote (example given in Annex 4.3-1) in Article 5 of the Radio Regulations which also references a WRC-03 Resolution (example given in Annex 4.3-1) providing guidance on its implementation.

Identification of bands for HD-FSS could be analogous to identification of bands for high-density applications in the fixed service (HDFS) in No. **5.547**.

Advantages:

- Provides a reference in the Table of Frequency Allocations and indicates all HD-FSS global and regional frequency bands in one or several footnotes in Article **5** of the Radio Regulations.

- Provides further guidance on the footnote implementation and explanatory text through a WRC Resolution.
- Could provide the date of implementation of the HD-FSS through the WRC Resolution.

Disadvantages:

- This regulatory format for HD-FSS applications compared to other services that are not referred to in a footnote in the RR could be misinterpreted as giving a different regulatory status to HD-FSS compared with other applications, if not properly clarified in the Resolution.
- Risks of misinterpretation of guidance given in a resolution for matters to be decided by administrations, if not properly clarified in the resolution.

4.3.3.4 Other considerations

Irrespective of the method chosen by the Conference, a WRC Recommendation could also be adopted giving guidance to administrations desiring to enable HD-FSS systems.

4.3.4 Regulatory and procedural considerations

International coordination using RR should ensure interference free operation, however as a consequence of the general characteristics of HD-FSS mentioned in § 4.3.1, procedures for the coordination of the earth stations for HD-FSS applications may need further elaboration.

HD-FSS earth stations may be considered, from the point of view of applying the RR procedures, as typical earth stations and it is appropriate that discussions on the regulatory/procedural aspects of HD-FSS earth stations be based on the assumption that these earth stations may be characterized as typical.

The topic of coordination and notification of typical Earth stations was discussed under agenda item 1.30 (see section 3.4.3.3). The result of these discussions may be applicable to HD-FSS.

Identification of frequency bands for HD-FSS does not eliminate the need for satellite network coordination in accordance with the ITU Radio Regulations. It is important that such identification does not preclude the use of other types of FSS earth stations than those associated with systems characterized in § 4.3.1. Such identification should not result in any additional regulatory burden on the part of GSO and non-GSO FSS networks with respect to intra-service sharing.

ANNEX 4.3-1

ADD

5.[HD-FSS] The space-to-Earth fixed-satellite service bands AA-BB GHz, CC-DD GHz, … and EE-FF GHz and the Earth-to-space fixed-satellite service bands ZZ-YY GHz, XX-WW GHz, … and VV-UU GHz, are identified for use by high-density applications in the fixed-satellite service (HD-FSS). Implementation of HD-FSS should be in accordance with Resolution **[HD-FSS] (WRC-03)**. This identification does not preclude the use of these bands by other fixed-satellite service applications or by other services to which these bands are allocated and does not establish priority among users of the bands in the Radio Regulations. Administrations should take this into account when considering regulatory provisions in relation to these bands.

Some administrations are of the opinion that the above footnote should be aligned with the HDFS footnote **5.547**.

EXAMPLE RESOLUTION [HD-FSS 4.3-1]

Guidelines for the implementation of high-density applications in the fixed-satellite service in frequency bands identified for HD-FSS

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that demand has been increasing steadily for global broadband communication services throughout the world, such as those provided by high-density applications in the fixed-satellite service (HD-FSS);

b) that HD-FSS systems are characterized by flexible, rapid and ubiquitous deployment of large numbers of cost-optimized earth stations employing small antennas and having common technical characteristics;

c) that HD-FSS is an advanced broadband communication application concept that will provide access to a wide range of broadband telecommunication applications supported by fixed telecommunication networks (including the Internet), and thus will complement other telecommunication systems;

d) that, as with other FSS systems, HD-FSS offers great potential to establish telecommunication infrastructure rapidly;

e) that HD-FSS applications can be provided by satellites of any orbital type, GSO or non-GSO;

f) that interference mitigation techniques have been and continue to be studied in the ITU-R to facilitate sharing between HD-FSS earth stations and terrestrial services;

g) that, to date, there is no agreement on the practicability of implementation of interference mitigation techniques for HD-FSS earth stations,

noting

a) that No. **5.[HD-FSS]** identifies bands for high-density applications in the fixed-satellite service (HD-FSS);

b) that in some of these bands, the FSS allocations are co-primary with fixed and mobile service allocations as well as other services;

c) that this identification does not preclude the use of these bands by other services or by other fixed-satellite service applications, and does not establish priority among users of the bands in the Radio Regulations;

d) that in the band 18.6-18.8 GHz, the FSS allocation is co-primary with the Earth exploration-satellite service (passive) with the restrictions of **5.522A** and **5.522B**;

e) that radio astronomy observations are carried out in the 48.94-49.04 GHz band, and that such observations require protection at notified radio astronomy stations;

f) that co-frequency sharing between transmitting HD-FSS earth stations and terrestrial services is very difficult in the same geographical area;

g) that co-frequency sharing between receiving HD-FSS earth stations and terrestrial stations in the same geographical area would require implementation of interference mitigation techniques (see considering *f)* and *g)*);

h) that a number of FSS systems with other types of earth stations and characteristics have already been brought into use or are planned to be brought into use in some of the frequency bands identified for HD-FSS in No. **5.[HD-FSS]**;

i) that HD-FSS stations in these bands are expected to be deployed in large numbers over urban, suburban and rural areas of large geographical extent,

recognizing

a) that in cases where FSS earth stations use bands that are shared on a co-primary basis with terrestrial services, the current (2001) Radio Regulations stipulate that earth stations of the FSS shall be individually notified to the Bureau when their coordination contours extend into the territory of another administration;

b) that as a consequence of their general characteristics, it is difficult and may be a rather long process to coordinate HD-FSS earth stations with fixed service stations on an individual site-by-site basis between administrations;

c) that to minimize the burden for administrations, procedures and provisions can be implemented by administrations for large numbers of HD-FSS earth stations associated with a given satellite system;

d) that harmonized worldwide bands for HD-FSS are desirable in order to achieve global access and the benefits of economies of scale,

recognizing further

a) that HD-FSS applications implemented on FSS networks and systems are subject to all provisions of the Radio Regulations applicable to the fixed-satellite service, such as coordination and notification pursuant to Articles **9** and **11**, including any ITU requirements to coordinate with terrestrial services across international borders, and the provisions of Articles **21** and **22**,

resolves

that administrations which implement HD-FSS:

1 consider making some or all of the frequency bands identified in No. **5.[HD-FSS]** available for HD-FSS applications;

2 in making frequency bands available under *resolves* 1, to take into account:

i) that HD-FSS deployment may be easier in bands that are not shared with terrestrial services;

ii) the impact that, in bands shared with terrestrial services, the further deployment of terrestrial stations or of HD-FSS earth stations would have on the existing and future development of HD-FSS or terrestrial services, respectively;

3 consider taking into account the relevant technical characteristics, as identified by ITU-R Recommendations (e.g., Recommendations ITU-R S.524-7 and S.1594;

4 take into account other existing and planned fixed-satellite service systems having different characteristics in frequency bands where HD-FSS is implemented in accordance with *resolves* 1 and the conditions specified in No. **5.[HD-FSS]**,

invites administrations

1 to give due consideration to the benefits of harmonized utilization of the spectrum for HD-FSS on a global basis, taking into account the use and planned use of these bands by all other services to which these bands are allocated, as well as other types of fixed-satellite service applications;

2 to consider implementing procedures and provisions that facilitate the deployment of HD-FSS systems within their territory in some or all of the bands identified in No. **5.[HD-FSS]**.

#########

4.4 Agenda item 1.26

"to consider the provisions under which earth stations located on board vessels could operate in fixed-satellite service networks, taking into account the ITU-R studies in response to Resolution **82 (WRC-2000)**"

4.4.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Relevant ITU-R Recommendations: ITU-R SF.[ESV-A] (Doc. 4/95–9/154)[1], SF.1585, SF.[ESV-C] (Doc. 4/92–9/151)[1], SF.[ESV-FREQ] (Doc. 4/91–9/150)[1], S.1587.

These Recommendations contain information on the characteristics, frequency bands, guidance and example methods for use with ESVs operating at 4/6 GHz and 11/14 GHz to provide protection to the fixed service. It can be noted however that these Recommendations do not cover the case of other terrestrial services. In order to properly examine various aspects of ESV under agenda item 1.26, it is necessary to identify technical and operational characteristics of the ESV currently operating 4/6 GHz and 11/14 GHz frequency bands including proper reference and adequate information with respect to their associated space stations, including their class of station as well as their category of allocation.

Recommendation ITU-R SF.[ESV-A] recommends distances beyond which in motion ESVs are assumed not to cause unacceptable interference to the fixed service. For the band 5 925-6 425 MHz, the distance is 300 km and for the 14 GHz band, the distance is 125 km based, among others, on the assumption of a moving vessel (10 knots).

Recommendation ITU-R SF.1585 gives example on the development of the composite area within which the interference to the FS from ESVs needs to be evaluated and Recommendation ITU-R SF.[ESV-C] gives guidance for determination of the interference potential between ESVs and the FS when the ESV is operating close to shore. These two Recommendations may be used as guidance for those administrations, which wish to coordinate ESVs with fixed service stations.

Finally, draft new Recommendation ITU-R SF.[ESV-FREQ] considers use of frequencies by ESV transmitting in the 6 and 14 GHz bands and Recommendation ITU-R S.1587 provides technical characteristics of ESV for both the 6 and the 14 GHz band and ESV characteristics for use in sharing studies between the FS and FSS.

---

[1] These ITU-R Recommendations were objected to by one Member State at the stage of adoption by ITU-R. Some other countries supported this objection.

4.4.2 Analysis of the results of studies

Since ESV shall not claim protection from terrestrial services (including the FS), the 4 GHz and 11 GHz bands, where the terrestrial systems have the potential to cause interference to ESVs, were not considered.

In addition, it was also acknowledged that if the ESV was intended to be operated only at specified fixed points the current regulations for specific FSS earth stations apply and thus there is no need for new regulatory procedures.

Studies carried out in the ITU-R indicate that in-motion ESVs may successfully operate in both the 4/6 GHz and the 11/14 GHz FSS allocations without causing unacceptable interference to the fixed service as well as other satellite services provided that necessary constraints be imposed on ESV operations.

In this regard, a distance beyond which unacceptable interference will not occur to fixed service stations has been determined to be 300 km at 6 GHz and 125 km at 14 GHz and certain technical limitations have been identified for operation of the ESVs.

Some administrations were of the view that it is necessary to complete studies to ensure protection of all terrestrial services in the 6 and 14 GHz bands before any use of these bands by ESVs. The minimum distances referred to in Resolution [ESV 4.4-1] and Resolution [ESV 4.4-2] beyond which an ESV will not have the potential to cause unacceptable interference to other services assume certain technical characteristics of ESVs. These distances will be affected if the assumptions used are changed.

Some administrations were of the view that there is a need to specify tracking control of the ESVs.

Regarding the protection of the fixed service, these limitations, required to ensure that the minimum distances remain valid for all ESVs, are:

In the 5 925-6 425 MHz

Maximum occupied bandwidth per vessel:	2.4 MHz
Maximum ESV e.i.r.p. spectral density toward the horizon:	17 dB(W/MHz)

In the 14-14.5 GHz

Maximum occupied bandwidth per vessel:	2.4 MHz
Maximum ESV e.i.r.p. spectral density toward the horizon:	12.5 dB(W/MHz)

In addition, a limit regarding the minimum antenna size is required in order to limit the number of vessels that would be able to implement an ESV. This limit also needs to be included in the RR.

Since a maximum ESV e.i.r.p. spectral density toward the horizon is proposed (consistently with the parameters used in the studies), several administrations were of the view that a reduction of the minimum antenna size will not necessarily lead to a significant increase in the number of vessels. Those administrations hence agreed that a minimum antenna size is required but that a certain level of flexibility on the antenna size in both bands would still ensure the same level of protection to the FS.

ITU-R Recommendations have been developed providing guidance and example on how to avoid unacceptable interference to fixed stations when ESV intend to operate within the distance.

In addition to the above limitations and in order to ensure the protection of the FSS networks, ESVs would also have to comply with the off-axis e.i.r.p. limits given in Recommendation ITU-R S.524. These limits should be met under normal operating conditions of ESVs. Some administrations sought clarification of the term "normal operation condition".

Some administrations were of the view that this limit could be included in the annexes of, for example, Resolutions [ESV 4.4-1] and [ESV 4.4-2], or in Article 21 or in a footnote in Article 5. For the 14-14.5 GHz band, the values are taken from Recommendation ITU-R S.728 as opposed to those in Recommendation ITU-R S.524. Further consideration of values for the band 14.0-14.5 GHz may be needed.

Finally, ITU-R also considered the possible use of ESVs in the FSS band 6 425-6 725 MHz (Earth-to-space). ITU-R was not able to conduct the relevant sharing studies with all systems using this band according to the current Radio Regulations and, noting that footnote No **5.458** states that passive microwave sensor measurements are carried out over the oceans in this band, and, prior to the completion of the studies, concluded that the 6 425-6 725 MHz band should not be recommended for ESV operations.

4.4.3 Methods to satisfy the agenda item and their advantages and disadvantages

For the 4 and 11 GHz downlink bands, it was agreed that ESV shall not claim protection from other services, according to the RR provisions.

In order to ensure the protection of the terrestrial services in the 5 925-6 425 MHz and 14-14.5 GHz bands from unacceptable interference, it is necessary to impose technical and operational limitations on the operation of ESV and corresponding regulatory provisions in an adequate Resolution intending to replace Resolution **82**, and to be incorporated by reference in the corresponding provisions in Article **5**.

This would include the minimum distance within which ESVs could not operate without prior agreement of the concerned administration, along with other appropriate constraints as specified in section 4.4.2.

With respect to the protection of the FSS, the ESVs should comply with the technical and operational characteristics studied by ITU-R (see section 4.4.2) and also proposed to be incorporated in the Resolution. This will ensure the protection and future development of FSS networks.

Some administrations proposed an example of such a Resolution as given in Annex 4.4-2; some administrations proposed another example of such a Resolution as given in Annex 4.4-3.

Some administrations were of the view that a) in point 3 of attachment 1 of example Resolutions (Annex 4.4-2) the expression of "terrestrial services" should be replaced by "other services", that b) the expression of "coastline" be replaced by "reference point" to be decided by the concerned administrations (point 3 of Attachment 1 of example Resolutions (Annex 4.4-2)) and that c) any cost incurred by the operation of ESVs inside the minimum distance shall be borne by the ESV operator. These administrations also do not agree with any modification to any parameters in the example Resolutions.

Some administrations express their concerns and objections with regards to the application of Resolution 82 and the example Resolutions as per the following:

- The operations of mobile earth stations using an FSS band.
- The use of the uplink band 14-14.5 is not to be considered by WRC-03 (see Resolution 82, *resolves* 2).
- The antenna diameters in the example Resolution ESV 4.4-1 (Annex 4.4-2).
- The use of a reference point that shall be determined by the concerned administration.
- Any cost which may arise from the request to operate an ESV inside the minimum distance shall be borne by the ESV operators.

Some administrations were of the view that the technical limitations prescribed in Annex 2/Attachment 2 of both example Resolutions as given in Annexes 4.4-2 and 4.4-3 should not apply to MMSS in accordance with the current RR.

Some administrations were of the view that there is a need for ESV antenna tracking control and off axis e.i.r.p. limits. Therefore, those administrations are of the view that tracking control of the ESV antenna shall be such that the off axis e.i.r.p. shall not exceed Recommendation ITU-R S.524 tightened by 3 dB for the 6 GHz band and Recommendation ITU-R S.728 relaxed by 3 dB for the 14 GHz, and between the topocentric angle at the ESV between the nominal location of the space station associated with the ESV and any orbital locations within 3 degree of the GSO arc.

Some administrations were of the view that the antenna diameter in the example Resolution ESV 4.4-1 (Annex 4.4-2) shall be 2.4 m for the 6 GHz band and 1.2 m for the 14 GHz band as considered in the determination of the minimum distance. Those administrations are also of the view that tracking accuracy should be included in the list of parameters irrespective of the antenna diameter.

The methods for satisfying this agenda item elaborate on the regulatory provisions under which such limitations and operational constraints could be enforced.

In particular, it considers the status of the allocation as well as the means upon which to impose technical constraints on the operation of ESV.

Depending on the outcome of WRC-03, some regulatory means may be necessary to permit the continued operation of MMSS earth stations in the 14 GHz band on a secondary basis that do not meet the proposed limits and currently using transponders of the FSS on a primary basis.

4.4.3.1 Method A

ESV possible operations under the existing FSS allocations

In this case, a footnote (see Annex 4.4-1) pointing to an adequate Resolution is attached to the existing FSS allocations in the 5 925-6 425 MHz and 14-14.5 GHz bands.

Advantages:

- No need for additional allocation.
- Permits the operation of ESVs while ensuring adequate protection to the fixed service.
- Clarifies the regulatory procedures to be used for ESVs.
- Possible use of the coordination agreements obtained for the FSS networks under which the ESV will operate with other FSS networks on a primary basis under Article 9.

Disadvantages:

- Imply changes to the Radio Regulations in order to allow the use of maritime mobile satellite earth stations under a fixed-satellite service allocation.
- Difference between ESV use under the footnote and other stations operating under the existing MMSS secondary allocation in the 14 GHz band.

Other considerations:

- May need a definition of ESV and its consequential implication.

4.4.3.2 Method B

ESV possible operations under a secondary MMSS allocation.

In this case, a footnote (see Annex 4.4-1) pointing to an adequate Resolution is attached to the existing 14-14.5 GHz or possible new 5 925-6 425 MHz secondary MMSS allocations. Another possibility could be to add a new section in Art. 51 (Maritime mobile services) (see Annex 4.4-1).

Advantages:

- Permits the operation of ESVs while ensuring adequate protection to the fixed service.
- Clarifies the regulatory procedures to be used for ESVs.
- No additional allocation required in the 14-14.5 GHz.
- Consistent with the mobile nature of the ESV.
- All mobile satellite use in the 14-14.5 GHz band operating under a secondary allocation.

Disadvantages:

- May not allow the protection of the MMSS space stations from FSS networks.
- Inconsistent with the technical and operational characteristics of mobile maritime terminals currently in use in the 14-14.5 GHz band.
- New allocation required in the 5 925-6 425 GHz.
- May constrain the coordination process for secondary networks providing ESV operation with respect to primary FSS networks.

Other considerations:

- Even though the primary FSS service has no obligation to respond to a coordination request, it leaves open the possibility of coordinating the space networks associated with ESV under No. **9.7**, but only if agreed by the primary service.
- May need a definition of ESV and corresponding space station and their consequential implications.
- The FS protection criteria used in the sharing studies were based on allowance for interference as if the services were co-primary service.

4.4.3.3 Method C

Suppression of Resolution 82 (WRC-2000).

Advantages:

- No additional impact on the existing systems other than those which could eventually exist when ESV functions under No. 4.4. of the RR.
- Less burden put on administrations due to the fact that they will receive fewer requests to operate ESVs.

Disadvantages:

- Provides no regulatory framework for administrations to reach an agreement on how ESV stations could operate near the coast, while ensuring no harmful interference to terrestrial services.
- Potential of interference to the existing services when ESVs operate under No. 4.4 of the RR.
- No advantage taken from ITU-R studies, agenda item is not satisfied.

4.4.4 Regulatory and procedural considerations

Should WRC-03 allow such use, the RR should be modified in such a way to assure protection of other services, including FS, and make the provisions as easy as possible for concerned administrations to implement.

Administrations considering that the request for prior agreement by an ESV operator for the operation of an ESV within the minimum distance would impose a heavy burden on the administrations, or prior agreements could not be concluded within certain time constraints, or where there is not a particular national usage of the considered band by the fixed service, could add their names in a suitable footnote, which would allow the administrations to permit ESVs to operate within a particular corresponding portion of that FSS frequency band without the need of the prior agreement. As a result no prior agreement may be required when ESVs operate within the minimum distance. On the other hand this could restrict the choice for the ESV operator within the FSS frequency band.

Some administrations were of the view that:

- there is a need to define/characterize the earth station on board a vessel (ESV) and its relation with the corresponding space station (in particular with regard to the class of station and the category of service) and to clarify services under which the ESV could operate (MMSS or FSS).

  Defining ESV is a good concept and may ease the path to a solution that is coherent in regulatory terms. Problems exist, however, regarding:

  a) clarification that the equipment is distinct from a ship earth station (as defined by Nos. 1.68 and 1.78) and does not form part of the mandatory equipment associated with the GMDSS; and

  b) associating an earth station that operates in a mobile environment with the fixed-satellite service in a manner consistent with the Radio Regulations.

  Depending on the class of station and category of service under which the ESV will operate, relevant regulatory procedures including the corresponding coordination and notification to be applied must be specified.

  Under Method B, this could be addressed by following the existing regulatory procedure.

  In order to use an ESV on a secondary basis a request for coordination of the ESV network is to be submitted to BR. This leads to the publication of a Special Section of the BR International Frequency Information Circular (BR IFIC). This publication is to initiate the coordination procedure for the ESV network where the class of station is matched for the space station and earth station, and the space station and earth station have the same category of allocation. These actions could therefore be done within the existing procedures of the Radio Regulations.

  The application of operational procedures described in Resolution [ESV 4.4-1] and Resolution [ESV 4.4-2] for operation inside the minimum distance could incur costs on the part of involved administrations. Any such cost should be borne by the ESV operators.

  The reference point from which the minimum distance is referred to is determined by the concerned administration.

- The proposed distances 300 km at 6 GHz and 125 km at 14 GHz are not adequate due to their geographical area composition. Therefore, these administrations believe it is necessary to include a footnote in Article 5 of the Radio Regulations that would require the cessation of the operation of ESVs in particular geographic areas. Other administrations believe that such a footnote goes beyond the norms of the RR and would be inconsistent with the UNCLOS[2] and customary international law.

- Under Method A, protection of FSS satellites adjacent to those providing service to ESVs could be provided through an appropriate regulatory provision (for example through a footnote to Article 5) that would specify the off-axis emission limits as given in Recommendations ITU-R S.524 (6 GHz) and S.728 (14 GHz).
- Consistent with UNCLOS[2], 1982, the point to measure distances identified in Annex 4.4.2 [ESV 4.4-1] and Annex 4.4-3 Example Resolution [ESV 4.4-2] is the normal baseline, normally the low water mark line, from which the territorial sea is measured.

ANNEX 4.4-1

With regard to the means upon which limitations and operational constraints could be enforced the following considerations can be noted:

1 Footnote pointing for a Resolution

Advantage:

Straightforward from Article 5.

Disadvantage:

None.

1.1 If this footnote was to be attached to the existing FSS allocation (under Method A in section 4.4.3.1) the following examples could be considered:

5.ESV-FSS1: The operation of earth stations on board vessels shall be in accordance with Resolution [ESV 4.4-1] (Annex 4.4-2).

5.ESV-FSS2: Administrations operating earth stations on board vessels in the bands 5 925-6 425 MHz and 14-14.5 GHz shall take all practicable steps to comply with Resolution [ESV 4.4-2] (Annex 4.4-3). Such use shall not cause harmful interference to, claim protection from, or otherwise impose constraints on the operation or development of other radio services operating in the band 5 925-6 425 MHz.

5.ESV-FSS3: In the bands [X,Y] MHz, earth stations in the fixed satellite service may be operated on board vessels. Such use shall be in accordance with Resolution [ESV 4.4-1] (Annex 4.4-2).

1.2 If this footnote was to be attached to the existing or new MMSS allocation (under Method B in section 4.4.3.2), the following examples could be considered:

5.ESV-MMSS1: Transmit earth stations in the maritime mobile-satellite service in this band shall operate in accordance with the provision of Resolution [ESV 4.4-1] (Annex 4.4-2).

5.ESV-MMSS2: The operation of earth stations in the maritime mobile-satellite service in this band is subject to the provisions of Resolution [ESV 4.4-2] (Annex 4.4-3).

[2] United Nations Convention on the Law of the Sea, 1982.

5.ESV-MMSS3: Ship earth stations in the maritime mobile-satellite service in this band shall operate in accordance with the provision of Resolution [ESV 4.4-1]
(Annex 4.4-2).

Different text may also be considered with regards to the 6 and 14 GHz bands.

2 Article 51 (limited to Method B)

Advantages:

- Do not need any footnote in Article 5 provided that the MMSS status is retained.
- Provide a global regulatory solution within Volume 1 of the RR.
- All provisions related to maritime services would be in a single article.

Disadvantage:

None.

ANNEX 4.4-2

EXAMPLE RESOLUTION [ESV 4.4-1]

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that there is a demand for global wideband satellite communication services on vessels;

b) that the technology exists that enables earth stations on board vessels (ESVs) to use fixed-satellite service (FSS) networks operating in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz;

c) that ESVs have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

d) that with respect to the bands considered in this Resolution global coverage is only available in the band 5 925-6 425 MHz and that only a limited number of geostationary FSS systems can provide such global coverage;

e) that without special regulatory provisions ESVs could place a heavy coordination burden on some administrations, especially those in developing countries;

f) that in order to ensure the protection and future growth of other services, ESVs shall operate with requisite technical and operational constraints;

g) that, based on agreed technical assumptions, minimum distances from the coast have been calculated, within ITU-R studies, beyond which an ESV will not have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz,

noting

that the regulatory procedures of Article 9 apply for ESVs operating at specified fixed points,

resolves

that ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands shall operate under the regulatory and operational provisions contained in Annex 1 and the technical constraints in Annex 2 of this Resolution,

encourages concerned administrations

to cooperate with administrations which license ESVs while seeking agreement under these provisions,

instructs the Secretary-General

to bring this Resolution to the attention of Secretary-General of the International Maritime Organisation (IMO).

ANNEX 1 TO EXAMPLE RESOLUTION [ESV 4.4-1]

Regulatory and operational provisions for ESV transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands

1 The administration that issues the licence for the use of ESVs in these bands (licensing administration) shall ensure that such stations follow the provisions of this attachment and thus do not present any potential to cause unacceptable interference to the services of other concerned administrations.

2 ESVs service providers shall comply with the technical limitations listed in Annex 2 and, when operating within the minimum distances as identified in item 4 below, with the additional limitations agreed by the licensing and other concerned administrations.

3 In the associated downlink bands, 3 400-4 200 MHz and 10.7-12.75 GHz, ESVs in motion shall not claim protection from transmissions of terrestrial services operating in accordance with the Radio Regulations.

4 The minimum distance from the coast beyond which ESVs can operate without the prior agreement of any administration is 300 km in the 5 925-6 425 MHz band and 125 km in the 14-14.5 GHz band. Any transmissions from ESVs within the minimum distances shall be with the prior agreement of the concerned administration(s).

5 The potentially concerned administrations referred to in the previous item 5 are those where fixed or mobile services are allocated in the Table of Frequency Allocations of the Radio Regulations:

Frequency bands	Potentially concerned Administrations
5 925-6 425 MHz	All three Regions
14-14.25 GHz	Countries listed in No. **5.505**
14.25-14.3 GHz	Countries listed in Nos. **5.505**, **5.508** and **5.509**
14.3-14.4 GHz	Regions 1 and 3
14.4-14.5 GHz	All three Regions

6 Administrations, in applying the minimum distance referred to in item 4 above, are encouraged to exclude those parts of their territory, such as remote small islands, where terrestrial services in the bands 5 925-6 425 MHz and 14-14.5 GHz are neither operating nor planned.

7 The ESV system shall include means of identification and mechanisms to terminate transmissions, on a mandatory basis, whenever the station operates outside its authorized geographic (see item 4 above) or operational limits.

8 Termination of transmissions as referred to in item 7 above shall be implemented in such a way that the corresponding mechanisms can not be by-passed on board the vessel, except under the provisions of No **4.9**;

9 ESVs shall be equipped so as to enable the licensing administration under the provisions of Article **18** to verify earth station performance and to terminate ESV transmissions immediately upon request by an administration whose services may be affected.

10 When ESVs operating beyond the territorial waters but within the minimum distance (as referred to in item 4 above) fail to comply with the terms required by the concerned administration pursuant to items 2 and 4, then that administration may:

– request the ESV to comply with such terms or cease operation immediately; or
– request the licensing administration to require such compliance or immediate cessation of the operation.

ANNEX 2 TO EXAMPLE RESOLUTION [ESV 4.4-1]

Technical limitations applicable to ESVs transmitting in the bands 5 925-6 425 MHz and 14-14.5 GHz

	5 925-6 425 MHz	14-14.5 GHz
Minimum diameter of ESV antenna*	1.2 m	0.6 m
Maximum occupied bandwidth per vessel	2.4 MHz	2.4 MHz
Tracking accuracy of ESV antenna	± 0.2° peak	± 0.2° peak
Maximum ESV e.i.r.p. spectral density toward the horizon	17 dB(W/MHz)	12.5 dB(W/MHz)
* The aim of this minimum antenna size is to limit the number of vessels that would be able to implement such antenna.		

ANNEX 4.4-3

EXAMPLE RESOLUTION [ESV 4.4-2]

Provisions relating to earth stations located on board vessels operating with fixed-satellite service networks in the bands 5 925-6 425 MHz and 14.0-14.5 GHz

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that there is a demand for global wideband satellite communication services on vessels;

b) that ESVs are currently operating through fixed-satellite service networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14.0-14.5 GHz;

c) that ESVs have the potential to cause unacceptable interference to other services in the 5 925-6 425 MHz and 14.0-14.5 GHz (Earth-to-space) bands;

d) that ESVs operating in these bands require considerably less than the full bandwidth in the FSS allocation and only a portion of the visible geostationary arc;

e) that the number of vessels equipped with ESVs may be such that the procedures could place a heavy coordination burden on some administrations, especially those in developing countries;

f) that in order to ensure the protection and future growth of other services, ESVs should operate with requisite technical and operational constraints;

g) that a minimum distance has been identified beyond which an ESV will not have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz,

noting

a) that ESVs may be assigned frequencies to operate in FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14.0-14.5 GHz pursuant to No. **4.4** of the Radio Regulations and shall not claim protection from, nor cause harmful interference to other services having allocations in these bands;

b) that existing regulatory procedures provide for ESVs operating at specified fixed points,

recognizing

that the references to the distances in *resolves* 2 is solely for the purpose of facilitating avoidance of radio interference and does not confer any territorial rights on administrations,

resolves

1 that any transmissions from ESVs, except those operating pursuant to No. **4.4** of the Radio Regulations, within the distances identified in *resolves* 2 of this Resolution be based upon the prior agreement of the concerned administrations;

2 that the minimum distances from the normal baseline ("low water mark" as defined by the United Nations Convention on the Law of the Sea, 1982 (UNCLOS, 1982)), beyond which these stations are assumed not to have the potential to cause unacceptable interference to stations of other services of any administration and beyond which no agreement is necessary are 300 km for the 5 925-6 425 MHz band and 125 km for the 14.0-14.5 GHz band;

3 that operation of ESVs follow the procedures in Attachment 1 and the technical constraints in Attachment 2,

encourages concerned administrations

to cooperate with administrations that license ESVs and seek agreement under the provisions of Annex 1,

encourages ESV licensing administrations

to consider registering their ESV frequency assignments in the Master International Frequency Register, for information purposes only,

instructs the Secretary-General

to bring this Resolution to the attention of the Secretary-General of the International Maritime Organization.

ATTACHMENT 1 TO EXAMPLE RESOLUTION [ESV 4.4-2]

Operational procedures for ESV use

A Initiation of contact

When ships equipped with ESVs intend to operate in the band 5 925-6 425 MHz within 300 kilometres and in the band 14-14.5 GHz within 125 km of the normal baseline ("low water mark" as defined by UNCLOS, 1982) of other administrations having terrestrial stations operating in the same band as the ESV, the ESV licensing administration should contact, in advance of ESV operations within those distances, the concerned administration(s) to obtain agreements that will establish the technical basis for avoiding unacceptable interference to the terrestrial facilities of the concerned administration or administrations.

B Recommended actions of licensing administrations, ESV operators, and concerned administrations

Each administration having terrestrial stations in these bands should have a point of contact for the ESV licensing administration or the ESV operator to initiate discussions.

Licensing administration or the ESV operator should provide the following information:

1) The technical and operational parameters, including the range of its frequency operation.
2) The proposed dates and ports to be visited and the routes of the ship(s) equipped with ESVs to reach those ports within the minimum distance from the normal baseline ("low water mark" as defined by UNCLOS, 1982) of the concerned administration.

Concerned administrations that have terrestrial stations that could be affected by ESV operations should do the following when contacted by the ESV licensing administration or the ESV operator:

1) Determine if they have terrestrial stations in the same frequency band as the ESV.

2) Identify frequencies for ESV use that would avoid the potential for interference.

C ESV operating agreements

A concerned administration is encouraged to enter into an agreement with the ESV licensing administration that describes the conditions for operation of the ESV when operating near the coast or in ports of the concerned administration. These agreements should be concluded prior to the operation of the ESV stations near the coast or in the ports of the concerned administration. The agreement should consider using the 5 925-6 425 MHz band outside certain limits and not using this band inside certain limits in countries that have fixed service stations in the same band and should include the possibility of switching to the 14.0-14.5 GHz band if there are no terrestrial services in the band. The operating agreement may be revised at any time at the discretion of the concerned administration, particularly whenever new terrestrial facilities are authorized that could potentially receive unacceptable interference.

D Frequency use arrangements

National practices, as well as Recommendations and guidelines of the ITU-R (such as ITU-R SF.[ESV-A] (Doc. 4/85-9/108), [ESV-FREQ] (Doc. 4/91-9/150), [ESV-C] (Doc. 4/92-9/151), and S.1587), may be used in reaching bilateral or multilateral frequency usage arrangements. Typical characteristics for ESV operations are contained in Attachment 2.

E Protection from transmissions of other services

ESVs are not protected from the transmissions of other services operating in the 4 GHz and 11/12 GHz bands.

F ESV point of contact

Each ESV operator should provide a point of contact to the administration with which agreements have been reached for the purpose of reporting unacceptable interference caused by the ESV.

G Avoidance of unacceptable interference

The ESV licensing administration shall ensure that such stations do not cause unacceptable interference to the services of other concerned administrations. In the event that unacceptable interference occurs, the ESV operator must eliminate the source of any interference from its station immediately upon being advised of such interference. Additionally, the ESV operator must immediately terminate transmissions at the request of either the concerned administration or the ESV licensing administration if either administration determines that the ESV is causing unacceptable interference or is otherwise not being operated in compliance with the operating agreement.

Additionally, ESV stations should have the following operational capabilities:

1) The ESV system should include a means of identification and location, and automatic mechanisms to terminate transmissions whenever the station operates outside its authorized geographic (see *resolves* 2) or operational limits.

2) The ESV system should be equipped so as to enable the ESV licensing administration under the provisions of Article 18 to verify earth station performance and to terminate ESV transmissions immediately upon request by a concerned administration whose services may be affected.

ATTACHMENT 2 TO EXAMPLE RESOLUTION [ESV 4.4-2]

This attachment contains typical characteristics of ESV operations on board ships in both the 5 925-6 425 MHz and 14.0-14.5 GHz band.

	5 925-6 425 MHz	**14.0-14.5 GHz**
Minimum diameter of ESV antenna:	2.4 m	1.2 m
Maximum necessary bandwidth per vessel:	24 MHz	24 MHz
Maximum ESV transmitter power spectral density at the input to the antenna:	17 dB(W/MHz)	12.5 dB(W/MHz)

#########

4.5 Agenda item 1.32

"to consider technical and regulatory provisions concerning the band 37.5-43.5 GHz, in accordance with Resolutions **128 (Rev.WRC-2000)** and **84 (WRC-2000)**"

4.5.1 Resolution 128 (Rev.WRC-2000)

"Protection of the radio astronomy service in the 42.5-43.5 GHz band"

4.5.1.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Relevant Recommendations ITU-R: RA.769, RA.1513, S.1542, S.1557, S.1586(Doc. 4/BL/30), SM.[BbB], DNR SF.1573 (Doc. 4-9/BL/3), SF.1484 (Doc. 4-9/BL/5) and DNR RA[PATTERN NGSO].

The provisional pfd levels given in No. **5.551G** are based on the radio astronomy protection criteria given in Recommendation ITU-R RA.769. This Recommendation, however, does not define explicitly the percentage of time for which this level applies in case of non-GSO systems. Recommendation ITU-R RA.1513 specifies that, over the sky, the percentage of data loss caused by any system should be lower than 2%. The provisional power flux-density (pfd) levels given in No. **5.551G** needed to be reviewed by using a methodology, which is appropriate to conduct studies between non-GSO systems and radio astronomy sites. ITU-R has developed such a methodology based on the equivalent power flux-density (epfd) concept to assess the unwanted emission levels from non-GSO systems at radio astronomy sites (see Recommendation ITU-R S.1586).

The 41.5-42.5 GHz band is allocated to the BSS and the FSS on a primary basis. Based on ITU filings, more than 250 GSO and non-GSO, FSS and BSS networks and systems plan to use this band. The adjacent band, 42.5-43.5 GHz, is allocated to the RAS on a primary basis. Very long baseline interferometry (VLBI) and single dish telescope (SDT) observations are conducted in the 42.5-43.5 GHz band. As of this date, at 42.5-43.5 GHz, there are approximately 40 single-dish telescopes worldwide.

Typical downlink system characteristics of FSS and BSS networks that are planned for operation in the 37.5-42.5 GHz band are shown in Table 4.5.2-2 in § 4.5.2.1.3.1 below.

Some FSS and BSS systems that plan to operate in the 40 GHz band intend to provide broadband service with high-link availability. It should be noted that the propagation impairments in the 40 GHz band are severe in bad weather. In order to achieve their desired link availability and high data rates, most FSS and BSS systems propose to operate with high-gain satellite antennas. The 3 dB beamwidths of the 40 GHz transmit and the receive antennas are in a range from 0.3° to 0.65° for GSO satellites (as compared with a 3 dB beamwidth range of 4° to 8º for satellites operating in the 4/6 GHz and 11/14 GHz bands) and in a range of 0.6º to 1.8º for non-GSO satellites. Also, due to satellite weight and power constraints, the area covered by the beams active at any instant in all proposed FSS systems that plan to operate in these bands will be very small, typically representing less than 5% of the satellite field of view.

Some FSS and BSS systems, in this frequency range, operate at the power flux-density limits in Table **21-4** for only a small percentage of time, typically to overcome fading conditions. Therefore, for those systems using fade compensation techniques, in normal operation in the band 42.0 to 42.5 GHz, the power flux-density levels of the FSS and BSS systems will be at clear-sky levels (i.e. at a level of -117 dB(W/(m^2 · MHz)), which is 12 dB lower than the Table **21-4** limits) for all but very short periods of time during fading conditions. Hence, the level of unwanted emissions from these networks in the 42 GHz range is assessed based on clear-sky values.

It should be noted that, to protect co-frequency fixed service systems (see § 4.5.2), RR Article **21**, provides provisional pfd limit for both FSS and BSS (GSO and non-GSO) systems in the band 40.5-42.5 GHz as -105 dB(W/(m^2 · MHz)) at elevation angles between 25° and 90°. This limit has been reflected in Recommendations ITU-R SF.1573 and SF.1484.

The 42.5-43.5 GHz band is allocated to the RAS on a primary basis. Based on Recommendation ITU-R RA.769-1, the detrimental interference criteria of RAS stations operating in this band are as follows:

Single Dish Telescope (SDT): The threshold level of detrimental interference to RAS spectral line observations is -153 dB(W/(m^2 · 500 kHz)). The interference threshold of RAS continuum observations is -137 dB(W/(m^2 · GHz)).

Very Long Baseline Interferometry (VLBI): The detrimental interference threshold for VLBI RAS stations operating in the 42.5-43.5 GHz band is -116 dB(W/(m^2 · 500 kHz)).

It should be noted that the current protection criteria given in No. **5.551G** do not take into account the reference bandwidth and the type of observations being conducted at the radio astronomy station. The revised criteria above would therefore improve on the provisions of No. **5.551G**.

Using the relevant characteristics and criteria, studies were performed on the impact of FSS and BSS unwanted emissions on RAS observations in the 42.5-43.5 GHz band. The studies led to the review of the provisional pfd limit of No. **5.551G** as requested by Resolution **128 (Rev.WRC-2000)**.

4.5.1.2 Analysis of the results of studies

Two cases were considered depending on the type of FSS/BSS systems, which may cause interference to the RAS (noting that in this band the characteristics of BSS and FSS systems will be essentially the same):

1) *For GSO satellite systems:*

- The assessment of pfd levels produced by GSO satellite networks presents no difficulty.
- The RAS protection criteria, in the band 42.5-43.5 GHz, taking into account the type of observation conducted at the radio astronomy station are based on the pfd values given in Recommendation ITU-R RA.769. Results of studies indicate that the unwanted emission levels of the GSO FSS and BSS systems operating in the 42.0-42.5 GHz band meet the detrimental interference threshold for VLBI RAS stations operating in the 42.5-43.5 GHz band.

2) *For non-GSO satellite systems:*

- The definition of specific protection criteria for the radio astronomy service with regard to non-GSO constellations has been made through revision of Recommendations ITU-R RA.769 and RA.1513. This allows epfd criteria to be derived from Recommendation ITU-R RA.769 using a 93 dBi reference antenna gain. The epfd criteria are 93 dB below the pfd, using the detrimental interference thresholds given in Recommendation ITU-R RA.769 (depending on the type of observation conducted at the considered radio astronomy station).
- The epfd level resulting from unwanted emissions of a non-GSO system at a radio astronomy station is calculated assuming a 93 dBi reference antenna gain and using the reference antenna pattern and the methodology given in Recommendation ITU-R S.1586.
- Results of studies indicate that the unwanted emission levels of the non-GSO FSS and BSS systems operating in the 41.5-42.5 GHz band meet the detrimental interference threshold for VLBI RAS stations operating in the 42.5-43.5 GHz band.

The detrimental interference thresholds for a single dish telescope, for continuum observations and for spectral line observations, may not be met by unwanted emissions from a GSO FSS or BSS satellite in the 42.0-42.5 GHz band or by unwanted emissions from a non-GSO FSS or BSS system in the 41.5-42.5 GHz band. Because there are relatively few RAS sites operating with single dish telescopes in the 42.5-43.5 GHz band, it may be feasible to employ interference mitigation techniques, such as operational constraints, geographical isolation, time sharing, better RAS antenna roll-off, etc., in order to reduce the potential for detrimental interference to the RAS receiver sites operating in this band. It may also be productive to conduct analyses using the operational parameters of the FSS systems and the operational RAS receiver in question.

4.5.1.2.1 Use of mitigation techniques by FSS and BSS systems

Mitigation techniques that may be implemented in order to protect stations in the radio astronomy service operating in the band 42.5-43.5 GHz are described in DNR ITU-R SM.[BbB]. Other potential mitigation methods are mentioned in Recommendation ITU-R SM.1542, Annex 2.

A combination of mitigation techniques could provide workable solution to all parties.

a) Geographical isolation

Geographic isolation consists of the separation between the SDT and the location of the peak gain of space station transmit antennas. This can be accomplished in one of two ways: deterministic or statistical avoidance. In the first case, the operator intentionally avoids the SDTs when designing the space station antenna pattern. The deterministic method may be feasible if the number of SDTs operating in the band is kept very small. A different approach would be to use a statistical method, which would allow for a small percentage of the Earth's surface to exceed the SDT detrimental interference threshold. The small percentage would allow for the operation of spot beams while making it unlikely that an SDT would receive power above the detrimental interference threshold. This method may not protect all existing single dish radiotelescopes.

If geographical isolation is used as an interference mitigation technique, studies indicate that the required separation distance between the centre beam of GSO satellite and the RAS receiver site operating with a single dish telescope is a few hundred kilometres, depending on the type of RAS observations and the satellite beam size. The calculated distances were based on the GSO clear sky power flux-density levels.

One study found that the single dish, continuum detrimental interference threshold level could be met on large portions of the surface of the Earth. Given that space stations operating in the band will make use of narrow beams to focus power on very limited geographical areas, it is highly unlikely that these small high power areas, which are typically concentrated in populated areas, will coincide with the location of a radio telescope operating in single dish mode.

b) Filtering

If carriers are at the maximum in-band pfd allowed by Article **21**, meeting detrimental interference threshold levels of a single dish telescope in the 42.5-43.5 GHz band at the FSS/BSS antenna boresight requires about 45 dB of filter rejection at the 42.5 GHz band edge and about 40 dB of filter rejection at the 42.7 GHz (spectral line) and 43.0 GHz RAS centre frequency. Based on current technology, it is difficult to design and implement such filter. Even if the technology were available, the insertion loss of this filter would be in a range of from 3 to 4 dB, and that does not include the additional degradation due to in-band phase distortion.

In the 41.5-42.0 GHz band, in order to meet the interference threshold of a single dish telescope in the 42.5-43.5 GHz band, 40 to 45 dB filter rejection is required depending on the type of observation. The study shows that, in order to meet the RAS interference threshold levels, a 7-pole filter would be needed. The transmit filter insertion loss would be 2.0 dB, which corresponds to a 37% degradation in system capacity. In addition, because most proposed non-GSO FSS systems in this band plan to use phased array transmit antennas in order to optimize the system capacity, each transmit power amplifier must support the entire band, 41.5-42.5 GHz. In order to meet the RAS interference threshold levels, an 11-pole filter would be needed and the filter insertion loss would be increased. Since the satellite field-of-view of an non-GSO satellite is very wide, typically in a range from 25 degrees to 110 degrees depending on the satellite altitude, and the satellite 3-dB beamwidth of non-GSO FSS satellites operating in this band is less than 1 degree, it will require from 1 000 to 2 000 elements in order to implement the phased array antenna. Because the output of each transmit element needs a transmit filter, the additional weight added to the payload due to transmit filters along will have severe and perhaps prohibitive consequential cost and performance penalties.

c) Guard band

A guard band between the FSS/BSS and the RAS would be a possible mitigation method. However, this would result in a loss of capacity on the service or services into which the guard band is placed.

d) Frequency isolation

The operators and users of FSS and BSS space stations employing the 42 GHz band could adopt one or more of the following techniques to mitigate space-to-Earth interference in the band 42.5-43.5 GHz:

- use the transponder adjacent to the 42.5 GHz band edge (edge transponder) only in single-carrier mode;

- avoid using the edge transponder for carriers having near-maximum spectral density;
- if the edge transponder must be employed for a mixture of carrier types, place the nearest carrier to the band edge, which should be the lowest density carrier, as close to 42.5 GHz as possible, locate other low-density carriers near to it, and locate the carriers with the highest spectral densities the furthest away from 42.5 GHz.

4.5.1.2.2 Use of mitigation techniques by radio astronomy stations

Mitigation techniques that may be implemented in order to protect stations in the radio astronomy service operating in the band 42.5-43.5 GHz are described in DNR ITU-R SM.[BbB]. Other potential mitigation methods are mentioned in Recommendation ITU-R SM.1542, Annex 3.

Other methods to be assessed include:

- Reduction of side-lobe levels.
- Taking actual RAS operating parameters into consideration.
- A guard band between the FSS/BSS and the RAS. However, there is limited scope for taking a guard band within the radio astronomy band, without losing the capability to observe one or more of the spectral lines.

The use of such techniques in addition to mitigation techniques applied by the FSS or BSS would assist in providing adequate protection to RAS operating.

4.5.1.3 Methods to satisfy the agenda item and their advantages and disadvantages

4.5.1.3.1 Method A

For 42-42.5 GHz band GSO networks and 41.5-42.5 GHz band non-GSO systems, protect single-dish radio telescope sites on an individual, bilateral basis; modify levels in No. 5.551G to be interference thresholds.

Under this method, No. **5.551G** would be modified to adopt the single dish, continuum threshold of -137 dB(W/(m^2 · GHz)) and -153 dB(W/m^2 · 500 kHz) as a threshold for bilateral arrangements at single-dish radio telescope sites. A Resolution, which would not require the involvement of the Bureau, would provide operational rules for bilateral sharing arrangements with affected single-dish radio telescope sites where the levels in No. **5.551G** are exceeded for more than 2% of the time.

Advantages:

- Limits the number of RAS sites that would have to be subject to bilateral discussions, and raises the prospect that SDT (single-dish radio telescope) sites could be accommodated on a site-by-site basis.
- Provides a basis for protection of 42.5-43.5 GHz band SDTs.
- Tailors the need for protection to sites where SDTs operate, and does not unduly constrain satellite operations in areas where SDTs do not operate.

Disadvantage:

Bilateral discussions would increase the administrative burden on the radio astronomy service and satellite services.

An example of how No. **5.551G** could be modified to implement this method is included in Annex 4.5.1-1.

4.5.1.3.2 Method B

For 42-42.5 GHz band, GSO systems apply the single dish interference criteria to all but a small percentage of the Earth's surface that is statistical in nature.

The single dish, continuum limit of –137 dB(W/(m^2 · GHz)) and –153 dB(W/(m^2 · 500 kHz)) for GSO would apply to 98% of the surface of the Earth.

Advantage:

Would limit emissions to most areas of world; including SDT sites that would not be within service areas of satellites.

Disadvantages:

- Existing SDTs may not be protected if they are not located within the 98% of the surface of the Earth where the SDT limit is met.
- No one knows where the 2% of unprotected Earth surface falls, creating uncertainty for RAS access to the 42.5-43.5 GHz band. Building new radio telescopes may be difficult.
- May constrain satellite operations in areas where SDTs do not operate.
- As the number of satellites grows, the area of the Earth available for RAS will be reduced.
- This method does not address the case of non-GSO systems.

4.5.1.3.3 Method C

Adopt permanent unwanted emission limits on GSO and non-GSO networks and systems only in the band 42-42.5 GHz; SUP Resolution 128.

Under this option, Resolution **128** would be suppressed. No. **5.551G** would be modified to apply to the non-GSO in the band 42.0-42.5 GHz (as well as to GSO, as it currently does). The levels derived from the protection criteria in Recommendation ITU-R RA.769 would apply at radio telescopes notified prior to the submission of advance publication information by the subject satellite network or system.

Advantages:

- Allows FSS and BSS to move forward with some regulatory certainty.
- Protects the RAS to the levels of the criteria in Recommendation ITU-R RA.769 from FSS and BSS transmissions in the 42.0-42.5 GHz band.
- Tailors the need for protection to sites where SDTs operate, and does not unduly constrain satellite operations in areas where SDTs do not operate.
- Allows conclusion of the Resolution 128 portion of agenda item 1.32 at WRC-03.
- Allows a relaxation for the FSS and BSS from the levels in the current version of No. **5.551G**.

Disadvantages:

- Does not mandate that RAS will be protected from non-GSO transmissions in the 41.5-42 GHz band, if limits are not included for non-GSO systems in 41.5-42 GHz.
- Imposes some constraints on FSS and BSS systems and networks in the 42-42.5 GHz band.

See Annex 4.5.1-1 for examples of how No. **5.551G** could be modified to implement this Method.

4.5.1.3.4 Method D

Adopt permanent unwanted emission limits on GSO networks in the band 42.0-42.5 GHz and on non-GSO systems in the band 41.5-42.5 GHz; review Resolution 128, as appropriate.

The levels derived from the protection criteria in Recommendation ITU-R RA.769 would apply at radio telescopes notified prior to the submission of advance publication information by the subject satellite network or system.

Advantages:

- Allows FSS and BSS to move forward with some regulatory certainty.
- Protects the RAS to the levels of the criteria in Recommendation ITU-R RA.769 from FSS and BSS transmissions in the 41.5-42.5 GHz band for non-GSO and in the band 42.0-42.5 GHz for GSO.
- Tailors the need for protection to sites where radio telescopes operate, and does not unduly constrain satellite operations in areas where radio telescopes do not operate.
- Allows a relaxation for the FSS and BSS from the levels in the current version of No. **5.551G**.

Disadvantages:

- Could constrain the deployment plans of administrations that contemplate using the band 41.5-42.0 GHz for ubiquitous deployment of non-GSO BSS and high-density non-GSO FSS earth terminals.
- Imposes some constraints on GSO operations at 42-42.5 GHz and non-GSO operations at 41.5-42.5 GHz.

See Annex 4.5.1-1 for an example footnote to implement this Method.

4.5.1.4 Regulatory and procedural considerations

Given the large number of demands currently placed on the Radiocommunication Bureau, along with the difficulty of gathering and analysing unwanted emission data from space station, it was concluded by ITU-R that BR could not be reasonably expected to make a finding in regard to the unwanted emission level of a space station. WRC-03, in developing regulations regarding Resolution **128** should consider explicitly limiting the involvement of BR. With regard to Methods C and D, and consistently with the current situation concerning No. **5.551G**, a modification to Appendix 4 may be required to include the compliance with the limits as a declaration by the relevant administrations (see Annex 4.5.1-1).

There will be a need to add fields to the radio astronomy station registration forms in Appendix 4, to denote a Single dish (S) or a VLBI (V) radio telescope, and the minimum operating elevation angle of the radio telescope. There may be a need for measures to ensure that the registration requirement is implemented in a practicable manner, and is not misapplied or used to protect sites where observations are not being made on an ongoing basis.

ANNEX 4.5.1-1

1 The following is an example of how No. **5.551G** could be modified to implement Method A from § 4.5.1.3.1 above:

MOD

5.551G The interference threshold in terms of the aggregate power flux-density produced by all the space stations in any non-geostationary-satellite system in the fixed-satellite service (space-to-Earth) or in the broadcasting-satellite service (space-to-Earth) system operating in the 41.5-42.5 GHz band shall be –137 dB(W/(m^2 · GHz)) for continuum observations in the 42.5-43.5 GHz band, and –153 dB (W/(m^2 · 500 kHz)) for spectral line observations in the 42.5*-43.5 GHz band, at the site of a radio astronomy station that is registered as a single-dish telescope in the 42.5-43.5 GHz band. The interference threshold in terms of the power flux-density produced by any geostationary station in the fixed-satellite service (space-to-Earth) or in the broadcasting-satellite service (space-to-Earth) operating in the band 42-42.5 GHz shall be –137 dB(W/(m^2 · GHz)) for continuum observations in the band 42.5-43.5 GHz, and –153 dB (W/(m^2 · 500 kHz)) for spectral line observations in the 42.5*-43.5 GHz band, at the site of a radio astronomy station that is registered as a single-dish telescope in the 42.5-43.5 GHz band. If the above thresholds are exceeded for more than 2%** of the time, bilateral arrangements between affected administrations would be required. The provisions of Resolution **[XXX]** (WRC-03) shall apply.

*****

This method may also be based on the epfd concept (see example in No. 2 b) below).

* Some administrations are still considering the lowest frequency in the 42.5-43.5 GHz range at which the spectral line protection level should begin and believe that it is premature for CPM to recommend a value at this time.

** Some administrations were of the view that the 2% time criterion does not apply to GSO networks according to Recommendations ITU-R RA.769 and RA.1513.

2 The following is an example of how No. **5.551G** could be modified to implement Method C from § 4.5.1.3.3 above:

a) Modify No **5.551G** as follows:

MOD

5.551G In order to protect the radio astronomy service in the band 42.5-43.5 GHz, the aggregate power flux-density produced by all the space stations in any non-geostationary-satellite system in the fixed-satellite service (space-to-Earth) or in the broadcasting-satellite service (space-to-Earth) system operating in the 42-42.5 GHz band shall not exceed, for more than 2% of the time, –137 dB(W/(m^2 · GHz)) for continuum observations in the band 42.5-43.5 GHz, and –153 dB(W/(m^2 · 500 kHz)) for spectral line observations in the 42.5*-43.5 GHz band, at the site of a radio astronomy station registered as a single dish telescope, and shall not exceed, for more than 2% of the time, –116 dB (W/(m^2 · 500 kHz)) at the site of a radio astronomy station where VLBI observations are being conducted. The power flux-density produced by any geostationary station in the fixed-satellite service (space-to-Earth) or in the broadcasting-satellite service (space-to-Earth) operating in the band 42-42.5 GHz shall not exceed, for more than 2%** of the time, –137 dB(W(m^2 · GHz)) for continuum observations in the band 42.5-43.5 GHz, and –153 dB(W/m^2 · 500 kHz) for spectral line observations in the 42.5*-43.5 GHz band, at the site of a radio astronomy station registered as a single dish telescope, and shall not exceed, for more than 2%** of the time, –116 dB(W/(m^2 · 500 kHz)) at the site of a radio astronomy station where VLBI observations are being conducted. These values shall apply at any radio astronomy station that has been notified to ITU either before [end of WRC-03] or before the date of receipt of the advance publication information (API) of the space station to which the limits are to apply. For other radio astronomy stations, notified after these dates, agreement may be sought with administrations authorizing the space stations.

*****

This method may also be based on the epfd concept (see example in No. 2 b) below).

*	Some administrations are still considering the lowest frequency in the 42.5-43.5 GHz range at which the spectral line protection level should begin and that it is premature for CPM to recommend a value at this time.

**	Some administrations were of the view that the 2% time criterion does not apply to GSO networks in accordance with Recommendations ITU-R RA.769 and RA.1513.

b)	Replace No. **5.551G** with two new footnotes as follows:

SUP

5.551G

ADD

5.551GX	The equivalent power flux-density produced by all the space stations in any non-geostationary-satellite system in the fixed-satellite service (space-to-Earth) or in the broadcasting-satellite service (space-to-Earth) system operating in the 42-42.5 GHz band, shall not exceed at the radio astronomy station (depending on the type of observations conducted), for more than 2% of the time:

- –230 dB(W/m^2) in 1 GHz (for single dish continuum observations) in the band 42.5-43.5 GHz;
- –246 dB(W/m^2) in any 500 kHz (for single dish spectral-line observations) in the band 42.5*-43.5 GHz; or
- –209 dB(W/m^2) in any 500 kHz (for VLBI observations) in the band 42.5-43.5 GHz.

These epfd shall be evaluated using the antenna pattern given in Annex 2 to Recommendation ITU-R S.1586 and a maximum RAS antenna gain of 93 dBi and shall apply for elevation angles higher than the minimum operating angle θmin of the radio telescope (for which a default value of 5° should be adopted in the absence of notified information).

These values shall apply at any radio astronomy station that has been notified to ITU either before [end of WRC-03] or before the date of receipt of the advance publication information (API) of the space station to which the limits are to apply. Other radio astronomy stations, notified after these dates, may seek an agreement with administrations authorizing the space stations.

ADD

5.551GY	The power flux-density produced by any geostationary space station in the fixed-satellite service (space-to-Earth) or in the broadcasting-satellite service (space-to-Earth) operating in the band 42-42.5 GHz** shall not exceed at a radio astronomy station (depending on the type of observations conducted):

- –137 dB(W/m^2) in 1 GHz (for single dish continuum observations) in the band 42.5-43.5 GHz;

- –153 dB(W/m^2) in any 500 kHz (for single dish spectral-line observations) in the band 42.5*-43.5 GHz; or
- –116 dB(W/m^2) in any 500 kHz (for VLBI observations) in the band 42.5-43.5 GHz.

These values shall apply at any radio astronomy station that has been notified to ITU either before [end of WRC-03] or before the date of receipt of the advance publication information (API) of the space station to which the limits are to apply. Other radio astronomy stations, notified after these dates, may seek an agreement with administrations authorizing the space stations.

*****

* Some administrations are still considering the lowest frequency in the 42.5-43.5 GHz range at which the spectral line protection level should begin and that it is premature for CPM to recommend a value at this time.

** Some administrations were of the view that the 2% of time criterion could also be applicable to the GSO networks. Other administrations were of the view that this criterion does not apply to GSO networks in accordance with ITU-R Recommendations ITU-R RA.769 and RA.1513.

3 The example footnotes as present in 2b) above apply to Method D so long as the band for the non-GSO is made to apply from 41.5 to 42.5 GHz instead of the bandwidth as stated above.

4 The following is an example of how Appendix 4 could be modified associated with example 2b of Method C and Method D:

A.17 Compliance with equivalent power flux-density limits

…

b) For non-geostationary-satellite systems operating in the fixed-satellite service and broadcasting-satellite service in the band 42-42.5 GHz[1] the calculated equivalent power flux-density produced at the site of a radio astronomy station in the band 42.5-43.5 GHz, as defined in No. **5.551GX**.

….

A.18 Compliance with power flux-density limits

For geostationary satellites operating in the fixed-satellite service and broadcasting-satellite service in the band 42-42.5 GHz the calculated power flux-density produced at the site of a radio astronomy station in the band 42.5-43.5 GHz, as defined in No. **5.551GY**.

#########

4.5.2 Resolution 84 (WRC-2000)

"Power flux-density limits in the bands 37.5-42.5 GHz for the fixed-satellite service, broadcasting-satellite service and mobile-satellite service"

4.5.2.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Relevant Recommendations ITU-R : P.530, F.1108, F.1245, F.1336, SF.1395, SF.1484, F.1498, F.[Doc. 9/BL/39], S.1557, SF.1572, SF.1573.

---

[1] When A.17 pertains to the example for Method D, it will include the non-GSO band from 41.5 to 42.5 GHz.

4.5.2.1.1 Characteristics of the FS systems in the 37.5-42.5 GHz bands

The following FS parameters and deployment characteristics, considered to be representative of FS broadband wireless access (BWA) applications were used in the sharing studies:

- receiver antenna gain: up to 44 dBi (16 dBi for P-MP hub stations);
- feeder losses: 0 dB;
- receiver noise figure: 4 dB;
- noise increase due to intra service interference: 1 dB;
- elevation angle: 0 to 60° (0° for P-MP hub stations) (see Recommendation ITU-R F.1498);
- linear polarization.

These parameters are assumed to be sufficient to allow the calculation of interference into an FS system from an FSS satellite(s) applying an I/N methodology. The actual impact of any given level of interference depends on the availability objective and the fade margin of the FS system.

Whereas statistical deployment information is available for the 37-40 GHz band (see Recommendation ITU-R F.1498), corresponding information for the 40.5-42.5 GHz is not available at this time. In particular, Recommendation ITU-R F.1498 provides deployment characteristics of existing BWA networks in the 37.5-40 GHz band and states that links in these networks are beginning to carry higher loads of traffic (up to 155 Mbit/s and higher).

On this basis, it has also to be noted that BWA could be characterized with high levels of availability (99.999%) and short hop lengths, since deployment statistics indicate that 50% of BWA links present link distances lower than 0.75 km. Rain margins for such level of availability are given in Table 4.5.2-1.

Finally, it has been confirmed that arc avoidance is not applicable to FS on a regulatory basis, in particular for P-MP systems. However, it has been considered as a possible mitigation technique, which may be used, to avoid satellite interference, especially for short FS links, and should therefore be taken into account when assessing the impact of GSO satellites on particular FS links.

In addition, the following ITU-R Recommendations have to be taken into account:

- FS antenna pattern: F.1336 (for hub stations) and
  F.1245 (including polarization losses as described in NOTE 7)
- Gaseous attenuation: SF.1395

These characteristics have been considered for both conventional and broadband wireless access using both point-to-point (P-P) or point-to-multipoint (P-MP) systems, and are generally agreed to be the most sensitive. With regard to P-MP systems, these parameters are representative of terminal stations (TS); P-MP HUB stations have not been considered due to the low antenna gain and elevation angles expected for this kind of station. Other FS systems and links with less sensitive characteristics are also deployed or planned for deployment in this frequency range.

TABLE 4.5.2-1

Rain fade margins for 99.999% availability

Link Distance (km)	Fade Margin at 39.3 GHz, H-Pol (dB)					Fade Margin at 39.3 GHz, V-Pol (dB)				
	Rain Rate (mm/hr) (Zone)					Rain Rate (mm/hr) (Zone)				
	12 (B)	22 (E)	42 (K)	63 (M)	95 (N)	12 (B)	22 (E)	42 (K)	63 (M)	95* (N)
0.1	0.8	1.3	2.5	3.6	5.2	0.6	1.1	2.1	3	3.0
0.3	2.2	4	7.3	10.6	15.4	1.9	3.4	6.2	9	8.8
0.5	3.7	6.5	12	17.4	25.1	3.2	5.6	10.2	14.7	14.3
0.7	5.2	9.1	16.6	24	34.3	4.5	7.8	14.2	20.3	19.6
0.9	6.6	11.6	21	30.4	43.2	5.7	10.0	18.0	25.8	24.7
1.1	8	14.1	25.5	36.7	51.7	6.9	12.1	21.8	31	29.5
1.3	9.4	16.5	29.9	42.8	59.8	8.1	14.2	25.5	36.2	34.1
1.5	10.8	18.9	34.1	48.7	67.6	9.3	16.2	29.1	41.3	38.6

* NOTE – Fade margins for the case of 95 mm/hr rain rate for vertical polarization were calculated under the assumption that the latitude is less than 30 degrees (which impacts the calculation in accordance with Recommendation ITU-R P.530).

Finally, it was acknowledged that not all the FS links with high elevation angles will be designed with the maximum 44 dBi antenna gain associated with the lowest fade margin, and that FS links with such specific parameter combinations (high elevation angles, low fade margin, high antenna gain and worst-case azimuth) should not be considered as to be typical. In some applications, high elevation angle FS links may have extra fade margins due to their location close to their hub station and due to the particular method used to design the cells.

4.5.2.1.2 Fixed service protection criteria in the 37.5-42.5 GHz bands

The FS protection criteria in the 37.5-40 and 40.5-42.5 GHz bands are given as follows in DNR ITU-R F.[Doc.9/BL/39] concerning time varying interference with regard to the non-GSO case:

- for the long term, the interference-to-noise ratio (I/N) at the input of the FS receiver should not exceed −10 dB for more than 20% of the time;
- for the short term, the interference-to-noise ratio (I/N) at the input of the FS receiver should not exceed +10 dB for more than 0.013% of the time, for systems designed in compliance with ITU-T Recommendation G.828, and 0.05% of the time for other systems;
- for the short term, for some links in certain BWA applications, the interference-to-noise ratio (I/N) at the input of the FS receiver should not exceed +5 dB for more than 0.013% of the time, for systems designed in compliance with ITU-T Recommendation G.828 and 0.05% of the time for other systems.

For the GSO case, the ITU-R studies pertaining to the definition of the protection criteria with regard to aggregate interference were not completed, but it was agreed that the interference-to-noise ratio (I/N) at the input of the FS receiver should not exceed –10 dB, except within a range of separation from the azimuth where the FS antenna main beam intersects with the GSO arc and for which positive I/N were agreed to apply. The range of azimuth and the maximum allowable I/N still need to be finalized, but the completion of these studies is not expected to modify in any way the conclusions concerning the pfd limits.

It has to be noted that these criteria were established to protect sensitive FS links.

4.5.2.1.3 Characteristics of satellite systems in the 37.5-42.5 GHz bands

4.5.2.1.3.1 Characteristics of FSS systems

The operational requirements and characteristics of FSS systems in the 38 and 40 GHz bands are given in Recommendation ITU-R S.1552. Table 4.5.2-2 summarizes the typical system parameters for FSS systems that have been considered in frequency sharing studies between FSS and FS systems operating in the 37.5-42.5 GHz band:

TABLE 4.5.2-2

Parameters	GSO FSS	Non-GSO FSS (MEO)
Satellite antenna beam size	0.3° to 0.65°	0.6° to 1.8° depending on the satellite altitude
Typical spacecraft DC power	10 kW to 15 kW	3 kW to 5 kW
Typical satellite transmit RF power into the antenna	2.5 kW to 3.5 kW	700 W to 1.1 kW
Number of beams[3)]	30 to 60 beams	10 to 20 beams
Bandwidth (per satellite)	Up to 2.0 GHz including HD-FSS and gateway/hub	Up to 2.0 GHz including HD-FSS and gateway/hub
Frequency reuse scheme	4 or 7 times (most systems use 4 times frequency reuse scheme)	4 or 7 times (most systems use 4 times frequency reuse scheme)
Link availability • Gateway/hub • HD-FSS (VSAT)	 • 99.9 to 99.95% • 99.5% to 99.7%	 • 99.9 to 99.95% • 99.5% to 99.7%
Payload	Transparent transponder or Processing payload	Transparent transponder or Processing payload
Minimum operation elevation angle	> 15°	> 20°
Modulation	QPSK/8PSK/16 QAM	QPSK/8PSK/16 QAM
BER	1E-8 to 1E-10	1E-8 to 1E-10
Coding	Concatenated code	Concatenated code
C/N threshold[1)]	7 dB to 10 dB depending on modulation and coding	7 dB to 10 dB depending on modulation and coding
Interference degradation[2)]	2 dB to 4 dB	2 dB to 4 dB
System margin	1 dB to 3 dB	1 dB to 3 dB
Earth terminal antenna size • Gateway/hub • HD-FSS (VSAT)	 • 1.8 m to 2.7 m • 0.3 m to 0.9 m	 • 1.5 m to 2.7 m • 0.3 to 0.9 m

Earth terminal system noise temperature	300 K to 500 K (user) 400 K to 800 K (gateway)	300 K to 500 K (user) 400 K to 800 K (gateway)
1) Required downlink C/N may be 3 dB higher depending on whether the payload functions as transparent transponder or processing payload. 2) Degradation due to intra system and inter system interference. 3) FSS systems use single circular polarization.		

Finally, based on the elements provided in this DNR ITU-R S.[Doc. 4/40], the levels of performance consistent with FSS operations in the 38 and 40 GHz bands in most locations will not be possible if the pfd levels are more restrictive than those from the current RR No. **21-4** limits.

4.5.2.1.3.2 Characteristics of BSS and MSS systems

Technical characteristics of BSS and MSS satellites in the 40 GHz range are understood to be sufficiently similar to those of FSS satellites as to permit the analyses and pfd results applicable to FSS/FS sharing to apply as well to the BSS and MSS sharing cases.

4.5.2.1.4 Methodologies used to assess the adequacy of the limits to protect the fixed service in the 37.5-42.5 GHz bands

Several analyses using the "pfd mask simulation method" have been made to assess the adequacy of the pfd limits for the protection of the FS in the 37.5-42.5 GHz bands. In this method, the statistics of the aggregate power levels received at an FS station are calculated by applying the pfd limits from RR Table **21-4** to each visible satellite of a non-GSO constellation or a fully populated GSO arc (for example, satellites evenly spaced every 2° or 4°). Annex 1 of Rec. ITU-R F.1108 provides guidance on the calculation of visibility statistics of space stations operating in circular non-GSO orbits as seen by a terrestrial station.

For the case of non-GSO systems, this methodology assumes the FS receiver antenna is pointing in the direction of the worst-case azimuth for the non-GSO constellation under consideration, since in that pointing direction, the long-term and short-term power levels generated by the non-GSO constellation into the FS receivers are at their maximum.

For the case of GSO satellites, the methodology takes into account all azimuths with regard to the FS receiver, and allows for the calculation of interference to an FS receiver antenna at any elevation angle that is pointing directly through the GSO arc or offset from it. In the calculation, all GSO satellites in view of the FS receiver were considered in deriving the received level of interference. Studies have also shown that the peak interference level at the FS receivers is produced from just one or two GSO satellites, which occurs over only limited combinations of azimuth and elevation.

The "pfd mask simulation method" analysis allows for the computation of interference for both GSO and non-GSO cases to a percentage of FS links and thus can be used to determine the extent to which the protection level is exceeded. In the calculation, all GSO satellites in view of the FS receiver were considered in deriving the received level of interference (GSO: 2 to 4 degree spacing; non-GSO: all proposed non-GSO FSS systems) and that all satellites operate at the maximum pfd levels in clear sky conditions. These are conservative assumptions. If the computation method were to take into account the coverage capability, the power limitations of each satellite, and frequency reuse self-interference constraints on an FSS system, these factors would combine to result in lower-than-predicted levels of interference to FS receivers.

Therefore, applications of the "pfd mask simulation method" during this study cycle have been based on the assumption that pfd limits derived using this method should be set at a level which, according to this method, would show some tolerable percentage of FS links to be potentially interfered with.

In addition to the above method, and in order to make a more detailed analysis of the cases for which the "pfd mask I/N methodology" presents a high level of interference, two different methodologies have been applied to calculate the FSS interference to FS receive terminals using different sets of assumptions.

The first alternative methodology takes into account some fundamental operational constraints on, and the characteristics of, satellites in the 37.5-42.5 GHz bands, such as antenna patterns, spacecraft power limitations, and minimum operational elevation angles. Using these constraints and characteristics according to § 4.5.2.1.3.1 above together with the current pfd masks in Table **21-4**, this methodology permits a probabilistic assessment to be made of the likelihood that any given point on the Earth will be within the coverage area of a satellite beam radiating a specified level of pfd. Using this method, it is possible to estimate the occurrence of "worst-case" combinations of azimuth and elevation angle as a percentage of total FS deployment, and then possibly further reduce this number by the probability that any given FS receiver will receive the maximum pfd from a satellite in view.

In addition, another methodology, described in Recommendation ITU-R SF.1572, takes into account FS network modelling on a statistical basis in order to simulate the effect of satellite downlink transmissions on an FS network's availability.

4.5.2.2 Analysis of the results of studies

4.5.2.2.1 Assessment of the pfd limits to protect the fixed service in the 37.5-42.5 GHz bands

Studies have been performed within ITU-R to assess the effect on the fixed service in the 37.5-42.5 GHz band from the non-GSO and GSO FSS pfd limits included in Table **21-4**. For non-GSO FSS satellites, the results of these studies are contained in Recommendation ITU-R F.1484, which recommends that the current pfd levels in Table **21-4** of Article **21** are sufficient to protect the fixed service. For the GSO FSS case, the results of these studies are contained in Recommendation ITU-R SF.1573. ITU-R has agreed that the current pfd levels in Table **21-4** of Article **21** provide a sufficient level of protection to the fixed service.

With regard to GSO satellites, it was acknowledged that in some particular cases, FS receivers that would present very specific parameter combinations (high elevation angles, short hop length, low fade margin, maximum antenna gain) and that would point directly through the GSO arc without being able to implement "arc avoidance" mitigation technique could experience degradation.

However, it was agreed that these cases would only occur in situations where the FS deployment is within the satellite service area and can be solved by each affected administration (see Recommendation ITU-R SF.1573).

In particular, ITU-R noted the position of some administrations that, to protect certain sensitive BWA FS links in the 37.5-40 GHz band, it would be necessary for a GSO FSS satellite providing service on their territory to reduce the pfd levels that are produced during clear-sky operation by 12 dB from the respective levels in Table **21-4** of Article **21**. ITU-R also acknowledged that these pfds may constrain the FSS to the use of only large coordinated earth stations in this band. Nevertheless, for both GSO and non-GSO FSS satellites, the conclusions support maintaining the pfd values in Table **21-4** of Article **21**.

Furthermore, it has to be noted that DNR ITU-R F.[Doc.9/BL/39] states that the application of the FS interference criteria in this Recommendation is not intended to lead to a revisitation of the conclusions on pfd levels required to protect the FS in the band 37.5-42.5 GHz that are stated in Recommendation ITU-R SF.1484-1. The same understanding is true for the FS interference criteria now under development within the ITU-R with respect to GSO satellites in the 37.5-40 GHz and 40.5-42.5 GHz bands.

4.5.2.2.2 Criteria and techniques for addressing interference from transmitters of the FS into earth station receivers in high-density applications in the bands 39.5-40 GHz and 40.5-42.5 GHz and intended for operation in the same geographic area

Many administrations intend to use parts of the band 39.5-42 GHz for high-density applications in the FSS. These administrations intend to use other portions of the 37.5-42.5 GHz band for low-density, individually coordinated gateway/hub applications. To date, the ITU-R has not completed its studies requested in *invites* 6 of Resolution **84 (WRC-2000)** on the appropriate criteria and techniques for addressing interference from transmitters of the fixed service into earth station receivers in high-density applications in the bands 39.5-40 GHz and 40.5-42.5 GHz and intended for operation in the same geographic area. ITU-R is continuing studies on these matters.

4.5.2.2.3 Percentage of time clear sky pfd levels may be exceeded by FSS satellites to overcome fading while protecting FS receivers

ITU-R noted the position of some administrations that, to protect certain sensitive BWA FS links in the 37.5-40 GHz band, it would be necessary for GSO FSS satellite beams providing service on their territory to reduce the pfd levels that are produced during clear-sky operation by 12 dB from the respective levels in Table **21-4** of Article **21**. ITU-R has heavily studied this issue, however the results are so far inconclusive with respect to the percentage of time to which this 12 dB relates. It was agreed that ITU should continue to work in this area in order to provide guidance to administrations on this topic.

4.5.2.3 Methods to satisfy the agenda item

Method

No change to the current pfd limits in Article **21,** suppression of Resolution **84 (WRC-2000)** and development of a new Resolution based on *invites* 6 of Resolution **84 (WRC-2000).**

4.5.2.3.1 Pfd limits for FSS, BSS, and MSS within the 37.5-42.5 GHz range

The ITU-R has studied the applicability of the current Article **21** pfd limits in the 37.5-40 GHz and 40.5-42 GHz bands that apply to non-GSO FSS and GSO FSS satellites, in the 40.5-42.5 GHz band that apply to BSS satellites, and in the 39.5-40.5 GHz band that apply to MSS satellites, and confirms the suitability of these limits for the Radio Regulations. As a consequence of this, and as explained in § 4.5.2.4, Resolution **84 (WRC-2000)** can be suppressed.

In the case of non-GSO FSS this confirmation was affirmed through Recommendation ITU-R SF.1484, and in the case of GSO FSS through Recommendation ITU-R SF.1573. This solution provides regulatory and operational certainty for both FSS and FS operators to deploy their desired systems in the bands 37.5-40.0 GHz and 40.5-42.5 GHz, and also provides a framework for use of the spectrum by both services (FS and FSS) without undue constraints on either service. This solution also retains the flexibility for administrations to adopt, on a national or regional basis, a requirement for the pfd levels produced on their territory during clear-sky operations to be reduced in order to provide the desired protection of the FS.

4.5.2.3.2 Interference from FS transmitters to FSS earth station receivers in high density applications

Because studies pursuant to *invites* 6 of Resolution **84 (WRC-2000)** are not yet complete (see § 4.5.2.1.4), but are part of the overall arrangement between the FSS and the FS in the 37.5-42.5 GHz band, ITU-R should continue the studies called for in *invites* 6 of Resolution **84**, with a view to identifying appropriate criteria and techniques for addressing interference from transmitters of the fixed service into earth station receivers in high-density applications in the bands 39.5-42 GHz and intended for operation in the same geographic area. The 40-40.5 GHz band would be included, given the presence of the FS allocation.

4.5.2.4 Regulatory and procedural considerations

The regulatory and procedural considerations associated with the method described in § 4.5.2.3.1 involve making no change to the pfd values for the FSS in Table 21-4 of Article **21**. It is proposed, however, to suppress Nos. **21.16.11**, **21.16.12**, and **21.16.13,** which are notes to the Table.

In addition, it would be necessary to suppress Resolution **84**. With respect to the issue raised in section 4.5.2.3.2, it is necessary to retain, in a new Resolution, the call for studies now contained in *invites* 6 of Resolution **84**. There is also a relationship between this subject and WRC-03 agenda item 1.25 (see section 4.3).

Additionally, to address the concern and requirements of some administrations concerning the protection of more sensitive fixed BWA links from FSS emissions, footnote 5.551AA to the Table of Frequency Allocations in the bands from 37.5-40 GHz and 40.5-42.5 GHz should be modified to read:

MOD

5.551AA While addressing the sharing conditions with the fixed service in the bands 37.5-40 GHz and 40.5-42.5 GHz, the power flux-density at the Earth's surface from any FSS satellite should be at the level(s) required to meet the FSS link availability and performance objectives of the subject applications. In any case, the levels shall not exceed the applicable power flux-density limits in Table **21-4**.

#########

CHAPTER 5

Maritime mobile, amateur and amateur-satellite, and broadcasting services in MF and HF bands

(WRC-03 agenda items 1.2, 1.7, 1.9, 1.10, 1.14, 1.23, 1.36)

CONTENTS

5.1 Agenda item 1.2

"to review and take action, as required, on No. **5.134** and related Resolutions **517 (Rev.WRC-97)** and **537 (WRC-97)** and Recommendations **515 (Rev.WRC-97)**, **517 (HFBC-87)**, **519 (WARC-92)** and Appendix **11**, in the light of the studies and actions set out therein, having particular regard to the advancement of new modulation techniques, including digital techniques, capable of providing an optimum balance between sound quality, bandwidth and circuit reliability in the use of the HF bands allocated to the broadcasting service"

Resolutions **517 (Rev.WRC-97)**

Transition from double-sideband to single-sideband or other spectrum-efficient modulation techniques in the high-frequency bands between 5 900 kHz and 26 100 kHz allocated to the broadcasting service

Resolution **537 (WRC-97)**

Survey of HF broadcasting transmitter and receiver statistics as called for in Resolution **517 (Rev.WRC-97)**

Recommendation **515 (Rev.WRC-97)**

Introduction of high-frequency broadcasting transmitters and receivers capable of operation with spectrum-efficient modulation techniques

Recommendation **517 (HFBC-87)**

Relative RF protection ratio values for single-sideband (SSB) emissions in the HF bands allocated exclusively to the broadcasting service

Recommendation **519 (WARC-92)**

Introduction of single-sideband (SSB) emissions and possible advancement of the date for cessation of the use of double-sideband (DSB) emissions in the HF bands allocated to the broadcasting service

5.1.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

ITU-R studies on the digital modulation techniques for use in the HF bands allocated to the broadcasting service have been carried out leading to a number of ITU-R Recommendations. Text regarding service requirements (Recommendation ITU-R BS.1348), system characteristics (Recommendation ITU-R BS.1514), and planning parameters (DNR ITU-R BS.[Doc. 6/324]) for digital broadcasting at frequencies below 30 MHz have been developed.

In relation to concerns that broadcasting services may face some constraints after 1 April 2007 in the bands identified in footnotes Nos. **5.136**, **5.143**, **5.146**, **5.147** and **5.151**, there are several ways in which administrations can ensure that harmful interference is not caused to the broadcasting service by other national services in those bands.

High frequency circuits can be managed in such a way as to avoid ionospheric propagation where the application requires only limited ranges. For instance, operating at high frequencies at night and at low frequencies during daylight. Vertical incident propagation using ionospheric propagation may be restricted in range by a suitable choice of antennas.

Fixed and/or mobile services using such management techniques can be operated so that their transmissions do not propagate via the ionosphere and thereby avoiding causing harmful interference to the broadcasting service.

5.1.2 Analysis of the results of studies

This agenda item is directed towards the introduction of digital modulation techniques for broadcasting in the HF bands. The modulation techniques to be considered under this agenda item may be limited to just the digital modulation techniques recommended in Recommendation ITU-R BS.1514.

The analytic results of the studies conducted during the last several years are reflected in Recommendations ITU-R BS.1348 and BS.1514 and in the protection ratios tabulated in DNR ITU-R BS.[Doc. 6/324].

5.1.3 Methods to satisfy the agenda item and their advantages and disadvantages

The complete set of revised and new texts described herein comprises an effective example of accommodating the introduction of digital modulation in the HFBC bands.

Component 1 Revision of Resolution 517 (Rev.WRC-97)

Example of a proposed revision is contained in Annex 5.1-1.

Component 2 Revision of RR Appendix 11

Example of a proposed revision is contained in Annex 5.1-2.

Component 3 New Recommendation [YYY] (WRC-03)

Example of a proposed new Recommendation [YYY], which contains protection ratios associated with the introduction of digital modulation in the HF BC bands, is contained in Annex 5.1-3.*

Component 4 Revision of Recommendation 517 (HFBC-87)

Example of a proposed revision is contained in Annex 5.1-4.

Component 5 Revision of No. 5.134

The purpose of the revision is to promote the use of digital modulation techniques for broadcasting and to clarify the conditions of access to the WARC-92 extension bands by the BS.

In order to protect existing use of these bands by the fixed and certain mobile services until the envisaged implementation date for the WARC-92 extension bands for HF broadcasting, the bands will only become available to the broadcasting service from 1 April 2007. The access date of 1 April 2007 corresponds to the end of the primary allocation of these bands to fixed or mobile services, as mentioned in Nos. **5.136**, **5.143**, **5.146** and **5.151**. And this provides the reasonably smooth transition necessary for these current services to find other bands which to move to in accordance with Resolution **21 (Rev.WRC-95)**.

Because the only conference currently planned prior to the 2007 implementation date is WRC-03, this revision deletes reference to the decisions of a future competent conference. WRC-03 is fully competent to determine the implementation date as it chooses.

Example of a proposed revision is contained in Annex 5.1-5.

Component 6 Suppression of Resolution 537 (WRC-97)

The information from this Resolution was submitted by the Director to WRC-2000. This has assisted in formulating the approach taken in developing proposals relating to agenda item 1.2. It is

---

* One administration has opposed the adoption of DNR ITU-R BS.[Doc.6/324] which has a bearing on proposed new Recommendation [YYY] (WRC-03).

felt that there would be no added benefit in continuing this survey and accordingly this Resolution may be suppressed.

Component 7 Suppression of Recommendation 515 (Rev.WRC-97)

This Recommendation was updated at WRC-97 to reflect the interests in developing digital systems for HF broadcasting. The development of such a system has moved on apace since then and Recommendation ITU-R BS.1514 has been approved and the IEC has been informed of this development. So Recommendation **515 (Rev.WRC-97)** may be suppressed.

Component 8 Suppression of Recommendation 519 (WARC-92)

There is concern within many administrations, expressed on many occasions at WRC-97, that the introduction of SSB into HF broadcasting should not restrict the ability of administrations to continue with their existing DSB transmissions for the foreseeable future and that at this point in time it is inappropriate to specify a cessation of DSB in favour of SSB in the year 2015. It is also evident from information presented at WRC-2000 by the Director, BR that the interest in SSB within HF broadcasting is virtually non-existent. This Recommendation may therefore be suppressed.

Component 9 Revision of RR Article 23

Example of a proposed revision is contained in Annex 5.1-6.

Component 10 Revision of Resolution 535 (WRC-97)

Example of a proposed revision is contained in Annex 5.1-7.

5.1.4 Regulatory and procedural considerations

See Annexes 5.1-1 through 5.1-7.

Resolution **537 (WRC-97)**, Recommendation **515 (Rev.WRC-97)** and Recommendation **519 (WARC-92)** may be suppressed.

ANNEX 5.1-1

Example of a proposed revision of Resolution 517 (Rev.WRC-97)

MOD

RESOLUTION 517 (Rev.WRC-03)

Introduction of digitally modulated and single-sideband emissions in the high-frequency bands between 5 900 kHz and 26 100 kHz allocated to the broadcasting service

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that digital techniques are being introduced into many existing services;*b)* that digital and single-sideband (SSB) techniques allow more effective utilization of the frequency spectrum than double-sideband (DSB) techniques;

c) that digital and SSB techniques enable reception quality to be improved;

d) relevant parts of Appendix **11** concerning the digital and SSB system specifications in the HF broadcasting services;

e) that ITU-R in its Recommendation ITU-R BS.1514 has recommended system characteristics for digital sound broadcasts in the broadcast bands below 30 MHz;

f) that digital modulation techniques are expected to provide the means to achieve the optimum balance between sound quality, circuit reliability and bandwidth;

g) that digitally modulated emissions can, in general, provide more efficient coverage than amplitude-modulated transmissions by using fewer simultaneous frequencies and less power;

h) that it may be economically attractive, using current technology, to convert modern conventional DSB broadcasting systems to digital operation in accordance with *considering d)* above;

i) that some DSB transmitters have been used with digital modulation techniques without transmitter modifications;

j) that ITU-R is carrying out further studies on the development of broadcasting using digitally modulated emissions in the bands allocated to the broadcasting service below 30 MHz,

)

resolves

1 that the early introduction of digitally modulated emissions as recommended by ITU-R in the HF bands between 5 900 kHz and 26 100 kHz allocated to the broadcasting service is to be encouraged;

2 that digitally modulated and SSB emissions shall comply with the characteristics specified in relevant parts of Appendix **11**;

3 that whenever an administration replaces a DSB emission by an emission using digital or SSB modulation techniques, it shall ensure that the level of interference is not greater than that caused by the original DSB emission, and shall use RF protection values specified in Recommendations YYY (WRC-03) and 517 (Rev.WRC-03);

4 that the continued use of DSB may be periodically reviewed by future competent world radiocommunication conferences in the light of the latest available complete statistics on the capability of administrations to introduce digital systems,instructs the Director of the Radiocommunication Bureau

to compile and maintain the statistics referred to in *resolves* 4, to make these statistics available to administrations and to submit summaries thereof to a competent future world radiocommunication conference,

invites ITU-R

to continue its studies on digital techniques in HF broadcasting with a view to assist in the development of this technology for future use,

invites administrations

to set standards for HF broadcasting transmitters that includes the capability to offer digital modulation in all new transmitters put into service after 1 January 2004, *further invites administrations*

1 to assist the Director of the Radiocommunication Bureau by providing the relevant statistical data and to participate in ITU-R studies on matters relating to the development and introduction of digitally modulated emissions in the HF bands between 5 900 kHz and 26 100 kHz allocated to the broadcasting service;

2 to bring to the notice of transmitter and receiver manufacturers the most recent results of relevant ITU-R studies on spectrum-efficient modulation techniques suitable for use at HF as well as the information referred to in *considering d)* and *e)*.

SUP

Annex to Resolution 517 (**Rev.WRC-97**)

ANNEX 5.1-2

Example of a proposed modification of Appendix 11

MOD

APPENDIX 11

System specifications for double-sideband (DSB), single-sideband (SSB) and digitally modulated emissions in the HF broadcasting service

NOC

PART A – Double-sideband (DSB) system

MOD

PART B – Single-sideband (SSB) system

1 System parameters

1.1 Channel spacing

In a mixed DSB, SSB and digital environment (see Resolution **517 (Rev.WRC-03)**), the channel spacing shall be 10 kHz. In the interest of spectrum conservation, it is also permissible to interleave SSB emissions midway between two adjacent DSB channels, i.e., with 5 kHz separation between carrier frequencies, provided that the interleaved emission is not to the same geographical area as either of the emissions between which it is interleaved.

In an all inclusive SSB environment, the channel spacing and carrier frequency separation shall be 5 kHz.

1.2 Equivalent sideband power

When the carrier reduction relative to peak envelope power is 6 dB, an equivalent SSB emission is one giving the same audio-frequency signal-to-noise ratio at the receiver output as the corresponding DSB emission, when it is received by a DSB receiver with envelope detection. This is achieved when the sideband power of the SSB emission is 3 dB larger than the total sideband power of the DSB emission. (The peak envelope power of the equivalent SSB emission and the carrier power are the same as that of the DSB emission.)

2 Emission characteristics

2.1 Nominal carrier frequencies

Nominal carrier frequencies shall be integral multiples of 5 kHz.

2.2 Frequency tolerance

The frequency tolerance shall be 10 Hz.[1]

2.3 Audio-frequency band

The upper limit of the audio-frequency band (at −3 dB) of the transmitter shall not exceed 4.5 kHz with a further slope of attenuation of 35 dB/kHz and the lower limit shall be 150 Hz with lower frequencies attenuated at a slope of 6 dB per octave.

2.4 Modulation processing

If audio-frequency signal processing is used, the dynamic range of the modulating signal shall be not less than 20 dB.

2.5 Necessary bandwidth

The necessary bandwidth shall not exceed 4.5 kHz.

2.6 Carrier reduction (relative to peak envelope power)

In a mixed DSB, SSB and digital environment the carrier reduction shall be 6 dB to allow SSB emissions to be received by conventional DSB receivers with envelope detection without significant deterioration of the reception quality.

In an all inclusive SSB environment, the carrier reduction shall be 12 dB.

2.7 Sideband to be emitted

Only the upper sideband shall be used.

2.8 Attenuation of the unwanted sideband

The attenuation of the unwanted sideband (lower sideband) and of intermodulation products in that part of the emission spectrum shall be at least 35 dB relative to the wanted sideband signal level. However, since there is in practice a large difference between signal amplitudes in adjacent channels, a greater attenuation is recommended.

3 Characteristics of the reference receiver

The reference receiver has the main characteristics as given below. For more detailed characteristics see the relevant ITU-R Recommendations.

3.1 Noise limited sensitivity

The value of the noise limited sensitivity is equal to or less than 40 dB(μV/m).

[1] See Note 21 of Appendix **2**.

3.2 Demodulator and carrier acquisition

The reference receiver is equipped with a synchronous demodulator, using for the carrier acquisition a device which regenerates a carrier by means of a suitable control loop which locks the receiver to the incoming carrier. The reference receiver should work as well with DSB emissions as with SSB emissions having a carrier reduced to 6 or 12 dB below peak envelope power.

3.3 Overall selectivity

The reference receiver has an overall bandwidth (at –3 dB) of 4 kHz, with a slope of attenuation of 35 dB/kHz.

NOTE – Other combinations of bandwidth and slope of attenuation are possible, as given below, and will provide the same performance at 5 kHz carrier difference.

Slope of attenuation	Overall bandwidth (–3 dB)
25 dB/kHz	3 300 Hz
15 dB/kHz	2 700 Hz

ADD

PART C – Digital system

1 System parameters

1.1 Channel spacing

The initial spacing for digitally modulated emissions use shall be 10 kHz. However, interleaved channels with a separation of 5 kHz may be used in accordance with the appropriate protection criteria appearing in Recommendation **[YYY] (WRC-03)**, provided that the interleaved emission is not to the same geographical area as either of the emissions between which it is interleaved.

1.2 Channel utilization

Channels using digitally modulated emissions may share the same spectrum or be interleaved with analogue emissions in the same HFBC band provided the protection to the analogue emissions is at least as great as that which is currently in force with analogue-to-analogue protection. To accomplish this may require that the digital spectral power density (and total power) be lower by several dB than is currently used for the same emission circuit using either DSB or SSB emissions.

2 Emission characteristics

2.1 Bandwidth and centre frequency

A full digitally modulated emission will have a 10 kHz bandwidth with its centre frequency at any of the 5 kHz centre frequency locations in the same channel raster within the HFBC bands.

Among several possible "simulcast" modes are those having a combination of analogue and digital emissions of the same programme in the same channel, that may use a digital emission of 5 kHz or 10 kHz bandwidth, next to either a 5 kHz or 10 kHz analogue emission. In all cases of this type, the 5 kHz interleaved raster used in HFBC shall be adhered to in placing the emission within the HFBC bands.

2.2 Frequency tolerance

The frequency tolerance shall be 10 Hz[1].

2.3 Audio frequency band

Digital source coding within a 10 kHz bandwidth, taking account of the need for various levels of error avoidance, detection and correction coding emission mitigation, can range from the equivalent of monophonic FM (approximately 15 kHz) to low level speech codec performance of the order of 3 kHz. The choice of audio quality is connected to the needs of the broadcaster/listener, and includes such characteristics to consider as the propagation channel conditions expected. There is no single specification, only the upper and lower bounds noted in this paragraph.

2.4 Modulation

Quadrature amplitude modulation (QAM) with Orthogonal frequency division multiplexing (OFDM) shall be used. 64 QAM is feasible under many propagation conditions; others such as 32, 16 and 8 QAM are specified for use when needed.

ANNEX 5.1-3

Example of a proposed Recommendation [YYY] (WRC-03)

DRAFT RECOMMENDATION [YYY] (WRC-03)

RF protection ratios associated with digitally modulated emissions in the HF bands allocated exclusively to the broadcasting service

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that this Conference has resolved to encourage the introduction of digitally modulated emissions in the high-frequency broadcast bands allocated exclusively to the broadcasting service;

b) that the current use of the spectrum is based on the use of double-sideband (DSB) emissions;

c) that RF co-channel and adjacent channel protection ratios are among the fundamental parameters when determining compatibility;

d) that this Conference has adopted [Resolution **517 (Rev.WRC-03)**] relating to the introduction of digitally modulated emissions in the HF bands allocated exclusively to the broadcasting service;

e) that [Part C of Appendix **11**] contains digital system specifications that refer to this Recommendation for matters dealing with appropriate protection ratios,

recommends

that in the application of Article **12**, the protection ratios specified in the Annex to this Recommendation be used for all those cases where digitally modulated emissions operate in the same bands as double-sideband analogue emissions.

ANNEX TO RECOMMENDATION YYY (WRC-03)

RF protection ratio values

1) In accordance with [Resolution **517 (Rev.WRC-03)**] digital modulation may be used in any of the HF bands allocated exclusively to the broadcasting service. This accommodation has to be made with the appropriate amounts of protection given to both analogue and digital emissions. RF protection ratios are part of the overall regulation of these emissions. Their values appear in the table in this annex.

2) The table consists of RF protection ratios for co-channel and adjacent channel conditions. The independent variable in the table is the centre frequency separation in kHz of any pair of emissions, wanted vs. unwanted. The table provides the required relative protection ratios for the DRM mode (Mode B3) that will be used extensively for HF skywave broadcasting in 10 kHz channels. The ratio data are in decibels.

3) The digital modulation governing these protection ratios is that which appears in summary in [Part C of Appendix **11**, as revised at this conference] and the analogue modulation is double-sideband modulation as summarized in Part A of the same appendix.

TABLE

Relative RF protection ratios (dB) between broadcasting systems below 30 MHz, and Digital (64-QAM, protection level No. 1) interfered with by Digital (identical robustness modes and spectrum occupancy types)

Wanted signal	Unwanted signal	Frequency separation $f_{unwanted}$-f_{wanted} (kHz)									Parameters	
		–20	–15	–10	–5	0	5	10	15	20	B_{DRM} (kHz)	S/I (dB)
AM	DRM_B3	–47	–42	–32	3	6	3	–32	–42	–47	10	–
DRM_B3	AM	–54	–48	–40	–3	0	–3	–40	–48	–54	10	7
DRM_B3	DRM_B3	–53	–47	–38	–3	0	–3	–38	–47	–53	10	16

AM: DSB AM signal

DRM_B3: DRM signal, robustness mode B, spectrum occupancy type 3

B_{DRM}: Nominal bandwidth of DRM signal

S/I: Signal-to-interference ratio for a BER of 10^{-4}

NOTE - For more complete and accurate information draft new Recommendation ITU-R BS.[Doc. 6/324] should be used.

ANNEX 5.1-4

Example of a revised Recommendation 517 (HFBC-87)

MOD

RECOMMENDATION 517 (REV.WRC-03)

RF protection ratio values for single-sideband (SSB) emissions in the HF bands allocated exclusively to the broadcasting service

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that WRC-97 adopted Article **12** as the seasonal planning procedure for the HF bands allocated exclusively to the broadcasting service;

b) that this procedure is based principally on the use of double-sideband (DSB) emissions;

c) that the RF co-channel protection ratio is one of the fundamental planning parameters;

d) that this Conference has adopted Resolution **517 (Rev.WRC-03)** relating to the introduction of digitally modulated and SSB emissions in the HF bands allocated exclusively to the broadcasting service

e) that the SSB system characteristics for HF broadcasting are contained in Appendix **11**;

f) that studies have shown that SSB emissions may require a lower RF co-channel protection ratio for the same reception quality,

recommends

that, in the preparation of the relevant Rules of procedure for the application of Article 12, the Bureau should use the values of RF protection ratio given in the Annex to this Recommendation relating to SSB and DSB emissions in the HF bands allocated exclusively to the broadcasting service.

ANNEX TO RECOMMENDATION 517 (Rev.WRC-03)

RF protection ratio values

1 The values of RF protection ratio given in the table should be used whenever SSB emissions in conformity with the specification in Appendix **11** are involved in the use of the HF bands allocated exclusively to the broadcasting service.

2 For the reception of DSB and SSB (6 dB carrier reduction relative to peak envelope power) wanted signals, a conventional DSB receiver with envelope detection designed for a channel spacing of 10 kHz is assumed.

3 For the reception of an SSB wanted signal (12 dB carrier reduction relative to peak envelope power), the reference receiver as specified in Appendix **11**, Part B, § 3, is assumed.

4 SSB signals with 6 dB carrier reduction relative to peak envelope power assume equivalent sideband power as specified in Appendix **11**, Part B, § 1.2.

5 The figures for case 2 in the following Table relate to a situation where the centre frequency of the intermediate frequency pass-band of the DSB receiver is tuned to the carrier frequency of the wanted SSB signal. If this is not the case, the value for a difference of +5 kHz may increase to –1 dB.

RF protection ratio values with reference to the co-channel RF protection ratio for DSB wanted and unwanted signals (dB)[1] for use in the HF bands allocated exclusively to the broadcasting service

	Wanted signal	Unwanted signal	Carrier frequency separation *f* unwanted – *f* wanted, Δ*f* (kHz)								
			–20	–15	–10	–5	0	+5	+10	+15	+20
1	DSB	SSB (6 dB carrier reduction relative to p.e.p.)	–51	–46	–32	+1	3	–2	–32	–46	–51
2	SSB (6 dB carrier reduction relative to p.e.p.)	DSB	–54	–49	–35	–3	0	–3	–35	–49	–54
3	SSB (6 dB carrier reduction relative to p.e.p.)	SSB (6 dB carrier reduction relative to p.e.p.)	–51	–46	–32	+1	0	–2	–32	–46	–51
4	SSB (12 dB carrier reduction relative to p.e.p.)	SSB (12 dB carrier reduction relative to p.e.p.)	–57	–57	–57	–45	0	–20	–47	–52	–57

[1] Frequency separation Δ*f* less than –20 kHz, as well as Δ*f* greater than 20 kHz, need not be considered.

ANNEX 5.1-5

Example of a proposed revision of RR No. 5.134

MOD

5.134 The bands 5 900-5 950 kHz, 7 300-7 350 kHz, 9 400-9 500 kHz, 11 600-11 650 kHz, 12 050-12 100 kHz, 13 570-13 600 kHz, 13 800-13 870 kHz, 15 600-15 800 kHz, 17 480-17 550 kHz and 18 900-19 020 kHz are allocated to the broadcasting service as from 1 April 2007 and are subject to the procedure of Article 12. Administrations are encouraged to use these bands to facilitate the introduction of digitally modulated emissions in accordance with the provisions of Resolution **517 (Rev.WRC-03)**.

ANNEX 5.1-6

Example of a proposed modification of Article 23

MOD

ARTICLE 23

23.12 § 3 Double-sideband, single-sideband and digitally modulated transmitting stations operating in the HF bands allocated exclusively to the broadcasting service shall meet the system specifications contained in Appendix **11**.

ANNEX 5.1-7

Example of a proposed revision of Resolution 535 (WRC-97)

MOD

RESOLUTION 535 (REV.WRC-03)

2 Software modules

DESCRIPTION 1

Methodology and data

MOD Paragraph 3

THE SOFTWARE SHOULD CALCULATE THE FIELD STRENGTH VALUES AND THE FADING MARGINS AT EACH TEST POINT INSIDE THE REQUIRED SERVICE AREA FOR EACH OF THE FREQUENCY BANDS DECLARED TO BE AVAILABLE, TAKING ACCOUNT OF THE RELEVANT TRANSMITTING ANTENNA CHARACTERISTICS FOR EACH FREQUENCY BAND. THE DESIRED RF SIGNAL-TO-NOISE RATIO SHOULD BE USER SELECTABLE WITH A DEFAULT VALUE OF 34 DB IN THE CASE OF DSB AND AS PROVIDED IN THE CURRENT ITU-R RECOMMENDATION[1] IN THE CASE OF DIGITAL EMISSIONS.DESCRIPTION 3

Specification of input data for a requirement

MOD Indent 13

– modulation choice, to specify if the requirement is to use double-side band (DSB), single-side band (SSB) (see Recommendation ITU-R BS.640) or digital emission (see Recommendation ITU-R BS.1514). This field may be used to identify any other type of modulation when this has been defined for use by HFBC in an ITU-R Recommendation;

---

1 Draft new Recommendation ITU-R BS.[Doc. 6/324].

DESCRIPTION 4

Methodology and data

MOD Paragraph 4

The desired RF signal-to-noise and RF protection ratios should be user selectable, the default values being 34 dB and 17 dB (DSB-to-DSB co-channel case), respectively. In the case of digital emissions, the corresponding values are as provided in the current ITU-R Recommendation[1]. The values for RF protection ratios should be used by the Bureau for its compatibility analyses.

#########

5.2 Agenda item 1.7

"to consider issues concerning the amateur and amateur-satellite services:

5.2.1 Agenda item 1.7.1

"possible revision of Article **25**"

5.2.1.1 Article 25.1

The conference may consider the suppression of No. **25.1** prohibiting international communications under certain conditions. It is the sovereign right of each Member State to regulate its telecommunications. If an administration chooses to prohibit international communications, it should be the concern of the administration to enforce this rule and not a general obligation.

Advantages:

- Simplify the Radio Regulations.
- Clarify the status of international radio communications following a disaster.
- Reduce the cost of ITU paper work regarding the notification for the objection of such communications.
- Still retaining the sovereign right of the State to regulate its communications.

Disadvantage:

None have been identified.

5.2.1.2 Article 25.2

The conference may consider simplifying and shortening the text of No. **25.2**, which defines the content of amateur communications.

An example of such modification could be:

MOD

25.2 Transmissions between amateur stations of different countries shall be limited to communications incidental to the purposes of the amateur service, as defined in No. **1.56** or of a personal character. Transmissions between amateur stations shall not be encoded for the purpose of obscuring their meaning.

Advantages:

- Simplify the Radio Regulations.

- Clarify the ambiguous wording.
- Take into account changes in telecommunications.
- Eliminate obsolete restrictions while retaining the non-commercial nature of the service.

Disadvantage:

None have been identified.

5.2.1.3 Article 25.3

5.2.1.3.1 Method A

The Conference may further consider revising No. **25.3** with regard to international communications. As several administrations currently permit this kind of communication, the general rule of the Radio Regulations should be to allow it unless an administration chooses to prohibit it.

An example of such modification could be:

MOD

25.3 2) Amateur stations may be used for transmitting international communications on behalf of third parties unless objected to by one of the administrations concerned.

Advantages:

- Simplify the Radio Regulations.
- Removes the burden for the administration.

Disadvantage:

None have been identified.

5.2.1.3.2 Method B

The conference may consider suppressing No. **25.3** with regard to international communications. As some administrations currently permit this kind of communication, the general rule of the Radio Regulations should be to allow it unless an administration chooses to prohibit it.

Advantages:

- Simplify the Radio Regulations.
- Removes the burden for the administration enter into specific bi-lateral or multi-lateral international agreements to permit the transmission of third party communications by amateur stations.
- Other regulations are sufficient to protect the non-commercial nature of the service.

Disadvantage:

None have been identified.

5.2.1.4 Article 25.4

In consequence with the above proposals the conference may consider the suppression of No. **25.4**.

Advantage:

Simplify the Radio Regulations.

Disadvantage:

None have been identified.

5.2.1.5 Article 25.5

5.2.1.5.1 Method A

The question of whether there should be a domestic Morse code requirement should be left up to administrations. In consequence the conference may consider the suppression of No. **25.5**.

Advantages:

- This would give administrations further flexibility in revising and updating the qualifications related to the use of Morse code.
- Abolition of the requirement for the knowledge of Morse code in the HF bands will increase the number of radio amateurs available for communications during disaster situations.
- Abolition of the requirement for the knowledge of Morse code in the HF bands will produce a significant increase in the number of radio amateurs licensed to operate below 30 MHz. This will possibly encourage newcomers into the service.
- May encourage the development of Amateur Services.

Disadvantages:

- Abolition of the requirement for the knowledge of Morse code in the HF bands will produce a significant increase in the number of radio amateurs licensed to operate below 30 MHz, possibly leading to a congestion of the amateur bands.
- Eliminating the requirement for knowledge of Morse code might lower the level of proficiency.

5.2.1.5.2 Method B

The conference may consider modifying No. **25.5** in such a way that Morse code is no longer mandatory but if an administration chooses to require Morse code, it should be the concern of the administration to apply such a rule and not an international obligation.

An example of such modification could be:

MOD

25.5 § 3 1) Administrations shall determine whether or not a person seeking a licence to operate an amateur station shall prove that this person is able to correctly send texts in Morse code signals.

Advantage:

Encourages the maintaining of the Morse code skill in the amateur services.

Disadvantages:

- Discourages a global harmonization of amateur services.

- May discourage the development of amateur services.

5.2.1.6 Article 25.6

5.2.1.6.1 Method A

The Conference may consider modifying No. **25.6**.

An example of such modification could be:

MOD

25.6 2) Administrations shall verify the operational and technical qualifications of any person wishing to operate the apparatus of an amateur station.

Advantage:

Simplifies the Radio Regulations.

Disadvantage:

None have been identified.

5.2.1.6.2 Method B

The conference may consider modifying No. **25.6** such that Recommendation ITU-R M.1544 becomes mandatory through the principle of incorporation by reference. See Resolution **27 (Rev.WRC-2000**).

An example of such modification could be:

MOD

25.6 2) Administrations shall verify the operational and technical qualifications of any person wishing to operate an amateur station. A person seeking a licence to operate an amateur station shall be required to demonstrate a knowledge of the topics specified in Recommendation ITU-R M.1544.

Advantages:

- Incorporation by reference of Recommendation ITU-R M.1544 establishes a minimum international standard for amateur licensing.
- This approach would give administrations some increase in flexibility in revising and updating the qualifications as appropriate in the context of rapidly evolving communications technology.

Disadvantages:

- Incorporation by reference may result in confusion or conflict between the version incorporated and any updated version.
- The Recommendation does not lend itself to incorporation by reference.
- This approach would remove flexibility for administrations in revising and updating the qualifications as appropriate in the context of rapidly evolving communications technology.

5.2.1.6.3 Method C

The conference may consider modifying No. **25.6** such that Recommendation ITU-R M.1544 becomes non-mandatory through the principle elaborated in § 6 of Annex 1 to Resolution **27 (Rev.WRC-2000)**.

An example of such modification could be:

MOD

25.6 2) Administrations shall verify the operational and technical qualifications of any person wishing to operate an amateur station. Standards of competence are contained in the most recent version of Recommendation ITU-R M.1544.

Advantage:

Provides flexibility to administrations as the Recommendation can be updated to a later version as desired since it is non mandatory text.

Disadvantage:

Administrations might lower the minimum competence level by either modifying or failing to implement the Recommendation.

5.2.1.7 Article 25.7

The conference may consider the suppression of No. **25.7**.

Advantages:

- Simplify the Radio Regulations.
- Redundant. See No. **15.2**, which provides that "Transmitting stations shall radiate only as much power as is necessary to ensure a satisfactory service".

Disadvantage:

None have been identified.

5.2.1.8 Article 25.8

The conference may consider the suppression of No. **25.8**, which is redundant with Nos. **3.6** and **3.7**.

Advantages:

- Simplify the Radio Regulations.
- The text reiterates concepts included generically in the Radio Regulations and applicable to all radio services.

Disadvantage:

None have been identified.

5.2.1.9 Article 25.9

The conference may consider the suppression of No. **25.9**, which is redundant with Nos. **19.4** and **19.5**.

Advantage:

Simplify the Radio Regulations.

Disadvantage:

None have been identified.

5.2.1.10 Article 25.11

The conference may wish to simplify the provision of No. **25.11**.

An example of such modification could be:

MOD

25.11 § 7 Administrations authorizing space stations in the amateur-satellite service shall ensure that sufficient earth command stations are established before launch to guarantee that any harmful interference caused by emissions from a station in the amateur-satellite service can be terminated immediately (see No. **22.1**).

Advantages:

- Simplify the Radio Regulations.
- The first sentence is redundant; see No. **22.1**.
- Procedures for notification to the Bureau are given in Resolution **642 (WARC-79)**.

Disadvantage:

None have been identified.

5.2.1.11 Additional provisions to Article 25

5.2.1.11.1 New provision concerning amateur communications in support of disaster relief

The conference may consider adding a provision to the regulations concerning amateur communications in support of disaster relief.

An example of such a provision could be:

ADD

25.X Administrations are urged to take the necessary steps to allow amateur stations to prepare for and meet communication needs in support of disaster relief.

Advantage:

Recognizes the value of amateur communications during disaster situations.

Disadvantage:

None have been identified.

5.2.1.11.2 New provision permitting amateurs from another administration to operate

The conference may consider adding a provision to the regulations which permits administrations to allow amateurs of other administrations to operate while temporarily in its territory.

Article **18** requires that all transmitting stations be licensed but provides for special arrangements in certain circumstances. None of these special arrangements apply to the amateur and amateur-satellite services.

An example of such a provision could be:

ADD

25.XX Administrations may determine whether or not to permit a person who has been granted a licence to operate an amateur station by another administration, to operate an amateur station while that person is temporarily in its territory, subject to such conditions or restrictions it may impose.

Advantages:

- Allows such an operation.
- The proposed addition makes it clear that administrations are authorized and encouraged to permit visiting amateurs to operate without being required to issue them a licence while protecting the prerogatives of administrations.

Disadvantage:

None have been identified.

5.2.1.12

An example as to how Article **25** may look giving all the proposed methods is contained in Annex 5.2.1-1.

ANNEX 5.2.1-1

Example of how Article **25** may look showing all the proposed changes and methods.

ARTICLE 25

Amateur services

Section I – Amateur service

SUP

25.1 § 1

MOD

25.2 § 2 1) Transmissions between amateur stations of different countries shall be limited to communications pertaining to the purposes of the amateur service, as defined in No. **1.56** or of a personal character. Transmissions between amateur stations shall not be encoded for the purpose of obscuring their meaning.

Method A

MOD

25.3 2) Amateur stations may be used for transmitting international communications on behalf of third parties unless objected to by one of the administrations.

Method B

SUP

25.3 2)

25.4 3)

Method A

SUP

25.5 § 3 1)

Method B

MOD

25.5 § 3 1) Administrations shall determine whether or not persons seeking a licence to operate an amateur station shall be required to prove that they are able to correctly send texts in Morse code signals.

Method A

MOD

25.6 2) Administrations shall verify the operational and technical qualifications of any person wishing to operate the apparatus of an amateur station.

Method B

MOD

25.6 2) Administrations shall verify the operational and technical qualifications of any person wishing to operate an amateur station. A person seeking a licence to operate an amateur station shall be required to demonstrate a knowledge of the topics specified in Recommendation ITU-R **M.1544**.

Method C

MOD

25.6 2) Administrations shall verify the operational and technical qualifications of any person wishing to operate an amateur station. Standards of competence are contained in the most recent version of Recommendation ITU-R **M.1544**.

SUP

25.7 § 4

25.8 § 5 1)**25.9** 2)

ADD

25.X Administrations are urged to take the steps necessary to allow amateur stations to prepare for and meet communication needs in support of disaster relief.

25.XX Administrations may determine whether or not to permit a person who has been granted a licence to operate an amateur station by another administration to operate an amateur station while that person is temporarily in its territory, subject to such conditions or restrictions as it may impose.

Section II – Amateur-satellite service

NOC

25.10 § 6 The provisions of Section I of this Article shall apply equally, as appropriate, to the amateur-satellite service.

MOD

25.11 § 7 Administrations authorizing space stations in the amateur-satellite service shall ensure that sufficient command earth stations are established before launch to guarantee that any harmful interference caused by emissions from a station in the amateur-satellite service can be terminated immediately (see No. **22.1**).

5.2.2 Agenda item 1.7.2

"review of the provisions of Article **19** concerning the formation of call signs in the amateur services in order to provide flexibility for administrations"

5.2.2.1 Composition of national identifiers

At the present time, some countries cannot have amateur call signs because of the restriction imposed by No. **19.49** when the letters O or I are used as the last character of the national identifier. Modes of radiocommunication in current use in the amateur services are such that there is no difficulty distinguishing between the numbers 0 and 1, and the letters O and I respectively.

5.2.2.1.1 Methods to satisfy the agenda item

The conference could consider suppression of No. **19.49 c)**.

Advantage:

Suppression of No. **19.49 c)** would remove the restriction for some identifiers, thus adding more flexibility for administrations, especially those unable to have amateur call signs at present.

Disadvantage:

None were identified.

5.2.2.2 Composition of call sign suffixes

No. **19.68** limits amateur and experimental call-sign suffixes to "a group of not more than three letters" This restriction places a limit on the number of possible call-sign combinations and their formulation and prohibits the use of certain combinations for special events.

5.2.2.2.1 Methods to satisfy the agenda item

The conference may consider revising No. **19.68** so that more flexibility is allowed for administrations to issue call signs.

An example of such modification could be:

MOD

19.68 § 30 1)

– one character (see No. **19.50.1**) and a single digit (other than 0 or 1), followed by a group of not more than four characters, the last of which shall be a letter, *or*

– two characters and a single digit (other than 0 or 1), followed by a group of not more than four characters, the last of which shall be a letter.

Advantage:

Such a change would considerably expand the number of possible call-sign combinations and provide administrations with increased flexibility without creating conflict with the call-sign formats specified for stations in other services.

Disadvantage:

None were identified.

ADD

19.Y On special occasions for temporary use, administrations may waive the requirement of the call sign to contain not more than four trailing characters.

Advantage:

Provides additional flexibility for administrations.

Disadvantage:

None were identified

#########

5.2.3 Agenda item 1.7.3

"review of the terms and definitions of Article **1** to the extent required as a consequence of changes made in Article **25**"

Studies conducted to date have not indicated the need for any consequential changes to Article **1**.

#########

5.3 Agenda item 1.9

"to consider Appendix **13** and Resolution **331 (Rev.WRC-97)** with a view to their deletion and, if appropriate, to consider related changes to Chapter VII and other provisions of the Radio Regulations, as necessary, taking into account the continued transition to and introduction of the Global Maritime Distress and Safety System (GMDSS)"

5.3.1 Summary of technical and operational considerations

During the transition period to full implementation of the GMDSS, the RR had dual provisions; Appendix **13** includes the non-GMDSS provisions. Since the GMDSS provisions are internationally required only for SOLAS ships, there are a considerable number of maritime vessels that are not yet fitted with automated communications systems, necessitating some continued operation on frequencies and modes of operation for distress and safety. Support of the old and new distress and safety systems for an extended period of time is costly. Many administrations have worked to increase fitting of GMDSS elements (e.g. radios incorporating digital selective calling (DSC) functions and satellite EPIRBs) on non-SOLAS vessels through rule-makings for specific classes of vessels and equipment certification requirements.

The International Maritime Organization (IMO) SOLAS Convention prescribes that all ships subject to that Convention are required to be fitted for GMDSS by 1 February 1999. IMO has decided that:

- Listening watch on 2 182 kHz on-board SOLAS ships is no longer mandatory after 1 February 1999.

IMO has urged administrations to implement GMDSS also for non-SOLAS vessels under national legislation as soon as possible and to encourage all maritime vessels voluntarily carrying maritime VHF radio equipment to be fitted with VHF DSC no later than 1 February 2005.

WRC-97 decided that listening watch on 2 182 kHz is no longer obligatory after 1 February 1999. WRC-97 also amended Resolution **331 (MOB-87)** to serve as a guidance for administrations on full transition to GMDSS and phasing out the listening watch on 2 182 kHz and VHF channel 16.

In heavy traffic areas, the announcement of safety messages, by using DSC techniques, causes an unnecessary burden on the duty watch officer. It does not enhance safety at sea when the DSC equipment generates an alarm several times a day and when in some cases the VHF equipment automatically switches to the frequency mentioned in the announcement. Busy watch officers have a tendency to silence the alarm and reset the equipment without listening to the actual safety broadcast, expecting that the same message to be received on NAVTEX as well.

According to RR No. **33.31**, the announcement of the safety message shall be made on one or more of the distress and safety calling frequencies referred to by Section I of Article **31**, using digital selective calling techniques. Recommendation ITU-R M.541-8 states that DSC on the distress and safety calling frequencies should be used by coast stations to advise shipping of the impending transmission of urgency, vital navigational and safety messages, except where transmissions take place at routine times.

Administrations have reported that there are a considerable number of maritime vessels that are not yet fitted with the automated communications systems, necessitating some continued operation on frequencies and modes used prior to the implementation of GMDSS. Additionally, many administrations have not yet required certain classes of non-SOLAS vessels to fit the new automated equipment. Therefore, consideration should be given to maintaining regulatory controls for these vessels for an extended period.

Administrations have also noted that support of duplicate systems for an extended period of time may be costly.

The information concerning the implementation of the GMDSS shore-based facilities worldwide, including operational and planned sea areas A1 (VHF DSC) and A2 (MF DSC), is disseminated by IMO in GMDSS/Circ. 8 and Corrigenda. GMDSS/Circ. 8/Corr. 5 was issued 30 April 2002 and contains information concerning almost 1400 VHF/DSC and MF/DSC stations.

Relevant Recommendations ITU-R: M.541-8, M.1169, M.1170.

5.3.2 Analysis of the results of considerations

This agenda item is intended to consider the deletion of Appendix **13** and Resolution **331 (Rev.WRC-97)** taking into account the continued transition to and introduction of the GMDSS. It was originally not intended that Appendix **13** be revised or edited.

5.3.3 Methods to satisfy the agenda item and their advantages and disadvantages

5.3.3.1 Method A

No change to Appendix **13**.

A large number of non-SOLAS vessels have not yet been fitted for GMDSS. Deletion of Appendix **13** is premature at this time; these maritime vessels should not be left without regulatory control to meet their distress and safety communication requirements. The provisions for use of 2 182 kHz and VHF channel 16 for distress, urgency and safety calling by voice should therefore be retained in Appendix **13** until they can be abrogated.

Advantages:

- There is no harm to shipping if Appendix **13** is retained.
- The provisions for use of 2 182 kHz and VHF channel 16 in the old distress and safety system are retained in Appendix **13** until they can be abrogated.
- One administration in Region 3 is still using and planning to use 500 kHz Morse telegraphy for distress and safety communication for domestic ship carriage requirements.

Disadvantages:

Some elements of Appendix **13** are out of date and not relevant to most domestic ship carriage requirements.

5.3.3.2 Method B

Modification of Resolution **331 (Rev.WRC-97)**.

Resolution **331 (Rev.WRC-97)** gives guidance to administrations on the full and final transition to the GMDSS, and on releasing stations from watchkeeping on 2 182 kHz and VHF channel 16 frequency-by-frequency and area-by-area when the transition to GMDSS and the prevailing conditions in the area concerned makes it reasonable to do so.

Considerations should therefore be given to retaining Resolution **331** as guidance for administrations on the final transition to the GMDSS. Considerations should be given to adjusting the Resolution to reflect the developments since WRC-97 and to encouraging all ships carrying maritime VHF equipment to be fitted with DSC on VHF channel 70 no later than 1 February 2005. The requirement for SOLAS ships to keep mandatory listening watch on VHF channel 16 will be reviewed by IMO prior to 2005. Consideration should also be given to modification of Resolution **331**, to request ITU-R to study the deletion of 500 kHz Morse telegraphy use and listening watch and associated certification requirements and to place this issue on the agenda of a future conference.

Advantages:

- Continues to encourage GMDSS shore based facilities to be implemented by administrations.
- Resolution **331 (Rev.WRC-97)** gives useful guidance to administrations on the final transition to GMDSS.

Disadvantages:

Continuation of Resolution **331** more than four years after the scheduled full implementation of GMDSS may send the message to administrations that GMDSS will never be fully implemented.

5.3.3.3 Method C

Modification of Chapter IX and Appendix **13**.

The international use of Morse telegraphy for distress and safety communications on 500 kHz has ceased. Delete from Appendix **13** and Chapter **IX** the requirement for use of 500 kHz and the associated obligatory operator certification requirements.

Advantages:

- The Radio Regulations would be simplified by the removal of some unnecessary provisions of Appendix **13** and suppression of associated international requirements for operator certificates.
- Administrations would no longer be required to use and maintain a listening watch on the 500 kHz Morse radiotelegraphy channel for distress and safety communications.
- Compulsory operators' certificates for Morse radiotelegraphy would no longer be required.

Disadvantages:

- Retains other provisions, which will have to be reviewed at each successive WRC with view to deletion.

- Deletion of provisions on use of 500 kHz Morse radiotelegraphy for distress and safety communications from Appendix **13** would require a significant amount of editorial work, if Appendix **13** is modified.

5.3.3.4 Method D

Modification to Article **33**.

Modify No. **33.31** in such a way that in heavy traffic areas, like the North Sea, the announcement of safety messages by using DSC will no longer be a mandatory requirement.

Advantage:

Alignment of No. **33.31** with the procedure prescribed in Recommendation ITU-R M.541-8.

Disadvantage:

None have been identified.

5.3.3.5 Method E

Modification of Chapter **IX**, Appendix **13** and Resolution **331 (Rev.WRC-97)**.

The international use of Morse telegraphy for distress and safety communications on 500 kHz has ceased. Delete from Appendix **13** and Chapter **IX** the requirement for use of 500 kHz and the associated obligatory operator certification requirements.

Resolution **331 (Rev.WRC-97)** gives guidance to administrations on the full and final transition to the GMDSS, and on releasing stations from watchkeeping on 2 182 kHz and VHF channel 16 frequency-by-frequency and area-by-area when the transition to GMDSS and the prevailing conditions in the area concerned makes it reasonable to do so.

Consideration should therefore be given to retaining Resolution **331** as guidance for administrations on the final transition to the GMDSS. Consideration should be given to adjusting the Resolution to reflect the developments since WRC-97 and to encouraging all ships carrying maritime VHF equipment to be fitted with DSC on VHF channel 70 as soon as possible taking into account the appropriate decisions of IMO. The requirement for SOLAS ships to keep mandatory listening watch on VHF channel 16 will be reviewed by IMO prior to 2005.

Advantages:

- The Radio Regulations are simplified by the removal of some unnecessary provisions of Appendix **13** and suppression of associated international requirements for operator certificates.
- Administrations would no longer be required to use and maintain a listening watch on the 500 kHz Morse radiotelegraphy channel for distress and safety communications.
- Compulsory operators' certificates for Morse radiotelegraphy would no longer be required.
- Continues to encourage GMDSS shore based facilities to be implemented by administrations.
- Resolution **331 (Rev.WRC-97)** gives useful guidance to administrations on the final transition to GMDSS.
- There is a suitable period of time for administrations to fit all ships carrying maritime VHF equipment with DSC.

Disadvantages:

- Retains other provisions, which will have to be reviewed at each successive WRC with a view to deletion.
- Deletion of provisions on use of 500 kHz Morse radiotelegraphy for distress and safety communications from Appendix **13** would require a significant amount of editorial work, if Appendix **13** is modified.
- Continuation of Resolution **331** more than four years after the scheduled full implementation of GMDSS may send the message to administrations that GMDSS will never be fully implemented.

5.3.4 Regulatory and procedural considerations

SUP

47.1

SUP

47.3

MOD

47.26 § 8 1) The holder of a radiocommunication general operator's certificate is authorized to embark as chief operator of a ship station of the fourth category (see Recommendation ITU-R M.1169).

SUP

47.27

MOD

47.28 3) Before becoming chief operator of a ship station of the second or third category (see Recommendation ITU-R M.1169), the holder of a radiocommunication general operator's certificate shall have had, as operator on board ship or in a coast station, at least six months' experience of which at least three months shall have been on board ship.

MOD

47.29 4) Before becoming chief operator of a ship station of the first category (see Recommendation ITU-R M.1169), the holder of a radiocommunication general operator's certificate shall have had, as operator on board ship or in a coast station, at least one year's experience of which at least six months shall have been on board ship.

MOD

55.1 The radiotelegraph procedure may be conducted in accordance with Recommendation ITU-R M.1170.

ANNEX 5.3-1

EXAMPLE OF A DRAFT REVISION OF RESOLUTION 331 (Rev.WRC-97)

MOD

RESOLUTION 331 (Rev.WRC-03)

Transition to the Global Maritime Distress and Safety System (GMDSS) and continuation of the distress and safety provisions in Appendix 13

The World Radiocommunication Conference (Geneva, 2003),

noting

that the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, prescribes that all ships subject to this Convention shall be fitted for the Global Maritime Distress and Safety System (GMDSS) by 1 February 1999,

noting further

a) that a number of administrations have taken steps to implement the GMDSS also for classes of vessels not subject to SOLAS, 1974, as amended;

b) that an increasing number of vessels not subject to SOLAS, 1974, as amended, are making use of the techniques and frequencies of the GMDSS prescribed in Chapter **VII**;

c) that some administrations and vessels, not subject to SOLAS, 1974, as amended, may wish to continue to use provisions of Appendix **13** for distress and safety communications for some time after 1 February 1999;

d) that it would be costly for administrations to maintain in parallel for an excessive period of time shore-based facilities necessary to support both the old and new distress and safety systems;

e) that there may be a need to continue existing shore-based distress and safety services for a certain period after 1 February 1999 so that vessels not subject to SOLAS, 1974, as amended and not yet using the techniques and frequencies of the GMDSS will be able to obtain assistance from these services until such time as they are able to participate in the GMDSS;

f) that separate provisions of the existing Radio Regulations designate VHF channel 16 and the frequency 2 182 kHz as the international channels for general calling by radiotelephony;

g) that the International Maritime Organization (IMO) has already decided for GMDSS vessels that:

– listening watches on 2 182 kHz will no longer be mandatory after 1 February 1999;

– listening watches on VHF channel 16 will be continued and that a final date for the cessation of mandatory watchkeeping on channel 16 by SOLAS ships while at sea will be reviewed prior to 2005;

h) that the Radio Regulations require GMDSS ships to keep watch on the appropriate digital selective calling (DSC) distress frequencies;

i) that the Radio Regulations establish that ship stations should, when practicable, keep watch on VHF channel 13;

j) that several administrations have established Vessel Traffic Service (VTS) systems and require their ships to keep watch on local VTS channels;

k) that ships that are required by SOLAS to carry a radio station are being equipped with DSC, but the majority of vessels that carry a radio station on a voluntary basis might not have DSC equipment;

l) that similarly, many administrations have established distress and safety service based on DSC watchkeeping, but the majority of port stations, pilot stations and other operational coast stations have not been equipped with DSC facilities;

m) that for the reasons listed above, it will remain necessary for some stations in the maritime mobile service to call each other by radiotelephony in certain situations,

considering

a) that the operation of the GMDSS described in Chapter **VII** and the present distress and safety system described in Appendix **13** differ in many crucial aspects, such as means and methods of alerting, communication facilities available, announcement and transmission of maritime safety information, etc.;

b) that operation of the two systems in parallel for a long period would cause ever-increasing difficulties and incompatibilities between ships operating in the two different systems and may thus seriously degrade safety at sea in general;

c) that the GMDSS overcomes the deficiencies of the aural watch-keeping on maritime distress and calling frequencies on which the distress and safety system described in Appendix **13** relies, by replacing these watches by automatic watch, i.e. digital selective calling and satellite communication systems,

resolves

1 that, until such time as voice calling has become obsolete, VHF channel 16 and the frequency 2 182 kHz may be used as voice-calling channels;

2 to urge all administrations to assist in enhancing safety at sea by:

– encouraging all ships to make use of the GMDSS as soon as possible;

– encouraging, where appropriate, establishment of suitable shore-based facilities for GMDSS, either on an individual basis or in cooperation with other relevant parties in the area;

– encouraging all ships carrying maritime VHF equipment to be fitted with DSC on VHF channel 70 as soon as possible, taking into account the relevant decisions of IMO;

3 that administrations may, taking account of all aspects involved, such as:

– decisions by IMO on aural watch on 2 182 kHz and VHF channel 16;

– the GMDSS radio systems available in the area concerned;

– the compatibility problems mentioned in *considering a)* and *b)* above;

– the density and classes of ships normally in the area;

– the geographical nature of the area and general navigational conditions within the area;

– other adequate measures taken to ensure safety communications for ships sailing in the area,

at a time after 1 February 1999, when the development on transition to the GMDSS and the prevailing conditions in the area makes it reasonable to do so, release their ship stations and coast stations within the area concerned from the obligations described in Appendix **13** on listening watch on 2 182 kHz or VHF channel 16 or both;

when doing so, administrations should:

– inform IMO of their decisions and submit to IMO details on the area concerned;

– inform the Secretary-General on the necessary details for inclusion in the List of Coast Stations,

resolves further

that the Secretary-General should ensure that such arrangements and details regarding the area concerned be indicated in relevant maritime publications,

invites the next world radiocommunication conference

to include the review of this Resolution, Appendix **13** and Chapter **VII** on the agenda of WRC07,

instructs the Secretary-General

to communicate this Resolution to IMO and the International Civil Aviation Organization (ICAO),

invites the Radiocommunication Study Group 8

to review the operational and procedural incompatibilities between the old and new systems with a view to presenting the information to WRC-07.

#########

5.4 Agenda item 1.10

"to consider the results of studies, and take necessary actions, relating to:"

5.4.1 Agenda item 1.10.1

"to consider the results of studies, and take necessary actions, relating to exhaustion of the maritime mobile service identity numbering resource (Resolution **344 (WRC-97)**);"

5.4.1.1 Summary of technical and operational studies, including a list of relevant ITU-R and ITU-T Recommendations

5.4.1.1.1 Background

Maritime mobile service identities (MMSIs) are required for many shipborne communications equipment (e.g. DSC, mobile earth stations). The MMSI (Article **19**) is a 9-digit number to uniquely identify ship stations, group ship stations, coast stations and group coast stations. Three of the nine MMSI digits are the Maritime Identification Digits (MIDs). MIDs represent the territory or geographical area of administrations and are assigned by the ITU. The total possible number of MMSIs is reduced by ITU Recommendations, which advise administrations to assign MMSIs with three trailing zeros to ships sailing worldwide and communicating with foreign coast stations. Additionally, ITU-T Recommendation E.215 has a requirement to assign MMSIs ending in 3-zeros to vessels requiring access to certain satellite services. This is in anticipation that these ships would want to take advantage of access to the public switched network via automatic radiocommunication systems. The routing and billing limitations within national telecommunication systems that led to the three trailing zero constraint still exist and some aspects appear to be unresolvable within a single stage dialling process.

Therefore, for each MID assigned, there are only 999 numbers available for use by ships with the present generation of maritime mobile-satellite networks operated by Inmarsat Ltd (Standard B, C and M). As the number of vessels carrying such systems increased, so has the demand for MMSIs with three trailing zeros. Early on, there was a recognition that a limited number of available Maritime Identification Digits (MIDs) existed. Additional MIDs are now assigned by the ITU to administrations when they have used 80% of the MMSIs with three trailing zeros. The ITU uses the notification requirements of Article **19** as evidence of use of the numbers with the three trailing zeros. Normally, these are notified and entered into the ITU maritime database and published in List VII A, List of Call Signs and Numerical Identities. The ITU, following established procedures, will not provide additional MIDs until administrations provide the ITU with evidence that 80% of their allotted MMSIs with three trailing zeros have been assigned. Although the resource of MIDs is limited, it is anticipated to be sufficient to meet the needs of the maritime community for the foreseeable future.

The ITU criteria for obtaining additional allotments of MIDs may need further development in respect of:

- specifying that the criteria under No. **19.36** should apply to the MID most recently allotted to the administration;
- clarifying that operation of the acceptance criteria given in No. **19.35.1** should relate to No. **19.36**, not **19.35**, and to all notified MMSIs in the basic category, not the active records, and that the formula itself should be modified so as to add one to the result of the division by 1000;
- modifying Resolution **344** so as to instruct ITU-R to develop a Recommendation on the management of the MID and MMSI resources entirely as an ITU-R responsibility, including concepts such as re-use of suppressed MMSIs.

The end of the useful life of the present generation of ship earth stations (Inmarsat Ltd. B, C and M) may ameliorate the present concern stemming from the numbering schemes for the maritime mobile-satellite service contained in ITU-T Recommendations E.215 and F.125. These Recommendations are expected to be replaced by a new ITU-T Recommendation covering these systems. The ITU will report on the status of the resource and if exhaustion is anticipated, urgent studies can be initiated between ITU-T Study Group 2 and ITU-R Study Group 8 to agree on necessary changes in their respective guidance to obtain some additional resources.

In the future, many new systems may evolve which will desire to participate in GMDSS. IMO has indicated that it is no longer valid to require that the MMSI be used in these systems as part of the diallable telephone number as long as the ship can be efficiently identified by accessing a database accessible 24 hours per day by appropriate authorities. Therefore, these new systems should not be restrained by inefficient numbering plans. There may be certain provisions in ITU-R and ITU-T Recommendations and in the Radio Regulations, which will need to be modified to remove ambiguity or to remove any constraints, which may be interpreted to require any relationship between the numbering plans for these systems and the MMSI.

5.4.1.1.2 Technical and operational considerations

Resolution **344 (WRC-97)** instructs the Director of the BR to monitor the status of the MMSI numbering resource and to report to each WRC regarding the anticipated reserve capacity and expected exhaustion of the resource. The most recent report from the Bureau (WRC-2000 Document 16) with respect to this indicates that there is no shortage at this time. However, this situation may change rapidly with the increased transition to GMDSS and the ever-increasing number of installed ship earth stations.

ITU-T SG 2 WP 1/2 has concluded that ITU-T Recommendation E.210 is no longer appropriate and that the issues of maritime communications in general are no longer a topic for study within ITU-T SG 2. Accordingly, it has decided that E.210 should be deleted and replaced with a new Recommendation (provisionally E.MMSI) that is better suited to the current situation. It has also decided that ITU-T Recommendations E.215 and F.125 should be deleted, but that the texts should be retained as annexes to the proposed new Recommendation. There will in turn be ramifications for Recommendation ITU-R M.585-2, which deals with the assignment and use of MMSIs since the proposed changes in ITU-T SG 2 will make clear that ITU-R should be entirely responsible for management of the MMSI and MID resources.

ITU-R (SG 8) is reviewing Recommendation ITU-R M.585 and has a proposed draft Revision to remove outdated guidance and provide some additional MID resources. This has been coordinated with ITU-T so that corresponding changes to ITU T Recommendations may be aligned. Revisions proposed also include the possibility to reserve an MID for special uses, such as for a Group Coast Station Call which includes all Coast Stations in the World.

Relevant Recommendations: ITU-R M.585-2, and ITU-T E.210, E.215 and F.125.

5.4.1.2 Analysis of the results of studies

When the format of MMSIs was originally drafted, the format of MMSIs assigned to ships with earth station terminals was required to be consistent with the identity number issued through Inmarsat Ltd. The end of the useful life of the present generation of maritime mobile-satellite systems may ameliorate the present concern caused by the ITU-T Recommendation E.215 numbering scheme.

Potential exhaustion is due to certain systems requiring MMSIs to end in "000". WRC-97 instructed the Director of the Radiocommunication Bureau to monitor the status of the MMSI resource and report to each world radiocommunication conference on the anticipated reserve capacity and expected exhaustion of the resource.

As new systems are implemented, the existing recommendations may be ambiguous and may lead systems providers to the conclusion that the existing numbering scheme, i.e. MMSIs with three trailing zeros, would be required.

Depending on the results from the Director of the Radiocommunication Bureau on the impending exhaustion of the MID resource, the ITU-R may need to address consequential changes to the relevant Recommendations, particularly Recommendation ITU-R M.585, affecting the assignment and use of MMSIs and thus, the MID numbering resource.

5.4.1.3 Methods to satisfy the agenda item and their advantages and disadvantages

It is necessary to give full authority to the Director of BR to manage the MMSI and MID numbering resources, including the ability to adjust the geographic structure of allocating MIDs to meet specific demands from certain geographical areas.

The present regional allocation structure of the MID resource should be retained as long as possible. There is still spare capacity available within the regional MID allocation blocks because MIDs with the format X79-X99 (where "X" is in the range 2 to 7) have been reserved for expansion. This capacity should now be brought into use. However, as MIDs within individual regional blocks approach exhaustion, non-geographic MID assignments starting with digit "1" should be made. Further non-geographic MID assignments may be possible starting with digits "8" or "9" when the MID 100-199 series nears exhaustion. If this is not the case then out of region allotments from any spare MIDs with the format X79-X99 should be considered.

Method

Revisions to Article **19**, Resolution **344 (WRC-97)** and additional guidance within ITU-R Recommendations.

Component 1

Article **19** should be revised in order to address the following requirements:

a) to remove any ambiguity from Article **19** and ITU Recommendations which could be interpreted as a requirement for future mobile service and mobile satellite service systems to imbed the MMSI within their numbering space;

b) to permit administrations to demonstrate use of 80% of assigned MID resources without requiring certain government vessels, which may require anonymity, to be published in List V; and

c) to make provision for the creation of special group calls which includes all Coast Stations in the World (00 MID 0000) where the MID would be a special reserved MID = 999 and could also be used for other applications where an MID assigned to particular administrations may not be appropriate.

Component 2

Resolution **344 (WRC-97)** should be revised in order to address the following requirements:

- to provide authority to the Director of the Radiocommunication Bureau to manage the allotment and distribution of the MID resource within the MMSI numbering format;
- to continue active monitoring of the use of the MID and MMSI resources and make a status report to each WRC.

In the event that WRC-03 is advised of impending exhaustion of the MID resource, the revisions to Resolution **344** should also include urgent action on the assignment and use of MMSIs and thus, the MID numbering resource, and invite the ITU-R and, if necessary ITU-T, to address consequential changes to their respective Recommendations.

Advantage:

None have been identified.

Disadvantage:

None have been identified.

Component 3

The better-defined ITU-R management responsibilities for the MID and MMSI resources that WRC-03 is recommended to introduce need to be supported by further guidance to the Director of BR and administrations on resource management. Specific guidance is required on the re-use of MMSIs and treatment of requests for additional MID resources when the national totals of MMSIs shown in ITU records fall significantly as a result of ships being removed from national ship registers. Such guidance will include considerable detail, which may be subject to change as MMSI use develops, and should therefore be included in ITU-R Recommendations. It is recommended that Recommendation ITU-R M.585 be adapted for this purpose.

Advantage:

None have been identified to satisfy the agenda item.

Disadvantage:

None.

5.4.1.4 Regulatory and procedural considerations

Several changes are needed to the Radio Regulations in order to remove existing ambiguity and confusion surrounding the management of the MID and MMSI resources and to assist administrations and the ITU Secretariat in making optimum use of these resources.

Examples of the necessary changes to Article **19** are shown below and Annex 5.4.1-1 shows the changes needed to Resolution **344 (WRC-97)** in order to implement the new resource management responsibilities.

ADD

19.31A 4) Means shall be provided for uniquely identifying mobile stations operating in automated terrestrial or satellite communication systems for the purposes of answering distress calls, avoiding interference and for billing. Identification of the mobile station by accessing a registration database is satisfactory, provided that the system can associate the mobile station calling number with the particular mobile station user.

SUP 19.35.1

MOD

19.36 § 17 Each administration has been allocated one or more maritime identification digits (MID) for its use. A second or subsequent MID should not be requested[2] unless the ~~first~~previously allocated MID is more than 80% exhausted in the basic category having three trailing zeros, and the rate of assignments is such that 90% exhaustion is foreseen.

ADD

[2] **19.36.1** In no circumstances may an administration claim more MIDs than the total number of its ship stations notified to the ITU divided by 1 000, plus one. Administrations shall make every attempt to reuse the MMSIs assigned from earlier MID resources which become redundant after ships leave their national ship registry. Such numbers should be considered for re-assignment after being absent from at least two successive editions of List VIIA. Administrations seeking additional MID resources must have notified all previous assignments, in accordance with No. **20.16**. This

criterion applies only to MMSIs in the basic category and to all MIDs assigned to the administration.

MOD

19.101 2) These identities are formed in such a way that the identity or part thereof can be used by telephone and telex subscribers connected to the public telecommunication network principally to call ships automatically in the shore-to-ship direction. Access to public networks may also be achieved by means of free-form numbering plans, so long as the ship can be uniquely identified using the registration database referred to No. **19.31A** to obtain the ship station identity, call sign or ship name and nationality.

ADD

19.108A § 42 The maritime identification digits $M_1I_2D_3$ are an integral part of the maritime mobile service identity and denote the geographical area of the administration responsible for the station so identified (see Nos. **19.102** to **19.106**).

SUP 19.109

MOD

19.112 *a)* follow the guidelines contained in the most recent version of Recommendation ITU-R M.585 concerning the assignment and use of ship station identities.

MOD

19.114 *c)* take particular care in assigning ship station identities with six significant digits (i.e. having three-trailing-zero identities), which should be assigned only to ship stations which can reasonably be expected to require such an identity for automatic access on a worldwide basis to public switched networks, in particular for mobile satellite systems accepted for use in GMDSS on or before 1 February 2002, as long as those systems maintain the MMSI as part of their numbering scheme.

SUP 19.115

SUP 19.116

ANNEX 5.4.1-1

Example of revised Resolution 344 (WRC-97)

RESOLUTION 344 (Rev.WRC-03)

Management of the maritime mobile service identity numbering resource

The World Radiocommunication Conference (Geneva, 2003),

noting

a) that the installation of digital selective calling equipment or Inmarsat B, C or M ship earth station equipment on ships participating in the Global Maritime Distress and Safety System

(GMDSS) on a mandatory or voluntary basis requires the assignment of a unique nine-digit maritime mobile service identity (MMSI);

b) that such equipment offers the possibility to connect with public telecommunication networks;

c) that only mobile-satellite systems have been able to resolve the various billing, routing, charging and signalling requirements needed to provide full two-way automatic connectivity between ships and the international public correspondence service;

d) that ships using the present generation of mobile-satellite ship earth stations have to be assigned an MMSI ending with three trailing zeros in order to support automatic access to public telecommunication networks through a dialable ship telephone number whose format is compliant with ITU-T Recommendation E.164 but can only accommodate the first six digits of the MMSI;

e) that the first three digits of a ship station MMSI form the maritime identification digits (MID), which denote the ship's administration or geographical area of origin;

f) that each MID only has sufficient capacity to identify 999 ships using the three-trailing-zero number format, with the result that widespread use of MMSIs with three trailing zeros rapidly exhausts the capacity of each MID,

considering

a) that digital selective calling distress alerts require valid identities recognizable by search and rescue authorities in order to ensure a timely response;

b) that Recommendation ITU-R M.585 contains guidance for the assignment of MMSIs,

recognizing

a) that even domestic ships which install the present generation of ship earth stations operating to Inmarsat B, C or M standards will require the assignment of MMSI numbers from those numbers originally intended for ships communicating worldwide, further depleting the resource;

b) that future growth of Inmarsat B, C or M ship earth station use by non-compulsory ships may further deplete the MMSI and MID resources;

c) that future generations of mobile-satellite systems offering access to public telecommunication networks and participating in the GMDSS will employ a free-form numbering system that need not include any part of the MMSI,

noting further

a) that ITU-T has recommended that ITU-R assume sole responsibility for managing the MMSI and MID numbering resources;

b) that ITU-R can monitor the status of the MMSI resource, through regular reviews of the spare capacity available within the MIDs already in use, and the availability of spare MIDs , taking account of regional variations,

resolves to instruct the Director of the Radiocommunication Bureau

1 to manage the allotment and distribution of the MID resource within the MMSI numbering format, taking into account:

– Sections II, V and VI of Article **19**;

– regional variations in MMSI use;

– spare capacity within the MID resource; and

– the guidelines on MID and MMSI management contained in the most recent version of Recommendation ITU-R M.585, in particular as regards the re-use of MMSIs;

2 to report to each world radiocommunication conference on the use and status of the MMSI resource, noting in particular the anticipated reserve capacity and any indications of rapid exhaustion of the resource,

invites ITU-R

to keep under review the Recommendations for assigning MMSIs, with a view to:

– improving the management of the MID and MMSI resources; and

– identifying alternative resources if there is an indication of rapid exhaustion of these resources,

instructs the Secretary-General

to communicate this resolution to the International Maritime Organization.

#########

5.4.2 Agenda item 1.10.2

"to consider the results of studies, and take necessary actions, relating to shore-to-ship distress communication priorities (Resolution **348 (WRC-97)**)."

5.4.2.1 Summary of technical and operational considerations

A shore-based search and rescue authority has no means to interrupt or preempt the satellite communications to a vessel in a distress or safety situation. This communications inability may increase the probability of loss of life and property.

At present, when vessels are using their ship earth stations, it is not possible to send them a distress or safety message without extremely complex and time-consuming manual intervention at a land earth station to remove all other shipboard traffic. Although this is technically possible, it is not practical. In a recent distress case, the shore-based search and rescue authorities were unable to contact a vessel because of on-going routine traffic to the vessel. This inability to preempt lower priority traffic hindered the overall search and rescue operation.

A shore-based search and rescue authority must have the means to interrupt or preempt the satellite communications to a vessel in a distress or safety situation, without using extremely complex and time-consuming manual intervention.

The International Maritime Organization considered this problem and decided that provisions are necessary for giving priority to shore-originated distress communications. Inmarsat Ltd. is aware of this requirement and has been studying how to provide such priority arrangements.

5.4.2.2 Analysis of the results of considerations

For any GMDSS system, including future generations of mobile satellite communications systems intended for use aboard ships as part of its distress and safety communications, shore-originated search and rescue communications must be given priority. If practicable, this capability should be incorporated in existing GMDSS systems. If not, specific manual procedures should be standardized. Future generations of GMDSS systems must include this capability.

5.4.2.3 Methods to satisfy the agenda item and their advantages and disadvantages

Method

Develop appropriate Resolutions or ITU-R Recommendations

Consider IMO and Inmarsat Ltd findings and their proposed methods to provide priority for shore-originated distress communications, with a view to modifying provisions of the Radio Regulations. Develop appropriate Resolutions or ITU-R Recommendations to ensure priority access is secured for shore-originated distress communications.

Advantage:

Priority for shore-originated distress communications would be secured.

Disadvantage:

None have been identified.

5.4.2.4 Regulatory and procedural considerations

None have been determined.

#########

5.5 Agenda item 1.14

"to consider measures to address harmful interference in the bands allocated to the maritime mobile and aeronautical mobile (R) services, taking into account Resolutions **207 (Rev.WRC-2000)** and **350 (WRC-2000)**, and to review the frequency and channel arrangements in the maritime MF and HF bands concerning the use of new digital technology, also taking into account Resolution **347 (WRC-97)**"

Background

Issue A: Measures to address harmful interference in the bands allocated to the maritime mobile and aeronautical mobile (R) services (Resolution **207 (Rev.WRC-2000)**)

At previous WRCs, administrations have reported interference on the HF calling, distress and safety frequencies used by the aeronautical and maritime mobile services. Resolution **207** contains provisions and measures to combat the growing concern of aviation and maritime authorities over the increased interference to operational distress and safety communications caused by unauthorized (illegal) transmissions.

Interference to safety communications in the HF maritime and AM(R)S bands in some areas of the world is now a matter of very serious concern to maritime and civil aviation authorities, and to aircraft operating in those areas. The international maritime and civil aviation community fully supports the development of measures to lessen the number and severity of unauthorized transmissions. Such measures could include the strengthening of the RR, as far as is feasible, and their application by administrations.

Any proposed solutions affecting the technical characteristics of currently-used equipment and solely aimed at mitigating the effects of interference must be carefully assessed as to their effect on internationally agreed standards and their effectiveness in both the short and the long term. The prime focus for action has to remain in the area of the regulatory control exercised by radio administrations. Technical means should primarily promote the control and make this more effective. Careful attention must be given to avoid unnecessary or ineffective changes to equipment, which would place an economic burden on operators. Enforcement of existing regulatory provisions, cooperative action by administrations, and the implementation of recommended measures and techniques, is necessary to help mitigate the occurrences of harmful interference on safety communication channels.

Issue B: Study on interference caused to the distress and safety frequencies 12 290 kHz and 16 420 kHz by routine calling (Resolution **350 (WRC-2000)**)

Having received several complaints of interference to the HF GMDSS distress and safety communication frequencies, especially the frequencies 12 290 kHz and 16 240 kHz, caused by general calling, IMO by circular letters and ITU WRC-97 by Resolution **346 (WRC-97)** decided to urge administrations to remove, where appropriate, their coast station calling frequencies from the channels 1221 and 1621 to any other suitable channel.

IMO in its submissions to WRC-2000 reaffirmed its opinion that the frequencies 12 290 kHz and 16 420 kHz should only be used for distress and safety communications and allocated solely for such purpose.

In an ongoing effort to reduce interference to HF distress and safety frequencies used in the GMDSS, WRC-2000 determined that, as soon as possible, and no later than 31 December 2003, general calling from ships should not be permitted on 12 290 kHz and 16 420 kHz. The RR currently permit routine voice calling from ships on these two simplex GMDSS distress and safety frequencies, which also constitute the lower legs of channels 1221 and 1621 in Appendix **17** of the Radio Regulations. WRC-2000 actions removed the calling function on these two channels. To compensate for the resultant loss of calling functionality, 12 359 kHz and 16 537 kHz were additionally allocated as alternative carrier frequencies for use by ship and coast stations for calling on a simplex basis.

Issue C: Review the frequency and channel arrangements in the maritime MF and HF bands concerning the use of new digital technology (Resolution **347 (WRC-97)**)

Use of some maritime mobile services such as Morse telegraphy and Narrow-Band Direct Printing (NBDP) are declining, while at the same time the need for spectrum for other maritime communications such as data communications and introduction of new digital technology for maritime mobile services is increasing. It would therefore be appropriate to review parts of the channel arrangements for the maritime mobile MF and HF services in order to make sufficient spectrum available for such other maritime mobile services.

5.5.1 Summary of technical and operational considerations

5.5.1.1 Issue A

The ITU-R Special Monitoring Programme in the HF bands by administrations as organized by the Radiocommunication Bureau in accordance with the decision of WRC-2000 and described in CR/147 has been useful in the collection of interference data for the MMS and AM(R)S in the MF and HF bands.

Studies related to the AM(R)S have considered alternative modulation methods, antenna pattern modification methods, channel barring of transmitter equipment, coordinated regional monitoring and DF strategies. These techniques are considered in more detail in section 5.5.3.1 Techniques 1-4.

Operational studies related to the AM(R)S have considered the transmission of warning messages on channels affected by harmful interference. This is considered in more detail in section 5.5.3.1 Technique 5.

In addition there has been consideration of national and regional education and publicity initiatives. This is considered in more detail in section 5.5.3.1 Technique 6.

Many of these studies also have applications to the maritime mobile service.

5.5.1.2 Issue B

No studies.

5.5.1.3 Issue C

Studies have been performed in ITU-R.

5.5.2 Analysis of the results of studies and considerations

5.5.2.1 Issue A

The results of the ITU-R Special Monitoring Programme in the HF bands are summarized in the ITU-R website http://www.itu.int/ITU-R/terrestrial/monitoring/index.html . The data indicates a continuing problem of interference for the maritime mobile and aeronautical mobile (R) services in the MF and HF bands. Monitoring has demonstrated that the problem is widespread particularly in the Asia-Pacific region. The problem has increased over recent years as more unauthorized operators have found it convenient to use the apparently clear aviation and maritime channels. Further, the availability of low cost HF SSB transceivers and the long-distance propagation characteristics of the HF band provide an economic incentive to use HF for communications.

5.5.2.2 Issue B

At WRC-2000 some administrations had difficulty with agreeing to the removal of the calling function on 12 290 kHz and 16 420 kHz. It was reasoned that if the existing RR were followed, use of these frequencies for calling would not interfere with distress traffic. It was also reasoned that if users on these frequencies were not following prescribed procedures within the RR, making additional changes to the RR would not solve the interference problem. Removal of the calling function may require additional equipment resources and possible operational costs for those search and rescue organizations who utilize and maintain watch on these frequencies for distress, safety and general calling as they may now have more channels to monitor. Though not the practice in Europe, some search and rescue organizations may decide to reduce the priority of distress and safety communications and focus their resources towards maintaining watch on the general calling frequencies alone. This will result in non-GMDSS vessels in emergency situations having to first make a distress call on the routine calling channel. They may remain on this channel instead of moving to the related 12 or 16 MHz band distress working channel. If required to move to the related distress working channel, which in practice is difficult to do, this may result in loss of communications. Additionally, an operational procedure that requires the mariner in distress to use a calling channel to initiate a distress call and then to manually change frequencies for distress communications places an unacceptable burden on the mariner.

5.5.2.3 Issue C

WRC-97 modified certain provisions in order to make it possible to use some of the maritime mobile MF and HF frequencies also for data transmissions. There is an urgent need for introduction of further possibilities for use of digital technology within the existing maritime MF and HF planned bands.

ITU-R is carrying out studies on the use of new digital technologies in the HF bands. Some of these technologies might also be useful for the introduction of new digital technology in the maritime mobile MF and HF services.

When these studies are complete, it will be necessary to completely review App. **17** to feature new technology services over the traditional services in light of the declining use of NBDP, the discontinuation of Morse and the lack of available coast stations offering voice services, without compromising GMDSS.

In order to provide full worldwide interoperability of equipment on ships, there should be one technology, or more than one interoperable worldwide technology, implemented under App. **17**.

5.5.3 Methods to satisfy the agenda item and their advantages and disadvantages

5.5.3.1 Issue A

5.5.3.1.1 Method A

Regulatory control by administrations

The prime focus for action has to be in the area of the regulatory control exercised by administrations. Enforcement of existing regulatory provisions, cooperative action by administrations, and the implementation of recommended measures and techniques, is necessary to help mitigate the occurrences of harmful interference.

Advantages:

- The maritime and aviation communities are best suited for assessing any HF maritime and aeronautical mobile (R) interference mitigation solutions.
- No regulatory changes to the ITU Radio Regulations are necessary.

Disadvantages:

None have been identified.

5.5.3.1.2

Together with regulatory control, the following recommended HF interference mitigation measures and techniques have been identified together with their advantages and disadvantages. Use of any or all of these techniques is not mandatory.

Technique 1 - Alternative modulation methods

Alternative modulation methods such as digital modulation protocols (FSK, QPSK, etc.) as a replacement for analogue SSB would reduce the effect of interference on services caused by unauthorized users in these bands. Its success would depend on the level and type of interference as well as the error-correction capability of the system. Any such initiative would need to be adopted internationally to allow the interoperability of equipment.

Advantages:

Advanced digital processing methods can reduce the effect of interference on the service.

Disadvantages:

- The cost of implementing this solution would be substantial. Authorities and operators would need to replace or substantially modify equipment to maintain international interoperability.
- It does not remove the interference from the channel.

Technique 2 - Passive and active/adaptive antenna systems

Passive and active/adaptive antenna systems are designed to attenuate noise originating from directions other than that of the desired signal.

One passive antenna method is the Near Vertical Incidence Skywave (NVIS) antenna. This method relies on reducing the antenna gain and hence interference signal levels from ground waves and low angle of incidence (to the horizon) skywaves.

Active (or "adaptive") antenna systems constantly update the beam pattern to optimize performance in all conditions. In order for the phased arrays to effectively block unwanted interferers they must first be able to isolate the desired signal. The antenna pattern is then modified to face the main lobe towards the desired signal source and a null towards the interferer. One operational system being used for HF digital systems has been demonstrated to reject unwanted jamming signals with jamming-to-signal power ratios of up to 40 dB. This solution may be suitable for digital maritime mobile services but no assessment has been made at this point.

Advantages:

Currently developed dynamic/adaptive antenna systems operate in a digital modulation environment and make use of anti-jamming algorithms that differentiate between desired and undesired signals based on the known characteristics of digital signals (synchronization codes or preambles). They can provide improvements in throughput of data and thus channel efficiency.

Disadvantages:

- Authorized HF AM(R)S communication is a mixture of medium- and long-distance communication and therefore passive NVIS antenna systems would attenuate both authorized users and interference together.
- For the current dynamic/adaptive antenna system solution to be appropriate without further development, systems would need to convert from analogue SSB to digital modulation (i.e. method 2). Further technical development of this solution is required to enable an assessment of its suitability in an analogue SSB environment.
- This method provides no benefit to countries or stations that do not have access to the system, as it does not reduce the amount or severity of channel interference.
- The currently developed systems would provide benefit only to the ground and shore-based operator. Due to size and weight considerations, the system would not be installed in aircrafts or ships and accordingly not reduce the amount of interference received by the mobile operator.
- Cost to implement changes may preclude uptake due to substantial infrastructure and equipment replacement.

Technique 3 - Channel barring

Administrations could require manufacturers of HF radio equipment to prevent users through electronic means from accessing frequencies allocated exclusively to the aeronautical mobile (R) service (see App. **27**) without proper authorization. Frequencies excluded would be those allocated for worldwide common use and shared with AM(OR)S (see App. **26/3.4**). This barring would apply to new equipment but could apply retrospectively by modification to existing equipment. This is a long-term strategy and its effectiveness increased through education and publicity.

Advantages:

New HF transmitter equipment employ digital tuner technology and so the modifications required to provide electronic barring would be minimal. It would be a relatively low-cost strategy to administrators. Aircraft equipment would not need modification, as they would be authorized users of these aeronautical frequencies. The approach would be of benefit to both operators (aircraft and ship pilots) and base stations in the aeronautical and maritime services.

Disadvantages:

- Unscrupulous operators could bypass barring. Old equipment and equipment already in circulation would be difficult (but not impossible) to apply the barring, and modification would need the cooperation of the operators and would involve a cost borne by someone.
- This method is a long-term strategy to mitigate interference.

Technique 4 - Regional HF monitoring and direction finding

The ability to ascertain the location of unauthorized users through the implementation of comprehensive and effective regional HF monitoring and direction finding networks would enable regulators to better identify and address interference. These networks would require significant cooperation and commitment from regional regulators, assisted by aviation and maritime authorities. Network accuracy would be proportional to the number and geographic spread of monitoring stations.

Several administrations in the Asia-Pacific region support this method as a means of mitigating interference.

Advantages:

Makes use of or builds on existing equipment infrastructure. Could reduce the cost and increase the effectiveness of policing the bands by administrations by identifying more accurately the location of unauthorized users. Several Asia-Pacific region countries have indicated that their current DF capabilities are limited to providing bearing information. Their operations could be enhanced through a regional coordination network. This method could have significant short and long-term effects.

Disadvantages:

Highly dependent on the establishment and maintenance of regional cooperation. National security issues may need to be addressed depending on the type of networking used.

Technique 5 - Transmission of warning messages

Some countries transmit multi-language warning messages on specific channels affected by harmful interference. The Australian civil aviation authority has used this method for a number of years to mitigate strong and/or persistent interference in the AM(R)S band.

Advantages:

- Operational reports tend to suggest success in clearing affected frequencies at least in the short term.
- Easy to implement and control by telecommunications administrations, aviation or maritime authorities.
- Often has immediate effect on the channel receiving the interference.

Disadvantages:

Potential for interference to authorized users.

Technique 6 - Education and publicity initiatives

Education and publicity initiatives could be provided on an ongoing basis by national administrations to non-compliant users supported by international and regional telecommunications, aviation and maritime bodies.

Advantages:

Sharing of experience and knowledge in education and publicity initiatives can provide benefits regionally and nationally.

Disadvantages:

Does not have immediate effect but a long-term strategy.

5.5.3.2 Issue B

5.5.3.2.1 Method A

Allow limited safety-related calling to and from rescue coordination centres on 12 290 kHz and 16 420 kHz subject to certain safeguards as contained in a new Resolution [XXX].

Advantages:

- Continuation of the calling function on these frequencies will enhance the capability of those search and rescue organizations who maintain watch on these distress and safety frequencies to call ships not required to fit GMDSS equipment.
- The protection of these frequencies from extensive calling for commercial communications would be retained while at the same time permitting Maritime Rescue Coordination Centres, required to offer some public correspondence of a safety-related character, to use these frequencies for limited calling for such purpose under controlled conditions.
- Those search and rescue organizations that maintain watch on these frequencies, where currently dedicated to distress and safety communications, would not be required to operate and maintain additional equipment for the calling frequencies. Additionally, this allows a vessel in a distress situation to communicate on these channels rather than making a distress call on a working channel; hence, de facto changing the working channel into a distress and safety channel.

Disadvantages:

- Additional emphasis and effort by administrations would be required to identify and report users that are causing interference on these frequencies by use of operational procedures not in accordance with the Radio Regulations.
- Transmitting ship stations not adhering to existing regulatory standards, which require a ship station to listen on its transmitting frequency prior to transmitting, may cause interference to ongoing distress and safety communications which will be exacerbated by the use of duplex channels as opposed to simplex channels.
- The requirement of IMO that these frequencies should be allocated exclusively for distress and safety communications would no longer be met.

5.5.3.2.2 Method B

Permit limited DSC routine calling on HF DSC distress and safety calling frequencies by coast stations and ships when attempting to communicate with ships. Such routine calling would be allowed if no other means are available and if no traffic is present on the channel.

Advantages:

- At present, routine calling is prohibited on channels allocated for digital selective calling (DSC) under the GMDSS. Lacking this, a calling facility presents considerable communications difficulties among and between GMDSS and non-GMDSS fitted vessels. This change should be made provided adequate precautions are taken not to interfere with distress calls.
- This will facilitate communications to and from ships that are outside coverage of MF/VHF radiotelephone frequencies.

- It allows DSC-equipped radios to meet the recommendations of IMO that GMDSS equipment not be reserved for emergency use only, as described in IMO COMSAR/Circ. 17.

Disadvantages:

Further study would be needed. Inclusion of a new requirement in the specifications for HF DSC equipment similar to the existing requirement for VHF DSC equipment to automatically prevent the transmission of a DSC routine call until the channel is free might be needed.

5.5.3.3 Issue C

5.5.3.3.1 Method A

Considerations should be given to make the current HF Morse telegraphy and narrow-band direct-printing channels in Appendix **17** available for digital maritime services.

The conference could consider modifications to Appendix **17** which would provide administrations with greater flexibility to use the current HF Morse telegraphy and narrow-band direct-printing channels available for the initial testing and possible future introduction of new technology, subject to non-interference and no protection. This would necessarily be subject to a special arrangement between interested or affected administrations.

Advantages:

- Use of digital formats will greatly increase the utility of these frequencies and enhance the communications capabilities to and from vessels.
- Use of internationally accepted standards will ensure worldwide interoperability of systems and, hence, enhance overall safety. This would allow any vessel to use this digital service to seamlessly transmit safety and other communications, such as ship reporting systems and weather observations.
- Use of internationally accepted standards will alleviate national entities (e.g. national weather agencies) from having to contract with every coast station that offers a proprietary data messaging service to ships.
- May permit facilitation of the development and testing of new technology.
- Use of channels for the development and testing of new technology may, in turn, encourage maritime radio equipment manufacturers to advance or accelerate such development and testing.
- This method will allow immediate use of certain bands for testing of new digital technology. The method will minimize the limitations put on the technology used, as the revision of the channelling arrangement will be deferred to a later conference. Consequently the changes made to Appendix **17**, Part A will not prejudge the outcome of the studies being carried out concerning new digital technology in the maritime-mobile MF and HF services.

Disadvantages:

- Use of channels for testing may increase the channel loading of the remaining operational channels for the concerned administrations.
- This change is only really an interim solution to the problem of allowing new technology on the HF bands. The disadvantage here is that it might put back the requirement for a thorough revision of Appendix **17**, which is urgently needed.

5.5.3.3.2 Method B

Adopt a Resolution inviting ITU-R to finalize studies on the introduction of digital technology in maritime-mobile MF and HF services.

Advantages:

Gives a clear framework for the ongoing studies for the introduction of digital technology in maritime-mobile MF and HF services.

Disadvantages:

None have been identified.

5.5.4 Regulatory and procedural considerations

5.5.4.1 Issue A

Modify Resolution 207 (Rev.WRC-2000) to incorporate the techniques in 5.5.3.1 as shown in Annex 5.5-3.

5.5.4.2 Issue B

5.5.4.2.1 Method A

MOD

52.221A 2) Limited safety-related calling on the carrier frequencies 12 290 kHz and 16 420 kHz shall be permitted only to and from rescue coordination centres (see No. **30.6.1**), subject to the safeguards of Resolution **(XXX)**. The alternative carrier frequencies 12 359 kHz and 16 537 kHz may be used by ship stations and coast stations for calling on a simplex basis, provided that the peak envelope power does not exceed 1 kW.

5.5.4.2.2 Method B

MOD APPENDIX 15, TABLE 15-1, Legend:

MOD

DSC These frequencies are used exclusively for distress and safety calls using digital selective calling in accordance with No. **32.5** (see Nos. **32.9**, **33.11** and **33.34**). Exceptionally, however, these frequencies may also be used for ship-to-ship and shore-to-ship routine calling if no other means are available and if no traffic is present on the channel (see No. **31.4**).

5.5.4.3 Issue C

An example of a possible modification of Appendix **17** is given in Annex 5.5-1 to this section and an example of a possible new Resolution is given in Annex 5.5-2.

ANNEX 5.5-1

APPENDIX 17 (WRC-03)

Frequencies and channelling arrangements in the high-frequency bands for the maritime mobile service

(See Article **52**)

PART A – Table of subdivided bands

In the Table, where appropriate[1], the assignable frequencies in a given band for each usage are:

– indicated by the lowest and highest frequency, in heavy type, assigned in that band;

– regularly spaced, the number of assignable frequencies (*f.*) and the spacing in kHz being indicated in italics.

Table of frequencies (kHz) to be used in the band between 4 000 kHz and 27 500 kHz allocated exclusively to the maritime mobile service

Add to the first column for the frequencies **4 172.5** to **4 181.5**, **4 181.75** to **4 186.75**, **4 187** to **4 202**, **4 202.5** to **4 207**, **4 209.5** to **4 219**, **6 281** to **6 284.5**, **8 365.75** to **8 370.75, 8 371** to **8 376, 8 376.5** to **8 396, 12 549.75** to **12 554.75, 12 555** to **12 559.5** Note *p)* and

Add new Note *p)* to the Table as follows:

p) These sub-bands may be used for initial testing and possible future introduction of new digital technology within the maritime mobile service. Stations using these sub-bands for this purpose shall not cause harmful interference to, and shall not claim protection from, other stations operating in accordance with Article **5**.

ANNEX 5.5-2

Example of possible new Resolution

DRAFT RESOLUTION [MMM]

Review of the frequency and channel arrangements in the maritime MF and HF bands with a view to improving efficiency by considering the use of new digital technology by the maritime mobile service

The World Radiocommunication Conference (Geneva, 2003),

[1] Within the non-shaded boxes.

considering

a) that the agenda of this conference included consideration of the use of new digital technology in the MF and HF bands in the maritime mobile service;

b) that the introduction of new digital technology in the maritime mobile service shall not disrupt the distress and safety communications in the MF and HF bands including those established by the International Convention of Safety of Life at Sea, 1974 as amended;

c) that changes made in Appendix **17** should not prejudice the future use of these frequencies or the capabilities of systems or new applications required for use by the maritime mobile service;

d) that the requirement to use new digital technologies in the maritime mobile service is growing rapidly;

e) that the use of new digital technology on maritime HF and MF frequencies will make it possible to better respond to the emerging demand for new services;

f) that the maritime HF A1A Morse telegraphy and narrow-band direct-printing frequency bands are significantly under-utilized at present;

g) that the ITU Radiocommunication Sector is conducting ongoing studies to improve the efficiency in these bands,

noting

a) Resolution **347** (**WRC-97**);

b) that different digital technologies have already been developed and used in the MF and HF bands in several radio services,

noting also

that this conference has modified Appendix **17** to permit, on a voluntary basis, the use of various channels or bands identified in the MF and HF bands for initial testing and future introduction of new digital technology,

resolves

1 that, in order to provide full worldwide interoperability of equipment on ships, there should be one technology, or more than one interoperable worldwide technology, implemented under Appendix **17**;

2 that, as soon as the ITU-R studies are completed, a future competent conference should consider necessary changes to Appendix **17** to enable the use of new technology by the maritime mobile service,

invites ITU-R

to finalize studies currently ongoing:

– to identify future requirements of the maritime mobile service;

– to identify the technical characteristics necessary to facilitate use of digital systems in the MF and HF maritime mobile bands taking into account any relevant ITU-R Recommendations;

– to identify the digital system(s) to be used by the MF/HF maritime service;

– to identify any necessary modifications to the frequency plan contained within Appendix **17**;

– to propose a timetable for the introduction of new digital technology and any consequential changes to Appendix **17**;

– to recommend how digital technology can be introduced while ensuring compliance with the distress and safety requirements,

instructs the Secretary General

to bring this Resolution to the attention of the International Maritime Organization, the International Civil Aviation Organization, the International Association of Lighthouse Authorities and the International Maritime Radio Association (CIRM).

ANNEX 5.5-3

Example of a proposed revision of Resolution 207 (Rev.WRC-2000)

MOD

RESOLUTION 207 (REV.WRC-03)

Measures to address unauthorized use of and interference to frequencies in the bands allocated to the maritime mobile service and to the aeronautical mobile (R) service

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that the HF frequencies currently used by the aeronautical and maritime mobile services for distress, safety and other communications, including allotted operational frequencies, suffer from harmful interference and are often subject to difficult propagation conditions;

b) that WRC-97 considered some aspects of the use of the HF bands for distress and safety communications in the context of the Global Maritime Distress and Safety System (GMDSS), especially with regard to regulatory measures;

c) that unauthorized operations using maritime and aeronautical frequencies in the HF bands are continuing to increase and are already a serious risk to HF distress, safety and other communications;

d) that some administrations have resorted to, for example, transmitting warning messages on operational HF channels as a means of deterring unauthorized users;

e) that provisions of the Radio Regulations prohibit the unauthorized use of certain safety frequencies for communications other than those related to safety;

f) that enforcing compliance with these regulatory provisions is becoming increasingly difficult with the availability of low-cost HF single side-band (SSB) transceivers;

g) that monitoring observations of the use of frequencies in the band 2 170-2 194 kHz and in the bands allocated exclusively to the maritime mobile service between 4 063 kHz and 27 500 kHz and to the aeronautical mobile (R) service between 2 850 kHz and 22 000 kHz show that a number of frequencies in these bands are still being used by stations of other services, many of which are operating in contravention of No. **23.2**;

h) that, in certain situations, HF radio is the sole means of communication for the maritime mobile service and that certain frequencies in the bands mentioned in *considering g)* are reserved for distress and safety purposes;

i) that, in certain situations, HF radio is the sole means of communication for the aeronautical mobile (R) service and that this is a safety service;

j) that WRC-2000 and this Conference have reviewed the use of the HF bands by the aeronautical mobile (R) and maritime mobile services with a view to protecting operational, distress and safety communications;

k) that this resolution identifies several interference mitigation techniques that can be employed by administrations on a non-mandatory basis,

considering in particular

a) that it is of paramount importance that the distress and safety channels of the maritime mobile service be kept free from harmful interference, since they are essential for the protection of the safety of life and property;

b) that it is also of paramount importance that channels directly concerned with the safe and regular conduct of aircraft operations be kept free from harmful interference, since they are essential for the safety of life and property,

resolves to invite ITU-R and ITU-D, as appropriate

to increase regional awareness of appropriate practices in order to help mitigate interference in the HF bands, especially on distress and safety channels,

urges administrations

1 to ensure that stations of services other than the maritime mobile service abstain from using frequencies in distress and safety channels and their guardbands and in the bands allocated exclusively to that service, except under the conditions expressly specified in Nos. **4.4**, **5.128**, **5.129**, **5.137** and **4.13** to **4.15**; and to ensure that stations of services other than the aeronautical mobile (R) service abstain from using frequencies allocated to that service except under the conditions expressly specified in Nos. **4.4** and **4.13**;

2 to make every effort to identify and locate the source of any unauthorized emission capable of endangering human life or property and the safe and regular conduct of aircraft operations, and to communicate their findings to the Radiocommunication Bureau;

3 to participate in any monitoring programmes organized by the Radiocommunication Bureau or administrations, if so agreed among those administrations, without adversely affecting the rights of other administrations or conflicting with any provisions of the Radio Regulations, in accordance with item 4 in the annex;

4 to make every effort to prevent unauthorized transmissions in bands allocated to the maritime mobile service and the aeronautical mobile (R) service;

5 to request their competent authorities to take, within their respective jurisdiction, such legislative or regulatory measures which they consider necessary or appropriate in order to prevent stations from unauthorized use of distress and safety channels or from operating in contravention of No. **23.2**;

6 to take all necessary steps in such cases of contravention of No. **23.2** to ensure the cessation of any transmissions contravening the provisions of the Radio Regulations on the frequencies or in the bands referred to in this Resolution;

7 to employ as many of the interference mitigation techniques in the annex as are appropriate for the maritime mobile and aeronautical mobile (R) services,

instructs the Radiocommunication Bureau

1 to seek the cooperation of administrations in identifying the sources of those emissions by all available means and in securing the cessation of those emissions;

2 when the station of another service transmitting in a band allocated to the maritime mobile service or to the aeronautical mobile (R) service has been identified, to inform the administration concerned;

3 to include the problem of interference to maritime and aeronautical distress and safety channels on the agenda of relevant regional radiocommunication seminars,

instructs the Secretary-General

to bring this Resolution to the attention of the International Maritime Organization and the International Civil Aviation Organization for such actions as they may consider appropriate.

ANNEX TO RESOLUTION 207 (Rev.WRC-03)

Interference mitigation techniques

This annex lists several possible HF interference mitigation techniques that may be used to protect receivers either in combination or singly depending on the resources of administrations. Use of any or all of these techniques is not mandatory.

1 Alternative modulation methods

The use of digitally modulated emissions, such as QPSK, to replace or supplement analogue SSB voice (J3E) and data (J2B) emissions. This initiative would need to be adopted internationally to allow the interoperability of equipment. For example, ICAO has adopted the HF datalink standard to provide packet data communications using automated link establishment and adaptive frequency control techniques as a supplement to analogue SSB voice communications, see ICAO Convention Annex 10.

2 Passive and dynamic/adaptive antenna systems

Use of passive and active/adaptive antenna systems to reject unwanted signals.

3 Channel barring

Administrations should ensure through their licensing, equipment standardization and inspection arrangements that, in compliance with No. **43.1**, HF radio equipment cannot transmit on frequencies exclusively assigned to the aeronautical mobile (R) service, as detailed in Appendix **27**, except for frequencies allocated for worldwide use and shared with the aeronautical mobile (OR) service (see Appendix **26**/3.4).

4 Regional HF monitoring and direction-finding facilities

Collaboration and cooperation between regional administrations to coordinate the use of monitoring and direction finding facilities.

5 Transmission of warning messages

Transmission of multi-language warning messages on specific channels affected by strong or persistent interference. Such transmissions should be conducted after coordination with the users of the affected services and the administration(s) or competent authorities concerned.

6 Education and publicity initiatives

Administrations provide education and publicity initiatives on the proper use of the radio-frequency spectrum in these bands.

ANNEX 5.5-4

Example of possible new Resolution
DRAFT RESOLUTION [XXX] (WRC-03)

Use of carrier frequencies 12 290 kHz and 16 420 kHz for limited safety-related calling, to and from rescue coordination centres

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that this Conference modified **52.221A** to allow limited safety-related calling on the carrier frequencies 12 290 kHz and 16 420 kHz;

b) that the limited safety-related calling function on these carrier frequencies will enhance the capability of those search and rescue organizations which maintain watch on these distress and safety frequencies to call ships not fitted for the GMDSS,

noting

a) that regulation IV/4.8 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, requires that SOLAS ships, while at sea, be capable of transmitting and receiving general radiocommunications to and from shore-based radio systems or networks;

b) that general communications may consist of safety-related communications necessary for the safe operation of shipping,

further noting

that safety-related communications must be afforded adequate, effective and immediate access and protection,

recognizing

that Resolution MSC.129(75) of the International Maritime Organization notes that distress, urgency and safety radiocommunications include, but are not limited to:

- transmissions of maritime safety information;
- distress calls and traffic;
- acknowledgment and relaying of distress calls;
- search and rescue coordination communications;
- ship movement service communications;
- communications related to the safe operation of ships;
- communications related to navigation;
- meteorological warnings;
- meteorological observations;
- ship position reports; and
- medical emergencies (e.g. MEDICO/MEDIVAC),

resolves

1 that the carrier frequencies 12 290 kHz and 16 420 kHz be used only for distress, urgency and safety communications, and limited safety-related calling;

2 that safety-related calling be initiated only after determination that other communications are not present on these frequencies;

3 that safety-related calling is minimized and does not cause interference to distress, urgency and safety communications,

requests the Secretary-General

to bring this Resolution to the attention of the International Maritime Organization.

#########

5.6 Agenda item 1.23

"to consider realignment of the allocations to the amateur, amateur-satellite and broadcasting services around 7 MHz on a worldwide basis, taking into account Recommendation **718 (WARC-92)**"

5.6.1 Summary of technical and operational studies

Studies in response to Recommendation **718 (WARC-92)** have been ongoing in ITU-R for a number of years.

The purpose of carrying out a realignment of the bands around 7 MHz is to remedy the long-standing difficulties experienced by the AS and the limitations placed on the BS as a result of the changes made to the frequency bands around 7 MHz at the Atlantic City WARC in 1947.

Historically until the 1938 Cairo Conference the band 7 000-7 300 kHz was allocated exclusively to the AS. Conditions in Europe and Asia lead to the reduction to 7 000-7 150 kHz in ITU Regions 1 and 3. A final reduction to 7 000-7 100 kHz took place at WARC-59. The Region 2 allocation remained unchanged at 7 000-7 300 kHz amateur exclusive.

For the AS the usefulness of the allocations around 7 MHz for worldwide links is limited because only 100 kHz of spectrum between 7 000 and 7 100 kHz is common to Region 2 and Regions 1 and 3. The 7 100-7 300 kHz band is allocated exclusively to the BS in Regions 1 and 3, and exclusively to the AS in Region 2. Given the large disparity in signal levels between the two services, broadcasting transmissions cause interference to the sensitive receivers used in the AS during periods of good propagation between Regions 1 and 2. The degree of interference experienced in Region 2 varies with the time-of-day, season, solar activity and distance from broadcasting stations in other regions.

It is essential that information on sharing between the services involved in the 7 MHz realignment is available to guide the discussions at WRC-03. Fortunately, much of the information on sharing scenarios in the HF bands is to be found in the Report of JIWP 10-6-8-9/1 (25 October 1990) concerning "*Compatibility considerations arising from the allocation of spectrum to HF broadcasting*". This study, which formed Section 5 of the CCIR Report to WARC-92 (Doc. 3), is still valid and was reproduced in the Report of the Director to WRC-2000 in response to Resolution **29 (WRC-97)** (see Attachment 1 to Document CMR-2000/5). The study concludes that:

1) the sharing of frequency bands by the AS and BS is undesirable and should be avoided, because of system incompatibility between BS and AS. (See Res. **641 (Rev.HFBC-87)**);

2) the AM(R)S cannot share with other services within a Region, because it contains safety of life communications;

3) above 6 MHz the AM(OR)S operates to a Plan and cannot share with other services, because it contains safety of life communications;

4) maritime mobile international distress and calling frequencies cannot be shared with other services except for search and rescue operations (e.g. concerning manned space vehicles) because it contains safety of life communications;

5) above 4 063 kHz, the MMS operates to a Plan and does not share with any other service except fixed in the band 8 100 to 8 195 kHz, because it contains safety of life communications;

6) the LMS is now sharing with the MMS (except international calling and distress frequencies), FS and AS;

7) the FS is now sharing with the LMS, MMS (except international calling and distress frequencies) and AS. Some sharing with the BS has been adopted within the broadcasting band extensions agreed by WARC-79 and WARC-92. (See No. **5.147**);

8) dynamic frequency sharing or real time frequency management is a useful tool for providing communication circuits that are not otherwise possible because of interference constraints. Dynamic sharing implies operation on a secondary basis where there is no possibility of a claim for interference-free communication. This type of sharing is possible with frequency-agile transmitting and receiving equipment made feasible by modern technology. Dynamic frequency sharing is enhanced when one service operates with high power on known or published frequencies, such as the BS and the dynamic service operates with low power involving two-way communications such as in the FS, MS and AS. No. **5.147** gives an example of bands in which dynamic sharing is possible.

Since WARC-92, there has been further progress on the use of dynamic frequency management and sharing in the bands below 28 MHz, as a result of ITU-R studies. Regulatory changes and modified notification procedures introduced at WRC-95 and WRC-97 give full recognition to frequency agile systems, thereby facilitating the use of intelligent radiocommunication systems which can make more effective use of the radio spectrum.

In the long term, the use of frequency adaptive techniques will serve to overcome the difficulties imposed by a fixed band allocation structure under variable propagation conditions and therefore allow the available spectrum to be used with better effect than at present. Comprehensive guidance on the introduction of frequency adaptive systems for the FS is given in the forthcoming Handbook on "Frequency Adaptive Communication Systems and Networks in the MF/HF bands", which has been developed by ITU-R.

It will be advantageous to change the allocation designations for the bands currently allocated to the fixed or non-planned MS to denote shared primary use by the FS and LMS. Such merged generic fixed/mobile allocations will allow greater flexibility in the use of the bands involved and also facilitate the use of frequency adaptive techniques, thereby leading to greater efficiency in the use of the spectrum.

Another ITU-R study shows that the spectrum immediately below 7 MHz is of prime importance to the FS and MS because of its dual use in supporting near vertical incidence skywave (NVIS) communications, over relatively short distances of 100 km or so, and its more traditional use for longer range communications using oblique incidence reflection from the ionosphere. Moreover, it is not possible to offset any loss of spectrum below 7 MHz because NVIS operations cannot make use of frequencies above 0.9 of the critical frequency, which for normal planning purposes has to be assumed to generally lie below 8 MHz.

5.6.2 Analysis of the results of studies

The following factors were identified during the studies as conditioning the search for a viable solution:

1) the fixed, land mobile and amateur allocations around 7 MHz support many important national and international applications, including those with a humanitarian and disaster relief dimension, which are particularly suited to the propagation characteristics of these bands;

2) any solution requiring sharing of spectrum between AS and BS is not desirable, since experience has shown that this is unacceptable in the long run;

3) the entire 300 kHz is required in Region 2 for the AS;

4) some movement in frequency of the allocation to the amateur services around 7 MHz may be acceptable;

5) a reduction of the amount of contiguous spectrum allocated to the BS in the 7 MHz band is unacceptable to broadcasters because of existing and anticipated congestion, but there is flexibility with regard to the actual location of this band;

6) attention should be given to the spectrum requirements of the LMS below 7 MHz;

7) spectrum allocated to the MMS, AM(OR)S, and AM(R)S should not be considered for reallocation;

8) the band 6 765-7 000 kHz has been identified as essential for supporting FS operations of all types and it is not feasible to relocate certain types of operations to higher bands because of propagation considerations;

9) sharing between the AS and the FS and MS may be possible;

10) the realignment should involve the minimum necessary shift in allocation blocks in order to limit the economic impact on users.

5.6.3 Methods to satisfy the agenda item and their advantages and disadvantages

Six methods are described in this section. Five methods result in additional allocations for the amateur service in Regions 1 and 3 immediately above its current 7 000-7 100 kHz allocation and retention of the current allocation of 7 100-7 300 kHz in Region 2, with the broadcasting service in Regions 1 and 3 moving up in frequency. Some methods also provide additional allocations to the broadcasting service in Region 2. In some cases the band above 7 350 kHz currently allocated to the fixed service on a primary basis and the land mobile service on a secondary basis would be affected.

Some administrations, in particular those of developing countries, are of the opinion that, due to the technical, operational and economic impacts of the proposed alignments contained in this document, the corresponding time-frames need to be sufficiently long in order to enable these administrations to implement the decisions, if so decided. Some other administrations are of the view that sufficient regard has been given to these aspects in the various methods.

5.6.3.1 Method A

The conference could consider modifications to Article **5** that would provide a worldwide exclusive allocation to the amateur service of 7 000-7 300 kHz and a worldwide primary allocation to the broadcasting service of at least 250 kHz of contiguous spectrum above 7 300 kHz.

In order to reduce the impact of the changes to the broadcasting, fixed and land mobile services to manageable levels it is envisaged that this option would be introduced over several years in two stages (starting date D1 and completion date D2) as follows:

Stage 1 (see Table 5.6-1)

6 765-7 000 kHz Fixed and mobile (except aeronautical mobile (R)) co-primary

7 000-7 100 kHz Amateur and amateur-satellite co-primary (NOC)

7 100-7 200 kHz Amateur primary

7 200-7 300 kHz Broadcasting primary Regions 1 and 3, amateur primary Region 2 (NOC)

7 300-7 450 kHz Broadcasting primary

MOD

5.142 The use of the band 7 200-7 300 kHz in Region 2 by the amateur service shall not impose constraints on the broadcasting service intended for use within Region 1 and Region 3.

*****

D1 could range from the date of entry into force for the WRC-03 changes and the 1 April 2007 implementation date for the WARC-92 extension bands for broadcasting.

Stage 2 (see Table 5.6-1)

6 765-7 000 kHz Fixed and mobile (except aeronautical mobile (R)) co-primary (NOC with respect to Stage 1)

7 000-7 100 kHz Amateur and amateur-satellite co-primary (NOC)

7 100-7 300 kHz Amateur primary

7 300-7 550 kHz Broadcasting primary

D2 = 3 to 5 years after D1 and no later than 2010.

Advantages:

Amateur service

- Global harmonization.
- Conforms with the present Region 2 amateur allocation.
- Removal of interregional amateur/broadcasting incompatibility.
- Spectrum requirements will be met in Regions 1 and 3.

Broadcasting service

- Global harmonization of 7 MHz broadcasting band.
- Additional spectrum in Region 2.
- Improved relationship between the 7 MHz broadcasting band and the 6 MHz and 9 MHz broadcasting bands, to meet changing propagation.
- Removal of interregional amateur/broadcasting incompatibility.

Fixed and land mobile services

- No impact on important fixed and land mobile networks below 7 MHz.
- Land mobile upgraded to co-primary status as (generic) mobile in the band 6 765-7 000 kHz.

Disadvantages:

Broadcasting service

- Economic impact of broadcast spectrum shift. Both broadcasters and listeners may be affected and/or face extra costs. However, it is easier for the broadcasting service to adapt under this two-stage process, rather than if all the changes came into effect at a single date.

Fixed and land mobile services

Impact on fixed and land mobile services above 7 350 kHz. Could be compensated for partly by upgrading land mobile to primary status as (generic) mobile and partly by use of adaptive techniques.

TABLE 5.6-1

Example of stage 1 of a realignment process, which improves the utility of the band allocations around 7 MHz while retaining regional differences during an interim period, commencing at date D1 and running to date D2

6 765-7 450 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
6 765-7 000	FIXED MOBILE except aeronautical mobile (R)	
7 000-7 100	AMATEUR AMATEUR-SATELLITE	
7 100-7 200	AMATEUR	
7 ~~1~~200-7 300 BROADCASTING	**7 ~~1~~200-7 300** AMATEUR	**7 ~~1~~200-7 300** BROADCASTING
7 300-7 450*	BROADCASTING	
* This block of spectrum is only intended to meet the criteria of agenda item 1.23 and is not intended to limit compatible proposals associated with other agenda items.		

As shown, the changes are appropriate to a first stage implementation date D1, as determined by WRC-03, but prior to 1 April 2007.

TABLE 5.6-2

Example of stage 2 of a realignment process, which provides for globally harmonized allocations around 7 MHz, following an interim period, retaining regional differences, commencing at date D2

6 765-7 550 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
6 765-7 000	FIXED MOBILE except aeronautical mobile (R)	
7 000-7 100	AMATEUR AMATEUR SATELLITE	
7 100-7 300	AMATEUR	
7 300-7 550	BROADCASTING	
* This block of spectrum is only intended to meet the criteria of agenda item 1.23 and is not intended to limit compatible proposals associated with other agenda items.		

5.6.3.2 Method B

The conference could consider modifications to Article **5** that would provide a worldwide exclusive allocation to the amateur service of 7 000-7 200 kHz, a regional allocation of 7 200-7 300 kHz to the amateur service in Region 2 and to the amateur, fixed, and mobile except aeronautical mobile (R) services in Regions 1 and 3, and a worldwide primary allocation to the broadcasting service of 7 300-7 550 kHz.

In order to minimize the time-frame for access to the new proposed bands for the amateur service to be as short as possible, the frequency band 7 100-7 200 kHz can be allocated to the amateur service on a secondary basis from 1 January 2005.*

In order to reduce the impact of the changes to the broadcasting, fixed and land mobile services to manageable levels it is envisaged that this option would be introduced over several years in two stages (starting date D1 and completion date D2) as follows:

Stage 1 (see Table 5.6-3)

6 765-7 000 kHz Fixed and mobile (except aeronautical mobile (R)) co-primary

7 000-7 100 kHz Amateur and amateur-satellite co-primary (NOC)

7 100-7 200 kHz Amateur, fixed and mobile (except aeronautical mobile (R)) co-primary Regions 1 and 3, amateur primary Region 2

7 200-7 300 kHz Broadcasting primary Regions 1 and 3, amateur primary Region 2 (NOC)

7 300-7 450 kHz Broadcasting primary

7 450-8 100 kHz Fixed and mobile (except aeronautical mobile (R)) co-primary

* Regulatory procedures for eliminating possible interferences to reception in the broadcasting service need to be developed.

D1 = 1 April 2007.

Stage 2 (see Table 5.6-4)

6 765-7 000 kHz	Fixed and mobile (except aeronautical mobile (R)) co-primary (NOC with respect to Stage 1)
7 000-7 100 kHz	Amateur and amateur-satellite co-primary (NOC)
7 100-7 200 kHz	Amateur primary
7 200-7 300 kHz	Amateur, fixed and mobile (except aeronautical mobile (R)) co-primary Regions 1 and 3, amateur primary Region 2
7 300-7 550 kHz	Broadcasting primary
7 550-8 100 kHz	Fixed and mobile (except aeronautical mobile (R)) co-primary

D2 = 25 October 2009.

Advantages:

Amateur service

- Conforms with the present Region 2 amateur allocation.
- Removal of interregional amateur/broadcasting incompatibility.
- Spectrum requirements will be met in Regions 1 and 3.

Broadcasting service

- Global harmonization of 7 MHz broadcasting band.
- Additional spectrum in Region 2.
- Improved relationship between the 7 MHz broadcasting band and the 6 MHz and 9 MHz broadcasting bands, to meet changing propagation.
- Removal of interregional amateur/broadcasting incompatibility.

Fixed and land mobile services

- No impact on important fixed and land mobile networks below 7 MHz.
- Additional shared allocation with amateur service in the band 7 200-7 300 kHz in Regions 1 and 3.
- Land mobile upgraded to co-primary status as (generic) mobile in the bands 6 765-7 000 and 7 550-8 100 kHz.

Disadvantages:

Amateur service

Requires sharing of 100 kHz with fixed and mobile services in Regions 1 and 3.

Broadcasting service

- Economic impact of broadcast spectrum shift. Both broadcasters and listeners may be affected and/or face extra costs. However, it is easier for the broadcasting service to adapt under this two-stage process, rather than if all the changes came into effect at a single date.

Fixed and land mobile services

Impact on fixed and land mobile services above 7 350 kHz. Compensated partly by additional shared allocation with amateur service in the band 7 200-7 300 kHz in Regions 1 and 3. Could be compensated for partly by upgrading land mobile to primary status as (generic) mobile and partly by use of adaptive techniques.

TABLE 5.6-3

Example of stage 1 of a realignment process, which improves the utility of the band allocations around 7 MHz while retaining regional differences during an interim period, commencing at date D1 and running to date D2

6 765-8 100 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
6 765-7 000	FIXED MOBILE except aeronautical mobile (R)	
7 000-7 100	AMATEUR AMATEUR-SATELLITE	
7 100-7 200 AMATEUR FIXED MOBILE except aeronautical mobile (R)	**7 100-7 200** AMATEUR	**7 100-7 200** AMATEUR FIXED MOBILE except aeronautical mobile (R)
7 200-7 300 BROADCASTING	**7 200-7 300** AMATEUR	**7 200-7 300** BROADCASTING
7 300-7 450	BROADCASTING	
7 450-8 100	FIXED MOBILE except aeronautical mobile (R)	

TABLE 5.6-4

Example of stage 2 of a realignment process, which provides for globally harmonized allocations around 7 MHz, following an interim period, retaining regional differences, commencing at date D2

6 765-8 100 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
6 765-7 000	FIXED MOBILE except aeronautical mobile (R)	
7 000-7 100	AMATEUR AMATEUR-SATELLITE	
7 100-7 200	AMATEUR	
7 200-7 300 AMATEUR FIXED MOBILE except aeronautical mobile (R)	**7 200-7 300** AMATEUR	**7 200-7 300** AMATEUR FIXEDMOBILE except aeronautical mobile (R)
7 300-7 550	BROADCASTING	
7 550-8 100	FIXED MOBILE except aeronautical mobile (R)	

5.6.3.3 Method C

The conference could consider modifications to Article **5,** which would provide administrations with a worldwide exclusive allocation of 200 kHz to the amateur service in the band 7 000-7 200 kHz. There would be no change to the allocation between 7 200-7 300 kHz. A worldwide exclusive allocation of 100 kHz would be allocated to the broadcasting service in the band 7 350-7 450 kHz. As well, the land mobile service would be upgraded to co-primary status as mobile, except aeronautical (R) (see Table 5.6-5):

6 765-7 000 kHz Fixed and mobile (except aeronautical mobile (R)) co-primary

7 000-7 100 kHz Amateur and amateur-satellite co-primary (NOC)

7 100-7 200 kHz Amateur primary

7 200-7 300 kHz Broadcasting primary Regions 1 and 3, amateur primary Region 2 (NOC)

7 300-7 450 kHz Broadcasting primary

7 450-8 100 kHz Fixed and mobile (except aeronautical mobile (R)) co-primary

Advantages:

Amateur service

- Worldwide exclusive allocation increases from 100 kHz to 200 kHz.
- Doubles the spectrum available to the amateur service in Regions 1 and 3.
- Decrease of interregional amateur/broadcasting incompatibility.

- Allocation of 300 kHz is maintained in Region 2.
- Provides improved interregional operability for the amateur service through the availability of 200 kHz of common spectrum.

Broadcasting service

- Worldwide exclusive allocation increases from 50 kHz to 150 kHz.
- Increases the allocation to the broadcasting service in Region 2 by 100 kHz.

Fixed/land mobile service

- Land mobile service is upgraded to primary status as (generic) mobile between 6 765-7 000 kHz and between 7 450-8 100 kHz.
- No impact on spectrum for the fixed and land mobile services below 7 MHz.

Disadvantages:

Amateur service

- 300 kHz exclusive worldwide spectrum requirement is not met.
- Interregional amateur/broadcasting sharing is not eliminated completely.

Broadcasting service

- Interregional amateur/broadcasting sharing is not eliminated completely.
- Some economic impact to broadcast spectrum shift. Both broadcasters and listeners may be affected and/or face extra costs.

Fixed service

- Fixed service and land mobile service lose 100 kHz worldwide.

TABLE 5.6-5

6 765-8 100 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
6 765-7 000	FIXED MOBILE except aeronautical mobile (R)	
7 000-7 100	AMATEUR AMATEUR-SATELLITE	
7 100-7 200	AMATEUR	
7 200-7 300 BROADCASTING	**7 200-7 300** AMATEUR	**7 200-7 300** BROADCASTING
7 300-7 450	BROADCASTING	
7 450-8 100	FIXED MOBILE except aeronautical mobile (R)	

The implementation date for this option should be 1 April 2007.

5.6.3.4 Method D

The conference could consider modifications to Article **5** that would provide a worldwide exclusive allocation to the amateur service at 7 000-7 300 kHz with no resultant loss or gain of spectrum by the broadcasting service. Also, to help compensate for the loss of spectrum by the fixed and mobile services in Regions 1 and 3, and to provide for more flexibility, the mobile service would be elevated to co-primary status with the fixed service, and would be changed from land mobile to the more generic MOBILE (except aeronautical mobile (R)) designation worldwide in the bands 6 765-7 000 kHz and 7 550-8 100 kHz, and in Region 2 in the band 7 350-7 550 kHz.

In order to reduce the impact of the changes to the broadcasting, fixed and land mobile services, by allowing sufficient time for administrations to manage this transition, it is proposed that these changes would be introduced over several years with a completion date of 1 April 2010.

The following schedule outlines a proposed timeline of the transition:

As of entry into force of the Final Acts of WRC-03:

7 100-7 300 Broadcasting primary and amateur secondary in Regions 1 and 3. No change in Region 2.

7 350-7 550 Broadcasting co-primary with fixed, land mobile secondary in Regions 1 and 3. No change in Region 2.

As of 1 April 2007

7 100-7 300 Amateur exclusive worldwide.

7 300-7 350 Broadcasting worldwide as of 1 April 2007 (WARC-92 extension band).

7 350-7 550 Broadcasting primary, fixed and land mobile secondary in Regions 1 and 3. No change in Region 2.

As of 1 April 2010

7 350-7 550 Broadcasting exclusive Regions 1 and 3. No change in Region 2.

Advantages:

Amateur service

- Global harmonization.
- Conforms with the present Region 2 amateur allocation.
- Removal of interregional amateur/broadcasting incompatibility.
- Spectrum requirements will be met in Regions 1 and 3.

Broadcasting service

- Removal of interregional amateur/broadcasting incompatibility.
- No loss of spectrum to broadcasting service.

Fixed and land mobile services

- No impact on important fixed and land mobile networks below 7 MHz.
- Land mobile upgraded to co-primary status as (generic) mobile in the band 6 765-7 000 kHz and 7 550-8 100 kHz worldwide and in the band 7 350-7 550 in Region 2.
- No loss of fixed and mobile spectrum in Region 2.

Disadvantages:

Broadcasting service

- Economic impact of broadcast spectrum shift. Both broadcasters and listeners may be affected and/or face extra costs. The impact is eased by a three-stage, rather than a one-stage process.
- The lack of interregional realignment as requested in the agenda item.

Fixed and land mobile services

- Loss of spectrum in Regions 1 and 3 between 7 350-7 550 kHz. Could be compensated for partly by upgrading land mobile to primary status as (generic) mobile and partly by use of adaptive techniques.
- Broadcasting in Regions 1 and 3 might interfere with critical fixed and mobile operations in Region 2 in the frequency band 7 350-7 550 kHz.

TABLE 5.6-6

Example of the Table of Frequency Allocations as it would appear after the completion of the realignment process

6 765-7 350 kHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>6 765-7 000</td><td colspan="2">FIXED
MOBILE (except aeronautical mobile (R))
5.138 5.139</td></tr>
<tr><td>7 000-7 100</td><td colspan="2">AMATEUR
AMATEUR-SATELLITE
5.140 5.141</td></tr>
<tr><td>7 100-7 300

AMATEUR</td><td>7 100-7 300
AMATEUR</td><td>7 100-7 300

AMATEUR</td></tr>
<tr><td>7 300-7 350</td><td colspan="2">BROADCASTING 5.134
5.143</td></tr>
</table>

TABLE 5.6-7

7 350-8 100 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
7 350-7 550 BROADCASTING	**7 350-7 550** FIXED MOBILE (except aeronautical mobile (R))	**7 350-7 550** BROADCASTING
7 550-8 100	FIXED MOBILE (except aeronautical mobile (R)) 5.144	

5.6.3.5 Method E

The conference could consider modifications to Article **5**, which would provide administrations with a worldwide allocation of 200 kHz to the amateur service in the band 7 000-7 200 kHz.
The band 7 100-7 200 kHz is also allocated to fixed and land mobile services with co-primary status in Regions 1 and 3. There would be no change to the allocation between 7 200-7 300 kHz.
A worldwide exclusive allocation of 100 kHz would be allocated to the broadcasting service in the band 7 350-7 450 kHz. (See Table 5.6-8):

6 765-7 000 kHz Fixed primary and land mobile secondary (NOC)

7 000-7 100 kHz Amateur and amateur-satellite co-primary (NOC)

7 100-7 200 kHz Amateur, fixed and land mobile co-primary in Regions 1 and 3, amateur primary in Region 2

7 200-7 300 kHz Broadcasting primary in Regions 1 and 3, amateur primary in Region 2 (NOC)

7 300-7 450 kHz Broadcasting primary

7 450-8 100 kHz Fixed primary and land mobile secondary (NOC)

Advantages:

Amateur service

- Worldwide allocation increases from 100 kHz to 200 kHz.
- Doubles the spectrum available to the amateur service in Regions 1 and 3.
- Some improvement of interregional amateur/broadcasting alignment.
- Allocation of 300 kHz is maintained in Region 2.
- Provides improved interregional operability for the amateur service through the availability of 200 kHz of common spectrum.

Broadcasting service

- Worldwide exclusive allocation increases from 50 kHz to 150 kHz.
- Increases the allocation to the broadcasting service in Region 2 by 100 kHz.

Fixed/land mobile service

- Land mobile service is upgraded to primary status between 7 100-7 200 kHz in Regions 1 and 3.
- Retains the current spectrum amount for existing services in Regions 1 and 3.

- No impact on spectrum for the fixed and land mobile services below 7 MHz.

Disadvantages:

Amateur service

- 300 kHz exclusive worldwide spectrum requirement is not met.
- Interregional amateur/broadcasting alignment is not completely achieved.

Broadcasting service

- Interregional amateur/broadcasting alignment is not completely achieved.
- Economic impact of broadcast spectrum shift, both broadcasters and listeners may be affected and/or face additional costs.

Fixed service/land mobile service

- Decreases the allocation to the fixed and land mobile services in Region 2 by 100 kHz.

TABLE 5.6-8

6 765-8 100 kHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>6 765-7 000</td><td colspan="2">FIXED
Land mobile</td></tr>
<tr><td>7 000-7 100</td><td colspan="2">AMATEUR
AMATEUR-SATELLITE</td></tr>
<tr><td>7 100-7 200
AMATEUR
FIXED
LAND MOBILE</td><td rowspan="2">7 100-7 300
AMATEUR</td><td>7 100-7 200
AMATEUR
FIXED
LAND MOBILE</td></tr>
<tr><td>7 200-7 300
BROADCASTING</td><td>7 200-7 300
BROADCASTING</td></tr>
<tr><td>7 300-7 450</td><td colspan="2">BROADCASTING</td></tr>
<tr><td>7 450-8 100</td><td colspan="2">FIXED
Land mobile</td></tr>
</table>

The implementation date for this option should be 1 April 2007.

5.6.3.6 Method F

WRC-03 may decide to make no changes to the allocations under this agenda item.

No change to Article 5 is required under this method.

Advantages:

Broadcasting service

- No change to current allocations.

Fixed service

- No change to current allocations.

Disadvantages:

Amateur service

- The current situation and resultant difficulties arising from unharmonized amateur service bands will continue.

Broadcasting service

- Interregional amateur/broadcasting alignment is not achieved.

5.6.4 Regulatory and procedural considerations

If any of the above methods, except Method F, are adopted the appropriate consequential amendments to the RR would need to be considered.

#########

5.7 Agenda item 1.36

"to examine the adequacy of the frequency allocations for HF broadcasting from about 4 MHz to 10 MHz, taking into account the seasonal planning procedures adopted by WRC-97"

5.7.1 Summary of technical and operational studies

It has been evident for several decades that the spectrum available to the broadcasting service between 4 and 10 MHz is inadequate. The bands are ideal for short- and medium-range coverage (up to 2 000 km) during daytime and are also needed to support longer-range services at night. In recent years, there has been a tendency for many broadcasters to improve the reliability of their transmissions by using short-distance, single hop-transmissions in the lower frequency bands to replace their long distance, multihop services.

Since 2000, a comprehensive study of the use of the HF bands for broadcasting, aided by the better information now available through the regional coordination arrangements introduced by WRC-97 as part of RR Article **12**, demonstrates that the total shortfall in spectrum in the 6, 7 and 9 MHz broadcasting bands is at least 250 kHz. That is if the objective is limited just to eliminating co-channel collisions. However, up to 800 kHz would be needed to eliminate adjacent channel collisions as well.

In addition, practical experience in planning confirms this analysis. This conclusion is remarkably similar to the estimate of a 700 kHz shortfall contained in proposals submitted to WARC-92.

Relevant Recommendations ITU-R: P.373, P.533.

5.7.1.1 HF propagation considerations

In common with all other services using the HF spectrum for beyond line-of-sight skywave transmissions, ionospheric conditions constrain broadcasting to the lower bands during periods of low to mid sunspot activity particularly during local winter. A typical example of this is demonstrated by the maps shown in Figures 5.7-1 and 5.7-2.

These maps show the Maximum Usable Frequency (MUF) at peak broadcasting time (typically 9 p.m. local time) for sunspot numbers (SSN) of 10 and 100 and local Winter. A NTIA/ITS implementation of Recommendation ITU-R P.533 was used to prepare these maps.

The light shading shows the area around a transmitter where the MUF is below 10 MHz while the dark shading shows the area where the MUF is above 10 MHz. Not only must a transmission be below 10 MHz to provide a service within the lighter shaded area from the transmitter location but also any transmission from within the lighter shaded area to the transmitter location will need to be below 10 MHz.

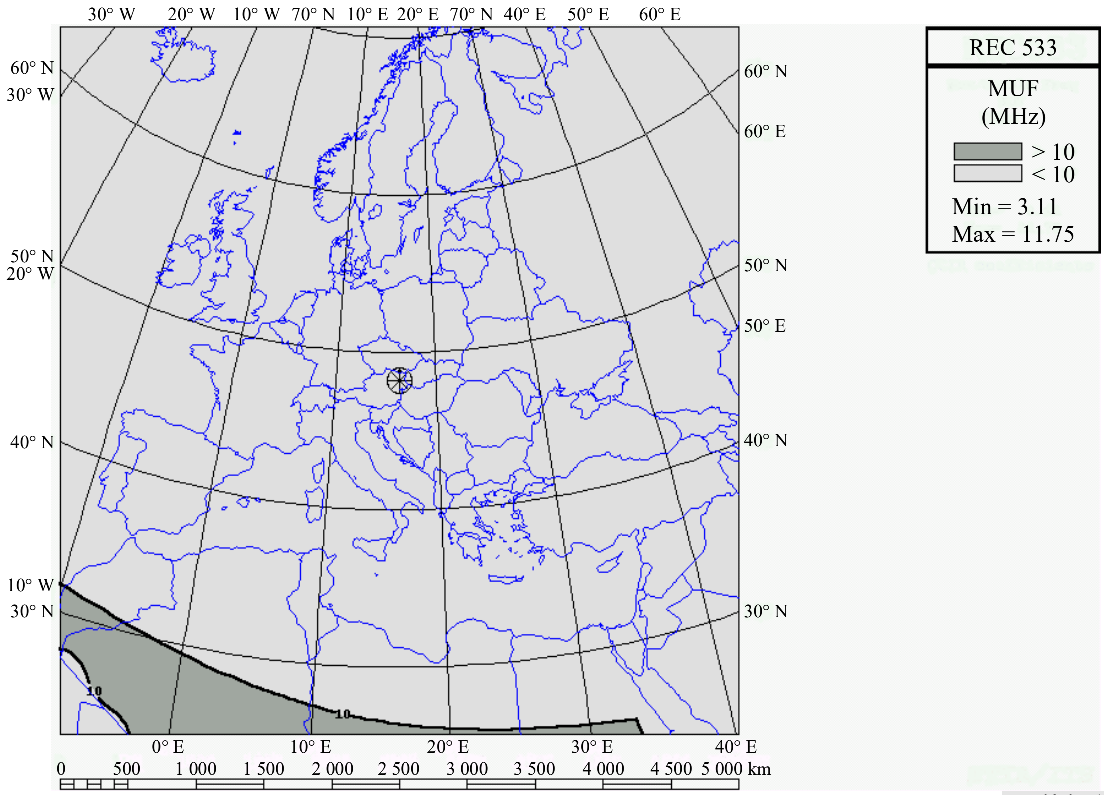
It should be noted that the MUF is a 50% value. This means that on 50% of the days for a given month the frequency is above, and on 50% of the days the frequency is below this value. A frequency can be supported for 80% of days if it is 85% of the MUF. This is referred to as the Frequency of Optimum Traffic (FOT). These terms are defined in Recommendation ITU-R P.373.

Broadcasters use the FOT to provide reliable transmissions, achieved in practice by selecting frequencies in the next band below the predicted MUF. Should the MUF be around 9 MHz, then the 7 MHz band will provide the best compromise between reliability and strength of signal delivered.

FIGURE 5.7-1

Vienna, Austria, December 2000 - UTC sun spot number 10

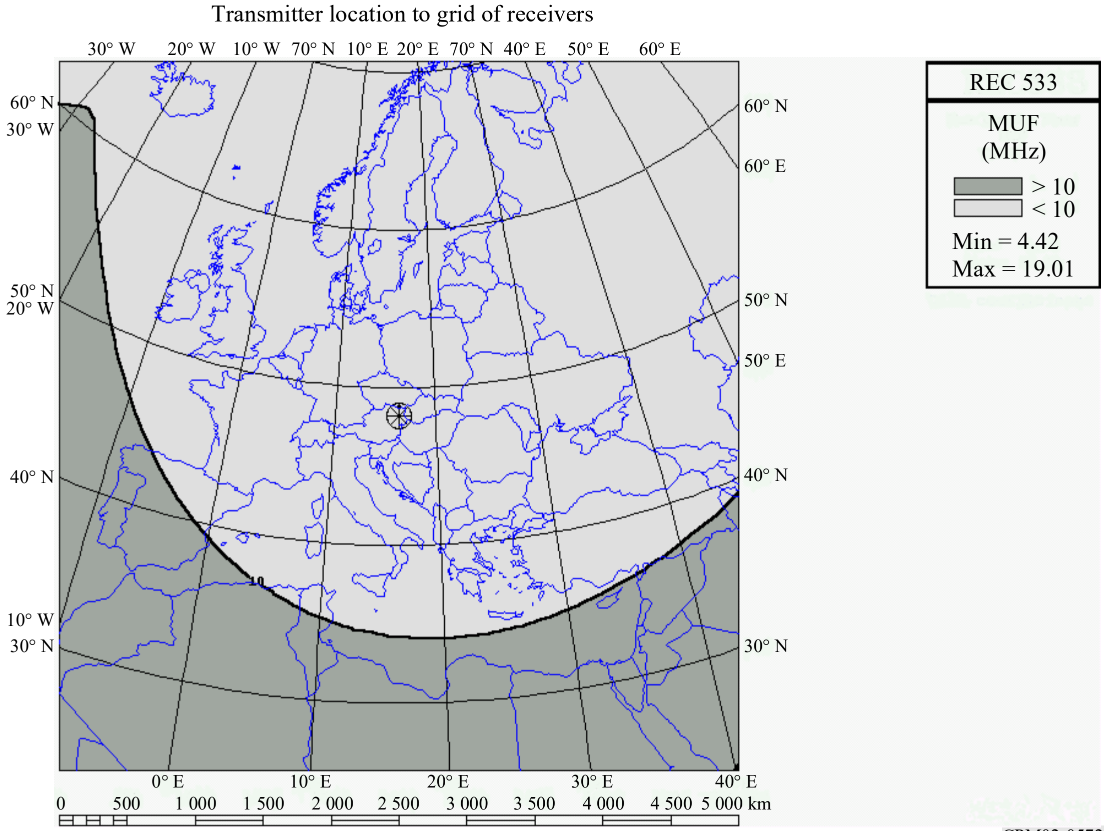
Transmitter location to grid of receivers



CPM02-0571
146496

FIGURE 5.7-2

Vienna, Austria, December 2000 - UTC sun spot number 100



CPM02-0572
146496

5.7.2 Analysis of the results of studies

A major advance in the RR Article **12** Procedure developed by WRC-97 is the encouragement given to regional coordination groups in coordinating their requirements prior to development of each season's tentative schedules for HF broadcasting. This coordination is currently achieved in two HF Coordination Groups recognized by ITU. These are:

HFCC/ASBU - an informal group of organizations with interests in HFBS from Europe, North America and the Arab States;

ABU-HFC - an informal group of organizations with interests in HFBS from the Asia Pacific region and others with interest in broadcasting within Asia.

A very positive effect of RR Article **12** (WRC-97) Procedure is that the activities of the regional coordination groups have helped to reduce incompatible spectrum requirements and congestion in the HF bands.

Collectively, these two groups coordinate over 80% of the broadcasting requirements worldwide. The HFBC requirements coordinated are considered to be realistic, as they are used in practice and provide a useful indication of how the HF broadcast bands are utilized.

However, congestion in the bands below 10 MHz continues, especially within the 6, 7 and 9 MHz bands, and there is considerable evidence that additional broadcasting spectrum below 10 MHz is needed as soon as possible.

The initial case for more broadcasting spectrum below 10 MHz was based on a consideration of the broadcasting hour requirements above and below 10 MHz and contrasting these with actual spectrum availability. The scheduling process for the year 1999 and 2000 seasons showed broadcasting hour requirements rising to 10 000 hours below 10 MHz where 900 kHz of spectrum is currently available, and would only rise to 1 100 kHz if the WARC-92 extension bands were available. In contrast 2 280 kHz is currently available above 10 MHz (rising to 2 870 kHz once the WARC-92 bands are included) and the current broadcasting requirement is only around 7 000 hours. This simple analysis demonstrated that transmitter hour requirements below 10 MHz are 133% of those in the range 10-30 MHz, whereas the available spectrum below 10 MHz is only 38% of the spectrum available above 10 MHz. In addition to this fundamental imbalance between capacity and requirement, the coordination process showed that between 20% to 33% of requirements remain unsatisfied. This was considered to be an underestimate because programming continuity requirements are not immediately taken into account when analysing the total number of incompatible co-channel or adjacent channel hours. However, even on the basis of such a simplistic calculation, there is a shortfall in spectrum requirements of between 250 and 400 kHz.

Additional statistics have since been generated using data available from the new Article 12 Procedure. HFCC has developed a pragmatic approach to identifying interference between requirements. This uses Recommendation ITU-R P.533 to calculate field strengths and then uses a special routine to identify interference between requirements both co- and adjacent channel (±5 kHz). The interference between two requirements is called a "collision". Experience has shown that this process provides a realistic assessment of interference. The collision hours calculated are the number of hours remaining in the schedule where no solution has been found to the interference situation during the coordination process.

The statistics shown in Tables 5.7-1 and 5.7-2, and Figures 5.7-3 to 5.7-6 have been prepared using the process outlined above. They include the actual broadcasting use of the WARC-92 bands, although these bands are not available to the broadcasting service until 2007.

Season B00 (November - March)

Source data: HFCC and ABU-HFC combined schedule B00 database version 03-02.

Collisions identified with Rec. ITU-R P.533 software, sun spot number 108, December 2000.

Season A01 (April - October)

Source data: HFCC and ABU-HFC combined schedule A01 database version 03-00.

Collisions identified with Rec. ITU-R P.533 software, sun spot number 109, July 2001.

5.7.2.1 Evaluation

The HF broadcasting statistics show that the broadcast bands below 10 MHz are congested even at the current high level of sunspot activity. Table 5.7-1 (B00 season) indicates most collisions occur in the bands below 10 MHz and that the 7 MHz band is the most congested with just 35% of transmission hours having no co- or adjacent-channel interference. Table 5.7-2 (A01 season) shows that the bands below 10 MHz are still congested although the highest level of congestion is now at 11 MHz.

These results can be easily seen in Figure 5.7-4 (B00) and Figure 5.7-6 (A01), which show the satisfied hours per band Figure 5.7-3 (B00) and Figure 5.7-5 (A01) show the number of co- and adjacent-channel hours per band.

Congestion in the bands below 10 MHz will increase as sunspot activity declines and broadcasters are forced to use the lower bands to maintain viable transmissions. The next sunspot minimum is predicted to occur around 2006/7 and so it is inevitable that the congestion in the bands below 10 MHz will increase.

For the most recent schedule periods, the statistics show that around 250 kHz of additional spectrum is needed to clear the co-channel collisions and up to 800 kHz to clear both the co-channel and adjacent channel collisions.

Consideration of propagation constraints underlying the planning of HF services leads to the conclusion that congestion is further exacerbated by the fact that the present broadcasting bands between 4 and 10 MHz are not optimally spaced, so as to allow frequency changes to take place that will maintain service to target areas on frequencies close to 85% of the MUF. The spacing between the 4 and 6 MHz bands and the 7 and 9 MHz bands is about double the optimum, which means that the spectrum available is being used inefficiently and that many services are scheduled to use a sub-optimal frequency. A more general conclusion is that the HF spectrum could be used more effectively if service allocations were determined on the basis of a larger number of appropriately spaced narrower bands than a smaller number of broader bands.

TABLE 5.7-1

B00 collision statistics and spectrum requirements per day

HF BS band (MHz)	Transmit hours	Mutual co-channel collision hours	Mutual adj-channel collision hours	Satisfied hours	Spectrum available (inc. WRC 92 bands) (kHz)	Additional spectrum required to satisfy co-channel requirements (kHz)	Additional spectrum required to satisfy adj-channel requirements (kHz)	Percentage of satisfied hours
6	2544.78	258.08	1041.65	1218.50	300	65	255	47.9
7	2461.20	416.58	903.75	864.88	250	120	260	35.1
9	3286.40	310.32	927.34	1544.67	500	100	300	47.0
11	2517.90	157.91	528.25	1588.07	500	50	165	63.1
13	522.40	19.35	46.25	420.62	300	15	35	80.5
15	1822.92	65.67	251.50	1391.75	700	35	125	76.3
17	1009.15	28.58	72.79	867.37	420	15	35	86.0
18	22.50	0.00	0.00	22.50	120	0	0	100.0
21	471.28	6.82	15.32	443.15	400	5	15	94.0
26	10.00	0.00	0.00	10.00	430	0	0	100.0
Total	**14668.53**	**1263.31**	**3786.85**	**8371.51**	**3920**	**405**	**1190**	**57.1**

FIGURE 5.7-3

B00 collision statistics per day

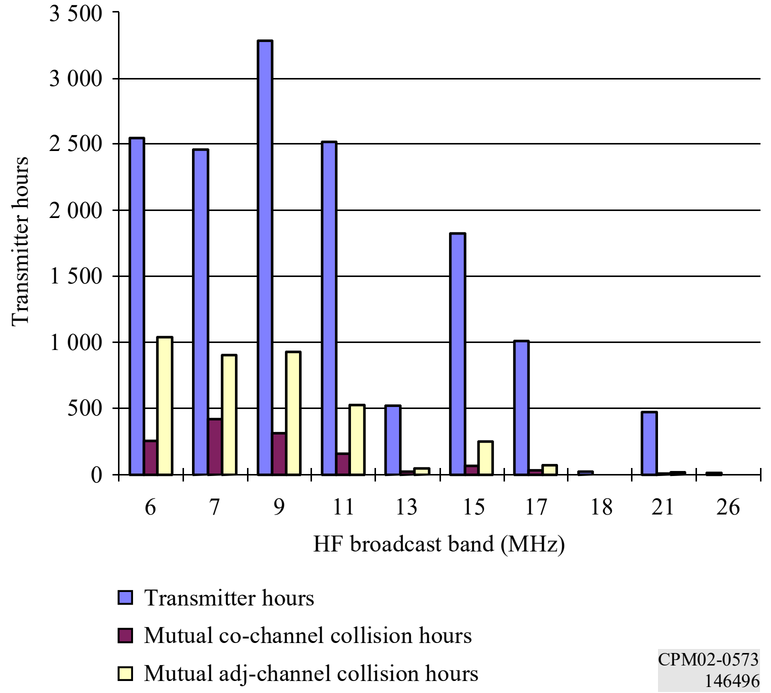


FIGURE 5.7-4

Percentage of satisfied hours per band for B00 season

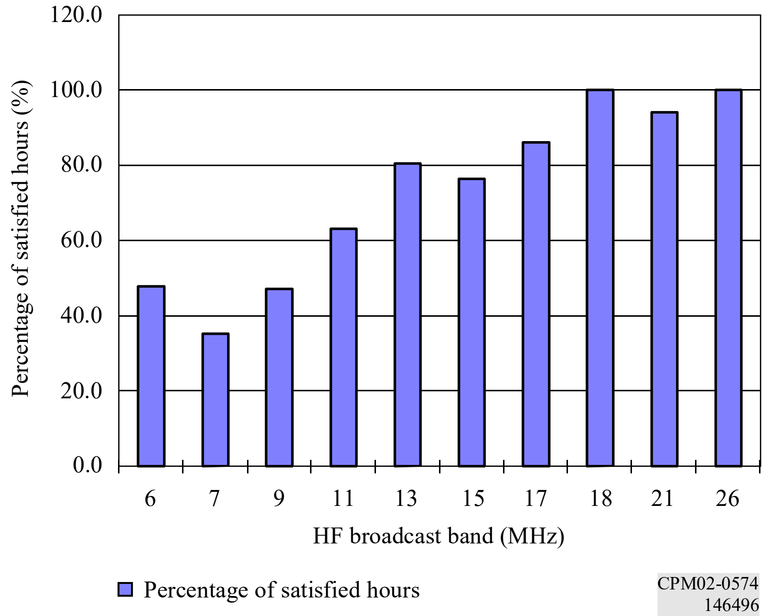


TABLE 5.7-2

A01 collision statistics and spectrum requirements per day

HF BS band (MHz)	Transmitter hours	Mutual co-channel collision hours	Mutual adj-channel collision hours	Satisfied hours	Spectrum available (inc. WRC 92 bands) (kHz)	Additional spectrum required to satisfy co-channel requirements (kHz)	Additional spectrum required to satisfy adj-channel requirements (kHz)	Percentage of satisfied Hours
6	2537.77	215.84	888.67	1536.09	300	40	175	60.5
7	1755.50	265.22	548.95	969.58	250	70	140	55.2
9	2935.68	368.60	1273.02	1437.33	500	130	445	49.0
11	2966.81	507.25	1262.01	1392.00	500	180	455	46.9
13	874.52	94.67	225.16	508.70	300	55	135	58.2
15	2401.21	147.58	569.15	1506.73	700	70	265	62.7
17	1409.92	79.45	216.60	997.78	420	35	90	70.8
18	19.50	0.00	0.00	19.50	120	0	0	100.0
21	644.51	16.23	43.90	531.15	400	10	35	82.4
26	4.00	0.00	0.00	4.00	430	0	0	100.0
Total	**15549.42**	**1694.84**	**5027.46**	**8902.86**	**3920**	**590**	**1740**	**57.3**

FIGURE 5.7-5

A01 collision statistics per day

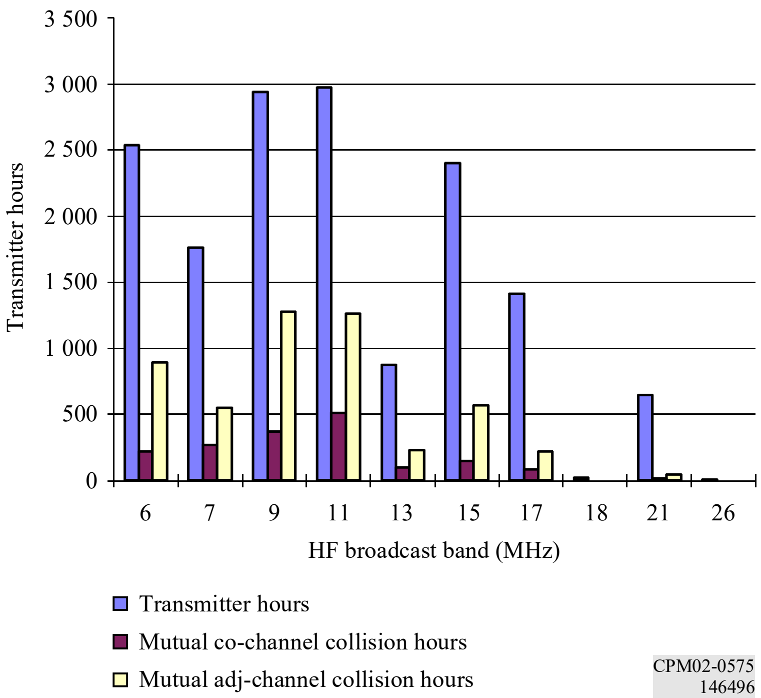
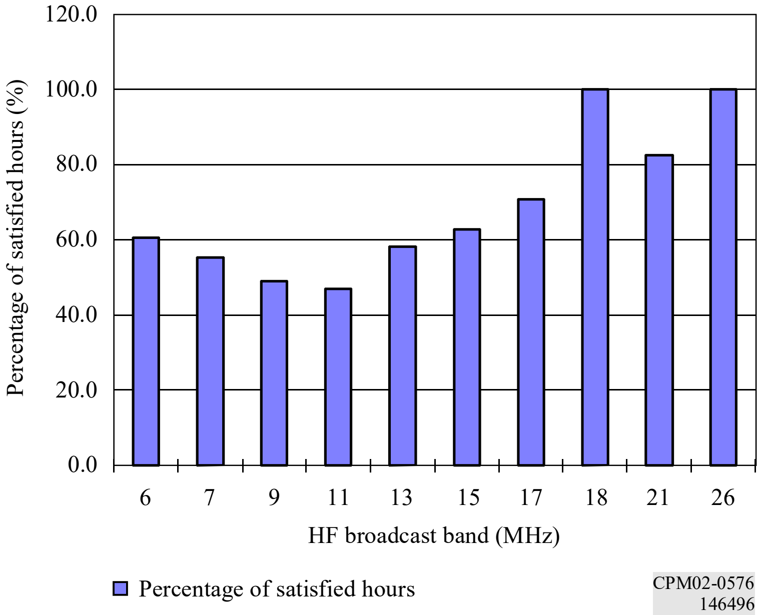


FIGURE 5.7-6

Percentage of satisfied hours per band for A01 season



5.7.3 Methods to satisfy the agenda item their advantages and disadvantages

Since many of the scheduling requirements in the 4-10 MHz range will be for relatively short-range coverage - subregional service in effect - it may be that there will be no need to adopt the same solution for new broadcasting bands across all three ITU Regions.

The results of the studies on spectrum requirements and optimum band location show that only the following parts of the HF spectrum should be studied further with a view to identifying suitable additional spectrum that would be effective in reducing the present deficiencies:

Band	Considerations
4 MHz	Review the current position in the band 4 500-4 650 kHz. The potential problems with displaced services will need careful investigation.
5 MHz	Review the current position on the band 5 060-5 250 kHz, which was proposed by several European countries as a source of additional spectrum for broadcasting at WARC-92. Again, the potential problems with displaced services will need careful investigation. Furthermore, the footnote RR No. **5.133** gives primary status, over part of the band, to the mobile services in a number of countries.
6 MHz	Review the current position on the band 5 840-5 900 kHz as a matter of urgency noting the potential problems with the displaced services.
7 MHz	Extend the 7 MHz band upwards by 300 kHz.
9 MHz	Extend the present 9 MHz band downwards by 110 kHz, i.e. 9 290-9 400 kHz Extend the present 9 MHz band upwards by 40 kHz, i.e. 9 900-9 940 kHz.

In view of the urgency of the problem, the aim should be to implement the resulting solutions on 1 April 2007, in line with the access date for the WARC-92 bands.

Other factors connected with the implementation of the additional spectrum are:

- The additional allocation around 7 MHz. This should be compatible with any changes agreed under agenda item 1.23 and should ideally be implemented within a common timeframe so that the totality of the changes needed around 7 MHz are implemented in an orderly manner, thus giving confidence to all the services involved.
- The additional allocations 5 840-5 900 kHz, 9 290-9 400 kHz and 9 900-9 940 kHz are adjacent to existing broadcasting bands.
- The additional band at 5 060-5 250 kHz is adjacent to an existing tropical broadcasting band.
- The additional band at 4 500-4 650 kHz is currently allocated to the fixed and mobile services.

In the case that further study is required on any or all of these candidate bands then a Resolution should be established to condition the completion of this work at the following conference. This is likely to be so for the bands, which are not adjacent to an existing international broadcasting band. An example format for such a Resolution is given in Annex 5.7-1[6].

No consideration should be given to expanding the use of the tropical zone broadcasting bands identified in No. **5.113**. Broadcasting operations in these bands commonly use near vertical incidence skywave (NVIS) techniques on frequencies less than 0.9 of the critical frequency. This type of operation is compatible with shared use elsewhere by the fixed service, which is either relatively short range, if NVIS techniques are also employed, or at lower power levels than broadcasting. In contrast broadcasting operations under RR Article **12** procedures tend to use relatively higher powers and would mostly operate using oblique incidence at a frequency of 1.1 to 3 times the critical frequency. Since the critical frequency would normally be lower outside the tropical zone, there would be good chance that the best choice of oblique incidence frequency outside the tropical zone would conflict with the optimum choice of NVIS frequency inside the tropical zone.

5.7.4 Regulatory and procedural considerations

Because any of the above potential sources of spectrum will inevitably involve some form of transition arrangements or adherence to sharing criteria in respect of existing services, a number of additions to the Radio Regulations will be necessary to define the circumstances under which any additional spectrum could be brought into use.

---

[6] Some administrations believe that proposals on the additional specific frequency bands for HF broadcasting cannot be made before the completion of studies on compatibility with other services which can be affected, and without taking into account progress in development of digital technologies. Some other administrations consider it necessary to implement additional allocations to the broadcasting service at WRC-03 in the bands identified here.

ANNEX 5.7-1

Example
RESOLUTION [XXX] (WRC-03)

Identification of additional spectrum for the broadcasting service in the HF bands

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that the spectrum allocated to the broadcasting service from 4 MHz to 10 MHz is about 25% of the all spectrum allocated to HF broadcasting;

b) that WARC-79 allocated only an additional 125 kHz of spectrum to the HF broadcasting service below 10 MHz (9 775-9 900 kHz);

c) that WARC-92 allocated an additional 200 kHz HF to the broadcasting service consisting of 100 kHz at 9 MHz, 50 kHz at 7 MHz and 50 kHz at 6 MHz. This additional spectrum will become available to the broadcasting service from [1 April 2007];

d) that the agenda for WRC-07 includes the revision of allocations to the services in HF bands;

e) that the results of coordination under Article **12** demonstrate that the broadcast bands below 10 MHz are congested, even when there are high levels of sunspot activity, with little more than half of the broadcasting requirements being satisfied;

f) that in the most recent periods of seasonal planning, the statistics show that around 250 kHz of additional spectrum is needed to clear the co-channel collisions and up to 800 kHz to clear both the co-channel and adjacent channel collisions in the bands below 10 MHz;

g) that the introduction and promotion of the new digital technology, that improves spectrum utilization and efficiency, cannot completely solve current congestion problems;

h) that the broadcasting service, in an era of convergence of services, will play an increased socio-political role,

resolves

that the following conference should conclude on additional spectrum requirements for the broadcasting service by making sufficient allocations from all the following bands:

[4.500-4.650 kHz]

[5.060-5.250 kHz]

[5.840-5.900 kHz (*)]

[7.350-7.650 kHz (*)(**)]

[9.290-9.400 kHz (*)]

[9.900-9.940 kHz (*)]

invites ITU-R

1 to carry out technical studies on this matter, taking into account technical, operational, economic and other relevant factors;

2 to bring the results of these studies to the attention of WRC-07,

urges administrations

to participate actively in the aforementioned studies by submitting contributions to ITU-R.

(*) bands adjacent to the HF broadcasting bands governed by Article **12**.

(**) band location may need to be revised in light of actions decided in respect of WRC-03 agenda item 1.23.

NOTE – Some administrations believe that proposals on the additional specific frequency bands for HF broadcasting cannot be made before the completion of studies on compatibility with other services which can be affected, and without taking into account progress in development of digital technologies.

CHAPTER 6

Other Matters

(WRC-03 agenda items 1.8, 2, 4, 7.1)

CONTENTS

Page

6.1 Agenda item 1.8

to consider issues related to unwanted emissions:

6.1.1 Agenda item 1.8.1

"consideration of the results of studies regarding the boundary between spurious and out-of-band emissions, with a view to including the boundary in Appendix **3**"

6.1.1.1 Summary of technical and operational studies

The general principle of the determination of the boundary between out-of-band and spurious emissions is given in RR Appendix **3** and Recommendation ITU-R SM.329-9. The variation of the boundary (from this general principle) is provided in detail by Recommendation ITU-R SM.1539.

Recommendation ITU-R SM.1539 has been developed to recommend the frequencies at which spurious emission limits should be applied to unwanted emissions from a transmitter. Recognizing that out-of-band and spurious emissions can occur in overlapping frequency ranges, Recommendations ITU-R SM.329 and SM.1541 include new definitions of the out-of-band and spurious "domains", disjoint frequency ranges in which either out-of-band or spurious emissions predominate (see section 6.1.1.4.2 below).

Using these new definitions, Recommendation ITU-R SM.1539 specifies exceptions from the general boundary of 250% of the necessary bandwidth of the emission ($2.5B_n$). To account for very narrow-band modulation types, the Recommendation specifies a minimum separation between the centre frequency and the boundary for different ranges of transmitter frequency. For wideband emissions exceeding a specified bandwidth threshold, the separation between the centre frequency and the boundary continues to increase with increasing bandwidth, but at a reduced rate. The Recommendation also includes additional guidance for certain specified service types, including a section devoted to primary radars.

It should also be noted that, in case of radar systems, the reference bandwidth to specify the spurious emission limit needs to be clearly defined and included in Appendix **3**.

Relevant Recommendations ITU-R SM.329, SM.1539 and SM.1541.

6.1.1.2 Analysis of the results of studies

The guidance provided in the three Recommendations described above is the result of ITU-R studies undertaken since July 1997. The studies concluded that these boundaries were generally appropriate for the application of the emission limits in RR Appendix **3**. However, they may be impractical for certain services.

In considering the boundary of the spurious domain for magnetron-driven pulsed primary radars, it is important to recognize that further study regarding calculation of the –40 dB bandwidth may be necessary. In practice, the value of the –40 dB bandwidth calculated using the pulse width and the pulse rise time may underestimate the actual bandwidth.

The reference bandwidth to define the spurious emission limit in the special case of radar systems was reviewed by ITU-R.

6.1.1.3 Methods to satisfy the agenda item and their advantages and disadvantages

6.1.1.3.1 Terminology related to the application of emission limits

Method

Adopt the new "domain" terminology described in the studies, adding the definitions of the out-of-band and spurious domains to RR Article **1**, since no "boundary" exists between out-of-band and spurious emissions.

Advantages:

- This new terminology will allow the application of RR Appendix **3** limits to emissions in the spurious domain, consistent with the definition of spurious emissions in RR Article **1**.
- The new terminology identifies unwanted emissions based solely on their separation from the centre frequency of the emission, consistent with usual emission measurement practice.
- The new definitions, which may have other application where reference is made to unwanted emissions based on their separation from the centre frequency, would be readily accessible for these uses.

Disadvantages:

- This method requires the inclusion of new terminology in the RR.

6.1.1.3.2 Addition to RR Appendix 3 of the boundary between the out-of-band and spurious domains

With regard to the specification of the boundary in RR Appendix **3**, as directed by the agenda item:

Method A

Provide specific exceptions from the general $2.5B_n$ boundary for narrow-band systems, wideband systems, and other specific cases in various frequency ranges based on the studies described above.

Advantages:

- This approach provides definite guidance for determining to what emissions RR Appendix **3** limits apply.
- Those concerned about interference from unwanted emissions have assurance of what attenuation of unwanted emissions is required as a function of frequency.

Disadvantages:

Additional exceptions from the general $2.5B_n$ boundary may be required in the future, since a $2.5B_n$ boundary may not be appropriate for all emissions and may impose impractical limits on certain types of services.

Method B

Provide all or part of the boundary exceptions by reference to Recommendation ITU-R SM.1539 and Recommendation ITU-R SM.1541.

Advantages:

- This approach requires minimal revision of RR Appendix **3**.
- Modifications to the boundary exceptions could be accomplished by revising a Recommendation, rather than by the more difficult and time-consuming process of modifying the Radio Regulations.

Disadvantages:

- Guidance for applying the limits of RR Appendix **3** would not be fully available without consulting an additional document.
- Boundary guidance provided in Recommendation ITU-R SM.1541 may eventually be moved to Recommendation ITU-R SM.1539.

Method C

Provide only the current exceptions from the general $2.5B_n$ boundary between the out-of-band and spurious domains, being guided by Recommendations ITU-R SM.1539 and ITU-R SM.1541.

Advantages:

- This approach requires minimal editorial changes to the existing text in RR Appendix **3**.
- This approach provides full flexibility to address, in a timely manner, new technologies, without any regulatory modifications.

Disadvantages:

- The definitions related to the boundary between the out-of-band and spurious domains would have no regulatory status.

6.1.1.4 Regulatory and procedural considerations

If the Radio Regulations are to be modified in accordance with the above-mentioned studies, the following changes will be required:

6.1.1.4.1 Terms related to the application of unwanted emission limits

Add the following definitions to RR Article **1**:

ADD

1.146*bis* *out-of-band domain* (of an emission): The frequency range, immediately outside the necessary bandwidth but excluding the *spurious domain*, in which *out-of-band emissions* generally predominate.

Out-of-band emissions, defined based on their source, occur in the out-of-band domain and, to a lesser extent, in the spurious domain. Spurious emissions likewise may occur in the out-of-band domain as well as in the spurious domain.

1.146*ter* *spurious domain* (of an emission): The frequency range beyond the *out-of-band domain* in which *spurious emissions* generally predominate.

*****

6.1.1.4.2 Provisions related to out-of-band and spurious emissions

In RR Article **3**, modify Nos. **3.6** and **3.7** to accommodate emissions specified using both the existing definitions of *out-of-band emission* and *spurious emission* (which constitute "unwanted emissions"), and the definitions proposed above. Other provisions, including Nos. **15.10**, **15.11**, **25.8** and **29.11** do not require revisions under this agenda item;

MOD

3.6 Transmitting stations shall conform to the maximum permitted power levels for spurious emissions or for emissions in the spurious domain specified in Appendix **3**.

3.7 Transmitting stations shall conform to the maximum permitted power levels for out-of-band emissions, or unwanted emissions in the out-of-band domain, specified for certain services and classes of emission in the present Regulations. In the absence of such specified maximum permitted power levels transmitting stations should, to the maximum extent possible, satisfy the requirements relating to the limitation of the out-of-band emissions, or unwanted emissions in the out-of-band domain, specified in the most recent ITU-R Recommendations (see Resolution **27 (Rev.WRC-97)**).

*****

6.1.1.4.3 Title of RR Appendix 3

Change the title of RR Appendix **3** to reflect the fact that Section I and Section II refer to different types of unwanted emissions.

MOD

APPENDIX 3

Tables of maximum permitted power levels for spurious or spurious domain emissions*

(See Article **3**)

6.1.1.4.4 Introductory paragraphs of RR Appendix 3

Modify the introductory paragraphs of Appendix **3** to reflect the distinction between the types of emissions to which the limits of Sections I and II apply.

MOD

1 The following sections indicate the maximum permitted levels of certain unwanted emissions, in terms of power as indicated in the tables, of components supplied by a transmitter to the antenna transmission line. Section I, which provides spurious emission limits, is applicable until 1 January 2012 to transmitters installed on or before 1 January 2003; Section II, which limits emissions in the spurious domain, is applicable to transmitters installed after 1 January 2003 and to all transmitters after 1 January 2012. The provisions of No. **4.5** apply to unwanted emissions not covered in Sections I and II.

2 Spurious emissions and spurious domain emissions (covered by Sections I and II) from any part of the installation, other than the antenna and its transmission line, shall not have an effect greater than would occur if this antenna system were supplied with the maximum permitted power at the frequency of that emission.

3 These levels shall not, however, apply to emergency position-indicating radiobeacon (EPIRB) stations, emergency locator transmitters, ships' emergency transmitters, lifeboat transmitters, survival craft stations or maritime transmitters when used in emergency situations.

4 For technical or operational reasons, more stringent levels than those specified may be applied to protect specific services in certain frequency bands. The levels applied to protect these

* Spurious domain emissions are unwanted emissions at frequencies within the spurious domain.

services, such as safety and passive services, shall be those agreed upon by the appropriate world radiocommunication conference. More stringent levels may also be fixed by specific agreement between the administrations concerned. Additionally, special consideration of transmitter spurious emissions or spurious domain emissions may be required for the protection of safety services, radio astronomy and space services using passive sensors. Information on the levels of interference detrimental to radio astronomy, Earth exploration satellites and meteorological passive sensing is given in the most recent version of Recommendation ITU-R SM.329.

5 Spurious emissions or spurious domain emission limits (covered by Sections I and II) for combined radiocommunication and information technology equipment are those for the radiocommunication transmitters.

6.1.1.4.5 First paragraphs of Section II of RR Appendix 3

Modify these paragraphs to reflect the domain terminology. Refer to Recommendation ITU-R M.1177 for guidance on measurement of radar emissions.

MOD

Section II – Spurious domain emission limits for transmitters installed after 1 January 2003 and for all transmitters after 1 January 2012

Application of these limits

7 The frequency range of the measurement of spurious domain emissions is from 9 kHz to 110 GHz or the second harmonic if higher.

8 Except as provided in § 9 and 10 of this Appendix, the spurious domain emission levels are specified in the following reference bandwidths:

– 1 kHz between 9 kHz and 150 kHz

– 10 kHz between 150 kHz and 30 MHz

– 100 kHz between 30 MHz and 1 GHz

– 1 MHz above 1 GHz.

9 The reference bandwidth of all space service spurious domain emissions should be 4 kHz.

10 For radar systems, the reference bandwidths for defining spurious domain emission levels should be calculated for each particular system. Thus, for the four general types of radar pulse modulation utilized for radionavigation, radiolocation, acquisition, tracking and other radiodetermination functions, the reference bandwidth values are determined using the following:

– for fixed-frequency, non-pulse-coded radar, one divided by the radar pulse length, in seconds (e.g. if the radar pulse length is 1 μs, then the reference bandwidth is 1/(1 μs) = 1 MHz);

– for fixed-frequency, phase coded pulsed radar, one divided by the phase chip length, in seconds (e.g. if the phase coded chip is 2 μs long, then the reference bandwidth is 1/(2 μs) = 500 kHz);

– for frequency modulated (FM) or chirped radar, the square root of the quantity obtained by dividing the chirp bandwidth in MHz by the pulse length, in μs (e.g. if the FM is from 1 250 MHz to 1 280 MHz, or 30 MHz, during the pulse length of 10 μs, then the reference bandwidth is $(30 \text{ MHz}/10 \text{ μs})^{½}$ = 1.73 MHz);

– for radars operating with multiple waveforms the reference bandwidth is determined empirically from observations of the radar emission and are obtained following the guidance given in Recommendation ITU-R M.1177.

In the case of radars, for which the bandwidth, as determined using the method above, is greater than 1 MHz, a reference bandwidth of 1 MHz should be used.

10*bis* Guidance regarding the methods of measuring spurious domain emissions is given in the most recent version of Recommendation ITU-R SM.329. The e.i.r.p. method specified in this Recommendation should be used when it is not possible to accurately measure the power supplied to the antenna transmission line, or for specific applications where the antenna is designed to provide significant attenuation in the spurious domain. Additionally, the e.i.r.p. method may need some modification for special cases. Specific guidance regarding the methods of measuring spurious domain emissions from radar systems is given in the most recent version of Recommendation ITU-R M.1177.

6.1.1.4.6 Paragraphs of Section II pertaining to the boundary between the out-of-band and spurious domains

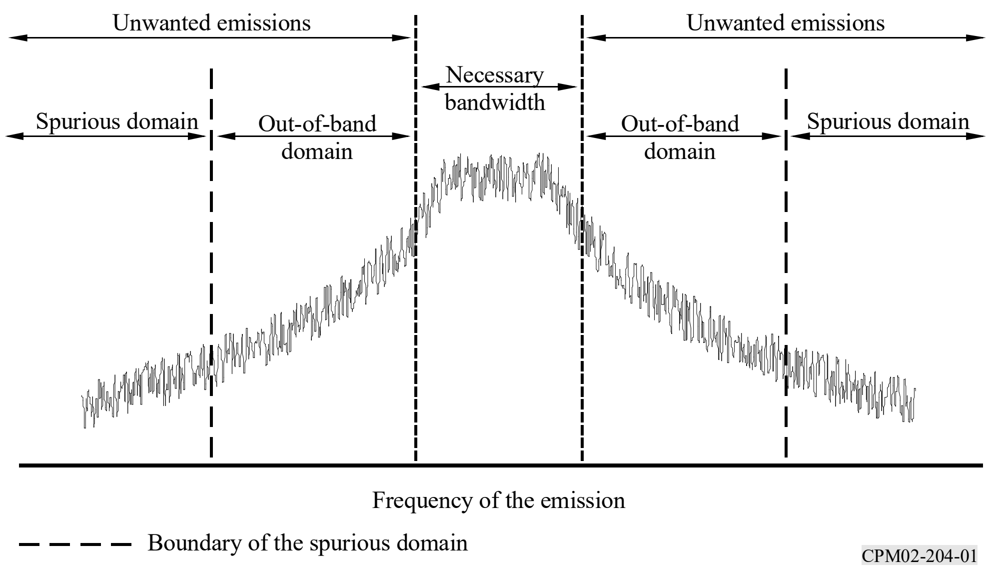
Modify § 11, add a figure and suppress § 11*bis* to describe the boundary between the domains and to make reference to the Annex.

MOD

11 The emission limits of this section apply to all emissions, including harmonic emissions, intermodulation products, frequency conversion products and parasitic emissions, at frequencies in the spurious domain (see Figure 1). The upper and lower parts of the spurious domain extend outward from a boundary determined using Annex 1.

ADD

FIGURE 1



SUP

11*bis*

6.1.1.4.7 Remaining paragraphs of Section II

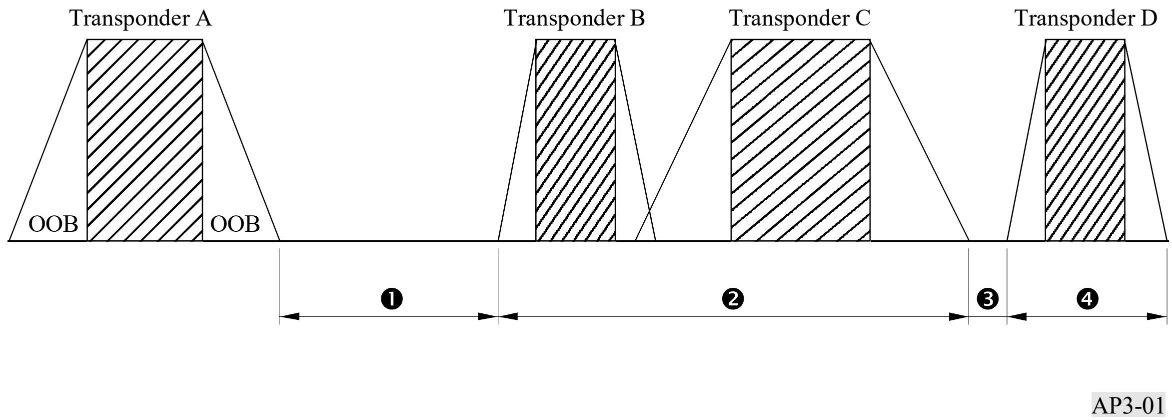
Modify these remaining paragraphs to reflect the domain terminology.

MOD

11*ter* For the case of a single satellite operating with more than one transponder in the same service area, and when considering the limits for spurious domain emissions as indicated in § 11 of this Appendix, spurious domain emissions from one transponder may fall on a frequency at which a second, companion transponder is transmitting. In these situations, the level of spurious domain emissions from the first transponder is well exceeded by the fundamental or out-of-band domain emissions of the second transponder. Therefore, the limits of this Appendix should not apply to those emissions of a satellite that fall within either the necessary bandwidth or the out-of-band domain of another transponder on the same satellite, in the same service area (see Fig. 2).

FIGURE 2

Example of the applicability of spurious domain emission limits to a satellite transponder



Transponders A, B, C and D are operating on the same satellite in the same service area. Transponder A is not required to meet spurious domain emission limits in frequency ranges ❷ and ❹, but is required to meet them in frequency ranges ❶ and ❸.

12 Examples of applying 43 + 10 log (*P*) to calculate attenuation requirements

Where specified in relation to mean power, spurious domain emissions are to be at least x dB below the total mean power P, i.e. $-x$ dBc. The power P (W) is to be measured in a bandwidth wide enough to include the total mean power. The spurious domain emissions are to be measured in the reference bandwidths given in the Recommendation. The measurement of the spurious domain emission power is independent of the value of necessary bandwidth. Because the absolute emission power limit, derived from 43 + 10 log (P), can become too stringent for high-power transmitters, alternative relative powers are also provided in Table II.

Example 1

A land mobile transmitter, with any value of necessary bandwidth, must meet a spurious domain emission attenuation of 43 + 10 log (P), or 70 dBc, whichever is less stringent. The reference bandwidths used to define the limits for spurious domain emissions are defined in § 8 to 10 of this Appendix. Applying this in the frequency range between 30 MHz and 1 GHz gives a reference bandwidth of 100 kHz.

With a measured total mean power of 10 W:

– Attenuation relative to total mean power = 43 + 10 log (10) = 53 dBc.

– The 53 dBc value is less stringent than the 70 dBc, so the 53 dBc value is used.

– Therefore: Spurious domain emissions must not exceed 53 dBc in a 100 kHz bandwidth, or converting to an absolute level, they must not exceed 10 dBW – 53 dBc = –43 dBW in a 100 kHz reference bandwidth.

With a measured total mean power of 1 000 W:

– Attenuation relative to total mean power = 43 + 10 log (1 000) = 73 dBc.

– The 73 dBc value is more stringent than the 70 dBc limit, so the 70 dBc value is used.

– Therefore: Spurious domain emissions must not exceed 70 dBc in a 100 kHz bandwidth, or converting to an absolute level, they must not exceed 30 dBW – 70 dBc = –40 dBW in a 100 kHz reference bandwidth.

Example 2

A space service transmitter with any value of necessary bandwidth must meet a spurious domain emission attenuation of 43 + 10 log (P), or 60 dBc, whichever is less stringent. To measure spurious domain emissions at any frequency, Note 10 to Table II indicates using a reference bandwidth of 4 kHz.

With a measured total mean power of 20 W:

– Attenuation relative to total mean power = 43 + 10 log (20) = 56 dBc.

– The 56 dBc value is less stringent than the 60 dBc limit, so the 56 dBc value is used.

– Therefore: Spurious domain emissions must not exceed 56 dBc in a 4 kHz reference bandwidth, or converting to an absolute level, they must not exceed 13 dBW – 56 dBc = –43 dBW in a 4 kHz reference bandwidth.

MOD

TABLE II

Attenuation values used to calculate maximum permitted spurious domain emission power levels for use with radio equipment

MOD

[17] Space stations in the space research service intended for operation in deep space as defined by No. **1.177** are exempt from spurious domain emission limits.

6.1.1.4.8 Variations in the boundary between the out-of-band and spurious domains

Include Annex 1 of Recommendation ITU-R SM.1539 as an Annex of RR Appendix **3**. Include a reference to Annex 8 of Recommendation ITU-R SM.1541, describing boundary variations for primary radars. Move related text from § 11 and 11*bis* of RR Appendix 3 into the Annex. Add text to RR Appendix **3** as appropriate to refer to the Annex.

ADD

ANNEX 1

Determination of the boundary between the out-of-band (OOB) and spurious domains

1 Except as provided in § 2 and 3 of this Annex, the boundary between the OOB and spurious domains occurs at frequencies that are separated from the centre frequency of the emission by the values shown in Table 1. For most systems, the centre frequency of the emission is the centre of the necessary bandwidth. For multichannel or multicarrier transmitters/transponders, where several carriers may be transmitted simultaneously from a final output amplifier or an active antenna, the centre frequency of the emission is taken to be the centre of the 3 dB bandwidth of the transmitter or transponder and the transmitter or transponder bandwidth is used in place of the necessary bandwidth for determining the boundary. For multicarrier satellite systems, guidance on the boundary between the out-of-band and spurious domains is provided in Recommendation ITU-R SM.1541.

Some systems specify unwanted emissions relative to channel bandwidth, or channel spacing. These may be used as a substitute for the necessary bandwidth in Table 1, provided they are found in ITU–R Recommendations.

TABLE 1

Values for frequency separation between the centre frequency and the boundary of the spurious domain

Frequency range	Narrow-band case		Normal separation	Wideband case	
	for B_n <	Separation		for B_n >	Separation
9 kHz < f_c < 150 kHz	250 Hz	625 Hz	2.5 B_n	10 kHz	1.5 B_n + 10 kHz
150 kHz < f_c < 30 MHz	4 kHz	10 kHz	2.5 B_n	100 kHz	1.5 B_n + 100 kHz
30 MHz < f_c < 1 GHz	25 kHz	62.5 kHz	2.5 B_n	10 MHz	1.5 B_n + 10 MHz
1 GHz < f_c < 3 GHz	100 kHz	250 kHz	2.5 B_n	50 MHz	1.5 B_n + 50 MHz
3 GHz < f_c < 10 GHz	100 kHz	250 kHz	2.5 B_n	100 MHz	1.5 B_n + 100 MHz
10 GHz < f_c < 15 GHz	300 kHz	750 kHz	2.5 B_n	250 MHz	1.5 B_n + 250 MHz
15 GHz < f_c < 26 GHz	500 kHz	1.25 MHz	2.5 B_n	500 MHz	1.5 B_n + 500 MHz
f_c > 26 GHz	1 MHz	2.5 MHz	2.5 B_n	500 MHz	1.5 B_n + 500 MHz

NOTE – In Table 1, f_c is the centre frequency of the emission and B_n is the necessary bandwidth. If the assigned frequency band of the emissions extends across two frequency ranges, then the values corresponding to the higher frequency range shall be used for determining the boundary.

Example 1: The necessary bandwidth of an emission at 26 MHz is 1.8 kHz. Since 2.5B_n is only 4.5 kHz, the minimum separation applies. The spurious domain begins 10 kHz each side of the centre of the necessary bandwidth.

Example 2: The necessary bandwidth of an emission at 8 GHz is 200 MHz. Since the wideband case applies for B_n > 100 MHz at that frequency, the spurious domain begins 400 MHz each side of the centre of the necessary bandwidth. Using the general separation formula, the OOB domain would have extended to 2.5 × 200 MHz = 500 MHz either side of the centre frequency.

2 Tables 2 and 3 show exceptions to Table 1 for narrow-band and wideband cases, respectively, applicable to particular systems or services and frequency bands.

TABLE 2

Variations for narrow-band systems or services and frequency bands

System or service	Frequency range	Narrow-band case	
		for B_n <	Separation
Fixed service	14 kHz-1.5 MHz	20 kHz[1]	50 kHz
Fixed service	1.5-30 MHz	80 kHz[2]	200 kHz

[1] This is based on an assumption that the maximum value of the necessary bandwidth is about 3 kHz for the frequency range 14 kHz - 1.5 MHz. The value of 50 kHz separation is extremely large as compared with the necessary bandwidth. It is because unwanted emissions of high power transmitters under modulated conditions have to be below the spurious limit (70 dBc) at the boundary between the OOB and spurious domains.

[2] This is based on an assumption that the maximum value of the necessary bandwidth is about 12 kHz for the frequency range 1.5-30 MHz. The value of 200 kHz separation is extremely large as compared with the necessary bandwidth. It is because unwanted emissions of high power transmitters under modulated conditions have to be below the spurious limit (70 dBc) at the boundary between the OOB and spurious domains. Also, if future systems in the fixed service operating in this frequency range require a necessary bandwidth larger than 12 kHz, it may become necessary to review the 200 kHz separation. It should be noted that for medium or low power transmitters (e.g. below 1 kW), a smaller value may be appropriate as the minimum separation. This matter requires further study.

TABLE 3

Variations for wideband systems or services and frequency bands

System or service	Frequency range	Wideband case	
		for B_n >	Separation
Fixed service	14-150 kHz	20 kHz	1.5 B_n + 20 kHz
FSS	3.4-4.2 GHz	250 MHz	1.5 B_n + 250 MHz
FSS	5.725-6.725 GHz	500 MHz	1.5 B_n + 500 MHz
FSS	7.25-7.75 GHz and 7.9-8.4 GHz	250 MHz	1.5 B_n + 250 MHz
FSS	10.7-12.75 GHz	500 MHz	1.5 B_n + 500 MHz
BSS	11.7-12.75 GHz	500 MHz	1.5 B_n + 500 MHz
FSS	12.75-13.25 GHz	500 MHz	1.5 B_n + 500 MHz
FSS	13.75-14.8 GHz	500 MHz	1.5 B_n + 500 MHz

BSS: broadcasting satellite service

FSS: fixed-satellite service

3 For primary radar stations, the boundary between the OOB and spurious domains is the frequency at which the out-of-band limits specified in applicable ITU–R Recommendations are equal to the spurious limit defined in Table II of RR Appendix **3**. Guidance on the boundary between OOB and spurious domains for primary radar systems is provided in Recommendation ITU-R SM.1541.

6.1.2 Agenda item 1.8.2

"consideration of the results of studies, and proposal of any regulatory measures regarding the protection of passive services from unwanted emissions, in particular from space service transmissions, in response to *recommends* 5 and 6 of Recommendation **66 (Rev.WRC-2000)**"

Recommendation 66 (Rev.WRC-2000)

Studies of the maximum permitted levels of unwanted emissions

5 study those frequency bands and instances where, for technical or operational reasons, more stringent spurious emission limits than the general limits in Appendix **3** may be required to protect safety services and passive services such as radio astronomy, and the impact on all concerned services of implementing or not implementing such limits;

6 study those frequency bands and instances where, for technical or operational reasons, out-of-band limits may be required to protect safety services and passive services such as radio astronomy, and the impact on all concerned services of implementing or not implementing such limits;

6.1.2.1 Summary of technical and operational studies including a list of relevant ITU-R Recommendations

A methodology for analysing compatibility between a passive service and an active service allocated in adjacent or nearby bands and providing guidance on possible solutions has been developed and is reflected in draft new Recommendation ITU-R SM.[BbB]. This DNR identifies specific passive service bands where it could be technically or economically difficult for active services to meet the passive protection criteria. In such cases, band-by-band studies have been carried out, documented in this DNR, where studies are complete, and the actual impact on all concerned services of implementing or not implementing such limits are taken into account.

Relevant Recommendations ITU-R: RA.769, SA.1029, RA.1513, DNR SM.[BbB], S.[1586, M.1583 and DNR RA.[PATTERN NGSO].

6.1.2.2 Analysis of the results of studies

Studies have been conducted in over 20 band pairs from 1 350 MHz to 52.8 GHz where compatibility concerns have been raised. The methodology and rationale for these studies are given in draft new Recommendation ITU-R SM.[BbB]. In a certain number of these band pairs incompatibilities between existing or planned active and passive systems were identified under the given operational conditions. Other band pairs were found to be compatible under conditions specific to each band pair; in this case no further study is necessary within the ITU-R. Within the bands considered, not all studies have been completed. The present status of the ITU-R study is presented in DNR ITU-R SM.[BbB].

6.1.2.3 Methods to satisfy agenda item and their advantages and disadvantages

6.1.2.3.1 Method A

Under this method, provisions to protect the RAS and EESS (passive), allocated on a primary basis, in specific frequency bands, from unwanted emissions of active services would be included in the Radio Regulations. Compliance with those provisions would be excluded from examination performed by the Bureau under RR Articles 9 and 11.

For the EESS (passive), incorporation in the RR of limits would be based on the result of band-by-band studies (draft new Recommendation ITU-R SM[BbB]) in some frequency bands allocated to that service. The limits derived from interference criteria given in Recommendation

ITU-R SA.1029 would provide protection to the levels specified as necessary by the EESS (passive).

For the radio astronomy service, provisions would apply at notified RAS stations.

For either RAS or EESS (passive), provisions would not apply to satellite networks for which complete advanced publication information has been received by the Bureau before [the end of WRC-03].

Advantage:

- Administrations, operators and manufacturers would know in advance which protection criteria need to be taken into account when developing new systems. The radio astronomy service would be protected from unwanted emissions through regulatory provisions to be applied consistently worldwide. Lengthy negotiations, which often constitute a significant burden for the parties involved, may be reduced. There is no additional burden on the Bureau.

Disadvantages:

- Some administrations believe that solutions under Method A that are based solely on protection levels from Recommendation ITU-R RA.769 do not satisfy the agenda item, because they are not based on studies that consider the impact on all concerned services, as required by Recommendation **66 (Rev.WRC-2000**). Some administrations believe that Method A does satisfy the agenda item and that the ITU-R conclusions on the impact to active services of applying limits based on Recommendation ITU-R RA.769 are clearly reflected in the disadvantages.
- The stringent protection requirements of the radio astronomy service may, in some cases, make systems in the adjacent or nearby active service bands impractical and/or prevent the development of some new applications or systems.
- It is not possible to determine the presence or magnitude of all cases of spurious emissions by pre-launch measurements and analysis alone. Post launch verification would be contrary to normal satellite notification practice and could only be done with extensive testing by extremely sensitive receive stations. Any corrective actions in orbit that may involve taking some, or all, of the satellite network out of service would be prohibitively costly. Therefore, even with the most stringent pre-launch testing procedures, the passive services may not be afforded the expected level of protection. Technical difficulties related to these measurements have not been resolved.

Implementation of Method A

For the radio astronomy service, three options are described below, that would be inserted in the Radio Regulations. For the Earth exploration-satellite service (passive), only Option A3 applies.

6.1.2.3.1.1 Option A1

Incorporation in the Radio Regulations of limits based on Recommendation ITU-R RA.769 within frequency bands allocated to the radio astronomy service.

Additional advantage:

Radio astronomy sites would be assured protection to Recommendation ITU-R RA.769 level, in all bands allocated to radio astronomy on a primary basis, from subsequent active service deployment.

Additional disadvantages:

- There will be a burden on administrations to confirm that the satellites are compliant with the regulations. There will be additional cost, project delays and burden on operators and manufacturers to demonstrate compliance with the regulations.
- Mandatory measures are less responsive to technological advances and mitigation methods, and may preclude consultation between active and passive services. The results of the band-by-band studies (DNR ITU-R SM.[BbB]) would be ignored, possibly rejecting beneficial solutions for both active and passive services.

6.1.2.3.1.2 Option A2

Incorporation in the Radio Regulations of the results of band-by-band studies in some frequency bands of the radio astronomy service, and of limits based on Recommendation ITU-R RA.769 in other radio astronomy service frequency bands.

Additional advantage:

For bands where Recommendation ITU-R RA.769 limits would be applied, the advantages are the same as Option A1, in other bands the results of the band-by-band studies provide satisfactory solutions to protect radio astronomy and may overcome some of the disadvantages of Option A1.

Additional disadvantage:

This option has the same disadvantages as Option A1 in bands where the band by band studies are not completed.

6.1.2.3.1.3 Option A3

Incorporation in the Radio Regulations of the results of band-by-band studies in frequency bands allocated to the EESS (passive) and the radio astronomy service, as appropriate.

Additional advantage:

The results of the band-by-band studies provide adequate protection to the passive services without unduly inhibiting the development of new applications or systems.

Additional disadvantage:

In bands where the band-by-band studies do not provide a solution, the passive services may suffer from interference due to unwanted emissions. In such bands, passive and active services may not have the stable regulatory environment required to develop new applications.

6.1.2.3.2 Method B

Adopt WRC-03 Resolution that encourages consultation between affected administrations. This method is not practical for EESS (passive) missions, since they typically cover most or all of the Earth's surface.

This method would:

a) establish procedures for consultation between administrations operating active services and passive services, including use of trigger levels based on protection criteria of the RAS;

b) invite the ITU-R to continue work on Recommendation ITU-R SM.[BbB] so as to complete those studies where additional work is necessary and to consider new band-pairs that may be identified.

Advantages:

- Consultation between administrations may lead to solutions offering the potential for rapid implementation that would not be considered when mandatory limits are applied.
- This would not unduly constrain the development of new active applications and operators of the same service would be subject to the same consultation procedure. Specific active systems and RAS characteristics and operational requirements can be taken into account in the exchange of information during the consultation process.
- This method accommodates the situation where elements of the band-by-band studies have not been completed.

Disadvantage:

- When necessary, the consultation procedure may be time-consuming and will constitute an additional burden on administrations. Depending on the outcome of the consultation procedure, it may, in some cases, result in the passive services not being adequately protected, while in others it may impose significant constraints on the active services.
- There is a level of uncertainty in the pre-launch assessment of the unwanted emissions.

6.1.2.3.3 Method C

This method would not require a change to any part of the Radio Regulations and would rely on the application of ITU-R Recommendations, relevant to the protection of the passive services, such as RA.769, SA.1029, DNR SM[BbB].

Advantage:

- Administrations have full flexibility to implement which ITU-R Recommendations they consider appropriate for both active and passive services. Revision of such Recommendations in order to adapt to changing technology, can be achieved more easily than mandatory measures. This method may allow the implementation of solutions meeting the protection criteria of the passive services without requiring a commitment to mandatory limits.

Disadvantages:

- Adequate protection might not be given to the passive services in cases where administrations did not apply the relevant ITU-R protection criteria. ITU-R Recommendations may be applied inconsistently, leading to competitive disadvantage between operators of the same service.
- This method may allow disruption of the passive service operations and discourage the radio astronomy and EESS (passive) communities from investing in the development of future systems. Active service operators and manufacturers may not have the stable regulatory environment required to develop new applications or systems.

6.1.2.3.4 Method D

Adopt WRC-03 Resolution(s) on the protection of the passive services from unwanted emission of active services, including consultation between affected administrations in cases where mandatory limits can not be applied (radio astronomy only). For the EESS, only the portion of the method (same as Method A3) applying to mandatory limits would apply since consultation is impractical for the EESS. Examination of compliance with the limits would be excluded from examination performed by the Bureau under RR Articles 9 and 11.

This method would:

a) provide, in some bands, limits based on the results of the band-by-band studies as contained in DNR ITU-R SM.[BbB] to protect the RAS and EESS from unwanted emissions of the active service falling into the passive service band with a primary allocation;

b) specify the bands, for cases referred to in a) above, where the band-by-band studies as contained in DNR ITU-R SM.[BbB] have concluded that such limits would not unduly constrain the development of active services;

c) provide, in some other bands, pfd trigger levels to initiate consultation based on the results of the band-by-band studies (DNR ITU-R SM.[BbB]) or protection criteria of the RAS as defined in Recommendation ITU-R RA.769;

d) establish, for cases refered to in (c) above, the procedures for consultation between administrations operating active services and RAS;

e) invite the ITU-R to continue work on Recommendation ITU-R SM.[BbB] so as to complete those studies where additional work is necessary and to consider new band-pairs pertaining to both the EESS(passive) and RAS that may be identified.

Advantages:

- In cases where mandatory limits can be applied, this will provide straightforward protection to the passive services. An appropriate selection of the bands where these limits apply may avoid unduly constraining the development of the active service.
- In cases where mandatory limits can not be applied, consultation between administrations may lead to solutions offering the potential for rapid implementation that would not be considered when mandatory limits are applied.
- This would not unduly constrain the development of new active applications and operators of the same service would be subject to the same consultation procedure. Specific active systems and RAS characteristics and operational requirements can be taken into account in the exchange of information during the consultation process.
- This method accommodates the situation where elements of the band-by-band studies have not been completed.

Disadvantages:

- When necessary, the consultation procedure may be time-consuming and will constitute an additional burden on administrations. Depending on the outcome of the consultation procedure, it may, in some cases, result in the passive services not being adequately protected, while in others it may impose significant constraints on the active services.
- There is a level of uncertainty in the pre-launch assessment of the unwanted emissions.
- Depending on the trigger level applied, a large number of consultations may be required.
- Some administrations believe that consultations trigger levels solely based on Recommendation ITU-R RA.769 do not satisfy the agenda item, because they are not based on studies that involve all concerned services, as required by Recommendation **66 (Rev.WRC-2000**).

6.1.2.4 Regulatory and procedural considerations

This section provides regulatory and procedural considerations regarding agenda item 1.8.2 for each Method described above. Satellite networks for which complete advanced publication information has been received by the Bureau before the end of WRC-03 will not be subject to these provisions.

Method A

Option A1

The following text addresses the protection of the radio astronomy service in bands allocated on a primary basis. This option is not applicable to the EESS (passive) service.

The following example provides a regulatory solution for implementing pfd limits for GSO systems and epfd limits for non-GSO systems, based on the epfd concept as defined in RR Article **22**. Another regulatory solution could be based on the definition of limits together with provisions similar to those that were adopted at WRC-2000 in Nos. **5.551G**, **5.511A** and **5.443B**.

Add a new section in RR Article 29: "pfd and epfd limits for unwanted emissions from space stations".

For the case of GSO, the power flux-density at a radio astronomy station in a frequency band allocated on a primary basis and resulting from unwanted emissions from a space station, for all conditions and for all methods of modulation, shall not exceed the limits given in the tables in Recommendation ITU-R RA.769.

For the case of non-GSO, the equivalent power flux-density (epfd) at a radio astronomy station resulting from unwanted emissions from all the space stations of a non-geostationary-satellite system in a frequency band allocated on a primary basis and for all conditions and for all methods of modulation, shall not exceed the specified limits for more than 2% of time at any radio astronomy station. The epfd calculation is performed in accordance with Recommendations ITU-R S.1586, M.1583 and RA.1513 using the reference antenna diagram and antenna gains given in ITU-R Recommendation RA.[PATTERN NGSO]. The epfd limit is derived from Recommendation ITU-R RA.769 and the antenna gains given in Recommendation ITU-R RA.[PATTERN NGSO].

The pfd/epfd limits:

- are applicable to any radio astronomy station for which complete notification information has been received by the Bureau prior to the reception of the complete advance publication information of the satellite network;
- shall be defined depending on the type of observation supported at the considered radio astronomy station (continuum, spectral line or VLBI observation) and shall be specified in the reference bandwidth defined in Recommendation ITU-R RA.769;
- may be exceeded on the territory of any country whose administration has so agreed; and
- shall be excluded from any examination performed by the Bureau, including its regulatory examination under RR Articles **9** and **11**.

This method would necessitate a modification of RR Appendix **4** to insert additional characteristics of the radio astronomy station, specifically the type of observation and the minimum operating elevation angle of the antenna. Appendix **4** should also be modified so that administrations may declare the compliance for their space stations with limits or trigger levels as defined in the RR (see A.17).

Option A2

The regulatory and procedural considerations will be a combination of those for Options A1 and A3.

Option A3

The band-by-band studies may result in a mixture of the application of mandatory limits such as in Option A1, operational constraints, or subjects for consultations.

Provisions involving emission limits or operational constraints could be added to the relevant RR Articles.

Method B

WRC-03 would adopt a Resolution:

a) identifying procedures, including the use of trigger levels and other means, for initiating and carrying out consultations between administrations operating active and passive services to address compatibility issues;

b) inviting the ITU-R to continue work on DNR ITU-R SM.[BbB] so as to complete those studies where additional work is necessary and to consider new band-pairs that may be identified;

c) urging administrations responsible for active services to take suitable steps to ensure that these services are designed to respect the trigger levels identified in a);

d) specifying that in the event that the trigger level defined in a) is exceeded, the administration responsible for such active service shall consult the administrations responsible for the affected passive services stations to arrive at a mutually acceptable solution;

e) specifying that the Resolution would only apply to systems submitting advance publication information after the end of WRC-03;

f) including a provision to address the fact that there may be spurious emissions that can only be detected after the launch of the space station and corrective action cannot be taken in most cases.

The Resolution would be referenced in a footnote associated with relevant allocations (RR Article **5**).

An example Resolution is contained in Annex 6.1-1. Related to this example Resolution, proposed example modifications to Annex 2A to Appendix 4 are shown in Annex 6.1-2. This method would necessitate a modification of RR Appendix **4** to insert additional characteristics of the radio astronomy station, specifically the type of observation and the minimum operating elevation angle of the antenna.

Method C

This Method involves no changes to the Radio Regulations.

Method D

WRC-03 would adopt a Resolution:

a) providing trigger levels for unwanted emissions of active services falling into some bands allocated to passive service on a primary basis. Limits may apply to protect adjacent or nearby passive service bands where band-by-band studies (DNR ITU-R SM.[BbB]) have concluded that this would not unduly constrain the development of active services, while consultation trigger levels may apply to other cases;

b) identifying procedures for initiating and carrying out consultations in relevant cases where trigger levels are exceeded between the concerned administrations to address compatibility issues;

c) inviting the ITU-R to continue work on Recommendation ITU-R SM.[BbB] so as to complete those studies where additional work is necessary and to consider new band-pairs pertaining to both the EESS(passive) and RAS that may be identified;

d) specifying that the Resolution would only apply to systems submitting advance publication information after the end of WRC-03;

e) urging administrations responsible for active services to take suitable steps to ensure that these services are designed to respect the trigger levels identified in a);

f) specifying that in the event that the trigger levels defined in a) is exceeded, the administration responsible for such active service should consult the administrations responsible for the affected passive services stations to arrive at a mutually acceptable solution;

g) including a provision to address the fact that there may be spurious emissions that can only be detected after the launch of the space station and corrective action cannot be taken in most cases.

The Resolution would be referenced in a footnote associated with relevant allocations (RR Article **5**). This method would necessitate a modification of RR Appendix **4** to insert additional characteristics of the radio astronomy station, specifically the type of observation and the minimum operating elevation angle of the antenna. Appendix 4 should be modified so that administrations may declare the compliance for their space stations with limits or trigger levels as defined in the Resolution (see A.17).

Calculation of the levels of power received by a RAS station would take into account the considerations given under Option A1. The applicability of limits or trigger levels would be subject to the same considerations as those given under Option A1.

The example Resolution given for Method B may also provide a suitable basis for the part of the Resolution under Method D which deals with trigger levels and consultation.

EXAMPLE OF PROPOSED RESOLUTION XXX (WRC-03)

Consultation procedure for achieving compatibility for the protection of the radio astronomy service from unwanted emissions of space stations

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that unwanted emissions from active services may cause unacceptable interference to the radio astronomy service;

b) that Recommendation ITU-R SM.[BbB] provides compatibility analysis between a passive service and an active service in adjacent and nearby bands;

c) that out-of-band emission can be controlled to a certain extent in the design process of satellite through careful design methods but that some narrow-band spurious emissions can be generated through some uncontrollable physical mechanisms;

d) that different coupling mechanisms apply to interfering emissions from transmitters on board geostationary (GSO) or non-GSO satellites;

e) that consultation between administrations may lead to innovative solutions offering the potential for rapid implementation, *noting*

a) that ITU-R has developed Recommendations ITU-R S.1586 and ITU-R M.1583, both providing a methodology based on the epfd concept for calculations of interference into radio astronomy stations from non-GSO systems of mobile satellite or radionavigation-satellite services in the first case, and, from the fixed-satellite services in the other case, and containing a model of a radiotelescope antenna pattern;

b) that ITU-R has developed Recommendation ITU-R RA.1513 providing acceptable levels of data loss to radio astronomy observations, stating in particular that the percentage of data loss caused by any system should be lower than 2%;

c) that the Bureau is not involved in the consultation procedure defined in this Resolution,

recognizing

that it is necessary to ensure an equitable burden sharing for achieving compatibility between the active and the passive services,

resolves

1 that, if an administration considers that the design of their space station cannot meet the unwanted emission trigger levels as given in the annex(es)[2] at a radio astronomy station, this administration shall consult with the administration operating this radio astronomy station in order to arrive at a mutually acceptable solution;

2 that space stations to be considered in the application of *resolves* 1 are those for which advance publication information has been received as of the [following day after the end of WRC-03] and which are operating in the space radiocommunication services[3] for which the annex(es) apply(ies);

3 that the radio astronomy stations to be taken into account in applying *resolves* 1 are those which are operating in the frequency bands where the space station cannot meet the unwanted emission levels referred to in *resolve*s 1, which are visible from this space station and which are notified before the date of reception of the advance publication information of the space station referred to in *resolves* 2;

4 that, in the event that the unwanted emission levels from a space station to which *resolves* 2 applies and which has been put into service exceed the trigger levels specified in *resolves* 1 at a radio astronomy station as defined in *resolves* 3, and where the consultation procedure in *resolves* 1 did not need to be applied, the notifying administration of such space station shall consult with the administration operating this radio astronomy station leading to measures to achieve compatibility, in order to arrive at a mutually acceptable solution, taking into account relevant ITU-R Recommendations agreed by administrations concerned to be used in this consultation process,

urges administrations

1 that, whenever practicable, space stations be designed to allow them to meet the unwanted emission levels as given in the annex(es)[1] at any radio astronomy station;

2 to actively participate in the consultation referred to in *resolves* 1 and 4,

---

[2] Such annex(es) is (are) to be developed and may include the space radiocommunication service to which the levels would apply.

invites ITU-R

to continue its studies on the development of a trigger level beyond those contained in the annex(es)[3].

Example of proposed modification to Appendix 4

MOD

APPENDIX 4 (WRC-03)

Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III

MOD

ANNEX 2A

Characteristics of satellite networks' earth stations or radio astronomy stations[2] (WRC-03)

C Characteristics to be provided for each group of frequency assignments for a satellite antenna beam or an earth station or radio astronomy station antenna

ADD

C.13*bis* Type of observations

The type of observations to be taken on the frequency band shown in § C.3 *b*). The different types of observations are: continuum, spectral line, VLBI.

C.13*ter* Radio astronomy station minimum observation elevation angle

The minimum elevation angle at which the radio astronomy station conducts observations in the frequency band of the group.

#########

6.2 Agenda item 2

"to examine the revised ITU-R Recommendations incorporated by reference in the Radio Regulations communicated by the Radiocommunication Assembly, in accordance with Resolution **28 (Rev.WRC-2000)**, and to decide whether or not to update the corresponding references in the Radio Regulations, in accordance with principles contained in the Annex to Resolution **27 (Rev.WRC-2000)**"

In accordance with the *instructs the Director of the Radiocommunication Bureau* of Resolution **28 (Rev.WRC-2000)**, the following is the list of those ITU-R Recommendations incorporated by reference in the Radio Regulations (see Resolution **27 (Rev.WRC-2000)**), which have been revised and approved during the elapsed study period since WRC-2000:

Recommendation ITU-R S.1428 "Reference FSS earth-station radiation patterns for use in interference assessment involving non-GSO satellites in frequency bands between 10.7 GHz and 30 GHz";

Recommendation ITU-R TF.460 "Standard-frequency and time-signal emissions";

Recommendation ITU-R BO.1293 "Protection masks and associated calculation methods for interference into broadcast-satellite system involving digital emissions;

Recommendation ITU-R BO.1443 "Reference BSS earth station antenna patterns for use in interference assessment involving non-GSO satellites in frequency bands covered by RR Appendix 30".

The most recent versions of the above ITU-R Recommendations are ITU-R S.1428-1, ITU-R TF.460-6, ITU-R BO.1293-2 and ITU-R BO.1443-1.

The conference may wish to consider the above revised versions with a view to updating the references. In addition, the conference may wish to consider the editorial consequential changes to the relevant provisions of the Radio Regulations that make reference to these ITU-R Recommendations as well as the other provisions referring to other ITU-R Recommendations incorporated by reference in Volume 4 of the Radio Regulations in accordance with agenda item 3 of the WRC-03 agenda.

The conference may also consider amending Resolution **27 (Rev.WRC-2000)** to allow administrations to submit proposals to future conferences to amend editorially those references to ITU-R Recommendations of a non-mandatory character with a view to referring to "the most recent version" of the Recommendations with necessary justification.

Several provisions of the Radio Regulations have been identified that include references to ITU-R Recommendations that are relevant to WRC-03 agenda items 1.9 and 1.14 where it may be necessary to clarify the status of the reference. These provisions are shown in Attachment 1 along with example text that the conference may wish to use to amend these provisions.

ATTACHMENT 1

Example modifications

Action	Provision No.	Provision	Reason
MOD	52.25 4)	Before transmitting on 500 kHz, stations shall (in accordance with Recommendation ITU-R M.1170) listen on this frequency for a reasonable period to make sure that no distress traffic is being sent.	More clearly indicates that reference to the Recommendation (which is in Volume 4 of the Radio Regulations) is mandatory. The reference was moved in the sentence to make it clearly relate to the act of listening and not the distress traffic.
MOD	52.31 § 13 1)	The frequency for replying to a call sent on the general calling frequency (see No. **52.27**) shall be as follows: – either 500 kHz, – or the frequency specified by the calling station in accordance with Recommendation ITU-R M.1170 (see No. **52.29**.	More clearly indicates that compliance with the Recommendation (which is in Volume 4 of the Radio Regulations) is mandatory.
MOD	52.32 2)	In regions of heavy traffic, coast stations may answer calls made by ship stations of their own nationality in accordance with special arrangements made by the administration concerned.	To delete reference to Recommendation **ITU-R M.1170** (which is in Volume 4 of the Radio Regulations) and does not refer to this matter.
MOD	52.69 § 28	In order to reduce interference on Morse radiotelegraphy calling frequencies, a coast station shall (in accordance with Recommendation ITU-R M.1170) take adequate steps to ensure, under normal conditions, the prompt receipt of Morse radiotelegraphy calls.	More clearly indicates that reference to the Recommendation (which is in Volume 4 of the Radio Regulations) relates to the coast stations' steps rather than the Morse calls themselves.
MOD	57.1 § 1	The procedure detailed in Recommendation ITU-R M.1171 shall be applicable to radiotelephone stations, except in cases of distress, urgency or safety, to which the provisions of Appendix **13** are applicable.	To standardize the language and clearly indicate that reference to the Recommendation (which is listed in Volume 4 of the Radio Regulations) is mandatory.

Agenda item 1.14 (Resolution 350 (WRC-2000)

Action	Provision No.	Provision	Reason
MOD	52.224 § 99 1)	Before transmitting on the carrier frequencies 4 125 kHz, 6 215 kHz, 8 291 kHz, 12 290 kHz or 16 420 kHz a station shall listen (in accordance with Recommendation ITU-R M.1171) on the frequency for a reasonable period to make sure that no distress traffic is being sent (see No. **52.221A**).	To clearly indicate that reference to the Recommendation (which is listed in Volume 4 of the Radio Regulations) relates to the listening rather than the distress traffic.

NOTE - These examples are not intended to suggest that any particular ITU-R Recommendation should be retained.

#########

6.3 Agenda item 4

"in accordance with Resolution 95 (Rev.WRC-2000), to review the resolutions and recommendations of previous conferences with a view to their possible revision, replacement or abrogation"

In response to Resolution 95 (Rev.WRC-2000), the Bureau performed an initial study in this respect and it submitted the results of this study to the Radiocommunication Advisory Group.

In a parallel activity, and in accordance with "*instructs 1*" of Resolution 95(Rev.WRC-2000), comments were invited from Chairmen and Vice-Chairmen of Study Groups. As some Resolutions and Recommendations might have regulatory impact, the results of the initial study of the Bureau were also presented to the July, 2002 meeting of the Special Committee on Regulatory/Procedural Matters. After incorporating advices obtained through this process, the Bureau submitted a report to the CPM. The CPM received additional contributions from regional organizations and administrations, commenting on the report from the Bureau. Attachment 1 was prepared on the basis of these contributions.

The CPM wishes to emphasize that the indications in the columns "Remark" and "Possible follow-up" should not be considered as proposals for the work of the Conference, but they are merely suggestions by some members and/or the Director, BR, as to the possible course of action to be taken in respect of the concerned Resolution/Recommendation which may assist administrations for preparing their proposals for the work of the Conference.

The Bureau was unable to indicate the possible responsible committees within the conference for each text, as required by "*instructs* 2" of Resolution 95 (Rev.WRC-2000), as the possible structure of the conference was still in a very early stage of consideration.

To facilitate the introduction of consequential changes and amendments to the Radio Regulations due to possible action with respect to the current Resolutions and Recommendations, as envisaged by agenda item 4 of the WRC-03, the Bureau also established an initial list of the texts contained in Volumes 1-4 of the Radio Regulations that are referencing various Resolutions and Recommendations contained in Volume 3 (Attachment 2). The references to obsolete versions are indicated with shaded text (the historical references are indicated with the symbol "/H" after the reference number. These references are valid.). The references appearing in RR Volume 4 are given for information purposes.

Attachment 2 raises the following issue which may be considered by WRC-03:

– numerous texts of RR Volumes 1-3 make references to Resolutions/Recommendations. Even after they have been revised, in many cases (i.e., the shaded texts in Attachment 2), references are made to previous versions of Resolutions/Recommendations. In some cases, these references (those indicated with symbol "H" after the reference) may be appropriate. However, in other cases it may be necessary to update the references to the latest versions of the Resolutions/Recommendations. This is because, in principle, the necessary updating should be carried out by the WRC itself in the framework of the relevant agenda item, but as a matter of fact it is difficult to complete the work within a limited time available for the same WRC. At the present there is no additional procedure to carry out the remaining updating. Some kind of a new procedure may be considered;
– in certain cases, even after Resolutions/Recommendations have been abrogated, texts of RR Volumes 1-3 make references to the abrogated texts (i.e., the shaded texts in Attachment 2). In some cases, these references (those indicated with symbol "H" after the reference) may be appropriate. However, in other cases it may be necessary to make editorial amendments to the texts making references to the abrogated Resolutions/Recommendations. This is

because, in principle, the necessary editorial amendments should be carried out by the WRC itself in the framework of the relevant agenda item, but as a matter of fact it is difficult to complete the work within a limited time available for the same WRC. At the present there is no authorized procedure to carry out the remaining editorial amendments. As for the 2001 version of the Radio Regulations, the Secretariat has added "Note by the Secretariat" to each relevant part. WRC-03 is invited to consider whether this practice is acceptable or some kind of a new procedure is necessary.

The CPM refrained under this agenda item from indicating any possible course of action in respect to those Resolutions/Recommendations that are explicitly on the agenda of WRC-03.

ATTACHMENT 1

Review of WARC/WRC Resolutions and Recommendations in response to Resolution 95 (Rev.WRC-2000)

Res. No.	Subject	Remark	Possible follow-up
1	Notification of frequency assignments	Still relevant.	NOC
2	Equitable use of GSO and frequency bands for space services	Still relevant. This Resolution may need to be amended so as to cover all satellite systems including non-GSO and the new HEO types.	NOC/MOD
4	Period of validity of GSO space systems	Still relevant; for consideration by a future WRC. This resolution may need to be amended for the same reason given under Resolution 2. (NB: This subject may be considered in the context of agenda item 1.30).	NOC/MOD
5	Technical cooperation – Propagation in tropical areas	The substance of this Resolution is still relevant. One option is to extend this Resolution to areas where propagation has a similar nature to that in tropical areas.	NOC/MOD/ SUP
7	National radio-frequency management	Some actions completed; new elements became relevant in the context of the structural changes within Member States. BR annual budget for this purpose was suggested.	MOD
10	Wireless communications by the International Red Cross and Red Crescent Movement	Still relevant, text recently updated (at WRC-2000)	NOC
13	Formation of call signs	Still relevant, without real problems (**Separate BR report to WRC-03**).	NOC
15	Cooperation in space radiocommunications	Many aspects are obsolete in view of the current BDT activities. On the other hand, MOD may be considered to provide for extending adequate assistance to developing countries.	MOD/SUP
18	Identification/non-parties in an armed conflict	Still relevant; may need to be modified if WRC-03 decides to suppress Appendix 13 under agenda item 1.9.	NOC/MOD
20	Technical cooperation – Aeronautical service	Still relevant, text recently updated (at WRC-2000). Some editorial amendment may be considered.	NOC/(MOD)
21	Transfer of HF-FX in 2007	Still relevant (some elements are obsolete).	MOD
25	Operation of Global Satellite Systems	Still relevant, text recently updated (at WRC-2000). Some amendment may be considered in "*considering* d)".	NOC/MOD

Res. No.	Subject	Remark	Possible follow-up
26	Review of footnotes	Still relevant (permanent agenda item at each WRC). The *further resolves* 1 c) may need to be modified to confine the scope of addition or modification of RR footnotes under Res. 26 to some extent. A proposal received that under *further resolves* 1, "considered" may be replaced by "adopted".	NOC/MOD
27	Incorporation by reference/principles	Still relevant (permanent agenda item at each WRC). This Resolution may still require some improvements in order to facilitate the identification of mandatory ITU-R Recommendations incorporated by reference. In addition, new paragraph 5 under "*resolves*" may be added which reads "5 that such use of incorporation by reference shall be limited in its application". The last remark under Res. 28 also applies.	MOD/NOC
28	Revision of references to ITU-R Recommendations	Still relevant. **Report by RA-03 to WRC-03 agenda item 2**. Possible change of the concept of "incorporation by reference" was suggested (from "a specific version" to "the most recent version of ITU-R Recommendation").	NOC/MOD
29	Occupancy by FX/MO of the HF bands allocated to the BC in 1992	This subject is implicitly on the WRC-03 agenda items 1.2 and 1.36. Interim report submitted to WRC-2000. **Additional report to WRC-03**.	-
33	Procedure for BSS prior to the entry into force of agreements and plans for the BSS	See Section 6.4.1 dealing with agenda item 7.1.	MOD
34	BSS in the band 12.5-12.75 GHz in R3	See Section 3.4.6 dealing with agenda item 1.30.	-
42	Interim systems in R2 (BSS and FSS) in AP30/30A bands	Still relevant, however needs to be reviewed in order to update the references to provisions revised by WRC-2000, as well as with other decisions from WRC-2000.	MOD
44	Compatibility of equipment in MSS	**No longer necessary** in view of current situation.	SUP
46	Coordination/notification procedures in non-GSO bands	WRC-2000 reviewed this Resolution and decided to maintain it with no change, as it is applicable to satellite networks whose frequency assignments were received by the Bureau prior to 1 January 1999. This Resolution shall apply to the frequency bands for which specific reference is made to this Resolution in the footnotes to the Table of Frequency allocations. The SC concluded that it would be premature to suppress Resolution 46 or references to it.	NOC/SUP
49	Administrative due diligence	Still relevant (implicitly on the WRC-03 agenda item 1.30). **BR Report to WRC-03**.	-

Res. No.	Subject	Remark	Possible follow-up
51	Transitional arrangements concerning coordination and notification	Still relevant.	NOC
53	Updating of the remarks of Appendices 30 and 30A	For consideration by WRC-03 agenda item 1.35. **BR report to WRC-03.**	-
55	Temporary procedures for improving satellite network coordination and notification procedure.	Still relevant. **BR report to WRC-03.** Implicitly on the WRC-03 agenda item 1.30	-
56	Early application of No. 9.2, as revised by WRC-2000	**No longer necessary** as from 1 January 2002.	SUP
57	Special arrangements for the networks above 71 GHz	Still relevant. Some elements are unclear – Additional details in the BR report of activities. In addition, No. 11.44 in "*considering* h)" needs to be replaced by No. 11.44.1 and *resolves* 3 may be deleted or modified.	MOD
58	Transitional measures for coordination in the bands 10.7-12.75 GHz, 17.8-18.6 GHz and 19.7-20.2 GHz	Some actions still to be completed. May be suppressed after the completion of all consequential actions. BR is expected to report to WRC-03 on the status of the above actions.	MOD/SUP
59	Early application of some provisions, as revised by WRC-2000	Some actions still to be completed. May be suppressed after the completion of all consequential actions. BR is expected to report to WRC-03 on the status of the above actions.	MOD/SUP
63	Protection from ISM equipment	**No longer necessary**, action completed. On the other hand, MOD may be considered. An example text submitted is given in Attachment 3. Some administrations consider that the proposed modification may go beyond the scope of Resolution 95.	MOD/SUP
72	Regional preparations	Still relevant. **BR reports to PP-02 and WRC-03.** May need to be reviewed in the light of the actions taken by PP-02 with respect to Resolution 80 (PP-98), bearing in mind the contents of Resolution 25 (PP-98).	MOD/SUP
73	Compatibility BSS-R1/FSS-R3 in 12 GHz	Still relevant.	NOC
74	Continuing updating of Appendix **7**	Still relevant. Permanent agenda item for each WRC (e.g. agenda item 5 of WRC-03)	NOC
75	Possible update of Appendix 7 for the bands 31.8-32.3 GHz	Still relevant (ongoing studies). Closely related to Resolution 74.	NOC
76	Development of calculation methodologies concerning aggregate epfd produced by non-GSO in the bands 10.7-30 GHz	Still relevant (ongoing studies, with some actions completed). **BR report to WRC-03**. Implicitly on the WRC-03 agenda item 1.29.	-

Res. No.	Subject	Remark	Possible follow-up
77	Criteria for protecting terrestrial services from FSS GSO networks in the band 11.7-12.2 GHz	See Section 6.4.3 dealing with agenda item 7.1.	-
78	Criteria for sharing between GSO and non-GSO systems (compliance with single-entry operational and additional operational limits)	For consideration by WRC-03 agenda item 1.29	-
79	Criteria for determining coordination distances to protect RA stations in 42.5-43.5 GHz	Still relevant (ongoing studies).	NOC
80	Principles of the Constitution, to be taken into consideration	For consideration by WRC-03 agenda item 7.1. Ongoing studies within RAG and RRB. **BR report to WRC-03.**	-
81	Evaluation of administrative due diligence	Ongoing consideration of the subject matter within SAT-BAG. **BR report to PP-02.** Implicitly on the WRC-03 agenda item 1.30.	-
82	Operation of earth stations on board vessels, in some of the allocations to the FSS	For consideration by WRC-03 agenda item 1.26.	-
83	Administrative procedures for cost recovery	See PP Res. 88 (Rev. Marrakesh 2002). Implicitly on the WRC-03 agenda item 1.30.	-
84	Pfd limits in 37.5-42.5 GHz for the FSS, BSS and MSS	For consideration by WRC-03 agenda item 1.32.	-
95	Review of Resolution/Recommendation	Still relevant (permanent agenda item at each WRC). Further improvement of this Resolution may be considered. An example text is given in Attachment 4.	MOD/NOC
105	Improvements in AP30B	Still relevant.	NOC
111	Planning of the FSS in 18/20/30 GHz	Still relevant. For consideration by a future WRC. Given the fact that no contributions were submitted to the ITU-R in response to this Resolution, since its approval by WARC-Orb-88, consideration could be given to its suppression. Another option may be to modify this Resolution in light of discussions under agenda item 1.27 and in case proposals are made for a new BSS plan affecting any frequency band covered by this Resolution.	SUP/MOD/ NOC
114	FSS (feeder links for MSS) in 5 GHz	For consideration by WRC-03 agenda item 1.4.	-
122	HAPS in 47/48 GHz	For consideration by WRC-03 agenda 1.13. NOTE – The former version of this Resolution is referred to in No. S5.552A.	-

Res. No.	Subject	Remark	Possible follow-up
124	Sharing FX/EESS in 8 GHz	ITU-R studies completed. Rec. ITU-R F.1502 contains pfd limits different from those referred to in No. 5.462A. WRC-03 may consider placing No. 5.462A on a future WRC agenda. Another option is to modify this Resolution, because some administrations are not aware of Rec. ITU-R F.1502.	NOC /MOD
125	Sharing MSS/RA in 1.6 GHz	Ongoing studies, future WRC to review.	NOC
127	New allocations for feeder links to GSO MSS in 1.4 GHz	For consideration by WRC-03 agenda item 1.16.	-
128	Protection of RA in 42 GHz	For consideration by WRC-03 agenda 1.32.	-
132	FSS in 18/28 GHz	Some elements are still relevant (e.g. *resolves* 2, which contains instructions to the Bureau as to the treatments of some submissions). MOD may not be essential.	NOC/MOD
135	Criteria concerning application of single-entry limits for non-GSO FSS in Article 22	For consideration of WRC-03 agenda item 1.19.	-
136	Criteria for sharing between GSO FSS and non-GSO FSS in 37.5-50.2 GHz	For consideration of WRC-03 agenda item 1.29.	-
137	Criteria for sharing (GSO/non-GSO and non-GSO/non-GSO)	Still relevant (ongoing studies). Could be modified to reflect the results from the studies already completed. New ITU-R Recommendations (e.g. Docs. 4/BL/19, 4/BL/23 and 4/BL/35) are available, satisfying *invites ITU-R* 1, 3 and 4.	MOD/NOC
138	Additional spectrum for non-GSO FSS (Earth-to-space)	No contributions to ITU-R study since 2000. SUP may be considered.	SUP/NOC
139	Use of FSS for provision of DTH television broadcasting	Ongoing studies. **BR report to WRC-03** for consideration, as appropriate in the development of future conference agendas.	NOC/MOD
205	Protection of MSS in 406-406.1 MHz	Still relevant (additional details in the **BR Report of activities**).	NOC
207	Monitor MMS/AM(R)S	For consideration by WRC-03 agenda item 1.14. Monitoring reports regularly posted on the ITU website. Additional details in the **BR Report of activities**.	-
209	Enlarging the scope of GMDSS	For consideration by a future WRC; **may not be relevant any longer**. This text has been maintained since 1987 and may be abrogated.	SUP
212	Implementation of IMT-2000	Still relevant. See Note 3.	NOC

Note 1 – Some administrations proposed that amendments may be considered (in *resolves*, to replace "should" by "be invited to").

Res. No.	Subject	Remark	Possible follow-up
214	Use of bands below 1 GHz by MSS	For consideration by WRC-03 agenda item 1.20.	-
215	Coordination among non-GSO MSS	Some elements are still relevant, ongoing studies. See also the Note in the comments related to Resolution 46.	NOC/MOD
216	Broadening the allocation to the MSS in 14-14.5 GHz	For consideration by WRC-03 agenda item 1.11.	-
217	Wind profiler radars	Still relevant.	NOC
221	HAPS for IMT-2000 in the bands around 2 GHz	For consideration by WRC-03 agenda item 1.33.	-
222	Use of the bands 1 525-1 559 MHz and 1 626.5-1 660.5 MHz by the MSS	Still relevant.	NOC
223	Additional bands identified for IMT-2000	Still relevant. **BR report to WRC-03.** (The subject matter is under consideration by WRC-03, agenda item 1.22).	NOC
224	Frequency bands for the terrestrial component of IMT-2000 below 1 GHz.	Still relevant (ongoing studies). See Note 1.	NOC/(MOD)
225	Use of additional bands for the satellite component of IMT-2000	Still relevant. Results of the studies to be reported to a future WRC. See Note 4	NOC
226	Sharing studies and possible allocation to the MSS (space-to-Earth) in the 1-3 GHz, including 1 518-1 525 MHz	For consideration by WRC-03 agenda item 1.31.	-
227	Sharing studies and possible allocation to the MSS (Earth-to-space) in the 1-3 GHz, including 1 683-1 690 MHz	For consideration by WRC-03 agenda item 1.31.	-
228	Further development of IMT-2000 and systems beyond IMT-2000	For consideration by WRC-03 agenda item 1.22. The subject is also on the preliminary agenda for WRC-07 agenda item 2.16.	-
300	Paired frequencies for NBDPT in HF/MMS	**No longer necessary** as from 1 January 2002.	SUP
310	Ship movement telemetry	Question ITU-R 55/8 referred to in *noting* a) was deleted by RA-2000. SUP of this Resolution may be considered.	SUP/NOC
312	Group channels for Morse telegraphy	**No longer necessary**, in view of the abolishing of the calling using Morse telegraphy.	SUP
331	Transition arrangements for the GMDSS	For consideration by WRC-03 agenda item 1.9.	-

Note 2 – Some administrations proposed amendments concerning the status of the bands 2 500-2 520 MHz and 2 670-2 690 MHz in order to alleviate ambiguities in this Resolution.

Res. No.	Subject	Remark	Possible follow-up
339	Coordination of NAVTEX	Still relevant.	NOC
340	Additional SAR information	Largely implemented by ITU, although some elements (e.g. in the "invites" part) are still relevant.	SUP/MOD
341	On-board communications in UHF	**No longer necessary** (action completed and modified Rec. ITU-R M.1174-1 approved in 1998).	SUP
342	Revision of AP18	Ongoing studies, for consideration by a future WRC (preliminary agenda item 2.14 for WRC-07 as per Resolution 801).	NOC
343	Certificates (vessels using GMDSS equipment on a non-compulsory basis)	Still relevant.	NOC/MOD
344	Exhaustion of MMSI	For consideration by WRC-03 agenda item 1.10.1. **BR Report to each WRC.**	-
345	Operation of GMDSS equipment on non-compulsory fitted vessels	Still relevant, ongoing activities.	NOC/MOD
346	Protection of distress and safety frequencies in 12/16 MHz	Still relevant, but may need updating. This subject is also related to agenda item 1.14 of WRC-03.	MOD
347	Digital modulation in the MMS at MF/HF	For consideration by WRC-03 agenda item 1.14.	-
348	Priority of distress and safety communications	For consideration by WRC-03 agenda item 1.10.2.	-
349	False alerts in GMDSS	Still relevant, ongoing activities.	NOC/MOD
350	Study of interference to distress and safety frequencies in 12 and 16 MHz by routine calling	For consideration by WRC-03 agenda item 1.14.	-
405	Frequencies for AM(R)	Still relevant, ongoing activities in ICAO.	NOC
506	GSO only, in BSS bands (12 GHz)	Still relevant, however needs to be revised in order to include the reference to the adoption by WRC-2000 of new Regions 1 and 3 Plans and Lists.	MOD
507	Agreements/Plans for BSS	Still relevant, but clarification is needed.	NOC/MOD
517	Transition from DSB to SSB in HFBC	For consideration by WRC-03 agenda item 1.2. **BR Report to WRC-03** (statistics on transmitters and receivers).	-
525	Introduction of HDTV in 22 GHz	Still relevant. See Section 6.4.1 dealing with agenda item 7.1.	-
526	Additional provisions for HDTV	Still relevant. For consideration by a future WRC.	NOC
527	Terrestrial VHF digital sound broadcasting	**No longer necessary** (in view of the action taken by C-01 (Resolution 1185)).	SUP

Res. No.	Subject	Remark	Possible follow-up
528	BSS (sound) in 1.5 GHz	Still relevant although some elements need updating. For consideration by a future WRC. Possible amendment calling for further study.	MOD/NOC
532	Review of AP30/30A	May no longer be necessary depending on decisions by WRC-03 under agenda item 1.35.	SUP/NOC
533	Implementation of certain provisions relating to AP30/30A	Some elements still relevant (e.g. *resolves* 4.2).	NOC
535	Application of Article 12	The major part implemented. May need to be modified as a result of the considerations under agenda item 1.2. Also may be amended in view of the importance in relation to Article 12 and to ensure the required financing through grants to developing countries. NOTE – Resolutions 508 and 523 (WARC-92) referred to in "*considering* b)" have been deleted.	MOD
536	BSS satellites serving other countries	Could be deleted. (in view of the decision of WRC-2000). Another option is to maintain this Resolution after appropriate modifications.	MOD/SUP
537	Statistics on HFBC equipment	For consideration by WRC-03 agenda item 1.2. **BR report to WRC-03** (statistics on transmitters and receivers).	-
539	Use of the band 2 630-2 655 MHz for non-GSO BSS	For consideration by WRC-03 agenda item 1.34.	
540	Regulatory procedures and sharing criteria in AP30/30A and in Articles 9 and 11	For consideration by WRC-03 agenda item 1.27.	-
541	Early application of some provisions of Appendices 30/30A	**Not applicable** as from 1 January 2002. (Instructs to the Bureau are covered by Article 5 of AP30/30A (WRC-2000)).	SUP
542	WRC-2000 Regions 1 and 3 Plans to be included in Appendices 30/30A, and Lists of additional uses to be annexed to the MIFR.	**No longer necessary** (Implemented).	SUP
602	Differential data correction on maritime radiobeacons	Implemented (Recommendation ITU-R M.823-2 approved in 1997, RRB Rules of procedure approved, no need for a conference).	SUP
603	Compatibility between RNSS (Earth-to-space) in 5 000-5 010 MHz and the MLS in 5 030-5 150 MHz	Still relevant (ongoing studies).	NOC
604	Compatibility between RNSS (space-to-Earth) in 5 010-5 030 MHz and the RA in 4 990-5 000 MHz	For consideration by WRC-03 agenda item 1.15; action to be taken in the light of the decisions of WRC-03.	-

Res. No.	Subject	Remark	Possible follow-up
605	Use of the band 1 164-1 215 MHz by systems in the RNSS (space-to-Earth)	For consideration by WRC-03 agenda item 1.15; action to be taken in the light of the decisions of WRC-03.	-
606	Use of the band 1 215-1 300 MHz by systems in the RNSS (space-to-Earth)	For consideration by WRC-03 agenda item 1.15.	-
607	Compatibility between RNSS (Earth-to-space) and the radio-location in 1 300-1 350 MHz	Still relevant (ongoing studies).	NOC
641	Use of the band 7 000-7 100 kHz	Still relevant. (NB. The subject matter is under consideration by WRC-03, agenda item 1.23).	NOC
642	Earth stations in the amateur satellite service	Still relevant.	NOC
644	Disaster communications	Still relevant (ongoing studies).	NOC
645	Global harmonization of spectrum for public protection and disaster relief	For consideration by WRC-03 agenda item 1.3.	-
703	Interference criteria for the shared bands	May need to be modified, bearing in mind the application of the concept of incorporation by reference of the relevant ITU-R Recommendations. An example text for a draft revision is given in Attachment 5.	MOD
705	Protection of services in 70-130 kHz	Some elements still relevant; for consideration by a future WRC.	NOC/MOD
706	Operation of the fixed service in 90-110 kHz	Still relevant; for consideration by a future WRC.	NOC
715	Sharing between RNSS and MSS in 149.9-150.5 MHz and 399.9-400.5 MHz	Implemented (Recommendation ITU-R M.1470 approved in 2000).	SUP
716	Use of bands around 2 GHz	Still relevant. **Progress report to WRC-03**. Some administrations consider that urgent studies not yet completed by ITU-R and ITU-D. NOTE – The former version of this Resolution is referred to in Nos. 5.389A, 5.389C and 5.390.	NOC
723	Allocations to space services	For consideration by WRC-03 agenda 1.12.	-
724	Use of the band 5 250-5 350 MHz by spaceborne active sensors	Rec. ITU-R SA.1280 referred to in this Resolution has been maintained unchanged since 1997.	SUP/NOC
725	Use of the band 5 350-5 460 MHz by spaceborne active sensors	Rec. ITU-R SA.1280 referred to in this Resolution has been maintained unchanged since 1997.	SUP/NOC
727	Use of 420-470 MHz by EESS (active)	For consideration by WRC-03 agenda item 1.38.	-

Res. No.	Subject	Remark	Possible follow-up
728	Non-GSO MSS in 470-862 MHz	Still relevant; for consideration by a future WRC (preliminary agenda item 2.8 for WRC-07, as per Resolution 801). Another option is that Resolution should be abrogated.	NOC/SUP
729	Adaptive systems at MF/HF	Some elements are implemented (e.g. under "instructs" part); other elements are still relevant: ongoing studies with a view to presenting results to a future WRC (preliminary agenda item 2.9 for WRC-70, as per Resolution 801).	MOD/NOC
730	Spaceborne precipitation radars in 35.5-35.6 GHz	For consideration by WRC-03 agenda item 1.12.	-
731	Sharing and adjacent-band compatibility between active and passive services above 71 GHz	Still relevant, ongoing studies (for consideration by a future WRC).	NOC
732	Sharing between active services above 71 GHz	Still relevant, ongoing studies (for consideration by a future WRC).	NOC
733	Review of sharing conditions between services in 13.75-14 GHz	For consideration by WRC-03 agenda item 1.24.	-
734	Use of HAPS in the FX/MO in the bands above 3 GHz allocated exclusively to terrestrial services	For consideration by WRC-03 agenda item 1.13.	-
735	Sharing between receiving earth stations in the BSS and transmitting earth stations or terrestrial stations	For consideration by WRC-03 agenda item 1.27.	-
736	Allocations to FX, MO, radiolocations, EESS (active) and space research (active) in 5 150-5 725 MHz	For consideration by WRC-03 agenda item 1.5.	-
737	Spectrum and regulatory requirements to facilitate terrestrial wireless interactive multimedia applications	For consideration by WRC-03 agenda item 1.21. The subject is also on the preliminary agenda item 2.15 for WRC-07	-
800	Agenda for WRC-03	**No longer necessary** in view of the actions taken by the Council (Resolution 1156).	SUP
801	Preliminary agenda for WRC-05/06	For consideration by WRC-03 agenda item 7.2.	-
7	Standard forms for licenses	Still relevant.	NOC
8	Automatic identification	Still relevant (in the new context), ongoing studies.	MOD/NOC
9	Operation of BC stations on board ships/aircraft	Still relevant.	NOC
14	Identification of special vessels	Some elements are obsolete, ongoing studies with a view to present results to a future WRC.	MOD

Res. No.	Subject	Remark	Possible follow-up
34	Principles for allocation of frequency bands	Still relevant, ongoing studies.	NOC
35	Procedure for modification of a Plan	Many aspects are obsolete, taking into account the approach used by recent WRCs (no need for a generalized procedure).	SUP
36	International monitoring of emissions from space stations	Still relevant; ongoing studies.	NOC
63	Calculation of necessary bandwidth	Still relevant (in the new context).	MOD
64	Protection ratios and E_{min}	**No longer necessary** (in view of the current work programmes in the ITU-R).	SUP/NOC
66	Max. level of unwanted emissions	For consideration by WRC-03 agenda item 1.8.2.	-
71	Type approval	Still relevant.	NOC
100	Bands for troposcatter	Partly obsolete. The text has served its purpose. If maintained, at least *instructs* and *invites* may be deleted.	SUP/MOD
104	pfd and e.i.r.p. limits	Still relevant, ongoing studies.	(MOD)
316	Use of SES within harbours	**No longer necessary** (in view of the implemented arrangements, e.g. Inmarsat MoU). Another option is NOC because not all states have joined INMARSAT or signed MoU.	SUP/MOD/ NOC
318	Improved AP18	Still relevant; ongoing studies with a view to present results to a future WRC (preliminary agenda item 2.14 for WRC-07 as per Resolution 801).	NOC
319	Adjacent channel interference in HF-MMS	Intended for consideration by a future WRC but may not be relevant any longer in view of the changes to the regulatory arrangement, e.g., abolishing of the examination of the probability of harmful interference and the possible suppression of Resolution 300.	SUP
401	Use of worldwide frequencies in AP27	Although this Recommendation contains useful suggestions to administrations, it is observed only by a few administrations.	NOC/MOD
402	Coordinated use of WW frequencies in AP27	Although this Recommendation contains useful suggestions to administrations, it is observed only by a few administrations.	SUP/MOD/ NOC
503	HFBC	Still relevant. (NB: the subject matter is on the WRC-03 agenda item 1.2).	NOC
506	Harmonics in BSS	Still relevant.	NOC
515	Other modulation in HFBC	For consideration by WRC-03 agenda item 1.2.	-
517	SSB PR in HFBC	For consideration by WRC-03 agenda item 1.2.	-
519	Introduction of SSB, cessation of DSB	For consideration by WRC-03 agenda item 1.2.	-

Res. No.	Subject	Remark	Possible follow-up
520	Elimination of out-of-band HFBC emissions	Still relevant.	NOC
521	Technical parameters for revision of AP30/30A	**No longer necessary** (in view of the decisions taken by WRC-97 and WRC-2000).	SUP
522	Coordination of HFBC schedules	Still relevant.	NOC
604	Characteristics of EPIRBs	Some elements are not relevant any longer (e.g. phasing out of some types of EPIRBs).	MOD/SUP
605	Shipborne transponders	Still relevant; ongoing studies with a view to present results to a future WRC.	NOC
606	Radionav. in 4 200-4 400 MHz	Still relevant, further studies with a view to present results to a future WRC. Another view is that Rec. 606 (Mob-87) was to provide additional bands for mobile services, but a preliminary agenda 2.7 of Res. 801 is different. After 15 years, this Rec. did not produce definitive results. Thus SUP may be considered.	SUP/NOC
622	Sharing of bands 2 025-2 110 MHz and 2 200-2 290 MHz	Still relevant.	NOC
700	Sharing of bands allocated to space services	Many elements are obsolete in view of current practices. To be updated or abrogated.	MOD/SUP
701	Use of 1.3 GHz by radio astronomy	After 23 years since the adoption, no progress has been made.	SUP/MOD
702	Intentional emissions of extraterrestrial origin	After 23 years since the adoption, no progress has been made.	MOD/SUP
705	Sharing BC/BSS in 700 MHz	Still relevant, ongoing studies (some elements are obsolete).	MOD
707	Sharing in 32-33 GHz	Still relevant, ongoing studies with a view to present results to a future WRC.	NOC
709	Sharing AMS and inter-satellite above 54 GHz	Some elements are obsolete (in view of the actions taken by WRC-97 and WRC-2000).	SUP/MOD
710	Use of airborne radars in shared bands	Some elements are obsolete (in view of the actions taken by WRC-97 and WRC-2000).	SUP/MOD
715	Multiservice satellites in GSO	Many elements are obsolete (in view of arrangements introduced in the regulatory procedures).	SUP/MOD
718	Alignment of allocations in 7 MHz	For consideration by a WRC-03 agenda item 1.23.	-
719	Multiservice satellites in GSO	Still relevant (ongoing studies)	NOC

ATTACHMENT 2

List of cross-references of Resolutions and Recommendations in other texts of Volumes 1-4 of the Radio Regulations

Res. No.	Version	Referred to in	Version	No
1	Rev.WRC-97	**AP26**		/5.2
2	WARC-79	**Res. 4**	Rev.Orb-88	*considering* a)
4	Rev.Orb-88	**AP4**		A.2 - b)
13	Rev.WRC-97	**Art. 19**		19.32
21	Rev.WRC-95	**Art. 5**		5.136
21	Rev.WRC-95	**Art. 5**		5.143
21	Rev.WRC-95	**Art. 5**		5.146
21	Rev.WRC-95	**Art. 5**		5.151
21	Rev.WRC-95	**Res. 29**	WRC-97	*considering* c)
22	WARC-92 (abrogated by WRC-97)	**Res. 21**	Rev.WRC-95	*considering* d)
23/H	WRC-95 (abrogated by WRC-2000)	**Res. 339**	Rev.WRC-97	*considering* e)
23/H	WRC-95 (abrogated by WRC-2000)	**Res. 729**	WRC-97	considering d)
26	Rev.WRC-97	**Res. 800**	WRC-2000	*resolves* 1.1
26	Rev.WRC-97	**Res. 801**	WRC-2000	*resolves* 2.1
27		**Art. 3**		3.7
27	Rev.WRC-2000	**Res. 28**	Rev.WRC-2000	*considering* c)
27	Rev.WRC-2000	**Res. 800**	WRC-2000	*resolves* 2
27	Rev.WRC-2000	**Res. 801**	WRC-2000	*resolves* 4
27	Rev.WRC-97	**Art. 21**		21.2.2
27	Rev.WRC-97	**Art. 21**		21.4.1
27	Rev.WRC-97	**Art. 32**		32.21
27	Rev.WRC-97	**Art. 32**		32.64
27	Rev.WRC-97	**Art. 32**		32.9.3
27	Rev.WRC-97	**Art. 34**		34.1
27	Rev.WRC-97	**Art. 34**		34.2
27	Rev.WRC-97	**Art. 51**		51.25
27	Rev.WRC-97	**Art. 52**		52.112
28	Rev.WRC-2000	**Res. 27**	Rev.WRC-2000	Annex 1-5
28	Rev.WRC-2000	**Res. 800**	WRC-2000	*resolves* 2
28	Rev.WRC-2000	**Res. 801**	WRC-2000	*resolves* 4
33/H		**Res. 33**	Rev.WRC-97	*considering* e)
33	Rev.WRC-97	**Art. 5**		5.311

33	Rev.WRC-97	**Art. 5**		5.396
33	Rev.WRC-97	**Res. 34**	WARC-79	*resolves* 1
33	Rev.WRC-97	**Res. 42**	Rev.Orb-88	Annex 5 f)
33	Rev.WRC-97	**Res. 49**	Rev.WRC-2000	Annex 1-1
33	Rev.WRC-97	**Res. 525**	WARC-92	Annex - Section II 2
33	Rev.WRC-97	**Res. 525**	WARC-92	Annex - Section III 3
33	Rev.WRC-97	**Res. 525**	WARC-92	Annex - Section III 4
33	Rev.WRC-97	**Res. 525**	WARC-92	Annex - Section IV 5
33	Rev.WRC-97	**Res. 528**	WARC-92	*resolves* 3
33	Rev.WRC-97	**Res. 507**	WARC-79	*resolves* 2
42	Rev.Orb-88	**AP30**		Art. 10-9/GR
42	Rev.Orb-88	**AP30**		Art. 5 - 5.2.1 e)
42	Rev.Orb-88	**AP30**		Art. 5 - 5.2.2.2
42	Rev.Orb-88	**AP30**		Art. 5 - 5.2.2.2
42	Rev.Orb-88	**AP30**		Art. 5 - 5.2.2.2
42	Rev.Orb-88	**AP30A**		Art. 11 - Annex 1-3
42	Rev.Orb-88	**AP30A**		Art. 11 - Annex 1-3
42	Rev.Orb-88	**AP30A**		Art. 11 - Annex 1-5
42	Rev.Orb-88	**AP30A**		Art. 3 - 3.3
42	Rev.Orb-88	**AP30A**		Art. 4 - 4.2.1 c)
42	Rev.Orb-88	**AP30A**		Art. 5 - 5.2.1 e)
42	Rev.Orb-88	**AP30A**		Art. 5 - 5.2.2.2
42	Rev.Orb-88	**AP30A**		Art. 5 - 5.2.2.2
42	Rev.Orb-88	**AP30A**		Art. 5 - 5.2.2.2
42	Rev.Orb-88	**AP30A**		Art. 9 - 9/GR a)
42	Rev.Orb-88	**Art. 11**		A.11.1
42	Rev.Orb-88	**Art. 9**		A.9.3
46		**Rec. M.1187**		Annex 1-1
46		**Rec. M.1187**		Annex 1-1 - Para. 4
46		**Rec. M.1187**		*considering* b)
46		**Rec. M.1187**		*considering* d)
46		**Rec. M.1187**		*considering* e)
46		**Rec. M.1187**		*considering* f)
46		**Rec. M.1187**		*recognizing* 1
46	WARC-92	**Rec. M.1187**		*considering* a)
46	WARC-92	**Res. 46**	Rev.WRC-97	Annex 2 - A2.1.2.2.1
46	Rev.WRC-95	**Rec. S.1256**		*considering* e)
46	Rev.WRC-95	**Rec. S.1256**		Figure 4
46	Rev.WRC-95	**Rec. S.1256**		page 6

46	Rev.WRC-95	**Res. 132**	WRC-97	*resolves* 1
46	Rev.WRC-97	**Rec. 104**	WRC-95	*recognizing* ITU-R 1
46	Rev.WRC-97	**Res. 127**	Rev.WRC-2000	*considering* b)
46	Rev.WRC-97	**Res. 132**	WRC-97	*considering* d)
46	Rev.WRC-97	**Res. 132**	WRC-97	*resolves* 1
46	Rev.WRC-97	**Res. 215**	Rev.WRC-97	*considering* b)
46	Rev.WRC-97	**Res. 46**	Rev.WRC-97	Annex 2 - A2.3.1
46	Rev.WRC-97	**Res. 46**	Rev.WRC-97	Annex 2 - A2.3.1
46	Rev.WRC-97	**Res. 49**	Rev.WRC-2000	Annex 1 - 1
46	Rev.WRC-97	**Res. 716**	Rev.WRC-2000	Note 1
46	Rev.WRC-97	**Res. 716**	Rev.WRC-2000	*resolves* 3
46	Rev.WRC-97	**Res. 728**	Rev.WRC-2000	*considering* b)
48	WRC-95 (abrogated by WRC-97)	**Res. 46**	Rev.WRC-97	Annex 1 - Section I - 1.2
49	Rev.WRC-2000	**AP30**		Art. 4 - 4.1.25 b)
49	Rev.WRC-2000	**AP30A**		Art. 4 - 4.1.25 b)
49	Rev.WRC-2000	**Art. 11**		11.44.1
49	Rev.WRC-2000	**Art. 11**		A.11.2
49	Rev.WRC-2000	**Art. 59**		59.6
49	Rev.WRC-2000	**Art. 9**		A.9.4
49	Rev.WRC-2000	**Res. 539**	WRC-2000	*resolves* 3
49	Rev.WRC-2000	**Res. 57**	WRC-2000	*considering* i)
49	WRC-97	**AP30**		Art. 11 - 11.2 - 7 b)
49	WRC-97	**Art. 11**		11.44B
49/H	WRC-97	**Art. 59**		59.4
49	WRC-97	**Res. 51**	Rev.WRC-2000	*resolves*
49	WRC-97	**Res. 55**	WRC-2000	*resolves* 5
49	WRC-97	**Res. 57**	WRC-2000	*resolves* 5
49/H	WRC-97	**Res. 81**	WRC-2000	*considering* a)
49/H	WRC-97	**Res. 81**	WRC-2000	*considering* c)
49/H	WRC-97	**Res. 81**	WRC-2000	*noting* b)
51	Rev.WRC-2000	**Art. 11**		A.11.3
51	Rev.WRC-2000	**Art. 59**		59.6
51	Rev.WRC-2000	**Art. 9**		A.9.5
51/H	WRC-97	**Art. 59**		59.4
51/H	WRC-97	**Res. 81**	WRC-2000	*noting* c)
52/H	WRC-97 (abrogated by WRC-2000)	**Art. 59**		59.4
53	Rev.WRC-2000	**Art. 59**		59.6

53	Rev.WRC-2000	**Res. 533**	Rev.WRC-2000	*resolves* 5
53	Rev.WRC-2000	**Res. 540**	WRC-2000	*noting*
53	Rev.WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.35
54/H	WRC-97 (abrogated by WRC-2000)	**Art. 59**		59.4
55	WRC-2000	**Art. 59**		59.6
56	WRC-2000	**Art. 59**		59.6
58	WRC-2000	**Art. 59**		59.6
59	WRC-2000	**Art. 59**		59.6
72	WRC-97	**Res. 72**	Rev.WRC-2000	*recognizing* a)
73	WRC-97	**Res. 73**	Rev.WRC-2000	*considering* f)
73	WRC-97	**Res. 73**	Rev.WRC-2000	*noting*
73	WRC-97	**Res. 73**	Rev.WRC-2000	*resolves* 1
74	WRC-2000	**Res. 75**	WRC-2000	*noting*
75	WRC-2000	**Art. 5**		5.547
76	WRC-2000	**Art. 22**		22.5K
76	WRC-2000	**Art. 22**		22.5K
76	WRC-2000	**Art. 22**		22.5K
76	WRC-2000	**Art. 22**		22.5K
77	WRC-2000	**Art. 5**		5.488
77	WRC-2000	**Art. 59**		59.6
78	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.29
79	WRC-2000	**Art. 5**		5.547
80	Rev.WRC-2000	**Res. 800**	WRC-2000	*resolves* 7.1
80	WRC-97	**Res. 80**	Rev.WRC-2000	*considering* f)
82	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.26
84	WRC-2000	**Art. 21**		21.16.11
84	WRC-2000	**Art. 5**		5.547
84	WRC-2000	**Art. 5**		5.551AA
84	WRC-2000	**Art. 59**		59.6
84	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.32
95	Rev.WRC-2000	**Res. 800**	WRC-2000	*resolves* 4
95	Rev.WRC-2000	**Res. 801**	WRC-2000	*resolves* 6
114	WRC-95	**Art. 5**		5.444
114	WRC-95	**Art. 5**		5.444A
114	WRC-95	**Res. 800**	WRC-2000	*resolves* 1.4
115	WRC-95 (abrogated by WRC-97)	**Rec. S.1256**		*considering* d)
116	WRC-95 (abrogated by WRC-97)	**Rec. S.1341**		*considering* a)

117	WRC-95 (abrogated by WRC-97)	**Rec. S.1340**		*considering* a)
118/H	WRC-95 (abrogated by WRC-97)	**Res. 132**	WRC-97	*considering* a)
118/H	WRC-95 (abrogated by WRC-97)	**Res. 132**	WRC-97	*considering* d)
118/H	WRC-95 (abrogated by WRC-97)	**Res. 132**	WRC-97	*considering* e)
118/H	WRC-95 (abrogated by WRC-97)	**Res. 132**	WRC-97	*considering* h)
122	Rev.WRC-2000	**Art. 59**		59.6
122	Rev.WRC-2000	**Res. 734**	WRC-2000	*considering* c)
122	Rev.WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.13
122	WRC-97	**Art. 5**		5.552A
124	WRC-97	**Art. 5**		5.462A
124/H	WRC-97	**Res. 124**	Rev.WRC-2000	*considering further* b)
127	Rev.WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.16
128	Rev.WRC-2000	**Art. 5**		5.551G
128	Rev.WRC-2000	**Art. 59**		59.6
128	Rev.WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.32
130/H	WRC-97 (abrogated by WRC-2000)	**Art. 59**		59.4
131	WRC-97 (abrogated by WRC-2000)	**Res. 46**	Rev.WRC-97	Annex 2 - A2.2.3
135	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.19
136	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.29
207	Rev.WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.14
211	WARC-92 (abrogated by WRC-97)	**Rec. SA.1154**		*considering* b)
211	WARC-92 (abrogated by WRC-97)	**Rec. SA.1154**		*recognizing* 3
212	Rev.WRC-97	**Art. 5**		5.351A
212	Rev.WRC-97	**Art. 5**		5.388
212	Rev.WRC-97	**Res. 221**	WRC-2000	*considering* e)
212	Rev.WRC-97	**Res. 223**	WRC-2000	*considering* g)
212	Rev.WRC-97	**Res. 225**	WRC-2000	*considering* a)
212	Rev.WRC-97	**Res. 225**	WRC-2000	*considering* b)
213	Rev.WRC-95 (abrogated by WRC-2000)	**Art. 5**		5.377
214	Rev.WRC-2000	**Res. 127**	Rev.WRC-2000	*noting* a)
214	Rev.WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.20

216	Rev.WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.11
217	WRC-97	**Art. 5**		5.162A
217	WRC-97	**Art. 5**		5.291A
220/H	WRC-97 (abrogated by WRC-2000)	**Res. 226**	WRC-2000	*considering* k)
221	WRC-2000	**Art. 5**		5.388A
221	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.33
222	WRC-2000	**Art. 5**		5.353A
222	WRC-2000	**Art. 5**		5.357A
222	WRC-2000	**Res. 801**	WRC-2000	*resolves* 3.2
223	WRC-2000	**Art. 5**		5.384A
223	WRC-2000	**Art. 5**		5.388
223	WRC-2000	**Res. 223**	WRC-2000	Annex 1
223	WRC-2000	**Res. 225**	WRC-2000	*considering* b)
224	WRC-2000	**Art. 5**		5.317A
224	WRC-2000	**Res. 223**	WRC-2000	*noting* a)
224	WRC-2000	**Res. 225**	WRC-2000	*considering* b)
225	WRC-2000	**Art. 5**		5.351A
225	WRC-2000	**Res. 223**	WRC-2000	*noting* a)
226	WRC-2000	**Res. 227**	WRC-2000	*noting* b)
226	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.31
227	WRC-2000	**Res. 226**	WRC-2000	*noting*
227	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.31
228	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.22
228	WRC-2000	**Res. 801**	WRC-2000	*resolves* 2.16
300	Rev.Mob-87	**Rec. 319**	Mob-87	*considering* b)
300	Rev.Mob-87	**Rec. 319**	Mob-87	Title
300	Rev.WRC-2000	**Art. 52**		52.106
308	WARC-79 (abrogated by WARC-Mob-87)	**Rec. M.489**	2	*considering* a)
311	WARC-79 (abrogated by WARC-Mob-87)	**Rec. M.541**	8	*considering* a)
312	Rev.WRC-97	**Art. 52**		52.80
325	Mob-87 (abrogated by WRC-95)	**AP17**		Part B - 8
325/H	Mob-87 (abrogated by WRC-95)	**AP25**		Note 10
325/H	Mob-87 (abrogated by WRC-95)	**AP25**		Section II - Note 4

325/H	Mob-87 (abrogated by WRC-95)	**AP25**		Table - Plan

325/H	Mob-87 (abrogated by WRC-95)	**AP25**		Table Update
331	Rev.WRC-97	**AP13**		Part A1 - 1
331	Rev.WRC-97	**AP13**		Part A1 - 10
331	Rev.WRC-97	**AP13**		Part A1 - 9 a)
331	Rev.WRC-97	**AP13**		Part A2 - 1
331	Rev.WRC-97	**AP13**		Part A2 - 10
331	Rev.WRC-97	**AP13**		Part A2 - 19
331	Rev.WRC-97	**AP13**		Part A2 - 19 b)
331	Rev.WRC-97	**AP13**		Part A2 - 2
331	Rev.WRC-97	**AP13**		Part A2 - 20
331	Rev.WRC-97	**AP13**		Part A2 - 21
331	Rev.WRC-97	**AP13**		Part A2 - 21 3)
331	Rev.WRC-97	**AP13**		Part A2 - 22
331	Rev.WRC-97	**AP13**		Part A2 - 23
331	Rev.WRC-97	**AP13**		Part A2 - 25
331	Rev.WRC-97	**AP13**		Part A2 - 25 2)
331	Rev.WRC-97	**AP13**		Part A2 - 25 3)
331	Rev.WRC-97	**AP13**		Part A2 - 25 4)
331	Rev.WRC-97	**AP13**		Part A2 - 4
331	Rev.WRC-97	**AP13**		Part A2 - 6
331	Rev.WRC-97	**AP13**		Part A2 - 7
331	Rev.WRC-97	**AP2**		Note - 2
331	Rev.WRC-97	**AP2**		Note - 4
331	Rev.WRC-97	**Art 30**		30.4
331	Rev.WRC-97	**Art 31**		31.17
331	Rev.WRC-97	**Art 5**		5.82
331	Rev.WRC-97	**Res. 800**	WRC-2000	*resolves* 1.9
339	Rev.WRC-97	**AP15**		Table 15-1 - MSI
339	Rev.WRC-97	**Art. 5**		5.79A
340	WRC-97	**Art. 32**		32.5A
341	WRC-97	**Art. 5**		5.287
341	WRC-97	**Rec. M.1174**	1	*considering* c)
342	Rev.WRC-2000	**Res. 801**	WRC-2000	*resolves* 2.14
343	WRC-97	**Art. 48**		48.7
344	WRC-97	**Res. 800**	WRC-2000	*resolves* 1.10.1
347	WRC-97	**Res. 800**	WRC-2000	*resolves* 1.14
348	WRC-97	**Res. 800**	WRC-2000	*resolves* 1.10.2
349	WRC-97	**Art. 32**		32.10A

350	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.14
507		**AP30**		Art. 12
507		**AP30**		Art. 12 - 12.1
507		**AP30**		TM - Art. 12
507		**Art. 11**		11.37.2
507		**Art. 5**		5.311
507		**Res. 33**	Rev.WRC-97	*considering* a)
507		**Res. 33**	Rev.WRC-97	Section C - 6.4
507		**Res. 34**	WARC-79	*recognizing*
507		**Res. 525**	WARC-92	*considering* e)
508/H	WARC-79 (abrogated by WRC-97)	**Res. 535**	WRC-97	*considering* b)
514/H	HFBC-87 (abrogated by WRC-97)	**Rec. 517**	HFBC-87	*considering* h)
514/H	HFBC-87 (abrogated by WRC-97)	**Rec. 517**	HFBC-87	*recommends*
517/H		**Rec. 517**	HFBC-87	*considering* d)
517/H		**Rec. 519**	WARC-92	*considering* a)
517	Rev.WRC-97	**AP11**		Part B - 1.1
517	Rev.WRC-97	**Rec. 503**	Rev.WRC-2000	*considering* f)
517	Rev.WRC-97	**Rec. 515**	Rev.WRC-97	*considering* a)
517	Rev.WRC-97	**Rec. 519**	WARC-92	*considering* e)
517	Rev.WRC-97	**Rec. 519**	WARC-92	*considering* f)
517	Rev.WRC-97	**Res. 537**	WRC-97	*considering* a)
517	Rev.WRC-97	**Res. 537**	WRC-97	*considering* b)
517	Rev.WRC-97	**Res. 537**	WRC-97	*resolves*
517	Rev.WRC-97	**Res. 537**	WRC-97	Title
517	Rev.WRC-97	**Res. 800**	WRC-2000	*resolves* 1.2
523/H	WARC-92 (abrogated by WRC-97)	**Res. 535**	WRC-97	*considering* b)
524/H	WARC-92 (abrogated by WRC-2000)	**Rec. 521**	WRC-95	*considering*
524/H	WARC-92 (abrogated by WRC-2000)	**Rec. 521**	WRC-95	*noting* a)
524/H	WARC-92 (abrogated by WRC-2000)	**Rec. 521**	WRC-95	*recognizing*
524/H	WARC-92 (abrogated by WRC-2000)	**Rec. 521**	WRC-95	Title
524/H	WARC-92 (abrogated by WRC-2000)	**Res. 532**	WRC-97	*considering* a)
525	WARC-92	**Art. 5**		5.530

525	WARC-92	**Res. 526**	WARC-92	*considering* c)
528	WARC-92	**Art. 5**		5.345
528	WARC-92	**Art. 5**		5.393
528	WARC-92	**Art. 5**		5.418
528	WARC-92	**Art. 5**		5.418A
528	WARC-92	**Res. 539**	WRC-2000	*considering* b)
529/H	WRC-95 (abrogated by WRC-97)	**Res. 29**	WRC-97	*considering* a)
531	WRC-95 (abrogated by WRC-2000)	**Rec. BO.1295**		*considering* a)
531	WRC-95 (abrogated by WRC-2000)	**Rec. BO.1296**		*considering* a)
531	WRC-95 (abrogated by WRC-2000)	**Rec. BO.1297**		*considering* a)
531/H	WRC-95 (abrogated by WRC-2000)	**Res. 532**	WRC-97	Annex 1
531/H	WRC-95 (abrogated by WRC-2000)	**Res. 532**	WRC-97	*considering* a)
533	Rev.WRC-2000	**Art. 59**		59.6
533/H	WRC-97	**Art. 59**		59.4
534/H	WRC-97 (abrogated by WRC-2000)	**Art. 59**		59.4
537	WRC-97	**Res. 517**	Rev.WRC-97	*resolves* 2
537	WRC-97	**Res. 800**	WRC-2000	*resolves* 1.2
538/H	WRC-97 (abrogated by WRC-2000)	**Art. 59**		59.4
539	WRC-2000	**AP5**		Table 5.1 - 9.11
539	WRC-2000	**Art. 5**		5.418
539	WRC-2000	**Art. 5**		5.418A
539	WRC-2000	**Art. 5**		5.418B
539	WRC-2000	**Art. 5**		5.418C
539	WRC-2000	**Art. 59**		59.6
539	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.34
540	WRC-2000	**AP30**		Art. 4 - 4.1.18
540	WRC-2000	**AP30A**		Art. 4 - 4.1.18
540	WRC-2000	**Art. 59**		59.6
540	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.27
541	WRC-2000	**Art. 59**		59.6
542	WRC-2000	**Art. 59**		59.6
603	WRC-2000	**Art. 5**		5.443A
604	WRC-2000	**Art. 5**		5.443B

604	WRC-2000	**Art. 59**		59.6
604	WRC-2000	**Res. 59**	WRC-2000	*considering further* b)
604	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.15
605	WRC-2000	**Art. 5**		5.328A
605	WRC-2000	**Art. 59**		59.6
605	WRC-2000	**Res. 59**	WRC-2000	*considering further* b)
605	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.15
606	WRC-2000	**Art. 5**		5.329
606	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.15
645	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.3
703	Rev.WARC-92	**Res. 33**	Rev.WRC-97	Note 1
703	Rev.WARC-92	**Res. 34**	WARC-79	*resolves* 3
703	Rev.WARC-92	**Res. 46**	Rev.WRC-97	Annex 1 - A.2
703	Rev.WARC-92	**Res. 528**	WARC-92	*resolves* 4
716	WRC-95	**Art. 5**		5.389A
716	WRC-95	**Art. 5**		5.389C
716	WRC-95	**Art. 5**		5.390
720/H	WRC-95 (abrogated by WRC-97)	**Res. 347**	WRC-97	*noting* a)
721/H	WRC-97 (abrogated by WRC-2000)	**Res. 57**	WRC-2000	*considering* a)
722/H	WRC-97 (abrogated by WRC-2000)	**Rec. 66**	Rev.WRC-2000	*noting* c)
723	Rev.WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.12
723/H	WRC-97	**Res. 57**	WRC-2000	*considering* b)
727	Rev.WRC-2000	**Res. 800**	WRC-2000	*further resolves* 8.3
728	Rev.WRC-2000	**Res. 801**	WRC-2000	*resolves* 2.8
729	WRC-97	**Res. 801**	WRC-2000	*resolves* 2.9
730	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.12
733	WRC-2000	**Art. 5**		5.502
733	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.24
734	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.13
735	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.27
736	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.5
737	WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.21
737	WRC-2000	**Res. 801**	WRC-2000	*resolves* 2.15
801	WRC-2000	**Res. 800**	WRC-2000	*resolves* 7.2

Rec. No.	Version	Referred to in	Version	No
14	Mob-87	**AP13**		Part A4 - 11A
14	Mob-87	**Art. 33**		33.28
34	WRC-95	**Res. 216**	Rev.WRC-2000	*considering* h)
34	WRC-95	**Res. 737**	WRC-2000	*noting* b)
66		**Res. 604**	WRC-2000	*noting* b)
66	Rev.WRC-2000	**Res. 800**	WRC-2000	*resolves* 1.8.2
66	Rev.WRC-2000	**AP3**		Table 1
66	Rev.WRC-2000	**AP3**		Table 1 - Note 8
66	Rev.WRC-2000	**AP3**		Table 1 - Note 9
66/H	Rev.WRC-97	**Res. 604**	WRC-2000	*considering* g)
312	WARC-79 (abrogated by WRC-97)	**Rec. M.541**	8	*considering* a)
318	Mob-87	**Res. 342**	Rev.WRC-2000	*considering* b)
515		**Rec. 517**	HFBC-87	*considering* d)
515	Rev. WRC-97	**Res. 517**	Rev.WRC-97	*considering* d)
515	Rev.WRC-97	**Rec. 519**	WARC-92	*considering* c)
515	Rev.WRC-97	**Res. 537**	WRC-97	*noting* a)
515	Rev.WRC-97	**Res. 537**	WRC-97	*noting* b)
515	Rev.WRC-97	**Res. 800**	WRC-2000	*resolves* 1.2
517	HFBC-87	**Res. 535**	WRC-97	Annex - desc 4
517	HFBC-87	**Res. 800**	WRC-2000	*resolves* 1.2
519	WARC-92	**Res. 800**	WRC-2000	*resolves* 1.2
521	WRC-95	**AP30**		Annex 5 - 3.4
521	WRC-95	**AP30**		Annex 5 - 3.4
521	WRC-95	**AP30A**		Annex 3 - 3.3
521	WRC-95	**AP30A**		Annex 3 - 3.3
521	WRC-95	**Rec. BO.1297**		*considering* b)
604	Rev.Mob-83	**Res. 205**	Rev.Mob-87	*considering* f)
705		**Art. 5**		5.311
707		**Art. 5**		5.548
715	Orb-88	**Rec. 719**	WARC-92	*considering* d)
718	WARC-92	**Res. 800**	WRC-2000	*resolves* 1.23

ATTACHMENT 3

EXAMPLE TEXT FOR DRAFT REVISION OF RESOLUTION 63

Relating to the protection of radiocommunication services against interference caused by radiation from industrial, scientific and medical (ISM) equipment and from wired telecommunication systems

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that ISM equipment generates and uses locally radio frequency energy, whereby outward radiation cannot always be avoided;

b) that there is an increasing amount of ISM equipment working on various frequencies throughout the spectrum;

c) that in some cases a considerable part of the energy may be radiated by ISM equipment outside its working frequency;

d) that Recommendation ITU-R SM.1056 recommends the use of CISPR Publication 11 as a guide for ISM equipment regulation to protect radiocommunication, but that CISPR 11 has not yet fully specified radiation limits for all frequency bands and, particularly, below 30 MHz;

e) that there are new wired telecommunication systems such as SDL and power line transmission (PLT) which utilize existing telephone lines and electricity power lines and transmit high data rate broadband signals using frequency bands of LF, MF, HF, and VHF which are already used by radiocommunications;

f) that those wirings are not designed or installed for the broadband signal transmission, and radiation from the wires will inevitably occur;

g) that radio services, especially those using low field strengths, may suffer interference caused by radiation from ISM equipment and the wired telecommunication systems, a risk which is unacceptable particularly in the case of radionavigation or other safety services;

h) that, in order to limit the risks of interference to specified parts of the spectrum:

i) the preceding Radio Conferences of Atlantic City, 1947, and Geneva, 1959, have designated some frequency bands within which the radiocommunication services must accept harmful interference produced by ISM equipment;

ii) WARC-79 accepted an increase in the number of bands to be designated for ISM equipment, but only on the condition that limits of radiation from such equipment be specified within the bands newly designated for worldwide use and outside all the bands designated for ISM equipment,

resolves

that, to ensure that radiocommunication services are adequately protected, studies are urgently required on the limits to be imposed on the radiation from ISM equipment and from wired telecommunication systems in the entire radio spectrum, particularly in the frequency bands below 30 MHz, *invites the ITU-R*

1 to continue, in collaboration with the International Special Committee on Radio Interference (CISPR), the International Electrotechnical Committee (IEC) and ITU-T, its studies relating to radiation from ISM equipment and wired telecommunication systems in the entire radio spectrum in order to ensure adequate protection of radiocommunication services;

2 to specify as soon as possible, in the form of Recommendations, the limits to be imposed on radiation from ISM equipment inside and outside the bands designated for their use in the Radio Regulations and from wired telecommunication systems.

Priority should be given to the studies relating to the frequency bands below 30 MHz and those which are not covered by Recommendation ITU-R SM.1056.

ATTACHMENT 4

EXAMPLE TEXT FOR DRAFT REVISION OF RESOLUTION 95 (Rev.WRC-2000)

General review of the Resolutions and Recommendations of world administrative radio conferences and world radiocommunication conferences

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that it is important to keep the Resolutions and Recommendations of past world administrative radio conferences and world radiocommunication conferences under constant review, in order to keep them up to date;

b) that the reports of the Director of the Radiocommunication Bureau submitted to previous conferences provided a useful basis for a general review of the Resolutions and Recommendations of past conferences;

c) that some principles and guidelines are necessary for future conferences to treat the Resolutions and Recommendations of previous conferences which are not related to the agenda of the conference;

d) that it is necessary for the conference to review the progress of ITU-R studies which are not placed on the agenda of the conferences in an immediate future in order to take appropriate action on the relevant Resolutions and Recommendations,

resolves to invite future competent world radiocommunication conferences

1 to review the Resolutions and Recommendations of previous conferences that are related to the agenda of the conference with a view to their possible revision, replacement or abrogation and to take appropriate action;

2 to review the Resolutions and Recommendations of previous conferences that are not related to any agenda item of the conference with a view to:

– abrogating those Resolutions and Recommendations that have served their purpose or have become no longer necessary;
– abrogating those Resolutions and Recommendations, or parts thereof, requesting ITU-R studies for which no progress has been made during the last two conference periods;
– updating and modifying Resolutions and Recommendations, or parts thereof that have become out of date, and to correct obvious omissions, inconsistencies, ambiguities or editorial errors and effect any necessary alignment;

3 at the beginning of the conference, to determine which committee within the conference has the primary responsibility to review each of the Resolutions and Recommendations referred to in *resolves* 1 and 2 above,

instructs the Director of the Radiocommunication Bureau

1 to conduct a general review of the Resolutions and Recommendations of previous conferences and, after consultation with the Radiocommunication Advisory Group and the Chairmen and Vice-Chairmen of the Radiocommunication Study Groups, submit a report to the second session of the Conference Preparatory Meeting in respect of *resolves* 1 and *resolves* 2;

2 if practicable, to include in the above report an indication of the agenda item, if appropriate, and possible responsible committees within the conference for each text, based on the available information as to the possible structure of the conference;

3 to include in the above report, with the cooperation of the Chairmen of the Radiocommunication Study Groups, the progress reports of ITU-R studies on the issues which have been requested by the Resolutions and Recommendations of previous conferences, but which are not placed on the agenda of the conferences in an immediate future,

invites the Conference Preparatory Meeting

to include, in its Report, the results of a general review of the Resolutions and Recommendations of previous conferences.

ATTACHMENT 5

EXAMPLE TEXT FOR REVISION OF RESOLUTION 703 (Rev.WRC-03)

Calculation methods and interference criteria recommended by the ITU-R for sharing frequency bands between space radiocommunication and terrestrial radiocommunication services or between space radiocommunication services

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that, in frequency bands shared with equal rights by space radiocommunication and terrestrial radiocommunication services, it is necessary to impose certain technical limitations and coordination procedures on each of the sharing services for the purpose of limiting mutual interference;

b) that, in frequency bands shared by space stations located on geostationary satellites, it is necessary to impose coordination procedures for the purpose of limiting mutual interference;

c) that the calculation methods and interference criteria relating to coordination procedures referred to in *considering a)* and *b)* are based upon ITU-R Recommendations;

d) that, in recognition of the successful sharing of the frequency bands by space radiocommunication and terrestrial radiocommunication services, and the continuing improvements in space technology and that of the Earth segment, each Radiocommunication Assembly has improved upon some of the technical criteria recommended by the preceding Assembly;

e) that the ITU Radiocommunication Assembly has approved a procedure for approving Recommendations between Radiocommunication Assemblies;

f) that the Constitution recognizes the right of Member States to make special arrangements on telecommunication matters; however, such arrangements shall not be in conflict with the terms of the Constitution, Convention or of the Regulations annexed thereto as far as harmful interference to the radio services of other countries is concerned,

is of the opinion

a) that future decisions of the ITU-R are likely to make further changes in the recommended calculation methods and interference criteria;

b) that the administrations should whenever possible apply the current ITU-R Recommendations on sharing criteria when planning systems for use in frequency bands shared with equal rights between space radiocommunication and terrestrial radiocommunication services, or between space radiocommunication services,

invites Administrations

to submit contributions to the Radiocommunication Study Groups, providing information on practical results and experience of sharing between terrestrial and space radiocommunication services or between space services, which help to bring about significant improvements in coordination procedures, calculation methods and harmful interference thresholds, and thereby to optimize the available orbit/spectrum resources,

resolves

1 that the Director of the Radiocommunication Bureau, in consultation with Study Group Chairmen, shall prepare a list identifying the relevant parts of new or revised Recommendations approved by the ITU-R affecting the calculation methods and the interference criteria and also those specific sections of the Radio Regulations to which they are applicable, relating to sharing between space radiocommunication and terrestrial radiocommunication services, or between space radiocommunication services. This list shall be prepared without delay following the approval of these Recommendations;

2 that the Director of the Radiocommunication Bureau shall forward this list to all administrations for information once every year.

#########

6.4 Agenda item 7.1

"to consider and approve the Report of the Director of the Radiocommunication Bureau on the activities of the Radiocommunication Sector since WRC-2000, including on any difficulties or inconsistencies encountered in the application of the Radio Regulations, and action in response to Resolution **80** (**Rev.WRC-2000**)"

6.4.1 Resolution 33 (Rev.WRC-97)

In Section 3.6.1 of his Preliminary Report to the Conference, the Director of the Radiocommunication Bureau indicated that the current text of Resolution 33 (Rev.WRC-97) contains ambiguities that have led to confusion when applying the procedures forming part of the Resolution. Modifications to Resolution 33 which resolve these ambiguities can be found in the example text included in Annex 6.4.1-1.

The Conference may wish to consider the following actions in respect to the provisions and Resolutions that are making reference to Resolution 33 (Rev.WRC-97). These actions flow from the proposed modifications to Resolution 33 explained above and included in Annex 6.4.1-1. The proposed course of action is indicated below:

MOD

resolves 1 of Resolution **34**

1 that, until such time as a Plan may be established for the broadcasting-satellite service in the band 12.5-12.75 GHz in Region 3, the relevant provisions of Sections A to B of Resolution **33 (Rev.WRC-03)** or of Article **9**, as appropriate (see Resolution **33** (Rev.WRC-03)), shall continue to apply to the coordination between stations in the broadcasting-satellite service in Region 3 and:

1) space stations in the broadcasting-satellite and fixed-satellite services in Regions 1, 2 and 3;

2) terrestrial stations in Regions 1, 2 and 3;

MOD

5.1. *f)* of Annex to Resolution **42** (Rev.ORB-88)

f) an administration of Region 3 is considered to be affected if it has a frequency assignment to a space station in the broadcasting-satellite service in the band 12.5-12.7 GHz with a necessary bandwidth any portion of which falls within the necessary bandwidth of the proposed assignment, and which:

- is recorded in the Master Register; *or*
- has been coordinated or is being coordinated under the provisions of Sections A to B of Resolution **33 (Rev.WRC-03)** or under the provisions of Articles **9** to **14**, as appropriate (see Resolution **33** (Rev.WRC-03)); *or*
- appears in a Region 3 Plan to be adopted at a future radiocommunication conference, taking account of modifications which may be introduced subsequently in accordance with the Final Acts of that conference,

and the limits of § 3, Annex 1 to Appendix **30** are exceeded.

MOD

resolves 2 of Resolution **507**

2 that during the period before the entry into force of such agreements and associated Plans the administrations and the Radiocommunication Bureau shall apply the procedure contained in Sections A to C of Resolution **33 (Rev.WRC-03)** or contained in Articles **9** to **14**, as appropriate (see Resolution **33** (Rev.WRC-03)),

MOD

§ 2 of Section II of Annex to Resolution **525** (WARC-92)

2 For the purpose of introducing experimental BSS (HDTV) systems in the band 21.4-22.0 GHz in Regions 1 and 3 before 1 April 2007 under the provisions of Article **27**, the procedures contained in Sections A to C of Resolution **33 (Rev.WRC-03)** or in Articles **9** to **14**, as appropriate (see Resolution **33** (Rev.WRC-03)), shall be applied.

MOD

§ 4 of Section III of Annex to Resolution **525** (WARC-92)

4 If the power flux-density at the Earth's surface produced by emissions from a space station does not exceed these limits, the procedure in Section A of Resolution **33 (Rev.WRC-03)** or No. **9.11**, as appropriate (see Resolution **33** (Rev.WRC-03)) shall not be applied.

MOD

§ 5 of Section IV of Annex to Resolution **525** (WARC-92)

5 For the purpose of introducing and operating BSS (HDTV) systems in the band 21.4-22.0 GHz in Regions 1 and 3 after 1 April 2007, and before a future conference has taken decisions on definitive procedures, all relevant provisions of Articles **9** to **14** except No. **9.11** shall be applied.

MOD

resolves 3 of Resolution **528** (WARC-92)

3 that in the interim period, broadcasting-satellite systems may only be introduced within the upper 25 MHz of the appropriate band in accordance with the procedures contained in Sections A to C of Resolution **33 (Rev.WRC-03)**, or in Articles **9** to **14**, as appropriate (see Resolution **33 (Rev.WRC-03)**). The complementary terrestrial service may be introduced during this interim period subject to coordination with administrations whose services may be affected;

MOD

Title, Article **9** (ADD new footnote)

Procedure for effecting coordination with or obtaining agreement of other administrations[6A]

ADD

[6A] **A.9.7** See also Resolution **33 (Rev.WRC-03)**.

MOD

Title, Article **11** (ADD new footnote)

Notification and recording of frequency assignments[5A]

ADD

[5A] **A.11.5** See also Resolution **33 (Rev.WRC-03)**.

ANNEX 6.4.1-1

Example text of modifications resolving ambiguities in Resolution 33 (Rev.WRC-97)

RESOLUTION 33 (REV.WRC-03)

Bringing into use of space stations in the broadcasting-satellite service, prior to the entry into force of agreements and associated plans for the broadcasting-satellite service

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that while Resolution **507** envisages plans for the broadcasting-satellite service (BSS), some administrations might nevertheless feel the need to bring stations in that service into use prior to such plans being established;

b) that administrations should, as far as possible, avoid proliferation of space stations in the BSS before such plans have been established;

c) that a space station in the BSS may cause harmful interference to terrestrial stations operating in the same frequency band, even if the latter are outside the service area of the space station;

d) that the procedures specified in Articles **9** to **14** and Appendix **5** contain provisions for coordination between stations in the BSS and terrestrial stations, between space systems in that service and space systems of other administrations;

e) that there are many existing and planned stations in the BSS not subject to agreements and associated plans that have submitted advance publication information (API) or a request for coordination under the existing Resolution **33** procedures and that some administrations are currently in coordination under these procedures;

resolves

1 that, except in those cases where agreements and associated plans for the BSS have been established and have entered into force, for satellite networks for which the API has been received following 1 January 1999, only the procedures of Articles **9** to **14** shall be applied for the coordination and notification of stations in the BSS and coordination and notification of other services in respect of that service;

2 that, except in those cases where agreements and associated plans for the BSS have been established and have entered into force, for satellite networks for which the API has been received by the Radiocommunication Bureau prior to 1 January 1999, only the procedure in Sections A to C in this Resolution shall be applied;

3 that a future conference review the requirement for the procedures in this Resolution.

Section A – Coordination procedure between space stations in the broadcasting-satellite service and terrestrial stations

2.1 Before an administration notifies to the Bureau or brings into use any frequency assignment to a space station in the broadcasting-satellite service in a frequency band where this frequency band is allocated, with equal rights, to the broadcasting-satellite service and to a terrestrial radiocommunication service, either in the same Region or sub-Region or in different Regions or sub-Regions, it shall coordinate the use of this assignment with any other administration whose terrestrial radiocommunication services may be affected. For this purpose, it shall inform the Bureau of all the technical characteristics of the station, as listed in the relevant sections of Appendix **4** to the Radio Regulations, which are necessary to assess the risk of interference to a terrestrial radiocommunication service[1].

2.2 The Bureau shall publish this information in a Special section of its Weekly Circular and shall also, when the Weekly Circular contains such information, so advise all administrations by circular telegram.

2.3 Any administration which considers that its terrestrial radiocommunication services may be affected shall forward its comments to the administration seeking coordination and, in any case, to the Bureau. These comments must be forwarded within four months from the date of the relevant BR IFIC. It shall be deemed that any administration which has not forwarded comments within that period considers that its terrestrial radiocommunication services are unlikely to be affected.

2.4 Any administration which has forwarded comments on the projected station shall either give its agreement, with a copy to the Bureau, or, if this is not possible, send to the administration seeking coordination all the data on which its comments are based as well as any suggestions it may be able to offer with a view to a satisfactory solution of the problem.

2.5 The administration which plans to bring into use a space station in the broadcasting-satellite service as well as any other administration which believes that its terrestrial radiocommunication services are likely to be affected by the station in question may request the assistance of the Bureau at any time during the coordination procedure.

2.6 In the event of continuing disagreement between an administration seeking to effect coordination and one with which coordination has been sought, the administration seeking coordination shall, except in the cases where the assistance of the Bureau has been requested, defer the submission of its notice concerning the proposed assignment by six months from the date of publication of the information according to § 2.2.

1 The calculation methods and the interference criteria to be employed in evaluating the interference should be based upon relevant ITU-R Recommendations agreed by the administrations concerned either as a result of Resolution **703 (Rev.WARC-92)** or otherwise. In the event of disagreement on an ITU-R Recommendation or in the absence of such Recommendations, the methods and criteria shall be agreed between the administrations concerned. Such agreements shall be concluded without prejudice to other administrations.

Section B – Coordination procedure between space stations in the broadcasting-satellite service and space systems of other administrations

3 An administration intending to bring into use a space station in the broadcasting-satellite service shall, for the purpose of coordination with space systems of other administrations, apply the following provisions of Article **11** of the Radio Regulations (edition of 1990, revised in 1994):

3.1 Nos. **1041** to **1058** inclusive.

3.2.1 Nos. **1060** to **1065**[2].

3.2.2 No coordination under § 3.2.1 is required when an administration proposes to change the characteristics of an existing assignment in such a way as not to increase the probability of harmful interference to stations in the space radiocommunication service of other administrations.

3.2.3 Nos. **1074** to **1105** inclusive.

Section C – Notification, examination and recording in the Master Register of assignments to space stations in the broadcasting-satellite service dealt with under this resolution

4.1 Any frequency assignment[3] to a space station in the broadcasting-satellite service shall be notified to the Bureau. The notifying administration shall apply for this purpose the provisions of Nos. **1495** to **1497** of the Radio Regulations (edition of 1990, revised in 1994).

4.2 Notices made under § 4.1 shall initially be treated in accordance with No. **1498** of the Radio Regulations (edition of 1990, revised in 1994).

5.1 The Bureau shall examine each notice with respect to:

5.2 *a)* its conformity with the Convention, the Table of Frequency Allocations and the other provisions of the Radio Regulations, with the exception of those relating to the coordination procedures and to the probability of harmful interference, which are the subject of §§ 5.3, 5.4, and 5.5;

5.3 *b)* its conformity, where applicable, with the provisions of § 2.1 of Section A above, relating to coordination of the use of the frequency assignment with the other administrations concerned;

5.4 *c)* its conformity, where applicable, with the provisions of § 3.2.1 of Section B above, relating to coordination of the use of the frequency assignment with the other administrations concerned;

5.5 *d)* where appropriate, the probability of harmful interference to the service rendered by a station in a space or terrestrial radiocommunication service for which a frequency assignment has already been recorded in the Master Register in conformity with the provisions of Nos. **1240** or **1503** of the Radio Regulations (edition of 1990, revised in 1994), or No. **11.31**, as appropriate, if that assignment has not, in fact, caused harmful interference to the service rendered by a station for which an assignment has been previously recorded in the Master Register and which itself is in

[2] See footnote 1.

[3] The expression *frequency assignment*, wherever it appears in this Resolution, shall be understood to refer either to a new frequency assignment or to a change in an assignment already recorded in the Master International Frequency Register (hereinafter called the *Master Register*).

conformity with Nos. **1240** or **1503** of the Radio Regulations (edition of 1990, revised in 1994), or No. **11.31** as appropriate.

6.1 Depending upon the findings of the Bureau subsequent to the examination prescribed in §§ 5.2, 5.3, 5.4 and 5.5, further action shall be as follows:

6.2 Where the Bureau reaches an unfavourable finding with respect to § 5.2, the notice shall be returned immediately by airmail to the notifying administration with the reasons of the Bureau for this finding together with such suggestions as the Bureau is able to offer with a view to a satisfactory solution of the problem.

6.3 Where the Bureau reaches a favourable finding with respect to § 5.2, or where it reaches the same finding after resubmission of the notice, it shall examine the notice with respect to the provisions of §§ 5.3 and 5.4.

6.4 Where the Bureau finds that the coordination procedures mentioned in §§ 5.3 and 5.4 have been successfully completed with all administrations whose services may be affected, the assignment shall be recorded in the Master Register. The date of receipt by the Bureau of the notice shall be entered in Column 2d of the Master Register with an entry in the Remarks Column indicating that such recording does not prejudge in any way the decisions to be included in the agreements and associated plans referred to in Resolution **507**.

6.5 Where the Bureau finds that the coordination procedures mentioned in §§ 5.3 or 5.4 have not, as appropriate, been applied or have been unsuccessfully applied, the notice shall be returned immediately by airmail to the notifying administration with the reason for its return together with such suggestions as the Bureau is able to offer with a view to a satisfactory solution of the problem.

6.6 Where the notifying administration resubmits the notice and states that it has been unsuccessful in endeavouring to effect the coordination, the notice shall be examined by the Bureau with respect to § 5.5.

6.7 Where the notifying administration resubmits the notice and the Bureau finds that the coordination procedures have been successfully completed with all administrations whose services may be affected, the assignment shall be treated as indicated in § 6.4.

6.8 Where the Bureau reaches a favourable finding with respect to § 5.5, the assignment shall be recorded in the Master Register. The appropriate symbol indicating the finding by the Bureau shall indicate that the coordination procedures, as appropriate, referred to in §§ 2.1 or 3.2.1 were not successfully completed. The date of receipt by the Bureau of the notice shall be entered in Column 2d of the Master Register, with the remark mentioned in § 6.4.

6.9 Where the Bureau reaches an unfavourable finding with respect to § 5.5, the notice shall be returned immediately by airmail to the notifying administration with the reasons for the Bureau's finding together with such suggestions as the Bureau is able to offer with a view to a satisfactory solution of the problem.

6.10 If the administration resubmits the notice unchanged with the insistence that it be reconsidered, but should the Bureau's unfavourable finding under § 5.5 remain unchanged, the assignment shall be recorded in the Master Register. However, this entry shall be made only if the notifying administration informs the Bureau that the assignment has been in use for at least four months without any complaint of harmful interference having been received. The date of receipt by the Bureau of the original notice shall be entered in Column 2d of the Master Register, with the remark mentioned in § 6.4. An appropriate remark shall be placed in Column 13 to indicate that the assignment is not in conformity with the provisions of §§ 5.3, 5.4 or 5.5, as appropriate. In the event that the administration concerned receives no complaint of harmful interference concerning the operation of the station in question for a period of one year from the commencement of operation, the Bureau shall review its finding.

6.11 If harmful interference is actually caused to the reception of any space station in the broadcasting-satellite service whose frequency assignment has been recorded in the Master Register as a result of a favourable finding with respect to §§ 5.2, 5.3, 5.4 and 5.5 of this Resolution, as appropriate, by the use of a frequency assignment to a space station which has been subsequently recorded in the Master Register in accordance with the provisions of § 6.10 of this Resolution or of No. **1544** of the Radio Regulations (edition of 1990, revised in 1994), or No. **11.41**, as appropriate, the station using the latter frequency assignment must, upon receipt of advice thereof, immediately eliminate this harmful interference.

6.12 If harmful interference is actually caused to the reception of any space radiocommunication station using an assignment recorded in the Master Register as a result of a favourable finding with respect to Nos. **1503** to **1512** of the Radio Regulations (edition of 1990, revised in 1994), or Nos. **11.31** to **11.34**, as appropriate, by the use of an assignment to a space station in the broadcasting-satellite service which has been subsequently recorded in the Master Register in accordance with the provisions of § 6.10 of this Resolution, the station using the latter assignment must, on receipt of advice thereof, immediately eliminate this harmful interference.

6.13 If harmful interference is actually caused to the reception of any terrestrial station using an assignment recorded in the Master Register as a result of a favourable finding with respect to No. **1240** of the Radio Regulations (edition of 1990, revised in 1994), or No **11.31**, as appropriate, by the use of an assignment to a space station in the broadcasting-satellite service which has been subsequently recorded in the Master Register in accordance with the provisions of § 6.10 of this Resolution, the station, using the latter assignment must, on receipt of advice thereof, immediately eliminate this harmful interference.

6.14 If harmful interference to the reception of any station whose assignment is in accordance with § 5.2 of this Resolution is actually caused by the use of a frequency assignment which is not in conformity with Nos. **1240**, **1352** or **1503** of the Radio Regulations (edition of 1990, revised in 1994), or No. **11.31**, as appropriate, the station using the latter frequency assignment must, upon receipt of advice thereof, immediately eliminate this harmful interference.

*****

6.4.2 Resolution 77 (WRC-2000)

Section 3.1.2 of the Preliminary Report of the BR to WRC-03, addressing the application of No. **5.488** in relation to Resolution **77 (WRC-2000)**, states that "The conference may wish to consider the wording of Resolution **77** and to introduce appropriate clarification so as to indicate the coordination mechanism to be applied in an unambiguous manner".

Resolution **77** contains pfd threshold levels and associated regulatory provisions which are intended to protect terrestrial services of all Regions from GSO FSS space station transmissions serving Region 2 in the 11.7-12.2 GHz band. This Resolution instructs that the notifying administration "seeks the agreement" of any administration of Regions 1, 2 and 3 having primary allocation to terrestrial services in the same frequency band if the power flux-density (pfd) produced on its territory exceeds the identified "thresholds".

This Resolution was intended to provide a process through which the notifying administration of the FSS network may exceed these thresholds.

It was agreed that the threshold pfd levels in Resolution **77 (WRC-2000)** are to be used by the Bureau to identify the administrations whose terrestrial services may be affected and this is clear in Resolution **77**.

In order to clarify the regulatory mechanism required by Resolution **77 (WRC-2000)**, these pfd threshold levels may be applied in conjunction with two possible regulatory approaches:

- As thresholds in the application of the provisions of No. **9.21** and associated Rules of Procedure[5], which involves implicit agreement in case of no response within four months of the publication of the FSS network, and the possibility to object to the FSS system only on the basis of terrestrial stations in service within three years of that publication. The agreements are examined by the Bureau under No. **11.31** but not under No. **9.35**, which enables the FSS network to continue to be protected by subsequent networks regardless of its pfd levels.
- As thresholds in the application the coordination procedure of No. **9.14**, which involves implicit agreement in case of no response within four months of the publication of the FSS network, and the possibility to protect only terrestrial stations in service within three years of that publication. The agreements would be examined by the Bureau under No. **11.32**. As a result, in case of disagreement, the FSS space station assignment may be recorded and brought into service, provided it does not cause harmful interference into the terrestrial stations which were the basis of the disagreement and have been recorded in the MIFR.

In addition to the above methods, the following was proposed by some administrations:

- Inclusion of hard limits in Article **21**.
- Providing different regulatory treatment for the protection of terrestrial services in Region 2 and the protection of terrestrial services in Region 1 and 3 from FSS in Region 2.

Other administrations believed that these additional proposals were not consistent with Resolution **77 (WRC-2000)** and would not answer the difficulties identified by the Bureau.

[5] There would be a need to reflect the current Rules of Procedure of No. **9.21** in the body of the Radio Regulations.

CHAPTER 7

Future work programme

(WRC-03 agenda items 1.21, 1.22, 7.2)

CONTENTS

7.1 Agenda item 1.21

"to consider progress of the ITU-R studies concerning the technical and regulatory requirements of terrestrial wireless interactive multimedia applications, in accordance with Resolution **737 (WRC-2000)**, with a view to facilitating global harmonization"

Resolution **737 (WRC-2000)**.

Review of spectrum and regulatory requirements to facilitate worldwide harmonization of emerging terrestrial wireless interactive multimedia applications.

7.1.1 Summary of technical and operational studies

7.1.1.1 Terms related to the studies

Most of the terms used in relation to WRC-03 agenda item 1.21 are defined in one or more ITU Recommendations. Due to the fact that the definitions have been developed in different groups and at different times there may be variations in the definitions. It is considered important to get a common understanding of the terms used in this section of the CPM Report and a list of references providing definitions has been developed to achieve this goal (see below).

The terms and definitions in the references list should be read in addition to those in the Radio Regulations. In some cases the same term may have been defined differently in an ITU-R Recommendation from that in the Radio Regulations (or even the Constitution). In these cases, the definition in the basic instruments of the ITU shall prevail.

Term	**Reference**
Bidirectional	Recommendation ITU-R V.662
Broadband	ITU-T Recommendation I.113
Broadband wireless access (BWA)	Recommendation ITU-R F.1399-1
Broadcasting	Recommendation ITU-R V.662
Core network (CN)	ITU-T Recommendation Y.101
Downstream	Recommendation ITU-R F.1399-1
End-user	Recommendation ITU-R F.1399-1
Fixed wireless access (FWA)	Recommendation ITU-R F.1399-1
Fixed wireless systems (FWS)	Recommendation ITU-R F.592-3
High Density applications in the Fixed Service (HDFS)	Recommendation ITU-R F.592-3
Interactive service	Recommendation ITU-R M.1224
Mobile wireless access (MWA)	Recommendation ITU-R F.1399-1
Multimedia service	Recommendation ITU-R M.1224 ITU-T Recommendation I.113
Multimedia wireless system (MWS)	Recommendation ITU-R F.1399-1
Narrow-band wireless access	Recommendation ITU-R F.1399-1
Network	Recommendation ITU-R M.1308
Nomadic wireless access (NWA)	Recommendation ITU-R F.1399-1
Service	Recommendation ITU-R M.1308
Station	Recommendation ITU-R F.1399-1
System	Recommendation ITU-R M.1308
Unidirectional	Recommendation ITU-R V.662
Universal personal telecommunications (UPT) service	ITU-T Recommendation I.114

Upstream	Recommendation ITU-R F.1399-1
User	Recommendation ITU-R F.1399-1
Wideband wireless access	Recommendation ITU-R F.1399-1
Wireless access	Recommendation ITU-R V.573-4 Recommendation ITU-R F.1399-1

7.1.1.2 General characteristics (technical and operational) of terrestrial wireless interactive multimedia systems, various applications and technologies

7.1.1.2.1 Technical and operational characteristics

With regard to earlier studies within ITU, issues related to "terrestrial wireless interactive multimedia" (TWIM) applications have resulted in a number of Recommendations (see Section 7.1.1.1).

In order to support TWIM applications, a system should be capable of carrying simultaneously many different radiocommunication services offered to individuals and capable of delivering specific information to individuals.

A key requirement is the availability of downstream and upstream communication between the provider(s) of the multimedia content and the user. The systems used for the downstream and upstream channels could be the same, or different, and might operate within the same or different services, as defined in the Radio Regulations.

The wireless access network traffic to and from users may be symmetrical or asymmetrical depending on the variety of communication services offered to these users.

The downstream and upstream bandwidth requirements will depend on the type of the multimedia content, the user interface devices, the desired quality, etc. The support of some services (for instance, "high definition television" (HDTV)) will require the capability for broadband access.

Other technical characteristics of these systems that are important for some types of TWIM applications include:

- support of various levels of quality of service (QoS);
- seamless[1] services across such systems and networks;
- roaming capability and interoperability between existing systems and future systems as they become available;
- the ability of the system to efficiently use the available bandwidth of the upstream and downstream channels.

7.1.1.2.2 Applications and technologies

Examples of applications that may be supported by TWIM:

- alternate scenario dramas
- broadcasting service on demand
- car navigation and passenger information and entertainment
- e-mail
- e-education
- shopping and "electronic funds transfer at point of sale" (EFTPOS)

[1] Seamless: connection between end-user and information source without the user being aware that the communication path may have used many different networks or connections.

- database access
- electronic newspapers
- emergency and alert functions
- file transfers and photo albums
- form filling and submission
- game show and talk show participation
- Internet and intranet access
- multi-camera angle sport viewing and replay
- e-health
- travel information
- video and music on demand
- video content contribution
- video games including multi-players
- virtual private networks services
- voting
- voice and video calls and conferencing
- web-casting and web-cameras

Table 7.1-1 provides technical characteristics of example systems, which could be considered relevant to enable TWIM applications.

TABLE 7.1-1

Some typical technical characteristics of example systems

System		Transmitted data rate	Typical frequency range	Information data rate
Cellular/MWA	Pre-IMT-2000 systems (Note 1)	14.4 kbit/s	0.8-2 GHz	14.4 kbit/s
	IMT-2000	2 Mbit/s (pico cells) 384 kbit/s (micro cells) 144 kbit/s (macro cells)	0.8-2.7 GHz	2 Mbit/s (pico) 384 kbit/s (micro) 144 kbit/s (macro)
	Systems beyond IMT-2000	(under study)	(under study)	(under study)
TICS (Note 2)		Up to 54 Mbit/s	0.9-6 GHz	Up to 54 Mbit/s
RLAN/wireless home networks		Up to 54 Mbit/s	0.9-6 GHz	Up to 54 Mbit/s
FWA/BWA (Note 3)		56 kbit/s up to 312 Mbit/s	1 to 66 GHz (Note 4)	n×1.5 Mbit/s (Note 6) n×2 Mbit/s (Note 6) n×6.3 Mbit/s (Note 6) 45 Mbit/s 52 Mbit/s 156 Mbit/s ≤10 Mbit/s (Note 7) ≤ 100 Mbit/s (Note 8)
LMCS/LMDS/MMDS/MVDS/ MCS/MWS (Note 5)		up to 156 Mbit/s	2 to 6 GHz, above 20 GHz (Note 4)	-
Broadcasting (Note 9)	Sound (digital)	up to 1.843 Mbit/s (Note 10) (stationary) 1.152 Mbit/s (mobile)	0.54-1 500 MHz	-
	DTTB (Note 11)	up to 32 Mbit/s (stationary) 5 Mbit/s (mobile)	45-900 MHz	-

NOTE 1 – It is recognized that some pre-IMT-2000 systems can provide some Internet browsing and an interactive channel for broadcasting systems.

NOTE 2 – Traffic Information Control System.

NOTE 3 – BWA: Wireless access in which the connection(s) capabilities are higher than the primary rate.

NOTE 4 – Systems operating at a lower frequency range typically have a lower data rate.

NOTE 5 – It is noted that there are also other abbreviations used for these systems (Local Multipoint Communication System/Local Multipoint Distribution System/Multichannel Multipoint Distribution System/ Multichannel Video Distribution System/ Multipoint Communication System/Multimedia Wireless System).

NOTE 6 – n = 1, 2, 3, 4.

NOTE 7 – Maximum per one direction for Ethernet access interface, Point-to-Multipoint only (10 Base-T as defined in IEEE 802.3).

NOTE 8 – Maximum per one direction for Ethernet access interface, Point-to-Multipoint only (100 Base-T as defined in IEEE 802.3).

NOTE 9 – When using broadcasting, interactivity can be provided through another service.

NOTE 10 – In some countries, where single channel systems are used, the transmitted data rate is lower.

NOTE 11 – Digital Terrestrial Television Broadcasting.

7.1.1.3 Summary of sharing studies

A number of studies have been made on frequency sharing between the terrestrial fixed or mobile service and other radiocommunication services in certain bands, and the results are summarized in Table 7.1-2.

TABLE 7.1-2

Summary of sharing study results between the Fixed or Mobile Service (including FWA and NWA systems) with other services

Other service, which is sharing the band with the FS or MS	Frequency band	Recommendation
FSS	3.4-3.8 GHz	SF.1486
	5.15-5.25 GHz	M.1454
	37.5-42.5 GHz	SF.1484 SF.1573
MS	800-900 MHz	F.1402
	1.8-1.9 GHz	F.1402, F.1518
BSS	1.4-1.5 GHz	F.1338
RL	3.4-3.7 GHz	F.1489
ISS	24-27 GHz	F.1249, F.1509
RN	31.8-33.4 GHz	DNR F.[Doc. 9/BL/27]
EESS (active) / SR (active)	5.25-5.35 GHz	DNR F.[Doc. 9/130] PDNR M.[WAS5GHz-EESS]
	5.47-5.57 GHz	PDNR M.[WAS5GHzexpansion-EESS]

7.1.2 Analysis of the results of studies

7.1.2.1 Scope of terrestrial wireless interactive multimedia

TWIM is a concept that is emerging in the marketplace and is not synonymous with any specific existing or planned system; it is, rather, more of a vision of future wireless applications.

In studies for preparation of the CPM Report it has been understood that the TWIM concept is a multi-network, multi-access, multi-service and interactive arrangement. This suggests the need for convergence:

– in the access network;
– of network management;
– of format of content;
– in methods of information exchange;
– of database functions and capabilities.

These functions and capabilities will likely include:

– integral seamless wireless access through broadcasting, fixed and mobile infrastructures,
– location and navigation facilities, and
– on-demand service,

supporting person-to-person, person-to-many persons, many persons-to-person, person-to-machine, machine-to-person and machine-to-machine communications. These understandings of the scope have been derived from the experience of the increased usage of Internet downstream capabilities, the accelerated penetration by mobile telephones, and the integration of FWA functionality into mobile systems.

This concept encompasses systems that allow the delivery of multimedia content with which the user may interact, as well as systems capable of conveying multimedia information and providing interactive functions between the user and the server or between users.

The term "interactive" implies a two-way, but not necessarily symmetrical, communication system in either a simplex or duplex form. More specifically, the term "interactive" implies not only two-way physical transport of information but also the functionality of conveying end-users' reaction or response to the network in order to provide a certain application. Depending on the application, interactivity can be real-time, such as voice communications, or non-real-time such as e-mail. Many applications are expected to deliver larger amounts of multimedia data in the downstream direction compared to the amount of data carried from the user in the upstream direction.

In consideration of the above, the following is a working description for the scope of TWIM applications:

– Applications in one or more of the terrestrial Mobile, Fixed and Broadcasting Services that are capable of supporting bidirectional exchange of information of more than one type (e.g. video, image, data, voice, sound, graphics) between users or between users and servers.

  NOTE – The bidirectional exchange of information may be provided with different levels of interactivity and mobility.

7.1.2.2 Current situation of spectrum use and sharing scenarios

7.1.2.2.1 Current use and future trends for spectrum

Since it is anticipated that there will be many different TWIM applications, the systems will inevitably operate in many different frequency bands, typically, but not exclusively, across the range up to 66 GHz, with higher mobility systems tending to favour the lower frequency bands.

The frequency bands, which are currently allocated to the broadcasting service, may, in time, be more efficiently used through the conversion from analogue to digital transmission. Under certain circumstances and with appropriate transition measures, the introduction of TWIM applications to the end user may take place.

In general, TWIM applications of one-to-many type, having broad appeal to a larger number of end users, would be suitable for the broadcasting infrastructure. In that way, content providers will be able to aggregate content over a large number of end users. Also, in that case, enough downstream data capacity will remain available for carriage of main broadcast content of the non-interactive type and the end users will still be able to perceive enough personalization within the application. In this way, since broadcasting is a service which may have the capability for some personalized addressable applications, the downstream data from interactive multimedia and non-interactive applications may be combined with conventional broadcasting applications and therefore use the same channel. However, in order to provide interactivity, the upstream channel must be provided either by another radiocommunication service or by non-radio means. In principle, multimedia applications provided by broadcasting operators may use a variety of frequency bands for the upstream channel in the fixed or mobile services through national planning and coordination. If the upstream and downstream channels share the same frequency band for TWIM applications, this could provide some economies of scale due to reuse of some existing user equipment, such as the antenna. In such cases, some international consideration would be required for equipment standardization for upstream channels to achieve economies of scale. In the case where the broadcasting service shares the same frequency band with the mobile service, fixed service, or both services, the above sharing of upstream and downstream channels can also be achieved by national planning or bilateral coordination. The other cases should be further considered.

For the mobile service, the spectrum used by mobile applications and technologies is heavily used, and studies are under way to both increase the spectrum efficiency of those systems, and the identification of additional spectrum that could be used.

For the fixed service, the ITU-R is currently considering certain bands in the 5-20 GHz range with a view to accommodating FWA applications in bands where there is little growth of traditional point-to-point systems. Moreover, work is being undertaken to identify spectrum in bands above 70 GHz for short-range, broadband FWA applications. Further, studies are also ongoing on how to use mobile-derived technologies for FWA systems underlining the convergence process (see for example, draft revised Recommendations ITU-R F.1401 and ITU-R F.757).

Some administrations are considering making TWIM applications available in rural and remote areas. To this effect, access to sufficient spectrum for broadband channels below 1 GHz would help service providers reach subscribers in areas with clutter and difficult terrain and allow greater reach for the base stations. Some other administrations from developing countries do not think that spectrum for broadband channels for such applications below 1 GHz is required, due to intensive use by these administrations of the bands below 1 GHz for existing Services.

The demand for spectrum for wireless access systems including radio local area networks (RLANs) is being studied by the ITU-R under WRC-03 agenda item 1.5, Resolution 736 (WRC-2000), *resolves* 1, which address a possible new allocation to the mobile service in the 5 GHz bands, and the studies have shown that spectrum requirements consistent with the bands covered by this *resolves* (455 MHz) is justifiable. Such a possible allocation is conditioned by the sharing analysis in section 2.2 of this Report.

7.1.2.2.2 Band sharing scenarios with other services

Systems carrying TWIM applications may require minimal technical and operational constraints with regards to sharing with other radiocommunication services. In this regard, special frequency coordination procedures may be necessary. For example, given the expected ubiquitous nature of these systems, it may not be practical to require frequency coordination on a site-specific basis with stations in other radiocommunication services. However, it may be possible to establish sharing conditions on the basis of technical and operational limits.

The feasibility of spectrum sharing will depend on the technologies used in different bands, wideband vs. narrow-band, high power vs. low power etc.; the nature of the terminal and the type of system modulation. It is believed that the sharing scenarios for systems carrying TWIM applications will be similar to those for a broadcasting system, a high-density land mobile system or a high-density FWA system where TWIM applications may be provided on a geographical basis.

The feasibility of spectrum sharing and need for frequency coordination procedures (if any) should be studied further.

7.1.2.3 Future trends

The convergence of certain telecommunication and broadcasting technologies and service aspects is expected over the next several years to satisfy the need for flexible use of spectrum, at reasonable cost, to users for delivery of a range of multimedia applications. The delivery of such applications to the end user will be achieved through systems carrying TWIM applications.

There are systems starting to appear that can offer a number of applications provided separately by the terrestrial Mobile, Fixed and Broadcasting Services. This situation may result in economies of scale by which the same user equipment is used to support applications within combinations of these three services complementing each other. A number of administrations believe that such trends will lead towards more efficient utilization of the spectrum and resources.

Multi-service networks supporting terrestrial mobile, fixed and broadcasting services may be developed in the future, forming a truly global phenomenon, and may become a dominant model for all further mainstream development of radiocommunications.

7.1.2.3.1 Market trends

A number of possible market trends, resulting from development of the above-mentioned multi-service networks and multi-purpose user equipment, may include:

- the further growth of Internet use and broadband applications, where users can access on-demand multimedia content;
- an increasing demand for miniature equipment that is driven by the phenomenal expansion of personalized, information services for which the user equipment is always accessible;
- the compelling case for e-services/applications (e.g. e-commerce);
- increasing strong demand for high-speed Internet, broadband telecommunication services and interactive broadcasting in semi-rural, rural and remote areas in developed countries;
- emergence of multiple wireless service providers offering various grades of service to meet specific requirements of client groups.

These trends will be driven by the emerging convergence in technology and applications in the field of terrestrial wireless services.

7.1.2.3.2 Technology trends

One trend that is already emerging and is anticipated to be further developed over the coming years is the integration of low power broadband wireless access devices to support coverage in limited geographical areas ("hot-spot" coverage), which may develop in the future to provide contiguous coverage through e.g. cellular-like re-use. Consequently, it is expected that such devices may facilitate more efficient use of the spectrum and the delivery of high-speed multimedia applications. A further trend is the increasing use of packet-based transport and in particular the use of packet-based protocols in the access network for most end-user and enterprise-based applications. It is also foreseen that the core network will increasingly become packet-based, supporting a wide variety of different user speed/mobility/coverage scenarios. Thus it will become possible to support such requirements as security[1], authentication and billing in a more flexible way than with currently operating digital transmission systems.

Asymmetric nature in communication will also be a factor of the future trends. The notion of point-to-multipoint mode in terrestrial broadcasting, fixed and mobile systems will be integrated in the access network to end users, in particular in delivering a set of services simultaneously to small as well as to large user groups. In the case of terrestrial fixed and mobile services, increase of downstream access transport will be achieved by:

- upgrading of existing system capability;
- supplementary or additional downstream connection through bearers operating in one of the three terrestrial services.

For extended interactivity, upstream access transport will also be a factor for more flexibility through the converged technologies including multi-service network and multi-service user equipment.

Such trends will further facilitate the convergence of systems which are now considered as being distinct (e.g. example systems given in Table 1, relevant to enable TWIM applications).

Advances in technologies, including the development of "software defined radio" (SDR), could facilitate the following functions:

- switching of the operating mode, e.g. public network, office network, home link;
- adaptive multi-states modulation and adaptive bit rate;
- adaptive array antenna;
- different grade of service;
- multiband operation including interactivity.

One of the SDR impacts is that manufacturers could develop a common hardware platform on which various SDR functions are implemented, and that a single hardware platform is economically applied to many operators' different specifications. The impact of SDR on spectrum utilization depends largely on adaptability of the software that defines the above-listed functions. Highly adaptive SDR may change its technical parameters on a real-time basis. For example, one SDR may operate in different systems in different radiocommunication services according to the designed software. SDR technology may become an important enabler to the future development of TWIM applications as well as to the possible enhancement of the spectrum utilization.

---

[1] There is no Recommendation on security in the ITU.

7.1.2.4 Future studies in ITU-R

The convergence of technologies and applications considered in this section may require future studies by ITU-R on whether modifications to ITU Radio Regulations Service definitions, or other Regulations, are necessary. It may also be necessary to review whether any such modifications may have an impact on the existing international frequency coordination procedures as well as future use of frequency spectrum.

Studies may be necessary to identify possible spectrum with a view to facilitating the development of TWIM applications. Studies may also be required to evaluate the extent to which TWIM applications may be introduced in frequency bands, which are not shared by all three terrestrial services (fixed, mobile, broadcasting).

Additional studies may also be required to assess the advantages and disadvantages of global and regional harmonization of spectrum for systems carrying TWIM applications, bearing in mind that this factor is important for potential cost advantages through economy of scale and the possible need to recognize the aspect of harmonization in the Radio Regulations. At the same time, studies should look at the potential advanced technologies, which could be used to lessen such need for global or regional harmonization.

7.1.3 Methods to satisfy the agenda item

Method A

In order to complete the work associated with this agenda item it will be necessary to conduct further studies with the results to be completed and reported to the WRC-07. WRC-03 may revise Resolution **737 (WRC-2000)**, based on considerations of §§ 7.1.1, 7.1.2 and 7.1.4. In doing so, relevant parts of these sections may be included in an Annex to the Resolution.

Further recommended exploration of issues related to the TWIM concept include:

- Study possible frequency bands for TWIM applications, taking into account the scope of TWIM systems as described in § 7.1.2.1 above (including sharing between different radiocommunication services, § 7.1.2.2).
- Study the advantages and disadvantages of global and regional harmonization of spectrum for TWIM applications and the possible need for recognition of such harmonization within the Radio Regulations.
- Review the existing radiocommunication service definitions, including how they are used to determine the use of frequency bands and the consequences they may have on international frequency coordination procedures.

Method B

It may be possible to conclude this agenda item at WRC-03 on the basis that no regulatory impediments have been identified. Resolution **737 (WRC-2000)** may be suppressed. The Study Groups within ITU-R may prepare relevant Questions and continue their work under the normal activities in order to examine any issues related to the deployment of TWIM applications.

Method C

Some administrations in Region 1 consider that no regulatory impediments have been identified, with the exception of the broadcasting service in Region 1 in the frequency range 470-790 MHz, where there is no co-allocation to the broadcasting, fixed or mobile services (as noted in § 7.1.2.2.1). This will restrict the possibilities for those countries in Region 1 that so wish, to develop TWIM applications associated with the broadcasting service. Noting that this frequency range will be the subject of re-planning for the introduction of digital broadcasting by two Regional

Radiocommunication Conferences (the first in 2004), it may be appropriate to have an item on the agenda of WRC-07 to consider if there are any consequential issues for terrestrial services (fixed, mobile, broadcasting) arising from this re-planning exercise that would need to be taken into consideration by WRC-07. WRC-03 may replace the general agenda item relating to TWIM applications by this item on the agenda of WRC-07. The general studies on TWIM applications may continue within the normal activities of the ITU-R.

Some other administrations are of the view that there should be no link between this agenda item and the revision of the Stockholm 61 and Geneva 89 Plan(s) foreseen to be carried out in 2004 and 2005/2006.

7.1.4 Regulatory and procedural considerations

The distinctions between the terrestrial fixed, mobile and broadcasting services have been clear and unambiguous, and the traditional national regulatory processes and the organization of the ITU-R were designed to reflect those distinctions. It is believed that the definitions of the three radiocommunication services are still valid and applicable; however it should be understood that systems are starting to appear that are capable of operating within two or even all of the three radiocommunication services.

Apart from that identified in Method C, there is no evidence at this time that there are any Radio Regulations impediments to the development of TWIM applications. However, it may be necessary to continue to study the boundaries between existing radiocommunication services to determine if any impediments to such TWIM applications may appear.

7.2 Agenda item 1.22

"to consider progress of ITU-R studies concerning future development of IMT-2000 and systems beyond IMT-2000, in accordance with Resolution **228 (WRC-2000)**"

7.2.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

7.2.1.1 The trends of mobile communications

The number of mobile communications subscribers has increased much faster than predicted, particularly for terrestrial use. By the end of the year 2000 the number of mobile subscribers was 736 million worldwide and by the year 2010 more than 1 700 million mobile subscribers are anticipated.

The majority of traffic, on first and second-generation mobile networks, is speech-oriented communications. However, the traffic from data and multimedia communications is already increasing rapidly, and this traffic is expected to become dominant on IMT-2000 and systems beyond IMT-2000 networks. As the majority of this traffic will be IP (packet) based, networks and systems must be designed to efficiently transfer packet data. The new multimedia data services will require both very high peak data rates and sustained high data rates. As one of such services, mobile world wide web applications will become commonplace and mobile radio terminals will become a important internet access tool.

The convergence and integration of the various forms of information technology (IT), media (content) and mobile telecommunications will continue to change and enhance the sharing and transmission of information in the 21st century.

7.2.1.2 Radio Conference decisions related to IMT-2000 and systems beyond IMT-2000

Spectrum was first identified for IMT-2000 by WARC-92, in No. **5.388**.

WRC-2000 considered issues related to IMT-2000, resulting in the identification of additional spectrum for the terrestrial component of IMT-2000 in Nos. **5.317A** and **5.384A**. This spectrum identification for IMT-2000 at WRC-2000 was based on the total forecasted need for spectrum by the year 2010. WRC-2000 also identified existing global MSS allocations as being available for use by the satellite component of IMT-2000, in accordance with Resolution **225 (WRC-2000)**.

In Resolution **228 (WRC-2000)**, the ITU-R was invited to continue studies on overall objectives, applications and technical and operational implementation for the future development of IMT-2000 and systems beyond IMT-2000. It was also invited to study spectrum requirements and potential frequency ranges suitable for the future development of IMT-2000 and systems beyond IMT-2000, and in what time-frame such spectrum would be needed.

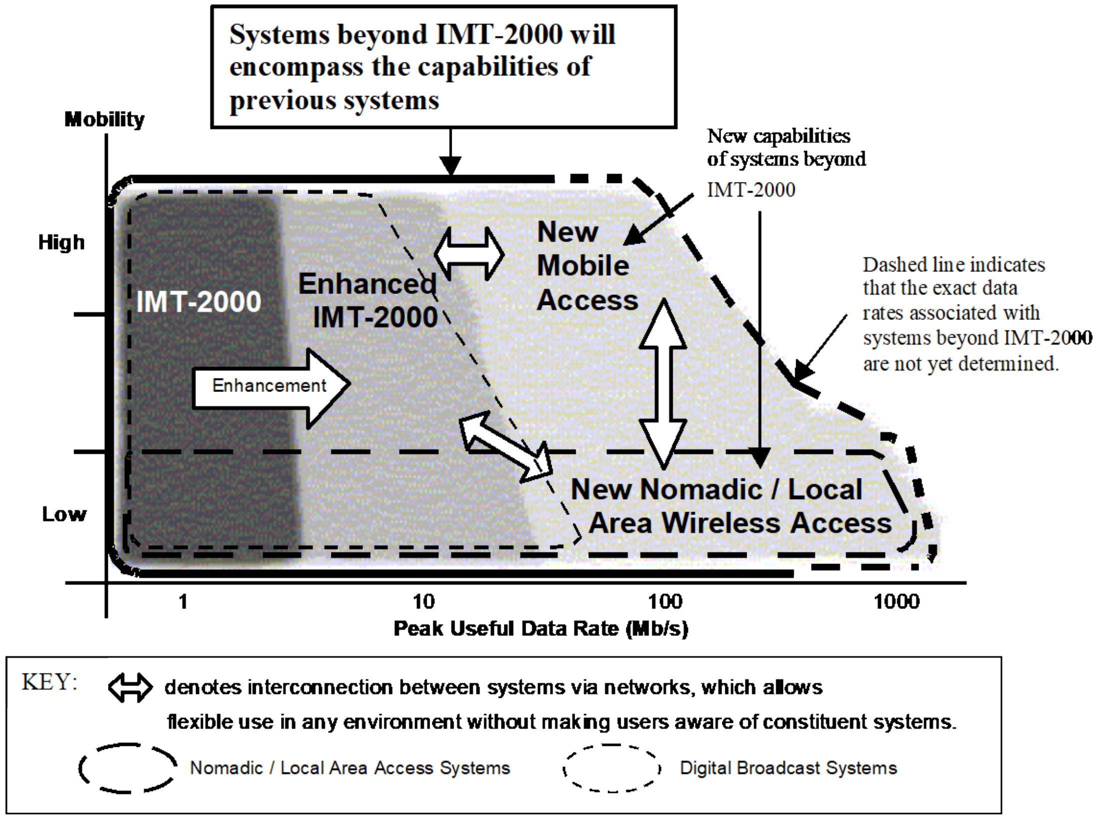
In accordance with Resolutions **228 (WRC-2000)** and **801 (WRC-2000)**, the requirements for the future development of IMT-2000 and systems beyond IMT-2000 are to be reviewed by WRC-07, taking into consideration the results of ITU-R studies presented to WRC-03.

7.2.1.3 Vision for the future development of IMT-2000 and systems beyond IMT-2000[2]

In response to Resolution **228 (WRC-2000)**, ITU-R has developed a vision for the further development of IMT-2000 and systems beyond IMT-2000, which will be documented in an ITU-R Recommendation.

The envisaged capabilities of IMT-2000 and systems beyond IMT-2000 are illustrated in Figure 7.2-1.

[2] There is a need for appropriate naming to be developed in advance of WRC-07 for the future development of IMT-2000 and systems beyond IMT-2000. This is being addressed within WP 8F.



Dark shading indicates existing capabilities, medium shading indicates enhancements to IMT-2000, and the lighter shading indicates new capabilities of systems beyond IMT-2000.

The degree of mobility as used in this figure is described as follows: Low mobility covers pedestrian speed, and high mobility covers high speed on highways or fast trains (60 km/h to ~250 km/h, or more).

The ITU vision is that IMT-2000, its enhancements, and systems beyond IMT-2000 will together provide a ubiquitous capability for all of the mobile communication needs of a user. It is envisaged that this vision will be achieved through three distinct, but overlapping, trends of technology development:

1) The existing IMT-2000 radio interfaces and networks will continue to be enhanced throughout their operational life times, perhaps reaching communication speeds of up to approximately 30 Mbit/s.

2) There will be an increasing relationship between IMT-2000 (as it is enhanced throughout its life) and other radio systems (possibly including WLAN, digital broadcasting and satellite elements).

3) In order to deliver the complete ITU Vision of systems beyond IMT-2000, new elements will be required, especially in the areas of mobile access (high data rates of up to approximately 100 Mbit/s for high mobility) and nomadic/local area access (high data rates of up to 1 Gbit/s for low mobility). These will also form part of the relationship with other radio systems.

However, it should be noted that the data rates available and the dates of introduction may vary from country to country.

Systems beyond IMT-2000 will be the result of these three trends of technology development, with seamless inter-working. It will support the two demands of *ubiquity* and *diversity* and will fulfil the user's requirements of the customized services based on diverse individual needs. ITU-R is currently developing a preliminary draft new Report on technology trends, which includes information on promising technologies applicable to the new elements of systems beyond IMT-2000.

7.2.1.4 Future development of IMT-2000

It is expected that operators who deploy IMT-2000 networks will continue to enhance their capabilities for at least the next 10 years. This would then be followed by continued operation of the network for possibly an additional 10 years.

Terrestrial IMT-2000 systems are already being enhanced (for instance, towards IP-based networks and to offer bit rates up to 10 Mbit/s under favourable circumstances). These initial enhancements, for which standards are already being developed, will be followed by further enhancements that could increase the peak aggregate useful data rate up to approximately 30 Mbit/s under favourable circumstances by around 2005; h0owever, some operators may need additional spectrum to realize these enhancements.

The satellite component of IMT-2000 may further evolve to provide complementary services in areas covered by cellular systems[3], such as broadcasting, multicasting, etc., in addition to providing services in those areas not planned for service by terrestrial systems.

The convergence of services and delivery platforms in the future development of IMT-2000 should offer users what they need in any specific mobile environment. An individual person, or machine, can from time to time be a user on one or more of these platforms, either sequentially or simultaneously, depending on the task in hand. A commonality of how services and applications are applied across the different platforms is therefore beneficial to users, and this has stimulated the current trend towards convergence. Furthermore, a broadly similar user experience across the different platforms leads to a large-scale take up of products and services, common applications and content, and an ease and efficiency of use.

The increasing prevalence of IP-based applications is a key driver of this convergence, and stimulates the establishment of relationships between previously separate wireless platforms. What form these relationships will take depends on what the market wants, but they might include, for example; hardware integration within a device, network inter-working, common access, authentication, accounting, common person-machine interfaces, portals, roaming and hand-over between platforms.

7.2.1.5 New capabilities for systems beyond IMT-2000

The ITU Vision for systems beyond IMT-2000 includes advanced services. There may be a need for a new wireless access technology to be developed around the year 2010 capable of supporting high data rates with high mobility, which could be widely deployed around the year 2015 in some countries. The new mobile access element(s) of systems beyond IMT-2000 will handle a wide range of supported data rates of up to approximately 100 Mbit/s, according to economic and service demands to achieve full area coverage for systems in multi-user and multi-cell environments and

[3] In this context, "cellular" refers to the method of deployment of base station sites and reuse of frequencies, and not to the frequency band employed.

with terminals moving at vehicular speeds (high mobility), as shown in Figure 7.2-1. Because the capabilities of systems beyond IMT-2000 will substantially exceed those of enhanced IMT-2000 to support new applications and market opportunities, systems beyond IMT-2000 will likely deploy new wireless access methods which will closely inter-work with those in Recommendation ITU-R M.1457.

Many types of access systems will be connected to a common, flexible and seamless core network. The mobility management will be part of a new wireless access system as an interface between the core network and a particular access technology to connect a user via a single number for different access systems to the core network. Global roaming for all access technologies is required. The interworking between these different access systems in terms of global roaming, inter-system handover and seamless services with service negotiation including mobility, security and QoS will be a key requirement, which will be handled in the newly developed wireless access systems and core network.

7.2.1.6 Related ITU-R Recommendations

Relevant ITU-R Recommendations: M.687; M.819; M.1311; M.1390; M.1457; P.1411.

7.2.2 Analysis of the results of studies related to the further development of IMT-2000 and systems beyond IMT-2000

7.2.2.1 Preliminary studies of spectrum requirements

Report ITU-R M.2023 "Spectrum Requirements for IMT-2000" forecasts the spectrum requirement for IMT-2000 in the year 2010, in those areas where the traffic is highest. It concluded that, in 2010, "there is a forecasted need for 160 MHz of additional spectrum for terrestrial IMT-2000, beyond the terrestrial IMT-2000 spectrum already identified in RR No. **5.388** and beyond the spectrum used in the various Regions for 1st and 2nd generation mobile systems". ITU-R is developing a recommendation that addresses spectrum implications that will detail the spectrum requirements and potential frequency ranges suitable for the future development of IMT-2000 and systems beyond IMT-2000, and in what time-frame such spectrum would be needed. ITU-R is also working on developing a framework of services for the future development of IMT-2000 and systems beyond IMT-2000, which will be used to help refine the spectrum requirements also being developed. Furthermore, the ITU-R is studying whether a revision to Recommendation ITU-R M.1390 to incorporate a spectrum calculation methodology for systems beyond IMT-2000 or a new Recommendation on a spectrum calculation methodology is needed. This will be completed in time for WRC-07.

7.2.2.2 Particular requirements of developing countries

In the era of globalization, it is recognized that developing countries have the same needs for telecom services as developed countries. These services may be provided by a combination of various IMT-2000 telecommunications networks: terrestrial mobile networks and/or satellite networks which may further evolve to provide complementary services in areas not planned for service by terrestrial systems. Particular needs of developing countries are not to be perceived in terms of new or special telecom services: they are to be examined in regard to particular conditions required to satisfy the time and economic needs of developing countries.

However, developing and developed countries may not have the same needs at the same time. These differences may include the overall amount of spectrum needed, when such spectrum will be needed, and in what frequency range it is needed. Additional ITU-R studies on the spectrum needs of developing countries for IMT-2000 will help identify these differences and assist developing countries meet certain objectives, defined in Recommendation ITU-R M.819.

Necessary spectrum should be identified worldwide to provide global roaming and economies of scale, which would be even more important for developing countries. Also there is a need to allow a smooth transition from the second generation to the third generation in many developing countries.

Therefore, the following characteristics and needs of the developing countries need to be considered:

7.2.2.2.1 Characteristics of most developing countries

- Low level of income per inhabitant (less than USD 600 per annum).
- Young population (more than 50% of the population is less than 35 years old).
- Large rural and sparsely populated areas (more than 50% of the population live in rural areas).
- Difficult geographical terrain.

7.2.2.2.2 Needs of most developing countries for IMT-2000

- Affordable pricing of mobile services, minimal initial investment and total cost of the network.
- Solutions that enable coverage of rural areas (with varied terrain characteristics) with large cells.

7.2.2.2.3 Additional studies to meet the needs of developing countries for IMT-2000

Additional ITU-R studies on the needs of developing countries for IMT-2000 will further promote the investigation on Question ITU-R 77-4/8 and assist developing countries in meeting certain objectives, as defined in Recommendation ITU-R M.819. These studies should focus on:

1) Assessing and forecasting market demand for mobile telecommunication services in developing countries.
2) Adapting mobile telecommunication technologies to the needs of developing countries focusing on establishing cost-effective, true nationwide IMT-2000 networks, solving the problems of propagation in forestry, mountainous, desert and/or coastal regions, and ensuring effective use of frequencies in sparsely populated and low-density traffic areas.
3) The advantages and disadvantages of the use of frequencies below 600 MHz for IMT-2000 systems.
4) Effective and economical use of frequency bands identified for IMT-2000 at WARC-92 and WRC-2000.

7.2.2.3 Progress towards potential frequency ranges for spectrum

The suitability of a frequency band or bands for the future development of IMT-2000 and systems beyond IMT-2000 depends, amongst others, on the following factors, which have technical and economic aspects:

a) Mobility

Viewed from the user perspective, those systems should support a level of mobility as high as that of the existing cellular systems. This should take into account the physical nature of the fading radio channels.

b) Area coverage

The area coverage is one of the essential requirements for mobile radio systems. As the operating frequency increases, the maximum practicable cell size reduces. As a result more base stations will be required to provide contiguous wide area coverage - impacting coverage and deployment cost.

c) Available bandwidth

Sufficient bandwidth should be available to enable the delivery of high data rate services that are expected to become increasingly important in the future development of IMT-2000 and systems beyond IMT-2000.

d) Global roaming

Viewed from the user perspective, there should be capability for global roaming. Therefore, globally harmonized frequency bands will minimize requirements for multi-mode/multi-band mobile terminals.

In addition, radio propagation characteristics will have significant impacts on the consideration of the potential frequency ranges for spectrum.

Therefore, the preferred frequency ranges for enhanced IMT-2000 and systems beyond IMT-2000 consist of those bands that are currently identified for IMT-2000, or currently allocated to primary mobile use and are not far from the existing frequency bands identified for IMT-2000.

7.2.2.4 Relationship with studies documented under other CPM Report sections

The spectrum requirements of the Nomadic/Local Area Wireless Access element of systems beyond IMT-2000 may also be related to WRC-03 agenda item 1.5, which addresses new allocation of frequencies to the mobile service in the 5 GHz range for the Nomadic/Local Area Wireless Access applications.

7.2.3 Methods to satisfy the agenda item and their advantages and disadvantages

WRC-03 may decide to include an agenda item for WRC-07 to review requirements for the future development of IMT-2000 and systems beyond IMT-2000, taking into account Resolution 228 (WRC-2000), and take any necessary action.

This agenda item should include the consideration of the particular requirements of developing countries for IMT-2000 as described in § 7.2.3.2.

WRC-03 may appropriately modify Resolution **228 (WRC-2000)** for further studies to consider detailed requirements, to enable any necessary action to be taken by WRC-07. The possible revision of Resolution **228 (WRC-2000)** is shown in Annex 7.2-1. WRC-03 may also invite the ITU-R to conduct and complete in time for WRC-07, the appropriate studies leading to technical and operational Recommendations, including spectrum requirements and potential frequency ranges suitable for the future development of IMT-2000 and systems beyond IMT-2000. These studies should consider:

i) the rapidly growing demand of the spectrum for these systems and other systems/services;

ii) sufficient time to ensure the availability of the spectrum;

iii) sufficient time for system development;

iv) possibilities for sharing and compatibility with services already allocated in potential spectrum for the future development of IMT-2000 and systems beyond IMT-2000, taking into account appropriate protection criteria for the existing services; and

v) the possible development of systems/services in potential spectrum for the future development of IMT-2000 and systems beyond IMT-2000.

7.2.4 Regulatory and procedural considerations

No regulatory or procedural considerations have been identified.

ANNEX 7.2-1

MOD

RESOLUTION 228 (REV.WRC-03)

Studies to consider frequency-related matters for the future development of IMT-2000 and systems beyond IMT-2000 as defined by ITU-R

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that International Mobile Telecommunications-2000 (IMT-2000) systems started operation in the year 2000;

b) that Question ITU-R 229/8 addresses the future development of IMT-2000 and systems beyond IMT-2000;

c) that the future development of IMT-2000 and systems beyond IMT-2000 is being studied within ITU-R;

d) that the technical characteristics of IMT-2000 are specified in ITU-R and ITU-T Recommendations, including Recommendation ITU-R M.1457 which contains the detailed specifications of the radio interfaces of IMT-2000;

e) that it was eight years ahead of the IMT-2000 initial deployment that WARC-92 identified the spectrum for IMT-2000 in No. **5.388** and in Resolution **212**;

f) that the review of IMT-2000 spectrum requirements at WRC-2000 concentrated on the bands below 3 GHz;

g) that information technology and telecommunication markets evolve rapidly;

h) that adequate spectrum availability is a prerequisite for the market and technological success of the future development of IMT-2000 and systems beyond IMT-2000;

i) that a continuing and accelerating growth in the demand for multimedia applications such as high-speed data, IP-packet and video by mobile communication systems is forecasted;

j) that the future development of IMT-2000 and systems beyond IMT-2000 is foreseen to address the need for higher data rates than those currently deployed for IMT-2000;

k) that an orderly process of change and development of IMT-2000 towards the capabilities and functionalities of systems beyond IMT-2000 is needed;

l) that, for global operation and economy of scale, which are key requirements for success of mobile communications services, it is desirable to agree on a harmonized time-frame and common technical, operational and spectrum-related parameters of systems, taking account of relevant IMT-2000 and other experience;

m) that it is therefore timely to study market, technical, spectrum and regulatory issues pertinent to the future development of IMT-2000 and systems beyond IMT-2000;

n) that sharing and compatibility should be addressed between existing services and the future development of IMT-2000 and systems beyond IMT-2000;

o) that Question ITU-R 77-4/8 addresses adaptation of mobile radiocommunication technology to the needs of developing countries, including the optimum arrangements and technical characteristics needed to use mobile technology/equipment in urban, rural or remote areas,

noting

a) that the IMT-2000 radio interfaces as defined in Recommendation ITU-R M.1457 are expected to evolve within the framework of ITU-R beyond those initially specified, to provide enhanced services and services beyond those envisaged in the initial implementation;

b) that ITU-R has envisaged that new elements of systems beyond IMT-2000 will be developed, which will closely interwork and be interoperable with currently operating IMT-2000 and its future enhancements;

c) *that there is a need for appropriate naming to be developed in advance of WRC-07 for the future development of IMT-2000 and systems beyond IMT-2000,recognizing*

a) the time necessary to develop and agree on the technical, operational, spectrum and regulatory issues associated with the continuing enhancement of mobile services;

b) that service functionalities in fixed, mobile and broadcasting networks are increasingly converging;

c) that, in the future, mobile systems are expected to adopt more spectrum-efficient techniques;

d) the needs of developing countries for the cost-effective implementation of advanced mobile communication technologies and the propagation characteristics of lower frequency bands that result in larger cells,

resolves

1 to invite ITU-R to further study and develop Recommendations on technical and operational issues relating to the future development of IMT-2000 and systems beyond IMT-2000;

2 to invite ITU-R to complete studies on the spectrum requirements and the potential frequency ranges suitable for the future development of IMT-2000 and systems beyond IMT-2000, and in what time-frame such spectrum would be needed, taking into consideration the evolving market, including the growth in demand for IMT-2000 services, and the evolution of IMT-2000 and other mobile systems through advances in technology;

3 that the studies referred to in *resolves* 1 and 2 should take into consideration the particular needs of developing countries;

4 that the studies referred to in *resolves* 1 and 2 should include sharing and compatibility studies with services already allocated in potential spectrum for the future development of IMT-2000 and systems beyond IMT-2000;

5 that the spectrum requirements for the future development of IMT-2000 and systems beyond IMT-2000 should be considered by WRC-07, taking into account the results of the ITU-R studies referred to in *resolves* 2,

urges administrations

to participate actively in the studies by submitting contributions to ITU-R.

7.3 Agenda item 7.2

"to recommend to the Council items for inclusion in the agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, taking into account Resolution **801 (WRC-2000)**"

7.3.1 Preliminary agenda items for WRC- 07

2.2 to review the operational procedures of the Global Maritime Distress and Safety System (GMDSS), taking into account the experience since its introduction and the needs of all classes of shipping;

The GMDSS entered into force in 1992. In light of the continued transition to the GMDSS, it is essential that an evaluation be made of the experience gained to date and that this be taken into account when reviewing the procedures of the GMDSS trying to best serve the needs of all classes of shipping. Given that the IMO has urged administrations to implement GMDSS for all non-SOLAS vessels under national legislation as soon as possible and, additionally, to encourage all maritime vessels voluntarily carrying maritime VHF radio equipment to be fitted with DSC, it is essential that the lessons learned be used to support and shape the evolution of such a widely implemented system. Furthermore the review of the VHF channel 16 watch-keeping requirements scheduled to take place some time prior to 2005 by IMO implies that some future adjustments to the operational procedures of GMDSS are indeed likely. In addition, there are provisions in the Radio Regulations that impose unnecessary operational burdens upon the maritime community, including those of Appendix **16** that impose outdated requirements on vessels. It is essential that all such provisions be identified and reviewed at the earliest opportunity.

2.3 to review studies and consider allocations in the frequency bands above 275 GHz;

This item has been under study within the ITU-R since 2000.

The ITU-R began studies in 2000 of fundamental propagation characteristics and prediction techniques relevant to systems operating in the range 20 and 375 THz (15-0.8 μm). The studies have resulted in DNRs on fundamental propagation characteristics, DNR ITU-R P.[OPTICAL] (see Doc. 3/69), and on propagation prediction techniques, DNR ITU-R P.[THz] (see Doc. 3/74), applicable to the range 20 to 375 THz (15-0.8 μm). Existing Recommendations on atmospheric absorption already address the spectrum between 275 and 1 000 GHz.

For the 275-1 000 GHz range, ITU-R studies have resulted in the identification of spectral lines of interest to radio astronomy. Studies are being conducted to determine continuum bands of interest in this range. ITU-R studies have resulted in the identification of bands of interest to EESS (passive) and SRS (passive), performance criteria, and permissible levels of interference. Sharing studies between active services and passive services in this frequency range will be completed when characteristics of active services become available. ITU-R studies have also identified the bands of interest to the amateur services. Studies establishing the requirements, performance criteria, and acceptable levels of interference for the amateur service are expected to be complete in time for WRC-06.

ITU-R studies have resulted in the description of the technical and operational characteristics of radio astronomy systems operating in the range 10-1 000 THz (30-0.3 μm). Studies to identify technical and operational characteristics of SRS and EESS systems operating in the frequency range 10-1 000 THz are ongoing. Sharing studies for this region of the spectrum have yet to be conducted.

ITU-R studies have resulted in a DNR ITU-R S.[4/65] on technical and operational characteristics of satellites operating in the range 20-375 THz (15-0.8 μm). Sharing studies for the frequency range 20-375 THz (15-0.8 μm) are being conducted and will be available by WRC-07.

Therefore, this item may be considered to be maintained in the agenda of WRC-07.

2.4 to consider a resolution specifying the technical bases for the global operation of stations in the land mobile and land mobile-satellite services between 30 MHz and 6 GHz;

2.5 to review the allocations to services in the HF bands, taking account of the impact of new modulation and adaptive control techniques and any recommendations by WRC-03 on the adequacy of the frequency allocations for HF broadcasting and the fixed and mobile services (excluding those bands whose allotment plans are in Appendices 25, 26 and 27), from about 4 MHz to 10 MHz;

Whether there is a need to maintain this item in the agenda for WRC-07 is dependent upon the conclusions of WRC-03 on agenda items 1.36 and 1.23.

Some administrations expect that WRC-03 will, having examined the adequacy of the frequency allocations for HF broadcasting, issue a resolution or recommendation specifying the broadcasters' analysis. This means that further studies will be needed for all services concerned with the quoted bands in order to analyse the consequences for these services. These studies shall also analyse the experience gained with new modulation techniques and adaptive control techniques; therefore, WRC-07 should consider the results of these studies under this agenda item.

Other administrations expect that the conclusions of WRC-03 with regard to agenda items 1.23 and 1.36 will effectively provide all decisions needed in connection with reallocations among the amateur, broadcasting, fixed and mobile services in the portion of the spectrum under consideration. These administrations believe that all parties concerned will have an opportunity at WRC-03 to state their case, and therefore there would be no need for an agenda item at WRC-07.

2.6 to consider possible changes in response to Resolution ***86*** *(Marrakesh, 2002): "Coordination and notification procedures for satellite networks";*

2.7 to consider potential for sharing at around 4 300 MHz between radio altimeters and space-based passive earth sensors;

Potential for sharing at around 4 300 MHz between radio altimeters and space-based passive earth sensors has been under study within the ITU-R since 1998. ITU-R studies have resulted in Recommendation ITU-R SA.[EESS-4300]. These studies are mature and conclude that sharing between passive spaceborne sensors operating in the Earth exploration-satellite service (passive) and radio altimeters operating in the aeronautical radionavigation service is feasible.

Due to the safety of life aspects of the radio altimeters operating in the airborne radionavigation service in this band, it may be necessary to implement a footnote that states that the use and development of the airborne radionavigation service is not to be constrained, nor can protection be claimed by the EESS (passive).

ITU-R studies on this item are expected to be completed in time for the next WRC.

Therefore, this item may be considered to be maintained in the agenda of WRC-07.

*2.8 on the basis of the results of studies, to consider allocations, if appropriate, to non-GSO MSS with service links below 1 GHz in the band 470-862 MHz, in accordance with Resolution 7**28 (Rev.WRC-2000)**;*

2.9 to consider the use of frequency adaptive systems in the MF/HF bands, in accordance with Resolution ***729 (WRC-97)****;*

2.10 to consider allocation of the frequency band 14.5-14.8 GHz to the fixed-satellite service (Earth-to-space) in Region 3 (expansion of the fixed-satellite service to include links other than feeder links of the broadcasting-satellite service);

2.11 to review the possibility for additional allocations for the fixed service in the bands above 3 GHz;

2.12 consider spectrum requirements for wideband aeronautical telemetry in the band between 3 and 30 GHz.

In response to Administrative Circular CA/109, administrations expressed a need for an additional allocation in this range, as close to 3 GHz as practical. Sharing studies are to be undertaken looking toward the identification of possible candidate bands.

For these reasons, the item may be considered to be maintained in the agenda of WRC-07.

2.13 to review No. ***S5.332*** *in respect of the frequency band 1 215-1 260 MHz and No.* ***S5.333*** *in respect of the frequency band 1 260-1 300 MHz, concerning the Earth exploration-satellite (active) service and other services;*

2.14 to take into account ITU-R studies in accordance with Resolution ***342 (Rev.WRC-2000)****, and to consider the use of new digital technology for the maritime mobile service in the band 156-174 MHz, and consequential revision of Appendix 18;*

Studies on this matter are still ongoing. The item may be considered to be maintained in the agenda of WRC-07.

2.15 to review, with a view to identifying necessary spectrum for global harmonization, spectrum and regulatory issues related to terrestrial wireless interactive multimedia applications in accordance with Resolution ***737 [GT PLEN-2/2] (WRC-2000)****;*

2.16 to review the requirements for the future development of IMT-2000 and systems beyond IMT-2000, taking into account Resolution ***228 (WRC-2000)****;*

ITU-R studies on the vision for the future development of IMT-2000 and systems beyond IMT-2000 have concluded and are documented in the Vision DNR [Doc. 8/110]. To fulfil the ITU vision for future development of IMT-2000 and systems beyond IMT-2000, it is envisaged that further spectrum may be needed, in addition to that identified for IMT-2000 at WARC-92 and WRC-2000. Work on this matter continues to be carried out by ITU-R and a work plan has been developed by ITU-R Working Party 8F that prepares for the potential identification of spectrum at WRC-07. This work will take into account relevant IMT-2000 and other experience, the frequency bands already identified and used for IMT-2000, and future needs of services already allocated to potential spectrum for the future development of IMT-2000 and systems beyond IMT-2000. ITU-R is studying the spectrum requirements and potential frequency ranges suitable for the future development of IMT-2000 and systems beyond IMT-2000, and in what time-frame such spectrum would be needed. ITU-R is also developing a framework of services for the future development of IMT-2000 and systems beyond IMT-2000, which will be used to refine these spectrum requirements.

For these reasons, the item may be considered to be maintained in the agenda of WRC-07.

A summary of the progress of ITU studies on the future development of IMT-2000 and systems beyond IMT-2000 is contained in section 7.2 of this report.

7.3.2 Items for inclusion in the agendas of future conferences

3.1 to consider results of ITU-R studies on the feasibility of sharing in the band 2 700-2 900 MHz between the aeronautical radionavigation service, meteorological radars and the mobile service, and to take appropriate action on this subject;

ITU-R has conducted studies on the feasibility of sharing between IMT-2000 and radar systems operated in the band 2 700-2 900 MHz. Those studies indicate sharing of the 2 700-2 900 MHz band between the MS (IMT-2000) and ARNS and meteorological radars is not feasible. WRC-03 may wish to consider deletion of this agenda item from the WRC-05/06 agenda.

NOTE – ITU-R is studying the possible identification of other frequency ranges for use by the AM(R)S in addition to the current allocations. This would be intended to overcome an expected shortage in spectrum expected by 2010 for line-of-sight air-ground communications.

*3.2 to consider results of ITU-R studies in accordance with Resolution **222 [COM5/22] (WRC-2000)** to ensure spectrum availability and protection for the aeronautical mobile-satellite (R) service and the Global Maritime Distress and Safety System (GMDSS), and to take appropriate action on this subject, while retaining the generic allocation for the mobile-satellite service;*

Spectrum availability and protection for the safety services are to be ensured in the bands 1 545-1 555 MHz and 1 646.5-1 656.5 MHz by RR Nos. **5.353A** and **5.357A**, and Resolution **222**. However, these frequency bands are fully used. Thus it is difficult to accommodate spectrum required for safety service, which are prioritized and protected by the above provisions, where at the same time safeguarding the investment and operation of other MSS systems. It is urgently required to improve this situation and to ensure long-term spectrum availability required for MSS, in particular the safety services.

Resolution **222 (WRC-2000)** invited ITU-R to complete studies to determine the feasibility and practicality of prioritization and real-time pre-emptive access between different networks of mobile-satellite systems, while taking into account the latest technical advances in order to maximize spectral efficiency.

ITU-R is now carrying out the studies on this subject mainly focusing to AMS(R)S in the bands 1 545-1 555 MHz and 1 646.5-1 656.5 MHz. The studies are not yet complete. Although some mobile-satellite networks currently provide intra-system pre-emptive access functions, there are no actual MSS systems providing inter-system pre-emptive access functions and there are no plans and no methods of inter-system pre-emptive access available.

7.3.3 Additional suggested item

Based on the contributions to the CPM, the following proposal for inclusion on the agenda of a future world radiocommunication conference (WRC) was also noted

*"to consider Nos. **5.530** and **5.484A**, and taking account Resolutions **507** and **525 (WARC-92)**, with a view to planning of the BSS band 21.4-22 GHz at a future competent conference"*

7.3.4 Principles for agendas for world radiocommunication conferences

In response to proposals to establish principles for agendas for World Radiocommunication Conferences (WRCs), CPM noted the basic provisions in the framework of the ITU Constitution and Convention.

Article 13 of the Constitution, No. 89, specifies the scope of a WRC to revise the Radio Regulations and to deal with any question of a worldwide character within its competence and related to its agenda.

Article 13 also prescribes that conferences shall take into account the foreseeable financial implications, and that they should avoid adopting resolutions and decisions which might give rise to expenditure in excess of the financial limits.

Article 7 of the Convention lists in some more detail relevant kinds of items that may be included in a WRC agenda:

- partial or, exceptionally, complete revision of the Radio Regulations;
- any other question of a worldwide character within the competence of the conference;

- an item concerning instructions to the Radio Regulations Board and the Radiocommunication Bureau regarding their activities, and a review of those activities;
- the identification of topics to be studied by the radiocommunication assembly and the radiocommunication study groups, as well as matters that the assembly shall consider in relation to future radiocommunication conferences.

Additionally, the Convention in Article 34 on financial responsibilities of conferences prescribes:

- that conferences, before adopting proposals or taking decisions with financial implications, the conferences of the Union shall take account of all the Union's budgetary provisions with a view to ensuring that they will not result in expenses beyond the credits which the Council is empowered to authorize;
- that no decision of a conference shall be put into effect if it will result in a direct or indirect increase in expenses beyond the credits that the Council is empowered to authorize.

The Plenipotentiary Conference at Marrakesh September/October 2002 reviewed the WRC process based on recommendations by the Reform Group of ITU and proposals to the conference. The conclusions are formulated in Resolution 80 (Rev. Marrakesh, 2002):

- that world radiocommunication conference preparations and administration, including budgetary appropriations, should be planned on the basis of two consecutive world radiocommunication conferences: a WRC shall propose the draft agenda of the next WRC and a provisional agenda for the second WRC;
- to support the regional harmonization of common proposals, as stated in Resolution 72 (Rev.WRC-2000), for submission to world radiocommunication conferences;
- to encourage both formal and informal collaboration in the interval between conferences, with a view to resolving differences on items already on the agenda of a conference or new items;
- that administrations, when proposing specific agenda items for WRC, should to the extent possible include some indication of the possible financial and resource implications (preparatory studies and decision implementation), to which effect they may request the assistance of the Radiocommunication Bureau.

In spite of the provisions of the Constitution and Convention, CPM noted the tendency that WRCs are proposing longer and more involved agendas, in several cases including very wide topics, and in some cases there are topics having a very limited scope.

The cumulative effect of the consequential workload upon administrations, ITU-R Sector and the Union in general both for preparatory work and for the implementation cycle is considerable. A great deal of time, effort and resources have been associated with several agenda items during the recent two WRC cycles, which only assess studies and do not require modification to the RR and repeatedly appear in or stem from agenda items of earlier WRCs; therefore, such "rolling agenda items" need to be restricted.

WRC agendas with a wide variety of subjects are cumbersome for most administrations, in particular for those of developing countries. Some limitations in the scope of a WRC would make it more manageable for the administrations as well as for ITU-R. It is also important to take into account the financial situation of ITU.

CPM concluded that there is a need for some principles for the establishment of a WRC agenda item, in addition to the provisions in Article 13 of the Constitution, Articles 7 and 34 of the Convention and Resolution 80 (Rev. Marrakesh, 2002), to reduce enumerated difficulties and to take into account the financial situation of ITU. CPM therefore recommends that, following studies by RAG, further improvements of the WRC process should be adopted by a WRC or PP as appropriate. The following guidelines were offered by some administrations for consideration:

a) the subjects on a WRC agenda should be kept within a range which is manageable for administrations as well as for ITU-R;

b) subjects that are not mature and studied within ITU-R, nor required to become items on the agenda for the first forthcoming WRC, could be stored as alternative agenda items in a "basket" for future conferences;

c) to the extent possible, any subject that has been on the agenda for two consecutive world radiocommunication conferences should not be considered for the following WRC;

d) subjects for WRC agenda items should be encouraged to be coordinated in regional preparation for the WRC establishing the agenda.

ANNEX TO THE CPM REPORT

List of the ITU-R Recommendations related to the CPM Report to WRC-03

Chapter 1 - Radionavigation, radionavigation-satellite and radiolocation services		
Recommendation ITU-R P.452-9	Prediction procedure for the evaluation of microwave interference between stations on the surface of the Earth at frequencies above about 0.7 GHz	Volume 2000 Series P, Part 2
Recommendation ITU-R S.465-5	Reference earth-station radiation pattern for use in coordination and interference assessment in the frequency range from 2 to about 30 GHz	Volume 2000 Series S, Part 1
Recommendation ITU-R SA.510-2	Feasibility of frequency sharing between the space research service and other services in bands near 14 and 15 GHz - Potential interference from data relay satellite systems	Volume 2000 Series SA
Recommendation ITU-R S.524-7	Maximum permissible levels of off-axis e.i.r.p. density from earth stations in GSO network operating in the fixed-satellite service transmitting in the 6, 14 and 30 GHz frequency bands	Supplement 1 Volume 2000 Series S, Parts 1, 2 and 3
Recommendation ITU-R P.526-6	Propagation by diffraction	Volume 2000 Series P, Part 1
Recommendation ITU-R S.580-5	Radiation diagrams for use as design objectives for antennas of earth stations operating with geostationary satellites	Volume 2000 Series S, Part 1
Recommendation ITU-R S.728-1	Maximum permissible level of off-axis e.i.r.p. density from very small aperture terminals (VSATs)	Volume 2000 Series S, Part 1
DRR ITU-R RA.769-1	Protection criteria used for radioastronomical measurements	Doc. 7/53
Recommendation ITU-R SA.1018	Hypothetical reference system for systems comprising data relay satellites in the geostationary orbit and user spacecraft in low Earth-orbits	Volume 2000 Series SA
Recommendation ITU-R S.1068	Fixed-satellite and radiolocation/radionavigation services sharing in the band 13.75 to 14 GHz	Volume 2000 Series S, Part 3
Recommendation ITU-R S.1069	Compatibility between the fixed-satellite service and the space science services in the band 13.75-14 GHz	Volume 2000 Series S, Part 3
Recommendation ITU-R SA.1071	Use of the 13.75 to 14.0 GHz band by the space science services and the fixed satellite service	Volume 2000 Series SA
Recommendation ITU-R M.1088	Considerations for sharing with systems of other services operating in the bands allocated to the radionavigation-satellite service	Volume 2000 Series M, Part 5
Recommendation ITU-R SA.1155	Protection criteria related to the operation of data relay satellite systems	Volume 2000 Series SA
Recommendation ITU-R M.1227-2	Technical and operational characteristics of wind profiler radars in bands in the vicinity of 1 000 MHz	Volume 2000 Series M, Part 4
Recommendation ITU-R M.1313-1	Technical characteristics of maritime radionavigation radars	Volume 2000 Series M, Part 4

Recommendation ITU-R M.1317	Considerations for sharing between systems of other services operating in bands allocated to the radionavigation-satellite and aeronautical radionavigation services and the global navigation satellite system (GLONASS-M)	Volume 2000 Series M, Part 5
Recommendation ITU-R S.1342	Method for determining coordination distances, in the 5 GHz band, between the international standard Microwave Landing System stations operating in the ARNS and non-geostationary MSS stations providing feeder uplink services	Volume 2000 Series S, Part 3
DRR ITU-R M.1372	Efficient use of the radio spectrum by radar stations in the radiodetermination service	Doc. 8/101
Recommendation ITU-R SA.1414	Characteristics of data relay satellite systems	Volume 2000 Series SA
Recommendation ITU-R S.1428-1	Reference FSS earth-station radiation patterns for use in interference assessment involving non-GSO satellites in frequency bands between 10.7 GHz and 30 GHz	Volume 2000 Series S, Part 1
Recommendation ITU-R M.1460	Technical and operational characteristics and protection criteria of radiodetermination and meteorological radars in the 2 900-3 100 MHz band	Volume 2000 Series M, Part 4
DRR ITU-R M.1461	Procedures for determining the potential for interference between radars operating in the radiodetermination service and systems in other services	Doc. 8/100
Recommendation ITU-R M.1463	Characteristics of and protection criteria for radars operating in the radiodetermination service in the frequency band 1 215-1 400 MHz	Volume 2000 Series M, Part 4
DRR ITU-R M.1464	Characteristics of and protection criteria for radionavigation and meteorological radars operating in the frequency band 2 700-2 900 MHz	Doc. 8/97
Recommendation ITU-R M.1477	Technical and performance characteristics of current and planned radionavigation-satellite service (space-to-Earth) and aeronautical radionavigation service receivers to be considered in interference studies in the band 1 559-1 610 MHz	Volume 2000 Series M, Part 5
DRR ITU-R RA.1513	Levels of data loss to radio astronomy observations and percentage-of-time criteria resulting from degradation by interference for frequency bands allocated to the radio astronomy on a primary basis	Doc. 7/51
Recommendation ITU-R M.1583	Interference calculations between non-GSO MSS or RNSS satellite systems and radio astronomy telescope sites	ITU Web (Doc. 8/BL/16)
DNR ITU-R M.[RAD.CHARZ]	Technical and operational characteristics, and criteria for protecting the mission of radars in the radiolocation and radionavigation service operating in the frequency band 13.75-14 GHz	Doc. 8/98
DNR ITU-R M.[RNSS1]	Protection criterion for the aeronautical radionavigation service with respect to aggregate emissions from space stations in the radionavigation-satellite service in the band 1 164-1 215 MHz	Doc. 8/77
DNR ITU-R M.[RNSS2]	Methodology for assessing the aggregate epfd from all RNSS satellites of all RNSS systems operating in the 1 164-1 215 MHz band.	Doc. 8/128

Chapter 2 - Mobile, mobile-satellite and space science services		
Recommendation ITU-R SA.363-5	Space operation systems. Frequencies, bandwidths and protection criteria	Volume 2000 Series SA
Recommendation ITU-R SA.364-5	Preferred frequencies and bandwidths for manned and unmanned near-Earth research satellites	Volume 2000 Series SA
Recommendation ITU-R SA.509-2	Generalized space research Earth station and radio astronomy antenna radiation pattern for use in interference calculations, including coordination procedures	Volume 2000 Series SA
Recommendation ITU-R SA.510-2	Feasibility of frequency sharing between the space research service and other services in bands near 14 and 15 GHz - Potential interference from data relay satellite systems	Volume 2000 Series SA
Recommendation ITU-R SA.577-5	Preferred frequencies and necessary bandwidths for spaceborne active remote sensors	Volume 2000 Series SA
Recommendation ITU-R SA.609-1	Protection criteria for telecommunication links for manned and unmanned near-Earth research satellites	Volume 2000 Series SA
DRR ITU-R RA.611-2	Protection of the radio astronomy service from spurious emissions	Doc. 7/71
Recommendation ITU-R S.672-4	Satellite antenna radiation pattern for use as a design objective in the fixed-satellite service employing geostationary satellites	Volume 2000 Series S, Part 3
Recommendation ITU-R S.728-1	Maximum permissible level of off-axis e.i.r.p. density from very small aperture terminals (VSATs)	Volume 2000 Series S, Part 1
DRR ITU-R F.758-2	Considerations in the development of criteria for sharing between the terrestrial fixed service and other services	Doc. 9/BL/51
DRR ITU-R RA.769-1	Protection criteria used for radioastronomical measurements	Doc. 7/53
Recommendation ITU-R SA.1014	Telecommunication requirements for manned and unmanned deep-space research	Volume 2000 Series SA
Recommendation ITU-R SA.1016	Sharing considerations relating to deep-space research	Volume 2000 Series SA
Recommendation ITU-R SA.1017	Preferred method for calculating link performance in the space research service	Volume 2000 Series SA
Recommendation ITU-R SA.1024-1	Necessary bandwidths and preferred frequency bands for data transmission from Earth exploration satellites (not including meteorological satellites)	Volume 2000 Series SA
DRR ITU-R SA.1029-1	Interference criteria for satellite passive remote sensing	Doc. 7/50
DRR ITU-R M.1036-1	Spectrum considerations for implementation of International Mobile Telecommunications-2000 (IMT-2000) in the bands 1 885-2 025 MHz and 2 110-2 200 MHz	Doc. 8/112
Recommendation ITU-R M.1039-2	Co-frequency sharing between stations in the mobile service below 1 GHz and mobile earth stations of non-geostationary mobile-satellite systems (Earth-to-space) using FDMA	Volume 2000 Series M, Part 5
DRR ITU-R M.1042-1	Disaster communications in the amateur and amateur-satellite services	Doc. 8/89

Recommendation ITU-R F.1094-1	Maximum allowable error performance and availability degradations to digital radio-relay systems arising from interference from emissions and radiations from other sources	Volume 2000 Series F, Part 1A
Recommendation ITU-R F.1105	Transportable fixed radiocommunications equipment for relief operations	Volume 2000 Series F, Part 1B
Recommendation ITU-R F.1108-3	Determination of the criteria to protect fixed service receivers from the emissions of space stations operating in non-geostationary orbits in shared frequency bands	ITU Web (Doc. 9/BL/36)
Recommendation ITU-R M.1141-1	Sharing in the 1-3 GHz frequency range between non-geostationary space stations operating in the mobile-satellite service and stations in the fixed service	Volume 2000 Series M, Part 5
Recommendation ITU-R M.1142-1	Sharing in the 1-3 GHz frequency range between geostationary space stations operating in the mobile-satellite service and stations in the fixed service	Volume 2000 Series M, Part 5
Recommendation ITU-R S.1151	Sharing between the inter-satellite service involving geostationary satellites in the fixed-satellite service and the radionavigation service at 33 GHz	Volume 2000 Series S, Part 3
Recommendation ITU-R SA.1155	Protection criteria related to the operation of data relay satellite systems	Volume 2000 Series SA
Recommendation ITU-R SA.1157	Protection criteria for deep-space research	Volume 2000 Series SA
DRR ITU-R SA.1158-2	Sharing of the 1 675-1 710 MHz band between the meteorological-satellite service (space-to-Earth) and the mobile-satellite service (Earth-to-space)	Doc. 7/77
Recommendation ITU-R SA.1166-2	Performance and interference criteria for active spaceborne sensors	Volume 2000 Series SA
Recommendation ITU-R M.1174-1	Characteristics of equipment used for on-board communications in the bands between 450 and 470 MHz	Volume 2000 Series M, Part 3
DRR ITU-R M.1184-1	Technical characteristics of mobile satellite systems in the frequency bands below 3 GHz for use in developing criteria for sharing between the mobile-satellite service (MSS) and other services	Doc. 8/111
Recommendation ITU-R F.1242	Radio-frequency channel arrangements for digital radio systems operating in the range 1 350 MHz to 1 530 MHz	Volume 2000 Series F, Part 1A
Recommendation ITU-R F.1245-1	Mathematical model of average radiation patterns for line-of-sight point-to-point radio-relay system antennas for use in certain coordination studies and interference assessment in the frequency range from 1 to about 70 GHz	Volume 2000 Series F, Part 2
DRR ITU-R SA.1260	Feasibility of sharing between active spaceborne sensors and other services in the range 420-470 MHz	Doc. 7/69
DRR ITU-R SA.1264	Frequency sharing between the meteorological aids service and the mobile-satellite service (Earth-to-space) in the 1 675-1 700 MHz band	Doc. 7/68
Recommendation ITU-R SA.1280	Selection of active spaceborne sensor emission characteristics to mitigate the potential for interference to terrestrial radars operating in frequency bands 1-10 GHz	Volume 2000 Series SA
Recommendation ITU-R M.1313-1	Technical characteristics of maritime radionavigation radars	Volume 2000 Series M, Part 4

DRR ITU-R F.1336-1	Reference radiation patterns of omnidirectional and other antennas in point-to-multipoint systems for use in sharing studies	Doc. 9D/212, Annex 6
Recommandation ITU-R SA.1344	Preferred frequency bands and bandwidths for the transmission of space VLBI data	Volume 2000 Series SA
DRR ITU-R M.1372	Efficient use of the radio spectrum by radar stations in the radiodetermination service	Doc. 8/101
Recommandation ITU-R M.1390	Methodology for the calculation of IMT-2000 terrestrial spectrum requirements	Volume 2000 Series M, Part 2
Recommandation ITU-R SA.1396	Protection criteria for the space research service in the 37-38 and 40-40.5 GHz bands	Volume 2000 Series SA
Recommandation ITU-R F.1399-1	Vocabulary of terms for wireless access	Doc. 9/BL/5
Recommandation ITU-R F.1400	Performance and availability requirements and objectives for fixed wireless access to public switched telephone network	Volume 2000 Series F, Part 1B
Recommandation ITU-R F.1401	Frequency bands for fixed wireless access systems and the identification methodology	Volume 2000 Series F, Part 1B
Recommandation ITU-R SA.1414	Characteristics of data relay satellite systems	Volume 2000 Series SA
Recommandation ITU-R S.1426	Aggregate power flux-density limits, at the FSS satellite orbit for radio local area network (RLAN) transmitters operating in the 5 150-5 250 MHz band sharing frequencies with the FSS (RR No. S5.447A)	Volume 2000 Series S, Part 2
Recommandation ITU-R S.1427	Methodology and criterion to assess interference from radio local area (RLAN) transmitters to non-GSO MSS feeder links in the band 5 150-5 250 MHz	Volume 2000 Series S, Part 3
Recommandation ITU-R SM.1448	Determination of the coordination area around an earth station in the frequency bands between 100 MHz and 105 GHz	Volume 2000 Series SM, Part 2
DRR ITU-R M.1450-1	Characteristics of broadband radio local area networks (RLANS)	Doc. 8/96
Recommandation ITU-R M.1454	E.i.r.p. density limit and operational restrictions for RLANS1 or other wireless access transmitters in order to ensure the protection of feeder links of non-geostationary systems in the mobile-satellite service in the frequency band 5 150-5 250 MHz	Volume 2000 Series M, Part 1
Recommandation ITU-R M.1456	Minimum performance characteristics and operational conditions for high altitude platform stations providing IMT-2000 in the bands 1 885-1 980 MHz, 2 010-2 025 MHz and 2 110-2 170 MHz in Regions 1 and 3 and 1 885-1 980 MHz and 2 110-2 160 MHz in Region 2	Volume 2000 Series M, Part 2
Recommandation ITU-R M.1459	Protection criteria for telemetry systems in the aeronautical mobile service and mitigation techniques to facilitate sharing with geostationary broadcasting-satellite and mobile-satellite services in the frequency bands 1 452-1 525 MHz and 2 310-2 360 MHz	Volume 2000 Series M, Part 3
DRR ITU-R M.1461	Procedures for determining the potential for interference between radars operating in the radiodetermination service and systems in other services	Doc. 8/100
Recommandation ITU-R M.1462	Characteristics of and protection criteria for radars operating in the radiolocation service in the frequency band 420-450 MHz	Volume 2000 Series M, Part 4

Recommendation ITU-R M.1480	Essential technical requirements of mobile Earth stations of geostationary mobile-satellite systems that are implementing the GMPCS-Memorandum of Understanding arrangements in parts of the frequency band 1-3 GHz	Volume 2000 Series M, Part 5
Recommendation ITU-R F.1490	Generic requirements for fixed wireless access (FWA) systems	Volume 2000 Series F, Part 1B
Recommendation ITU-R F.1499	Radio transmission systems for fixed broadband wireless access (BWA) based on cable modem standards	Volume 2000 Series F, Part 1B
DRR ITU-R RA.1513	Levels of data loss to radio astronomy observations and percentage-of-time criteria resulting from degradation by interference for frequency bands allocated to the radio astronomy on a primary basis	Doc. 7/51
Recommendation ITU-R M.1583	Interference calculations between non-GSO MSS or RNSS satellite systems and radio astronomy telescope sites	ITU Web (Doc. 8/BL/16)
Recommendation ITU-R F.1567	Radio-frequency channel arrangement for digital fixed wireless systems operating in the frequency band 406.1 to 450 MHz	ITU Web (Doc. 9/BL/23)
DNR ITU-R M.[DR.RCIRC]	Global cross-border circulation of radiocommunication equipment in emergency and disaster relief situations	Doc. 8/73
DNR ITU-R M.[8B-CHAR]	Characteristics of and protection criteria for radiolocation, aeronautical radionavigation and meteorological radars operating in the frequency bands between 5 250 and 5 850 MHz	Doc. 8/74 + Corr.1
DNR ITU-R F.[FWA5GHz-EESS]	Operational and deployment requirements for fixed wireless access (FWA) systems in Region 3 to ensure the protection of systems in the EESS (active) in the band 5 250-5 350 MHz	Doc. 9/BL/46
DNR ITU-R SA.[Doc. 7/46]	Sharing in the band 5 250-5 350 MHz between the Earth exploration-satellite service (active) and wireless access systems (including RLANs) in the mobile service	Doc. 7/46
PDNR ITU-R M.[WAS5GHz-EESS]	E.i.r.p. limit and operational restrictions for wireless access systems (including RLANs) [in the mobile service] in order to ensure the protection of systems in the Earth exploration-satellite service (active) and the space research service (active) in the band 5 250-5 350 MHz	Attachment 12 to Doc. 8A-9B/132
PDNR ITU-R M.[METHOD. NWA. SPECTRUM]	Methodology for accessing the required spectrum for generic broadband NWA networks (RLANs)	Attachment 11 to Doc. 8A-9B/205
PDNR ITU-R M.[WAS5GHz EXPANSION-EESS]	Operational and deployment requirements for wireless access systems (including RLANs) [in the mobile service] to facilitate sharing between these systems and systems in the Earth exploration-satellite service (active) and the space research service (active) in the band 5 470-5 570 MHz	Attachment 11 to Doc. 8A-9B/132
PDNR ITU-R M.[8A-9B.RLAN.DFS]	Dynamic frequency selection (DFS) in wireless access systems including RLANs to facilitate sharing between these systems and radiodetermination systems in the frequency bands [5 250-5 350] and 5 470-5 725 MHz	Attachment 10 to Doc. 8A-9B/132
DNR ITU-R M.[AMSS]	Technical and operational requirements for aircraft earth stations of aeronautical mobile-satellite service networks operating in the band 14-14.5 GHz (Earth-to-space)	Doc. 8/78
DNR ITU-R SA.[15SHAR]	Feasibility of sharing between the space research service (space-to-Earth) and the fixed and mobile services in the band 14.8-15.35 GHz	Doc. 7/58

DNR ITU-R SA.[26SHAR]	Feasibility of sharing between the space research service (space-to-Earth) and the fixed, inter-satellite, and mobile services in the band 25.5-27.0 GHz	Doc. 7/57
DNR ITU-R SA.[Doc. 7/60]	Sharing in the band 35.5-36 GHz between the Earth exploration-satellite service (active) and space research service (active), and other services allocated in this band	Doc. 7/60
DNR ITU-R M. [8B-33GHz]	Characteristics of, and protection criteria for radars operating in the radiodetermination service in the frequency band 33.4-36 GHz	Doc. 8/102
DNR ITU-R SA.[Doc. 7/62]	Sharing between command links in the space research and space operation services with the fixed, mobile and mobile-satellite services in the frequency band 257-262 MHz	Doc. 7/62
DNR ITU-R M. [IMT.HAPSINT]	A methodology for co-channel interference evaluation to determine separation distance from a system using HAPS to a cellular system to provide IMT-2000 service	Doc. 8/106
Chapter 3 - Issues concerning fixed-satellite and broadcasting-satellite services		
Recommendation ITU-R S.465-5	Reference earth-station radiation pattern for use in coordination and interference assessment in the frequency range from 2 to about 30 GHz	Volume 2000 Series S, Part 1
Recommendation ITU-R S.580-5	Radiation diagrams for use as design objectives for antennas of earth stations operating with geostationary satellites	Volume 2000 Series S, Part 1
Recommendation ITU-R P.620-4	Propagation data required for the evaluation of coordination distances in the frequency range 100 MHz to 105 GHz	Volume 2000 Series P, Part 2
Recommendation ITU-R S.673-2	Terms and definitions relating to space radiocommunications	ITU Web or Doc. 4/BL/26
Recommendation ITU-R SF.675-3	Calculation of the maximum power density (averaged over 4 kHz) of an angle-modulated carrier	Volume 2000 Series SF
Recommendation ITU-R P.681-5	Propagation data required for the design of Earth-space land mobile telecommunication systems	Supplement 1 Volume 2000 Series P, Parts 1 and 2
DRR ITU-R M.1036-1	Spectrum considerations for implementation of International Mobile Telecommunications-2000 (IMT-2000) in the bands 1 885-2 025 MHz and 2 110-2 200 MHz	Doc. 8/112
Recommendation ITU-R F.1108-3	Determination of the criteria to protect fixed service receivers from the emissions of space stations operating in non-geostationary orbits in shared frequency bands	ITU Web (Doc. 9/BL/36)
Recommendation ITU-R M.1187	A method for the calculation of the potentially affected region for a mobile-satellite service (MSS) network in the 1-3 GHz range using circular orbits	Volume 2000 Series M, Part 5
Recommendation ITU-R BO.1213	Reference receiving earth station antenna patterns for replanning purposes to be used in the revision of the WARC-77 BSS plans for Regions 1 and 3	Volume 2000 Series BO
Recommendation ITU-R M.1225	Guidelines for evaluation of radio transmission technologies for IMT-2000	Volume 2000 Series M, Part 2
Recommendation ITU-R F.1245-1	Mathematical model of average radiation patterns for line-of-sight point-to-point radio-relay system antennas for use in certain coordination studies and interference assessment in the frequency range from 1 to about 70 GHz	Volume 2000 Series F, Part 2

Recommendation ITU-R SF.1320	Maximum allowable values of power flux-density at the surface of the Earth produced by non-geostationary satellites in the fixed-satellite service used in feeder links for the mobile-satellite service and sharing the same frequency bands with radio-relay systems	Volume 2000 Series SF
Recommendation ITU-R S.1323-2	Maximum permissible levels of interference in a satellite network (GSO/FSS; non-GSO/FSS; non-GSO/MSS feeder links) in the fixed-satellite service caused by other codirectional networks below 30 GHz	ITU Web (Doc. 4/BL/32)
Recommendation ITU-R S.1325-2	Simulation methodologies for determining statistics of short-term interference between co-frequency, codirectional non-geostationary-satellite orbit (non-GSO) fixed-satellite service (FSS) networks and other non-GSO FSS or GSO FSS networks	Volume 2000 Series S, Part 2
DRR Recommendation ITU-R S.1328-4	Satellite system characteristics to be considered in frequency sharing analyses within the fixed-satellite service	ITU Web (Doc. 4/BL/36)
Recommendation ITU-R F.1336-1	Reference radiation patterns of omnidirectional, sectoral and other antennas in point-to-multipoint systems for use in sharing studies in the frequency range from 1 to about 70 GHz	Volume 2000 Series F, Part 2
DRR ITU-R SM.1413	Radiocommunication data dictionary	Doc. 1/BL/16
Recommendation ITU-R S.1428-1	Reference FSS earth-station radiation patterns for use in interference assessment involving non-GSO satellites in frequency bands between 10.7 GHz and 30 GHz	Volume 2000 Series S, Part 1
Recommendation ITU-R S.1431	Methods to enhance sharing between non-GSO FSS systems (except MSS feeder links) in the frequency bands between 10-30 GHz	Volume 2000 Series S, Part 3
Recommendation ITU-R BO.1443-1	Reference BSS earth station antenna patterns for use in interference assessment involving non-GSO satellites in frequency bands covered by RR Appendix S30	ITU Web (Doc. 6/BL/40)
Recommendation ITU-R BO.1504	Effective utilization of spectrum assigned to the broadcasting-satellite service (sound)	Supplement 1 to Volume 2000 Series BO
Recommendation ITU-R BO.1505	Coordination procedure for assignments of space operation service in the guardbands of Appendices S30 and S30A Plans of the Radio Regulations (RR)	Supplement 1 to Volume 2000 Series BO
Recommendation ITU-R S.1527	Procedure for the identification of non-geostationary-satellite orbit satellites causing interference into an operating geostationary-satellite orbit earth station	Supplement 1 to Volume 2000 Series S, Parts 1, 2 and 3
Recommendation ITU-R S.1529	Analytical method for determining the statistics of interference between non-geostationary-satellite orbit fixed-satellite service systems and other non-geostationary-satellite orbit fixed-satellite service systems or geostationary-satellite orbit fixed-satellite service networks	Supplement 1 to Volume 2000 Series S, Parts 1, 2 and 3
Recommendation ITU-R S.1554	Methodology for determining the overall accuracy of epfd↓ measurements	ITU Web (Doc. 4/BL/19)
Recommendation ITU-R S.1557	Operational requirements and characteristics of FSS systems operating in the 50/40 GHz bands for use in sharing studies between the fixed-satellite service and the fixed service	ITU Web (Doc. 4/BL/22)
Recommendation ITU-R S.1558	Methodologies for measuring epfd↓ caused by a non-geostationary-satellite orbit space station to verify compliance with operational epfd↓ limits	ITU Web (Doc. 4/BL/23)

Recommendation ITU-R S.1560	Methodology for the calculation of the worst-case interference levels from a particular type of non-geostationary fixed-satellite service system using highly-elliptical orbits into geostationary fixed-satellite service satellite networks operating in the 4/6 GHz frequency bands	ITU Web (Doc. 4/BL/25)
Recommendation ITU-R S.1592	Methodology to assess compliance of non-GSO FSS satellite systems with the additional operational limits on epfd↓ in Article S22 of the Radio Regulations	ITU Web (Doc. 4/BL/40)
Recommendation ITU-R S.1593	Methodology for frequency sharing between certain types of homogeneous non-GSO FSS systems in the 4/6 and 11/14 GHz frequency bands	ITU Web (Doc. 4/BL/41)
Recommendation ITU-R S.1595	Interference mitigation techniques to facilitate coordination between non-geostationary fixed-satellite service systems in highly elliptical orbit and non-geostationary fixed-satellite service systems in low and medium earth orbit	ITU Web (Doc. 4/BL/43)
DNR ITU-R F.[FS-BSS 2.6 GHz]	Power flux-density threshold levels between systems in the broadcasting-satellite service (sound) in the geostationary and non-geostationary satellite orbits for space-to-Earth transmissions and the fixed service in the band 2 535-2 655 MHz	Doc. 9/118
Chapter 4 - Fixed and fixed-satellite services and High Altitude Platform Systems		
Recommendation ITU-R S.524-7	Maximum permissible levels of off-axis e.i.r.p. density from earth stations in GSO network operating in the fixed-satellite service transmitting in the 6, 14 and 30 GHz frequency bands	Supplement 1 Volume 2000 Series S, Parts 1, 2 and 3
Recommendation ITU-R P.530-10	Propagation data and prediction methods required for the design of terrestrial line-of-sight systems	Supplement 1 Volume 2000 Series P
DRR ITU-R F.758-2	Considerations in the development of criteria for sharing between the terrestrial fixed service and other services	Doc. 9/BL/51
DRR ITU-R RA.769-1	Protection criteria used for radioastronomical measurements	Doc. 7/53
DRR ITU-R SA.1029-1	Interference criteria for satellite passive remote sensing	Doc. 7/50
Recommendation ITU-R F.1108-3	Determination of the criteria to protect fixed service receivers from the emissions of space stations operating in non-geostationary orbits in shared frequency bands	ITU Web (Doc. 9/BL/36)
Recommendation ITU-R F.1245-1	Mathematical model of average radiation patterns for line-of-sight point-to-point radio-relay system antennas for use in certain coordination studies and interference assessment in the frequency range from 1 to about 70 GHz	Volume 2000 Series F, Part 2
Recommendation ITU-R S.1328-4	Satellite system characteristics to be considered in frequency sharing analyses within the fixed-satellite service	ITU Web (Doc. 4/BL/36)
Recommendation ITU-R F.1336-1	Reference radiation patterns of omnidirectional, sectoral and other antennas in point-to-multipoint systems for use in sharing studies in the frequency range from 1 to about 70 GHz	Volume 2000 Series F, Part 2
Recommendation ITU-R SF.1395	Minimum propagation attenuation due to atmospheric gases for use in frequency sharing studies between the fixed-satellite service and the fixed service	Volume 2000 Series SF

Recommendation ITU-R S.1432	Apportionment of the allowable error performance degradations to fixed satellite service (FSS) hypothetical reference digital paths arising from time invariant interference for systems operating below 15 GHz	Volume 2000 Series S, Part 1
Recommendation ITU-R SF.1481-1	Frequency sharing between systems in the fixed service using high-altitude platform stations and satellite systems in the geostationary orbit in the fixed-satellite service in the bands 47.2-47.5 and 47.9-48.2 GHz	ITU Web (Doc. 4-9/BL/1)
Recommendation ITU-R SF.1484	Maximum allowable values of power flux-density at the surface of the Earth produced by non-geostationary satellites in the fixed-satellite service operating in the 37.5-42.5 GHz band to protect the fixed service	ITU Web (Doc. 4-9/BL/5)
Recommendation ITU-R F.1498-1	Deployment characteristics of fixed service systems in the band 37-40 GHz for use in sharing studies	ITU Web (Doc. 9/BL/33)
Recommendation ITU-R F.1501	Coordination distance for systems in the fixed service (FS) involving high-altitude platform stations (HAPS) sharing the frequency bands 47.2-47.5 GHz and 47.9-48.2 GHz with other systems in the fixed service	Volume 2000 Series F, Part 1A
DRR ITU-R RA.1513	Levels of data loss to radio astronomy observations and percentage-of-time criteria resulting from degradation by interference for frequency bands allocated to the radio astronomy on a primary basis	Doc. 7/51
DRR ITU-R SM.1542	The protection of passive services from unwanted emissions	ITU Web
Recommendation ITU-R S.1557	Operational requirements and characteristics of FSS systems operating in the 50/40 GHz bands for use in sharing studies between the fixed-satellite service and the fixed service	ITU Web (Doc. 4/BL/22)
Recommendation ITU-R F.1569	Technical and operational characteristics for the fixed service using high altitude platform stations in the bands 27.5-28.35 GHz and 31.0-31.3 GHz	ITU Web (Doc. 9/BL/25)
Recommendation ITU-R F.1570	Impact of uplink transmission in the fixed service using high altitude platform stations (HAPS) on the Earth exploration-satellite service (passive) in the 31.3-31.8 GHz band	ITU Web (Doc. 9/BL/26)
DNR ITU-R F.[9B/HAPS-MT]	Interference mitigation techniques for use by high altitude platform stations (HAPS) in the 27.5-28.35 GHz and 31.0-31.3 GHz bands	Doc. 9/BL/40
DNR ITU-R F.[HAPS-RAS]	Interference evaluation and operational procedure of the fixed service using High Altitude Platform Stations (HAPS) to protect the radio-astronomy service (RAS) from uplink transmission in HAPS systems in the 31.3-31.8 GHz band	Doc. 9/BL/45
DNR ITU-R F.[9B/HAPS1]	Frequency sharing between systems in the fixed service using high altitude platform stations and conventional systems in the fixed service in the bands 47.2-47.5 and 47.9-48.2 GHz	Doc. 9/BL/41
DNR ITU-R F.[HAPS-FWA]	Interference evaluation from fixed service systems using high altitude platform stations to conventional fixed service systems in the bands 27.5-28.35 and 31.0-31.3 GHz	Doc. 9/BL/42

DNR ITU-R SF. [HAPS-FSS METHOD]	A methodology for interference evaluation from the downlink of the fixed service using high altitude platform stations to the uplink of the fixed-satellite service using the geostationary satellites within the band 27.5-28.35 GHz	Doc. 4-9/BL/7
Recommendation ITU-R S.1586	Calculation of unwanted emission levels produced by a non-geostationary FSS satellite system at radio astronomy sites	ITU Web (Doc. 4/BL/30)
PDNR ITU-R SM.[BbB]	Compatibility analysis between a passive service and an active service allocated in adjacent and nearby bands	Doc. 1/1004
DNR ITU-R SF.[PFD-MULTI]	Methodology for determining power flux-density statistics for use in sharing studies between FWS and multiple FSS satellites	Doc. 4-9/BL/8
DNR ITU-R SF.[ESV-A]	The minimum distance from the coastline beyond which in-motion earth stations located on board vessels would not cause unacceptable interference to the fixed service in the bands 5 925-6 425 MHz and 14-14.5 GHz	Doc. 4/95-9/154 (Rev.1)
Recommendation ITU-R SF.1585	Example approach for determination of the composite area within which interference to fixed service stations from earth stations on board vessels when operating in motion near a coastline would need to be evaluated	ITU Web (Doc. 4-9/BL/6)
DNR ITU-R SF.[ESV-C]	Guidance for determination of interference from earth stations on vessels (ESVs) to stations in the fixed service when the ESV is within the minimum distance	Doc. 4/92-9/151 (Rev.1)
DNR ITU-R SF.[ESV-FREQ]	Use of frequencies by earth stations on board vessels transmitting in certain bands allocated to the fixed-satellite service	Doc. 4/91-9/150 (Rev.1)
Recommendation ITU-R S.1587	Provisional technical characteristics of earth stations on board vessels (ESVs) operating in the FSS networks in the frequency bands 5 925-6 425 MHz, and 14-14.5 GHz	ITU Web (Doc. 4/BL/31)
Recommendation ITU-R S.1557	Operational requirements and minimum characteristics of FSS systems operating in the 50/40 GHz bands for use in sharing studies between the fixed-satellite service and terrestrial services	ITU Web (Doc. 4/BL/22)
Recommendation ITU-R SF.1572	Methodology to evaluate the impact of space-to-Earth interference from the fixed-satellite service to the fixed service in frequency bands where precipitation is the predominant fade mechanism	ITU Web (Doc. 4-9/BL/2)
Recommendation ITU-R SF.1573	Maximum allowable values of power flux-density at the surface of the Earth by geostationary satellites in the fixed-satellite service operating in the 37.5-42.5 GHz band to protect the fixed service	ITU Web (Doc. 4-9/BL/3)
Recommendation ITU-R S.1594	Technical characteristics of high density FSS earth stations transmitting towards geostationary FSS space stations in the 30 GHz range	ITU Web (Doc. 4/BL/42)
DNR ITU-R F.[9A/NGSO3]	Interference criteria to protect fixed wireless systems from time varying aggregate interference produced by non-GSO satellites operating in other services sharing the 37-40 GHz and 40.5-42.5 GHz bands on a co-primary basis	Doc. 9/BL/39
Chapter 5 - Maritime mobile, amateur and amateur-satellite, and broadcasting services in MF and HF bands		
Recommendation ITU-R P.373-7	Definitions of maximum and minimum transmission frequencies	Volume 2000 Series P, Part 1

Recommendation ITU-R P.533-6	HF propagation prediction method	Volume 2000 Series P, Part 2
Recommendation ITU-R M.541-8	Operational procedures for the use of digital selective calling equipment in the maritime mobile service	Volume 2000 Series P, Part 3
DRR ITU-R M.585-2	Assignment and use of maritime mobile service identities	Doc. 8/75(Rev.1)
Recommendation ITU-R M.1169	Hours of service of ship stations	Volume 2000 Series P, Part 3
Recommendation ITU-R M.1170	Morse telegraphy procedures in the maritime mobile service	Volume 2000 Series P, Part 3
Recommendation ITU-R BS.1348	Service requirements for digital sound broadcasting at frequencies below 30 MHz	Volume 2000 Series BS, Part 1
Recommendation ITU-R BS.1514-1	System for digital sound broadcasting in the broadcasting bands below 30 MHz	ITU Web (Doc. 6/BL/45)
Recommendation ITU-R M.1544	Minimum qualifications of radio amateurs	ITU Web (Doc. 8/BL/1)
DNR ITU-R BS.[Doc. 6/324]	"Planning parameters" for digital sound broadcasting at frequencies below 30 MHz	Doc. 6/324 (Rev.1)
Chapter 6 - Other matters		
DRR ITU-R SM.329-9	Spurious emissions	ITU Web
DRR ITU-R RA.769-1	Protection criteria used for radioastronomical measurements	Doc. 7/53
DRR ITU-R SA.1029-1	Interference criteria for satellite passive remote sensing	Doc. 7/50
Recommendation ITU-R S.1428-1	Reference FSS earth-station radiation patterns for use in interference assessment involving non-GSO satellites in frequency bands between 10.7 GHz and 30 GHz	Volume 2000 Series S, Part 1
DRR ITU-R RA.1513	Levels of data loss to radio astronomy observations and percentage-of-time criteria resulting from degradation by interference for frequency bands allocated to the radio astronomy on a primary basis	Doc. 7/51
Recommendation ITU-R SM.1539	Variation of the boundary between the out-of-band and spurious domains required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329	Doc. 1/BL/18
Recommendation ITU-R SM.1541	Unwanted emissions in the out-of-band domain	Doc. 1/BL/19
DNR ITU-R SM.[BbB]	Compatibility analysis between a passive service and an active service allocated in adjacent and nearby bands	Doc. 1/1004
Recommendation ITU-R S.1586	Calculation of unwanted emission levels produced by a non-geostationary FSS satellite system at radio astronomy sites	ITU Web (Doc. 4/BL/30)
Recommendation ITU-R M.1583	Interference calculations between non-GSO MSS or RNSS satellite systems and radio astronomy telescope sites	ITU Web (Doc. 8/BL/16)
Chapter 7 - Future work programme		
Recommendation ITU-R V.573-4	Radiocommunication vocabulary	Volume 2000 Series V

Recommendation ITU-R F.592-3	Terminology used for radio-relay systems	Volume 2000 Series F, Part 1A
Recommendation ITU-R V.662-3	Terms and definitions	Volume 2000 Series V
Recommendation ITU-R M.1224	Vocabulary of terms for International Mobile Telecommunications-2000 (IMT-2000)	Volume 2000 Series M, Part 2
Recommendation ITU-R M.1308	Evolution of land mobile systems towards IMT-2000	Volume 2000 Series M, Part 2
Recommendation ITU-R F.1399-1	Vocabulary of terms for wireless access	Volume 2000 Series F, Part 1B
Recommendation ITU-R M.687-2	International Mobile Telecommunications-2000 (IMT-2000)	Volume 2000 Series M, Part 2
Recommendation ITU-R M.819-2	International Mobile Telecommunications-2000 (IMT-2000) for developing countries	Volume 2000 Series M, Part 2
Recommendation ITU-R M.1311	Framework for modularity and radio commonality within IMT-2000	Volume 2000 Series M, Part 2
Recommendation ITU-R M.1390	Methodology for the calculation of IMT-2000 terrestrial spectrum requirements	Volume 2000 Series M, Part 2
Recommendation ITU-R P.1411-1	Propagation data and prediction methods for the planning of short-range outdoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz	Supplement 1 to Volume 2000 Series P, Parts 1 and 2
DRR ITU-R M.1457-1	Detailed specifications of the radio interfaces of IMT-2000	Doc. 8/BL/18
Recommendation ITU-R S.1590	Technical and operational characteristics of satellites operating in the range 20-375 THz	ITU Web (Doc. 4/BL/37)
DNR ITU-R SA.[EESS-4300]	Sharing between the Earth exploration-satellite (passive) and airborne altimeters in the aeronautical radionavigation service in the band 4 200-4 400 MHz	Doc. 7/49
DNR ITU-R P.[OPTICAL]	Propagation data required for the design of Earth-space systems operating between 20 and 375 THz	Doc. 3/74(Rev.1)
DNR ITU-R P.[THz]	Prediction methods required for the design of Earth-space systems operating between 20 and 375 THz	Doc. 3/69(Rev.1)
DNR = Draft new Recommendation DRR = Draft revised Recommendation PDNR = Proposed draft new Recommendation		