INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

YELLOW BOOK

VOLUME IV - FASCICLE IV.1

MAINTENANCE; GENERAL PRINCIPLES, INTERNATIONAL CARRIER SYSTEMS, INTERNATIONAL TELEPHONE CIRCUITS

RECOMMENDATIONS M.10-M.761

VII[TH] PLENARY ASSEMBLY
GENEVA, 10-21 NOVEMBER 1980

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[1] "Telematic services" is used provisionally.

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1) "Telematic services" is used provisionally.

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REMARKS

1 The Questions entrusted to each Study Group for the Study Period 1981-1984 can be found in Contribution No. 1 to that Study Group.

2 Supplements to the Series M and N Recommendations can be found in Fascicle IV.3 and those to the Series O Recommendations in Fascicle IV.4.

CCITT NOTE

In this fascicle, the expression "Administration" is used for shortness to indicate both a telecommunication Administration and a recognized private operating agency.

FASCICLE IV.1

Recommendations M.10 to M.761

GENERAL MAINTENANCE PRINCIPLES
AND
MAINTENANCE OF INTERNATIONAL CARRIER SYSTEMS AND TELEPHONE CIRCUITS

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INTRODUCTION

Recommendation M.10

GENERAL RECOMMENDATION CONCERNING MAINTENANCE

To enable Administrations to cooperate effectively in maintaining the characteristics required for the international telecommunication service, the relevant CCITT Recommendations, which are based on long experience, should be applied.

Recommendation M.15

MAINTENANCE CONSIDERATIONS FOR NEW SYSTEMS

1 General

To ensure that new systems are implemented so as to permit compatible international operation and maintenance in the most effective manner, the following guiding principles are indicated.

2 Principles

2.1 When a new system is being studied, early consideration should be given to operational and maintenance requirements.

2.2 The maintenance organisation and maintenance facilities (including test equipment) should be considered early enough to ensure their availability when the new system is introduced.

2.3 Where existing maintenance procedures, for example fault reporting, are not appropriate, alternative procedures should be considered early enough to ensure their application when the new system is introduced. However, any new procedures should consider established maintenance principles accepted by the CCITT.

Recommendation M.25

LINE-UP AND MAINTENANCE LIMITS

The following principles have been adopted in respect of line-up and maintenance action limits for analogue and digital international circuits, links and lines:

i) There should be separate limits for line-up and maintenance action.

ii) There should be a single limit specified for maintenance action, and this limit should be chosen such that, if exceeded, a fault would be considered to exist. (However, the subject of prompt and deferred maintenance action requirements is under study and the result of this study may reflect on the number of limits required for maintenance action.)

iii) After clearance of a fault, an international circuit, link or line should be returned to service within the line-up limit or, in the circumstances where this is not practical, as close as possible to the line-up limit. In all cases, the circuit, link or line should be returned to service within the maintenance action limit.

It is intended that, wherever practical, these principles be embodied in new M and N Recommendations, and be taken into account when the M and N Recommendations have cause to be reviewed or amended.

Recommendation M.50

VOCABULARY

For their dealings with their colleagues in other countries, personnel at repeater stations and other maintenance units will find it helpful to refer to the *Vocabulary of basic terms used in line transmission* published by the CCITT for their benefit.

This *Vocabulary* gives transmission terms in the following languages: English, French, Spanish, Russian, German, Italian, Polish, Dutch, Portuguese and Swedish.

The terms of telecommunication used in the CCITT Books have been collected in the volume *Terms and Definitions* of this Book. This vocabulary gives the terms in English, French and Spanish.

SECTION 1

GENERAL

1.1 Maintenance organization

Recommendation M.70

GUIDING PRINCIPLES ON THE GENERAL MAINTENANCE ORGANIZATION FOR TELEPHONE-TYPE INTERNATIONAL CIRCUITS

1 General

In order to furnish guiding principles to Administrations, the CCITT recommends the following principles for the general maintenance organization for international circuits.

1.1 Definitions relating to the various maintenance elements, each representing a set of functions, are given in Recommendations M.700 to M.720 [1] for automatic circuits, and in Recommendations M.82, M.92 and M.95 for leased and special circuits.

1.2 The size and complexity of the maintenance organization will depend on the particular case and the particular country concerned. In some instances it may be possible to carry out all sets of functions from a single location; in others only some of the functions might be combined and carried out from one location. The precise arrangement will depend on the Administration concerned, and the CCITT limits itself to defining the functions of the separate elements, leaving the manner in which the elements are grouped to be determined by the Administration.

1.3 If a country so desires and/or if it judges that the complexity of its international telecommunications so requires, the international maintenance organization can be responsible for all types of circuit for which Study Group IV makes recommendations.

2 Types of circuits to be catered for

The types of circuits to be catered for are as follows:

public circuits:

- telephone circuits,
- voice-frequency telegraph circuits,
- phototelegraph circuits,
- sound-programme circuits, etc.;

leased circuits:

- telephone circuits: point-to-point and multiterminal,
- voice-frequency telegraph circuits,
- data circuits: point-to-point and multiterminal,
- multi-facility circuits, that is, phototelegraph plus voice-frequency telegraph; speech plus voice-frequency telegraph; simultaneous or alternative transmission,
- phototelegraph circuits,
- sound-programme circuits, etc.

3 Maintenance organization

The maintenance of international public telephone circuits relies upon the ability of each Administration to fulfil the various functions and responsibilities noted in the Series M Recommendations. Where such circuits are manual, as opposed to automatic, it is assumed that the Administration will select and provide the relevant elements such as the *fault report point (circuit)* and the *testing point (transmission)* together with *circuit control* and *sub-control station* assignments as appropriate.

For automatic circuits all the elements noted in Recommendation M.710 [2] apply.

Leased and special international circuits require the services of a Transmission Maintenance Point (International Line) (TMP-IL) which is described in Recommendation M.95. The circuit control and sub-control functions and responsibilities on leased and special international circuits are noted in Recommendations M.82 and M.92 and include a close cooperation with the TMP-IL.

For operations at other levels (group, supergroup, etc.), specific responsibilities are allotted to particular repeater stations. At each level, maintenance is based on the appointment of a *control station* and one or more *sub-control stations* Additional information concerning control and sub-control stations follows in Recommendations M.80 and M.90 and is supplemented by that contained in Recommendations M.82, M.92, M.723 [3], M.724 [4], N.5 [5] and N.55 [6].

The attention of Administrations is drawn to the need for exchanging contact forms (similar to those for maintenance units for automatic circuits as described in Recommendation M.728 [7]) which give telephone numbers, staffing hours, etc. for units involved in the maintenance of leased circuits and the higher order transmission systems.

References

[1] CCITT Recommendations M.700 to M.720, Vol. IV, Fascicle IV.1.

[2] CCITT Recommendation *General maintenance organization for the international automatic and semiautomatic service*, Vol. IV, Fascicle IV.1, Rec. M.710.

[3] CCITT Recommendation *Circuit control station*, Vol. IV, Fascicle IV.1, Rec. M.723.

[4] CCITT Recommendation *Circuit sub-control station*, Vol. IV, Fascicle IV.1, Rec. M.724.

[5] CCITT Recommendation *Control and sub-control stations for sound-programme circuits, connections, etc.*, Vol. IV, Fascicle IV.3, Rec. N.5.

[6] CCITT Recommendation *Organization, responsibilities and functions of control and sub-control ITCs and control and sub-control stations for international television connections, links, circuits and circuit stations*, Vol. IV, Fascicle IV.3, Rec. N.55.

[7] CCITT Recommendation *Guidelines for the cooperation between maintenance elements*, Vol. IV, Fascicle IV.1, Rec. M.728.

Recommendation M.80

CONTROL STATIONS

1 Definition of control station

A control station is that point within the general maintenance organization which fulfils the control responsibilities for the circuit, group, supergroup or line section, etc., assigned to it.

2 Appointment of control stations

The following principles for control stations apply to:

- every international circuit (circuit control station),
- every international group, supergroup, etc. (group control station, supergroup control station, etc.),
- every line link and every regulated line section (line link control station, regulated line section control station), particularly on carrier transmission systems using a symmetric pair line, a coaxial line or a radio-relay link.

2.1 *Circuit control station*

A circuit control station is nominated for each international circuit used for public telephony or for leased or special purposes in accordance with Recommendations M.82 and M.723 [1] as appropriate. In the case of sound-programme or television circuits, the terminal ISPC (International Sound-Programme Centre) or ITC (International Television Centre) at the receiving end should be nominated as the control station. (See Recommendations N.1 [2], N.5 [3] and N.55 [4].)

2.2 *Group, supergroup, etc. control stations*

For each international group, supergroup, etc., each terminal repeater station is a control station for its incoming direction of transmission. There are thus two control stations, one for each direction of transmission.

2.3 *Regulated line section control station*

The procedure is the same as for groups, supergroups, etc., that is to say, each of the terminal repeater stations is a control station for the incoming direction of transmission.

3 Responsibilities of circuit control stations

See Recommendations M.82 and M.723 [1] concerning public automatic telephone circuits, leased circuits and special circuits, respectively. See Recommendations N.5 [3] and N.55 [4] in connection with sound-programme and television circuits.

4 Responsibilities of control stations for groups, supergroups, etc.

4.1 Group, supergroup, etc., or regulated line section or line link control stations are responsible for the incoming direction of transmission only.

4.2 Each control station is responsible for ensuring that the group, supergroup, etc., link, or line with which it is concerned is set up and maintained to the required standards. In particular, it is responsible for:

a) controlling lining-up measurements to within the recommended limits and keeping records of reference measurements (initial measurements);

b) ensuring that routine maintenance measurements are carried out on the due dates, using the specified methods and in such a way that interruptions to service are limited to the shortest possible duration;

c) ensuring that the stations concerned take action when a fault occurs, and controlling the various tests or investigations necessary in clearing the fault. It must be possible to report faults discovered at any time of the day or night;

d) informing the circuit control station of any condition which might affect the operation of the circuits under its control;

e) seeking the authority of the circuit control station for any action which will take a circuit, or circuits, out of service;

f) knowing what are the possibilities of rerouting any faulty groups, supergroups, etc.;

g) recording, on forms provided for the purpose, all incidents which arise, giving the time of occurrence of the incident, the exact location if known, the action taken if any, and the time of restoration to service.

4.3 Thus, for technical purposes (maintenance, lining-up) the control function for groups, supergroups, mastergroups, supermastergroups and regulated line sections are divided between the two directions of transmission, the station at the incoming end being the control station in each case. However, it is considered desirable to have a single routing form for each, giving information about both directions of transmission, and in order that this and similar documentation may be prepared and distributed on a methodical basis, these documentary functions shall be added to the responsibilities of one of the control stations, this *control station for documentary purposes* being chosen by agreement between the Administrations concerned.

References

[1] CCITT Recommendation *Circuit control station*, Vol. IV, Fascicle IV.1, Rec. M.723.

[2] CCITT Recommendation *Definitions for application to international sound-programme transmissions*, Vol. IV, Fascicle IV.3, Rec. N.1.

[3] CCITT Recommendation *Control and subcontrol stations for sound-programme circuits, connections, etc.*, Vol. IV, Fascicle IV.3, Rec. N.5.

[4] CCITT Recommendation *Organization, responsibilities and functions of control and sub-control ITCs and control and sub-control stations for international television connections, links, circuits and circuit sections*, Vol. IV, Fascicle IV.3, Rec. N.55.

Recommendation M.82

CIRCUIT CONTROL STATION (LEASED AND SPECIAL CIRCUITS)

1 Definition of circuit control station

The circuit control station is that point within the general maintenance organization which fulfils the control responsibilities for leased and special circuits assigned to it such as voice-frequency telegraph, facsimile and phototelegraph.

2 Responsibilities

The circuit control station is responsible for ensuring that the circuit assigned to it is set up and maintained to the required end-to-end standards in both directions of transmission and that, if the circuit fails, the outage time is kept to a minimum.

3 Functions

3.1 Arranging for the setting up of the circuit and of the signalling equipment associated directly with the circuit and the related adjustments.

3.2 Controlling transmission measurements for the setting up and lining up of international circuits to within the recommended limits and keeping records of reference measurements (initial measurements).

3.3 Receiving fault reports from the:

- circuit user or his representative, either directly or via nominated fault report points;
- staff at the maintenance entities;
- transmission maintenance point (international line) (TMP-IL) (see Recommendation M.95);
- sub-control station via the TMP-IL.

3.4 Controlling routine maintenance measurements and tests on the due dates if scheduled, using the specified methods and in such a way that interruptions to service are limited to the shortest possible durations.

3.5 Obtaining cooperation from the circuit sub-control station, either directly or via the TMP-IL.

3.6 Directing the location of faults to the national line or the terminal national section in its own country, or beyond the national line to the international line, or to the foreign country.

3.7 Controlling the withdrawal of circuits from service.

3.8 Controlling the return of circuits to service after fault clearance.

3.9 Keeping records of the routing of the leased and special circuits.

3.10 Keeping accurate records of circuit outage times.

3.11 Knowing the possibilities of rerouting any circuit under its control.

4 Appointment of control stations

For each international leased or special circuit a circuit control station is nominated by common agreement between the technical services of the Administrations concerned. For making the choice, special consideration will be given to the location of the principal user and the length of the circuit within the territory of each terminal country.

For unidirectional constituted circuits the circuit control station should be located in the receiving country.

The circuit control station may be located at or near the terminal repeater station serving the user or at the terminal international centre which defines the terminal of the international line in the control country.

The considerations involved in locating the circuit control station in a given country include the following:

- availability of staff;
- availability of adequate staff expertise;
- availability of communication with user and other pertinent locations;
- ability to fulfil the functions indicated in this Recommendation.

Recommendation M.90

SUB-CONTROL STATIONS

1 Definition of sub-control station

A sub-control station is that point within the general maintenance organization which fulfils the sub-control responsibilities of the circuit, group, supergroup, etc. assigned to it.

2 Appointment of sub-control stations

The following principles apply to:

- every international circuit (circuit sub-control station), for whatever purpose (telephony, telegraphy, sound-programme, data transmission, etc.). (See in particular Recommendations N.5 [1] in connection with sound-programme circuits and N.55 [2] in connection with television circuits);
- every international group, supergroup, mastergroup or supermastergroup (group sub-control station, supergroup sub-control station, etc.);
- every line link and regulated line section (line link sub-control station, regulated line section sub-control station), particularly on carrier transmission systems using a symmetric pair line, a coaxial line or a radio-relay link.

The technical service of the Administration concerned designates the station that is to act as a sub-control station in its country and informs the technical service of the country responsible for the control station accordingly.

2.1 *Terminal sub-control stations*

2.1.1 *Terminal sub-control stations for circuits*

For each circuit a terminal circuit sub-control station is appointed in accordance with Recommendation M.92 or M.724 [3] as appropriate.

For unidirectional constituted circuits the terminal station at the sending end should be the terminal circuit sub-control station. In particular, in the case of sound-programme or television circuits, the terminal ISPC or ITC at the sending end should be the terminal sub-control station. (See Recommendations N.5 [1] and N.55 [2].)

2.1.2 *Terminal sub-control stations for groups, supergroups, etc.*

At the two ends of a group link, supergroup link, etc., the terminal stations are designated as terminal group link, supergroup link, etc., sub-control stations for the direction of transmission for which they are not the group link, supergroup link, etc., control station.

2.1.3 *Terminal sub-control station for a line link or a regulated section*

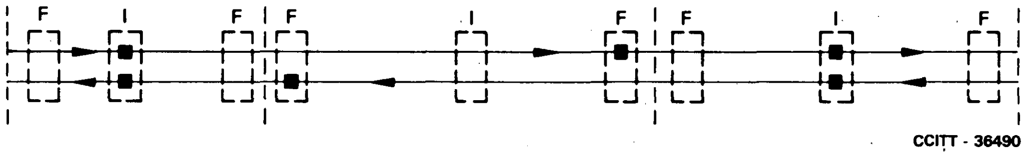
At the two ends of a line link or a regulated line section, the terminal stations are designated as terminal line link or regulated line section sub-control station for the direction of transmission for which they are not the line link or regulated line section control station.

2.2 *Intermediate sub-control stations*

2.2.1 *Intermediate sub-control stations for circuits*

In transit countries in which a circuit is brought to audio frequencies, an intermediate circuit sub-control station is appointed at a suitable point for each direction of transmission. It is left to the country concerned to choose:

- where this point shall be;
- whether the sub-control functions for the two directions of transmission are vested in one station or two stations (see Figure 1/M.90);
- whether, as may be desirable in the case of a large country, each direction of transmission has more than one circuit sub-control station per transit country.



F = frontier station I = intermediate station —■— = sub-control station

FIGURE 1/M.90

Possible choice for sub-control stations in a transit country

2.2.2 *Intermediate sub-control stations for links*

In general, for links (group, supergroup, etc., line), in transit countries in which the link concerned appears in its basic frequency range, an intermediate sub-control station is appointed for each direction of transmission, the same discretion as for circuits being given to the country concerned (see 2.2.1 above and Figure 1/M.90).

2.2.3 *Intermediate sub-control stations for regulated line sections*

In transit countries, a regulated line section intermediate sub-control station is appointed for each direction of transmission, the same discretion as for circuits being given to the country concerned (see 2.2.1 above and Figure 1/M.90).

2.3 *Combination of functions*

Any, or all, of the above functions may be vested in one station, depending on the arrangements in the country concerned.

3 Responsibilities of sub-control stations for circuits

See Recommendations M.724 [3] and M.92 concerning automatic public telephone circuits, leased circuits and special circuits, respectively. See also Recommendations N.5 [1] and N.55 [2] in connection with sound-programme and television circuits.

4 Responsibilities of sub-control stations for groups, supergroups, etc.

The responsibilities of sub-control stations are, for the sections which they control, similar to those given in Recommendation M.80 for control stations, but in addition they include:

- cooperating with the control stations and other sub-control stations in locating and clearing faults;
- setting up and maintaining that part of the group link, supergroup link, mastergroup link, or regulated line section link between the through-connection stations nearest to the two frontiers;
- seeing that the transmission on the national section with which they are concerned is within the prescribed limits;
- reporting to the control station all relevant details concerning the location and subsequent clearance of faults;
- keeping the necessary records on lining-up, fault location and fault clearing for the section for which they are responsible.

References

[1] CCITT Recommendation *Control and sub-control stations for sound-programme circuits, connections, etc.*, Vol. IV, Fascicle IV.3, Rec. N.5.

[2] CCITT Recommendation *Organization, responsibilities and functions of control and sub-control ITCs and control and sub-control stations for international television connections, links, circuits and circuit sections*, Vol. IV, Fascicle IV.3, Rec. N.55.

[3] CCITT Recommendation *Circuit sub-control station*, Vol. IV, Fascicle IV.1, Rec. M.724.

Recommendation M.92

SUB-CONTROL STATION (LEASED AND SPECIAL CIRCUITS)

1 Definition of circuit sub-control station

The circuit sub-control station is a point within the general maintenance organization that assists the circuit control station for international leased and special circuits with which it is concerned and fulfils the control responsibilities for one or more circuit sections assigned to it.

2 Responsibilities

It is the responsibility of the circuit sub-control station to inform the circuit control station about all noted events likely to affect the circuit under their control. If circuit sections are assigned to the circuit sub-control station for the purpose of controlling them, the circuit sub-control station is responsible for these circuit sections in the same way as the circuit control station is for the complete circuit.

3 Functions

3.1 Performing the control functions for circuit sections, especially national sections, as given for the circuit control station.

3.2 Cooperating with the circuit control station and other circuit sub-control stations either directly or via the TMP-IL (see Recommendation M.95) in ensuring that routine maintenance, fault location and clearance are carried out by the responsible testing points and/or maintenance units in a proper manner.

3.3 Arranging that all relevant details concerning the location and subsequent clearance of faults are reported to the circuit control station either directly or via the TMP - IL.

4 Appointment of sub-control stations

For each international leased or special circuit a terminal circuit sub-control station is appointed. This is as close as practical to the end of the circuit remote from the circuit control station.

In transit countries in which a circuit is brought to audio frequencies, an intermediate circuit sub-control station is appointed at a suitable point for each direction of transmission. It is left to the Administration concerned to choose:

- where this point shall be,
- whether the sub-control functions for the two directions of transmission are vested in one station or two stations,
- whether, as may be desirable in the case of a large country, each direction of transmission has more than one circuit sub-control station per transit country.

The technical service of the Administration concerned indicates its choice to the Administration responsible for the control station.

Recommendation M.95

TRANSMISSION MAINTENANCE POINT (INTERNATIONAL LINE) (TMP-IL)

1 Definition of transmission maintenance point (international line)

The transmission maintenance points (international line) are elements within the general maintenance organization located at the terminals of that part of a leased or special circuit known as the international line. An international line is defined in Recommendation M.1010 [1]. The class of circuits considered here are also referred to in Recommendations M.82 and M.92 concerning circuit control and sub-control functions for international leased and special circuits.

2 Responsibilities and functions

The transmission maintenance point (international line) is responsible for the following set of functions:

2.1 Carrying out transmission measurements on the international line as appropriate for line-up and subsequent maintenance purposes.

2.2 Carrying out transmission measurements and tests in conjunction with TMP-IL points in other countries to localize faults to the international line, or beyond, and taking subsequent fault clearance action, as appropriate.

2.3 Carrying out those functions in accordance with national procedures that will result in the isolation and clearance of any fault located in its country on behalf of the transmission maintenance point (international line) of the country with circuit control. Such functions should also be carried out where the circuit control station is located in its own country.

2.4 Acting as liaison point with other countries in maintenance matters of mutual concern, as required.

3 Facilities

The TMP-IL should be provided with the following facilities:

3.1 Access to the line access point directly or indirectly.

3.2 Association of test equipment to the line access points directly or indirectly to permit specified line parameters to be measured and fault localization to be made.

3.3 Communication with circuit control and sub-control stations in its own country.

3.4 Communication with TMP-ILs in other countries to which circuits are routed to enable cooperation and information to be obtained and given.

Reference

[1] CCITT Recommendation *Constitution and nomenclature of international leased circuits,* Vol. IV, Fascicle IV.2, Rec. M.1010.

Recommendation M.97

EXCHANGE OF CONTACT POINT INFORMATION FOR INTERNATIONAL LEASED AND SPECIAL CIRCUIT MAINTENANCE

The attention of Administrations is drawn to the need for exchanging information about telephone numbers, staffing hours, etc., for units involved in the maintenance of leased and special circuits. The exchange of such information is of great assistance to international cooperation and has an important bearing on maintenance efficiency.

The contact points to be identified in this exchange of information should be restricted to those contact points necessary for international cooperation between the staffs of international centres, for example:

- circuit control/sub-control station (See Recommendations M.82 and M.92);
- transmission maintenance point (international line) (TMP-IL) (See Recommendation M.95);
- fault report point;
- testing point;
- restoration point of individual circuits.

The form to be used for this purpose is shown in Figure 1/M.97. It provides for specific telephone and telex numbers and answer back codes, together with the hours of staffing for each contact point and the name of the unit responsible. In some situations a single telephone number, telex number and answer back code, etc. will cover all contact points in a particular international centre. In other situations this may not be the case; for example, each contact point may have its own telephone number, etc. The actual arrangements will depend upon the particular organization existing within the Administration concerned. The *Remarks* column of the form should be used to give other useful information, such as languages spoken. One form is required for each international centre concerned with leased and special circuits.

Where staff separate from those concerned with day-to-day maintenance are used for setting up and lining up new or rearranged leased and special circuits, the relevant contact point information should be indicated by a separate entry.

Each Administration should distribute the completed forms to other Administrations as appropriate. The distribution might conveniently be done in conjunction with the distribution of contact point information for the automatic and semiautomatic telephone service (Recommendation M.728 [1]), and for group, supergroup, etc., and transmission system maintenance (Recommendation M.98).

Information concerning the contact point within the technical services for leased and special circuit maintenance should also be exchanged in a similar manner to that shown in Figure 2/M.728 [1].

Reference

[1] CCITT Recommendation *Guidelines for the cooperation between maintenance elements,* Vol. IV, Fascicle IV.1, Rec. M.728.

CONTACT POINTS FOR INTERNATIONAL LEASED AND SPECIAL CIRCUIT MAINTENANCE

COUNTRY:

INTERNATIONAL CENTRE:

DATE OF ISSUE:

POSTAL ADDRESS:

Contact point	Telephone No.	Telex No. and answer back	Service hours (GMT)	Name of unit Responsible	Remarks[1]
Circuit control/ sub-control station					
TMP-IL					
Fault report point					
Testing point					
Restoration of individual circuits					

[1] Language information may be included.

FIGURE 1/M.97

Form for the contact points for international leased and special circuit maintenance

EXCHANGE OF CONTACT POINT INFORMATION FOR GROUP, SUPERGROUP, ETC., AND TRANSMISSION SYSTEM MAINTENANCE

The attention of Administrations is drawn to the need for exchanging information about telephone numbers, staffing hours, etc., for units involved in the maintenance of groups, supergroups, etc. The exchange of such information is of great assistance to international cooperation and has an important bearing on international efficiency.

The contact points to be identified in this exchange of information should be restricted to those contact points necessary for international cooperation between the staffs of international repeater stations, for example:

- fault report point (see Recommendation M.130),
- control/sub-control station (see Recommendations M.80 and M.90),
- testing point (for routines, functional tests and fault localization),
- restoration implementation point,
- restoration control point (see Recommendation M.725 [1]).

The form to be used for this purpose is shown in Figure 1/M.98. It provides for specific telephone and telex numbers and answer back codes, together with the hours of staffing for each contact point and the name of the unit responsible. In some situations a single telephone number, telex number and answer back code, etc. will cover all contact points in a particular international repeater station. In other situations this may not be the case, for example, each contact point may have its own telephone number, etc. The actual arrangements will depend upon the particular organization existing within the Administration concerned. The *Remarks* column of the form should be used to give other useful information, such as, languages spoken. One form is required for each international repeater station.

Where staff separate from those concerned with day-to-day maintenance are used for setting up and lining up new or rearranged groups, supergroups, etc., the relevant contact point information should be indicated by a separate entry.

Each Administration should distribute the completed forms to other Administrations as appropriate. The distribution might conveniently be done in conjunction with the distribution of contact point information for the automatic and semiautomatic telephone service (Recommendation M.728 [2]), and for leased and special circuits (Recommendation M.97).

Information concerning the contact point within the technical services for transmission system maintenance should also be exchanged in a similar manner to that shown in Figure 2/M.728 [2].

References

[1] CCITT Recommendation *Restoration control point*, Vol. IV, Fascicle IV.1, Rec. M.725.

[2] CCITT Recommendation *Guidelines for the cooperation between maintenance elements*, Vol. IV, Fascicle IV.1, Rec. M.728.

CONTACT POINTS FOR TRANSMISSION SYSTEM MAINTENANCE

COUNTRY:

DATE OF ISSUE:

INTERNATIONAL REPEATER STATION (IRS):

POSTAL ADDRESS:

INTERNATIONAL CENTRES SERVED BY THIS IRS:

Contact point	Telephone No.	Telex No. and answer back	Service hours (GMT)	Name of unit Responsible	Remarks[1]
Fault report point					
Control/sub-control station					
Testing point					
Restoration implementation point					
Restoration control point (Recommendation M.725 [1])					

[1] Language information may be included.

FIGURE 1/M.98

Form for the contact points for transmission system maintenance

SERVICE CIRCUITS

To facilitate the general maintenance of the international telephone network, *service circuits* should be set up as may be necessary between relevant maintenance units taking part in the international service.

For the purposes of this Recommendation, a distinction is made between the following types of service circuit:

- **Direct service circuit**: a telephone or teleprinter (teletypewriter) service circuit serving only two stations and linking them directly.

  Note – It will also be necessary to consider the communications required by technical staff for setting up and maintaining very long circuits routed over a number of major systems in tandem, e.g. London – Singapore circuits. These may require service circuits to be interconnected.

- **Omnibus service circuit** (see Figure 1/M.100 below): a telephone or teleprinter (teletypewriter) service circuit serving more than two stations connected in series, any or all of which may make connection to the service circuit simultaneously.

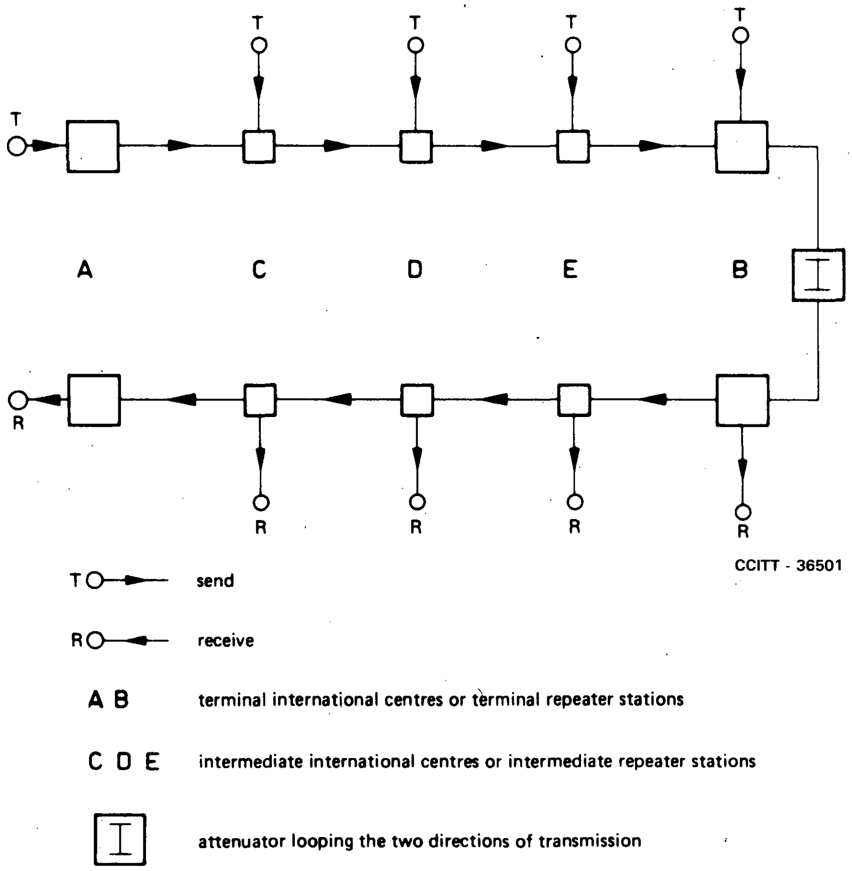


FIGURE 1/M.100

Example of an omnibus service circuit

- **Multiterminal service circuit** (see Figure 2/M.100 below): a telephone or teleprinter (teletypewriter) service circuit serving more than two stations and having at least one branching point. On each *branch* of this circuit a certain number of stations can be connected in series. Every station served can enter the circuit individually.

  Note – Attention is drawn to the possible use of selective signalling on omnibus and multiterminal service circuits and to the problems that may arise in achieving the necessary stability on such circuits.

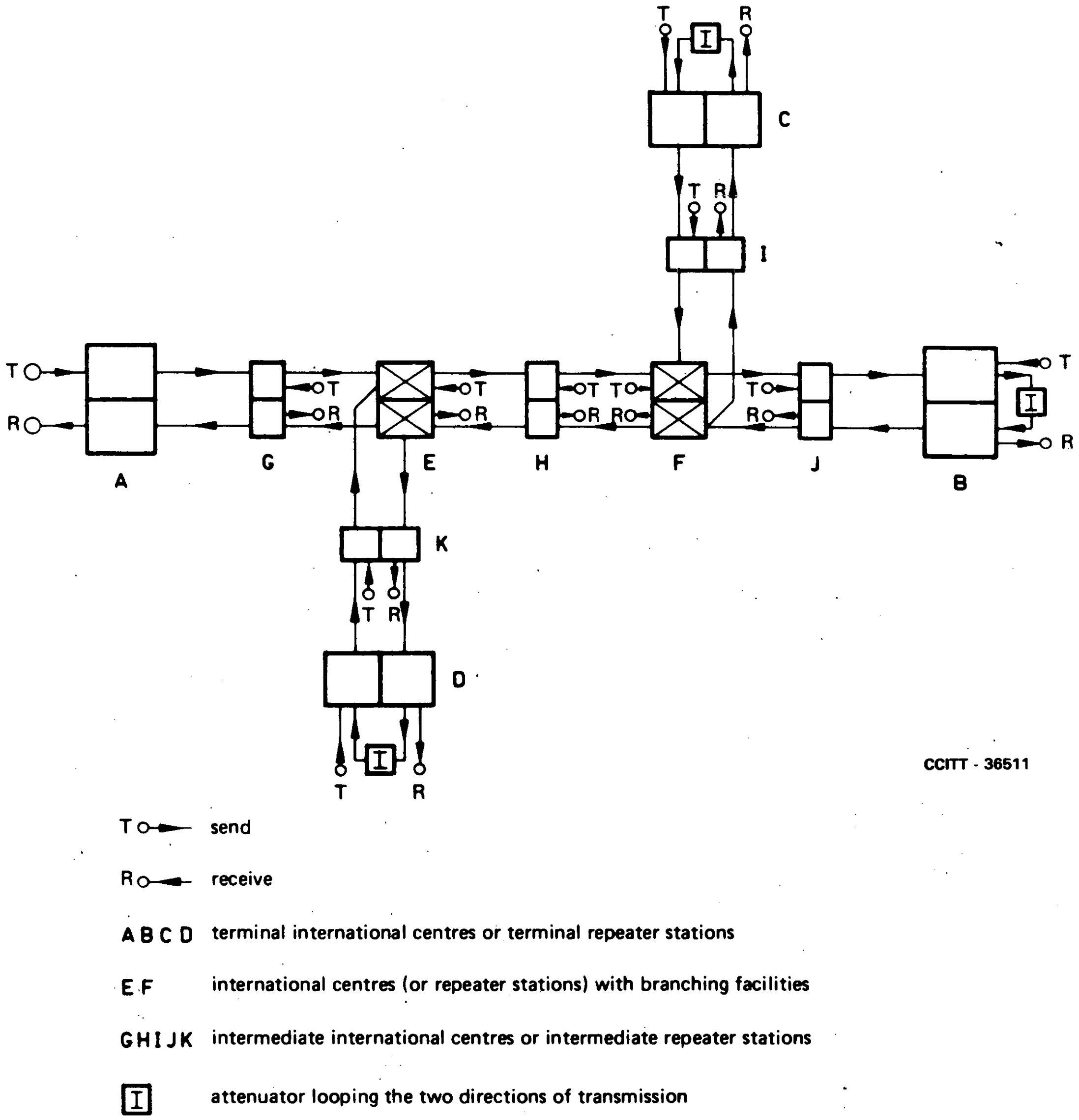


FIGURE 2/M.100

Multiterminal service circuit

It is recommended that for the maintenance of international circuits:

1) all attended stations should be connected direct to the public telephone network;

2) the terminal stations of an international system should be provided with a direct telephone service circuit;

3) terminal and intermediate stations on an international system should be provided with an omnibus telephone service circuit;

4) where the provision of direct teleprinter (teletypewriter) service circuits is impracticable or uneconomical, important repeater stations on international routes should be provided with international telex facilities;

   The equipment of the telegraph local end used on service telegraph circuits must be capable of transmitting and receiving signals conforming to International Telegraph Alphabet No. 2 and must be in accordance with the provisions of CCITT Recommendations;

5) Maintenance staff responsible for international circuits should have authority to make priority calls in the international service [1];

[1] The order of priority of such calls is given in [1].

6) all service circuits should in general conform to the Recommendations of the CCITT in respect of their quality and maintenance. However, service circuits may have a restricted quality which must nevertheless be such as to provide efficient communication when maintenance personnel have to use languages other than their mother tongue;

7) in the event of a major interruption involving service circuits, these should be accorded priority in restoration;

8) the terminal stations of a long international submarine cable system should be provided with a direct teleprinter (teletypewriter) service circuit;

9) terminal and intermediate stations on a long international submarine cable system should be provided with an omnibus teleprinter (teletypewriter) service circuit.

The CCIR has issued Recommendation 400-2 (Kyoto, 1978) concerning service circuits for radio-relay links. (For the convenience of readers, this Recommendation is reproduced below. CCIR Report 444-1 [2] also applies.)

CCIR RECOMMENDATION 400-2 *

SERVICE CHANNELS TO BE PROVIDED FOR THE OPERATION AND MAINTENANCE OF RADIO-RELAY SYSTEMS

(Question 4/9)

(1956 - 1959 - 1963 - 1966 - 1970)

The CCIR,

CONSIDERING

(a) that service channels are required for the maintenance, supervision and control of radio-relay systems;

(b) that if, for any reason, the radio-relay system itself fails to function, communication between various stations along the route, and from those stations to other points is likely to assume special importance;

(c) that agreement is desirable on the number and function of the service channels to facilitate the planning of radio-relay systems;

(d) that service channels will be used to provide:

– omnibus voice circuits,

– express voice circuits,

– supervisory circuits,

– control and operational circuits;

(e) that service channels will not be connected to the public telephone network,

UNANIMOUSLY RECOMMENDS

that, on international radio-relay systems:

1. all staffed stations should be connected directly to the public telephone network;

2. when a radio-relay link is extended by means of short cable sections, and these cable sections and the radio-relay link taken together constitute a regulated line section, the terminal stations of the radio-relay link itself should have speaker circuits to the stations at the ends of the regulated line section;

3. a telephone service channel (omnibus voice circuit) should be set up to connect together all the stations on the system, whether staffed or not;

* This Recommendation applies to radio-relay systems which will transmit at least 60 telephone channels or a television signal and comprise two staffed terminal stations, in which the signals are demodulated to baseband, and any number of unstaffed intermediate stations. This Recommendation applies, where appropriate, to trans-horizon radio-relay systems.

4. a second telephone service channel (express voice circuit) should be provided for direct telephonic communication between the staffed stations receiving supervisory signals;

5. provisions for the transmission of supervisory and control signals should be subject to agreement between the Administrations concerned;

6. the telephone service channels should possess, whenever possible, the characteristics (excluding noise power) recommended by the CCITT for international telephone circuits and, in particular, should be able to transmit the frequency band 300 to 3400 Hz;

7. all telephone service channels (including those used for supervisory and control circuits) up to a length of 280 km should, whenever possible, not exceed a mean noise power in any hour of 20 000 pW0p psophometrically weighted, at a point of zero relative level.

Note – Service channels may be provided over an auxiliary radio-relay system, over the main radio-relay system, or by other unrelated means, either on a primary or stand-by basis. In the case of express voice circuits, the use of regular multiplex channels within the telephony baseband is acceptable, where this is possible.

References

[1] CCITT, *Instructions for the International Telephone Service,* Articles 46 to 49, p. 22, ITU, Geneva, 1973, modified by CCITT Circular No. 41 of 3.6.1977.

[2] CCIR Report *Service channels for analogue radio-relay systems*, Vol. IX, Report 444-1, ITU, Geneva, 1978.

Recommendation M.110

CIRCUIT TESTING

1 Test access points

1.1 Recommendation M.700 [1] gives the definition of an international automatic circuit used for public telephony. *Access points* are required to enable lining-up and subsequent maintenance operation to be performed on such a circuit.

1.2 The Recommendation cited in [2] describes the access points needed on public telephony circuits, these points being referred to as *line access points* and *circuit access points*, and recommends that these access points should be provided and used in measurements made by the testing points – as defined in Recomendations M.717 [3] and M.718 [4].

1.3 *Line access points* and *circuit access points* (or appropriate means for reaching the *circuit access points*) should be provided for testing all circuits in the public service.

Test access points should also be provided for circuits connected through a repeater station in transit from one country to another.

On a leased circuit, the *circuit access points* are regarded as being located in the renter's premises.

Test access points should also be available at the terminal international centre for circuits terminating within the country at a place remote from the international centre, for example, in the premises of the users of leased circuits or in a voice-frequency telegraph terminal station, etc. Such line access points should be available directly or indirectly to the transmission maintenance point (international line) as defined in Recommendation M.95 for such circuits.

Figure 1/M.110 shows an example of basic testing access on various classes of circuits.

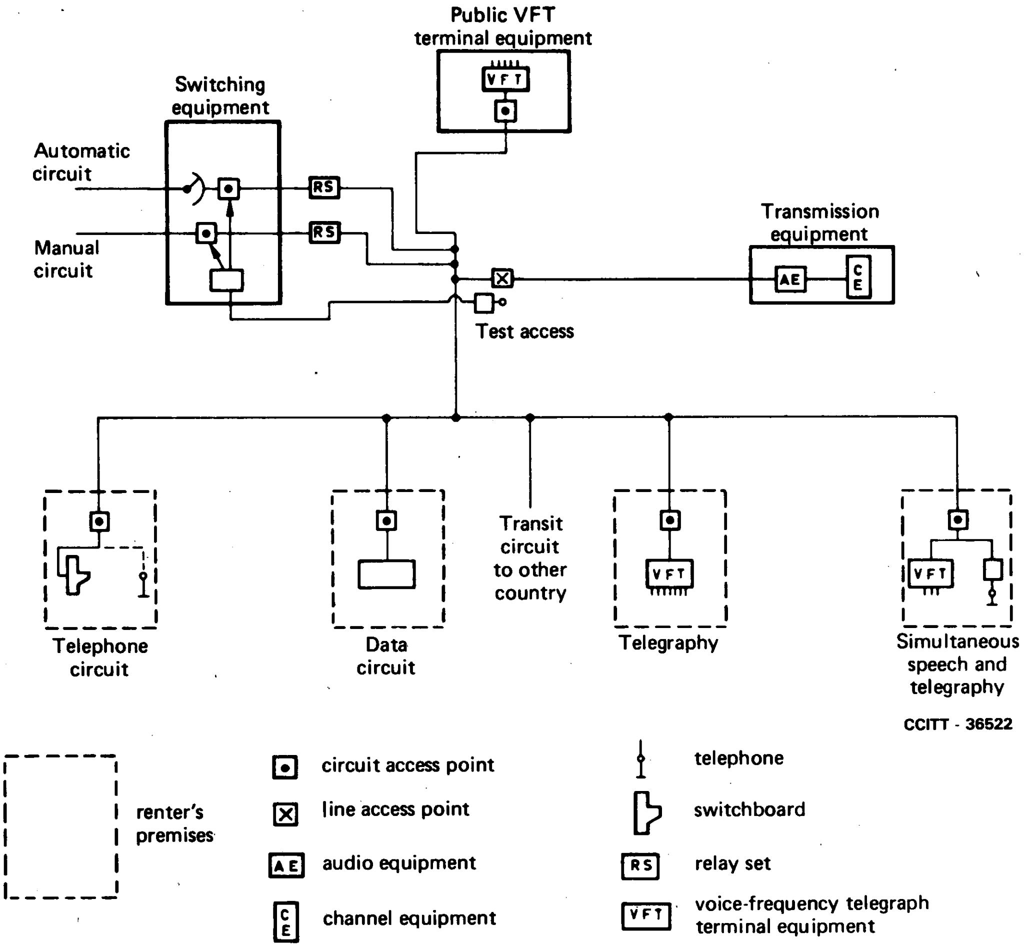


FIGURE 1/M.110

Example of basic test access on various classes of circuits

2 Measuring and testing equipment

2.1 The basic types of measuring equipment needed in the testing centre will comprise:

- signal generators (fixed and variable frequency oscillators and calibrated sending units),
- level-measuring sets,
- calibration units,
- psophometers,
- standard frequency source (or access to such a source),
- equipment for signalling tests.

In addition, delay distortion-measuring equipment, frequency counters, interruption recorders, programme meters, impulse-noise counters, phase jitter meters, automatic transmission-measuring equipment, equipment for nonlinear distortion measurement, etc., will be required depending upon the types of circuit existing at the centre.

2.2 The implementation of the worldwide transmission and switching plans makes it necessary for international circuits to be lined up and maintained to a very high degree of accuracy.

It is essential, therefore, to use measuring equipment of high accuracy and stability in order that the maintenance requirements given in the relevant Series M Recommendations for circuits are met, and to ensure uniformity of measurement results.

2.3 To this end it is desirable that measuring equipment provided for lining-up and maintenance of all classes of circuits should wherever possible conform to the measuring instrument specifications given in the Series O Recommendations. Where no CCITT specification is available, the best order of accuracy and stability should be provided, consistent with cost and type of measurement to be made.

References

[1] CCITT Recommendation *Definitions for the maintenance organization*, Vol. IV, Fascicle IV.1, Rec. M.700.

[2] CCITT Recommendation *Four-wire switched connections and four-wire measurements on circuits*, Vol. IV, Fascicle IV.1, Rec. M.640, §§ 2.1 a), 2.1 b) and 2.1 c).

[3] CCITT Recommendation *Testing point (transmission)*, Vol. IV, Fascicle IV.1, Rec. M.717.

[4] CCITT Recommendation *Testing point (line signalling)*, Vol. IV, Fascicle IV.1, Rec. M.718.

Recommendation M.130

OPERATIONAL PROCEDURES IN LOCATING AND CLEARING TRANSMISSION FAULTS

1 The reporting of faults on automatic circuits is dealt with in Recommendations M.715 [1] and 716 [2] and for leased circuits in Recommendations M.82, M.92 and M.95. These principles should likewise be applied to the reporting of faults on groups, supergroups, etc., to the *fault report point* in a repeater station.

2 Basic principles for locating a fault on a circuit

2.1 The following principles apply to all types of circuit, however constituted:

i) The fault report is received by the relevant fault report point and passed on to the circuit control station.

ii) The circuit control station should immediately arrange for the circuit to be withdrawn from service.

iii) Appropriate overall measurements and tests should be made to verify the existence of the fault.

iv) Measurements should be made on the sections of the circuit between the *end* of the circuit (circuit access point, voice-frequency telegraph terminal or renter's termination, etc.) and the international line access point at the terminal international centre to find whether the fault is on these sections in either of the terminal countries concerned.

v) If the fault is proved in these sections, national practices should be applied to locate and clear the fault.

vi) If the fault is proved to be on the international line, maintenance personnel at the terminal international centres involved should make tests and measurements appropriate to the type of fault in cooperation with any intermediate sub-control station until the fault has been located between two adjacent sub-control stations, that is, to a circuit section. These two stations should then control the detailed location of the fault and its subsequent clearance within their section.

vii) As soon as possible, the use of any permitted rerouting possibilities that there may be for the line or sections thereof should be made, in order to restore service on the circuit.

viii) If the circuit section is routed on a channel of a group, the group control station should be informed of the fault in order to take the necessary action.

ix) When the fault has been cleared the sub-control station in whose country the fault was located should immediately notify the control station either directly or via the appropriate maintenance unit of the nature of the fault and the time and details of its clearance.

x) The controlling end should cooperate with the noncontrolling end and should make overall measurements, requesting further adjustments if necessary.

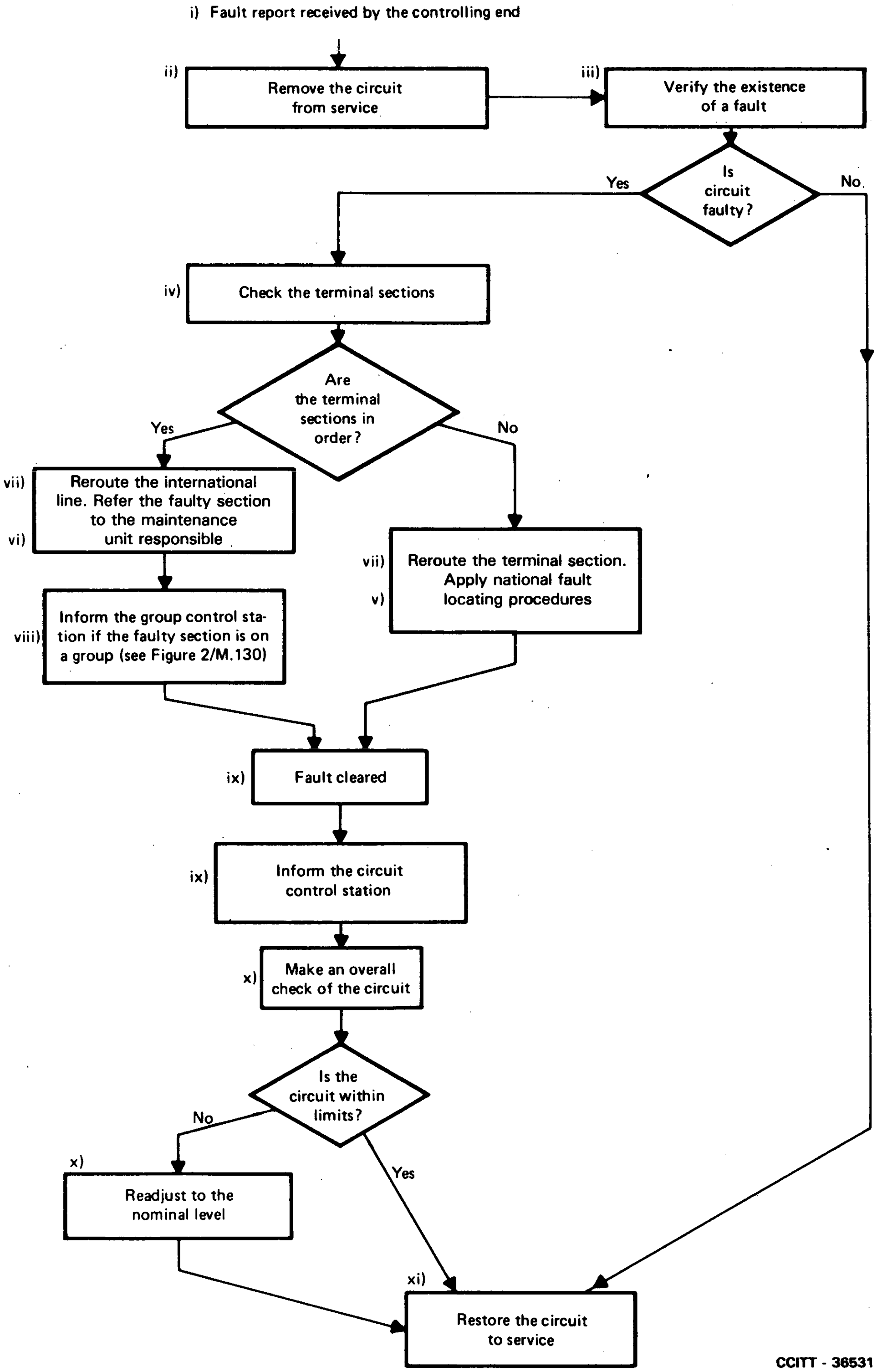
xi) When the circuit meets the specified requirements, the control station arranges to restore the circuit to service.

2.2 Figure 1/M.130 shows a sequence of operations that may be followed applying the principles given in § 2.1 above.

2.3 When a fault in a circuit section is proved to be due to a group or a supergroup fault the basic fault procedures for the group and supergroup are the same as those given for faults on an international line (see § 2.1, vii and viii above).

The sequence of operations followed by the group control station and the group sub-control station in locating faults on a group is shown in Figure 2/M.130. Associated operations by other control and sub-control functions are shown in Figures 3/M.130 and 4/M.130.

2.4 The operations mentioned above can sometimes be modified according to special circumstances. For example, if there is a cable fault in a terminal country and if this fault affects a large number of circuits, it will not generally be necessary to carry out all the operations given in § 2.1 above and Figure 1/M.130 in the order shown.



Note. —The Roman numbers correspond to those in § 2.1 of the text.

FIGURE 1/M.130

Exemple of possible action following a circuit fault report

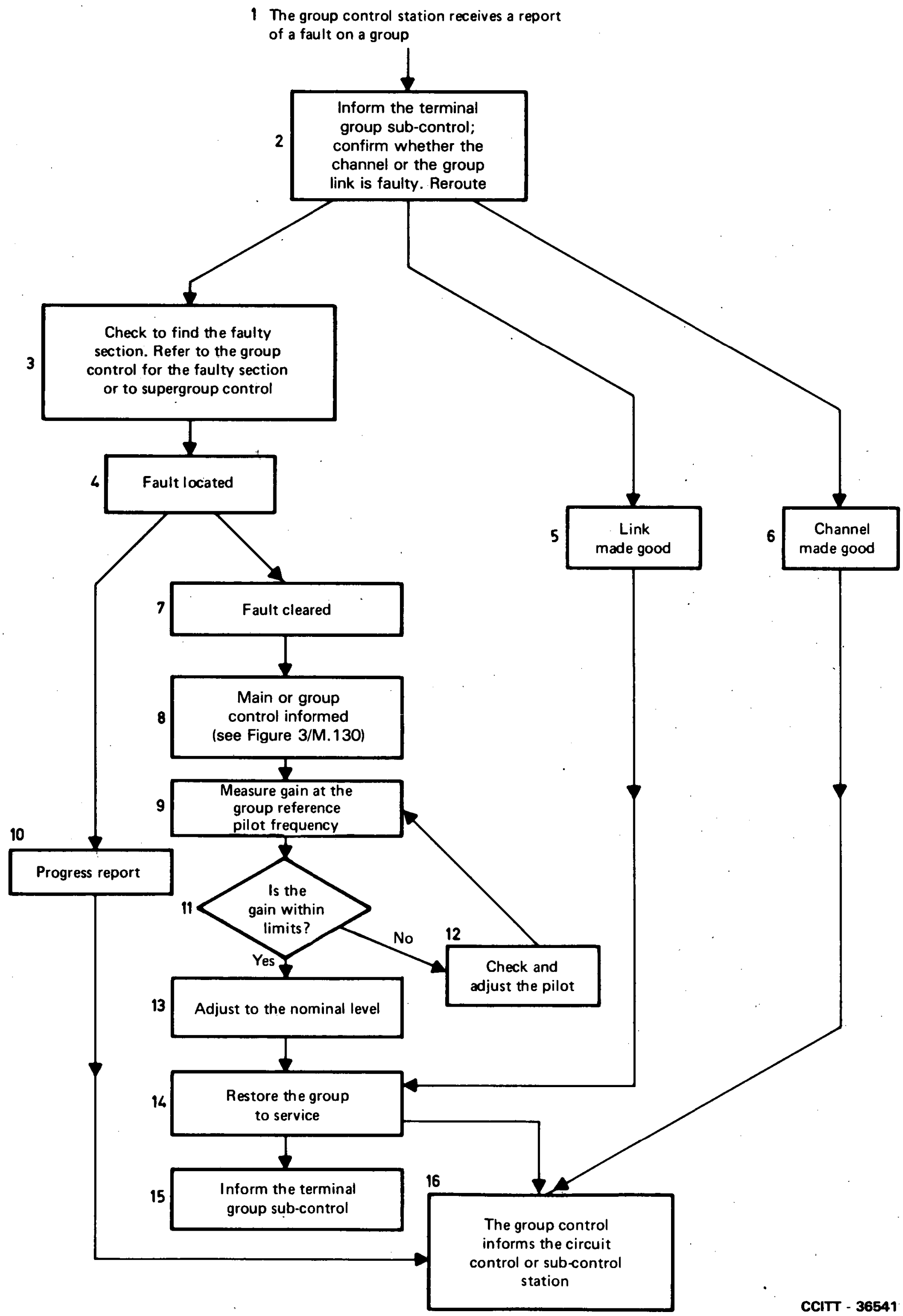


FIGURE 2/M.130

Exemple of possible action by a group control station following a fault report

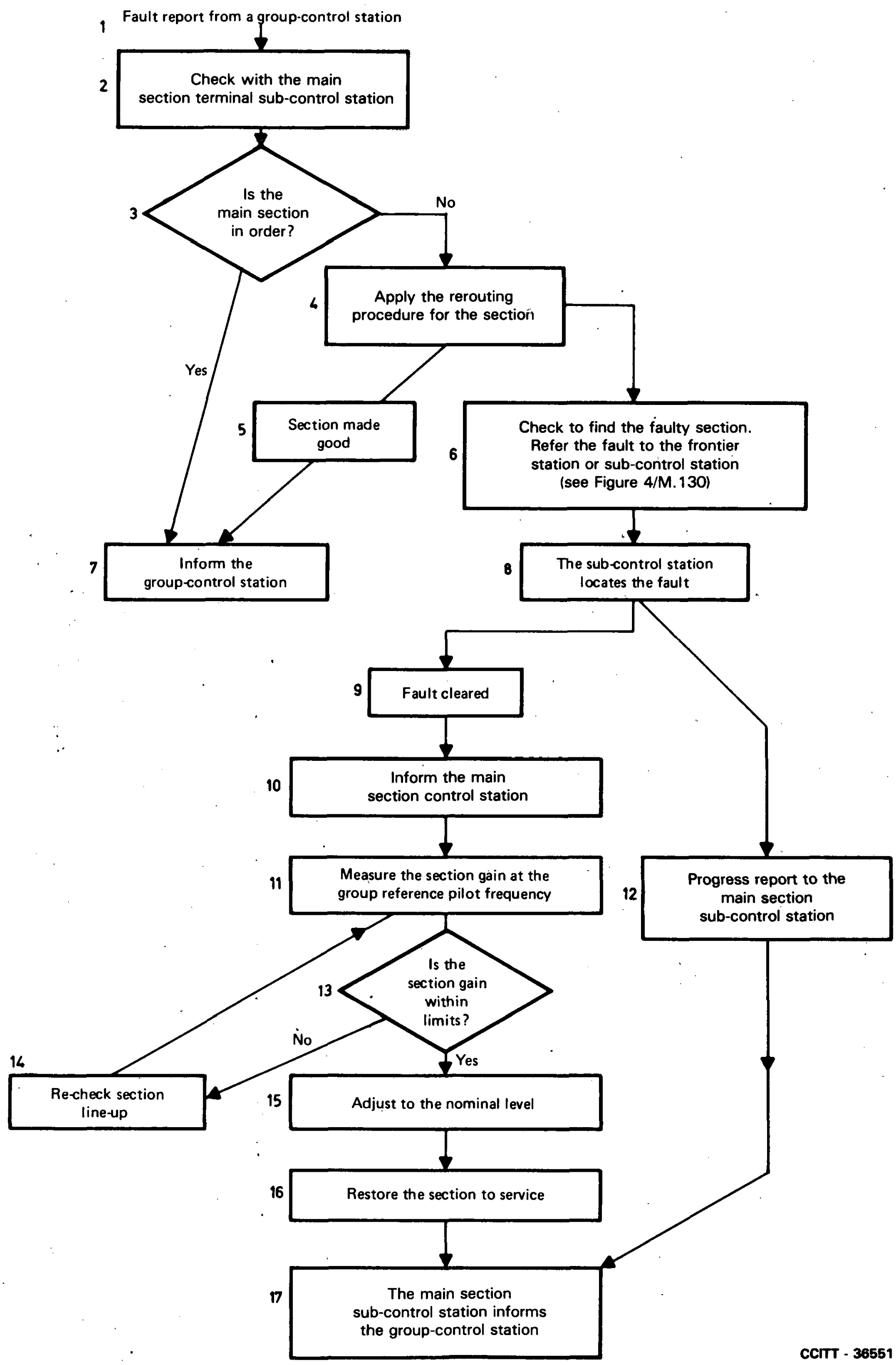


FIGURE 3/M.130

Example of possible action by a main section control station following a fault report

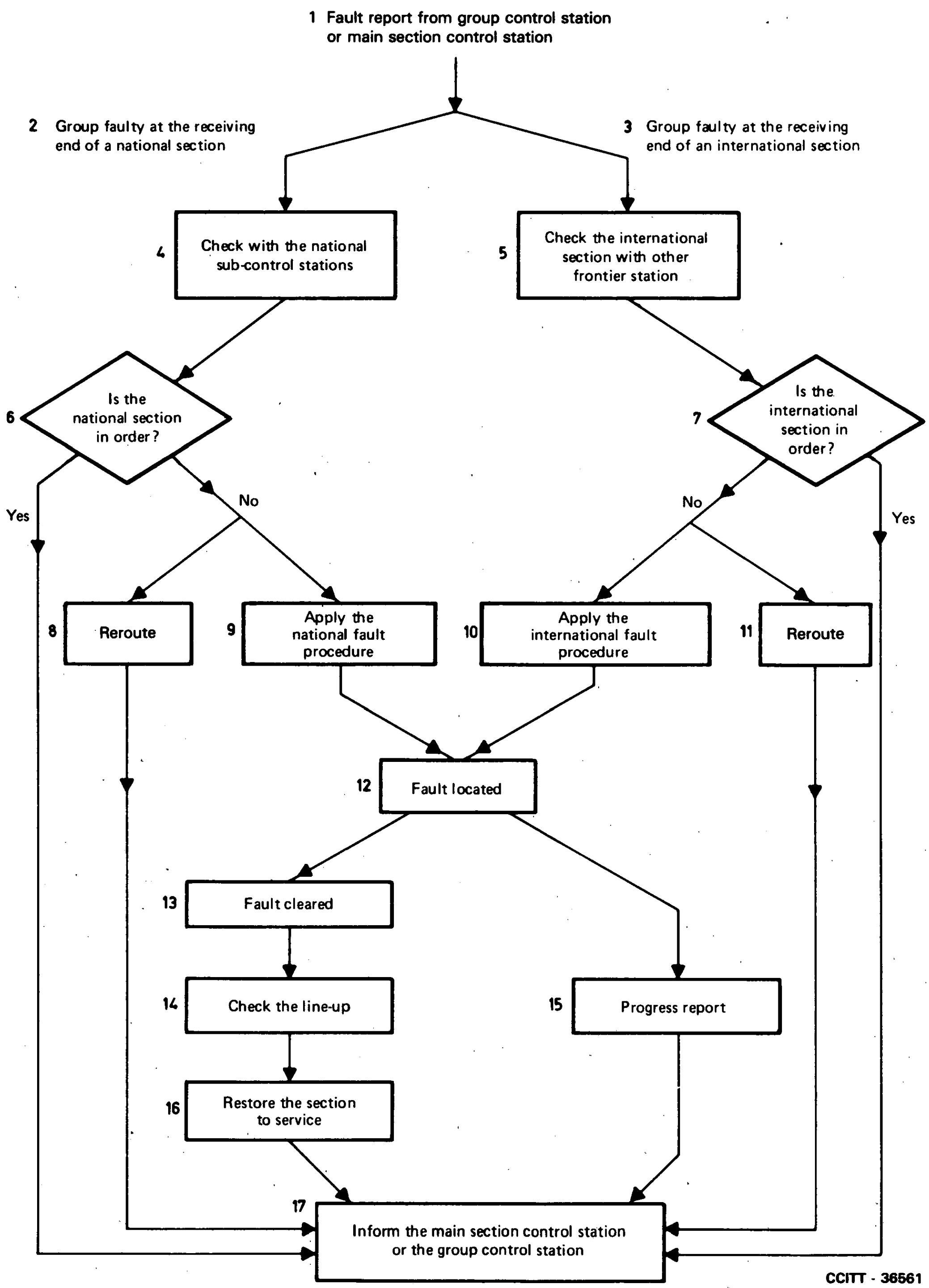


FIGURE 4/M.130

Example of possible action by a frontier station following a fault report

3 Faults observed at repeater stations as a result of local or extended alarms

All fault conditions affecting transmission that are observed at repeater stations as a result of local or extended alarms should be reported to the relevant fault report points of the country concerned, so that arrangements can be made to apply the fault clearing procedure.

4 Special faults

In the case of unusual faults, or faults which are difficult to locate with the testing equipment that is available, or faults of a similar kind occurring very frequently on a particular section, the appropriate control station should inform its technical service without delay. This service, in cooperation with other technical services involved, will take the necessary action to locate such faults or, where appropriate, prevent such faults in the future by rearrangement of the circuit layout or equipment involved. The circuit control station should be kept informed of the progress of the action taken or proposed, the prospects of clearance and other pertinent details.

ANNEX A

(to Recommendation M.130)

Method proposed by ATT Co. for locating faults on circuits routed via a TASI system

A.1 *Circuits assigned to a TASI (Time Assignment Speech Interpolation) system*

The testing of circuits assigned to a TASI system follows a technique that is different from that for non-TASI circuits.

Basically, the equipment used for the TASI system consists of a transmitter and a receiver for each direction of transmission joined by a number of connection-channels, which is less than the total number of circuits. The transmitter is a universal access-switch which permits any combination of connections between any of the circuits and the connection channels. The receiver is also a switch under the control of the transmitter. It establishes the required connections between the channels and the circuits at the far end in accordance with the signals received from the transmitter.

A.1.1 *The programme of connection is controlled by*:

a) logic-circuits which ascertain the need for a channel-connection;

b) memory-circuits which store the circuit and the channel identity and status information;

c) a signalling system that advises the receiving terminal of the required connection;

d) a switch that makes the connection of the circuit and the terminal to the channel selected.

When TASI equipment is switched out of service, the basic traffic circuits are switched through to the channel facilities on a predetermined basis, one circuit per channel. These basic circuits are called *TASI and through* circuits. The additional circuits derived by TASI are called *TASI only* circuits.

When TASI is switched out of service, due to major troubles occurring in the TASI equipment, or during equipment routine test periods, the basic *TASI and through* circuits are switched through to the channels to maintain service continuity. The *TASI only* circuits are taken out of service until the TASI equipment is restored.

The circuit control stations of circuits assigned to TASI equipment are kept informed of the routine test periods of the TASI equipment. In addition, the circuit control stations of *TASI only* circuits are informed when the circuits are out of service due to TASI being inoperative.

The testing of TASI circuits should follow the principles outlined in the following in order to obtain the correct interpretation of the test results. The test procedures differ slightly depending on whether the circuit under test is a basic *TASI and through* circuit or a *TASI only* circuit. The procedure is outlined separately for each type.

A.1.2 *TASI and through circuits*

The tests are made without regard to the identity of the connection-channel (unless the tests are made during a period when TASI is known to be inoperative, in which case see below). The existence of a fault is first confirmed by an initial test. If no fault is detected on the initial test made or if the fault has disappeared by the time of a report test, it is safe to assume that the fault may have been due to the connection-channel being used at the time the fault was reported or when the initial test was made.

The probability of the same connection-channel being associated with the circuit for a repeat test is remote, unless the repeat test is made immediately following the receipt of the fault report and, in addition, the test is made during extremely light traffic periods, when the demand for connection-channels is very small.

The circuit on which test results of the above nature were obtained would be returned to service. A record of the fault reported would be given to the TASI system maintenance station for their information and use when connection-channel tests were made.

If the fault is confirmed by the initial and repeat tests, it can be assumed to be located externally to the connection-channel and further sectionalization tests would be made. However, if the tests were made during extremely light traffic periods, and identical faults were detected on each test, there might be a chance that the connection-channel was at fault, as the TASI system might not have switched the channel. Additional repeat tests would be made in an attempt to eliminate the effect of the connection-channel. In any event the sectionalization tests made would include those made at the TASI channel terminals to confirm the existence of connection-channel trouble.

If the fault reported was being investigated during a period when TASI was known to be inoperative, the fault-location procedures would be similar to those specified for a *non-TASI* circuit.

A.1.3 *TASI only circuits*

Tests on the circuit when a fault was reported would be made without regard to the identity of the connection-channel in use during the test period. Repeat tests would be made in a similar way to the tests for *TASI and through* circuits, in an attempt to confirm that the fault existed, and if it did, to prove it to be external to the connection-channel. If no fault were detected on the initial or repeat tests, the circuit would be returned to service. A record of the fault reported would be given to the TASI system maintenance station for their information and use when the connection-channel tests were made.

If the fault existed on the initial and repeat tests, sectionalization tests would be made to locate it externally to the connection-channels. If the testing were done during extremely light traffic periods, the same precaution would apply as given for *TASI and through* circuits.

During TASI switchout periods, this type of circuit would have been removed from service.

A.1.4 *Application*

During light traffic periods with TASI in service, there is a reduced demand for connection-channels over the TASI system. The possibility exists, therefore, that repeat tests made on the circuit in an attempt to confirm the existence of a fault and, in addition, to determine if the fault is external to the connection-channel, would not produce the desired results if the connection-channel did not switch.

It would be necessary to make sectionalization tests at the TASI channel terminal itself to determine the condition of the connection-channel when repeat test results indicated no change whatsoever and when the connection-channel was suspected. These repeat tests would be made as part of the initial test attempt or as the fault sectionalization test effort progressed. Experience with testing procedures on circuits routed over TASI systems should produce dependable indications of whether the fault is external to the connection-channel.

References

[1] CCITT Recommendation *Fault report point (circuit)*, Vol. IV, Fascicle IV.1, Rec. M.715.

[2] CCITT Recommendation *Fault report point (network)*, Vol. IV, Fascicle IV.1, Rec. M.716.

DESIGNATION OF INTERNATIONAL CIRCUITS, GROUPS, ETC.

The designation of international circuits should identify the two terminal points of a circuit and the circuit number. For switched circuits, the identification of a terminal point consists of the town name followed by a suffix indicating the international switching centre at which the circuit terminates if there is more than one switching centre in a town. In the case of non-switched circuits the designation should include the town name and, where necessary, a suffix to further identify the terminal point.

Similarly, the designation of international groups, supergroups, etc., should identify the terminal towns and international repeater stations (the latter by a suffix) where there is more than one international repeater station in a town.

The suffix can be the name of the terminal point (e.g. international switching centre) or may be in the form of a code such as letters and/or numerals. The suffix should be enclosed by parentheses.

Whatever scheme is adopted by an Administration for identifying its international switching centres and international repeater stations in such designations, it should be applied consistently and give a clear distinction between them.

To assist in circuit identification it is desirable that the numbering of circuits should be based on each town-to-town traffic relation. Thus each circuit in such a relation should have a unique number no matter where the circuits terminate in the towns. The same principle should also apply to the numbering of groups, supergroups, etc.

The place names should always be written in roman characters taking the official name of a town as used in the country to which it belongs. If identical place names occur in different countries, and if confusion is likely to arise, the Administrations concerned should agree to identify the country in the circuit designation by adding after the place name the telex network identification code. This code is given in [1].

If it is of interest to distinguish the private operating agency concerned, this may be done by inserting after the place name a suitable code identifying the agency.

The code for the country should be placed between fraction bars (division signs) / . . . . . /.

This is necessary to avoid any confusion either with the designatory letters assigned to the various types of circuit, or with the abbreviations used to designate private operating agencies or other recognized authorities.

1 Circuits in public service

1.1 *Telephone circuits*

1.1.1 *Telephone circuits used in manual operation*

The circuit number preceded by the prefix M follows immediately after the names of the two terminal exchanges arranged in alphabetical order.

Examples: London (Faraday) – Paris M1
Auckland – London (Faraday) M1

1.1.2 *One-way circuits used for semiautomatic or automatic operation*

These circuits are designated by the names of the two international terminal exchanges arranged in the order corresponding to the direction in which the circuit is operated and the number of the circuit is preceded by the letter Z.

The numbers of the two directions of operation of semiautomatic or automatic circuits must therefore be distinct. Circuits operated in the direction corresponding to the alphabetical order of the international terminal exchanges should have odd numbers. Circuits operated in the direction corresponding to an inverse alphabetical order of the international terminal exchanges should have even numbers.

Examples: for a circuit operated in the London – Montreal direction (alphabetical order):
London (Mollison) – Montreal Z21.

for a circuit operated in the Montreal-London direction (inverse alphabetical order):
Montreal – London (Mollison) Z18.

1.1.3 *Both-way circuits used for semiautomatic or automatic operation*

The circuit number follows immediately and without a letter prefix after the names of the two terminal exchanges arranged in alphabetical order.

Example: London (De Havilland) – New York (24) 1

1.2 *Circuits used to provide telegraph systems*

Note – Where necessary, the associated telegraph link should be identified by the designation of the overall telegraph system.

1.2.1 *Circuits used to provide voice-frequency telegraph links*

For the public service, these are distinguished by the letter T.

Example: Montreal – Zurich T1

In some cases the voice-frequency telegraph link terminates at one or both ends in the premises of a private operating agency. If it is of interest and useful to distinguish the private operating agency concerned, this may be done by inserting, after the place name, a suitable abbreviation in parentheses (.....) to identify the agency.

Example: Bruxelles – New York (RCA) T1

In the case of telephone circuits used as *reserve circuits* for voice-frequency telegraph links, the telephone circuit designation for such a circuit (in accordance with the above) is followed by a supplementary indication, in parentheses, comprising the letters ST followed by the number of the voice-frequency telegraph link for which the circuit under consideration is normally used as a reserve.

Example: London (Faraday) – Montreal M10 (ST1)

describes the circuit designated as a reserve for the London – Montreal T1 voice-frequency telegraph link [1)].

1.2.2 *Circuits used to provide TDM (time division multiplex) telegraph systems*

For the public service, these are distinguished by the letters TD.

Example: London-Montreal TD1

If it is of interest or useful to indicate that one or both ends of the TDM telegraph system are on the premises of a private operating agency, this may be done in a similar manner to voice frequency links.

Example: Bruxelles – New York (RCA) TD1

(The CCITT has not yet specified the transmission characteristics which should apply to TDM telegraph links. This is under study. Until such time as these characteristics are specified, Administrations should make bilateral arrangements between themselves. However, the designation "TD" will apply at this time whatever characteristic is used.)

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1) It might happen that a telephone circuit, for example London-Oslo M9, is designated as a reserve section for a part of a voice-frequency telegraph link, for example, New York-Oslo T1. The complete designation of the telephony circuit to be used as a reserve section would then include an indication of the normal voice-frequency telegraph link concerned, that is, using the examples above, the London-Oslo telephone circuit would be designated "London-Oslo M9 (New York-Oslo ST1)" or, if it were a general reserve for a number of sections of voice-frequency telegraph links, it would be designated "London-Oslo M9 (ST)".

1.3 *Data transmission circuits*

For data-transmission circuits, the letter D and a special number system are used.

Example: London (Faraday) – Paris D1

1.4 *Circuits specially designated for phototelegraphy or facsimile*

In the case of a circuit specially designated for phototelegraphy or facsimile, the designation of the circuit as a telephone circuit (in accordance with the above) is followed by a supplementary indication, in parentheses, comprising the letter F followed by the number of the circuit when it is used for phototelegraph transmissions.

Examples: London (Faraday) – Paris Z23 (F1)
London (Faraday) – Montreal M3 (F1)

1.5 *Circuits for occasional sound-programme or television transmission*

The letter R is used in the case of a unidirectional sound-programme circuit and the letter V for a unidirectional television circuit. An additional letter H is used for designating the two circuits which form a stereophonic pair of circuits. The letters RK are used for a narrow-band circuit (e.g., telephone circuit) used for independent sound-programme transmissions in each direction or for a sound-programme transmission in one direction and a feedback path in the other direction.

The letters RR should be used in the case of a reversible sound-programme circuit and the letters VV for a reversible television circuit.

For a stereophonic pair of circuits the normal sound-programme circuit designation should be followed by the letter H and a number for the particular pair.

The names of the terminals in the designation for a unidirectional circuit (for sound or television) are placed in the order corresponding with the direction of transmission (instead of alphabetically). Telephone circuits taken from traffic for narrow band sound-programme transmissions should have the designation RK and ordinal number, all shown in parentheses, following the telephony circuit designation.

Examples: unidirectional sound-programme circuit transmitting in the direction Wellington – Montreal:
Wellington/NZ/ – Montreal R1

stereophonic pair of circuits:
London – Paris R1 H1
London – Paris R2 H1

telephone-type circuit set up permanently for narrow band sound-programme transmissions between Madrid and Milano:
Madrid – Milano RK1

telephone circuit taken from traffic for narrow-band sound-programme transmissions between Montreal and Wellington:
Montreal – Wellington/NZ/Z5 (RK2).

If it is of interest to distinguish any broadcasting organization this may be done by inserting, after the place name, a suitable abbreviation in parentheses (. . . . .) to identify the organization.

Where it is necessary for sound-programme circuit designations to include an indication of the bandwidth, this is done by adding in parentheses the top nominal frequency in kHz, in which case it is to be assumed that the lower limit of the frequency band effectively transmitted is 50 Hz, or less.

Examples: London – Montreal R1 (10 kHz)
London – Sydney R1 (8 kHz)
Paris – London (Faraday) Z24 (RK1) (3.4 kHz)

Exceptionally, when the lowest frequency is above 50 Hz, a special mention of this should be made on the circuit record (circuit layout).

1.6 *Circuits used as transfer links for common channel signalling systems (No. 6)*

The circuit number preceded by the prefix DL follows immediately after the names of the two international terminal exchanges arranged in alphabetical order.

Example: Denver – Tokyo DL1

In the case of telephone circuits used as a nominated direct circuit reserve for transfer links, the telephone circuit designation for such a circuit is followed by a supplementary indication, in parenthesis, comprising the letters SDL followed by the number of the circuit when it is used to replace a transfer link.

Example: Denver – Tokyo 5 (SDL1)

2 Leased circuits

Special circuits for private services or particular purposes (e.g. military, diplomatic, meteorological, civil aviation, electric power distribution, banks, permanent service circuits between repeater stations, permanently-used control circuits for sound or television broadcasting, etc.) are distinguished by the letter P.

The designations of the different categories of leased circuits are given in 2.1 and 2.2 below. In special cases in which CCITT Recommendations cannot be followed, agreement should be reached between the Administrations involved (terminal and transit) concerning the designation.

If it is of interest or useful to distinguish any private operating agency, sound or television broadcasting organization that is involved, this may be done by inserting, after the place name, a suitable abbreviation in parentheses (. . . . .) to identify the agency. Examples of this are given in various places in this section.

The various categories of leased circuit are as follows:

2.1 *Leased circuits connecting only two locations*

2.1.1 *Leased circuit used wholly for telephony*

The circuit number preceded by the letter P follows immediately after the two terminal place names arranged in alphabetical order.

Example: Paris – Wellington P1

2.1.2 *Leased circuit used wholly for telegraphy*

2.1.2.1 *Voice-frequency telegraphy*

These are distinguished by the letters TP.

Example: Bern (RS) – New York (RCA) TP1

2.1.2.2 *TDM telegraphy*

These are distinguished by the letters TDP.

Example: London-Montreal TDP3

2.1.3 *Leased circuit used wholly for data transmission*

These are distinguished by the letters DP.

Examples: London – Paris DP3
New York (PAA) – Roma (PAA) DP1

2.1.4 *Leased circuit used wholly for phototelegraphy or facsimile*

These are distinguished by the letters FP.

Examples: London – Paris FP2
London – New York (AP) FP2

2.1.5 *Leased circuit used wholly for sound-programme transmission*

The letters RP are used in the case of a unidirectional sound-programme circuit and the letters RRP in the case of a reversible sound-programme circuit. The names of the terminals in the designation for a unidirectional circuit are placed in the order corresponding to the direction of transmission (instead of the alphabetical order if this is different).

Examples: circuit transmitting in the direction Montreal to Wellington:
Montreal – Wellington/NZ/RP1

circuit transmitting in the direction Wellington to Montreal:
Wellington/NZ/ – Montreal RP1

Where it is necessary for sound-programme circuit designations to include an indication of the bandwidth this is done by adding in parentheses the top nominal frequency in kHz, in which case it is to be assumed that the lower limit of the frequency band effectively transmitted is 50 Hz or less.

Examples: London – Montreal RP1 (10 kHz)
London – Sydney RP1 (8 kHz)

2.1.6 *Leased circuit used wholly for television transmission*

Similar in principle to the designations for sound-programme circuits except that the letters VP and VVP are used.

2.1.7 *Leased circuit used for services other than those designated in 2.1.1 to 2.1.6 above or used for combinations of services*

In this category are circuits used for different transmissions at different times or circuits in which the bandwidth is divided into two or more bands, thus providing two or more derived circuits which may be used for different types of transmission.

These specialized circuits are distinguished by the letters XP.

Example: Bruxelles – Paris XP8

2.2 *Leased circuits connecting three or more locations*

Into this category fall multiterminal circuits of various types and configurations. They are distinguished by the letter M (indicating the multiplicity of locations served) added to the designatory letters recommended in §§ 2.1.1 to 2.1.7 above.

This leads, in principle, to the categories PM, TPM, DPM, FPM, RPM, RRPM, VPM, VVPM and XPM.

The circuit number, preceded by the appropriate designatory letters follows immediately after the two place names which are at the end of the longest path provided by the circuit, the place names being arranged in alphabetical order.

Example: the designation of a telephone circuit interconnecting Aachen, Bruxelles, Edinburgh, Marseille and Paris would be:
Edinburgh – Marseille PM1.

The designation of a branch of such a circuit is the two terminal place names distinguishing the branch in alphabetical order placed in parentheses and preceded by the circuit designation.

Example: the Paris – Bruxelles branch of the example above would be:
Edinburgh – Marseille PM1 (Bruxelles – Paris).

3 International groups, supergroups, etc.

The numbering of a group, supergroup, etc., is applied between the point where it is assembled to the point where it is broken down, independently of the position it occupies in the band of line frequencies.

3.1 *Group* (see the definitions in Recommendation M.300 [2])

Groups should be designated by a number whose first figure(s) indicate(s) the number of circuits in the groups, as follows:

Examples: 801, 802, 803, ... 898, 899, 8100, 8101, 8102, ... for 8 channel groups;
1201, 1202, 1203, ... 1298, 1299, 12100, 12101, 12102, ... for 12 channel groups;
1601, 1602, 1603, ... 1698, 1699, 16100, 16101, 16102, ... for 16 channel groups;

and in general:

*X*01, *X*02, *X*03, ... *X*98, *X*99, *X*100, *X*101, *X*102, ... for *X* channel groups.

3.2 *Supergroups* (see the definitions in Recommendation M.300 [2])

Supergroups should be designated by the numbers 6001, 6002, etc.

Example: Amsterdam – London (Stag Lane) 6001

3.3 *Mastergroups* (see the definitions in Recommendation M.300 [2])

Mastergroups should be designated by the numbers 30001, 30002, etc.

Example: Bruxelles – London (Mondial) 30001

3.4 *Supermastergroups* (see the definitions in Recommendation M.300 [2])

Supermastergroups should be designated by the numbers 90001, 90002, etc.

Example: Amsterdam – Paris 90001

3.5 *Other designations*

The designatory letters, T, D, F, R, V, and X as defined in §§ 2.1.1 to 2.1.7 above, placed immediately after the number, may be used to identify groups, supergroups, etc., used for purposes other than telephony. Such groups, supergroups, etc., take their place in the normal numbering sequence and do not constitute a numbering sequence of their own.

Examples: London (Wood Street) – Montreal 1201D
London (Stag Lane) – Paris 6001D

The above designations may be used in conjunction with the various designatory letters given in §§ 1.2, 1.3 and 1.4 above, as appropriate. If the group, supergroup, etc., is provided for private service then the letter P should additionally be used.

Example: A supergroup provided between renters' premises in London and Paris devoted to data transmission should be designated as shown below:
London (Mondial) – Paris 6001DP.

3.6 *Restoration groups and supergroups*

Groups and supergroups set up on restoration or spare group and supergroup links for restoration purposes should be designated by numbers taken from the following *800* series:

restoration groups	8899, 8898, 8897, etc., 12899, 12898, 12897, etc., or 16899, 16898, 16897, etc. as appropriate
restoration supergroups	60899, 60898, 60897, etc.
Examples: London (Stag Lane) – Sydney	12898
Amsterdam – Bruxelles	60899

4 International group and supergroup links

In practice it may be that terminal equipment is not connected to a group or supergroup link. Nevertheless, for designation purposes the link will be numbered as though groups or supergroups had been set up.

4.1 *Conventional links not connected to their terminal equipment*

Such links are included in the normal numbering sequence of groups and supergroups and are not given a separate numbering sequence.

If the link is provided for private service then the letter P should additionally be used.

Example: A group link provided between renters' premises in London and Montreal devoted to data transmission should be designated as shown below:
London (Wood Street) – Montreal 1201DP.

When a group or supergroup link is used only part time with terminal translating equipment (to provide a conventional group or supergroup) it should also be designated in accordance with § 3 above followed by the letter X.

Examples: Amsterdam – London (Wood Street) 1206X
London (Stag Lane) – Paris 6003X

4.2 *Restoration links not connected to their terminal equipment*

Group and supergroup links nominated for restoration purposes should be designated by a number from the following *800* series:

restoration group links:	12801, 12802, 12803, etc.
restoration supergroup links:	60801, 60802, 60803, etc.

Examples: Hong Kong – Sydney 12802
Bruxelles – London (Wood Street) 60801

The first 2 digits *12* in the designation of a restoration group link do not necessarily indicate the number of channels in the group which is set up via the link. For example, a restoration group link London – Montreal 12801 might be used to restore the group London – Montreal 1605.

5 Unidirectional groups and supergroups routed via multiple-access satellite systems

5.1 *Multiple destination unidirectional groups and supergroups*

The unidirectional path will be designated by the name of the sending terminal station followed by a dash and the letters MU (*M*ultiple destination *U*nidirectional) in parentheses. This will be followed by the number of the group or supergroup.

Examples: A supergroup from London to Bogota, Lusaka and Montreal, would be designated:
London (Stag Lane) – (MU) 6001

The next such supergroup from the same point of origin to whatever destinations would take the next number in the series; for example, the second supergroup from London would be designated:
London (Stag Lane) – (MU) 6002
but might go, for example, to Tokyo, Hawaii and Melbourne.

A supergroup from Montreal to London, Lusaka and Paris would be designated:
Montreal – (MU) 6001.

Note – Groups and supergroups routed via a multiple-access satellite system may be provided for exclusive use between two terminal stations only, in which case the normal designations given above in this Recommendation will apply.

5.2 *Single destination unidirectional groups and supergroups*

The unidirectional path will be designated by the name of the sending terminal station followed by a dash and the name of the receiving terminal station. This will be followed by the letter U (*U*nidirectional) in parentheses and the number of the group or supergroup.

Example: A unidirectional group transmitting in the direction from Paris to Etam, which, in the reverse direction of transmission is assigned to a multiple destination unidirectional (MU) group from Etam to Paris and Rio de Janeiro, would be designated as:
Paris – Etam (U) 1201.

The next group between these locations, Paris and Etam, if bidirectional, would be designated in the normal manner as:
Etam – Paris 1202.

Note – Groups and supergroups routed via a multiple-access satellite system may be provided on a bidirectional basis for exclusive use between two terminal stations only, and in this case the normal designations given above in this Recommendation will apply.

References

[1] *Indicators for the telegram retransmission system (TRS) – Telex network identification codes (TNIC)*, 4th edition, ITU, Geneva, 1979.

[2] CCITT Recommendation *Definitions concerning international carrier systems*, Vol. IV, Fascicle IV.1, Rec. M.300.

Recommendation M.150

ROUTINE MAINTENANCE SCHEDULE FOR INTERNATIONAL PUBLIC TELEPHONY CIRCUITS

1 General

A schedule for the routine maintenance of the international public telephony circuits linking any two countries is drawn up by bilateral agreement between the technical services [1] of the countries concerned. The programming of the tests to be performed within the agreed scheduled time is the responsibility of each Administration. It is for the circuit control stations to ensure that the routines are carried out within the agreed schedule except as allowed for in § 2.5 below.

2 Routine measurements carried out manually: establishment of the schedule

2.1 *Schedule form*

Figure 1/M.150 shows the form to be used for establishing the routine schedule; an example of its use is given in Figure 2/M.150.

As far as possible the schedule is drawn up on the principle of batch measurements of circuits on a given route and shows the days and times during which the routine maintenance measurements should be carried out.

Each international test centre will require a set of eight forms to cover the four weeks of the *odd* and the four weeks of the *even* months, four weeks constituting a month for the purpose of the schedule.

Week 1 is the first whole week of a month beginning with a Monday. Week 4 may include days belonging to the following calendar month.

Odd months denotes January, March, May, etc., and *even* months February, April, etc.

The schedule form allows for simultaneous testing on two different routes where two test positions are provided for routine measurements. If more than two routine test positions are available, additional or suitably modified forms will be required.

[1] In some Administrations this function may be delegated by the technical service, but in all cases the technical services are responsible for ensuring the satisfactory preparation and application of the schedule.

2.2 *Arranging the schedule*

The periodicity for circuit routines should be determined from Recommendation M.610 [1].

The total time required to routine test all the circuits on a route should be assessed. It will depend on:

a) the total number of circuits,

b) the type of measurements and tests to be made, and

c) the expected rate of completion of routines for each circuit.

The determination of item c) will require particular care. The duration of circuit routines may be expected to differ from one test centre to another due to the different facilities provided: for example, circuit test access arrangements, and the organization of the work. Thus, no guidance can be given to the expected rate of completion of routines.

To reduce the need to make frequent changes to the schedule, due allowance should be made for any planned increase of the number of circuits on a route.

The individual testing periods may be of 1, 2, 3 or 4 hours duration. Where the total routine time required for a route would make a single testing period impracticable, two or more testing periods should be allocated to the route, but these periods should be separated in time by at least 4 hours.

The days and times of the testing periods will be decided by a bilateral agreement between the two technical services concerned. To initiate the scheduling of routines for a route, the technical service to which the circuit control station is responsible should request copies of the current schedule form from the distant end technical service. The controlling end technical service should indicate on the forms the day(s) and time(s) it proposes, choosing any unallocated periods on the forms for this purpose. The forms should then be returned to the distant technical service and agreement sought on the proposals [1)].

It is intended that individual testing periods be allocated to the circuits of one control station only. However, subject to the bilateral agreement between the two technical services involved, individual testing periods may be used on a common basis for the circuits of both control stations.

2.3 *Changes to the schedule*

As far as possible testing periods should be chosen so that new circuits can be incorporated without change to the schedule.

Modifications to the days and/or times of testing for existing circuits, or expansion of the schedule to accommodate additional circuits or new routes should be determined by the technical service to which the circuit control station is responsible, in agreement with the other interested technical service(s). If the technical service responsible for a circuit sub-control station considers it necessary to alter the routine maintenance schedule, it should propose changes and obtain the agreement of the technical service responsible for the control station. Any intended modifications or additions to the schedule should be entered in red on a current copy which should be forwarded to the distant technical service(s) concerned. Agreement or counterproposals can then be made by any suitable means [1)].

2.4 *Programming of routine measurements and tests*

It is the responsibility of each Administration to decide how the agreed scheduled test periods should be utilized for the effective completion of routines on the circuits it controls.

This will involve determining the type of measurements and tests to be made on each circuit taking into account the recommended periodicities.

2.5 *Unscheduled periods*

Available periods in the schedule which are unallocated may be used for any purpose relating to circuit routines. Such use is on an *ad hoc* basis and each occasion must be agreed by the terminal control and sub-control stations concerned.

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1) In some Administrations this function may be delegated by the technical service, but in all cases the technical services are responsible for ensuring the satisfactory preparation and application of the schedule.

3 Circuit routines by automatic transmission measuring equipment ATME No. 2

Note – As long as ATME No. 1 equipment is still in use a corresponding procedure should be applied (see Recommendation cited in [2]).

3.1 *Schedule form*

For the orderly and effective use of ATME for circuit routines it is necessary to schedule its use.

For each distant end international centre an Administration will require the following information to enable it to make proposals for ATME routines on the circuits for which it has control responsibility:

a) type and quantity of responding facilities at distant end;

b) periods when distant end responding facilities are not scheduled for use;

c) periods to be avoided due to exchange peak traffic at distant end.

This information should be applied by the distant end Administration on request and use of a standard form for this purpose is considered necessary. The form to be used is shown in Figure 3/M.150; an example of its use is given in Figure 4/M.150. Weeks 1, 2, 3 and 4 and *odd* and *even* months are as defined in § 2.1 above.

For ATME No. 2, three types of responding facilities are possible (see Recommendation O.22 [3]):

type a – for signalling tests and transmission measurements;

type b – for signalling tests only;

type c – for busy flash tests.

Two forms will be required for *each type a* and *b* responding equipment to cater for *odd* and *even* months. If the controlling end wishes to conduct routines at monthly or more frequent intervals then appropriate entries will need to be made on both *odd* and *even* month forms.

The type of ATME No. 2 responding equipment (*type a* or *b*) needs to be entered on the form. Each form should be given a unique reference number for administrative purposes.

Although two forms are required for each *type a* and *b* responding equipment, this does not imply that a particular responding equipment of the required type will be accessed. This will depend on local incoming arrangements.

Separate forms are *not* required for *type c* responding facilities. Where busy flash tests are to be made at the same time as transmission and/or signalling routines they should be considered as an extension of these routines and due allowance should be made for them when estimating the scheduled testing time required. An indication to show if *type c* responding facilities are or are not provided should be given on the schedule forms for *type a* and *b* responders.

The incoming access address for each type of responding facility is standard for each signalling system (see the Recommendation cited in [4]) and need not be entered on the schedule form.

3.2 *Arranging the schedule*

The technical service of an Administration wishing to commence routine testing using its ATME directing equipment, or to modify its routine programme, should request a copy of the current schedule of responding equipment availability for the distant international centre(s) of interest from the technical service concerned. This schedule will be entered on the form given in Figure 3/M.150.

The technical service at the controlling (i.e., directing equipment) end should indicate the test period(s) it proposes on the schedule and return it to the distant end for agreement.

The technical service at the controlling end will need to take the following factors into consideration when determining the test periods required on a route:

a) circuit routine periodicity (from Recommendation M.610 [1]);

b) total routine time for all circuits on the route. This will depend on:

i) total number of circuits;

ii) type of tests and measurements;

iii) routine time for circuits;

c) quantity of available responding equipments of required type at distant end (This is required when it is intended to test with more than one directing equipment simultaneously to the same distant testing centre.);

d) quantity of directing equipments to be used;

e) that test periods should be multiples of 1 hour;

f) that busy traffic periods should be avoided.

To reduce the need to make frequent changes to the schedule, due allowance should be made for any planned increase of the number of circuits on a route.

3.3 *Utilization of scheduled test periods*

It is the responsibility of each Administration to decide how the agreed scheduled test periods should be utilized for the effective completion of routines on the circuit it controls.

3.4 *Unscheduled periods*

Demand testing with ATME No. 2.

During the busy traffic period, when ATME No. 2 is not being used for routine testing, it can serve the need to permit single and rapid circuit testing on a demand basis for fault location and for testing of individual circuits following fault clearance, as well as for testing of new circuits to be added. For this reason responding equipments should be available at all times. Demand testing of large numbers of circuits for whatever purpose should be agreed between testing centres concerned.

3.5 *Utilization of directing equipment*

In addition to a current schedule of the availability of responding equipments at each of its international centres for the information of other Administrations, each Administration will have to maintain a schedule of the utilization of its own directing equipments. This is a matter for each Administration to arrange and does not require formulating by CCITT but the same type of form may also be used as indicated in Figure 5/M.150.

3.6 *Down time of ATME No. 2 equipment*

If ATME No. 2 equipment is to be out of service for a long period of time (several days), e.g. due to a fault condition or rearrangements in the international centre, so that automatic testing cannot be carried out or is heavily effected, the Administrations concerned should be advised accordingly.

International centre: ______________________ Month: odd/even[1]

Telephone number: ______________________ Week: 1/2/3/4[1]
(for circuit routine
cooperation)

For one routine test position use row A.

For two routine test positions use rows A and B.

Time (GMT)		0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
MON	A																									
	B																									
TUES	A																									
	B																									
WED	A																									
	B																									
THUR	A																									
	B																									
FRI	A																									
	B																									
SAT	A																									
	B																									
SUN	A																									
	B																									

[1] Delete as applicable.

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FIGURE 1/M.150

Manual routine testing schedule

International centre: London – Wood Street

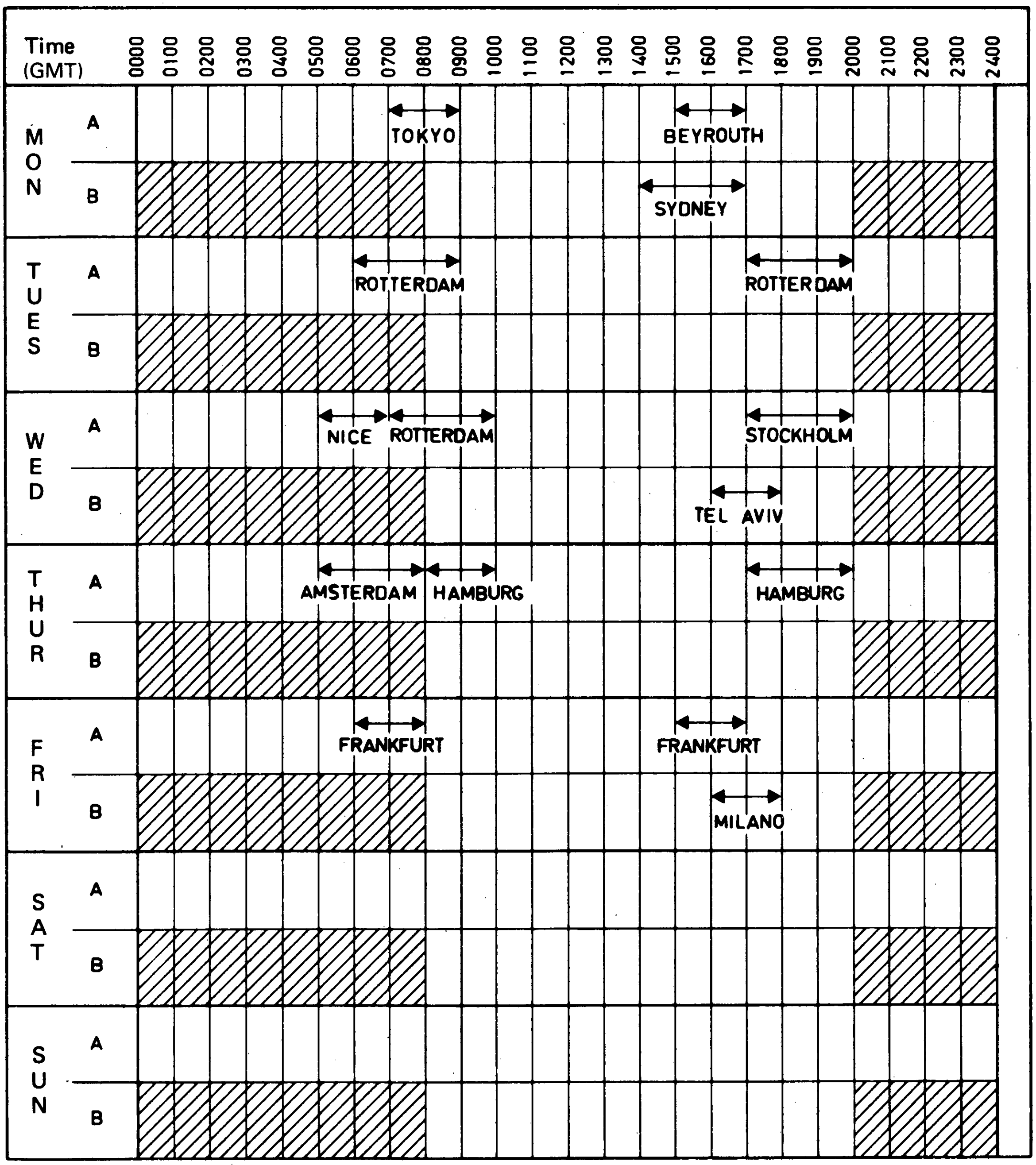
Month: odd/~~even~~[1]

Telephone number: London 606 2064
(for circuit routine cooperation)

Week: 1/~~2/3/4~~[1]

For one routine test position use row A.

For two routine test positions use rows A and B.



[1] Delete as applicable.

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FIGURE 2/M.150

Manual routine testing schedule (hypothetical example)

International centre:

Month: odd/even[1]

Reference number:

Responding equipment *type a*/*type b*[1]

Type c responding facility is/is not[1] available at this centre.

Week/day	Time (GMT)	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
1	Mo																									
	Tu																									
	We																									
	Th																									
	Fr																									
	Sa																									
	Su																									
2	Mo																									
	Tu																									
	We																									
	Th																									
	Fr																									
	Sa																									
	Su																									
3	Mo																									
	Tu																									
	We																									
	Th																									
	Fr																									
	Sa																									
	Su																									
4	Mo																									
	Tu																									
	We																									
	Th																									
	Fr																									
	Sa																									
	Su																									

[1] Delete as applicable.

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FIGURE 3/M.150

ATME No. 2 availability schedule

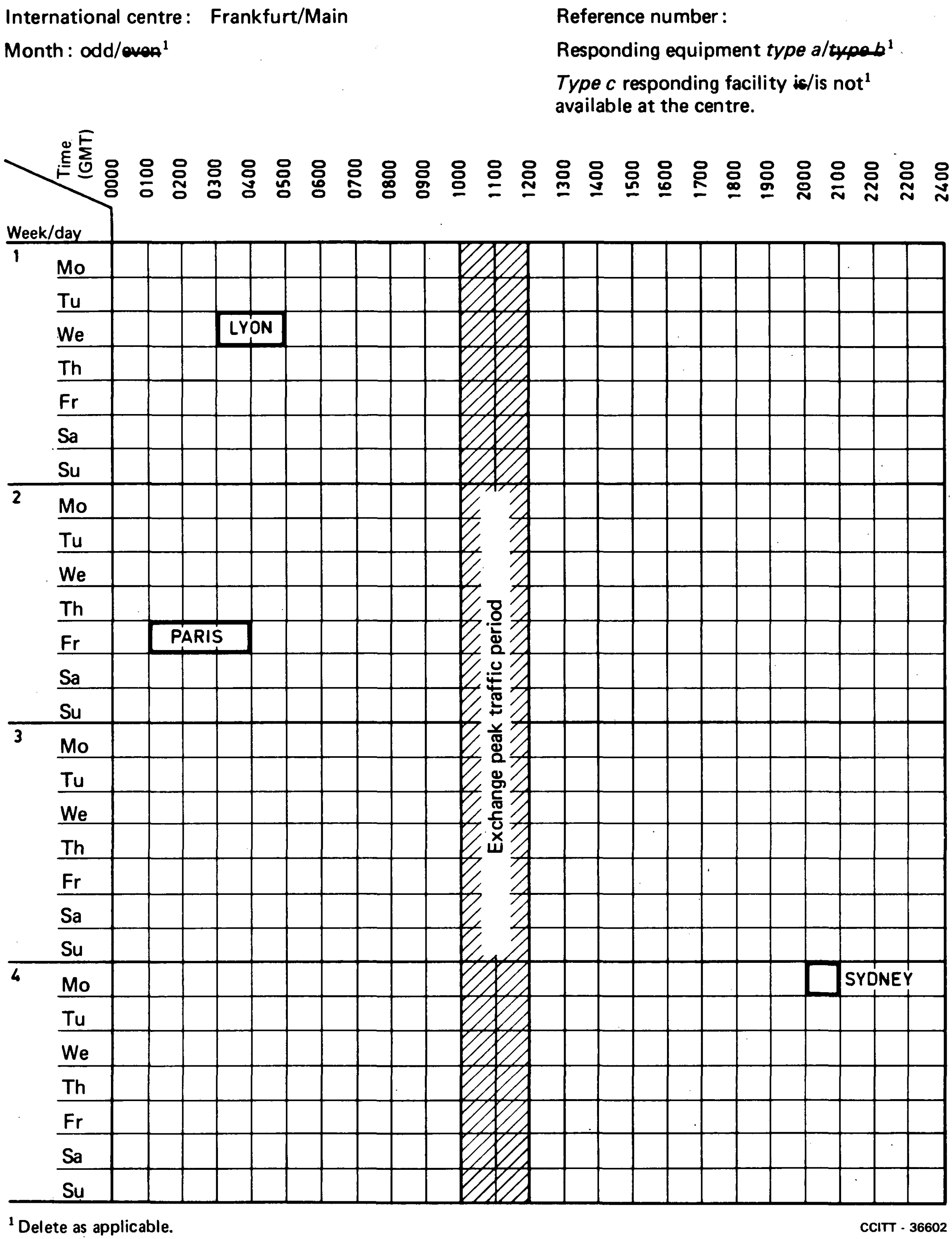
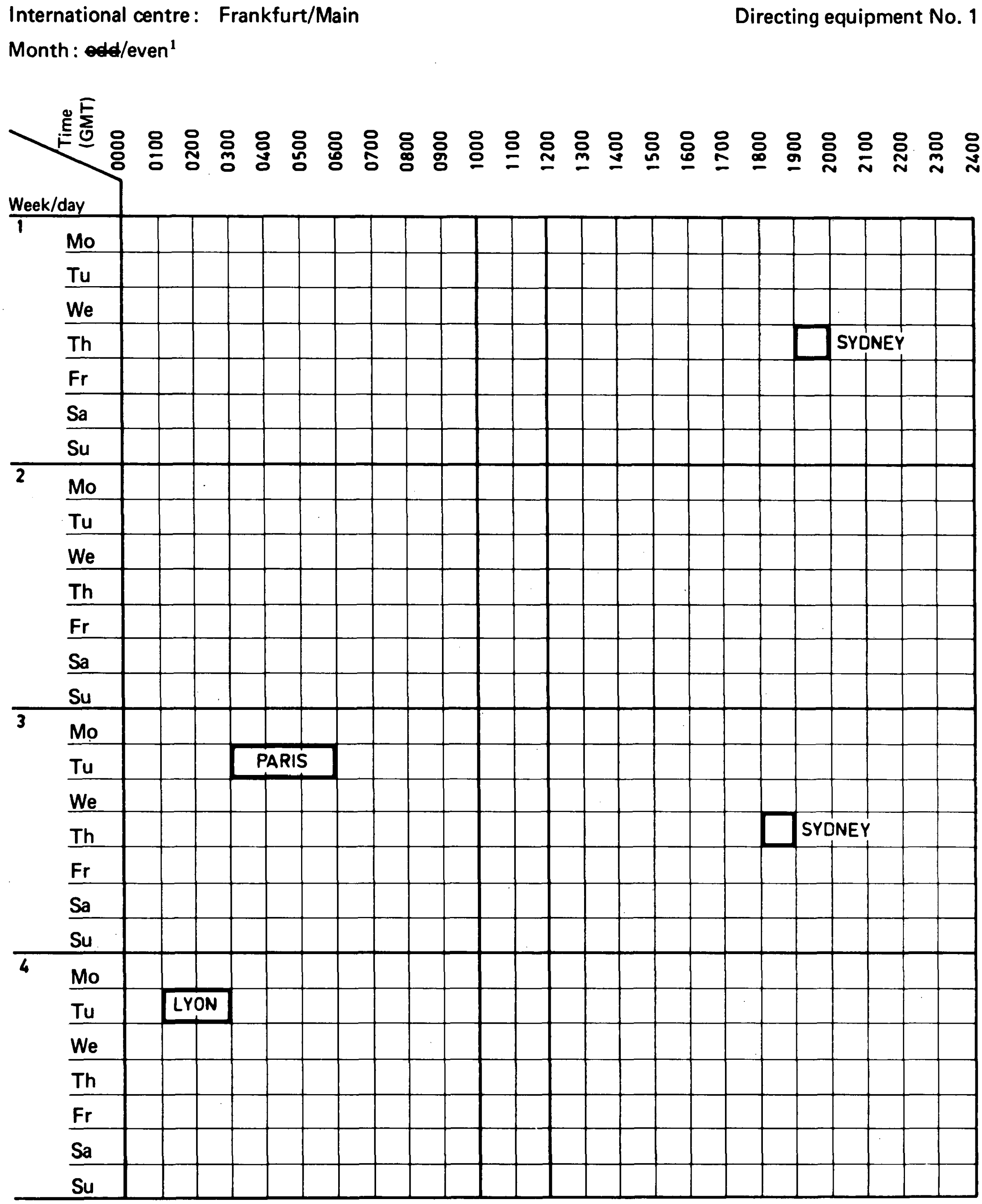


FIGURE 4/M.150

ATME No. 2 availability schedule (hypothetical example for a responding equipment)



[1] Delete as applicable.

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FIGURE 5/M.150

ATME No. 2 availability schedule (hypothetical example for a directing equipment)

References

[1] CCITT Recommendation *Periodicity of maintenance measurements on circuits*, Vol. IV, Fascicle IV.1, Rec. M.610.

[2] CCITT Recommendation *Routine maintenance programme*, Green Book, Vol. IV.1, Rec. M.15, ITU, Geneva, 1973.

[3] CCITT Recommendation *Specification for the CCITT automatic transmission measuring and signalling testing equipment ATME No 2.*, Vol. IV, Fascicle IV.4, Rec. O.22.

[4] *Ibid.*, § 4.4.1.

1.2 Transmission stability

Recommendation M.160

STABILITY OF TRANSMISSION

1 Variation of circuit overall loss with time [1)]

1.1 The objective is that the following values should not be exceeded:

1.1.1 difference between the mean value and the nominal value of the overall transmission loss:

0.5 dB for all circuits,

1.1.2 standard deviation about the mean value of the variation of the overall transmission loss:

1.0 dB for all circuits.

However, in the case of circuits which are set up, wholly or in part, on older type equipment, and which are composed of two or more circuit sections, a standard deviation not exceeding 1.5 dB may be admitted.

1.2 The method for achieving the above objective values is left to the discretion of Administrations (better maintenance, fitting of automatic regulators, etc.).

2 Variation of pilot levels with time on group, supergroup, etc. links

2.1 The objective is that the following values of M and S should be met, where M represents the mean deviation of the pilot level from its nominal value and S represents the standard deviation of the variations of the pilot level:

2.2 conditions concerning through-connection points of group, supergroup, etc. links:

$$|M| \leq 0.5 \text{ dB}, \qquad S \leq 1.3 \text{ dB}$$

2.3 conditions concerning the receiving end:

2.3.1 group links:

$$|M| \leq 0.3 \text{ dB}, \qquad S \leq 0.6 \text{ dB}$$

2.3.2 supergroup links:

$$|M| \leq 0.3 \text{ dB}, \qquad S \leq 0.5 \text{ dB}$$

2.3.3 mastergroup links:

$$|M| \leq 0.3 \text{ dB}, \qquad S \leq 0.4 \text{ dB}$$

2.3.4 supermastergroup links:

$$|M| \leq 0.3 \text{ dB}, \qquad S \leq 0.3 \text{ dB}.$$

3 Practical application of limits

The assumption is made that the limits set out in §§ 1 and 2 above for the variation with time of

– the loss of each individual circuit, or

– the level of each individual group, supergroup, etc. pilot

may be used as limits for the results of measurements made on a set of circuits, groups, supergroups, etc. at a given time. Experience indicates that such a use has a practical validity and hence Administrations are encouraged to use this Recommendation as giving currently practical limits for sets of circuits, groups, supergroups, etc. This does not preclude the application of these limits to single circuits, groups, supergroups, etc.

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1) See [1] concerning questions of statistical theory.

4 Re-line-up of circuits, groups, supergroups, etc.

When a circuit, group, supergroup, etc., has its routing or composition permanently changed over part or all of its length, it is essential to ensure that a complete line-up of the circuit, group, etc., is made in accordance with the relevant line-up Recommendations since the rerouting constitutes a reestablishment of the circuit, group, etc.

This procedure is necessary in order to maintain the transmission performance and stability of the network. The pressing needs of the operating services should not be allowed to prevent these measurements from being properly carried out, since this could only result in a degradation of the stability and performance of the circuits in the network. Under all circumstances the circuit control station should be kept advised.

5 Basic factors for transmission stability

The CCITT recommends that the following basic factors should be taken into account for achieving a stable network:

5.1 *Staff training*

The importance of this factor cannot be overemphasized.

The staff should understand why level variations are to be kept to a low value and should be made fully aware of the results of incorrect adjustments. It is important that adjustments should be made only when absolutely necessary and an adjustment should never be made to cover up a fault.

The staff must realize the possible effects of a brief interruption on any type of circuit.

5.2 *Design of installations*

Installations should be such that sudden interruptions are avoided. For example, this may be achieved by:

a) the arrangement of transmission equipment to facilitate maintenance, patching out, the replacement of subassemblies;

b) the design of carrier generators with a view to great reliability;

c) the design of power supplies; attention is particularly drawn to the importance of the judicious choice and grading of protective devices (fuses, circuit-breakers) in the power feeds to repeater station racks.

Note – See in this connection Recommendation G.231 [2].

5.3 *Care in the organization of work in international exchanges, repeater stations, and on the transmission lines, cables and systems used in the international network*

Experience has shown that operations carried out on exchange and repeater station equipment and on the external plants (underground cables, etc.) are a major cause of attenuation and phase variations and of interruptions to service in the international network.

All work liable to cause interference should therefore be carried out, when possible, at times of light traffic. It must be recognized that for very long routes it will become increasingly difficult to find suitable periods of light traffic, bearing in mind the time differences which will exist between the terminal countries on such routes. This will require good coordination and cooperation between Administrations. In particular, the control stations should be consulted well in advance (see Recommendation M.221).

5.4 *Care in the organization of maintenance*

The same reasons for transferring working operations to times of light traffic apply to maintenance operations.

It is desirable to avoid all equipment changeovers which are not absolutely necessary.

It is also desirable to guard against maintenance operations which appear harmless but which may, however, result in short interruptions and which are all the more dangerous if they affect common units (e.g. changeover of master oscillators).

5.5 *Power supplies*

5.5.1 Too frequent changeover of power supplies for routine maintenance must be avoided. It should be possible to make partial tests to check that the standby motor-generator starts, without changing over the power supplies.

5.5.2 The instruction or training of staff during the day on working power supplies should be forbidden.

5.5.3 Changeover of power supplies should be carried out at times of light traffic and as far as possible at night.

5.5.4 To ensure that circuits in the international network are not interrupted owing to the failure of public power supplies, repeater stations in the international network should have power-continuity arrangements which ensure that the transmission equipment continues to operate, *without any interruption*, in the event of a failure of the public power supply.

5.6 *Care in the testing of new equipment*

Equipment should not be put into service until after the most thorough inspection. It is necessary to ensure that the pressing needs of the operating services do not result in these tests being omitted or hastily done.

Where the urgent requirements of the operating services resulted in equipment being put into service before it has been sufficiently tested, the equipment should be temporarily taken out of service and a thorough inspection made as soon as possible.

5.7 *Vibration testing*

Vibration tests, using the principles described in [3], help in improving transmission stability and in ensuring satisfactory operation of transmission equipment. They should be made, wherever applicable, when new equipment is put into service, under special circumstances for fault locating purposes or even as a routine measure for preventive maintenance, if the Administration concerned deems it necessary.

5.8 *Automatic regulation by pilots (group pilots, supergroup pilots, etc.)*

In carrier systems, the presence of pilots (line pilots, group pilots, supergroup pilots, etc.) makes it possible to supervise transmission, to keep track of short-duration phenomena where necessary and to give the alarm if there are large variations in level.

Regulation by pilots and the way such regulation (manual or automatic) is carried out has a decisive effect on transmission stability. In addition to regulation by line pilots, with which wideband transmission systems are normally equipped, it may be necessary to regulate the group links themselves (group links, supergroup links, etc.), both to achieve adequate stability for the circuits formed from the groups and to reduce system overloading risks due to the existence of unduly high line levels.

Automatic regulation of links is a convenient means to meet the requirements for the values of M and S of the pilot levels as stated under § 2 above. Therefore, automatic regulators should be fitted into a link when these limits cannot be achieved by other means.

However, when setting up a link the need for fitting automatic regulators cannot be determined solely by these requirements. It is also necessary to take practical considerations into account such as those given in the Annex to this Recommendation.

In the case of through-connection points of group, supergroup, etc. links the insertion of automatic regulators prevents overloading of sections further down the line. If a link is through-connected several times and several regulators have to be inserted for the same direction of transmission to meet the conditions of § 2.2 above, the first insertion should be made at the first through-connection point requiring regulation in that direction of transmission. A regulator should be inserted at the through-connection point nearest the frontier (in the outgoing direction) when there are one or more other through-connection points before this point on the same link. This is to ensure that the level of the signals entering the next country is kept within the prescribed limits.

ANNEX A

(to Recommendation M.160)

Practical aspects to be considered when determining the need for regulators

When setting up a link the need for fitting regulators cannot be determined solely by the requirements of § 2 above of this Recommendation. It is necessary to take the following practical considerations into account.

A.1 In order to establish that a link meets the stability requirements of this Recommendation it is either necessary to conduct long-term tests at the time of setting up the link or to accept measurements made on similar links, that is, to predict the performance.

If the former method is adopted, then, in the case of a link passing in transit through the territory of a third Administration it is probable that transit charges will apply from the date the link is set up. In any event, the cooperation of the distant terminal Administration will be required and this may not be readily forthcoming.

If the latter method is adopted and the stability requirements are not met, then the problem will arise of taking the link out of service to fit a regulator and to re-line the link. This could entail a substantial loss of revenue and will require distant end cooperation.

A.2 It is unusual for a supergroup to be provided with all five groups allocated from the outset and it cannot be assumed that these groups will end at the same point as the supergroup. In any case, if a group that ends at the same point is changed to a through-group, then, unless a supergroup regulator has already been fitted, it may be necessary to interrupt service to fit a regulator and re-line the supergroup link.

A.3 Consideration also has to be given to the restoration requirements when deciding to fit regulators to supergroup links. Lack of such regulators may seriously hamper restoration arrangements.

A.4 Frequent rearrangements occur on international routes and are outside the control of the distant Administration.

References

[1] *Statistical theory requirements*, Green Book, Vol. IV.2, Supplement No. 1.6, ITU, Geneva, 1973.

[2] CCITT Recommendation *Arrangement of carrier equipment*, Vol. III, Fascicle III.2, Rec. G.231.

[3] *Vibration testing*, Green Book, Vol. IV.2, Supplement No. 2.9, ITU, Geneva, 1973.

1.3 Transmission path restoration

Recommendation M.201

TRANSMISSION PATH RESTORATION FOR SERVICE PROTECTION

1 Definitions concerning transmission path restoration methods

1.1 *Preventive method*

Protection switching is that category of restoration in which one transmission path is substituted for another to permit maintenance operations either for the protection against component failure or to remedy temporary conditions such as fading. This is intended to reflect a configuration in which *m* paths protect *n* paths on the same route.

1.2 *Corrective methods*

These are either *physical repair* or *rerouting.* **Rerouting** may be defined as the restoration of a transmission path on another path when a total or partial physical route failure has occurred or when the normal route protection channel is not available due to a previous or simultaneous failure, or when there is no such protection channel provided. Such rerouting is normally effected by manual switching using plugs and cords but it could be accomplished by automatic switching, if appropriate.

2 Principles of transmission path restoration

2.1 In case of a failure on an international transmission system complete service restoration is a maintenance objective. Line and terminal equipment allocated for restoration should be left available to the extent that the objective can be achieved. This equipment may sometimes be used for other purposes as required, e.g. planned outages.

2.2 When planning new routes or changes to existing routes, account should be taken of the requirements of restoration.

2.3 The responsibility for restoration should be based on the following principles in the case of an interruption due to a fault or to a planned outage of a route:

a) when the interruption of an international route takes place on a national section, restoration is solely the affair of the country involved;

b) when an interruption takes place on an international section of an international route, restoration is the affair of the two countries directly involved even if other countries are concerned;

c) in the case of satellite failure the responsibility to restore the satellite capability rests with the designated satellite system manager;

d) restoration should be effected in the transmission network at the highest order of group or line permitted by the network (group, supergroup, etc.) taking into account the service restoration required;

e) it would be desirable to arrive, if possible, at complete restoration based upon bilateral and/or multilateral agreements. Special consideration is necessary when, in practical cases, complete restoration cannot be achieved. When complete restoration is not possible the group, supergroup, etc. line links to be restored should contain those circuits that satisfy the special needs of the Administrations involved to the extent possible. Sufficient restoration capacity should therefore be provided to reflect the special interests of each Administration involved;

f) in the case where it is not possible to restore all circuits through the procedures envisaged under a), b), and c), each terminal country should make the necessary agreements to use all available routes lending themselves to restoration.

3 Methods of transmission path restoration

3.1 *Restoration methods*

The links provided for service restoration are used in the event of both failures and planned outages. Methods for restoration will necessarily vary according to the particular system and circumstances involved. They will include protection switching, physical repair and rerouting using manual, semiautomatic or fully automatic methods. In order to choose the restoration method, it is appropriate for the Administrations involved to take into account the following elements in a bilateral or multilateral agreement:

a) the level of availability desired;

b) the facilities that may be used for restoration;

c) the economics related to the particular system being considered;

d) the compatibility of equipment at appropriate locations.

3.2 *Manual restoration (patching)*

The complexity of the evolving international transmissions network demands flexibility in any service restoration arrangement. In general, service restoration is presently achieved by manual patching. The links used for service restoration are arranged in a network configuration with particular restoration requirements being met by using such links either singly or connected in tandem. This arrangement is flexible and maximizes the use of international restoration links which are expensive to provide and therefore limited in number.

3.3 *Semiautomatic restoration*

Where manual patching is used for restoration, especially in the case of planned outages, an interruption of service will occur for a significant time while the operation takes place. Any such interruption is undesirable and may be avoided by the use of high speed switchers. Such switchers would be activated manually when it is required to change from the normal route to a previously set-up and tested restoration route.

3.4 *Considerations involved in planning automatic switching systems for corrective restoration*

Restoration arrangements for transmission systems may be applied at any level in the multiplex hierarchy that is bilaterally or multilaterally agreed upon. The switching configuration itself may be a one-to-one or more complex relationship, involving more than one system to be protected by more than one alternative path. When planning a physical restoration system on an international basis the following considerations, among others, should be taken into account in the context of the desired availability and the economics involved:

a) availability of restoration capacity, taking into account the number of standby and normal working paths;

b) transmission characteristics of the standby path(s);

c) services to be restored and the acceptability of additional delay to minimize switching and confirm failure;

d) threshold at which failure is to be established (this may be adjustable in a range);

e) switching level in the multiplex hierarchy and whether any restorative switching is to be applied at more than one level;

f) switch-back techniques to be manual or automatic, if desired at all;

g) telemetry and control system to be used if required;

h) the need for a unidirectional or bidirectional system;

i) maximum degradation to be permitted by the switches.

It would also be useful to consider the restoration system in terms of the component time intervals involved. Some of these have been identified as follows:

T1 – time interval between the actual failure and the initial recognition of that failure;

T2 – time interval to ensure that the apparent failure requires a restoration action;

T3 – time interval required for the processing and the transmission of appropriate controls to establish the necessary restoration switching;

T4 – time interval for switch operations;

T5 – time interval to permit the restored system to stabilize (this may include the verification of switch operations).

The above time intervals would vary depending on whether the transmission system was analogue or digital. If it were digital the bit rate involved would also be a factor. None of these intervals have been considered appropriate to standardize to date.

1.4 Planned outages

Recommendation M.221

EXCHANGE OF INFORMATION FOR PLANNED OUTAGES OF TRANSMISSION SYSTEMS

1 General

Planned outages of transmission systems are required to allow planned work to be done with the minimum impairment to the service concerned. All tests, measurements, rearrangements, etc., which are not attributed directly to a failure – and are known in advance – are considered to be *planned work.* Such work will include installation of new equipment, routine maintenance, work on power supply equipment and in some cases, work for the clearance of faults which at first could only be remedied provisionally (mainly cable faults).

In the event of planned work which results in the complete or partial break in a transmission system, efforts are at first made to reroute the telecommunication traffic as required. If special restoration plans exist for cases of faults, these plans can also be used in the event of planned outages. Should rerouting be impossible, planned work is generally carried out during periods of light traffic, e.g. at night. To allow appropriate measures to be taken, all stations affected by the planned outage must be informed in good time.

2 Planned outages of international groups, supergroups, etc.

When an Administration plans the outage of a transmission system carrying international group/supergroup, etc. links, it should inform all other Administrations in whose territories the links concerned terminate. This information should be given by telex at least three working days in advance. [1] An example is given in Figure 1/M.221. There are cases in which more than three days are necessary, such as those involving extensive rearrangements. If, in exceptional cases, a three-day notice cannot be given, advice should be given by telephone so as to ensure that the Administrations concerned still have sufficient time to take the appropriate steps. Planned outages should not be carried out if notice cannot be given and received at least 24 hours in advance.

[1] The time limit of three working days is not intended to affect other agreements in special cases, e.g. a notification time of two weeks in planned outages of submarine cable systems.

from: . . . .

to: . . . .

because of urgent work in our country the following groups and supergroups will be out of service from 20th march 23.00 to 21st march 06.00 (gmt):

ffm – luxemburg 6003
ffm – paris 6002
ffm – oslo 1202
ffm – rotterdam 6002, 6005
ffm – amsterdam 6002
amsterdam – budapest 1201
ffm – london 1214, 1246
duesseldorf – milano 6001

regards.

FIGURE 1/M.221

Example of a telex message concerning a planned outage of international groups and supergroups

In practice, Administrations have entrusted different entities, i.e. either their international centres or their technical services with the exchange of information for planned outages. Therefore, it is essential that each Administration states clearly to whom reports on outages are to be sent [2]. In any case, the technical service of an Administration should be aware of the outages planned in its own country, and try to reduce their impact on international services to a minimum. Passing on of the information within the area of an Administration, e.g. to the control stations for leased and special circuits, or to the users of leased circuits, is done according to the national practice.

3 Planned outages of national transmission systems, which affect international leased and special circuits

In the international centres, international leased and special circuits are frequently through-connected in the voice-frequency band and routed to the destination via national group links. An outage of these group links leads to a break in the international circuit. In these cases, informing the circuit control station and the users is of particular importance in order to avoid unnecessary fault location in the other country.

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2) Normally such information is exchanged between the System Availability Information Points (see Recommendation M.721 [1]).

If an outage is planned for a national system within the area of the Administration being entrusted with the terminal sub-control function for a circuit, the circuit control station should be informed direct or via the two transmission maintenance points (international line) (see Recommendation M.95) or via the technical service so as to enable the control station to inform the user in good time. In addition, it may be advisable that the terminal sub-control station informs the user at its end of the circuit of the planned outage, since an exchange of information between the users at both ends of the circuit is not always possible. Figure 2/M.221 illustrates the possible flow of information for this case.

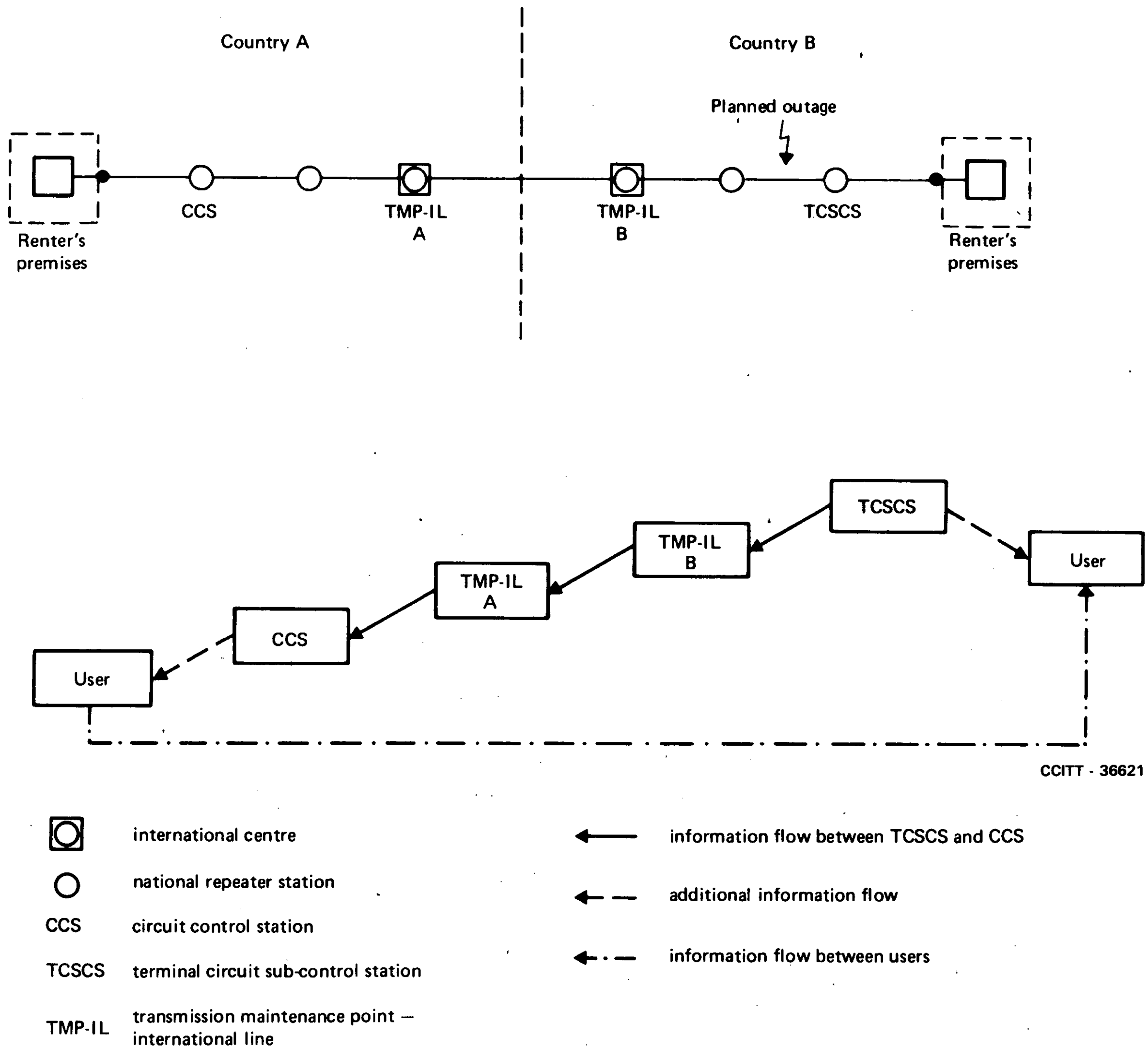

FIGURE 2/M.221

Example of a possible information flow in case of a planned outage of a national transmission system affecting an international leased circuit

A similar procedure should be applied if a planned outage of a national system in a transit country affects an international leased or special circuit.

If an outage is planned for a national system within the area of an Administration having control functions for a circuit, it is recommended that the sub-control station be advised in order to avoid unnecessary queries in the event of a fault report being submitted by the user in the distant country concerned. The transmission maintenance point (international line) in its own country should be informed in any case.

Reference

[1] CCITT Recommendation *System availability information point*, Vol. IV, Fascicle IV.1, Rec. M.721.

SECTION 2

INTERNATIONAL CARRIER SYSTEMS

2.1 Definitions

Recommendation M.300

DEFINITIONS CONCERNING INTERNATIONAL CARRIER SYSTEMS

Note 1 – This Recommendation is partly duplicated in Recommendation G.211 [1].

Note 2 – Figure 1/M.300 refers to definitions 2 to 13. Figures 2/M.300, 3/M.300 and 4/M.300 refer to definitions 1 to 18.

Those of the following definitions that concern *links* or *sections* apply, unless otherwise stated, to the combination of both directions of transmission. A distinction between the two directions of transmission may, however, be necessary in the case of unidirectional, multiple-destination *links* or *sections* set up over multiple-destination communication satellite systems.

1 line link (using symmetric pairs, coaxial pairs, radio-relay link, etc.)

A transmission path, however provided, together with all the associated equipment, such that the bandwidth available, while not having any specific limits, is effectively the same throughout the length of the link.

Within the link there are no direct filtration points nor any through connection points for groups, supergroups, etc., and the ends of the link are the points at which the band of line frequencies is changed in some way or other.

2 group link

The whole of the means of transmission using a frequency band of specified width (48 kHz) connecting two terminal equipments, for example, channel translating equipments, wideband sending and receiving equipments (modems, etc.). The ends of the link are the points on group distribution frames (or their equivalent) to which the terminal equipments are connected.

It can include one or more group sections.

3 group section

The whole of the means of transmission using a frequeny band of specified width (48 kHz) connecting two consecutive group distribution frames (or equivalent points).

4 group

A group consists of a group link connected at each end to terminal equipments. These terminal equipments provide for the setting-up of a number of telephony channels (generally 12), one or more data transmission or facsimile channels, etc.

It occupies a 48-kHz frequency band. Figures 1/M.320, 2/M.320, and 3/M.320, show various possible arrangements of telephony channels in a basic group B (60 to 108 kHz).

5 supergroup link

The whole of the means of transmission using a frequency band of specified width (240 kHz) connecting two terminal equipments, for example, group translating equipments, wideband sending and receiving equipments (modems, etc.). The ends of the link are the points on supergroup distribution frames (or their equivalent) to which the terminal equipments are connected.

It can include one or more supergroup sections.

6 supergroup section

The whole of the means of transmission using a frequency band of specified width (240 kHz) connecting two consecutive supergroup distribution frames (or equivalent points).

7 supergroup

A supergroup consists of a supergroup link connected at each end to terminal equipments. These terminal equipments provide for the setting-up of five group links or sections occupying adjacent frequency bands in a 240 kHz band or for one or more data transmission or facsimile channels, etc.

The basic supergroup occupies the band 312 to 552 kHz. Figure 1/M.330 shows the position of groups and channels within the supergroup.

8 mastergroup link

The whole of the means of transmission using a frequency band of specified width (1232 kHz) connecting two terminal equipments, for example supergroup translating equipments, wideband sending and receiving equipments (modems, etc.). The ends of the link are the points on mastergroup distribution frames (or their equivalent) to which the terminal equipments are connected.

It can include one or more mastergroup sections.

9 mastergroup section

The whole of the means of transmission using a frequency band of specified width (1232 kHz) connecting two consecutive mastergroup distribution frames (or equivalent points).

10 mastergroup

A mastergroup consists of a mastergroup link terminated at each end by terminal equipments. These terminal equipments provide for the setting-up of 5 supergroup links or sections occupying frequency bands separated by 8 kHz in a 1232-kHz band.

The basic mastergroup consists of supergroups 4, 5, 6, 7 and 8 within the band of frequencies 812 kHz to 2044 kHz. (See Figure 1/M.340.)

11 supermastergroup link

The whole of the means of transmission using a frequency band of specified width (3872 kHz) connecting two terminal equipments, for example, mastergroup translating equipments, wideband sending and receiving equipment (modems, etc.). The ends of the link are the points on supermastergroup distribution frames (or their equivalent) to which the terminal equipments are connected.

It can include one or more supermastergroup sections.

12 supermastergroup section

The whole of the means of transmission using a frequency band of specified width (3872 kHz) connecting two consecutive supermastergroup distribution frames (or equivalent points).

13 supermastergroup

A supermastergroup consists of a supermastergroup link connected at each end to terminal equipments. These terminal equipments provide for the setting-up of 3 mastergroup links or sections separated by two free spaces of 88 kHz and occupying a band whose total width is 3872 kHz. The basic supermastergroup is composed of mastergroups 7, 8 and 9 occupying the frequency band 8516 - 12 388 kHz. (See Figure 1/M.350.)

14 15 supergroup assembly link [1)]

The whole of the means of transmission using a frequency band of specified width (3716 kHz) connecting two 15 supergroup assembly distribution frames (or equivalent points). It can be made up of a number of 15 supergroup assembly sections. When terminal equipments are connected to both ends, it becomes a constituent part of a 15 supergroup assembly for carrying telephony or telegraphy channels or data or facsimile, etc.

15 15 supergroup assembly section [1)]

The whole of the means of transmission using a frequency band of specified width (3716 kHz) connecting two consecutive 15 supergroup assembly distribution frames (or equivalent points) and connected, at least at one end, to through-15 supergroup assembly connection equipment. It always forms part of a 15 supergroup assembly link.

16 15 supergroup assembly

A 15 supergroup assembly consists of a 15 supergroup assembly link terminated at each end by terminal equipments. These terminal equipments provide for the setting-up of 15 supergroup links or sections separated by free spaces of 8 kHz and occupying a band whose total width is 3716 kHz. The basic 15 supergroup assembly is made up of supergroups 2 to 16 occupying the frequency band 312 - 4028 kHz.

17 through-group connection point

When a *group link* is made up of several *group sections*, they are connected in tandem by means of *through-group filters* at points called through-group connection points.

18 through-supergroup connection point

When a *supergroup link* is made up of several *supergroup sections*, they are connected in tandem by means of *through-supergroup filters* at points called through-supergroup connection points.

19 through-mastergroup connection point

When a *mastergroup link* is made up of several *mastergroup sections*, they are connected in tandem by means of *through-mastergroup filters* at points called through-mastergroup connection points.

20 through-supermastergroup connection point

When a *supermastergroup link* is made up of several *supermastergroup sections*, they are connected in tandem by means of *through-supermastergroup filters* at points called through-supermastergroup connection points.

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1) This definition is still under study by Study Group IV and is not identical to the one given in Recommendation G.211 [1].

21 through-15 supergroup assembly connection point

When a *15 supergoup assembly link* is made up of several *15 supergroup assembly sections*, these sections are interconnected in tandem by means of *through-15 supergroup assembly filters* at points called through-15 supergroup assembly connection points.

Note – In a country normally using mastergroup and supermastergroup arrangements a 15 supergroup assembly can be through-connected without difficulty at the supermastergroup distribution frame by means of through-supermastergroup filters. In this case, the 15 supergroup assembly is through-connected to position *3* (8620-12 336 kHz) instead of position *1* (312-4028 kHz) as required by the definition of the through-connection point of such an assembly. The point where this through-connection is made is a through-supermastergroup connection point and not a through-15 supergroup assembly connection point.

22 regulated line section (symmetric pairs, coaxial pairs or radio-relay links)

In a carrier transmission system, a line section on which the line-regulating pilot or pilots are transmitted from end to end without being subjected to any intermediate amplitude regulation associated with the pilot or pilots.

23 national section

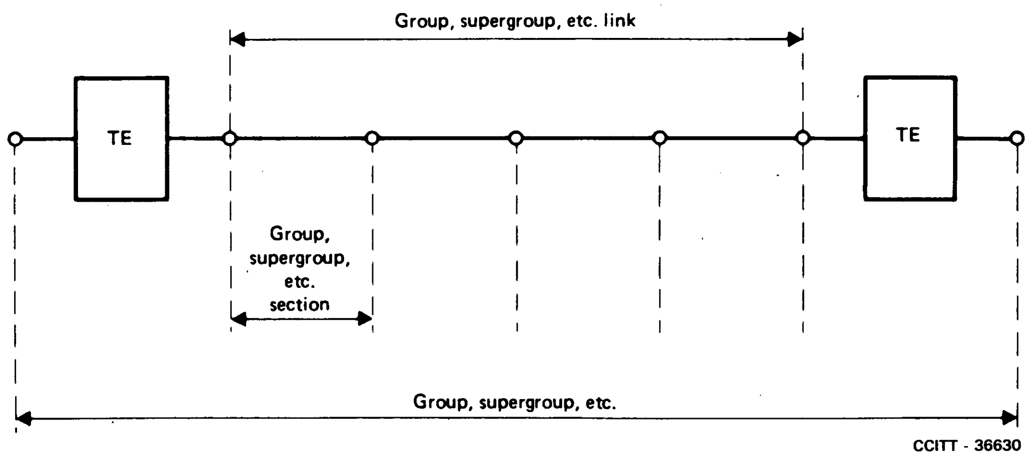
The group, supergroup, etc., sections between a station with control or sub-control functions and a frontier station within the same country are termed comprehensively a national section. A national section will usually comprise several group, supergroup, etc., sections. The group, supergroup, etc., sections between the two stations with control functions within one country also constitute a national section.

24 international section

The group, supergroup, etc., sections between two adjacent frontier stations in different countries constitute an international section. Some international sections may be a single group, supergroup, etc., section routed over long submarine cable carrier systems. If the international group, supergroup, etc., is routed via intermediate countries without demodulation to the basic frequency band, the frontier stations at the ends of the international group, supergroup, etc., section are still considered to be *adjacent*.

25 main section

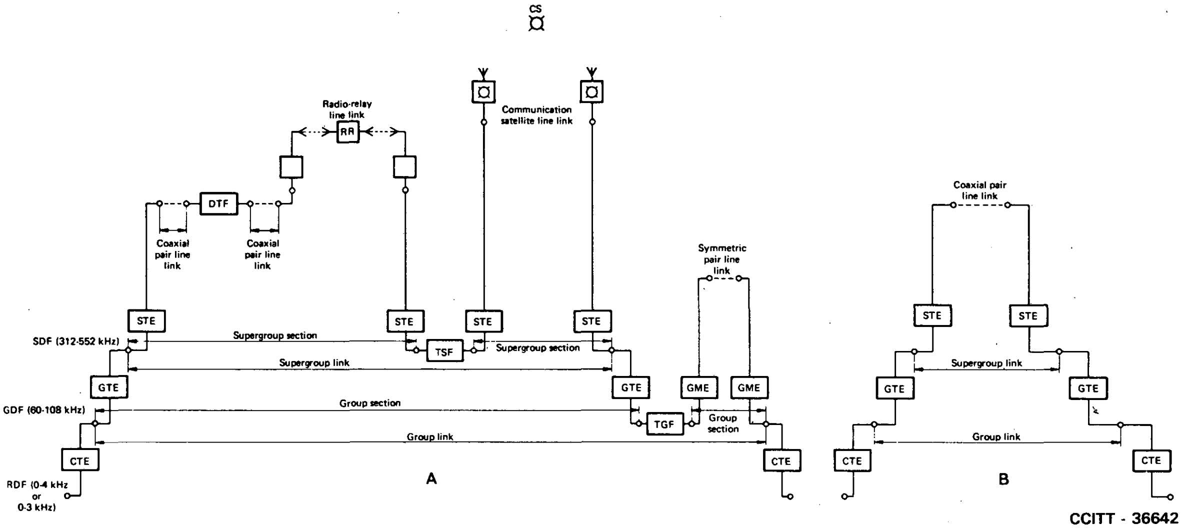
The sections into which the group, supergroup, etc. link is divided by the group, supergroup, etc., control and sub-control stations are called main sections. A main section is the portion of the group, supergroup, etc., link between two adjacent stations having control functions. In many cases these two stations are in different countries. In the case of a country which has elected to have more than one station with control functions, a main section will lie wholly within that country. (See Figure 2/M.460.)



TE = terminal equipment for telephony, data, facsimile transmission, etc.

FIGURE 1/M.300

Group, supergroup, etc. link



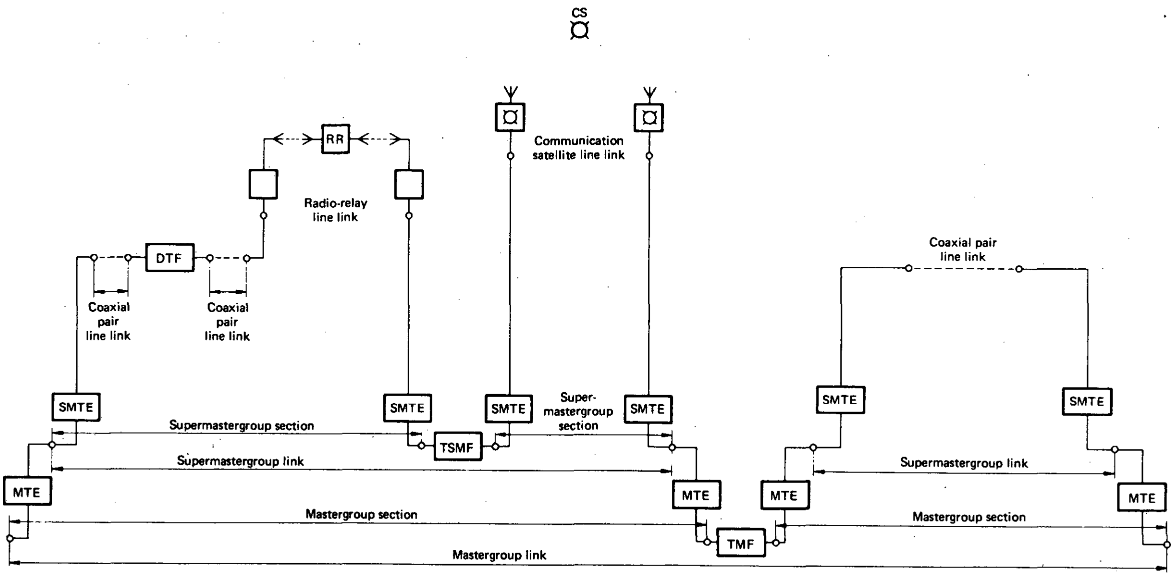
CTE = channel translating equipment
(translation of the audio band into the basic group or vice versa)
GTE = group translating equipment
(translation of the basic group into the basic supergroup)
STE = supergroup translating equipment
(translation of the basic supergroup into the line frequency on coaxial cable, or radio-relay system or vice versa)
GME = group modulating equipment

DTF = direct through-connection filter
TSF = through-supergroup filter
TGF = through-group filter
RDF = repeater distribution frame
GDF = group distribution frame
SDF = supergroup distribution frame
RR = radio-relay station
CS = communication satellite

(The terminology used in this figure is in conformity with the definitions of Recommendation M.300. However, there are small inconsistencies with respect to recommendations giving details of lining-up procedure.)

FIGURE 2/M.300

Channel of a group set-up on: several line links in tandem (A), a single line link (B)

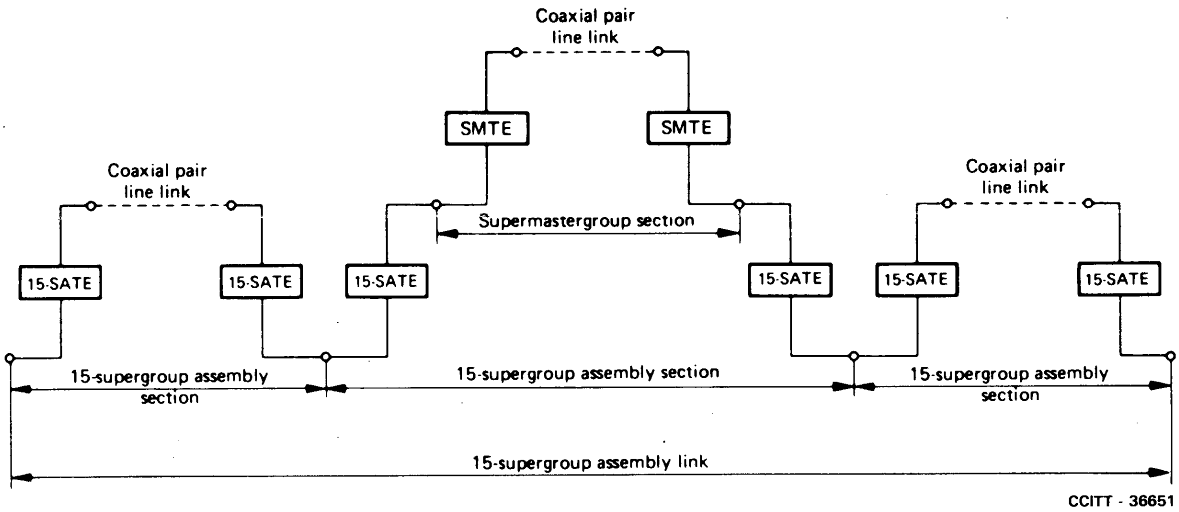


MTE = mastergroup translating equipment
SMTE = supermastergroup translating equipment
TMF = through-mastergroup filter
TSMF = through-supermastergroup filter

DTF = direct through-connection filter
RR = radio-relay station
CS = communication satellite

FIGURE 3/M.300

Mastergroup link



SMTE = supermastergroup translating equipment
15-SATE = 15-supergroup assembly translating equipment

FIGURE 4/M.300
15-supergroup assembly link

Reference

[1] CCITT Recommendation *Make-up of a carrier link*, Vol. III Fascicle III.2, Rec. G.211.

2.2 Numbering of channels, groups, supergroups, mastergroups and supermastergroups in carrier transmission systems

Recommendation M.320

NUMBERING OF THE CHANNELS IN A GROUP

1 General

The position of a channel within a group is identified by a number starting from 1, the numbers of the different channels being taken in order of frequency in the basic group frequency band.

A channel is said to be *erect* within a group when the frequencies in the group-frequency band corresponding to the audio-frequencies in the channels *ascend* in the same relative order as those in the channels forming the group.

Similarly, a channel is said to be *inverted* within a group when the frequencies in the group-frequency band descend in the same relative order as the ascending order of the frequencies in the channels.

A group, supergroup, etc., is said to be *erect* when all of its channels are *erect* and is said to be *inverted* when all of its channels are *inverted.*

1.1 *8 channel group*

Basic group B is *inverted.* The channels will be numbered from 1 to 8 in descending order of frequency within the group-frequency range. (See the recommended arrangement in Recommendation G.234 [1]).

The numbering is as shown in Figure 1/M.320.

1.2 *12 channel group*

Basic group B is *inverted.* The channels will be numbered from 1 to 12 in descending order of frequency within the group-frequency range.

The numbering is as shown in Figure 2/M.320.

1.3 *16 channel group*

Channels of a 16 channel group are normally assembled in the basic group B frequency range. The channels are numbered from 1 to 16 in descending order of frequency within the basic group B frequency band, the odd-numbered channels being *erect* and the even-numbered channels being *inverted.* It is therefore not possible in this case to speak of an *erect* or *inverted* group.

The numbering is as shown in Figure 3/M.320.

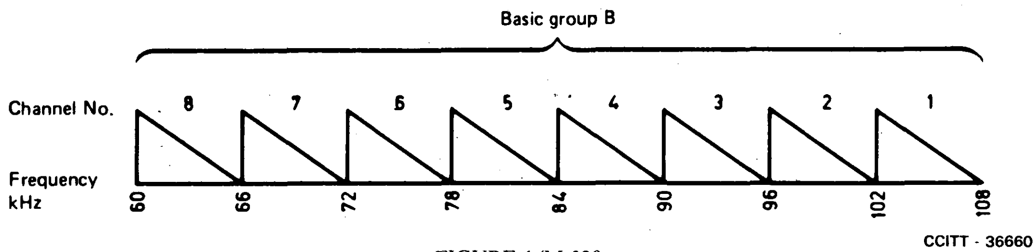


FIGURE 1/M.320
Numbering of channels in 8 channel group

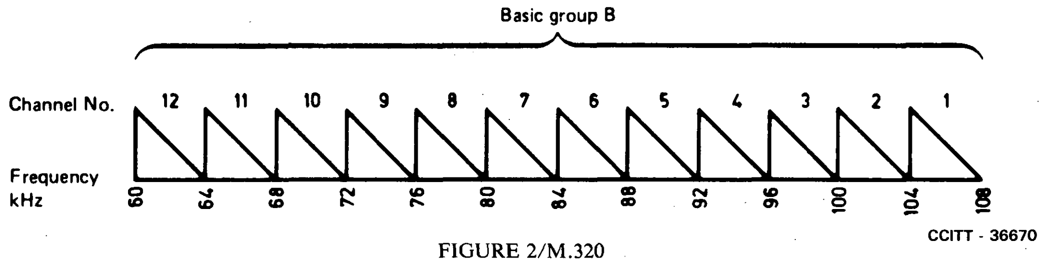


FIGURE 2/M.320
Numbering of channels in 12 channel group

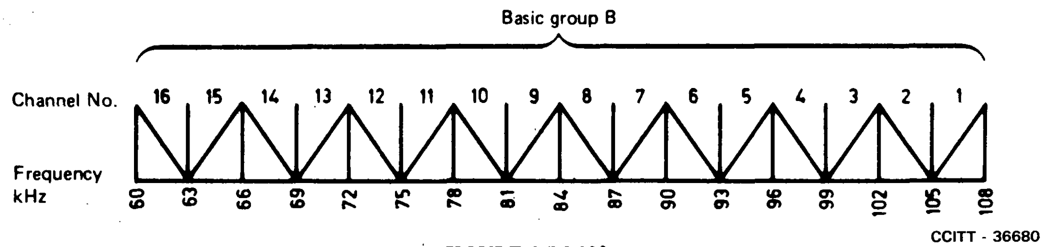


FIGURE 3/M.320
Numbering of channels in 16 channel group

Reference

[1] CCITT Recommendation *8-channel terminal equipments,* Orange Book, Vol. III-1, Rec. G.234, ITU, Geneva, 1977.

Recommendation M.330

NUMBERING OF GROUPS WITHIN A SUPERGROUP

The position occupied by a group within a supergroup is identified by a number in the series from 1 to 5, the numbers being allocated in ascending order of frequency in the basic supergroup 312 kHz to 552 kHz and in descending order of frequency in the other supergroups. (See Figure 1/M.330.)

If all the groups comprising the supergroup are erect:

– the basic supergroup is said to be *erect*;

– the other supergroups are said to be *inverted.*

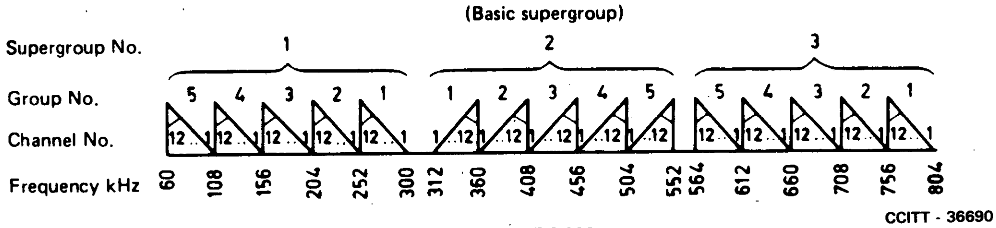


FIGURE 1/M.330

Numbering of 12 circuit groups and channels in supergroups

Recommendation M.340

NUMBERING OF SUPERGROUPS WITHIN A MASTERGROUP

The position of a supergroup within a mastergroup is identified by a number in the series from 4 to 8 which refers to one of the numbers of the supergroups constituting the basic mastergroup in the supergroup arrangement of the standard 4-MHz coaxial system.

The numbering is shown in Figure 1/M.340.

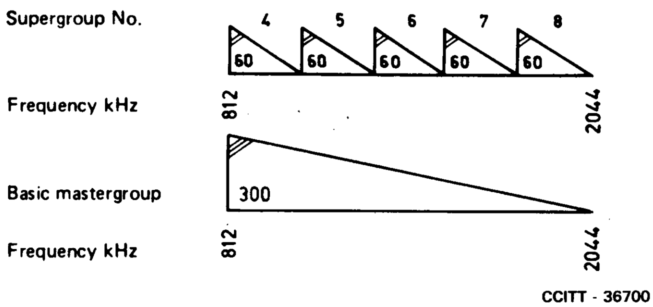


FIGURE 1/M.340

Numbering of supergroups within the basic mastergroup

Recommendation M.350

NUMBERING OF MASTERGROUPS WITHIN A SUPERMASTERGROUP

The position of a mastergroup within a supermastergroup is identified by a number in the series from 7 to 9 which refers to one of the numbers of the mastergroups constituting the basic supermastergroup.

The numbering is shown in Figure 1/M.350.

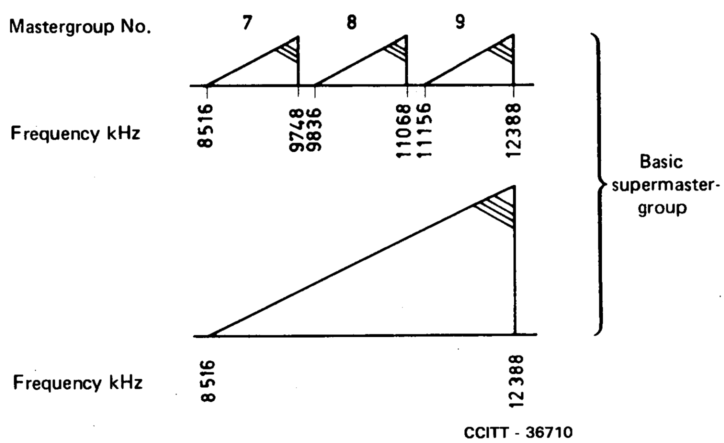


FIGURE 1/M.350
Numbering of mastergroup within a supermastergroup

Recommendation M.380

NUMBERING IN COAXIAL SYSTEMS

1 Numbering of groups, supergroups, etc., and of channels in coaxial systems

1.1 *Numbering of a supermastergroup or of a 15 supergroup assembly*

The supermastergroups and 15 supergroup assemblies of a coaxial system are identified by numbers giving their respective position in the frequency spectrum transmitted on the line. The numbering is shown in Figures 1/M.380, 2/M.380 and 3/M.380.

1.2 *Numbering of a mastergroup*

The mastergroups of a coaxial system are identified by numbers giving their respective position in the frequency spectrum transmitted on the line. The numbering is shown in Figures 1/M.380, 2/M.380, 4/M.380, 8/M.380 and 10/M.380.

Alternatively, when a mastergroup is regarded as being part of a supermastergroup, the position of the mastergroup can be indicated by the number of that supermastergroup followed by the number of mastergroup within the basic supermastergroup (for example, in Figure 1/M.380, the 5652 - 6884 kHz mastergroup in a 12 MHz system with supermastergroup frequency allocation is designated by the two numbers 2 and 8).

1.3 *Numbering of a supergroup*

The supergroups of a coaxial system are identified by numbers giving their respective position in the frequency spectrum transmitted on the line. The numbering is shown in Figures 2/M.380, 5/M.380, 6/M.380, 7/M.380 and 9/M.380.

The position of a supergroup that is part of a mastergroup is designated by the number of that mastergroup followed by the number of the supergroup within the basic mastergroup (examples: in Figure 1/M.380, the 5652 - 5892 kHz supergroup in a 12-MHz system with supermastergroup frequency allocation is designated by the three numbers 2, 8 and 4; in Figure 8/M.380, the 4332 - 4572 kHz supergroup in a 6-MHz system with mastergroup frequency allocation is designated by the two numbers 4 and 4).

The position of a supergroup that is part of a 15 supergroup assembly is designated by the number of that 15 supergroup assembly followed by the number of the supergroup within the basic 15 supergroup assembly (for example, in Figure 3/M.380, the 10 356 - 10 596 kHz supergroup in a 12-MHz system with frequency allocation by 15 supergroup assemblies is designated by the two numbers 3 and 9).

1.4 *Numbering of a group*

The position of a group is designated by the number of the supergroup in which it is placed followed by the number of the group within that supergroup (examples: in Figure 1/M.380 the 5844 - 5892 kHz group in a 12-MHz system with supermastergroup frequency allocation is designated by the four numbers 2, 8, 4 and 1; in Figure 8/M.380, the 4924 - 4972 kHz group in a 6-MHz system with mastergroup frequency allocation is designated by the three numbers 4, 6 and 3).

1.5 *Numbering of a channel*

The position occupied by a channel is designated by the number of the group to which it belongs followed by the number of the channel within that group (examples: in Figure 1/M.380, the 5884 - 5888 kHz channel in a 12-MHz system with supermastergroup frequency allocation is designated by the five numbers 2, 8, 4, 1 and 2; in Figure 8/M.380, the 4936 - 4940 kHz channel in a 6-MHz system with mastergroup frequency allocation is designated by the four numbers 4, 6, 3 and 9).

Note – In this system of numbering, the order of the numbers corresponds to a decreasing bandwidth, that is to say, number of supermastergroup (if any) followed by the numbers of the mastergroup, supergroup, group and channel.

2 Standard frequency allocations on 2.6/9.5 mm coaxial pairs

The CCITT has recommended various methods for allocating supermastergroups, mastergroups, supergroups and 15 supergroup assemblies on 2.6/9.5-mm coaxial pairs. The method for each standard system is given below. The identification numbers are shown in each figure to facilitate application of the rules set forth above.

2.1 *12-MHz systems using valves or transistors*

The frequency allocation for 12-MHz systems is in conformity with scheme 1A, 1B or 2 shown in Figures 1/M.380, 2/M.380 and 3/M.380.

The CCITT has also recommended the frequency-allocation scheme in Figure 4/M.380 for the simultaneous transmission of telephony and television.

2.2 *4-MHz systems*

Scheme A of Figure 5/M.380 shows the frequency-allocation scheme used in this case. The 2604-kHz pilot is used only in the 2.6-MHz system described below in § 2.3.

The 4287-kHz pilot is recommended only for 4-MHz systems on 1.2/4.4-mm coaxial pairs.

2.3 *2.6-MHz systems*

The frequency-allocation scheme for a 2.6-MHz system uses the scheme in Figure 5/M.380 retaining only supergroups 1 to 10 inclusive.

The pilots are: 60 or 308 kHz and 2604 kHz.

3 Standard frequency allocations on 1.2/4.4-mm coaxial pairs

The CCITT has recommended various methods for allocating supermastergroups, mastergroups, supergroups and 15 supergroup assemblies on 1.2/4.4-mm coaxial pairs. The method for each standard system is given below. The identification numbers are shown in each figure to facilitate application of the rules set forth in § 1 above.

3.1 *12-MHz systems*

The frequency-allocation schemes are the same as for 2.6/9.5-mm pairs (see Figures 1/M.380, 2/M.380 and 3/M.380).

3.2 *6-MHz systems*

The frequency allocation for 6-MHz systems is in conformity with scheme 1, 2 or 3 shown in Figures 6/M.380, 7/.380 and 8/M.380.

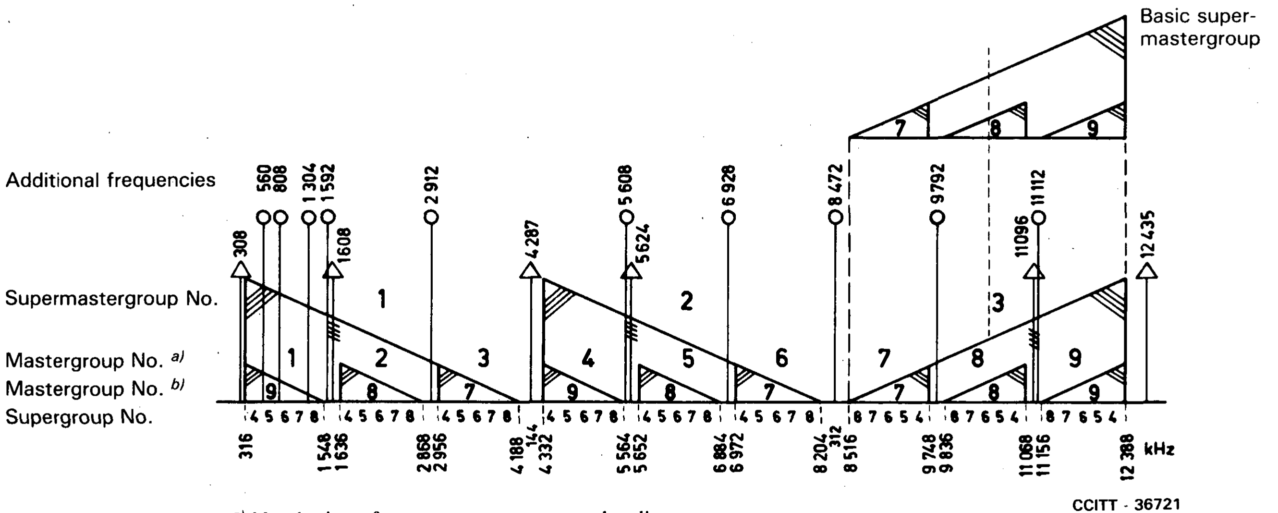
3.3 *4-MHz systems*

The line-frequency allocation scheme A shown in Figure 5/M.380 is the same as for 2.6/9.5-mm pairs. However, the 4287 kHz pilot must be transmitted continuously if one of the Administrations concerned so requests.

Scheme B of Figure 5/M.380 shows the line-frequency allocation scheme used for mastergroups.

3.4 *1.3-MHz systems*

The line-frequency allocation scheme is in conformity with one of the schemes shown in Figures 9/M.380 and 10/M.380.



a) Numbering of mastergroups transposed to line
b) Numbering of mastergroups transposed within the supermastergroups

FIGURE 1/M.380

Frequency allocation (Scheme 1A) for 12-MHz systems

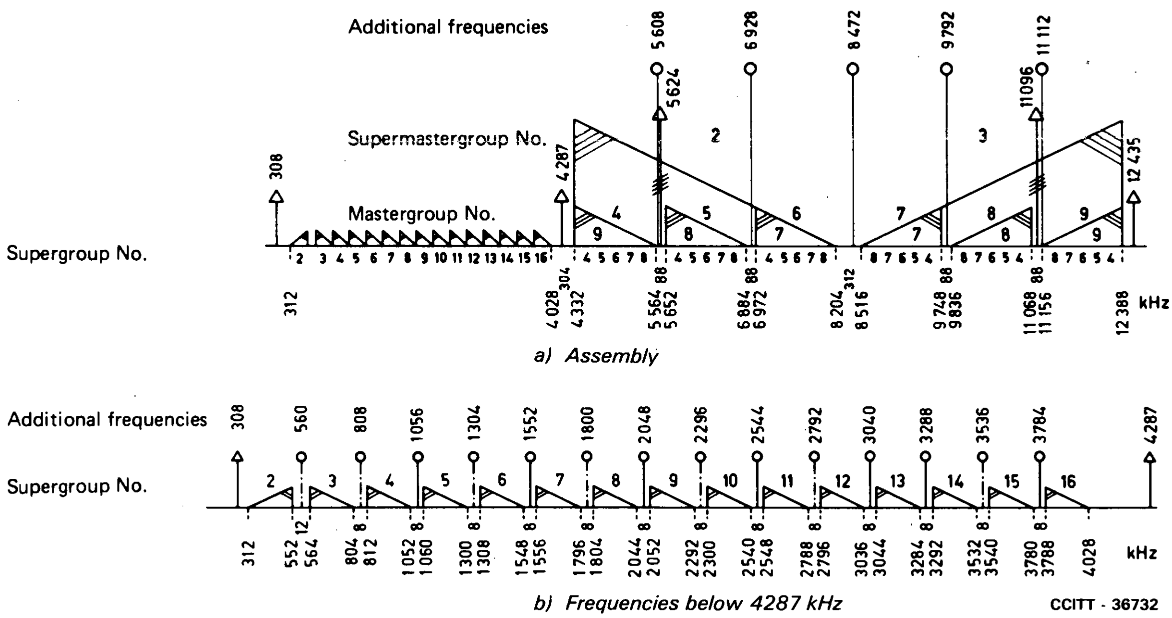


FIGURE 2/M.380

Frequency allocation (Scheme 1B) for 12-MHz systems

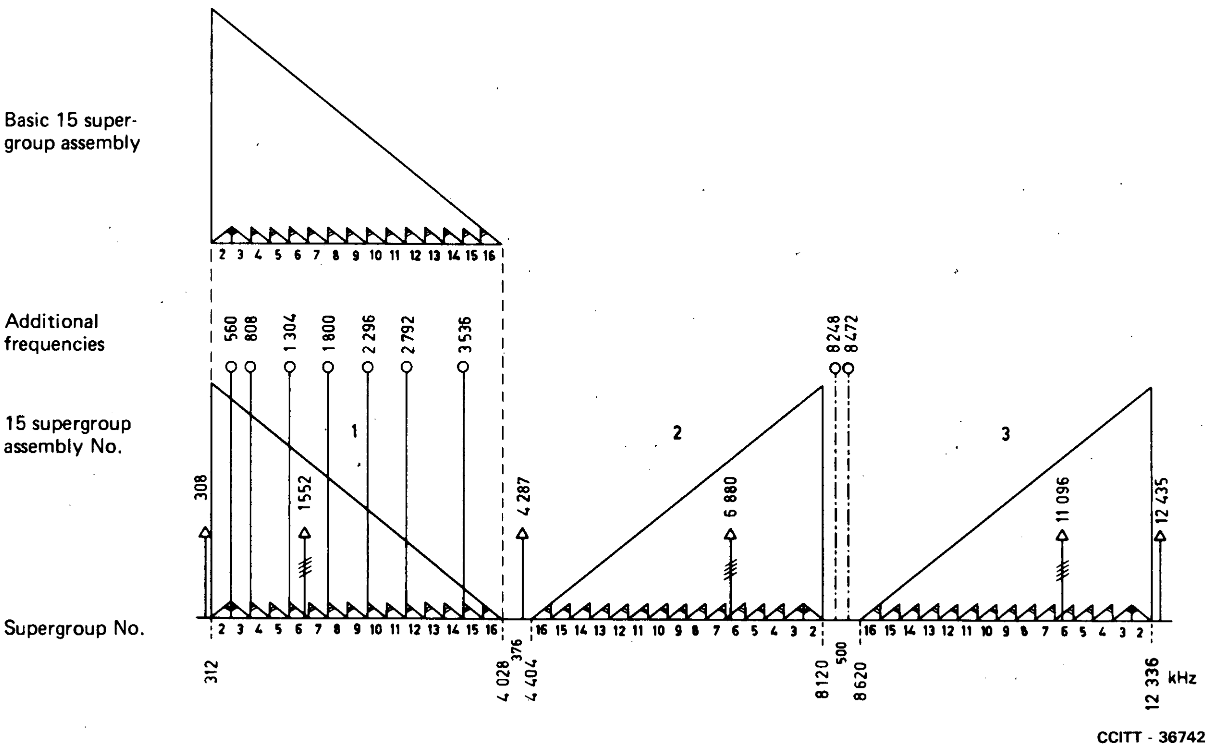


FIGURE 3/M.380

Frequency allocation (Scheme 2) for 12-MHz systems

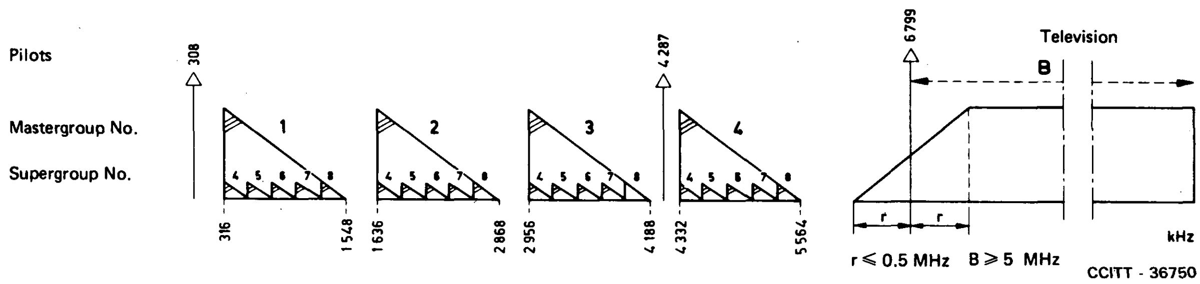


FIGURE 4/M.380

Line-frequency allocation for 12-MHz systems (simultaneous transmission of telephony and television)

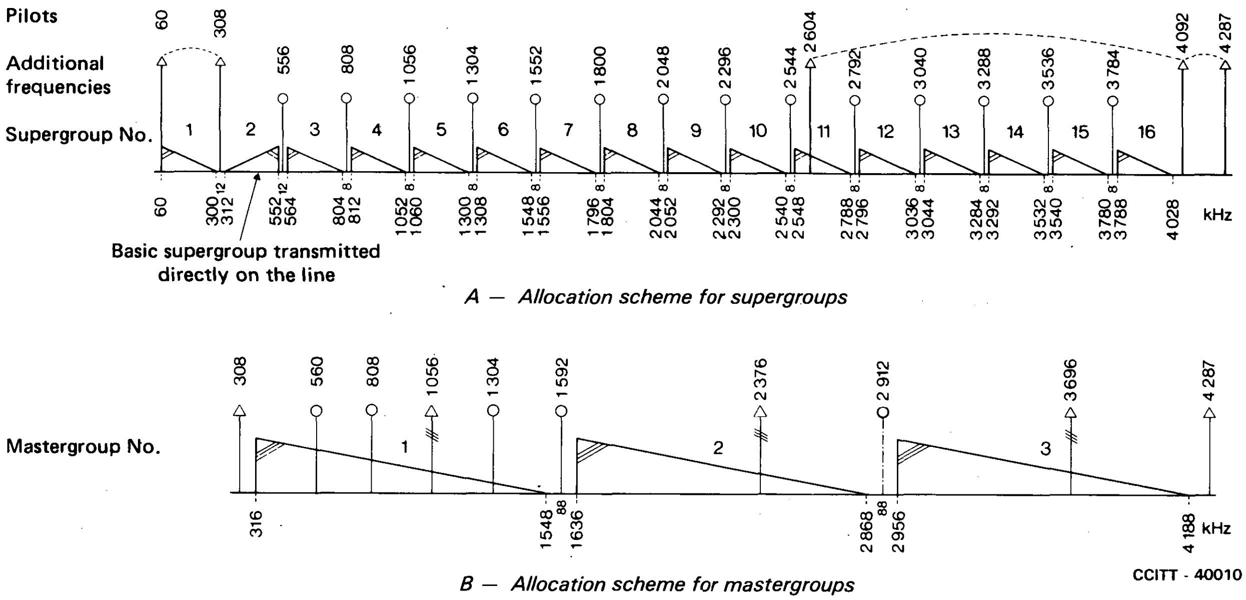


FIGURE 5/M.380

Line-frequency allocation for 4-MHz systems

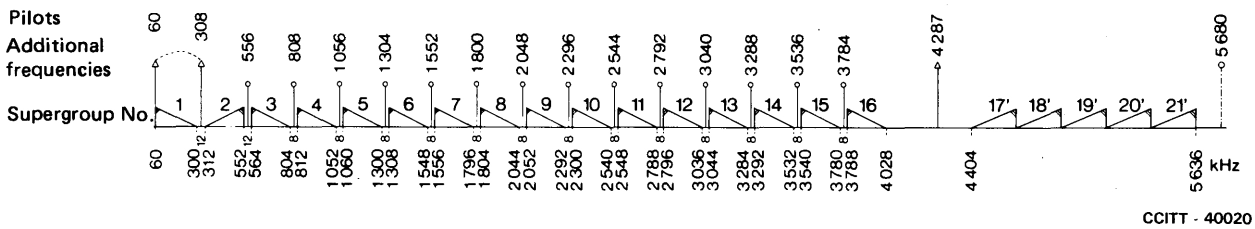


FIGURE 6/M.380

Line-frequency allocation for 6-MHz systems (Scheme 1)

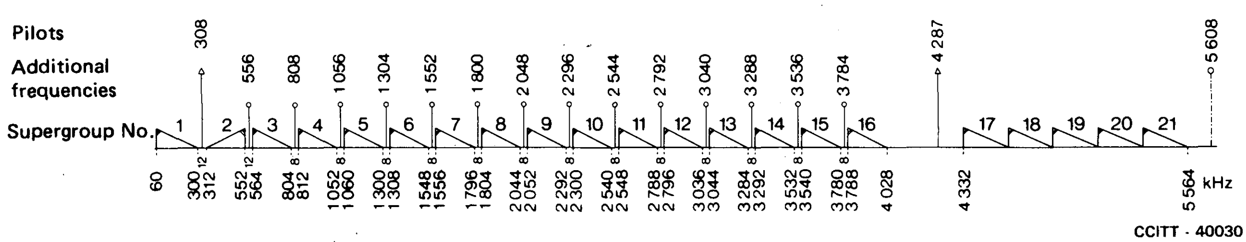
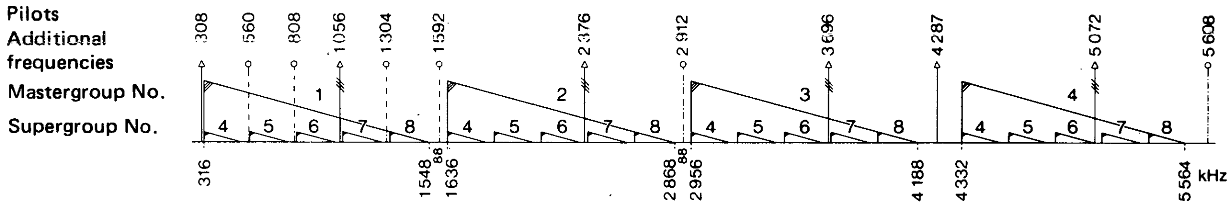


FIGURE 7/M.380

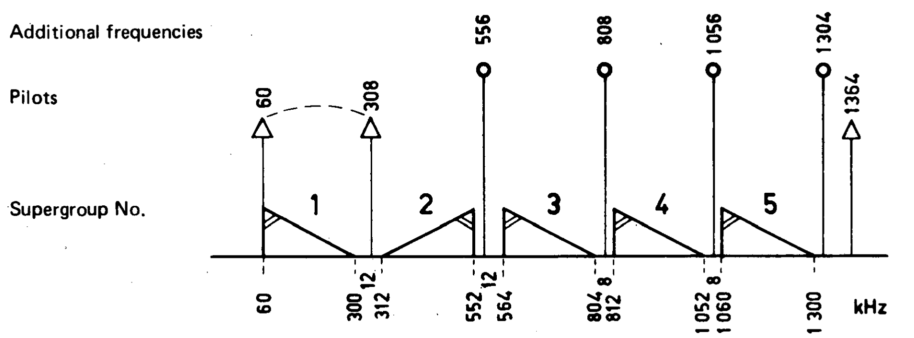
Line-frequency allocation for 6-MHz systems (Scheme 2)



CCITT - 40040

FIGURE 8/M.380

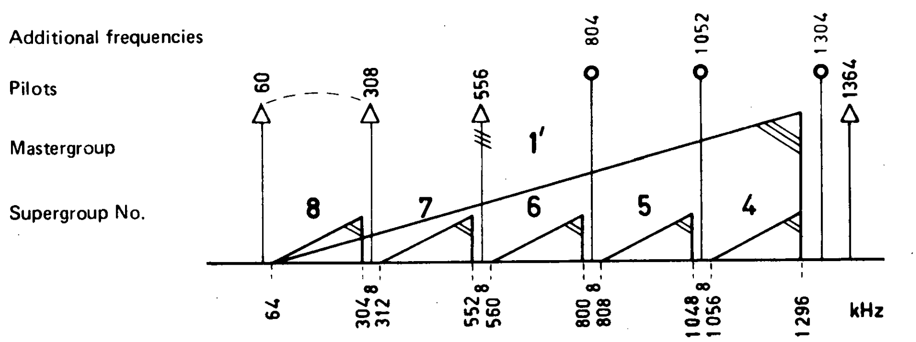
Line-frequency allocation for 6-MHz systems (Scheme 3)



CCITT - 36760

FIGURE 9/M.380

Line-frequency allocation for 1.3-MHz systems (Scheme 1)



CCITT - 36770

FIGURE 10/M.380

Line-frequency allocation for 1.3-MHz systems (Scheme 2)

NUMBERING IN SYSTEMS ON SYMMETRIC PAIR CABLE

1 Systems providing 12 telephone carrier circuits on a symmetric pair in cable (12 + 12) systems

In systems of the 12 + 12 type, 12 go and 12 return channels constitute one 12 circuit group.

For the arrangement of the line frequencies transmitted for 12 + 12 cable systems using transistors, the Administrations concerned in setting up such an international system can make their choice from scheme 1 or scheme 2 of Figure 1/M.390. Systems using scheme 2 can use only pilot frequencies of 54 kHz or 60 kHz.

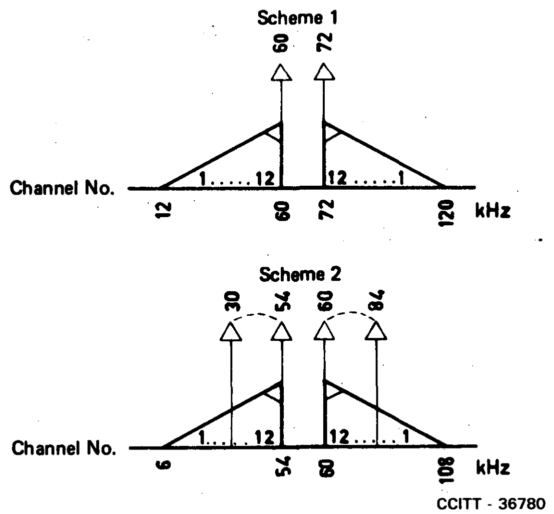


FIGURE 1/M.390

Figure 1/M.390 also applies to (12 + 12) systems using valves, provided that in the case of scheme 2 the indicated line-regulating pilots of 54 kHz and 60 kHz, or 30 kHz and 84 kHz, can be chosen as pilot frequencies.

2 Systems providing five groups or less

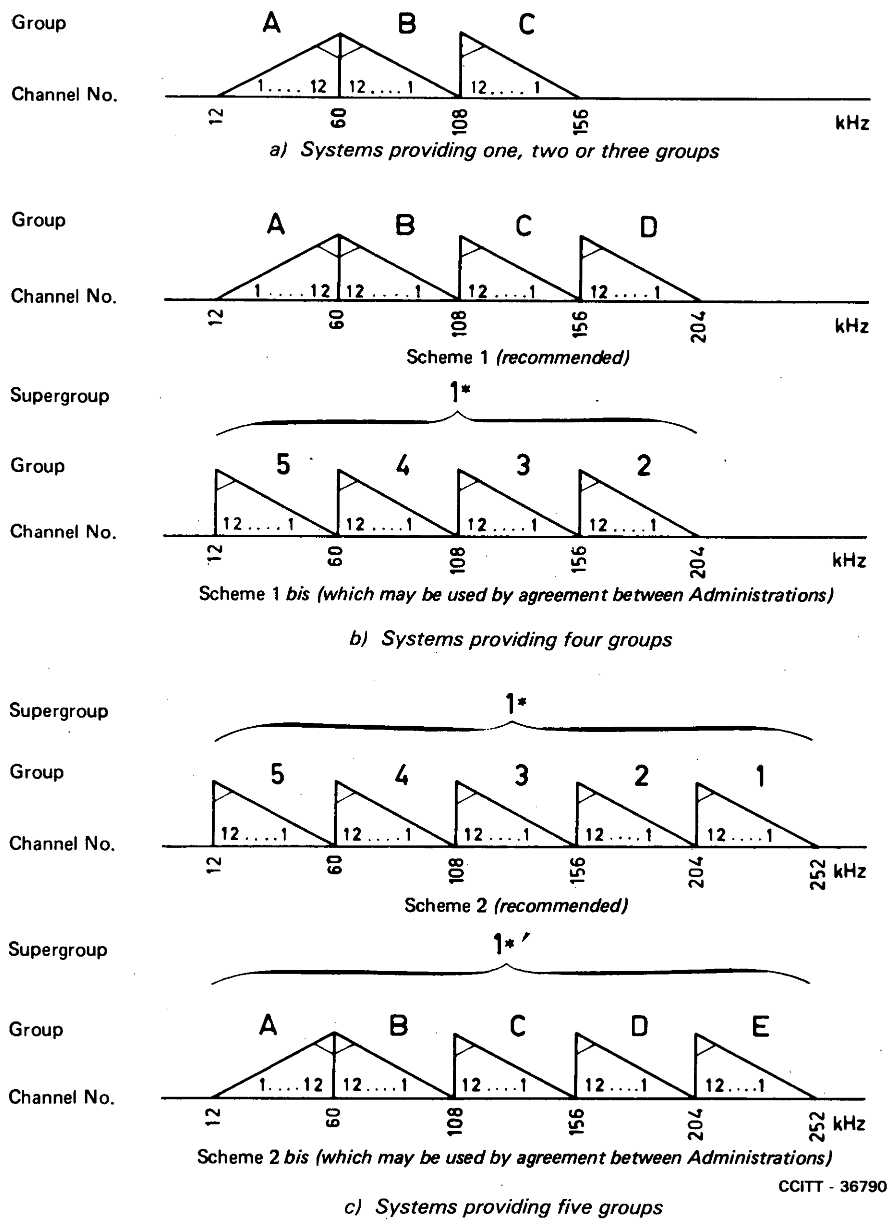
2.1 *Numbering in systems comprising both erect and inverted groups*

2.1.1 *Designation of groups*

The following indications are used to define the position of the group on the line, as shown in Figure 2/M.390:

A: 12-60 kHz group; B: 60-108 kHz group; C: 108-156 kHz group;

D: 156-204 kHz group; E: 204-252 kHz group.



Note — This figure also shows the channel numbering in the case of 12-channel groups. For the channel numbering of 8-channel and 16-channel groups respectively, see Figures 1/M.320 and 3/M.320.

FIGURE 2/M.390

Line-frequency allocation and arrangement of sidebands for carrier systems on symmetric pair cables

2.1.2 *Designation of channels*

The position occupied by a telephone channel of a carrier system is designated by means of a letter giving the position of the group (transmitted on the line) containing the channel and by means of the number of the channel within this group.

The designation of a channel on such a carrier system is therefore of the form A-7, C-9, D-4, etc. (i.e. group A, channel 7, etc.).

2.2 *Numbering in systems with inverted groups*

In this case, all the groups are in the same sense. For systems with five groups on symmetric pair cable, this is the normal arrangement which is as shown in Scheme 2 of Figure 2/M.390 *c)*.

2.2.1 *Numbering of the groups*

The five groups, all in the same sense, are numbered in the direction of ascending frequency, 5, 4, 3, 2, 1 and the assembly constitutes a supergroup having a displacement by 48 kHz towards the lower frequencies of supergroup 1 of 4-MHz coaxial system. For this reason the assembly of groups in the figure is designated by the number 1*, in order to integrate this supergroup with the general numbering for supergroups.

2.2.2 *Numbering of channels*

The place occupied by a telephone channel in such a carrier system is also designated by three numbers, e.g. 1*-4-11 (i.e. supergroup 1*, 12 channel group 4, channel 11).

2.3 *Systems with four groups*

By agreement between the Administrations concerned, one group of supergroup 1* may be omitted, but the above numbering of the groups and channels in the groups should be retained as if no group had been omitted [see scheme 1 *bis* of Figure 2/M.390 *b)*].

3 Systems providing two supergroups

3.1 *Alternative frequency arrangements*

The two recommended frequency arrangements are shown in scheme 3 and scheme 4 of Figure 3/M.390. In scheme 4, the line-frequency allocation is the same as that for coaxial cable systems, and permits satisfactory interconnection at basic supergroup frequencies (312 - 552 kHz) between supergroups in these coaxial systems and the two supergroups on symmetric pair cable systems.

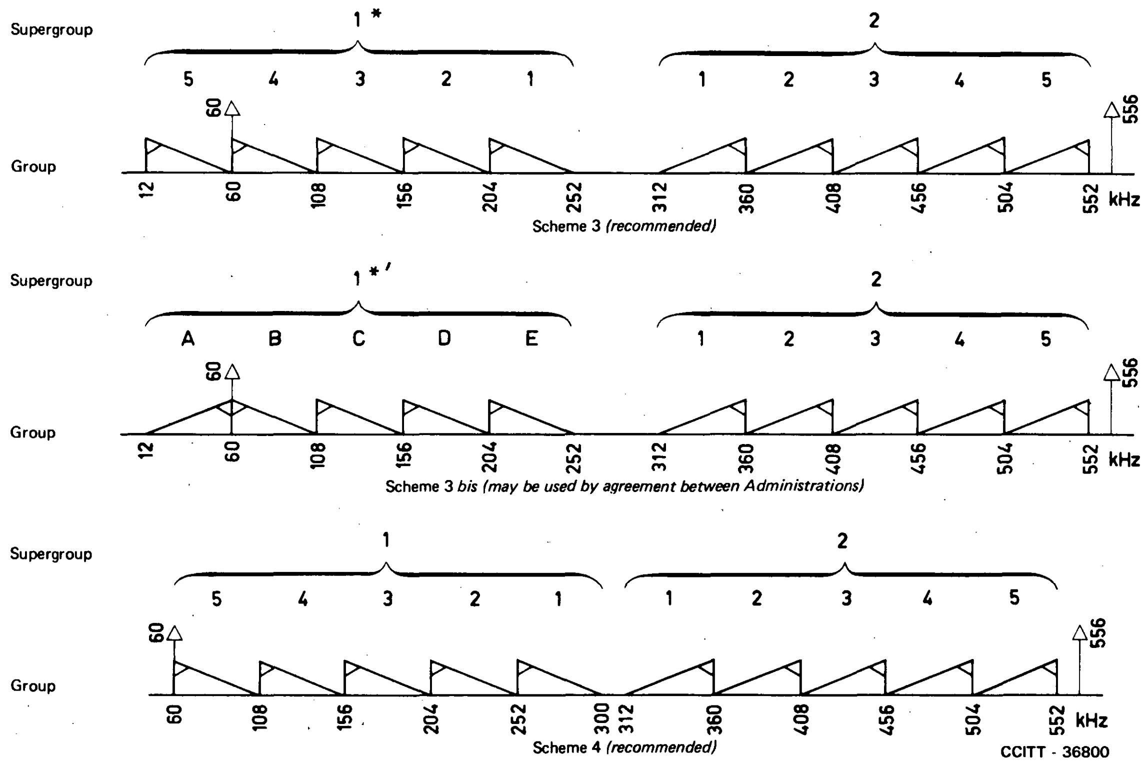


FIGURE 3/M.390

Line-frequency allocation for carrier systems providing two supergroups on symmetric pair cables

In scheme 3, the line-frequency allocation for supergroup 1* is the same as that recommended for a 5 group system on symmetric pair cables [scheme 2, Figure 2/M.390 *c)*].

The frequency allocation shown for supergroup 1* in scheme 3 *bis* may be used by agreement between Administrations where interconnection with existing systems having five groups or less is required.

3.2 *Numbering of supergroups, groups and channels*

3.2.1 The numbering of the groups and channels on a 2 supergroup system follows the principles given in Recommendations M.320 and M.330.

3.2.2 For supergroup 2 in each scheme and for supergroup 1 in scheme 4 the numbering used is that given in Recommendations M.320 and M.330 for coaxial systems.

3.2.3 For supergroup 1* and 1*' the numbering used is the same as that shown for scheme 2 and scheme 2 *bis* in Figure 2/M.390 *c)*.

Recommendation M.400

NUMBERING IN RADIO-RELAY LINKS OR OPEN-WIRE LINE SYSTEMS

For numbering in a radio-relay link using freqency division multiplex, the channels, groups, supergroups, etc., are considered in the position they occupy in the baseband to be transmitted by that link.

In the interests of direct interconnection the CCIR and CCITT have collaborated in drawing up Recommendation G.423 [1] from which it follows that the numbering of the telephony channels, groups and supergroups, etc., of the radio-relay link is as described in Recommendations M.320 to M.390.

The same rules are applied to carrier systems on open-wire lines providing at least one group having 12 telephone channels.

Reference

[1] CCITT Recommendation *Interconnection at the baseband frequencies of frequency-division multiplex radio-relay systems*, Vol. III, Fascicle III.2, Rec. G.423.

2.3 Bringing new carrier systems into service. Setting up and lining up. Reference measurements

Recommendation M.450

BRINGING A NEW INTERNATIONAL CARRIER SYSTEM INTO SERVICE

1 Preliminary exchange of information

As soon as Administrations have decided to bring a new international carrier system into service, the necessary contacts are made between their technical services [1] for the exchange of information. Those services jointly select the control and sub-control stations for the new system (see Recommendations M.80 [1] and M.90 [2]).

[1] The *technical service* represents the appropriate authorities within the international maintenance organization of an Administration which have the responsibility for making international agreements on engineering provision and maintenance matters, specifying provision and maintenance facilities, determining engineering and maintenance policy and overseeing its implementation.

The technical service of each Administration is responsible for the setting-up and lining-up of the line sections on its territory and for arranging that the adjustments and tests required are made by the repeater station staff concerned.

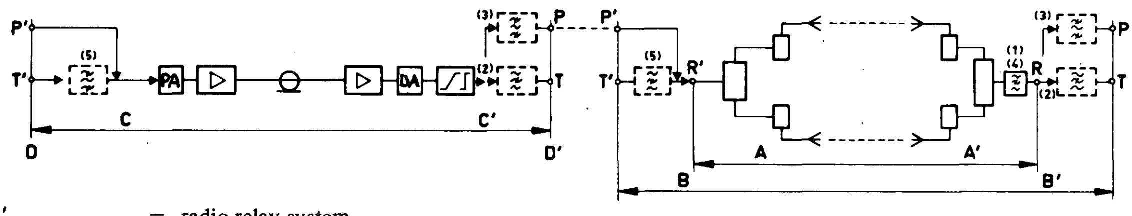
To set up a line section which crosses a frontier, Administrations should arrive at bilateral arrangements on the basis of CCITT Recommendations and, for radio-relay sections, the Recommendations of the CCIR.

2 Setting up sections crossing a frontier

2.1 *Radio-relay section*

Details of the following points will have been settled by a bilateral agreement between the technical services of Administrations:

- geographical position of the radio-relay station nearest to the frontier;
- contour of the terrain of the radio section crossing the frontier, with details of the height of the antennae above normal level;
- directivity characteristic and gain of the antennae;
- radio-frequency channel arrangement (centre frequency, polarization, intermediate frequency);
- provision of supervisory system;
- radio equipment line-regulating pilots (if any);
- continuity pilots, used for supervising the radio-relay link, in accordance with the CCIR Recommendations on the frequency and frequency deviation of this signal, each country transmitting the pilot required by the system in the receiving country;
- noise measurement channels outside the transmitted baseband;
- total noise for the radio-relay section;
- frequency deviation of the telephony channel the level of which at the centre frequency is unaffected by pre-emphasis (either of the telephony channel itself or of the radio-frequency channel of the system);
- pre-emphasis characteristics of the radio-frequency channel;
- service, supervisory and remote channel circuits;
- level, frequency and coding of the signals transmitted over these lines;
- protective switching equipment;
- interconnection points T, R, T′, R′ (see Figure 1/M.450) defined in Recommendation G.213 [3] (see also [4] and especially the return loss at points R and R′ if required (see CCIR Recommendation 380-3 [5] for values).



A, A′	= radio-relay system
B, B′	= line link via radio-relay system
C, C′	= line link via cable system
D, D′	= boundary of the high-frequency line equipment
Point P′	= provided for possible injection of regulating pilots
R	= radio-relay system output
R′	= radio-relay system input
Between T and T′	= telephony translating equipment and/or direct through-connection equipment
DA	= de-emphasis network
PA	= pre-emphasis network
(1)	= blocking of continuity pilots and, if necessary, of regulating pilots
(2)	= blocking, if necessary, of line-regulating pilots, and of pilots that must not go beyond the line link.
(3)	= through-connection filter for line-regulating pilots, if necessary. A through-connection filter for telephone groups can, if necessary, be inserted
(4)	= blocking of unspecified pilots or supervisory signals
(5)	= filter for blocking any unwanted frequency before injecting a pilot ensuring with (2) the requisite protection against a pilot (or other frequency) coming from another regulated line-section (system B or C, as the case may be)

FIGURE 1/M.450

Interconnection points T, R, T′, R′

2.2 *Coaxial-pair line section*

Details of the following points will have been settled by bilateral agreement between the technical services of the Administrations:

- the choice of the frequency arrangement to be adopted;
- the pilot signals to be used for regulating the line, in accordance with CCITT Recommendations on the frequency and level of such signals, each country transmitting the pilot signals required by the equipment of the other country (see the table in Recommendation M.540 indicating the pilot frequencies for various systems);
- service, supervisory and remote control circuits;
- repeater identification method and frequencies for fault location and monitoring on transistorized systems;
- provisions for remote power feeding, where a section of the supply line crosses the frontier;
- the regulation systems used by each country;
- the nominal level at various frequencies, at the output of the frontier repeater.

Concerning this last item, at the incoming point, each Administration should as far as possible accept the conditions usual for the system of the other country.

During the lining-up tests, the relative power level measured at the output of the repeater in the unburied repeater station nearest to the frontier should not differ, for any frequency, by more than $\pm$ 2 dB from the nominal value (as defined by a graph drawn up beforehand and based on the characteristics of the system in question).

The frequencies used in lining up the line are determined by agreement between the Administrations concerned. Experience shows that, provided the number of test frequencies required is not too large, it is useful to make these tests at frequencies lying very close to each other at the edges of the frequency band, or at points where irregularities have to be corrected, and at frequencies less close to each other elsewhere in the band.

If the necessary test equipment is available sweep measurements can substantially facilitate the line-up procedure. But in this case also, some test frequencies have to be agreed upon to obtain reference values for later in-service maintenance measurements.

2.3 *Symmetric-pair line section*

The following points will have been settled by bilateral agreement between the Administrations:

- frequency allocation;
- pilots (see the table in Recommendation M.540 indicating the pilot frequencies for various systems);
- service, supervisory or remote control lines, etc.;
- repeater identification method and frequencies for fault location and monitoring on transistorized systems;
- provisions for remote power feeding, where a section of the supply line crosses the frontier.

When a symmetric-pair line section crossing a frontier section is first set up, tests should be made at clearly defined frequencies to determine the insertion loss/frequency characteristics. For example, frequencies spaced at the following intervals could be used, except at the edges of the band, where more closely spaced measuring frequencies are desirable.

4 kHz between 12 kHz and 60 kHz,

8 kHz between 60 kHz and 108 kHz,

12 kHz between 108 kHz and 252 kHz,

24 kHz between 288 kHz and 552 kHz,

The conditions for making measurements at line-pilot frequencies should be agreed by the technical service concerned.

Level measurements at the frequencies chosen will be made at each line amplifier at the unburied repeater station nearest to the frontier. The relative power level measured at any of the frequencies chosen should not differ by more than ± 2.0 dB from the nominal value.

3 Overall reference measurements for the line

The section across frontiers and national sections having been set up and connected, reference measurements are made between the high-frequency line terminals of the carrier system, excluding the terminal equipment.

3.1 *Level measurements*

These are made at several frequencies, even if the regulated line section or line link has been equalized by means of sweep frequency measurements.

3.1.1 *Radio-relay line section*

When a radio-relay section is put into service, measurements and adjustments in accordance with the CCIR Recommendations for the radio-relay system concerned are first made of:

- the frequency at which the level is unchanged by pre-emphasis and the deviation of that frequency;
- the level and frequency of the baseband reference frequency;
- the *central position of the intermediate frequency* (if necessary);
- check and adjustment of input and output levels baseband/baseband (see CCIR Recommendation 380-3 [5] for values);
- measure of overall loss/frequency characteristics using additional measurement frequencies [2].

3.1.2 *Coaxial line section*

The frequencies for reference measurements should be selected from the following values. (These values comprise the line pilot frequencies which, of course, cannot be sent into a system with the pilots already being transmitted.)

3.1.2.1 *For a 1.3-MHz system:* 60, 308, 556, 808, 1056, 1304, 1364 kHz.

3.1.2.2 *For a 2.6-MHz system:* 60, 308, 556, 808, 1056, 1304, 1552, 1800, 2048, 2296, 2604 kHz.

3.1.2.3 *For a 4-MHz system:*

- frequency allocation with supergroups:
  60, 308, 556, 808, 1056, 1304, 1552, 1800, 2048, 2296, 2544, 2792, 3040, 3288, 3536, 3784, 4092, 4287 kHz;
- frequency allocation with mastergroups:
  Figure 5/M.380 (scheme 2):
  308, 560, 808, 1304, 1592, 2912, 4287 kHz.

3.1.2.4 *For a 6-MHz system:*

- frequency allocation with supergroups:
  308, 556, 808, 1056, 1304, 1552, 1800, 2048, 2296, 2544, 2792, 3040, 3288, 3536, 3784, 4287 (5680 [3]) kHz;
- frequency allocation with mastergroups:
  Figure 8/M.380 (scheme 3):
  308, 560, 808, 1304, 1592, 2912, 4287, 5608 [3] kHz.

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[2] Reference measurements should be made at several frequencies in both directions of transmission between accessible measuring points corresponding as nearly as possible to points R and R′ as defined in Recomendation G.213 [3]. These measurements should be made at the frequencies specified in § 3.1.2 for each transmitted bandwidth.

[3] This frequency may be 5640 kHz.

3.1.2.5 *For a 12-MHz system:*

- at frequencies below 4 MHz:
  if frequency allocation without mastergroups is used: *308*, *560*, *808*, 1056, *1304*, 1552, *1800*, 2048, *2296*, 2544, *2792*, 3040, 3288, *3536* and *3784* kHz (the frequencies in italics are those at which the measurements must always be made);
  if frequency allocation with mastergroups is used:
  308, 560, 808, 1304, 1592 and 2912 kHz;

- at frequencies above 4 MHz: if frequency allocation with 15 supergroup assemblies is used:
  5392, 7128, 8248, 8472, 8864, 9608 and 11 344 kHz; if frequency allocation with mastergroups is used: 5608, 6928, 8248 [4)], 8472, 9792 and 11 112 kHz.

3.1.2.6 *For an 18-MHz system:*

- if frequency allocation is according to Plan 1 of the Recommendation cited in [6]: 560, 808, 1304, 1592, 2912, 5608, 6928, 8248 [4)], 8472, 9792, 11 112, 12 678 or 12 760, 14 408, 15 728 and 17 242 kHz;

- if frequency allocation is according to Plan 2 of the Recommendation cited in [6]: *560*, *808*, 1056, *1304*, 1552, *1800*, 2048, *2296*, 2544, *2792*, 3040, 3288, *3536*, 3784, *5392*, *7128*, *8248*, *8472*, *8864*, *9608*, *11 344*, *12 678* or *12 760*, *14 408*, *15 728* and *17 242* kHz (the frequencies in italics are those at which measurements must always be made);

- if frequency allocation is according to Plan 3 of the Recommendation cited in [6]: 552, 1872, 3192, 4758, 6272, 7592, 9158, 10 672, 11 992, 13 558, 15 072 and 16 392 kHz [5)].

3.1.2.7 *For a 60-MHz system:*

- frequencies which do not cause interference to a regulated line section and, therefore, can be sent at any time:
  8472, 12 678 or 12 760 [6)], 17 488, 26 922, 31 322, 35 722, 40 122 [6)], 42 322, 46 722, 51 122, 55 522 kHz;

- frequencies which should not be sent without the agreement of the Administration at the receiving end:
  4200 [7)] or 4287 [8)], 8316 [7)], 12 435[8)], 22 302, 22 372 [8)], 40 920 8), 59 992 kHz.

3.1.3 *Symmetric-pair line section*

Frequency of the line pilot or pilots, and frequencies showing the insertion loss/frequency characteristic of the line, for example, frequencies spaced at:

4 kHz between 12 kHz and 60 kHz,

8 kHz between 60 kHz and 108 kHz,

12 kHz between 108 kHz and 252 kHz,

24 kHz between 288 kHz and 552 kHz.

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4) A frequency of 8248 can be used as a radio-relay link line regulating pilot. In such a case, the precautions shown in Recommendation G.423 [7] should be applied.

5) These measuring frequencies are provisional and subject to further study by Study Group XV.

6) It may be necessary to use this frequency if an adjacent auxiliary line pilot is used for regulation.

7) These frequencies may also be in use as frequency comparison pilots.

8) In accordance with Recommendation M.500, Administrations choosing to use these frequencies must ensure that interference is not caused to a following regulated line section which may be using these frequencies as line pilots.

3.2 *Loss/frequency distortion*

The loss/frequency distortion of the regulated line section (symmetric pair, coaxial or radio-relay link) shall be such that the relative level at any frequency does not differ by more than ± 2 dB from the nominal level for older type-systems and ± 1 dB in case of modern transistorized systems.

Reference measurements at the frequencies chosen will be made at all attended stations at the output of each amplifier and also at the unburied station nearest the frontier.

Reference tests at unattended stations other than frontier stations are left to the discretion of each Administration.

The setting of equalizers should be noted and recorded during the reference measurements as well as the temperature of the cable, or the resistance of one of the conductors, from which the temperature could be deduced.

3.3 *Measurement of noise power*

Measurements of noise power shall be made by sending a uniform continuous spectrum signal in the transmitted frequency band in accordance with Recommendations G.228 [8] and G.371 [9] and CCIR Recommendation 399-3 [10] [9)].

3.4 *Complementary measurements*

If the Administrations find it necessary, the following measurements could also be made:

- check of near-end crosstalk with artificial loading of radio channels;
- check of the suppression of line pilots from other regulated sections;
- check of power supply modulation, etc. (including checking of the baseband for the presence of interfering signals from radio-frequency sources outside the system);
- check of stability using a level recorder.

3.5 *Line-up record*

The results of the reference measurements made at the line terminals and at the output of frontier repeaters will be entered in a line-up record, specimens of which are included as examples in Appendices I (coaxial or radio-relay regulated line section line-up record) and II (symmetric-pair regulated line section line-up record) below.

9) In the case of a radio-relay line section, measurements should also be taken outside the baseband on the noise measurement channels indicated in CCIR Recommendation 398-3 [11]. These noise values will serve serve as reference values for subsequent maintenance measurements.

APPENDIX I
(to Recommendation M.450)

Line-up record for a coaxial-pair regulated line section*

Control station:	Annemasse	Date of measurements:	16 November 1972
Designation of link:	Annemasse-Courmayeur	Direction of transmission[4] :	Courmayeur-Annemasse

Stations	Courmayeur	Chamonix			Cluses			Annemasse	
Distance (km)	18.6			42.3			34.96		
Resistance of conductor used for temperature compensation (ohms)	982			2222			1846		
Frequencies (kHz)	Send[1]	Var. eq.[2]	Rec.[3]	Send[1]	Var. eq.[2]	Rec.[3]	Send[1]	Var. eq.[2]	Rec.[3]
$\boxed{308}$	−65	−8	−53.8	−65		−53.7	−64.7	−4	−53.8
560	−65	−6	−53.9	−65.2		−53.7	−64.8	−2	−53.7
808	−65.2	−6	−53.8	−65.2		−53.7	−65.1	−4	−53.8
1056	−65.3	−6	−53.8	−65.3		−53.7	−65.1	−4	−53.8
1304	−65.3	−6	−53.9	−65.4		−53.9	−65	−4	−53.9
1800	−65.4	−4	−53.8	−65.5		−53.8	−65.4	−2	−53.9
2296	−65.4	−4	−53.8	−65.5		−53.8	−65.4	−2	−53.9
2792	−65.4	−6	−53.8	−65.4		−53.8	−65.4	−2	−53.9
3536	−65.4	−8	−53.8	−65.4		−53.9	−65.4	−2	−53.9
4032	−65.3		−53.6	−65.2		−53.7			
$\boxed{4287}$	−65.3	−4	−53.8	−65.3		−53.7	−64.8	−2	−53.8
4648	−65.3		−53.8	−65.2		−54	−65.1		−53.9
5144	−65.2		−54.9	−65.3		−54	−65.2		−54.1
5640	−65.1	−6	−53.8	−65	Not used	−53.8	−65	−4	−53.8
6136	−65		−53.9	−65		−53.8	−64.9		−54
6632	−64.7	−8	−53.9	−64.7		−53.9	−64.9	−6	−53.8
7128	−64.5		−53.9	−64.5		−54.1	−64.8		−53.8
7624	−64.3		−53.9	−64.3		−54	−65.1		−53.8
8124	−64	−6	−53.8	−64		−53.8	−63.9	−6	−53.7
8864	−63.4		−53.9	−63.5		−54.1	−63.6		−53.7
9360	−63	−8	−53.9	−63		−53.8	−62.8	−4	−53.7
9856	−62.4		−53.9	−62.5		−53.8	−62.3		−53.6
10352	−61.7		−53.8	−61.8		−53.8	−61.6		−53.6
10848	−61		−53.8	−61		−53.9	−60.9		−53.6
11344	−60.2	−6	−53.8	−60.2		−54.1	−60.4	−6	−53.8
12340	−58.6		−53.9	−58.6		−54	−58.6		−53.7
$\boxed{12435}$	−58.1	−6	−53.9	−58.5		−54.1	−58.4	+4	−53.8

* Can also be used for a radio-relay regulated line section.
[1] 600 ohm through-level (dB) at repeater output points.
[2] Variable equalizer setting.
[3] 600 ohm through-level (dB) at special measuring points.
[4] There will be a corresponding form for the other direction of transmission.

APPENDIX II
(to Recommendation M.450)

Line-up record for a symmetric-pair line

Control station: . . . . Antwerpen
Designation of link: . . . . Antwerpen-Rotterdam

Date of measurements: . . . . 10 October 1959
Issue: . . . . 22 March 1960

	Direction: Antwerpen-*Rotterdam*				Direction: Rotterdam-*Antwerpen*			
Distance (km)	15.8		17.7	72.4	72.4		17.7	15.8
Test frequencies kHz	Ant-werpen dB	Bras-schaat dB	Zun-dert dB	Rotter-dam dB	Rotter-dam dB	Zun-dert dB	Bras-schaat dB	Ant-werpen dB
12	+1.75	+1.75	+1.80	+1.85	+1.75	+1.65	+1.65	+1.65
16		1.75	1.80	1.90		1.65	1.70	1.65
20		1.75	1.80	1.90		1.70	1.70	1.70
24		1.80	1.85	1.95		1.70	1.70	1.70
28		1.85	1.85	1.90		1.70	1.65	1.75
32		1.85	1.90	1.90		1.75	1.65	1.80
36		1.85	1.90	1.85		1.75	1.70	1.80
40		1.80	1.90	1.85		1.75	1.70	1.85
44		1.80	1.85	1.85		1.80	1.75	1.90
48		1.75	1.85	1.80		1.80	1.75	1.90
52		1.75	1.85	1.75		1.75	1.70	1.90
56		1.75	1.80	1.75		1.75	1.75	1.85
60		1.80	1.80	1.75		1.70	1.65	1.85
68		1.75	1.75	1.75		1.70	1.65	1.85
76		1.70	1.75	1.80		1.70	1.60	1.80
84		1.70	1.80	1.80		1.70	1.65	1.75
92	Sending station	1.75	1.80	1.85	Sending station	1.65	1.65	1.75
100		1.80	1.80	1.85		1.65	1.70	1.75
108		1.80	1.85	1.85		1.65	1.70	1.70
120		1.85	1.85	1.90		1.70	1.75	1.70
132		1.85	1.85	1.95		1.70	1.80	1.70
144		1.85	1.90	1.95		1.75	1.85	1.75
156		1.80	1.90	1.95		1.80	1.85	1.80
168		1.80	1.90	1.90		1.85	1.90	1.80
180		1.85	1.85	1.90		1.85	1.95	1.85
192		1.90	1.85	1.85		1.90	1.90	1.80
204		1.85	1.80	1.80		1.90	1.85	1.80
216		1.80	1.75	1.75		1.95	1.80	1.80
228		1.75	1.75	1.70		2.00	1.80	1.75
240		1.75	1.70	1.65		2.00	1.80	1.75
252		1.70	1.70	1.65		1.85	1.80	1.70
256		1.70	1.65	1.60		1.70	1.75	1.70
60 kHz line pilot	–13.2	–13.1	–13.1	–13.2	–13.2	–13.2	–13.3	–13.1
Additional measuring frequencies[1]	–	–	–	–	–	–	–	–
Equalizers	–	0	+1	0	–	+1	+1	+1
Temperature or resistance . .	–	391 Ω	221 Ω	+4.7°C	–	+4.5°C	226 Ω	392 Ω

[1] Indicate frequencies of these pilots.

References

[1] CCITT Recommendation *Control stations*, Vol. IV, Fascicle IV.1, Rec. M.80.

[2] CCITT Recommendation *Sub-control stations*, Vol. IV, Fascicle IV.1, Rec. M.90.

[3] CCITT Recommendation *Interconnection of systems in a main repeater station*, Vol. III, Fascicle III.2, Rec. G.213.

[4] CCIR Recommendation *Interconnection at baseband frequencies of radio-relay systems for telephony using frequency-division multiplex* , Vol. IX, Rec. 380-3, Annex I, ITU, Geneva, 1978.

[5] CCIR Recommendation *Interconnection at baseband frequencies of radio-relay systems for telephony using frequency-division multiplex*, Vol. IX, Rec. 380-3, ITU, Geneva, 1978.

[6] CCITT Recommendation *18-MHz systems on standardized 2.6/9.5-mm coaxial cable pairs*, Vol. III, Fascicle III.2, Rec. G.334.

[7] CCITT Recommendation *Interconnection at the baseband frequencies of frequency-division multiplex radio-relay systems*, Vol. III, Fascicle III.2, Rec. G.423.

[8] CCITT Recommendation *Measurement of circuit noise in cable systems using a uniform-spectrum random noise loading*, Vol. III, Fascicle III.2, Rec. G.228.

[9] CCITT Recommendation *FDM carrier systems for submarine cable*, Vol. III, Fascicle III.2, Rec. G.371.

[10] CCIR Recommendation *Measurement of noise using a continuous uniform spectrum signal on frequency-division multiplex telephony radio-relay systems*, Vol. IX, Rec. 399-3, ITU, Geneva, 1978.

[11] CCIR Recommendation *Measurements of noise in actual traffic over radio-relay systems for telephony using frequency-division multiplex*, Vol. IX, Rec. 398-3, ITU, Geneva, 1978.

Recommendation M.460

BRINGING INTERNATIONAL GROUP, SUPERGROUP, ETC., LINKS INTO SERVICE

1 Preliminary exchange of information

The technical services concerned nominate the control and sub-control stations for the link to be brought into operation in accordance with Recommendations M.80 [1] and M.90 [2].

The technical services should indicate the routing to be followed and the method given in Recommendation M.570 [3] may be applied. In the case of group or supergroup links, they will mutually agree on the pilot or pilots to be used.

In determining the routing of group links, in order to avoid interference between the pilots on two supergroup links, the technical services will try to arrange that position No. 3 is not occupied by the same group link on two supergroup links. (Where this is impossible, the supergroup pilot should be blocked at the through-group connection point.)

Information necessary for the control station, which will be entered on a *routing form* [see specimens in Appendix I (supergroup routing form) and Appendix III (A or B) (group routing form) of this Recommendation] is indicated below:

- routing of the link,
- names of control and sub-control stations,
- through-connection points,
- points where regulators are fitted.

The overall routing form for the entire link is drawn up by the control station on the basis of information furnished by its technical service and by each sub-control station for the sections for which the latter is responsible.

2 Frequencies and levels of group, supergroup, etc., pilots

2.1 Details of the recommended frequency and level of pilots are given in Table 1/M.460.

The specifications of terminal equipments provide that for every group or supergroup two pilots can be simultaneously transmitted. However, the normal case is that only one is being transmitted.

Note – Special considerations apply to the use of group and supergroup pilots if circuits are to be provided using Signalling System R2. Group and supergroup pilots placed at 140 Hz from a virtual carrier frequency are incompatible with signalling at 3825 Hz. Hence, the pilot at 84 140 kHz should not be applied to groups in which channel 6 is to be operated with this out-of-band signalling. Similarly, the pilot on 411 860 kHz should not be applied to supergroups in which channel 1 of the group in the group 3 position is to be operated with signalling at 3825 Hz.

TABLE 1/M.460

Group, supergroup and mastergroup pilots for	Frequency (kHz)		Power level[a)]
	8 ch. and 12 ch.	16 ch.	dBm0
Basic group (60-108 kHz)	84.080 84.140 104.080	84[b)]	−20 −25 −20
Basic supergroup	411.860 411.920 547.920	444[c)]	−25 −20 −20
Basic mastergroup.	1552		−20
Basic supermastergroup	11096		−20
Basic 15 supergroup assembly	1552		−20

a) To avoid errors in interpreting measurement results, the results of measurements on pilots will be stated in terms of the departure from the nominal pilot level in dBm at that particular point.
b) A pilot of 84 kHz is normally used. A different frequency can be used by agreement between Administrations.
c) A pilot of 444 kHz with a power level of —20 dBm0 is used.

2.2 *Level tolerances for transmitted pilots*

2.2.1 At the point where a pilot is injected, its level should be so adjusted that its measured value is within ± 0.1 dB of its nominal value. The measuring equipment used for making this measurement must give an accuracy of of at least ± 0.1 dB.

2.2.2 The change in output level of the pilot generator with time (which is a factor included in equipment specifications) must not exceed ± 0.3 dB.

2.2.3 The total maximum variation resulting from §§ 2.2.1 and 2.2.2 above will be ± 0.5 dB. It is advisable to have a device to give an alarm when the variation at the generator output exceeds these limits, the zero of the warning device being aligned as accurately as possible with the lining-up level of the transmitted pilot.

2.3 *Frequency tolerances for transmitted pilots*

The permissible frequency tolerances for transmitted pilots are as follows:

– 84 kHz and 444 kHz (if used as reference pilots for 16-channel systems) . . . . ± 1 Hz
– 84.080-kHz and 411.920-kHz pilots . . . . ± 1 Hz
– 84.140-kHz and 411.860-kHz pilots . . . . ± 3 Hz
– 104.080-kHz and 547.920-kHz pilots . . . . ± 1 Hz
– 1552-kHz pilot . . . . ± 2 Hz
– 11 096-kHz pilot . . . . ± 10 Hz

3 Frequencies and levels of test signals

Reference measurements for a link and its component sections are made at some or all of the following frequencies:

- supermastergroup link:

  8516, 9008, 11 096, 11 648, 12 388 kHz;

- 15 supergroup assembly link:

  312, 556, 808, 1056, 1304, 1552, 2048, 2544, 3040, 3536, 4028 kHz;

- mastergroup link:

  814, 1056, 1304, 1550, 1800, 2042 kHz;

- supergroup link (4-kHz channels):

  313, 317, 333, 381, 412, 429, 477, 525, 545, 549 kHz;

- supergroup link (3-kHz channels or 3 + 4-kHz channels):

  312.1, 313, 317, 333, 381, 412, 429, 477, 525, 545, 549, 551.9 kHz;

- group link (4-kHz channels):

  61, 63, 71, 79, 84, 87, 95, 103, 107 kHz [1];

- group link (3-kHz channels):

  60.1, 60.6, 61, 63, 71, 79, 84, 87, 95, 103, 107, 107.3, 107.9 kHz [1].

Administrations may also make measurements at other frequencies as considered necessary. In the case of group and supergroup links of simple constitution, three measuring frequencies (midband and at the two edges) may suffice.

The overall loss will be measured by means of a test frequency being equal or very close to the reference pilot frequency.

The level of the test signal to be used for the measurements will be −10 dBm0 [2].

4 Reference measurements for a link

The measurements described in § 7.2 below for lining-up also constitute reference measurements. These data should be recorded at every group, supergroup, etc. sub-control station and in the through-connection stations adjacent to frontiers and, on request, forwarded to the control station which then can draw up a *line-up record.*

5 Some features of a multiple destination unidirectional transmission link as might be provided by a communication-satellite system

This section refers to Figure 1/M.460, which is drawn in terms of a supergroup. An analogous arrangement can occur for groups or, in principle, for higher-order assemblies. There is no loss of generality in describing the arrangement of a supergroup.

5.1 In the example the supergroup is assembled in London and portions of it appear in three other places. Hence the designatory letter M standing for **MULTIPLE DESTINATION**.

5.2 In the return directions of transmission for any or all of the groups in this supergroup, the transmission path may be quite different and will not necessarily bear any relationship to the direction illustrated. Hence the designatory letter U standing for **UNIDIRECTIONAL**.

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1) If the group-measuring frequencies are generated by applying 800 Hz to the input of channel modulating equipment, special precautions will have to be taken at the receiving end to prevent carrier leak from affecting the readings of the measuring equipment. In these circumstances, the measuring device must be of the selective kind.

2) A level of 0 dBm0 may be used by agreement between the Administrations concerned.

5.3 The supergroup may be set up initially with only some of the destinations, for example, Montreal may be connected some time, say a year or so, after Bogota and Lusaka.

Furthermore, a destination may alter the amount of bandwidth it exploits, e.g. Bogota may initially derive Groups 1 and 2, Group 5 being derived some time later.

5.4 The portions of the supergroup defined by the stations 1-2-3, 4-5-6, and 8-9 are supergroup sections which are to be treated in the way described in the following paragraphs of this Recommendation.

5.5 The routings connecting stations 3, 4, 7 and 8 to their corresponding earth stations A, B, C and D can be markedly dissimilar. For example, the routing to control station 4 from earth station B need not resemble in any way the analogous routing from earth station D to control station 8. Control station 4 may be at the earth station, that is, the *distance* between B and 4 is zero whereas the *distance* between D and 8 may be several hundreds of miles perhaps and may be routed over a variety of coaxial line or radio-relay systems.

5.6 The portion 1-2-3 is referred to as a common path. Operations on the common path can affect all destinations whereas operations on the other paths (4-5-6 and 8-9) can affect only one destination.

5.7 Station 3 is likely to have a community of interest with each of stations 4, 7 and 8. This is not necessarily so likely among 4, 7 and 8 themselves.

5.8 The stations 4, 7 and 8 each receive the whole of the basic supergroup band from station 3 though none of them exploits the whole of it.

The above-mentioned distinctive features of a multiple destination unidirectional group, supergroup, etc. (such as might be provided by a communication-satellite system) make special procedures for lining-up and maintenance a necessity. This fact is taken into account below.

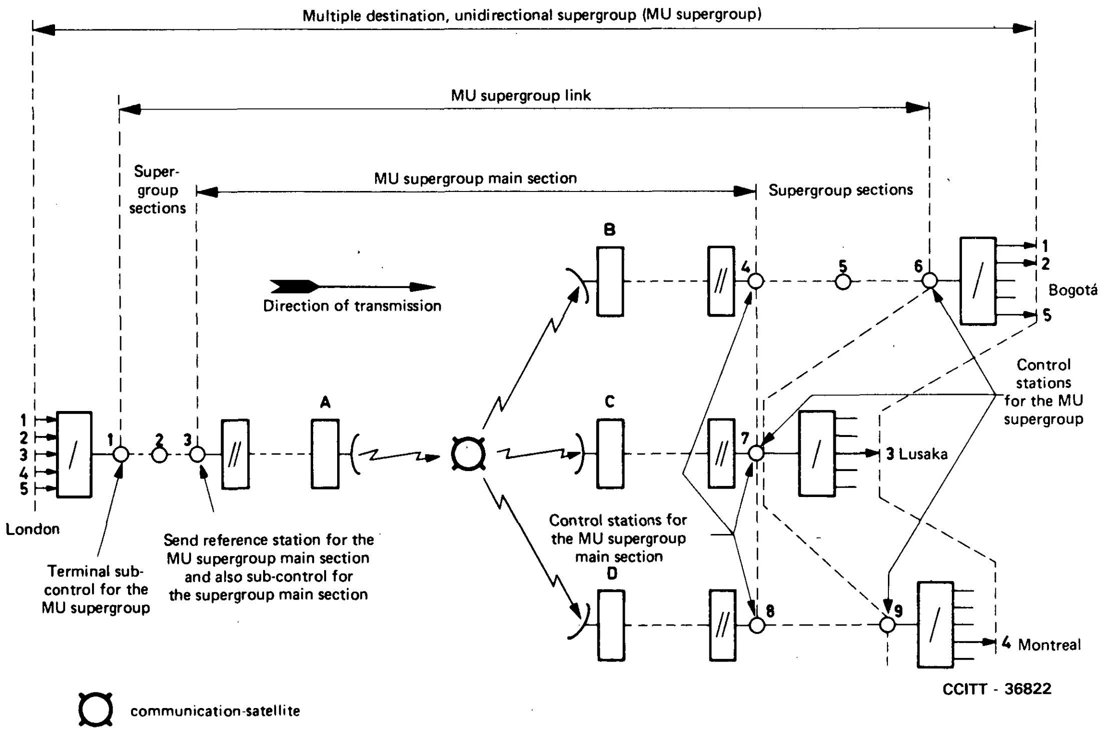

FIGURE 1/M.460

Arrangements for a multiple-destination, unidirectional supergroup (MU supergroup)

6 Organization of the control of an international group, supergroup, etc.

6.1 *Classes of station*

6.1.1 As far as international cooperation is concerned, only two classes of through-connection stations need be designated by any country:

a) stations which exercise control functions, i.e. group, supergroup, etc., control stations and group, supergroup, etc., sub-control stations;

b) attended stations nearest the frontier, which in this Recommendation are referred to as *frontier stations.*

6.1.2 In accordance with Recommendations M.80 [1] and M.90 [2] the station at each end of the group, supergroup, etc., is the *control station* for the receiving direction of transmission and the terminal *sub-control station* for the sending direction. Stations having control functions in intermediate countries are *group, supergroup, etc., intermediate sub-control stations.* Other stations involved in international maintenance are frontier stations.

6.1.3 In general, a transit country will have one station with control functions or one with sub-control functions and two frontier stations. A country in which the group, supergroup, etc., terminates has only one frontier station. In some countries, a station with control functions or sub-control functions and a frontier station will be the same.

6.2 *Classes of group, supergroup, etc. section*

For the purposes of setting-up, lining-up and subsequent maintenance, an international group, supergroup, etc., link is subdivided into national sections, international sections and main sections as defined in Recommendation M.300.

These terms are illustrated in Figure 2/M.460.

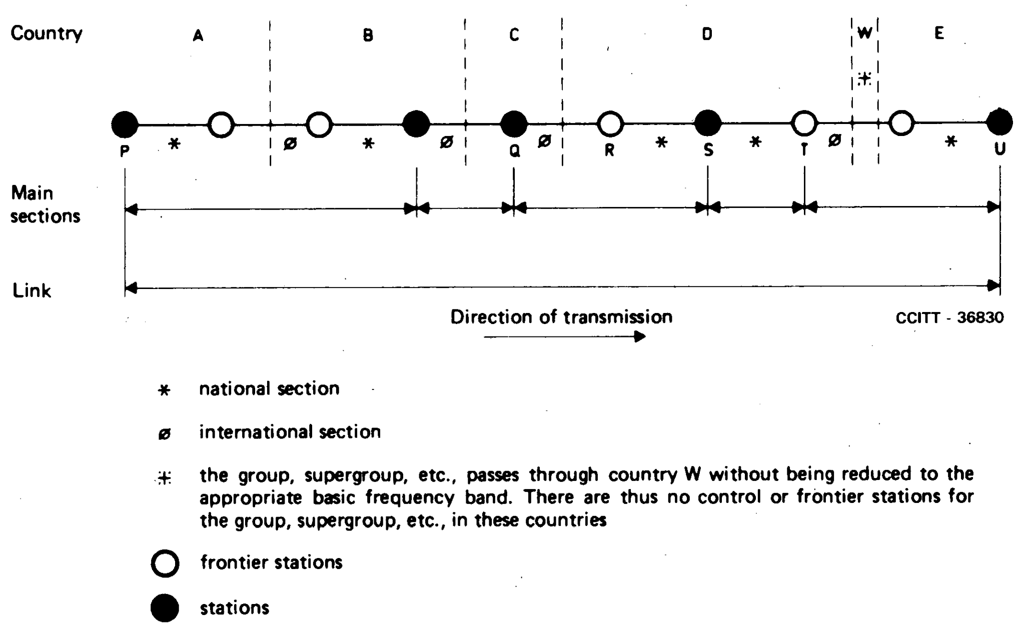

FIGURE 2/M.460

Example of an international link showing how it may be divided into sections of control for lining-up and maintenance

6.3 *Organization of control functions*

The terminal stations of each national, international and main section will be appointed as a control or sub-control station for that class of section with which they are concerned. However, as a consequence of the definitions of national, international and main sections of a link some stations will be nominated for more than one control or sub-control function. For example, station S in Figure 2/M.460 is:

- control station for main section Q-S,
- sub-control station for main section S-T,
- control station for national section R-S.

6.4 *Control functions in case of multiple destination (MU) transmission links*

The multiple destination unidirectional section defined by the through-connection stations nearest to the earth stations is to be a main section. The full designation is: *multiple destination unidirectional main group, supergroup, etc., section.*

In the example (Figure 1/M.460), stations 3, 4, 7 and 8 serve to define this main section.

The through-connection stations defining the extent of the MU main section will be assigned the control functions normally called for in the case of group, supergroup, etc. sections.

It follows that if the group, supergroup, etc., appears in the earth station at the basic group, supergroup, etc., frequencies, the earth station must function as a main section control or sub-control station for the multiple destination unidirectional section.

A very clear distinction must be made between:

- satellite control stations that might be concerned with baseband-to-baseband response (for example),
- group, supergroup, etc., control stations concerned with the performance of the group, supergroup, etc. (These are places where the bands 60 - 108, 312 - 552 kHz, etc., are normally accessible.) Such control stations are not called *satellite* stations because group, supergroup, etc., control functions are independent of the means of transmission.

In addition:

- the sub-control station for the MU main group, supergroup, etc., section is designated the *send reference station* for the MU main group, supergroup, etc., section (in the example, station 3 is so designated).

Again the distinction must be maintained between any coordination stations nominated for the satellite system (concerned with baseband, etc., matters) and MU main group, supergroup, etc., section reference stations. If stations 3, 4, 7 and 8 are physically in earth stations A, B, C and D respectively, then those earth stations will also have to function as the MU main section reference stations in addition to other responsibilities associated with coordination functions of the satellite system.

In addition to the responsibilities conferred on the send reference station by Recommendations M.80 [1], M.90 [2] and this Recommendation, the following responsibilities also apply:

a) coordinating the lining-up of the MU main section;

b) cooperating with MU main section control stations during the lining-up of the section;

c) keeping a record of the measurements made at MU section control stations during the lining-up of the section;

d) coordinating maintenance action for the MU main section when called upon to do so by one of the MU main section control stations.

7 **Setting up and lining up an international group, supergroup, etc., link**

7.1 *Setting up the link*

7.1.1 Once the route has been agreed, the supermastergroup, mastergroup, supergroup or group link control station will direct the operations needed to set up the link.

All the repeater stations concerned – i.e. the stations at the ends of each supermastergroup, mastergroup, supergroup, or group section that will make up the link – should make setting-up tests and check the equipment to be used, such as the through supermastergroup, mastergroup, supergroup, and group filters, etc. The check should include a general visual inspection and vibration tests, particularly if the equipment has remained unused for some time since acceptance tests were carried out after installation.

7.1.2 Each country sets up the national part within its territory, each international supermastergroup, mastergroup, supergroup or group section is set up by the stations at the ends of this section in the two countries concerned (which are the supermastergoup, mastergroup, supergroup or group through-connection stations closest to the frontier) and these national and international supermastergroup, mastergroup, supergroup or group sections are interconnected by through-supermastergroup, through-mastergroup, through-supergroup or through-group filters, as may be appropriate. The sub-control stations inform the control station when each interconnection is completed.

7.2 *Lining up the link*

7.2.1 The lining-up procedure for an international group, supergroup, etc., link is based on the progressive line-up of its component sections as follows. The limits to apply are given in Table 2/M.460.

i) National and international sections, which are then interconnected to form main sections.

ii) Main sections. When there are three or more main sections, the line-up is made in two or more stages. The first two main sections are connected together and lined up to main section standards, the third main section is added and this part of the link lined up, and so on.

iii) Overall link

   a) Comprising two main sections. The two main sections are connected together and the link lined up to the standards given in Table 2/M.460.

   b) Comprising three and more main sections. Lining-up is in two or more stages. The first two main sections are connected together and lined up to main section standards. The third main section is added and the complete link lined up. With more than three main sections the overall link is lined up accordingly in more than two stages.

The frequencies and levels of the pilots and testing signals are given in §§ 2.1 and 3 above.

Note – Where circuits using Signalling System R2 are to be provided, additional measurements on group and supergroup links may be necessary. The group-translating and through-connection equipments are specified with a passband extending from 60.600 kHz to 107.700 kHz. If it is wished to use channel 12 with signalling at 3825 Hz, it is necessary to ensure when the group is set up, that the corresponding frequency (60.175 kHz) is transmitted satisfactorily from end to end of the group link.

Provisionally, in view of the operating margin of the receiving part of the signalling equipment, it is desirable to check that the attenuation at this frequency does not exceed the attenuation at the group-pilot frequency by more than 3 dB.

A similar precaution should be taken on setting up group links when signalling is to be used at 3825 Hz on channel 12 of the group transmitted in position 5 of the supergroup.

7.2.2 In addition to the measurements specified in § 7.2.1 above, the levels of unwanted signals and random noise at the receive end of group and supergroup links may also be checked. Such additional measurements are optional, and need only be carried out at the discretion of Administrations. the following (provisional) limits should apply for group and supergroup links:

7.2.2.1 *Unwanted signals*

The levels of unwanted signals should not exceed the following values:

a) –40 dBm0 (provisional), where such signals originate from carrier or pilot generating equipment;

b) –60 dBm0 (provisional), where such signals originate from other sources.

The measured levels of any unwanted signals, and their location in the group or supergroup frequency band, should be recorded for subsequent maintenance purposes.

TABLE 2/M.460

Line-up limits

	Loss at reference or pilot frequency as appropriate		Loss/frequency response relative to loss at reference or pilot frequency		Remarks
	Groups (dB)	Supergroups etc. (dB)	Groups (dB)	Supergroups (db)	
1. National and international sections					
a) Sections which are not main sections	± 0.5	± 0.5	± 1	± 1.5	
b) Main sections	± 0.1	± 0.1	± 1	± 1.5	
2. Main sections	± 0.1	± 0.1	± 1	± 1.5	A main section equalizer, whether terminal or intermediate, is not considered to be part of a national or international section.
3. Link	± 0.1	± 0.1	± 1.5	± 2.0	A link equalizer is not considered to be part of a main section.

7.2.2.2 *Random noise*

Random noise should be measured using an instrument with an effective noise bandwidth of 3.1 kHz taking into account the correction factor for weighting which is 2.5 dB or using an instrument with an effective bandwidth of 1.73 kHz. (See Recommendation G.223 [4].)

The provisional limits in Table 3/M.460 apply.

TABLE 3/M.460

Limits (provisional) for random noise on group and supergroup links

Distance in kilometres	⩽ 320	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5 001 to 10 000	10 001 to 20 000
Noise (dBm0p)	—56	—54	—52	—50	—47	—44	—41

It should be noted that the measured level of random noise will be influenced by unwanted signals in the group or supergroup frequency band. This must be taken into account when considering the results of random noise measurements.

7.3 *Lining up an MU main section for the first time*

The MU main section will first be lined up between the send reference station and the initial MU main section control station using the procedure and limits given above. The whole of the band should be brought to within the appropriate limits even if the destination concerned is not exploiting the whole band. This is to ensure that the various pilots and other measuring signals that can be inserted (for example, intersupergroup measuring signals) are received at the correct levels, and can be measured at the receive station to provide valid reference measurement results for use in maintenance. There are other obvious advantages if this could be done. Unforeseen increases in exploitation or rearrangement of the allocated bandwidth (permanent or emergency) would be eased if the whole band were equalized. Such matters the Administration concerned must decide.

The sections to the other MU main section control stations (associated with the paths to the other destinations) should now be lined up in accordance with the procedures given above.

7.4 *Lining up (or other maintenance operations) on the common path of an MU group, supergroup, etc., when portions of its bandwidth are already in service*

Operations on the exclusive path to a particular destination, made by an intermediate station, need the consent of only one control station. However, operations on the common path would, in principle, require the consent of several remote control stations.

In consequence, the following recommendations are made:

7.4.1 Control and sub-control stations on the common path should be equipped with decoupled testing points (see [5]). It is recommended that these decoupled testing points be test hybrids because, as explained in [5], there is no need to break the transmission path and make terminated-level measurements if test hybrids are used and, furthermore, test signals may be inserted via a test hybrid.

7.4.2 The only signals that may be inserted and measured are:

- pilot signals;
- additional measuring signals (e.g. intersupergroup measuring signals);
- test signals at frequencies lying within the portion of the band concerned (for example, referring to Figure 1/M.460 if Group 4 to Montreal is to be lined up (all others being in service) then stations 1 or 3 may be required to inject signals only at frequencies lying in the band 456 - 504 kHz).

7.4.3 On the MU main section the record of the response of the portion of bandwidth concerned held by the send reference station can be used to see if any significant difference exists between what was originally achieved on the portion between the send and receive stations.

7.5 *Records*

For each class of section, terminal receiving stations will make terminated-level measurements and sending and intermediate stations will make through-level measurements.

The measurements made at each station should be recorded for reference purposes and be made available to the appropriate control stations as required.

7.6 *Connecting the group, supergroup, etc., reference pilot*

Control stations, sub-control stations and frontier stations may be equipped with reference pilot monitors fitted with limit alarms. In addition, there may be automatic devices at these stations in accordance with Recommendation M.160 [6]. Pilot monitors should be provided at the input to the automatic regulator.

The settings of such pilot monitors and automatic regulators at different stations are interdependent and the devices must be set up successively.

7.6.1 The sending terminal station should connect the reference pilot at a level that is within ± 0.1 dB of the nominal value. (This sometimes requires an appropriate translating equipment to be connected at this stage.)

7.6.2 The frontier stations and the control station of the first main section should be successively asked to check the level of the reference pilot and, where appropriate, to adjust any pilot monitors, automatic regulators or other devices associated with the link.

a) The level at the frontier stations and at the main section control station should be checked to verify that there is nothing obviously wrong. (In general, small variations in level are to be expected and no limits can be given. Automatic regulation devices are installed to compensate for these small changes, which must therefore be accepted.)

b) The pilot monitors should be adjusted so that they subsequently indicate departures from the line-up value, that is to say, they should be adjusted to indicate 0 dB under line-up conditions. Stations not equipped with pilot monitors should measure and record the level of the group reference pilot.

c) At stations where automatic regulation devices are fitted they should be arranged to operate symmetrically about the line-up level. At main section control stations they should be adjusted, where appropriate, so that the output level of the reference pilot is within ± 0.1 dB of the nominal value of the reference pilot level.

7.6.3 When the first main section has been dealt with, the first main section control station should inform the control station of the second main section, which should then follow the procedure of § 7.6.2, a)-c) above, the sending terminal station leaving the reference pilot connected.

7.6.4 When the second main section has been dealt with, the second main section control station should inform the control station of the third main section, which again follows the procedure of § 7.6.2 a)-c) above, and so on until the whole of the link has been lined up.

In the case of MU links the appropriate reference pilot should be connected by the MU terminal sub-control station after the sections in the common path have been successively adjusted in accordance with 7.2 and 7.3 above. Then, the MU main section control stations should make any necessary adjustments to pilot receivers or automatic regulators. The reference pilot signals now appearing on the remaining section on each of the paths to the various destinations are adjusted as stated above.

8 Reliability tests on the link

When the initial overall lining-up measurements have been made on a link, and the automatic regulators (if any) have been installed, it is desirable to check the working of the link before putting it into service by testing it over a period of a few hours, if practicable. If the observed results are not satisfactory, taking into account the routing of the link and the services involved, the check should be continued to allow the trouble to be investigated and cleared. The checking is done using the pilot (or, if there is none, using a test frequency at about the same frequency), whose level is continuously recorded during the test, at the far end of the link. The recording devices should be able to record short interruptions in addition to recording the level.

9 Setting up lower order sections after line-up of the higher order links

The different orders of sections have to be set up in sequence.

9.1 Thus, when a supermastergroup link, mastergroup link or supergroup link has been lined up, each end of it is connected to the appropriate translating equipment (supermastergroup link to mastergroup translating equipment, mastergroup link to supergroup translating equipment, and supergroup link to group translating equipment) and the corresponding lower-order sections are then set up.

9.2 The translating equipment, before it is connected to the ends of the link, must be checked and adjusted to ensure that it meets CCITT Recommendations and other relevant specifications.

9.3 When the lower-order sections have been set up in the above manner, they are interconnected as necessary to form links, as described in § 7.1 above, and the appropriate link line-up procedure as detailed in §§ 7.2 to 7.4 above, is then applied.

10 Setting up and lining up links for wide-spectrum transmission (data, facsimile, etc.)

When the whole bandwidth of a group, supergroup, etc., link is used for wide-spectrum transmission (data, facsimile, etc.) the transmission characteristics are those of the relevant Recommendations of Volume III and IV of the *CCITT Book*. In particular, Recommendations H.14 [7], M.900 [8] and M.910 [9] concern such group links.

APPENDIX I
(to Recommendation M.460)

Routing form[1] for a supergroup

1.	Date of issue	1 December 1978
2.	Technical service of	United Kingdom
3.	Supergroup designation	Bruxelles (1) - London (Stag Lane) 6011
4.	Length	446 km
5.a)	Control stations for supergroup	London (Stag Lane), Bruxelles (1)
5.b) i)	Sub-control stations in the direction London to Bruxelles	London (Stag Lane), Broadstairs, Oostende
5.b) ii)	Sub-control stations in the direction Bruxelles to London	Bruxelles (1), Oostende, Broadstairs
6.	Stations where automatic regulators are fitted	London (Stag Lane)
7.	Supergroup pilot frequency(ies)	411.92 kHz

Stations and designation of cable[2]	Length of section (km)	Section in cable				Section on radio link		Nominal levels at supergroup measuring points dBr		Remarks[3]
		Symmetrical pair sections		Coaxial pair sections						
		Pair number	Position of supergroup	Number of coaxial system	Position of supergroup	Designation of radio link	Position of supergroup	↓	↑	
A	B	C	D	E	F	G	H	J	K	L
London (Stag Lane)								—35	—30	
	193			1002	6					Coaxial pair
Broadstairs								—35	—30	
	119									Submarine cable
Oostende								—35	—30	
	134			30002	4					Coaxial pair
Bruxelles (1)								—30	—35	

[1] A diagram can be associated in complicated cases.
[2] Underline through-supergroup points.
[3] Mention any special types of carrier system, e.g. submarine cable system. In such cases state the frequency band for the two directions of transmission. Show type of through-supergroup equipment and supplementary information if necessary.

APPENDIX II
(to Recommendation M.460)

Line-up record for a supergroup link

Date of issue	1 December 1978
Technical service of	United Kingdom
Supergroup designation	Bruxelles (1) - London (Stag Lane) 6011
Length	446 km
Control station	Bruxelles (1)
Sub-control stations	Broadstairs, Oostende, London (Stag Lane)
Date of measurements	November 1978
Direction	London-Bruxelles

Distance (km)	Stations	Relative levels[1], dB									Pilot A[1]	Pilot B[1]	Meas-uring point	Meas-uring equip-ment[2]	Nominal relative level at meas-uring point dBr	Impe-dance at meas-uring point (ohms)	Re-marks[3]
		Test frequencies kHz															
		313	317	333	381	429	477	525	545	549							
	London (Stag Lane)	0	0	0	0	0	0	0	0	0	0		HF Test and fatch frame	NS	—35	75	
193																	
	Broadstairs	−0.1	−0.1	−0.1	0	0	0	0	−0.1	−0.1	0		HF Test and fatch frame	NS	—35	75	
119																	
	Oostende	−0.3	−0.1	−0.1	0	0	0	0	−0.2	−0.2	0		SDF	S	—35	75	
134																	
	Bruxelles (1)	−0.4	−0.2	−0.1	0	0	0	0	−0.2	−0.4	0		SDF	S	—30	75	

Frequency (kHz) of supergroup reference pilot: 411.920 kHz.
Absolute power level dBm (referred to 1 mW) of supergroup reference pilot at a zero relative level point: —20 dBm0.

[1] Show in these columns the differences relative to the nominal values.
[2] State if the equipment is selective (S) or not (NS).
[3] Indicate the presence of supergroup automatic gain control (AGC).
SDF: Supergroup distribution frame.

APPENDIX III (A)
(to Recommendation M.460)

EXAMPLE FOR A SIMPLE GROUP

Routing form[1] for a group

1.	Date of issue	1 June 1979
2.	Technical service of	United Kingdom
3.	Group designation	London (Faraday) - Amsterdam (1) 1203
4.	Length	516.5 km
5.a)	Control stations for group	London (Faraday), Amsterdam (1)
5.b) i)	Sub-control stations in the direction London to Amsterdam	London (Faraday), Aldeburgh, Goes
5.b) ii)	Sub-control stations in the direction Amsterdam to London	Amsterdam (1), Goes, Aldeburgh
6.	Stations where automatic regulators are fitted	London (Faraday), Amsterdam (1)
7.	Group pilot frequency(ies)	84.080 kHz

Stations and designation of cable[2]	Length of section (km)	Group sections[3]		Supergroup sections[4]		Nominal levels at through-group points dBr		Remarks[5]
		Pair numbers	Position (A B C D E) of group	Super-group number	Position of the supergroup followed by the position of the group in the supergroup	↓	↑	
A	B	C	D	E	F	G	H	J
London (Faraday)						—37	— 8	
	152			6001	14/3			Coaxial pair
Aldeburgh						—37	— 8	
	153							Submarine cable
Domburg								
	39			6001	3/5			
Goes						—30	—30	
	164.5			6004	4/3			Microwave
Amsterdam (2)						—37	—30	
	8			6024	2/2			Coaxial pair
Amsterdam (1)						—30	—37	

[1] A diagram can be associated in complicated cases.
[2] Underline the through-group points.
[3] Sections in cable, open-wire or radio link not providing a supergroup.
[4] Sections in cable or radio links with at least one supergroup.
[5] Mention the type of carrier system: 12, 24..., 12 + 12... channels and if not underground cable, state: open-wire, radio link, submarine cable. In such cases give the frequency bands for the two directions of transmission. Show the type of through-group equipment.

APPENDIX III (B)
(to Recommendation M.460)

EXAMPLE OF A COMPLICATED GROUP

Routing form* for a group

1.	Date of issue	July 1979
2.	Technical service of	United Kingdom
3.	Group designation	London (Stag Lane) - Sydney (Broadway) 1214
4.	Length	12606 km + satellite section
5.a)	Control stations for group	London (Stag Lane), Sydney (Broadway)
5.b) i)	Sub-control stations in the direction London to Sydney	London (Stag Lane), Beaver Harbour, Montreal, Vancouver, Lake Cowichan, Moree
5.b) ii)	Sub-control stations in the direction Sydney to London	Sydney (Broadway), Moree, Lake Cowichan, Vancouver, Montreal, Beaver Harbour
6.	Stations where automatic regulators are fitted	London (Stag Lane), Sydney (Broadway)
7.	Group pilot frequency(ies)	104.08 kHz

Stations and constitutions[1,4]	Length of section (km)	Group sections[2]		Supergroup sections[3]		Nominal levels at through-group points dBr		Remarks[4]
		Pair numbers	Position of group	Super-group number	Position of the supergroup followed by the position of the group in the supergroup	↓	↑	
A	B	C	D	E	F	G	H	J
London (Stag Lane)						—37	— 8	
	317				8/2			Coaxial pair
Widemouth Bay						—37	— 8	
	5180			6008	20/2			Submarine cable (CANTAT 2)
Beaver Harbour						—37	—37	
	1931			6006	12/5			Microwave
Montreal						—37	—37	
	4431			6004	3/5			Microwave
Vancouver						—37	—37	
	97			6004	4/5			Microwave
Lake Cowichan						—37	—37	
	(satellite)			6001	4/4			Satellite (Pacific Ocean)
Moree						—30.5	—36.5	
	650			6010	10/4			Coaxial pair
Sydney (Broadway)						—30.5	—36.5	

* A diagram can be associated in complicated cases.

[1] Underline the through-group points.

[2] Sections in cable, open-wire or radio link not providing a supergroup.

[3] Sections in cable or radio links with at least one supergroup.

[4] Mention the type of carrier system: 12, 24..., 12 + 12... channels and if not underground cable, state: open-wire, radio link, submarine cable. In such cases give the frequency bands for the two directions of transmission. Show the type of through-group equipment.

APPENDIX IV (A)
(to Recommendation M.460)

EXAMPLE FOR A SIMPLE GROUP LINK

Line-up record for a group link

Date of issue	1 June 1979
Technical service of	United Kingdom
Group designation	Amsterdam (1) - London (Faraday) 1203
Length	516.5 km
Control station	Amsterdam (1)
Sub-control stations	Goes, Aldeburgh, London (Faraday)
Date of measurement	14 January 1979
Direction	London - Amsterdam

Distance (km)	Stations	Relative levels[1] dB											
		Test frequencies in kHz (4 kHz spacing)											
		61	63	71	79	84	87	95	103	107			
	London (Faraday)	0	0	0	0	0	0	0	0	0			
152													
	Aldeburgh	+0.3	+0.7	+0.7	+0.3	+0.3	+0.5	+0.4	+0.7	+0.9			
192													
	Goes	—0.8	—0.2	0	0	0	0	0	—0.1	+0.2			
172.5													
	Amsterdam (1)	—1.5	—0.3	—0.2	—0.2	0	—0.15	—0.05	—0.45	0			

Distance (km)	Stations	Pilot A[1] dB	Measuring point	Measuring equipment[2]	Nominal relative level at measuring point dBr	Impedance at measuring point (ohms)	Remarks[3]
	London (Faraday)	0	GDF	NS	—37	75	
152							
	Aldeburgh	+0.1	GDF	NS	—37	75	
192							
	Goes	0	GDF	S	—30	150	
172.5							
	Amsterdam (1)	0	GDF	S	—30	150	AGC

Frequency of group reference pilot in kHz: 84.080 kHz.
Absolute power level dBm (referred to 1 mW) of group reference pilot at a point of zero relative level: —20 dBm0.

[1] Show in these columns the differences relative to the nominal values.
[2] State if the equipment is selective (S) or not (NS).
[3] Indicate the presence of group automatic gain control (AGC).
GDF: Group distribution frame.

APPENDIX IV (B)
(to Recommendation M.460)

EXAMPLE FOR A COMPLICATED GROUP LINK

Line-up record for a group link

Date of issue	July 1979
Technical service of	United Kindom
Group designation	London (Stag Lane) - Sydney (Broadway) 1214
Group length	12606 km + satellite section
Control station	Sydney (Broadway)
Subcontrol stations	London (Stag Lane), Beaver Harbour, Montreal, Vancouver, Lake Cowichan, Moree
Date of measurement	18 July 1978
Direction	London - Sydney

Distance (km)	Stations	Relative levels[1] dB — Test frequencies in kHz								
		61	63	71	79	84	87	95	103	107
	London (Stag Lane)	0	0	0	0	0	0	0	0	0
7428	Montreal	—0.4	—0.7	—0.3	—0.15	—0.1	0	0	0	+0.2
4431	Vancouver	—0.7	—0.5	—0.3	—0.1	—0.1	—0.1	—0.1	0	0
747 + satellite	Sydney (Broadway)	—1.0	—1.0	—0.8	—0.7	—0.2	—0.5	—0.25	—0.1	—0.05

Distance (km)	Stations	104.08 kHz pilot[1]	Measuring point	Measuring equipment[2]	Nominal relative level at measuring point dBr	Impedance at measuring point (ohms)	Remarks[3]
	London (Stag Lane)	0	HF Test and Patch frame	NS	—37	75	
7428	Montreal	0	GDF	S	—37	75	
4431	Vancouver	0	GDF	S	—37	75	
747 + satellite	Sydney (Broadway)	0	Group control rack	S	—30.5	150	AGC

Absolute power level dBm (referred to 1 mW) of group reference pilot at a point of zero relative level: —20 dBm0.

[1] Show in these columns the difference relative to the nominal values.
[2] State if the equipment is selective (S) or not (NS).
[3] Indicate the presence of group automatic gain control (AGC).
GDF: Group distribution frame.

References

[1] CCITT Recommendation *Control stations*, Vol. IV, Fascicle IV.1, Rec. M.80.

[2] CCITT Recommendation *Sub-control stations*, Vol. IV, Fascicle IV.1, Rec. M.90.

[3] CCITT Recommendation *Constitution of the circuit; preliminary exchange of information*, Vol. IV, Fascicle IV.1, Rec. M.570.

[4] CCITT Recommendation *Assumptions for the calculation of noise on hypothetical reference circuits for telephony*, Vol. III, Fascicle III.2, Rec. G.223.

[5] *Measuring errors and differences due to impedance inaccuracies of instruments and apparatus. Use of decoupled measuring points*, Green Book, Vol. IV.2, Supplement No. 2.5, ITU, Geneva, 1973.

[6] CCITT Recommendation *Stability of transmission*, Vol. IV, Fascicle IV.1, Rec. M.160.

[7] CCITT Recommendation *Characteristics of group links for the transmission of wide-spectrum signals*, Vol. III, Fascicle III.4, Rec. H.14.

[8] CCITT Recommendation *Use of leased group and supergroup links for wide-spectrum signal transmission (data, facsimile, etc.)*, Vol. IV, Fascicle IV.2, Rec. M.900.

[9] CCITT Recommendation *Setting up and lining up an international leased group link for wide-spectrum signal transmission*, Vol. IV, Fascicle IV.2, Rec. M.910.

Recommendation M.470

SETTING UP AND LINING UP THE CHANNELS OF AN INTERNATIONAL GROUP

1 Check of channel-translating equipment

The translating equipment, before it is connected to the ends of the link, must be checked and adjusted to ensure that it meets CCITT Recommendations and the other relevant specifications. The check should include a general visual inspection and vibration tests, if applicable. This is of particular importance if the equipment has remained unused since acceptance tests were carried out after installation.

2 Setting up and lining up the channels

2.1 *Measurement and adjustment of levels*

After the group link has been set up, and the channel-translating equipment at each end of the group link has been connected and checked, the channels are adjusted as follows.

An 800 Hz [1)] test signal is sent over each channel in turn at a level of −10 dBm0. [2)] At the transmitting end, the channel-translating equipment is adjusted so that the sideband level on each channel at its output is as near to nominal as possible. At the receiving end, the channel-translating equipment should then be adjusted to bring the received level on each channel as near as possible to its nominal value.

2.2 *Checking the channel performance*

Channel performance measurements are only required when the need is indicated during circuit line-up. On such occasions the parameters to be checked will depend on the particular difficulty experienced during circuit line-up.

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1) For international circuits, 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements, since it is a fact that 1000 Hz is widely used for single-frequency measurements on international and intercontinental circuits.

Multi-frequency measurements made to determine the loss/frequency characteristic will include a measurement at 800 Hz, and therefore the reference frequency for such characteristics can still be 800 Hz.

Reference should be made to supplement No. 3.5 [1] concerning measuring frequencies to be used on circuits routed over PCM systems.

2) A level of 0 dBm0 may be used by agreement between the Administrations concerned.

3 Check level of line signalling

In the case of groups which are intended to be used for telephone circuits employing Signalling System R2, the checks of signalling level stipulated in the Specifications of Signalling System R2 should be made [2].

For other signalling systems, the check of signalling level should be carried out at the circuit line-up stage (see the Recommendation cited in [3]).

References

[1] *Test frequencies on circuits routed over PCM systems*, Supplement No. 3.5, Vol. IV, Fascicle IV.4.

[2] CCITT Recommendations *Specifications of Signalling System R2*, Vol. VI, Fascicle VI.4, Recs. Q.400 to Q.480.

[3] CCITT Recommendations *Setting up and lining up an international circuit for public telephony*, Vol. IV, Fascicle IV.1, Rec. M.580, § 8.

2.4 Routine maintenance of an international carrier system

Recommendation M.500

ROUTINE MAINTENANCE MEASUREMENTS TO BE MADE ON REGULATED LINE SECTIONS

1 Radio-relay regulated line section

Measurements should be made as indicated below:

1.1 *Regulated line section terminal stations:*

a) daily reading of the line pilot level if necessitated by the type of system. It is preferable that such measurements should always be made at the same time of day;

b) as necessary, readjustment to the nominal value as described in Recommendation M.510.

1.2 *Radio-systems terminals*

1.2.1 At intervals to be determined by agreement between the Administrations concerned, and based on experience of the reliability of the system:

- measurement of the loss/frequency distortion at frequencies in the baseband (additional measuring frequencies) (permissible limits ± 2 dB);
- when there is no continuous recording of noise, measurement of the total noise level on the noise-measurement channels outside the baseband in accordance with CCIR Recommendation No. 398-3 [1)] [1]. This measurement can be made without causing any interference in the transmission channel.

1.2.2 When the measurement mentioned in 1.2.1 above gives unacceptably high noise values, or more often, when the reliability of the system makes it desirable, check of the following measurements in accordance with the appropriate CCIR Recommendations for the radio-relay system concerned should be made, the radio-frequency channel being switched to the standby equipment, and the measurement results compared with the results of the reference measurements required by Recommendation M.450, § 3:

- the deviation of the frequency at which the level is unchanged by pre-emphasis;
- the pilot frequency deviation;
- the central position of the intermediate frequency in the non-modulated condition of the system;
- the level of the baseband reference frequency (single frequency check);
- the relative level at the radio reference measurement frequencies (multifrequency check);
- the level of individual interfering signals in the baseband in the nonmodulated condition of the system.

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1) Where a protection channel is provided, and if Administrations so desire, noise measurements may be made on that channel with artificial loading, in accordance with CCIR Recommendation 399-3 [2].

1.2.3 So as to enable the limits for circuit loss variation to be met (see Recommendation M.160 [3]), the difference in response between two systems in diversity reception or between a working and standby system should be minimized.

2 Coaxial regulated line section

The following measurements should be made at regulated line section terminal stations:

a) daily reading of the line pilot level if necessitated by the type of system. It is preferable that such measurements should always be made at the same time of day;

b) as necessary, readjustment to the nominal value as described in Recommendation M.510.

The Administrations concerned are left to decide for themselves about measurements at additional measuring frequencies and about checking the operation of the regulators.

Note – Precautions to be taken with additional measuring frequencies:

i) When the end of a regulated line section:

- is not the same as the end of a line link (i.e. when all the groups, supergroups, etc., are through-connected from one regulated line section to another without passing via the through-connection equipment to the basic groups);
- is the same as the end of a line link without complete demodulation to the groups, supergroups or mastergroups (i.e. when only part of the groups, supergroups, etc., are through-connected direct from one line link to another, without passing via the through-connection equipment to the basic groups);

the maintenance personnel should:

a) avoid sending a measuring frequency that is the same as a pilot frequency of a following regulated line section (unless the pilot frequency on such a following section is protected by a blocking filter at the beginning of the section);

b) take into account the possibility of attentuation to additional measuring frequencies lying at the edges of the frequency band of a through-connected basic group, supergroup, etc., due to the presence of through-connection filters.

ii) Interference between additional measuring frequencies on adjacent coaxial links is possible if precautions are not taken to avoid carrying out simultaneous measurements on adjacent links. For this reason:

a) there should be different dates for routine maintenance measurements on two adjacent links;

b) before making any measurement using an additional measuring frequency, and especially those made when clearing faults, repeater station staff should see to it that measurements are not in progress on an adjacent coaxial link.

3 Symmetric pair regulated line section

The following measurements should be made at regulated line section terminal stations:

a) daily reading of the line pilot level if necessitated by the type of system. It is preferable that such measurements should always be made at the same time of day;

b) as necessary, readjustment to the nominal value as described in Recommendation M.510.

The Administrations concerned are left to decide on measurements at additional measuring frequencies and on checking the operation of the regulators, if applicable. The same applies to any kind of measurement or pilot level reading at intermediate attended or unattended stations.

References

[1] CCIR Recommendation *Measurements of noise in actual traffic over radio-relay systems for telephony using frequency-division multiplex*, Vol. IX, Rec. 398-3, ITU, Geneva, 1978.

[2] CCIR Recommendation *Measurement of noise using a continuous uniform spectrum signal on frequency-division multiplex telephony radio-relay systems*, Vol. IX, Rec. 399-3, ITU, Geneva, 1978.

[3] CCITT Recommendation *Stability of transmission*, Vol. IV, Fascicle IV.1, Rec. M.160.

Recommendation M.510

READJUSTMENT TO THE NOMINAL VALUE OF A REGULATED LINE SECTION (ON A SYMMETRIC PAIR LINE, A COAXIAL LINE OR A RADIO-RELAY LINK)

After the routine measurement or clearance of the fault and when it has been ensured that no faults remain on the system, adjustments should be made as necessary to bring the levels of the line pilots and additional measuring frequencies as close as possible to their nominal value.

Making the whole adjustment in the receiving terminal station should be avoided; adjustments should be made where they are necessary, under the direction of the control or sub-control station concerned.

Methodical readjustment should be carried out when the level measured at the terminal station exceeds the maintenance limits for the carrier system. Due allowance should be made for measuring errors and for random effects which may cause slight short-term variation. The tolerance to be allowed depends on the type of system, its length and the periodicity of the measurements.

For example, the following tolerances may be allowed:

a) in the case of a system with continuous gain control an adjustment should be made only if an improvement of at least 0.3 dB can be obtained;

b) in the case of a system with step-by-step gain control allow a permissible tolerance of ± (one-half the gain control step ± 0.3 dB).

Recommendation M.520

ROUTINE MAINTENANCE ON INTERNATIONAL GROUP, SUPERGROUP, ETC., LINKS

1 Type of routine tests

Only measurements of the pilot level are made on international group, supergroup, etc. links. These do not involve other stations. Therefore, Administrations are free to decide on the methods and periodicities. In order to ensure that the performance limits of the links laid down in Recommendation M.160 [1] are met, the following tests are recommended for consideration.

2 Links without an automatic regulator

At control stations routine measurements should be made of the pilot level. The periodicity of these routines may be weekly or monthly depending on the complexity of the routing and constitution of the link.

3 Links with an automatic regulator

At control stations where a regulator is installed, the level at the input and output of the regulator, if these measurement points are provided by the equipment, may be measured every six months.

4 Continuous recording of pilot level

In addition to the above it is useful to be able to take continuous pilot-recordings as required to detect fault conditions which do not trigger the normal alarm systems.

Reference

[1] CCITT Recommendation *Stability of transmission*, Vol. IV, Fascicle IV.1, Rec. M.160.

READJUSTMENT TO THE NOMINAL VALUE OF AN INTERNATIONAL GROUP, SUPERGROUP, ETC., LINK

1 General

Before any adjustment is made to a link it must first be ensured that each regulated line section or higher-order link over which the link concerned is routed is correctly adjusted and that the level of the reference pilot at the transmitting end is correct. No readjustments will be made on the link except under the direction of the control station, after consideration of measurement results.

2 Links without a regulator

2.1 For links which use only one regulated line section, or one higher-order link, readjustment of levels to values as close as possible to their nominal value must be made systematically after any measurement or clearance of a fault. Any departure in excess of ± 2 dB from the original line-up at the time the link was first established must be investigated to ensure that there is no fault.

2.2 For links of more complex constitution, no readjustment need be made until the departure from the nominal value exceeds 0.5 dB (see the Note at the end of this Recommendation). When the departure from the nominal value exceeds these limits, adjustment to a value as near as possible to the nominal value should be carried out. Adjustment at the terminal station only is permissible within the limits of departure from the settings at the time of the previous reference measurements as a function of the distance to the origin of the link or to the nearest upstream automatic regulator, as given in Table 1/M.530.

TABLE 1/M.530

Distance to origin or regulator	Limit for departure from the settings noted for previous reference measurements beyond which the possibility of a fault should be investigated (see the note at the end of this Recommendation)
Up to 1000 km	± 2 dB
1000-2000 km.	± 3 dB
Above 2000 km	± 4 dB

If, for the distance concerned, adjustment at the terminal station would cause departures greater than those permitted by the table, measurements should be made at all through-connection points to find if a fault exists. If a fault exists, it should be located and cleared. If no fault exists, but the change is due to normal causes, e.g. temperature changes, aging, etc., adjustments should be made at each through-connection point to bring the level of the reference pilot as near as possible to its nominal value before making a final adjustment at the terminal station.

3 Links with a regulator

No readjustment need be made until the departure from the nominal value measured at the input to the regulator exceeds ± 4 dB. Any departure in excess of ± 4 dB from the nominal value measured at this point must be investigated.

Note – In determining the margins within which equipment should be readjusted, it has been found useful to distinguish three ranges about the nominal value into which the received level might fall:

– a relatively small range in which no action need be taken. This enables the staff to avoid waste of time in continually readjusting in order to compensate minor changes;

- a somewhat larger range in which the received level may be readjusted to as near the nominal value as possible by the terminal station, without having to ask intermediate stations to measure and/or readjust. (This is subject to the overriding proviso that the cumulative adjustment made at the terminal station must not exceed a certain amount relative to the settings noted when the last set of reference measurements was made);
- a range in which it must be assumed that a fault may exist which must be sought and cleared before any readjustment is permitted. After the fault (if any) has been found and all stations, intermediate and terminal, have, if necessary, readjusted their levels to as near the nominal value as possible, the new settings are noted for future reference purposes when making subsequent adjustments.

The three ranges are shown in Figure 1/M.530 in relation to a typical distribution of level values.

A suitable value for y in Figure 1/M.530 is considered to be 2 S, where S is the observed standard deviation. This concept is the basis of Table 1/M.530.

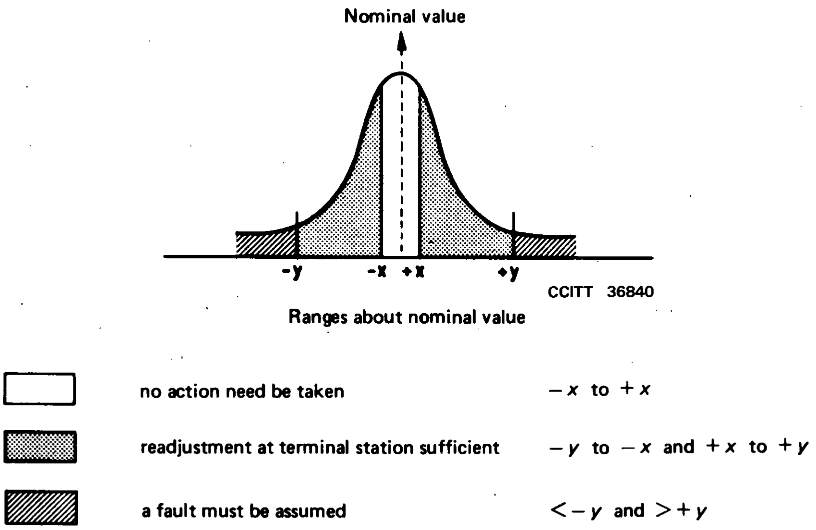

FIGURE 1/M.530

Typical distribution of observed values of level, showing ranges in which different action is necessary

Recommendation M.535

SPECIAL MAINTENANCE PROCEDURES FOR MULTIPLE DESTINATION, UNIDIRECTIONAL (MU) GROUP AND SUPERGROUP LINKS

The Recommendations covering the maintenance of groups and supergroups will apply as far as possible but there will be a number of new maintenance problems which are peculiar to multiple destination links. In particular, arrangements will be needed to check the performance of the MU main section of such links. In order to simplify the procedures and minimize interference to other users of the common path, it is recommended that the send reference station (see Figure 1/M.460) for the MU main section should act as a focal point for reports and inquiries concerning the MU main section. The group, supergroup, etc., control stations will still be responsible for localizing a fault to a particular section of a link in accordance with Recommendation M.130 [1].

When a fault is found to be in the communication satellite link, the send reference station will report the fault to the satellite control responsible for this link from baseband-in to baseband-out. When the fault is cleared, the send reference station will advise the MU main section controls which will in turn advise the group, supergroup, etc., controls concerned.

Reference

[1] CCITT Recommendation *Operational procedures in locating and clearing transmission faults*, Vol. IV, Fascicle IV.1, Rec. M.130.

ROUTINE MAINTENANCE OF CARRIER AND PILOT GENERATING EQUIPMENT

1 If a country has a national frequency standard, it is desirable to use it for checking the frequency of the master oscillators of carrier systems. (See Table 1/M.540 showing the recommended frequency accuracy for various carrier systems.) This frequency standard can be guaranteed to about 1 part in 10^8 by means of the three-way frequency comparisons organized by the CCIR. However, we must note that a larger accuracy can be obtained in the countries that will use an atomic frequency standard (for example cesium or rubidium).

2 If a country has no national frequency standard, there are two possibilities:

a) to receive by radio the standard signals transmitted in accordance with CCIR Recommendations;

b) to receive from a neighbouring country, over a metallic circuit, a frequency derived from the national standard of that country.

It may be necessary in some cases to make a direct comparison of the frequency of the master oscillators of the carrier systems of different countries; this comparison will be effected by means of the frequency comparison pilots.

3 The changeover of master oscillators may cause a short interruption of a few milliseconds and a sudden phase-change. Because the effect of these interruptions and phase-changes is felt throughout the carrier system, changeover of master oscillators should be made only when absolutely necessary.

TABLE 1/M.540

Table showing the recommended frequency accuracy for reference pilots, carriers, etc., in various carrier systems

System		Frequency and accuracy		
		Reference pilot		Carrier generator
(1)		(2)		(3)
(1 + 3) open-wire 8 circuit open-wire		16.110 kHz 31.110 kHz	2.5×10^{-5}	2.5×10^{-5} 10^{-5}
12 circuit open-wire		5×10^{-6}		5×10^{-6}
Symmetric pair 1, 2, 3, 4 or 5 groups		Line regulating 60 kHz Auxiliary	 ± 1 Hz ± 3 Hz	
2 supergroups	2.6 MHz	Line regulating 60 kHz 556 kHz Line regulating 2604 kHz	 ± 1 Hz ± 3 Hz ± 30 Hz	
Coaxial pair 2.6/9.5 mm	4 MHz	Line regulating 60 kHz 308 kHz 4092 kHz Auxiliary 2792 kHz Additional measuring frequencies (all)	 ± 1 Hz ± 3 Hz ± 40 Hz ± 5 Hz ± 40 Hz	
	12 MHz	Line regulating 308 kHz 4287 kHz 12435 kHz Additional measuring frequencies: < 4 MHz > 4 MHz	 $\pm 1 \times 10^{-5}$ ± 40 Hz $\pm 1 \times 10^{-5}$	Channel virtual carriers of a group $\pm 10^{-6}$ Groups and supergroups $\pm 10^{-7}$ Mastergroups and supergroups $\pm 5 \times 10^{-8}$
	60 MHz	Line regulating 4287 kHz 12435 kHz 22372 kHz 40920 kHz 61160 kHz Additional measuring frequencies (all)	 $\pm 1 \times 10^{-5}$ $\pm 1 \times 10^{-5}$	
Coaxial pair 1.2/4.4 mm	1.3 MHz	Line regulating 1364 kHz Auxiliary 60 or 308 kHz	 $\pm 1 \times 10^{-5}$ $\pm 1 \times 10^{-5}$	
	4 MHz	Line regulating 60, 308, 4287 kHz	$\pm 1 \times 10^{-5}$	
	6 MHz	Line regulating 308, 4287 kHz	$\pm 1 \times 10^{-5}$	
12 + 12		60 kHz Others by agreement between Administrations	± 1 Hz	Error in reconstituted frequency over a 140 km section not to exceed 0.3 Hz (provisional value)

TABLE 1/M.540 (continued)

System	Frequency and accuracy	
	Reference pilot	Carrier generator
(1)	(2)	(3)
6 MHz		Video carrier 1056 kHz ± 5 Hz
12 MHz		Video carrier 6799 kHz ± 100 Hz
4 kHz spacing		
Basic group B and Basic supergroup	84.080 kHz, 104.080 kHz 411.920 kHz and 547.920 kHz ± 1 Hz 84.140 kHz and 411.860 kHz ± 3 Hz	
Basic mastergroup and 15-supergroup assembly	1552 kHz ± 2 Hz	
Basic supermastergroup	11096 kHz ± 10 Hz	
3 kHz spacing	84 kHz or other frequency by agreement ± 1 Hz	
Basic group and Basic supergroup	*	

* A supergroup reference pilot frequency of 444 kHz with a tolerance of ± 1 Hz is used.

SECTION 3

INTERNATIONAL TELEPHONE CIRCUITS

3.1 Bringing an international telephone circuit into service

Recommendation M.560

OVERALL LOSS OF A CIRCUIT [1]

1 Former transmission plan [2]

In the former transmission plan, the overall loss of circuits in terminal service is defined with reference to the 2-wire ends of such circuits. In this former transmission plan:

- for all international circuits, the nominal overall loss should be the same for the two directions of transmission;
- for manually-operated international circuits, the nominal overall loss (insertion loss between non-reactive resistances of 600 ohms) between the switchboard jacks at the terminal international exchanges, including the line transformers, etc., measured at 800 Hz, should not exceed 7 dB. This limit also applies to a chain of two circuits interconnected at an international transit centre;
- for semiautomatic international circuits, the value recommended by the CCITT is 7 dB in each direction of transmission. This value includes the insertion loss of the incoming and outgoing switching equipments and also of pads included in the circuit in terminal service.

2 New transmission plan [3], [4]

The new transmission plan considers international circuits to be 4-wire circuits interconnected on a 4-wire basis at each end, either to another international circuit (at a transit international centre) or to a "national system" in a terminal international centre.

References

[1] *Measurements of loss*, Green Book, Vol. IV-2, Supplement No. 2.2, ITU, Geneva, 1973.

[2] *The old transmission plan*, Blue Book, Vol. III, Appendix to Section 1 of Part I, ITU, Geneva, 1964.

[3] CCITT Recommendation *The transmission plan*, Vol. III, Fascicle III.1, Rec. G.101.

[4] CCITT Recommendation *Four-wire switched connections and four-wire measurements on circuits*, Vol. IV, Fascicle IV.1, Rec. M.640.

CONSTITUTION OF THE CIRCUIT; PRELIMINARY EXCHANGE OF INFORMATION

As soon as it is decided to bring a new circuit into operation, the technical services of the terminal countries should agree upon the circuit control station, and the technical service of each transit country should advise the other technical services concerned of the name of the sub-control station chosen for its territory. If the circuit is routed in a direct group crossing a transit country without demodulation, no sub-control station need be provided for the transit country.

Also the technical services of all the countries concerned should send to the technical service responsible for the circuit control station information which will be required for the preparation of the circuit routing form (see the Appendix to this Recommendation) using the letter and number code on the form. The information for a circuit without audio sections will consist of the numbers of the groups used and the number of the channel in each group.

The information should preferably be sent by telex and the examples below show typical telex messages concerning the provision of Bucuresti-London 1.

This method using the telex services enables agreement on routing details to be obtained quickly and also enables circuit routing forms to be completed by the technical services responsible for the circuit control stations as soon as a circuit is put into service or rearranged.

Example I – Telex message from the technical services of the United Kingdom Post Office to the technical services of the Federal Republic of Germany, Austria, Hungary and Roumania:

```
SERVTECH LONDON, E.C.1. TO FTZ DARMSTADT
                           GENTEL WIEN
                           GENTEL BUDAPEST
                           GENTEL BUCUREŞTI
AH 1036/2
PROPOSE PROVISION OF BUCUREŞTI LONDON 1
USING FRANKFURT LONDON 1201/9 SIGNALLING 500/20
GRATEFUL FOR YOUR AGREEMENT OR COUNTER PROPOSALS. REGARDS.
```

Example II – Telex message from the technical services of the Federal Republic of Germany in reply to telex in example I:

```
FTZ SCHALT DMST A SERVTECH LONDON E.C.1.
10 APR
FS NR 38
2 = FEDERAL REPUBLIC OF GERMANY 3—BUCURESTI—LONDON 1
5 = FRANKFURT/MAIN
A = FFT — L 1201/9 B = 840
A = FFT — WIEN 1201/11 B = 740
      REGARDS.
            COPIES TO WIEN, BUDAPEST, BUCUREŞTI
```

Using the above-mentioned information and the data supplied by sub-control stations, the circuit control station makes out a *circuit routing form* (see Appendix to this Recommendation, which can serve as a routing form or level diagram) which is used as a level diagram for voice-frequency sections. This routing form shows the nominal relative levels at:

- circuit control and sub-control stations;
- frontier stations, if the circuit is reduced to a voice-frequency section across a frontier;
- stations where the circuit is reduced to voice frequency, in those cases where the circuit passes via a series of groups.

The technical service of the circuit control station sends the routing form to the technical services of the sub-control stations of the international circuit concerned in the following cases:

a) only at the specific request of one of the Administrations concerned when the circuits are routed on one channel of a single international group link;

b) in all cases for circuits otherwise constituted.

The despatches are sent in duplicate, one copy for the technical service and one for the sub-control station.

APPENDIX
(to Recommendation M.570)

Routing form for an international circuit

1.	Date of issue	
2.	Technical service of.	American Telephone and Telegraph Co.
3.	Circuit designation	New York (10) – Stockholm 1
4.	Length	7870 km
5a.	Control station	New York
5b.	Sub-control stations	London, Stockholm
6.	Date of putting into service	October 1972
7.	Echo suppressors at.	New York (1/2), Stockholm (1/2)
8.	Compandors at	None
9.	Signalling.	System No. 5
10.	Switching equipment	
11.	Special equipment at	None
12.	Speech concentrator[1]	None
13.	Estimated weighted noise power	–48 dBm0 (36 dBa)
14.	Special performance requirements at.	None
15.	Hangover time of suppressors at.	New York: 50 ms Stockholm: 50 ms

Stations and constitution	Length of section (in km)	Nominal relative level at reference measurement point[2] (dBr)		Estimated group delay time at 800 Hz (milliseconds)	Remarks[3]
		Direction ↓	Direction ↑		
(A)	(B)	(C)	(D)	(E)	(F)
New York		0.0	–4.5		Through-group connection points Conil (Spain), Sesimbra (Portugal)
34-A-/C/-8	522			3.2	
Green Hill		+7.0	+7.0		
1602-05-/A/-5	5813			36.5	
London		+4.0	–4.0		
1211/1	1535			9.5	
Stockholm		+3.5	–11.0		

[1] Insert *TASI only, through and TASI,* or *none* as appropriate (or equivalent).
[2] An asterisk after the relative level indicates that the nominal value of the impedance at the measuring point differs from 600 ohms.
[3] When this column is completed for loaded cables the effective bandwidth of the section will be inserted.

SETTING UP AND LINING UP AN INTERNATIONAL CIRCUIT FOR PUBLIC TELEPHONY

1 Introduction

This Recommendation applies to all circuits operated on a manual, semiautomatic or fully automatic basis.

2 Organization

The guiding principles for the general maintenance organization of international circuits are given in Recommendation M.70 [1].

2.1 An international circuit may consist of various national and international circuit sections; these circuit sections consist of two telephony channels, one for each direction of transmission, each consisting of a channel of a group or an audio-pair.

2.2 At the terminal stations of the circuit, access points are provided in accordance with Recommendation M.110 [2] (see also Recommendation M.640). At intermediate stations an access point is provided (see also Recommendation M.110 [2] for transit circuits), its position in the circuit being so chosen that as much as possible of the audio-frequency apparatus in the station is included in any measurement made at that station in the direction of transmission concerned.

2.3 In establishing an international circuit, the circuit, line and circuit section access points define the limits of the circuit, line and circuit section, and these are used as the basic elements involved in setting-up, lining-up, and fault location.

Note – The line access point at the terminal station will also be used as the circuit section access point at that station.

3 Limits for the overall loss of a circuit and circuit sections

3.1 *Limits for overall loss at 800 Hz*

The objective is to make the value of overall loss at 800 Hz as near as possible to its nominal value. When adjustment is provided in steps, these should enable the loss to be adjusted to within ± 0.3 dB of the nominal value.

3.2 *Limits for the overall loss/frequency characteristic*

National telephone networks are planned and provided by Administrations to give satisfactory telephone transmission on national calls in the most economical way and will, in consequence, have but little margin against additional transmission impairment in calls on the longest connections.

International telephone calls require the two corresponding parts of the national networks in the terminal countries to be interconnected by a switched chain of international circuits. The present CCITT plan for worldwide telephone connections specifies a maximum of six international circuits in a connection. In some circumstances the nominal reference equivalent of the connection could be 3 dB greater than in the past. This additional loss, in combination with increased line noise, makes it very desirable to minimize the transmission impairments introduced by the international circuits.

In order to have an objective for a circuit for maintenance purposes, the following principles should be applied.

3.3 The overall loss/frequency distortion of a circuit depends on whether it is set up entirely on 4-kHz spaced channels, or entirely on 3-kHz spaced channels or on combinations of such channels, even including small sections of audio cable. Three sets of limits are given in Tables 1/M.580, 2/M.580 and 3/M.580.

The principles on which the tables are based are as follows:

a) the maximum loss in the relevant frequency range should not be greater than 9.0 dB relative to the loss at 800 Hz in order to avoid disturbing the noise power distribution in the circuit to any extent;

b) the use of equalizers at intermediate stations should be avoided as far as possible;

c) where a mixed type of composition is used the arrangement of 3-kHz plus 4-kHz spaced channels in a circuit would cater for most of the cases of composition likely to be encountered in practice (for example, one 3-kHz channel in series with two 4-kHz channels);

d) to permit some flexibility to Administrations to use a measure of pre-equalization if necessary in order to avoid low-level signals entering a long section.

TABLE 1/M.580
(Previously Table A/M.580)

Limits for the overall loss/frecuency characteristic between circuit access points and the access points of circuit sections for circuits and circuit sections using 4-kHz spacing

Frequency Hz	Overall loss relative to that at 800 Hz	
	Between circuit access points	At the access point at intermediate stations
	dB	dB
Below 300	not less than 0.0 otherwise unspecified	not less than −3.0 otherwise unspecified
300 to 400	+3.5 to −1.0	+9.0 to −3.0
400 to 600	+ 2.0 to −1.0	+6.0 to −3.0
600 to 2400	+1.0 to −1.0	+6.0 to −3.0
2400 to 3000	+2.0 to −1.0	+6.0 to −3.0
3000 to 3400	+3.5 to −1.0	+9.0 to −3.0
Above 3400	not less than 0.0 otherwise unspecified	not less than −3.0 otherwise unspecified

TABLE 2/M.580
(Previously Table B/M.580)

Limits for the overall loss/frequency characteristic between circuit access points and the access points of circuit sections for circuits and circuit sections using 3-kHz spacing

Frequency Hz	Overall loss relative to that at 800 Hz	
	Between circuit access points	At the access point at intermediate stations
	dB	dB
Below 200	not less than 0.0 otherwise unspecified	not less than − 1.5 otherwise unspecified
200 to 250	+10.5 to −0.5	not less than −1.5 otherwise unspecified
250 to 300	+ 6.5 to −0.5	+9.0 to −1.5
300 to 2700	+1.0 to −0.5	+7.0 to −1.5
2700 to 2900	+2.5 to −0.5	+7.0 to −1.5
2900 to 3050	+6.5 to −0.5	+9.0 to −1.5
Above 3050	not less than 0.0 otherwise unspecified	not less than − 1.5 otherwise unspecified

TABLE 3/M.580
(Previously Table C/M.580)

Limits for the overall loss/frequency characteristic between circuit access points and the access points of circuit sections for circuits and circuit sections using 3-kHz and 4-kHz spacing

Frequency Hz	Overall loss relative to that at 800 Hz	
	Between circuit access points	At the access point at intermediate stations
	dB	dB
Below 300	not less than 0.0 otherwise unspecified	not less than − 3.0 otherwise unspecified
300 to 400	+3.5 to − 1.0	+9.0 to − 3.0
400 to 600	+ 2.0 to − 1.0	+6.0 to − 3.0
600 to 2400	+1.0 to − 1.0	+6.0 to − 3.0
2400 to 2700	+2.0 to − 1.0	+6.0 to − 3.0
2700 to 2900	+2.5 to − 1.0	+9.0 to − 3.0
2900 to 3050	+6.5 to − 1.0	+9.0 to − 3.0
Above 3050	not less than 0.0 otherwise unspecified	not less than −3.0 otherwise unspecified

3.4 Table 1/M.580 is based on the limits recommended for a pair of 4-kHz channel equipments (Recommendation G.232 [3]), a small addition having been made to the recommended limits to allow for the additional distortions likely to be introduced by the group link and by the circuit and exchange apparatus. The equalization limits are three times the circuit limits.

Table 2/M.580 is similarly based on the limits recommended for a pair of 3-kHz channel equipments (Recommendation G.235 [4]) with an allowance for the group link and for circuit and exchange apparatus.

For international circuits composed of 4-kHz and 3-kHz sections, the limits given in Table 3/M.580 are a combination of the limits given in Tables 1/M.580 and 2/M.580, taking into account the factors given in 3.3 a) to 3.3 c) above.

The limits to be imposed on the loss/frequency characteristic at intermediate stations are also shown in Tables 1/M.580, 2/M.580 and 3/M.580.

4 Setting up and lining up the circuit sections

4.1 The circuit sub-control stations responsible for the various national and international circuit sections should arrange to set up these sections.

The circuit sections are lined up and the overall loss/frequency characteristic of each is recorded from terminated-level measurements.

This is done by sending at a level of -10 dBm0 [1] at the reference test frequency at the access point at the intermediate sub-control station or at the line access point at the control station or terminal sub-control station and adjusting the received level at the access point at the adjacent intermediate sub-control station to as close to its nominal level as possible in the direction of transmission concerned.

4.2 The loss/frequency characteristic should then be measured at frequencies chosen from the following list, according to the characteristics of the circuit section to be set up:

200, 250, 300, 400, 600, 800, 1000, 1400, 2000, 2400, 2700, 2900, 3000, 3050 and 3400 Hz.

Technical services may agree to make measurements at other frequencies if it is considered useful to do so. The test signals should be applied at a level of -10 dBm0 [1].

For circuit sections effectively transmitting up to only 3000 Hz (for example, circuits using 3 kHz spaced channels) the measurement at 3400 Hz is, of course, not applicable.

The overall loss at 800 Hz [2] should be as near as possible to the nominal value.

The overall loss at other frequencies should lie within the limits given in Tables 1/M.580, 2/M.580 and 3/M.580 (see 3.3 above).

For each circuit section the results for each direction of transmission are forwarded to the control and terminal sub-control stations.

At terminal stations, during these measurements, the signalling connections to the automatic equipment should be disconnected if the signalling units are incorporated in the carrier terminal equipment. When the line-signalling relay sets are included in the lines and apparatus being measured, any voice-frequency signalling receiver must be rendered inoperative or its action made ineffective.

5 Setting up and lining up an international circuit

5.1 *Setting up the circuit*

5.1.1 The sub-control station responsible for the various circuit sections having completed the setting-up and lining-up of those sections should arrange to connect them together and advise the control station. In addition, the control and terminal sub-control stations, in conjunction with their testing points, should ensure that all associated signalling, switching and other terminal equipment has been connected, is free from faults, and is operating satisfactorily.

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[1] This is the preferred level. However, by agreement Administrations, a level of 0 dBm0 may be used.

[2] For international circuits, 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements, since it is a fact that 1000 Hz is widely used for single-frequency measurements on some international circuits.

Multi-frequency measurements made to determine the loss/frequency characteristic will include a measurement at 800 Hz and therefore the reference frequency for such characteristic can still be 800 Hz.

Reference should be made to Supplement No. 3.5 [5] concerning measuring frequencies to be used on circuits routed over PCM systems.

5.1.2 When the control station has **been advised by all the sub-control stations that the sections constituting the** circuit have been connected together, the control station should agree with the sub-control stations upon a time when the whole circuit may be lined up.

5.2 *Lining up the circuit*

5.2.1 *Preliminary work*

5.2.1.1 The receiving terminal sub-control station studies the test results of the individual circuit sections, particularly observing the way in which the variations within the permissible tolerances will accumulate when the sections are interconnected. The receiving terminal sub-control station for each direction of transmission determines from these studies and observations the amount of gain and equalization adjustment which will be required at intermediate and terminal stations to obtain a satisfactory overall characteristic.

5.2.1.2 From the test results the cumulative overall loss over the frequency band at intermediate sub-control stations is calculated with respect to the overall loss at 800 Hz. An equalizer should be fitted at the request of the receive terminal sub-control station at those stations at which the sum of the measured overall loss/frequency characteristics of the individual sections exceeds the provisional limits (see 3.4 above). In determining the limits, due account must be taken of the presence of 3-kHz spaced channel translating equipment.

The number of intermediate equalizers should be kept to a minimum. When the receiving terminal sub-control station has been advised by all the other sub-control stations that the circuit sections and any prescribed equalizers have been connected together, a time when the circuit can be lined up should be agreed upon.

5.2.2 *Adjustment of the overall loss at the reference test frequency*

5.2.2.1 At the appropriate time of line-up, the control station, in cooperation with the various sub-control stations, proceeds with the overall line-up of the circuit, first at a frequency of 800 Hz [2].

For this, the control station arranges to send an 800-Hz test signal at a level of −10 dBm0 [1], for example at the circuit access point of the circuit. In addition, the level at the line access point at the terminal stations should be adjusted to as close to the nominal value as possible.

5.2.2.2 The intermediate sub-control stations will then arrange to measure the level of the 800-Hz test signal and to adjust it to the nominal value at the access points of the circuit (as defined in 2.2 above) in that direction of transmission. Measurements and adjustments should also be made at frontier stations where the circuit includes an audio-frequency section crossing a frontier.

5.2.2.3 At the distant terminal sub-control station the received level of the test signal should be adjusted until the required overall loss is obtained at the circuit access point.

The procedure is then repeated for the other direction of transmission of the circuit.

In order to minimize cumulative gain or loss at 800 Hz the receive terminal sub-control station may request intermediate sub-control stations to alter the gain setting for the receive direction of their sections by not more than one gain control step. In this way it should be possible to compensate, at successive stations, the departures from the nominal value while staying within the permissible limits. Theoretically, this adjustment will be needed in not more than half the stations.

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1) This is the preferred level. However, by agreement Administrations, a level of 0 dBm0 may be used.

2) For international circuits, 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements, since it is a fact that 1000 Hz is widely used for single-frequency measurements on some international circuits.

Multi-frequency measurements made to determine the loss/frequency characteristic will include a measurement at 800 Hz and therefore the reference frequency for such characteristic can still be 800 Hz.

Reference should be made to Supplement No. 3.5 [5] concerning measuring frequencies to be used on circuits routed over PCM systems.

5.2.2.4 It is not possible to recommend a value for the nominal transmission loss between the circuit access points of a switched public telephony circuit because of the freedom accorded to Administrations in arranging the relative levels at these points. However, bearing in mind that at each end of the circuit the attenuation between the circuit access point and the virtual switching points will have a fixed and known value and that it is possible to *build out* the wiring to circuit access points to a known loss, the send level at the circuit access point should be so chosen that, on the circuit, the circuit level diagram is respected. [See also Recommendation M.640, § 2.1 d).]

5.2.3 *Measurement of the overall loss/frequency response*

5.2.3.1 When the circuit has been lined up at 800 Hz, measurements should be made between circuit access points at the terminal stations and also at intermediate sub-control stations and frontier stations when an audio-section crosses a frontier. The loss/frequency characteristic should then be measured at frequencies chosen from the following list, according to the characteristics of the circuit to be set up:

200, 250, 300, 400, 600, 800, 1000, 1400, 2000, 2400, 2700, 2900, 3000, 3050 and 3400 Hz.

Technical services may agree to make measurements at other frequencies if it is considered useful to do so. The test signals should be applied at a level of -10 dBm0 [1].

5.2.3.2 If necessary, the receiving terminal sub-control station may equalize the circuit at this stage by means of an equalizer in that station, so that the overall loss/frequency characteristic lies within the required limits. Minor adjustments to compensate for accumulated manufacturing tolerances in pad and equalizer values can now also be made at intermediate stations. Those stations at which receive equalizers were necessary should remeasure the section including the equalizer, making terminated-level measurements. The results of those measurements should be passed to the receive terminal station.

These results now replace those previously submitted under operation § 5.2.1.2 above for these sections, and are the results with which comparison is to be made in subsequent maintenance. (The overall loss/frequency characteristic of a *section + equalizer* may not now lie within the limits appropriate to a circuit section. It should be noted that one consequence of this is that such a combination cannot be used as a replacement for a faulty circuit section; for such replacement purposes the circuit section should be transferred without the equalizer.)

5.2.4 When the above measurements and necessary adjustments have been carried out, the control and terminal sub-control stations ensure that the limits are achieved. The circuit can be regarded as being lined up.

6 Measurement of circuit noise

6.1 The measurement of circuit noise should be made for both directions of transmission.

For the measurements of noise in one direction of transmission, the far end of the circuit should be terminated at the circuit access point, with an appropriate value of pure resistance.

At the circuit access point at the other end of the circuit (near end) a measurement of the psophometric voltage should be made, using a psophometer having the characteristics recommended by the CCITT (see the weighting curve for this psophometer in [6]).

6.2 Circuit line-up noise measurements should be compared with the noise maintenance objectives shown in Table 4/M.580 according to the length of the circuit concerned. The values in Table 4/M.580 apply to single measurements (see Note). It is assumed that the noise measurement will follow the measurements and adjustments outlined in 5.2.2 and 5.2.3 above.

6.3 Where the measured noise is higher by 5 decibels or more than the appropriate value from Table 4/M.580, or is higher than -37 dBm0p, whichever is the more stringent requirement, action should immediately be taken to locate and remedy any fault where possible. It may be useful to compare noise measurements on circuits of identical or similar constitution to help locate a possible fault.

[1] This is the preferred level. However, by agreement Administrations, a level of 0 dBm0 may be used.

TABLE 4/M.580
(Previously Table D/M.580)

Noise objectives for public telephone circuit maintenance

Distance in kilometres	<320	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5001 to 10000	10001 to 20000
Noise (dBm0p)	–55	–53	–51	–49	–46	–43	–40

Note — For circuits routed via satellite, the section of the circuit provided by satellite (between earth stations) will contribute approximately 10 000 pWp (—50 dBm0p) to the overall circuit noise. Therefore, for the purpose of determining the maintenance noise limits for international public telephony circuits, the section of the circuit provided by the satellite may be considered, from Table 4/M.580, to be equivalent to a length of 2500 km. The effective *noise length* of such a circuit will be 2500 km plus the total length of the terminal routings.

6.4 Where the measured noise is greater than –44 dBm0p, and once it is ensured that no fault exists, the fitting of a compandor should be considered. Such consideration is particularly necessary if the circuit is likely to be used in a 6-circuit chain. Reference should be made to Recommendation G.143 [7] for technical guidance on the fitting of compandors. In particular, note should be taken of the need to restrict their use to circuit sections provided on inherently stable transmission systems.

6.5 The noise measured at the circuit access point during the initial line-up should be recorded for comparison against subsequent maintenance measurements.

7 Measurements of other parameters

Circuits used for reserve purposes in certain applications, for example, data and facsimile transmission, have particular requirements in respect of group-delay distortion, noise, etc. Reference should be made to the CCITT Recommendations relating to the type of circuit concerned in order to find what these requirements are.

8 Check of signalling level

Measurements should also be made to check that the absolute power level of the signalling current at the transmitting end of the circuit in each direction of transmission has a nominal value in accordance with Table 5/M.580, or as agreed between Administrations for signalling systems not covered by CCITT Recommendations.

Reference should be made to Recommendation M.470 [8] for the check of Signalling System R2 line signals. The interregister signals will be found in Table 5/M.580.

TABLE 5/M.580
(Previously Table E/M.580)

Absolute power of signalling current

Type of signalling	Signalling frequency		Absolute power
	Nominal value	Tolerance	Nominal value in dBm0 (tolerance ± 1 dB)
Manual signalling (System No. 1)	500 Hz interrupted at 20 Hz	± 2%	uninterrupted (500 Hz) 0
		± 2%	interrupted (500/20 Hz) —3
One-frequency signalling (System No. 3)	2280 Hz	± 6 Hz	—6
Two-frequency signalling (System No. 4)	2040 Hz 2400 Hz	± 6 Hz ± 6 Hz	—9 —9
Multi-frequency systems (Systems No. 5 and 5*bis*) Line signals[a] (two-frequency)	 2400 Hz 2600 Hz	 ± 6 Hz ± 6 Hz	 —9 —9
Register signals[b] (multi-frequency)	700 Hz 900 Hz 1100 Hz 1300 Hz 1500 Hz 1700 Hz	± 6 Hz ± 6 Hz ± 6 Hz ± 6 Hz ± 6 Hz ± 6 Hz	—7 —7 —7 —7 —7 —7
Signalling System R1. Line signals	2600 Hz	± 5 Hz	—8/—20[c]
Register signals[d]	700 Hz 900 Hz 1100 Hz 1300 Hz 1500 Hz 1700 Hz	± 1.5% ± 1.5% ± 1.5% ± 1.5% ± 1.5% ± 1.5%	—7 —7 —7 —7 —7 —7
Signalling System R2. Register signals[b]			
Forward	1380 Hz 1500 Hz 1620 Hz 1740 Hz 1860 Hz 1980 Hz	± 4 Hz ± 4 Hz ± 4 Hz ± 4 Hz ± 4 Hz ± 4 Hz	—8 —8 —8 —8 —8 —8
Backward	540 Hz 660 Hz 780 Hz 900 Hz 1020 Hz 1140 Hz	± 4 Hz ± 4 Hz ± 4 Hz ± 4 Hz ± 4 Hz ± 4 Hz	—8 —8 —8 —8 —8 —8

a) For compound signals, the difference between the sent levels of f_1 and f_2 should not exceed 1 dB.

b) The difference between the sent levels of two frequencies of which a signal is composed should not exceed 1 dB.

c) —8 dBm0 for the duration of the signal or for a minimum of 300 ms (whichever is the shorter) and for a maximum of 550 ms after which the level of the signal shall be reduced to —20 dBm0.

d) The difference between the sent levels of the two frequencies of which a signal is composed should not exceed 0.5 dB.

9 Functional tests

9.1 When the line-up procedure as described above has been completed, a check should be made of the functioning of the compandors where appropriate in accordance with Recommendation M.590. This should be followed by a speaking test including a check of the satisfactory operation of echo suppressors and a check that signalling transmission over the circuit is satisfactory. For an automatically operated circuit the signal-transmission testing facilities available at the control station should at least enable a check to be made of the line-signals transmitted between circuit access points, for example, to verify that the forward signals are followed by the return of the appropriate backward signals.

9.2 For manually operated circuits a check should be made to confirm that line-signalling to the distant end is satisfactory.

Where possible, both for manually and automatically operated circuits, test calls should be made to the distant-end operators or technical staff, as the case may be, to check the circuit both for signalling and transmission performance.

9.3 Some Administrations find a rapid check of the echo suppressors useful when setting up a circuit. A suitable method is described in [9] which can be carried out by agreement between Administrations.

10 Records of results

Each station should keep a careful record of the measurement results for the receiving direction of transmission of the sections terminating in the station. A record should be kept of the overall loss at the reference frequency and also of the overall loss/frequency characteristic relative to the overall loss at 800 Hz.

The measurements made must include the characteristics of any equalizers which have been fitted and the final choice of gain setting must be stated.

The receiving terminal stations will also maintain a careful record of all the section measurements in the receiving direction of transmission. In addition the terminal sub-control station should send a copy of the overall records to the control station which thus will hold records for both directions of transmission. (Stations should prepare local records of in-station tests of equalizers and records of equalizer and gain settings.)

Careful records of the results of tests given in §§ 4 to 9 above should be made by both terminal stations. The control station should hold a copy of the records for both directions of transmission.

References

[1] CCITT Recommendation *Guiding principles on the general maintenance organization for telephone-type international circuits*, Vol. IV, Fascicle IV.1, Rec. M.70.

[2] CCITT Recommendation *Circuit testing*, Vol. IV, Fascicle IV.1, Rec. M.110.

[3] CCITT Recommendation *12-channel terminal equipments*, Vol. III, Fascicle III.2, Rec. G.232.

[4] CCITT Recommendation *16-channel terminal equipments*, Vol. III, Fascicle III.2, Rec. G.235.

[5] *Test Frequencies on circuits routed over PCM systems*, Vol. IV, Fascicle IV.4, Supplement No. 3.5.

[6] *Noise-measuring instruments for telecommunication circuits*, Green Book, Vol. IV.2, Supplement No. 3.2, ITU, Geneva, 1973.

[7] CCITT Recommendation *Circuit noise and the use of compandors*, Vol. III, Fascicle III.1, Rec. G.143.

[8] CCITT Recommendation *Setting up and lining up the channels of an international group*, Vol. IV, Fascicle IV.1, Rec. M.470.

[9] *Rapid verification test for echo control*, Green Book, Vol. IV.2, Supplement No. 2.11, ITU, Geneva, 1973.

Recommendation M.590

SETTING UP A CIRCUIT FITTED WITH A COMPANDOR

1 The compandor should first be tested in accordance with the appropriate design information which should be made available in a suitable form to the repeater station staff.

2 The compandor should be fitted to the circuit only after the circuit without its compandor is satisfactory in respect of loss and loss/frequency response (see Recommendation M.580). The loss/frequency characteristic of a circuit fitted with a compandor is likely to be misleading and need not be measured.

3 The loss (or gain) at the reference frequency between circuit access points [1)] should be measured in both directions of transmission with an input level of *U* dBm0 both with and without the compandor in circuit, where *U* dBm0 is the unaffected level of the circuit (see Recommendation G.162 [1]). The difference caused by inserting the compandor should not exceed 0.3 dB.

4 The noise power level, psophometrically weighted and unweighted, should be measured with and without the compandor in circuit and the values noted. The inputs to the channels should be terminated with 600-ohm resistors during this test. No limit is specified as the apparent noise advantage gained depends on the level of uncompandored noise, the unaffected level, the compression ratio and the dynamic range of the compandor.

5 A speaking test should be made on the circuit to verify that there are no gross tracking errors.

Note – Repeater station staff should be well instructed as to the subjective effect of errors and the location of faults affecting compandors.

Reference

[1] CCITT Recommendation *Characteristics of compandors for telephony*, Vol. III, Fascicle III.1, Rec. G.162.

3.2 Routine maintenance of international telephone circuits

Recommendation M.600

ORGANIZATION OF ROUTINE MAINTENANCE MEASUREMENTS ON CIRCUITS

The organization of routine maintenance measurements on all telephone-type circuits should follow the general requirements given in Recommendation M.733.

1) A compandor, if fitted, should be connected on the line side of the line test-access points and not between the line test-access point and the circuit test-access point. In this way the relationship between the nominal transmission levels at these two points on a circuit with a compandor is the same as for other circuits.

PERIODICITY OF MAINTENANCE MEASUREMENTS ON CIRCUITS

Routine maintenance measurements should be made on a complete circuit and should comprise measurements of:

a) overall loss and levels at one frequency;

b) overall loss and levels at several frequencies;

c) stability (for two-wire audio circuits or sections of circuit only);

d) signalling current and operation of signalling units;

e) noise.

The periodicity for measurements of loss, noise, stability and signalling is given in Tables 1/M.610 and 2/M.610; in addition, other types of measurements are given in Table 1/M.610 for which the periodicity may be determined by the Administrations concerned.

Table 1/M.610 shows the periodicity for measurements on the types of circuit normally used in the international telephone network (except for frontier circuits). When automatic transmission measuring and testing equipments are available, transmission measurements and signalling tests may be carried out more frequently than indicated in this table.

These circuits are:

– 4-wire audio-frequency circuits. Included also in this category are circuits on carrier systems providing a small number of telephone channels. No distinction is made between circuits in underground cables and circuits on open-wire lines unless the open-wire section is equipped with repeaters;

– 4-wire carrier circuits on telephone channels of systems providing at least one group;

– 4-wire circuits of mixed constitution, i.e. consisting of a mixture of audio and carrier sections.

Table 2/M.610 shows the periodicity of measurements to be made on short-distance international circuits that are generally used for terminal traffic, but which can, when necessary, be used to extend more important international circuits. It is desirable that the same recommendations be applied to national circuits that are frequently used for international communications.

TABLE 1/M.610
(Previously Table A/M.610)

Periodicity of measurements and tests to be made on international telephone circuits
(circuits normally used in the international network)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	
Type of Circuit	Description	Measurement of overall loss at one frequency and measurement of noise[a)]	Measurements of overall loss at several frequencies	Systematic subjective testing Signal-to-crosstalk ratio between *go* and *return* paths Frequency translation error	Signalling tests	
					Manual circuits	Automatic circuits
Audio frequency 4-wire	1 to 14 repeaters	Monthly	Half-yearly	None	To be tested at the same time as the measure-ment of overall loss at several frequencies	Testing to follow the Series Q Recom-menda-tions
	15 or more repeaters	Weekly	Half-yearly			
	Same, with open-wire section with at least one repeater	At least monthly or as agreed	Half-yearly			
Wholly carrier	Circuits set up on channels on a simple group link and ter-minating at the same points as the group	Two-monthly or as agreed	Yearly	As agreed in accordance with need and experience		
	Circuits routed over several groups	Monthly	Yearly	As agreed in accordance with need and experience		
4-wire circuits of mixed consti-tution		At least monthly or as agreed	Yearly	As agreed in accordance with need and experience		

a) Measurements of overall loss at one frequency and of noise shown in column 3 are included in the measurements made at several frequencies shown in column 4.

TABLE 2/M.610
(Previously Table B/M.610)

Periodicity of measurements to be made on international telephone circuits
(Types of circuit not normally used in the international network)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	
Category of circuit	Type of circuit	Measurements of overall loss at one frequency and measurement of noise[a)]	Measurements of overall loss at several frequencies	Measurements of stability	Signalling tests	
					Manual circuits	Automatic circuits
Audio-frequency	2-wire circuits with one repeater	Yearly	Yearly	Yearly	At the same time as measurements of overall loss and levels at several frequencies (see column 4)	As agreed between Administrations
	2-wire circuits with two or three repeaters	Half-yearly	Yearly	Half-yearly		
	2-wire circuits with at least four repeaters	Quarterly	Half-yearly	Quarterly		
	2-wire circuits including an open-wire section with at least one repeater	Monthly	Half-yearly	Monthly		
	4-wire circuits with a 2-wire section having at least one repeater	As agreed between Administrations				

a) Measurements of overall loss at one frequency and of noise shown in column 3 are included in the measurements made at several frequencies shown in column 4.

Recommendation M.620

METHODS FOR CARRYING OUT ROUTINE MEASUREMENTS ON CIRCUITS

1 Measurements and tests carried out manually

1.1 *Measurements of overall loss*

The measurements should be made by applying to the circuit access points (see Recommendation M.640, § 2) test signals at a level of -10 dBm0 [1]:

- at the frequency of 800 Hz [2] when measurements are confined to one frequency;
- at frequencies of 400, 800, (or 1000) and 2800 Hz, when measurements are made at more than one frequency. Measurements may be made at additional frequencies if required.

Whenever automatic level recorders or display sets are available at the ends of the circuit, the measurements should be made with this equipment at all frequencies over the range of interest.

1) This is the preferred level. However, by agreement between Administrations, a level of 0 dBm0 may be used.

2) For international circuits, 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements, since it is a fact that 1000 Hz is widely used for single-frequency measurements on some international circuits.

Multi-frequency measurements made to determine the loss/frequency characteristic will include a measurement at 800 Hz and therefore the reference frequency for such characteristic can still be 800 Hz.

Reference should be made to Supplement No. 3.5 [1] concerning measuring frequencies to be used on circuits routed over PCM systems.

1.2 *Noise measurements*

The psophometric noise power as indicated by a CCITT psophometer should be measured in both directions of transmission. It would be useful to make this measurement at the same time as the measurement of overall loss.

1.3 *Signalling tests*

1.3.1 *Manually operated circuits*

The power of the voice-frequency signalling current, in its normal operating condition, should be measured at the same time as the overall loss at several frequencies is measured.

If n is the relative power level at the point of measurement, the measured absolute power level of the signalling current transmitted at 500/20-Hz interrupted signalling current should fall within the following limits:

$$(n - 3) \pm 1/2 \text{ dB}$$

assuming that the signalling units used conform to the specifications of the Series Q Recommendations.

The operation of the voice-frequency signalling receivers is tested as an in-station test.

For information, the operating limits of the signalling receiver are as follows:

If n is the relative power level at the point of connection in the circuit where the receiver is connected, it will operate reliably when the absolute power level N of the signalling current at the input of the receiver falls within the following limits:

$$-8.5 + n \leqslant N \leqslant + 2.5 + n \text{ dB}.$$

1.3.2 *Semiautomatic or automatic circuits*

See Recommendation M.732.

1.4 *Records*

All the results of measurements and tests should be recorded by the control and sub-control stations concerned.

2 **Use of automatic transmission measuring and signalling testing equipment – ATME No. 2**

See Recommendation O.22 [2].

2.1 *Transmission measurements*

When ATME No. 2 is available for the routine maintenance of automatic and semiautomatic international circuits, it should be used to make the following measurements:

- overall loss at 800 (or 1000) Hz or at 400, 800 (or 1000) and 2800 Hz, as required;
- psophometric noise power level.

The test frequencies for overall loss measurements should be at a level of -10 dBm0 [1)].

2.2 *Signalling tests*

The signalling functions involved in the setting-up and clearing down of a connection between the directing and responding equipments will be checked during each test call. In addition, ATME No. 2 should be used to make the following line signalling tests:

- forward transfer (where provided),
- clear back,
- re-answer,
- busy flash.

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1) This is the preferred level. However, by agreement between Administrations, a level of 0 dBm0 may be used.

3 Corrective action

3.1 *Readjustment of overall loss*

When, during a routine measurement, the overall loss at 800 Hz or 1000 Hz is not equal to its nominal value, the procedure below should be followed.

Deviations of less than ± 1 dB from nominal shall be deemed not to require adjustment. If measurements at a terminal station reveal a deviation from the nominal value of ± 1.0 dB up to and including ± 2.5 dB, adjustment to as near the nominal value as possible should be made at the terminal station and if practical at any intermediate station involved. Where it is appropriate and practical to do so, adjustment shall be made on the group or supergroup links in accordance with Recommendation M.530 [3]. If the deviation from nominal exceeds ± 2.5 dB a fault should be suspected which should be sought and cleared. If no fault is found, readjustment should be carried out at the intermediate and terminal stations as necessary, with particular attention to alignment of the group and supergroup link or links that may be involved.

3.2 *Measurements at more than one frequency*

When measurements are made at more than one frequency, a check should be made to ensure that the values obtained are within the limits permitted (see Tables 1/M.580, 2/M.580 and 3/M.580). If they are not, appropriate steps should be taken.

3.3 *Noise measurements*

It should be noted that any substantial deterioration in performance from the original line-up value may serve to indicate a fault. Comparison should also be made to noise measurements on circuits of identical or similar constitution to help locate a possible fault.

4 Other measurements without recommended periodicity

a) Systematic subjective testing, see Recommendation M.731;

b) Measurement of signal-to- crosstalk ratio between *go* and *return* channels. The measured signal-to-crosstalk ratio should not be worse than 43 dB;

c) Frequency errors arising from frequency translation. The difference between the sent and received audio frequencies should not exceed 2 Hz. See Recommendation O.111 [4] for a method of measuring this error.

References

[1] *Test frequencies on circuits routed over PCM systems*, Vol. IV, Fascicle IV.4, Supplement No. 3.5.

[2] CCITT Recommendation *Specification for the CCITT automatic transmission measuring and signalling testing equipment ATME No. 2*, Vol. IV, Fascicle IV.4, Rec. O.22.

[3] CCITT Recommendation *Readjustment to the nominal value of an international group, supergroup, etc., link*, Vol. IV, Fascicle IV.1, Rec. M.530.

[4] CCITT Recommendation *Specification of essential clauses for an instrument to measure frequency shift on a carrier channel*, Vol. IV, Fascicle IV.4, Rec. O.111.

Recommendation M.630

MAINTENANCE OF CIRCUITS USING CONTROL CHART METHODS

Administrations which so wish may replace the periodical measurements specified in Recommendations M.610 and M.620 by measurements using sampling methods. They will need to arrange their own programme for these on a bilateral basis. Administrations which wish to use such methods are requested to report their conclusions to the CCITT giving their comments on:

– the method used (for information, some methods are described in [1];
– the saving in manpower;
– the transference of work from field staff to administrative offices;
– any observed change in the quality of groups of circuits maintained by sampling methods.

Reference

[1] *Methods of quality control*, Green Book, Vol. IV.2, Supplement No. 1.4, ITU, Geneva, 1973.

Recommendation M.640

FOUR-WIRE SWITCHED CONNECTIONS AND FOUR-WIRE MEASUREMENTS ON CIRCUITS

1 Principles, definitions and relative levels [1] (formerly Part A)

1.1 *Principles*

A new transmission plan has been drawn up with the object of making use, in the international service, of the advantages offered by 4-wire switching. However, the recommendations in the plan are considered to be met if the use of technical media other than those described gives an equivalent performance at the international centre.

Note – Short transfrontier circuits are not covered by the new transmission plan; they should be the subject of agreement between the Administrations concerned.

1.2 *Definitions relating to a complete international telephone connection*

1.2.1 *The international chain and the national systems*

A complete international telephone connection has three parts, as shown in Figure 1/M.640, namely:

– An **international chain**

An international chain is made up of one or more 4-wire international circuits. These are connected on a 4-wire basis to other international circuits (in transit international centres) or to national systems (in international centres).

– Two **national systems** one at each end.

These may comprise one or more 4-wire amplified national circuits with 4-wire interconnection, and circuits with 2-wire connection to terminal exchanges and subscribers.

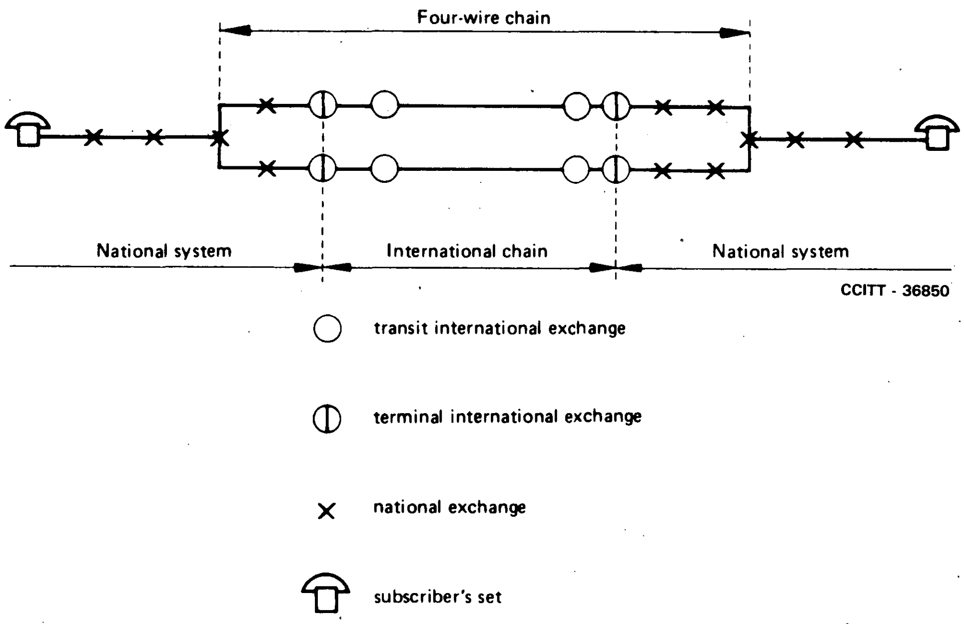

FIGURE 1/M.640

Constituent parts of an international telephone connection

[1] In § 1 extracts from the relevant Recommendations in Volume III and Recommendation Q.45 [1] are included.

1.2.2 *Four-wire circuit: virtual switching points; circuit terminals (Figures 2/M.640 and 3/M.640)*

- **virtual switching points**

  A 4-wire circuit is defined by its virtual switching points in the international centres. These are theoretical points with specified relative levels.

- **circuit terminals**

  The virtual switching points may not be the same as the points at which the circuit terminates physically in a switching equipment. These latter points are known as the circuit terminals; the exact position of the terminals is decided in each case by the Administration concerned (see Figure 2/M.640) [2].

In an international centre, the boundary between the international chain and the national system is determined by the virtual switching points of the international circuit.

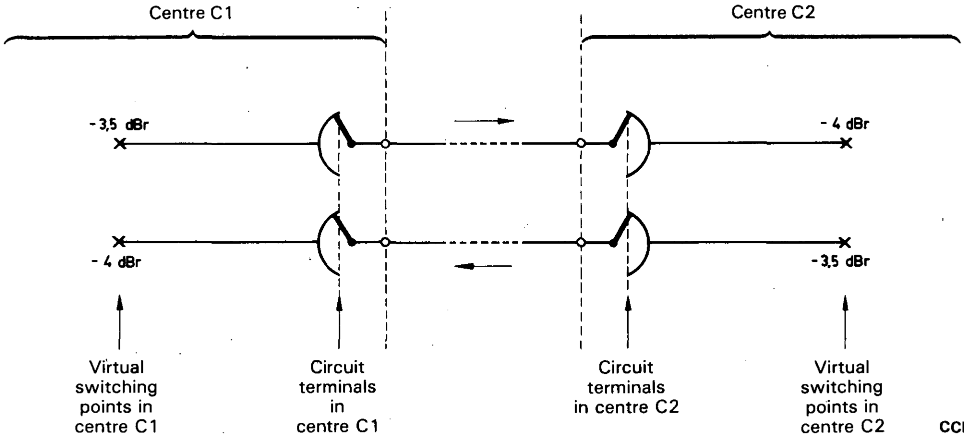

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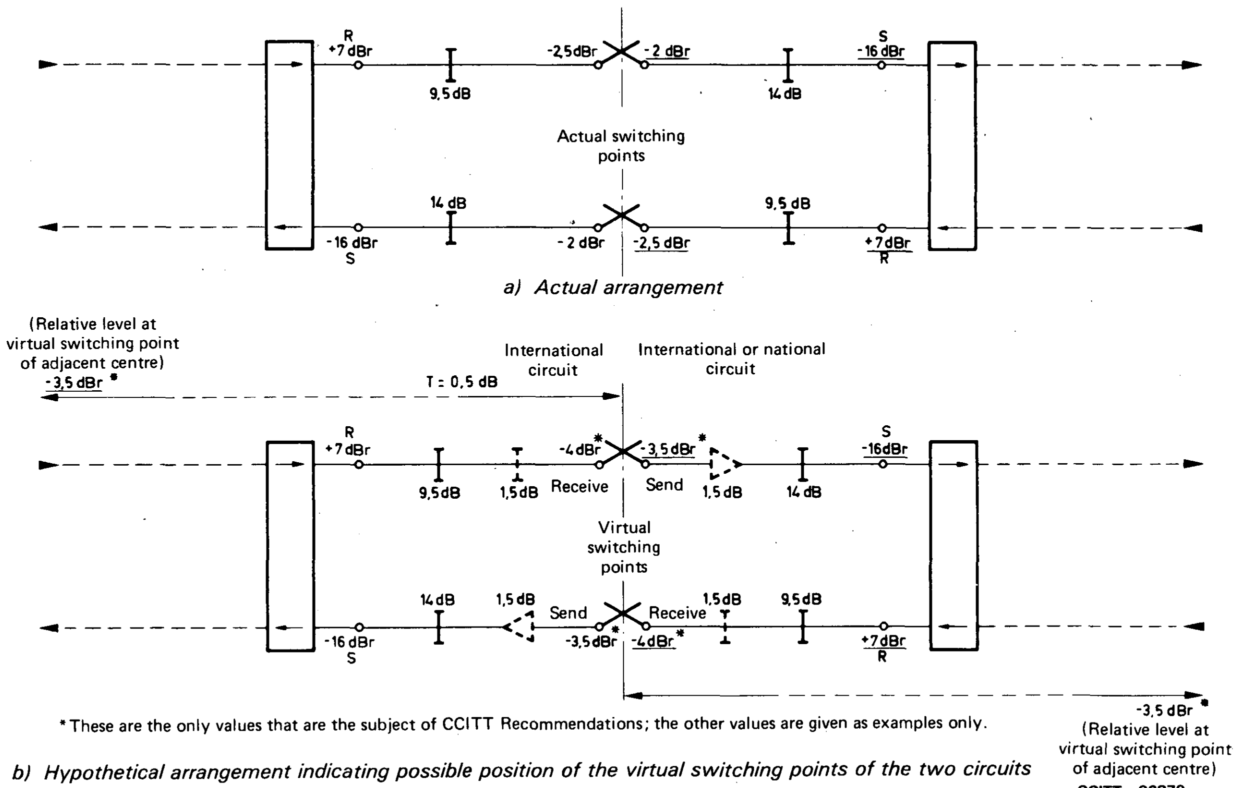
FIGURE 2/M.640

Definitions for an international circuit



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Note — Underlined values of relative level refer to the circuit on the right of the point concerned. Values of relative level not underlined refer to the circuit on the left of the point concerned. In an actual switching centre the virtual switching points would not physically exist.

FIGURE 3/M.640

Example showing a simplified representation of a transit connection in an international exchange with actual arrangement and possible location of virtual switching points

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[2] It should not be assumed that the *actual switching points* are the same as the *circuit terminals.*

1.2.3 *Definition of* nominal transmission loss between virtual switching points

The difference between the nominal values at the virtual switching points of the sending and receiving relative levels at the reference frequency is, by definition, the nominal transmission loss of the 4-wire circuit between virtual switching points.

1.3 *Relative levels specified at the virtual switching points of international circuits*

The virtual switching points of an international 4-wire telephone circuit are fixed by convention at points of the circuit where the nominal relative levels at the reference frequency are:

- sending: −3.5 dBr;
- receiving: −4.0 dBr.

The nominal transmission loss of this circuit at the reference frequency between virtual switching points is therefore 0.5 dB.

The relationship between the actual switching points and the virtual switching points in a practical international exchange is illustrated in Figure 3/M.640.

1.4 *Interconnection of international circuits*

Two international circuits interconnected in an international centre are considered to be connected together directly at their virtual switching points without any pad or amplifier between those virtual switching points (see Figure 2/M.640).

Therefore a chain of *n* international circuits has a nominal transmission loss in transit of *n* times 0.5 dB in each direction of transmission; this contributes to the stability of the connection.

2 Access points and their relative levels (formerly Part B)

2.1 *Access points*

An international 4-wire telephone circuit is defined by its *virtual switching points* in the transit or terminal international centre. Virtual switching points are theoretical points having specified relative levels and between which nominal transmission losses are calculated. For maintenance purposes, access points are required and these should be provided and used in accordance with the following principles:

a) The international circuit for public telephony includes the international line. Points serving to distinguish the ends of the international line should be provided in the form of 4-wire test access points called *line access points* as defined below.

   line access points *(points d'accès à la ligne – puntos de acceso a la línea)*

   Points used by the CCITT to define the limits of an international line, and from which measurements are made. Only one such "line access point" exists at each end of an international line. The precise location of each such point depends on the Administration concerned.

   In addition, test access points should be provided at the audio input and output of the channel-translating equipment.

b) At the international 4-wire switching centres at the terminals of a circuit there should also be "circuit access points" as defined below.

   circuit access points *(points d'accès au circuit – puntos de acceso al circuito)*

   Four-wire test access points so located that as much as possible of the international circuit is included between corresponding pairs of these access points at the two centres concerned. These points, and their relative level (with reference to the transmission reference point) are determined in each case by the Administration concerned. They are taken as the basic practical reference points of known relative level to which other transmission measurements will be related. In other words, for measurement and lining-up purposes, the level at the appropriate circuit test access point is the relative level with respect to which other levels are adjusted.

c) Both the line test access points and the circuit test access points will be used in tests made by the relevant maintenance units depending upon the local arrangement [3].

[3] A compandor, if fitted, should be connected on the line side of the line test access points and not between the line test access point and the circuit test access point. In this way the relationship between the nominal transmission levels at these two points on a circuit with a compandor is the same as for other circuits.

d) It is not possible to recommend a value for the nominal transmission loss between the circuit test access points of a switched public telephony circuit, because of the freedom accorded to Administrations in choosing the transmission levels at these points. However, bearing in mind that the attenuation between the circuit test access points and the virtual switching points will have a fixed and known value and that it is possible to *build out* the wiring to circuit test access points to a known loss, the send level at the circuit test/access point should be so chosen that the circuit level diagram is respected.

e) The impedance at the access points should have a return loss against the nominal impedance of the measuring apparatus of the station (for example 600 ohms, non-reactive) of not less than 20 dB over the range 600-3400 Hz and not less than 15 dB over the range 300-600 Hz.

2.2 *Choice of levels at access points for line measurements*

2.2.1 It is advantageous to adopt the same value of relative level at the send line test access points for every circuit connected to the exchange. Similarly, all the receive line test access points could also be at a particular common nominal value of relative level. When relative levels are made uniform in this way, lines can be readily cross-connected at the line test access points, which is useful in the immediate replacement of faulty lines in an emergency.

2.2.2 If the nominal relative level at the receive line test access point is chosen to be higher than that at the send line test access point of the same exchange this level difference can be used to offset the inherent transmission loss in the signalling and switching equipment, and the requirements of the new switching plan can be met without the obligation to install supplementary audio-frequency amplifiers.

Note – It is preferred to make transmission measurements between 4-wire test access points but, as a permissible alternative, a terminating unit may be provided together with an associated 2-wire test access point for measurement purposes. The transmission levels and losses must be chosen so that the nominal loss between virtual switching points is 0.5 dB and the circuit level diagram is respected.

Reference

[1] CCITT Recommendation *Transmission characteristics of an international exchange*, Vol. VI, Fascicle VI.1, Rec. Q.45.

Recommendation M.650

ROUTINE LINE MEASUREMENTS TO BE MADE ON THE LINE REPEATERS OF AUDIO-FREQUENCY SECTIONS OR CIRCUITS

Besides the routine tests made from end to end on the complete circuit, routine maintenance measurements of the equipment of audio-frequency circuits should be made throughout the line for purposes of repeater maintenance.

These routine measurements comprise:

- measurements of repeater gain (where there is little or no feedback);
- measurements for *testing* and *rejecting electronic valves* (measurements of slope or measurements of anode current, variation with heater current variation);
- measurements of *relative level* at the output of the repeaters (when measuring overall loss on the complete circuit, in the frontier stations and wherever else such measurements are considered necessary);
- measurements of circuit *stability* and test for determining singing points (with 2-wire repeaters).

The measurement of stability is obtained from the definition of stability σ of the circuit considered:

$$\sigma = q - (q_1 + q_2)/2$$

q being the mean of the nominal overall loss of the circuit in each of the two directions of transmission under normal working conditions and q_1 and q_2 being the singing points measured for the two directions of transmission respectively.

In order to measure these singing points in the case of a 2-wire circuit, singing is started by increasing, step-by-step and simultaneously for the two directions of transmission, the gains of one or of several repeaters (preferably those in the middle of the circuits because they are usually in the most critical position from the point of view of singing). Having done this, without touching the adjustment which has been obtained, the transmission in the reverse direction is suppressed and the overall loss of the circuit at 800 Hz is measured for the forward direction of transmission; this is the singing point q_1 above. Next the transmission in the first direction is suppressed and the overall loss of the circuit at 800 Hz is measured for the reverse direction of transmission: this is the singing point q_2 above.

When the circuit is composed of 2-wire and 4-wire sections, or carrier sections, the method of measurement given for 2-wire circuits is valid.

This stability should be determined with the ends of the circuit open-circuited; when there are high-impedance relays permanently connected across the line during a call, these relays may remain during stability tests.

Recommendation M.660

PERIODICAL IN-STATION TESTS OF ECHO SUPPRESSORS COMPLYING WITH RECOMMENDATION G.161 OF VOLUME III OF THE CCITT ORANGE BOOK

Note 1 – Certain of the tests in this Recommendation may conveniently be carried out on an in-station (or in-circuit) basis using measuring equipment to the specification in Recommendation O.141 [1].

Note 2 – The tests and periodicities specified in this Recommendation have been prepared to meet the needs of echo suppressors conforming to Recommendation G.162 [2]. The tests and periodicities for echo suppressors conforming to Recommendation G.164 [3] is under study.

1 Tests and periodicities applied to valve rectifier and relay type echo suppressors (formerly Part A)

1.1 The following tests should be made monthly:

1.1.1 *Check of suppression operate level*

If not within ± 2 dB of the initial value, readjust to be as close to the initial value as possible.

1.1.2 *Check of suppression loss (blocking attenuation)*

The suppression loss should not be less than 30 dB in the frequency range 200 - 3500 Hz and not less than 40 dB in the range 1000 - 1500 Hz.

1.1.3 *Check of differential sensitivity*

a) Check that the suppression loss is removed in the presence of signal on the send path of sufficient magnitude as compared with a signal on the receive path. This check should be made with magnitudes of the signal on the receive path, ranging from the operate level to the expected maximum speech level.

b) Check also that the suppression loss is not removed by the echo produced under the conditions corresponding to the worst expected return loss. Use of an interrupted signal at the operate-frequency or a test speech signal is likely to be effective for this check.

Note – These tests will be necessary when the break-in function is provided.

1.1.4 *Check of disabling facilities*

a) Some echo suppressors can be disabled by the associated signalling and switching equipment. The correct performance of this function, when provided, should be checked.

b) Some echo suppressors can be disabled by special audio frequency signals on **the circuit. The correct** performance of this function, when provided, should be checked.

1.2 The following characteristic times should be measured every six months and if they are not within 20% of the initial values they should be readjusted to be as close to the initial values as possible.

1.2.1 *Suppression operate times*

a) Relay-type echo suppressor. The operate time should not exceed 4 ms. Alternatively, the operate time should not be greater than 12 ms with a test signal at the operating frequency and 3 dB above the operate level.

b) Valve or rectifier type echo suppressor. The operate time should not exceed 4 ms. The period subsequent to the operate time, during which the specified suppression loss is achieved, should not exceed 0.5 ms. Thereafter, as long as the test signal is applied, the loss should not fall below that specified.

1.2.2 *Suppression hangover time*

The hangover time of the echo suppressor should be 50 ms. Exceptionally, where there is a long chain of national or international circuits beyond the point where the half-echo suppressor is fitted, the hangover time should be 70 ms.

2 Tests and periodicities applicable to semi-conductor type echo suppressors (formerly Part B)

2.1 The following tests should be made every six months:

2.1.1 *Check of suppression operate level*

If not within ± 2 dB of −31 dBm0 readjust to be as close to this level as possible.

2.1.2 *Check of suppression loss*

The suppression loss should be at least 50 dB.

2.1.3 *Check of break-in differential sensitivity and receive loss*

Check that the suppression loss is removed when the signal applied to the send-in port is within ± 2 dB of the level of a signal of the same frequency signal applied to the receive-in port. The level of the signal applied at the receive-in port should be between −15 and −20 dBm0. Check that the loss in the receive path (receive loss), when break-in occurs is between 5 and 15 dB when the level applied at the receive-in port is in the range −15 to −20 dBm0.

2.1.4 *Check of signalling disabling*

The operation and release of the signalling disabler circuit should be checked.

2.1.5 *Check of tone disabling*

The characteristics of the tone disabler circuit should be checked and should be within the following limits:

a) *Disabler sensitivity*

The disabler should operate for any single frequency within the disabling design range at a level of −30 dBm0.

The disabler should be released when the disabling tone is reduced to a level of −36 dBm0.

b) *Guard sensitivity*

With either an 800-Hz or 1000-Hz signal applied to the receive-in port and a 2100-Hz signal at a level of −28 dBm0 applied simultaneously to the send-in port, the suppressor should disable when the level of the 800-Hz or 1000-Hz signal is below −33 dBm0 and should not disable when this signal is above −28 dBm0.

c) *Broadband holding and release*

Once disabled a −31 dBm0 signal of either 800 or 1000 Hz should hold disabling and a −36 dBm0 signal should not.

2.2 The following characteristic times should be measured every six months and should be within the limits shown:

2.2.1 *Suppression*

a) Suppression operate time: 5 ms (maximum);

b) Suppression hangover time: 40-75 ms.

2.2.2 *Break-in*

a) Break-in operate time: 30 ms (maximum);

b) Break-in hangover time: 150-350 ms.

2.2.3 *Tone disability*

a) Tone disabler operate time: 300 ± 100 ms;

b) Tone disabler hangover time: 250 ± 150 ms.

Note – The disabler should not release for breaks of less than 100 ms in the disabling tone.

(For definitions of terms see Recommendation G.161 [2].)

References

[1] CCITT Recommendation *Description and basic specification for a semiautomatic in-circuit echo suppressor testing system (ESTS)*, Vol. IV, Fascicle IV.4, Rec. O.141.

[2] CCITT Recommendation *Echo suppressors suitable for circuits having either short or long propagation times*, Orange Book, Vol. III, Rec. G.161, ITU, Geneva, 1977.

[3] CCITT Recommendation *Echo suppressors*, Vol. III, Fascicle III.1, Rec. G.164.

Recommendation M.670

MAINTENANCE OF A CIRCUIT FITTED WITH A COMPANDOR

1 In-station tests

The compandor should be tested at intervals determined by the Administration. The tests should be in accordance with the appropriate design information which should be made available in a suitable form to the repeater station staff.

2 Circuit tests

No special objective test of the circuit to check the operation of the compandor is recommended, but when the circuit is routine tested a speaking test should also be made.

The unaffected level of the circuit and the noise advantage should be checked in accordance with §§ 3 and 4 of Recommendation M.590, at intervals determined by the Administration.

3.3 Maintenance of demand assignment circuits

Recommendation M.675

LINING UP AND MAINTAINING INTERNATIONAL DEMAND ASSIGNMENT CIRCUITS (SPADE)

General

Section 3.3 refers to Figure 1/M.675 and describes the features of *demand assignment circuits* [1] (abbreviated as DA circuits) established by means of single channel per carrier, PCM, multiple access demand assignment, equipment (SPADE) located in satellite earth stations.

Circuits thus provided are established between two international exchanges (CTs) on demand, with the constituent transmission paths making up the circuit being connected only for the duration of each demand. A transmission link is established between earth stations as required by the outgoing CT. The international DA circuit is formed via the distant earth station and its connection to the incoming CT by the terrestrial demand assignment section.

Upon release of this demand the transmission link establishing the demand assignment section is returned to a common pool allowing its reuse when required by other international exchanges operating in the demand assignment satellite network. Recommendation Q.48 [1] outlines the signalling system incorporated between demand assignment equipments located in satellite earth stations.

In general the Series M Recommendations concerned with preassigned international circuits apply equally to the sections of DA circuits. However, because of the variable nature concerning the establishment of circuits on demand, special consideration in provisioning, maintenance and fault finding is required. The following sections will provide details concerning these requirements.

1 Initial line-up and maintenance of demand assignment circuits and their constituent parts

1.1 The demand assignment circuit may be seen as being divided into three parts for setting-up, lining-up and maintenance: the outgoing terrestrial demand assignment section, the satellite demand assignment section and the incoming terrestrial demand assignment section. It is considered that the overall limits in Recommendation M.580 will be met by the application of the line-up limits given in Table 1/M.675 for the individual DA sections. However, sectional requirements prevail if the limits of Recommendation M.580 are not met on overall measurements.

1.2 The maintenance schedule, Table 2/M.675, should be utilized in the development of an initial demand assignment capability with a given CT (for example, commissioning of a new SPADE terminal) and establishing the appropriate periodic tests.

1.3 When terrestrial DA sections are added or a new corresponding terminal comes into service, tests should be conducted in accordance with Table 2/M.675.

2 Demand assignment circuit control responsibilities and fault location procedures

2.1 In the assignment of maintenance responsibilities, recognition is given to the constitution of a DA circuit as outlined in § 1.1 above. Section control and sub-control stations will be nominated for each terrestrial DA section. The initiation of fault localization procedures for a faulty DA circuit will be the responsibility of the fault report point (circuit) receiving the report. Upon being notified, the control station initiates tests to determine the location of the fault. If the fault condition is located beyond the satellite DA section, the fault report point (circuit) associated with the distant terrestrial DA section will be notified of the condition and will assume control responsibility for further localization and clearance of the fault.

[1] This type circuit may be considered to be equivalent to an international telephone circuit (preassigned) from a transmission point of view and is under study by Study Group XVI.

2.2 Faults should be investigated in a systematic manner, section by section. After verifying the report, e.g., by performance records or test calls, a recommended procedure for fault location is as follows:

2.2.1 Establish a CT to one's own CT satellite loop circuit, utilizing the suspected outgoing terrestrial DA section.

2.2.2 Determine if this configuration is faulty. If this is not the case then the associated earth station should, as sub-control, be instructed to check the satellite DA section to the particular distant earth station involved. If this section is found to be performing satisfactorily then the fault report is passed to the fault report point (circuit) at the distant CT. The distant CT then assumes responsibility for fault localization and the originating fault report point (circuit) advises its associated network analysis point of the action taken.

2.2.3 If the satellite loop of § 2.2.1 above was found faulty, action should be taken by the control station and its associated DA terminal to localize the fault to the outgoing terrestrial DA section.

2.3 Full use should be made of the operational status indications available to the DA satellite section sub-control station to determine fault situations on the outgoing terrestrial DA section and on the incoming and outgoing satellite DA sections. The DA section sub-control station should advise the fault report point (circuit) or fault report point (network), as appropriate, at its associated CT, of any observations indicating fault situations and ensure that the control station is aware of the situation.

2.4 Administrations establishing international circuits utilizing satellite demand assignment links should be able to obtain statistical information concerning the outgoing call processing of their respective countries from the demand assignment system operating authority. The information is required by the network analysis points, in their continuing analysis of the quality of the international network.

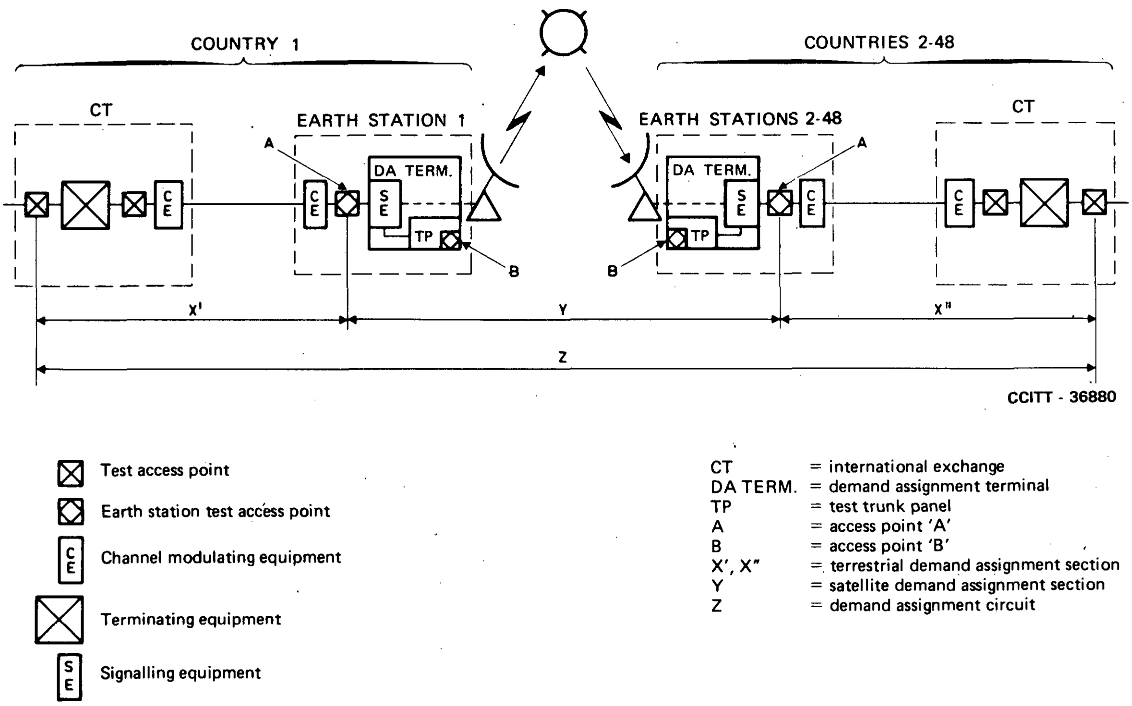

FIGURE 1/M.675

Constitution of an international demand assignment circuit

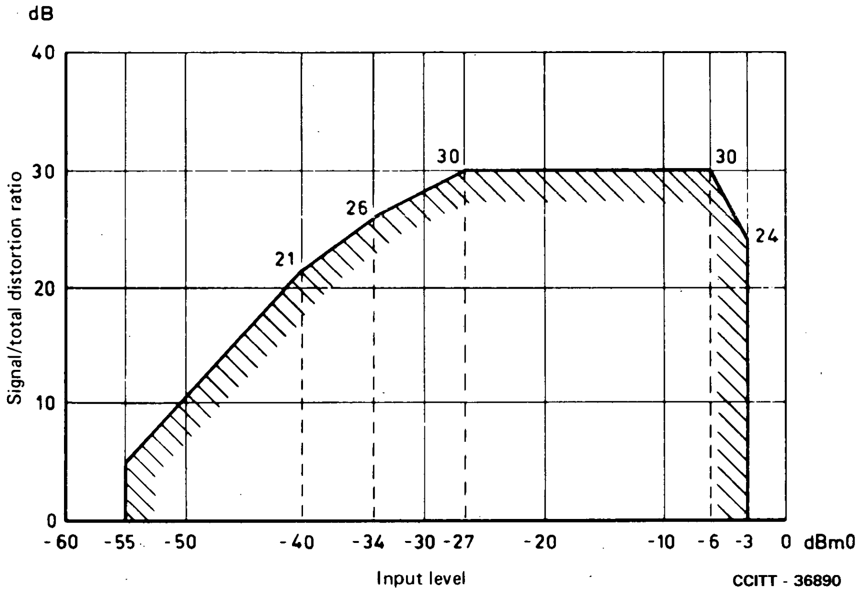

FIGURE 2/M.675

Signal/total distortion ratio as a function of input level utilizing a (provisional) **pseudo-random noise stimulus**

TABLE 1/M.675

Target objectives for setting up and lining up a demand assignment (SPADE) international public telephone circuit and its sections

Transmission parameters	Demand assignment circuit	Demand assignment section	
	Z CT to CT between circuit access points	Y Between SPADE terminals, demand assignment	X CT to SPADE terminal, terrestrial
1. Loss/frequency* relative to the loss at reference frequency (in dB)	(Series M Recommendations)		
300- 400 Hz	+3.5 to −1.0	+0.5 to −0.5	+1.7 to −0.5
400- 600 Hz	+2.0 to −1.0	+0.5 to −0.5	+0.9 to −0.5
600-2400 Hz	+1.0 to −1.0	+0.5 to −0.5	+0.5 to −0.5
2400-3000 Hz	+2.0 to −1.0	+0.9 to −0.5	+0.9 to −0.5
3000-3400 Hz	+3.5 to −1.0	+1.8 to −0.5	+1.7 to −0.5
2. Overall loss at reference frequency. Line-up level limits relative to nominal (in dB)	± 0.3	± 0.2	± 0.2
3. Idle Noise (−dBm0p)	Table 4/M.580 (See Note 3)	−60	Table 4/M,580
4. Quantizing distortion (signal/total distortion ratio in dB)	Not applicable	Figure 2/M.675 (See Note 1)	Not applicable
5. Signal crosstalk ratio (Go-return) (in dB)	43	60	48

* Reference frequency = 1020 Hz (see Note 2).

Notes to Table 1/M.675

1. Quantizing distortion should be measured in accordance with the test procedure agreed upon by the satellite system operators.
2. Test frequencies that are sub-harmonics of the PMC sampling rate should be avoided. (See Supplement No. 3.5 [a].)
3. Noise measurements should be made with the demand assignment codec voice detector enabled. This can be accomplished by utiizing a holding tone and notch filter or by conducting tests with the demand assignment equipment, in the pre-assigned mode.

TABLE 2/M.675

Testing and maintenance schedule

Tests	Demand assignment terminal access point	CT-Earth station X′, X″	From CT to own CT looped via satellite* Z	Earth station-earth station Y	Demand assignment terminal access point	CT-CT Z
		When tested				When tested
Comprehensive signalling and compatibility tests Q.163 [3] or equivalent	A and B (Note 1)	Initial system commissioning	—	—	—	—
Functional signalling test Q.163 [4] or equivalent	B (Note 1)	Initial line-up and periodic maintenance of section	Initial line-up and periodic maintenance of section	Initial system commissioning and new channel line-up (Notes 5 and 8)	B (Note 1)	(Note 7)
Measurement of loss and noise Rec. M.610	(Note 4)	Initial line-up and periodic maintenance of section	Initial line-up and periodic maintenance of section (Notes 2 and 3)	Initial system commissioning and new channel line-up (Notes 5 and 8)	A (Note 1)	(Notes 6 and 3)
Loss/frequency characteristics and crosstalk ratio Rec. M.610	(Note 4)	Initial line-up and periodic maintenance of section	Initial line-up and periodic maintenance of section (Notes 2 and 3)	Initial system commissioning and new channel line-up (Note 8)	A (Note 1)	(Notes 6 and 3)
Measurement of quantizing distortion	—	—	—	Initial system commissioning and new channel line-up (Note 8)	A (Note 1)	—
Spurious signal and channel intermodulation	—	—	—	Initial system commissioning and new channel line-up (Note 8)	A (Note 1)	—
Subjective tests Rec. M.610	B (Note 1)	Initial line-up and periodic maintenance of section	Initial line-up and periodic maintenance of section (Notes 2 and 3)	Initial system commissioning and new channel line-up (Notes 5 and 8)	B (Note 1)	(Notes 9 and 3)

* Simulated demand assignment circuit.

Notes to Table 2/M.675

1. *A* and *B* refer to the DA terminal testing interface. See Figure 1/M.675 for the location of these interfaces.
2. The outgoing CT must be capable of outpulsing its own country code and exchange digits.
3. Sectional requirements supersede if the overall requirements of Recommendation M.580 are not met.
4. *A* and/or *B* for line-up and *A* or *B* for periodic tests. (Reference measurements at initial line-up should include measurements made at the access point decided upon for periodic tests.)
5. Demand assignment system is assumed to operate internal diagnostics to check functional capability and continuity.
6. Loss, noise, loss/frequency and signal/crosstalk ratio tests may be applied on a sample basis when the system is initially commissioned, and as required for the extension of service.
7. Test calls may be carried out to verify operational capability initially, and as required.
8. These are as agreed upon by the satellite system operators.
9. Subjective testing CT-CT may be used on a sample basis, as required.

References

[1] CCITT Recommendation *Demand assignment signalling systems*, Vol. VI, Fascicle VI.1, Rec. Q.48.

[2] *Test frequencies on circuits routed over PCM systems*, Vol. IV, Fascicle IV.4, Supplement No. 3.5.

[3] CCITT Recommendation *Manual testing*, Green Book, Vol. VI-2, Rec. Q.163, § 4.3.4, parts 1 and 2, ITU, Geneva, 1973.

[4] Ibid., § 4.3.3.

3.4 Guiding principles for the maintenance of the international automatic service *

The guiding principles for the maintenance of automatic telephone circuits deal with the division of responsibility for the maintenance of international automatic or semiautomatic telephone circuits between those concerned (operating services, transmission services, etc.). These principles are found in Recommendations M.700 to M.733. The maintenance organization for transmission systems and leased and special circuits is outlined in Recommendation M.70.

Recommendation M.700

DEFINITIONS FOR THE MAINTENANCE ORGANIZATION

international line

Transmission system contained between the *line access points* (see § 2 of Recommendation M.640), of the two terminal international centres.

international automatic circuit

The whole of the international line and the outgoing and incoming equipment (or both-way equipments) proper to the automatic circuit considered. The ends of this circuit are defined by the *circuit access points* [1)] (see § 2 of Recommendation M.640).

automatic switching equipment

That part of an international exchange concerned with switching operations for routing the call in the desired direction.

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*) As is mentioned in Volumes IV and VI, the expression *automatic circuit*, except where otherwise indicated, means circuits which may be used either for semiautomatic or automatic operation.

1) See also Figure 1/M.110 [1] for an example of basic test access on various classes of circuits.

maintenance

The whole of the operations required for setting up and maintaining, within prescribed limits, any element entering into the setting-up of a connection. In international automatic service, maintenance is particularly concerned with circuits and automatic switching equipment. Circuit and automatic equipment maintenance includes:

a) carrying out setting-up measurements and adjustments [2];

b) planning and programming a maintenance scheme;

c) carrying out the prescribed routine preventive maintenance measurements and all other tests and measurements deemed necessary;

d) locating and clearing faults.

preventive maintenance

Method involving the use of systematic operations intended to discover and clear faults before they affect service.

corrective maintenance

Method based solely on locating and clearing faults after they have affected the service.

controlled maintenance [3]

A method to sustain a desired quality of service by the systematic application of analysis techniques using centralized supervisory facilities and/or sampling to minimize preventive maintenance and to reduce corrective maintenance.

international connection

Whole of the means joining temporarily two subscribers and enabling them to exchange information (see Recommendation G.101 [3]).

measurement

The numerical assessment in suitable units of the value of a simple or complex quantity or magnitude.

test

A direct practical trial in whatever manner it may be made.

yes or no test

A test made to indicate whether a quantity or magnitude would fall above or below a specified limit or boundary defined to distinguish pass and fail conditions.

functional test

A *yes or no* test made to indicate whether a circuit, equipment or part of an equipment will function or not function under actual working conditions.

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[2] It is considered that maintenance commences from the start of measurements and adjustments that precede entry into service. The results of these measurements provide reference values for subsequent maintenance, in the strict sense of the word.

[3] See [2] for a method of controlled maintenance procedure.

limit test [4)]

A test made to indicate whether a quantity would fall within or outside a pair of limits or boundaries.

The required degree of precision of expression is to be achieved by extending the term to state:

- on what the limit test is made, for example, *circuit limit test,*
- the function or characteristic that is tested, for example, *limit test of signalling,*
- for what purpose the limit test is intended, for example, *limit test for readjustment purposes.*

localization of faults

The *broad localization* of a fault consists of finding the general part of the equipment in which it exists. *Fault finding* consists of determining the faulty item of the equipment.

References

[1] CCITT Recommendation *Circuit testing,* Vol. IV, Fascicle IV.1, Figure 1/M.110 of Rec. M.110.

[2] *Methods of quality control,* Green Book, Vol. IV, Supplement No. 1.4, ITU, Geneva, 1973.

[3] CCITT Recommendation *The transmission plan,* Vol. III, Fascicle III.1, Rec. G.101.

Recommendation M.710

GENERAL MAINTENANCE ORGANIZATION [1)] FOR THE INTERNATIONAL AUTOMATIC AND SEMIAUTOMATIC SERVICE

1 General

To ensure satisfactory service quality in the international automatic and semiautomatic telephone service, it is necessary to have an organization which can use the techniques recommended for achieving this. The essential elements of such an organization are defined in § 2 below and relate to the maintenance of the different component parts of the international automatic network. Administrations are requested to apply these recommendations in order to obtain satisfactory service quality.

2 Maintenance organization

2.1 Any maintenance organization must include the following basic functions:

- setting-up and lining-up activities,
- routine testing activities,
- repair and restoration activities,
- reception and dissemination of maintenance information,
- analysis of maintenance information,
- recording of data.

Each of these basic functions is related to the different techniques (i.e. switching, signalling, transmission), or constituent parts of the international automatic network.

2.2 Cooperation in the maintenance of the international automatic and semiautomatic service should be based on an organization comprising the following elements in each country, each of which represents a set of functions:

a) fault reporting (circuits),

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4) Such a test might be made to ascertain the margin of security in actual operating conditions.

1) The phrase *general maintenance organization* does not necessarily relate to a specific organizational structure in any particular Administration.

b) **fault reporting (network)** [2],

c) testing (transmission),

d) testing (line signalling),

e) testing (switching and interregister signalling),

f) network analysis [2],

g) system availability information,

h) network management [2],

i) circuit control,

j) circuit sub-control,

k) restoration control.

2.3 The grouping of elements in a maintenance organization depends on the size and complexity of the maintenance organization and the particular country concerned. In some instances it may be possible to carry out all sets of functions assigned to the elements listed in § 2.2 above from a single unit (at one international centre common to many international centres); in others each set of functions may be carried out from separate locations or, alternatively, only some of the sets of functions might be combined and carried out from one location. The CCITT limits itself to defining the sets of functions for the separate elements, and it is left to the Administration concerned to decide whether to keep these sets of functions separate or to combine them in a manner to suit the Administration. However, the responsibilities for one set of functions at an international centre should not be divided up between two or more organizational entities.

The elements in § 2.2 above should be grouped in the manner most suitable for a given Administration. The simplest form would combine all the elements into one working unit capable of carrying out all the specified functions. Such an arrangement may be appropriate for those countries whose international automatic circuits are few in number. For countries that support larger numbers of international automatic circuits, the functional grouping should be based on the following considerations and the feasibility of change or expansion which may be appropriate to them:

a) the location of testing and measuring facilities;

b) the physical environment of the existing circuit, switching and other equipment;

c) the location of records of circuits, fault reports and service quality;

d) the location and availability of communication facilities;

e) the existence of comparable national functions which might be expanded to include international purposes;

f) the location of national system availability and traffic flow information which should be related to the international automatic network;

g) the level of coordination that is anticipated between elements within the Administration;

h) the staff work load that is anticipated for each element and the potential efficiencies involved in combining elements;

i) the anticipated ability to provide the necessary staff expertise and language facility where needed;

j) the arguments for and against centralization of a given element for an Administration;

k) the availability of supervisory and surveillance facilities at potential maintenance locations;

l) the existence of elements for other services, e.g. leased circuits, having similar maintenance functions.

All of the above specified elements should be provided for, while Administrations are free to combine the elements to best advantage as long as they are identified for other Administrations.

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[2] The use of the word *network* in this and subsequent Recommendations refers to the public telephone network. This does not restrict the combination of any element with other maintenance entities which have functions dedicated to services not noted herein.

The proposed approach does not necessarily preclude the retention of the terminology relating to *ITMC*, *ISMC*, and *ISCC*[3] but is directed at avoidance of duplication of responsibilities and functions and improvement of information flow.

Some typical groupings are indicated in Annex A of this Recommendation. Administrations that have large numbers of international automatic circuits tend to provide more groupings; this lends itself to more staff specialization. Some natural combinations are encouraged such as the coupling of the fault report point (circuit) and the circuit control (circuit sub-control). These would normally be kept together at a given international centre in order to minimize the coordination that would be required to permit them to function separately.

2.4 The responsibilities and functions as well as the facilities needed for the elements listed in § 2.2 a)-k) above are described in the Series M Recommendations M.700 to M.733. A brief definition of these elements is given below.

2.4.1 The *fault report point (circuit)* accepts and assigns for clearance all faults relating to one, or more, specifically identified circuits.

2.4.2 The *fault report point (network)* accepts and assigns for clearance all faults that, when reported, are not identified with specific circuits. This should include all switching difficulties.

2.4.3 The *testing point (transmission)* performs transmission testing on international circuits for lining-up purposes, on a routine basis, and in case of reported faults.

2.4.4 The *testing point (line signalling)* performs testing of line signalling on international circuits for setting-up purposes, on a routine basis, and in case of reported faults.

2.4.5 The *testing point (switching and interregister signalling)* performs testing of switching and interregister signalling on international equipment for setting-up purposes, on a routine basis, or in case of reported faults.

2.4.6 The *network analysis point* receives information on service quality, and faults not identified with specific circuits. It carries out the analysis of this information to investigate the problems involved.

2.4.7 The *system availability information point* collects and disseminates information concerning the nonavailability of telecommunications systems which affects the international automatic and semiautomatic service.

2.4.8 The *network management point* initiates and cooperates in applying network management actions as defined in Recommendation E.410 [1].

2.4.9 The *circuit control station* is responsible for the satisfactory operation of the international circuits that it controls.

2.4.10 The *circuit sub-control station* is responsible for the satisfactory operation of the international circuit sections that it controls. It will assist the circuit control in its work to ensure the satisfactory operation of the entire circuit.

2.4.11 The *restoration control point* initiates and coordinates the restoration activities in case of failures or planned outages of transmission systems.

2.5 Those responsible for the different sets of functions may communicate directly with one another and with their corresponding elements or the fault report points in other countries.

Communication between units in different countries may be carried out by means of telephone or telegraph service circuits or through switching networks, as arranged between the Administrations concerned.

It is essential that information on telephone and telex numbers of contact points be exchanged frequently between Administrations (see Recommendation M.728).

[3] *ITMC*, *ISMC*, *ISCC* refer to the international transmission maintenance centre, the international switching maintenance centre, and the international service coordination centre.

2.6 In addition to the requirements of technical and operational knowledge, the staff responsible for the above-listed sets of functions should be selected and trained with a view to avoiding language difficulties.

The attention of Administrations is also drawn to the benefit that may be derived from enabling staff in the international service who work in corresponding units in different countries to meet and discuss their work.

ANNEX A

(to Recommendation M.710)

Illustrative groupings of elements into maintenance units

A.1 *All testing facilities are at one location, viz, Group A*

Group A	*Group B*
Testing point (transmission)	Network analysis point
Testing point (switching and interregister signalling)	Fault report point (network)
Testing point (line signalling)	System availability information point
Fault report point (circuit)	Network management point
Circuit control and circuit sub-control	Restoration control point

A.2 *Circuit access points are extended to a transmission testing location and it is convenient to separate this element*

Group A	*Group B*	*Group C*
Testing point (transmission)	Network analysis point	Fault report point (circuit)
	Fault report point network	Circuit control and circuit sub-control
	System availability information point	Testing point (line signalling)
	Network management point	Testing point (switching and interregister signalling)
	Restoration control point	

A.3 *Circuit access points and line signalling access are remote from the switching centre at a location which has all circuit and circuit fault records*

System availability and network management functions are executed where similar national functions are fulfilled:

Group A	*Group B*
Fault report point (circuit)	Testing point (switching and interregister signalling)
Circuit control and circuit sub-control	
Testing point (line signalling)	
Testing point (transmission)	

Group C	*Group D*
Fault report point (network)	System availability information point [4)]
Network analysis point	Network management point [4)]
Restoration control point	

Reference

[1] CCITT Recommendation *International network management – Planning and operating procedures*, Vol. II, Fascicle II.3, Rec. E.410.

Recommendation M.715

FAULT REPORT POINT (CIRCUIT)

1 Definition of fault report point (circuit)

The fault report point (circuit) is an element within the general maintenance organization for the international automatic and semiautomatic service at each international centre or common for more than one international centre.

The fault report point (circuit) is equipped with all the necessary facilities and arranged in such a way that it may receive fault reports relating to one or more specifically identified circuits from different sources or make such fault reports to other points and initiate the fault localization and clearing operations.

2 Responsibilities and functions

The fault report point (circuit) is responsible for the following set of functions:

2.1 Receiving fault reports from:

- similar fault report points of other Administrations;
- fault report point (network);
- staff at the repeater station for faults indicated by:
  - group pilot or line pilot alarms,
  - local alarms at the repeater station,
  - routine maintenance measurements and functional tests, or
  - measurements in a special event;
- staff at the testing point (transmission) for faults indicated by:
  - routine maintenance measurements and functional tests, or
  - measurements in a special event;
- staff at the testing point (line signalling) for faults indicated by:
  - circuit alarms,
  - routine maintenance measurements and functional tests, or
  - tests in a special event;
- staff at the testing point (switching and interregister signalling) for faults indicated by:
  - local alarms and supervisory or analytical devices,
  - routine tests, or
  - tests in a special event;

4) Where similar national functions are fulfilled.

- traffic operating personnel;
- staff at the network analysis point;
- services concerned with the national network of the country;
- any other source.

2.2 Recording the fault reports and keeping fault records up to date;

2.3 Performing preliminary diagnosis to determine to which maintenance unit the fault has to be assigned for clearance;

2.4 Initiating detailed fault location and subsequent clearing;

2.5 Sending fault reports as appropriate to:

- circuit control station in its own country in case of controlling end;
- the distant end fault report point (circuit) in case of noncontrolling end;
- the fault report point (network).

2.6 Providing the information and cooperation needed to deal with inquiries by traffic and maintenance staff or by the fault report point (circuit) at the distant end;

2.7 Advising the fault report point (network), the network analysis point, the system availability information point and the network management point of faults affecting the automatic service as required;

2.8 Requesting the circuit control station within its own country, if controlling end, to arrange for the withdrawal from service of circuits reported faulty;

2.9 Keeping informed of the progress of fault clearance;

2.10 Receiving the information about the cause of the faults;

2.11 Notifying details of fault clearance to the point of origin of a fault report when the fault has been cleared;

2.12 Requesting the circuit control station to arrange for the return of the circuit of service, if controlling end;

2.13 Making or arranging for an analysis of faults as may be necessary;

2.14 Identifying repeated faults and advising the circuit control station;

2.15 Forwarding details of faults found or faults the causes of which could not be found to the network analysis point for analysis to detect long-term trends.

3 Facilities

3.1 Service circuits.

3.1.1 Access to direct telephone service circuits to international centres in other countries;

3.1.2 Direct telephone service circuits to the relevant contact points within its own Administration (at the same international centre or at different international centres as necessary);

3.1.3 Access to direct teleprinter service circuits to international centres in other countries.

3.2 Direct connection to the public telephone network.

3.3 Access to the international telex network.

3.4 Authority to make priority calls in the international service.

3.5 Access to information concerning circuits in service.

Recommendation M.716

FAULT REPORT POINT (NETWORK)

1 Definition of fault report point (network)

The fault report point (network) is an element within the general maintenance organization for the international automatic and semiautomatic service at each international centre or common for more than one international centre. If more than one international centre is associated with a given relation, it is desirable to designate one fault report point (network) as the principal one for that relation. If such is not practical, one of the fault report points (network) or a central organization may be nominated to coordinate the activities of the various fault report points (network) that are involved.

The fault report point (network) is equipped with all the necessary facilities and arranged in such a way as to enable it to:

a) receive, from different sources, fault reports of difficulties on the international telephone network or of problems with the international service that, at the time of reporting, are not identified with specific circuits; and

b) make such fault reports to other points and initiate the fault location and clearing operations.

2 Responsibilities and functions

The fault report point (network) is responsible for the following set of functions:

2.1 Receiving fault reports from:

- similar fault report points of other Administrations;
- traffic operating personnel;
- customers via the appropriate customer service points;
- service observation staff;
- accounting (charging) analysis service;
- staff at the network analysis point;
- various maintenance centres including information regarding the quantities of equipment or circuits available following a major breakdown;
- services concerned with the national network of the country;
- any other source.

2.2 Recording the fault reports and keeping fault records up to date.

2.3 Performing preliminary diagnosis to determine to which maintenance unit the fault has to be assigned for clearance.

2.4 Initiating detailed fault location and subsequent clearing.

2.5 Sending fault reports as appropriate to similar fault report points of other Administrations.

2.6 Providing the information and cooperation needed to deal with inquiries by traffic and maintenance staff or by fault report points of another Administration.

2.7 Advising the network analysis point, the system availability information point and the network management point of faults affecting the automatic service.

2.8 Arranging where appropriate for the withdrawal from service of faulty equipment and restoral after clearance.

2.9 Keeping informed of the progress of fault clearance.

2.10 Receiving the information about the cause of the faults.

2.11 Notifying details of fault clearance to the point of origin of a fault report when the fault has been cleared.

2.12 Keeping general routing information, diagrams or plans of the arteries relevant to the international network and the national network of the country concerned up to date.

2.13 Making an analysis of faults as may be necessary.

2.14 Identifying repeated faults, and advising the circuit control station.

2.15 Forwarding details of faults found or faults the cause of which could not be detected to the network analysis point for analysis to detect long-term trends.

2.16 Advising all fault report points (network) that may be concerned with changes in the numbering plan of its country together with actions taken to deal with calls to old numbers.

3 Facilities

3.1 Service circuits.

3.1.1 Access to direct telephone service circuits to international centres in other countries.

3.1.2 Direct telephone service circuits to the relevant contact points within its own Administration (at the same international centre or at different international centres as necessary).

3.1.3 Access to direct teleprinter service circuits to international centres in other countries.

3.2 Direct connection to the public telephone network.

3.3 Access to the international telex network.

3.4 Authority to make priority calls in the international service.

3.5 Access to appropriate network information, e.g. number of circuits in service, routing plans, network configuration.

Recommendation M.717

TESTING POINT (TRANSMISSION)

1 Definition of testing point (transmission)

The testing point (transmission) is an element within the general maintenance organization for the international automatic and semiautomatic service at each international centre. It carries out transmission testing on international circuits.

2 Responsibilities and functions

The testing point (transmission) is responsible for the following set of functions:

2.1 Carrying out transmission measurements in connection with the setting-up and lining-up of international circuits.

2.2 Carrying out routine transmission tests.

2.3 Diagnostic testing on receipt of fault indications.

2.4 Passing details of the location of faults to the appropriate maintenance unit and cooperating as necessary in detailed fault localization.

2.5 Advising the circuit control or the sub-control station and the fault report point (circuit) of any difficulties detected by routine tests and the action taken in progressing the clearance of faults.

2.6 Cooperating with staff in other international centres as required.

3 Facilities

The testing point (transmission) should be provided with the following facilities:

3.1 Access to the circuit access point (for definition of these access points, refer to § 2 of Recommendation M.640).

3.2 Access to the line access point (for definition of these access points, refer to § 2 of Recommendation M.640).

3.3 Association of test equipment to the access points so that all transmission parameters specified for the circuits concerned may be measured.

3.4 Communication to the circuit control station and other points concerned with circuit maintenance within the same international centre.

3.5 Communication to similar points in other international centres to which circuits are routed to enable cooperation to be obtained and given.

Recommendation M.718

TESTING POINT (LINE SIGNALLING)

1 Definition of testing point (line signalling)

The testing point (line signalling) is an element within the general maintenance organization for the international automatic and semiautomatic service at each international centre. It carries out line signalling tests on international circuits [1].

2 Responsibilities and functions

The testing point (line signalling) is responsible for the following set of functions:

2.1 Carrying out line signalling tests in connection with the setting-up and lining-up of international circuits.

2.2 Carrying out routine line signalling tests.

2.3 Carrying out diagnostic tests to localize a reported difficulty in line signalling.

2.4 Passing details of line signalling problems to the apropriate maintenance unit as necessary and cooperating in detailed fault localization.

2.5 Reporting details to the circuit control station, the fault report point (circuit) or the originating fault report point as appropriate of action taken.

2.6 Cooperating with staff in other international centres as required.

3 Facilities

The testing point (line signalling) should be provided with the following facilities:

3.1 Access to the circuit access point (for definition of these access points, refer to § 2 of Recommendation M.640).

3.2 Access to the line access point (for definition of these access points, refer to § 2 of Recommendation M.640).

3.3 Association of test equipment to the access points to assess the performance of the line signalling entities.

3.4 Communication with other points concerned with circuit maintenance and signalling equipment maintenance within the same international centre.

3.5 Communication with similar points in other international centres to which circuits are routed to enable cooperation to be obtained and given.

Recommendation M.719

TESTING POINT (SWITCHING AND INTERREGISTER SIGNALLING)

1 Definition of testing point (switching and interregister signalling)

The testing point (switching and interregister signalling) is an element within the general maintenance organization for the international automatic and semiautomatic service at each international centre. It carries out tests concerned with switching and interregister signalling functions associated with international circuits. This should include tests associated with common channel signalling systems.

2 Responsibilities and functions

The testing point (switching and interregister signalling) is responsible for the following set of functions:

2.1 Carrying out switching and interregister signalling tests in connection with the setting-up and lining-up of international circuits.

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[1] The supervisory aspects of common channel signalling are considered in Recommendation M.719.

2.2 Ensuring that new circuits can be accessed via the switching equipment, and that auxiliary equipment (e.g. accounting equipment, ATME) is correctly associated.

2.3 Carrying out routine tests of the switching and interregister signalling entities.

2.4 Diagnostic testing to confirm existence and location of switching and interregister signalling problems indicated by monitorial equipment or fault reports.

2.5 Passing details of the locations of faults to the appropriate maintenance units for clearance, and cooperating with them as necessary.

2.6 Advising the fault report point (network) and the network management point of any problems which may affect service on a route or routes and the action taken.

2.7 Advising the circuit control station of any difficulties detected by routine tests or monitorial means which affect individual circuits.

2.8 Cooperating with staff in other international centres as required.

3 Facilities

The testing point (switching and interregister signalling) should be provided with the following facilities:

3.1 Ability to test common equipment elements for performance and/or availability.

3.2 Means for assessing switching capability and interregister signalling in accordance with the annex to this Recommendation.

3.3 Communication with other maintenance entities as appropriate.

ANNEX A

(to Recommendation M.719)

Measuring and testing equipment (signalling and switching)

The basic types of equipment needed by a testing point (switching and interregister signalling) are as follows:

1) Equipment for signalling tests.

2) Equipment for switching tests.

3) Signalling encoders consisting of:
   - a signal generator with facilities to vary frequency, amplitude and timing within defined limits, in conjunction with:
   - a test call generator, so that test calls using nominal or marginal signals can be generated.

4) Signal decoders, i.e. a device capable of responding to incoming signals such as to indicate whether or not the received signals are within limits.

5) Signal displays, i.e. a device capable of displaying the signals, line or register, transmitted or received by a circuit. The display should preferably be in digital form.

6) Signal timers, i.e. a device capable of measuring the length of signals and the interval between signals (line and register), transmitted or received over a circuit.

7) Signal level measuring device.

8) Signal distortion measuring device.

9) Signal recording device, for permanent records of line and register signals.

Further details of equipment for testing switching and interregister signalling are given in the relevant Recommendations on the different signalling systems.

NETWORK ANALYSIS POINT

1 Definition of network analysis point

The network analysis point is an element within the general maintenance organization for the international automatic and semiautomatic service associated with one or more international centres.

It receives information concerning service quality and faults not associated with specific circuits. It analyzes all relevant information to investigate the problems involved. It may request the fault report point (network) to initiate investigatory and/or remedial actions in one or more maintenance centres in its own country or via a fault report point (network) in another country.

2 Responsibilities and functions

The network analysis point is responsible for the following set of functions:

2.1 Analyzing all fault reports received from the fault report point (network).

2.2 Collecting and analyzing all information necessary for the evaluation and supervision of the quality of the international service and the diagnosis and localization of faults reported to it. The following items are recommended for consideration:

a) Call failure information derived from operator and subscriber reports.

b) Traffic service observations for preparation of Tables 1/E.422 [1] and 3/E.421 [2].

c) Traffic service observations undertaken for specific purposes.

d) Results of manual and automatic test calls.

e) Reports from fault report points (network) of other Administrations and also from maintenance units of its own Administration.

f) Summarizing information from group reference pilots.

g) Information from automatic supervision of switching equipment.

h) Information that all circuits on a route are busy.

i) Summarized information from traffic monitoring and accounting equipment.

j) Information derived from circuit and circuit group surveillance equipment.

k) Periodic data from traffic measuring equipment, e.g. loading in erlangs, percentage occupancy and overflow intensities.

2.3 Analyzing summaries of transmission measurements that may be received from maintenance units of its own Administration.

2.4 Receiving information concerning major breakdowns affecting international service and evaluating their effect with respect to network condition.

2.5 Receiving reports of all events likely to affect the international service.

2.6 Analyzing out-of-service times and cooperating with the maintenance units in their efforts to reduce such times to a minimum.

2.7 Making optimum use of statistical methods (e.g. trouble pattern techniques) for determining the probable location of failure points.

2.8 Cooperating with the network analysis points of other countries in order to coordinate action in case of service defects existing in the part of the network depending on those points.

2.9 Employing information concerning routing, signalling, switching, and transmission systems in its country and other countries to help locate and clear impediments to good service.

2.10 Advising the fault report point (network) of the results of its analyses as necessary.

3 Facilities

3.1 The network analysis point should have appropriate communication facilities in order to assume its responsibilities.

3.2 It should have the means to receive and process information associated with the functions listed above.

3.3 It should have the means of storing received and processed information.

3.4 It should have the means of accessing stored information.

References

[1] CCITT Recommendation *Observations on international outgoing telephone calls for quality of service*, Vol. II, Fascicle II.3, Table 1/E.422 of Rec. E.422.

[2] CCITT Recommendation *Observations on traffic set up by operators*, Vol. II, Fascicle II.3, Table 1/E.423 of Rec. E.423.

Recommendation M.721

SYSTEM AVAILABILITY INFORMATION POINT

1 Definition of system availability information point

The system availability information point is an element within the general maintenance organization for the international automatic and semiautomatic service associated with one or more international centres. It collects and disseminates information concerning the nonavailability of telecommunications systems which affects the international service. The term availability is used here in the broadest sense of the word.

2 Responsibilities and functions

The system availability information point is responsible for the following set of functions:

2.1 Collecting information concerning major breakdowns, planned outages, or other special circumstances in the *national* and *international* networks which would materially affect international traffic whether incoming, outgoing or transit.

2.2 Keeping aware of the probable duration of major breakdowns and noting whether the relevant traffic load is such that service is likely to be affected.

2.3 Keeping close contact with the restoration control point(s) and assisting in restoration matters.

2.4 Collecting information concerning the status of restoration activities related to major failures, and the return to normal conditions.

2.5 Making available information concerning failures and restoration progress to interested parties and other centres not directly involved in the activities, as appropriate.

2.6 Furnishing reports to the operating authorities of abnormal conditions, as required, including progress reports in connection with prolonged disruptions.

2.7 Furnishing major breakdown information to network management or traffic operating personnel when a major breakdown occurs, so that suitable changes may be made in operating procedures.

2.8 Notifying other international centres as required, through the appropriate authorities, of actions taken in connection with major breakdowns.

2.9 Continuously observing system conditions and if a situation arises where service disturbances can be minimized with a change in normal procedures, advising the appropriate maintenance unit (e.g. concerning postponement of a planned outage).

3 Facilities

3.1 The system availability information point should have appropriate communication facilities in order to assume its responsibilities.

3.2 It should have the means to receive, store, have access to, and up-date system availability information.

Recommendation M.722

NETWORK MANAGEMENT POINT

1 Definition of the network management point

The network management point is an element within the general maintenance organization for the international automatic and semiautomatic service associated with one or more international centres. It is responsible for ensuring the management of traffic flow, to optimize such flow under all circumstances of load and faults in equipment and transmission arteries. The techniques and functions involved are indicated in Recommendation E.410 [1].

The network management point receives all information concerning failures, planned outages or congestion in national and international switching centres, groups of circuits and transmission arteries that may significantly affect international traffic flow. It should have access to all information available to the system availability information point. The actions such a network management point may take to optimize traffic flow are indicated in Recommendation E.410 [1].

2 Responsibilities and functions

2.1 The network management point is responsible for the following set of functions:

2.1.1 Determining the need for the control of traffic as indicated by one or more of these conditions:

a) the failure or planned outage of an international or national transmission system,

b) congestion in an international switching centre,

c) the failure or planned outage of an international switching centre,

d) congestion in a national network,

e) heavy traffic caused by any unusual condition.

2.1.2 Applying or arranging for network management controls as described in Recommendation E.410 [1] in one of the following categories as appropriate to ensure maximum utilization of the network under all conditions:

a) prearranged by mutual agreement,

b) initiated by the outgoing Administration at the time, for example, suppression of traffic,

c) negotiated by the Administrations involved at the time.

2.1.3 Liaising and cooperating with other similar points in the application of network management controls.

2.1.4 Disseminating information as appropriate within its own Administration concerning network management actions taken.

2.2 The following are typical functions executed in accordance with the Recommendation cited in [2] as a result of common control switching system congestion or final route congestion or both.

2.2.1 Removal from the network of those calls with a low probability of successful completion as close to the origin as possible. For example, one of these actions may be applicable:

a) Cancellation of alternate routing via congested common switching equipment. This action must be taken in response to switching (common control) load indications which are transmitted to the switching centres involved.

b) Directionalization of international two-way trunk groups to favour traffic leaving the international network over that which is entering. This action is taken in response to network-congestion indications and is a function of trunk-group loads.

c) Partial cancellation of first-routed traffic in congested switching centres. This action is similar to a) above, where the switching centre is loaded with first-routed traffic.

d) Cancellation of alternate routing via congested final routes. This action could be taken in response to trunk and/or exchange load information.

e) Recorded announcements to subscribers in the originating country and special instructions to operators for them to take appropriate action.

2.2.2 Transfer of traffic encountering congestion on its normal routes to lightly loaded facilities (by agreement between the Administrations involved) and based on trunk load information concerning the routes involved.

2.3 Exchanging information with restoration control points for coordination purposes as appropriate.

3 Facilities

3.1 The network management point should have appropriate communication facilities in order to assume its responsibilities.

3.2 The network management point will require the facilities to measure traffic route load and switching congestion directly or it should receive all such information that relates to the international automatic service. The specific measurements (bids, overflow bids and seizures per unit time, lengths of queues waiting for access to common equipment, and equipment occupancy) are to be made in accordance with the Recommendation cited in [3]. Indicators of *all trunk busy* on final routes should also be available.

3.3 It should have access to all information appropriate to its functions.

References

[1] CCITT Recommendation *International network management – Planning and operating procedures*, Vol. II, Fascicle II.3, Rec. E.410.

[2] Ibid., § 6.

[3] Ibid., § 3.

Recommendation M.723

CIRCUIT CONTROL STATION

1 Definition of circuit control station

The circuit control station is the point within the general maintenance organization for the international automatic and semiautomatic service that fulfils the control responsibilities for the automatic circuits assigned to it.

2 Responsibilities

The circuit control station is responsible for ensuring that an automatic circuit assigned to it is set up and maintained to the required standards in both directions of transmission and that, if the circuit fails, the outage time is kept to a minimum.

3 Functions

3.1 Arranging for the setting-up of the circuit, and of the signalling and switching equipment associated directly with the circuit, and the related adjustment.

3.2 Controlling lining-up measurements to within the recommended limits.

3.3 Ensuring that routine maintenance measurements and tests are carried out in accordance with the agreed schedule using the specified methods and in such a way that interruptions to service are limited to the shortest possible duration.

3.4 Requesting that the circuit sub-control station takes action as required.

3.5 Arranging for the blocking of circuits as required.

3.6 Ensuring that fault location and clearing is carried out by the responsible testing point and/or maintenance unit in a proper manner.

3.7 Initiating investigation of repeated circuit faults.

3.8 Controlling the withdrawal of circuits from service.

3.9 Controlling the return of circuits to service, after the fault clearance.

3.10 Being continuously informed of the condition of the automatic circuits under its control.

3.11 Keeping up to date records of the routing of the automatic circuits under its control.

3.12 Knowing what are the possibilities of rerouting any faulty circuits and making arrangements for such reroutings where necessary.

4 Appointment of circuit control stations

A circuit control station is appointed for each international circuit used for the automatic and semiautomatic telephone service. When the circuit is operated unidirectionally the circuit control station is generally at the outgoing end. When the circuit is operated both-way, the circuit control station can be at either end by common agreement between the technical services of the Administrations concerned. In making the choice, special consideration will be given to:

- whether the location to be nominated as the circuit control station is permanently attended,
- the amount of work at each terminal point,
- the length of the circuit within the territory of each terminal country.

Recommendation M.724

CIRCUIT SUB-CONTROL STATION

1 Definition of circuit sub-control station

The circuit sub-control station is a point within the general maintenance organization for the international automatic and semiautomatic service that assists the circuit control station and fulfils the control responsibilities for a circuit section assigned to it.

2 Responsibilities

It is the responsibility of the circuit sub-control station to inform the circuit control station about all noted events likely to affect the circuit under their control. If the circuit sections are assigned to the circuit sub-control for the purpose of controlling them, the circuit sub-control is responsible for these circuit sections in the same way as the circuit control station is for the complete circuit.

3 Functions

3.1 Performing the control functions for circuit sections, especially national sections, as given for the circuit control station.

3.2 Cooperating with the circuit control station and other circuit sub-control stations in ensuring that routine maintenance fault location and clearance are carried out by the responsible testing points and/or maintenance units in a proper manner.

3.3 Arranging that all relevant details concerning the location and subsequent clearance of faults are reported to the fault report point (circuit) at the controlling end.

4 Appointment of circuit sub-control stations

For each circuit used for the automatic and semiautomatic telephone service a terminal circuit sub-control station is appointed. This is generally the end of the circuit remote from the circuit control station. In transit countries in which a circuit is brought to audio frequencies, an intermediate circuit sub-control station is appointed at a suitable point for each direction of transmission. It is left to the Administration concerned to choose:

- where this point shall be,
- whether the sub-control functions for the two directions of transmission are vested in one station or two stations,
- whether, as may be desirable in the case of a large country, each direction of transmission has more than one circuit sub-control station per transit country.

The technical service of the Administration concerned indicates its choice to the technical service of the Administration responsible for the control station.

Recommendation M.725

RESTORATION CONTROL POINT

1 Definition of restoration control point (RCP)

The restoration control point (RCP) is an element within the general maintenance organization for the international services. It initiates and coordinates service restoration activities in case of failures or planned outages of transmission systems in accordance with plans and *ad hoc* arrangements agreed by the technical services [1] of the Administrations concerned.

Since two or more RCPs are involved in agreed restoration plans, it is practical to nominate one RCP as the Overall RCP which then initiates and controls implementation of the plan. The additional responsibilities and functions of an Overall RCP are given in § 3 below.

2 Responsibilities and functions

The restoration control point is responsible for the following set of functions:

2.1 Initiating the implementation of a restoration plan and *ad hoc* arrangements with the other stations involved within its Administration's boundaries.

2.2 Monitoring the implementation of the restoration plan.

2.3 Coordinating the restoration activities of the repeater stations and other stations involved within its Administration's boundaries.

2.4 Liaising with restoration control points of other Administrations as necessary and agreeing the times of events with them.

2.5 Exchanging information with the network management point for coordination purposes as appropriate.

[1] Generally, Administrations involved in agreeing such restoration plans or *ad hoc* arrangements have appointed restoration liaison officers (RLO) who are responsible for liaising or restoration matters. However, some Administrations may wish to delegate the responsibility for the agreement of *ad hoc* arrangements to their RCPs.

2.6 Monitoring and coordinating the return to normal service conditions after the fault has been cleared or the planned work has been finished.

2.7 Keeping, throughout the period during which the restoration and the return to normal conditions is executed, an accurate log of events, including any circuit, channel, group, supergroup, etc., or baseband patching which takes place.

2.8 Requesting and receiving reports from other RCPs and disseminating this information within its own Administration as required.

2.9 Reporting the events to the responsible authorities [1] of its Administration as desired and advising the system availability information point about the progress of restoration.

2.10 Sending a final restoration report, after the return to normal, containing all relevant data (including agreed times) for accounting purposes to the responsible authorities [1] within its Administration.

2.11 If no restoration plan exists or, for some reason, an existing plan cannot be implemented, advising the responsible authorities [1] in its own Administration and suggesting suitable *ad hoc* arrangements in the light of the information available.

3 Additional responsibilities of an overall RCP

The responsibilities of an overall RCP are much the same as an ordinary RCP but with additional responsibilities as follows:

3.1 Initiating the implementation of a restoration plan with other RCPs concerned.

3.2 Requesting and receiving reports from other RCPs and disseminating this information as necessary.

3.3 Coordinating and controlling all restoration activities including the return to normal conditions.

4 Facilities

4.1 The RCP should have appropriate communication facilities in order to assume its responsibilities.

4.2 It should have access to information appropriate to its functions and this includes:

a) status of relevant international transmission systems;

b) current restoration plans;

c) list of the sections of border-crossing transmission traffic routes;

d) routing information for international group, supergroup, etc., links;

e) inventory of spare transmission facilities, in its own and neighbouring countries, lending themselves to restoration.

Recommendation M.728

GUIDELINES FOR THE COOPERATION BETWEEN MAINTENANCE ELEMENTS

1 General

1.1 *Cooperation between maintenance elements within an Administration*

Elements should normally be free to contact each other as required except for any restrictions placed on such contacts by the Administration itself for reasons of efficiency or organization. See Recommendation M.710 for an appreciation of the potential grouping of elements. The information paths and interactions among elements will be influenced by the choice of such grouping.

1.2 *Cooperation between maintenance elements in different Administrations*

Maintenance elements should primarily communicate with their corresponding elements in other countries. Other channels of communication may also appear necessary or useful under certain circumstances. Figure 1/M.728 illustrates in a matrix probable communication paths from a given country to a foreign country. It demonstrates the possibility of fault reports, for example, from a number of elements to the foreign fault report point (circuit).

Home country		*Foreign country*										
		FRP (N)	NMP	NAP	SAIP	FRP (C)	TP (T)	TP (LS)	TP (SIS)	CSCS	CCS	RCP
Fault report point (network)	FRP (N)	X										
Network management point	NMP	0	X	0	0							
Network analysis point	NAP	0		X		0						
System availability information point	SAIP				X							0
Fault report point (circuit)	FRP (C)	0				X					0	
Testing point (transmission)	TP (T)					0	X				0	
Testing point (line signalling)	TP (LS)					0		X	0		0	
Testing point (switching and interregister signalling)	TP (SIS)					0		0	X		0	
Circuit control station	CCS					0	0	0	0	X		
Circuit sub-control station	CSCS					0					X	
Restoration control point	RCP				0							X

X — Primary intercommunication symbol is indicated for communication paths between corresponding elements. Note that the corresponding element for CCS is CSCS.

0 — This symbol represents other intercommunications that may be necessary or useful under certain circumstances.

FIGURE 1/M.728

An illustration of the matrix of probable communication paths between elements of the maintenance organizations of two countries

Each fault report received by a fault report point should be identified (to include the date and the hour if possible) for reference by all concerned during fault clearance and for informing the reporting element of the disposition of the faults. Fault reports should be accepted by any element performing tests with a foreign maintenance element. The element which accepts the report should always forward it to its appropriate fault report point. The fault report point should give priority to receiving fault reports and initiating fault clearances over all other duties.

1.3 *List of contact points*

The most important benefit to be derived from the development of defined functional elements is to establish the means whereby those responsible for such elements may be contacted. Two forms (Figure 2/M.728 and Figure 3/M.728) are recommended for this purpose. Figure 2/M.728 relates to general information concerning a given Administration and Figure 3/M.728 provides for the specific telephone and telex addresses together with service hours, the name of the maintenance unit that is responsible for the given element, and any additional information deemed useful such as the telephone address of the supervisor of the maintenance unit itself. Each element is afforded two horizontal lines to permit a record that includes any alternate location to which the functions of the element are delegated during certain hours, should such delegation apply. Note that each Administration is free to use any contact to represent one or more elements. Additional contact points, such as repeater stations, in a given Administration may be found in a supplementary list of contacts made reference to in Recommendation M.70 [1].

If more than one international centre is associated with a given relation, it is desirable to designate one fault report point (network) as the principal one for that relation. In this case, the choice of a principal contact location is also desirable for the network analysis point and the network management point, respectively.

Each Administration should issue completed contact forms as shown in Figures 2/M.728 [1] and 3/M.728 for the maintenance of circuits for the automatic and semiautomatic service and distribute them to Administrations as appropriate. Where groups of staff, separate from those concerned with day-to-day maintenance, are used for setting up and lining up new or rearranged circuits, the relevant contact information should be indicated by a separate entry. Revised issues of the forms should be distributed to reflect changes as required.

COUNTRY:

ADMINISTRATION OR PRIVATE OPERATING AGENCY:

Contact point of the Technical Service:

Postal address:
Telephone No.:
Telex No.:
Office hours (GMT):

International centres:

Further information:

(e.g. contact points common for more than one international centre, or principal contact points for certain traffic relations or where more than one technical service applies).

FIGURE 2/M.728

Contact points for the maintenance of the international automatic and semiautomatic telephone service

[1] The *technical service* referred to in Figure 2/M.728 represents the appropriate authorities within the international maintenance organization of an Administration which have the responsibility for making international agreements on maintenance matters, specifying maintenance facilities, determining maintenance policy and overseeing its implementation.

CONTACT POINTS FOR THE INTERNATIONAL AUTOMATIC AND SEMIAUTOMATIC TELEPHONE SERVICE

COUNTRY: INTERNATIONAL CENTRE:

DATE OF ISSUE: POSTAL ADDRESS:

Contact point	Telephone No.	Telex No. Answer-back code	Service hours (GMT)	Name of unit responsible	Remarks[1]
Fault report point (circuit)					
Fault report point (network)					
Testing point (transmission)					
Testing point (line signalling)					
Testing point (switching and interregister signalling)					
Network analysis point					
System availability information point					
Network management point					
Circuit control station subcontrol					
Restoration control point					
SS No. 6 transfer link					

[1] Language information may be included.

FIGURE 3/M.728

Form for the contact points for the international telephone service

Note – Signalling System No. 6 transfer link is *not* a maintenance element as defined by CCITT. The need for specific contact points for the maintenance of SS No. 6 is under study.

In view of the urgency which should be attached to the clearance of faults on the Signalling System No. 6 transfer link and the standby transfer link, it is provisionally recommended that Administrations exchange appropriate contact point information on the form shown in Figure 3/M.728. If necessary, Administrations may subdivide the maintenance functions of the Signalling System No. 6 transfer link (for example, into fault reporting, testing), and should exchange contact point information accordingly.

2 Examples of cooperation between elements

The maintenance elements defined by the CCITT will normally be grouped into maintenance units. Administrations are free to group these elements in whatever manner is suitable to themselves.

The examples of cooperation indicated in Figure 4/M.728 and Figure 5/M.728 show only simple cases of cooperation between elements.

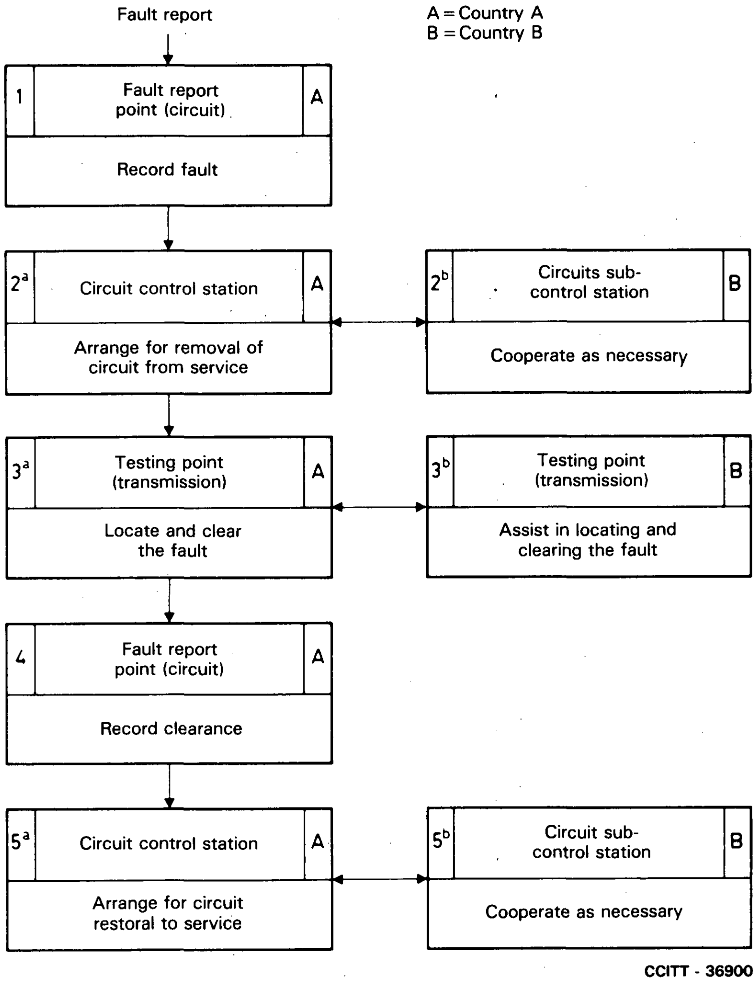

FIGURE 4/M.728

General procedure in acting upon the report of a circuit transmission fault

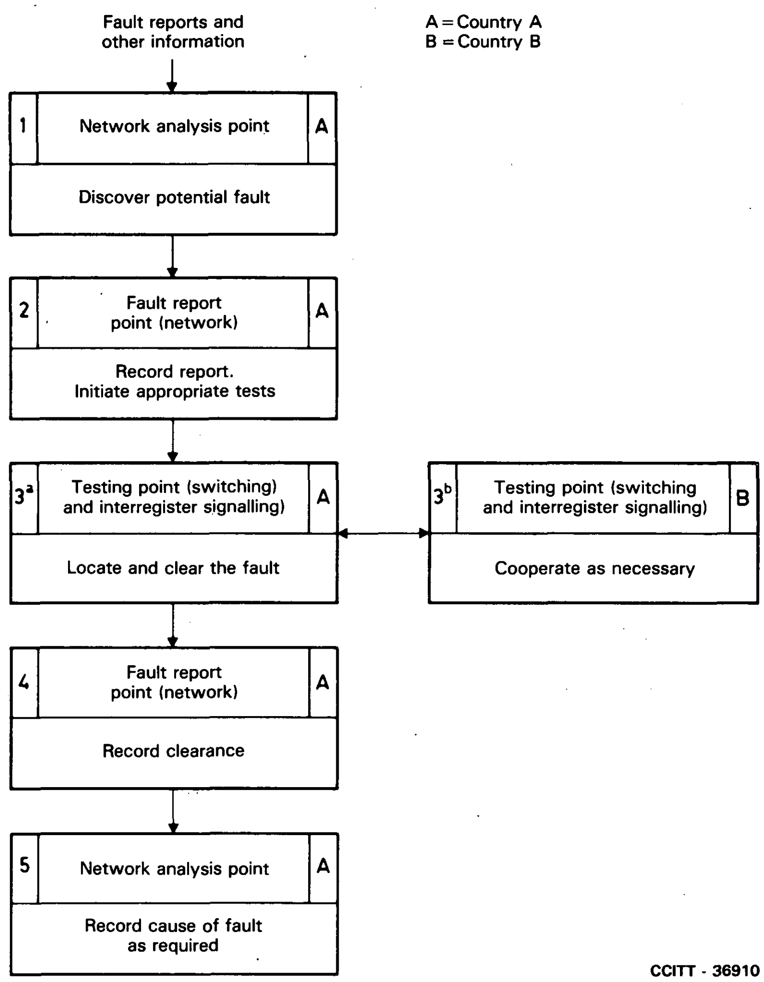

FIGURE 5/M.728

General procedure in acting upon indications of potential faults revealed by the network analysis point

Reference

[1] CCITT Recommendation *Guiding principles on the general maintenance organization for telephone-type international circuits*, Vol. IV, Fascicle IV.1, Rec. M.70.

Recommendation M.730

MAINTENANCE METHODS

1 General

In order to meet the service demands of a progressive and rapidly expanding international full automatic telephone network with the best possible quality of service, it is essential that all factors adversely affecting the quality of service should be detected and service restored as quickly as possible. This objective recognizes the fact that perfect performance is unattainable and that beyond a certain point, costs can rise sharply out of proportion to service quality gain.

When choosing a suitable maintenance method or a combination of methods one should consider:

- the reliability of the plant to be maintained;
- the availability of testing and supervisory facilities as well as the availability and quality of manpower in the maintenance organization:

- the availability of facilities in the plant that indicate the existence and frequency of disturbances;
- the availability of arrangements for automatic remedial action;
- the availability of automatic means to process and analyze operational data received from the plant;
- that the objective is to ensure a satisfactory overall service quality (subscriber-to-subscriber) in the international connection, giving equal importance to the national and international parts of the chain that constitute the connection.

It is recognized that a combination of maintenance methods may be applied.

See [1].

2 Preventive maintenance methods

2.1 *Functional tests*

2.1.1 In carrying out functional tests, ordinary working conditions apply and the equipment and circuits are taken as found.

They are carried out on a systematic basis to discover faults that would influence the quality of service. The response to each signal may be tested by equipment provided for this purpose. Such tests may be applied to any part of the signalling path.

2.1.2 Functional tests are carried out locally, or from either end of an international circuit to the other.

2.1.3 The organization of the programme for carrying out functional tests locally is left to the discretion of the Administration responsible for the international exchange.

2.1.4 Overall functional tests on an international circuit are such that they can be made from one end of the circuit without cooperation of technical personnel at the other end of the circuit. These tests may utilize the switching equipment at each end of the circuit, but such equipment is not being tested directly, only the circuit.

The verification of satisfactory signalling operation may be done by using various types of tests:

- Certain types of tests not requiring any special equipment, for example checking that a seizing signal is followed by the return of a proceed-to-send signal and that a clear-forward signal is followed by the return of a release-guard signal.
- Other types combining several tests, using special equipment at both ends. Any type which is in general use by Administrations may be used if suitable and agreed between the Administrations concerned [1)].

2.2 *Circuit limit tests*

2.2.1 A circuit limit test is made to verify that the international circuit meets specified operating margins. These tests enable the performance of the whole international circuit to be checked. They will be made as required but normally at the following times:

- before putting the circuit into service;
- according to a systematic test programme which may be based on measurement results or fault (trouble) statistics or quality of service observations.

They may also be made if functional tests indicate a fault, in order to locate such a fault.

Circuit limit tests may be made with respect either to transmission or to signalling conditions.

2.2.2 The frequency of such tests will be determined by the Administrations concerned and the test conditions to be applied will be in conformity with CCITT Recommendations.

2.2.3 The test equipment, the specifications and methods of gaining access to this equipment are described in the specifications of international signalling, switching and transmission equipment.

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1) See the specification for the CCITT Automatic Transmission Measuring and Signalling Testing Equipment ATME No. 2 (Recommendation O.22 [2]).

2.3 *Limit tests on the constituent parts of a circuit*

2.3.1 These limit tests are made to verify that the constituent parts of a circuit meet specified operating margins. They will be made as required but normally at the following times:

- at installation;
- if functional or limit tests on the circuit indicate a fault, if such tests will help in fault location;
- systematic test programmes which may be based on measurement results or trouble statistics or quality of service observations.

2.3.2 The frequency of such tests will be determined by the Administrations concerned and the test conditions to be applied will be in conformity with CCITT Recommendations.

2.3.3 Limit tests on constituent parts may indicate that the latter need to be readjusted; in such a case, measurements are made on those constituent parts and they are then readjusted in accordance with the relevant CCITT Recommendations.

2.3.4 The test equipment, its specification and the provision of access points will be determined by the Administration concerned taking into account the relevant CCITT Recommendations.

2.4 *Maintenance measurements*

2.4.1 *General*

Maintenance measurements are made periodically on complete circuits as well as on their constituent parts. Their object is to indicate whether the circuits and equipments are maintained to their specified values when first put into service and, if not, to allow the necessary readjustment to be carried out.

Some maintenance measurements are made to check signalling; others are made to check transmission. They are carried out by the respective technical services responsible for signalling and transmission.

2.4.2 *Measurements concerning signalling*

The conditions for carrying out such measurements, the apparatus used and the periodicity of operations are determined by the relevant Series Q Recommendations. Interventions following such measurements are determined by:

a) CCITT Recommendations;

b) equipment specifications when these are not given in detail by the CCITT.

For example, for carrying out local measurements concerning signalling on circuits using CCITT Signalling System No. 4, the CCITT, in Recommendation Q.138 [3], has specified a calibrated signal generator and a signal measuring set.

In Recommendation Q.164 [4] analogous specifications are given for Signalling System No. 5.

2.4.3 *Measurements concerning transmission*

These measurements include:

- local measurements, for which the Administrations concerned decide the conditions and periodicity;
- circuit and line measurements for which the conditions are generally defined in the Series M Recommendations.

These Series M Recommendations give, in particular, the periodicity of the measurements and the conditions for readjustment of transmission equipment. (See also Recommendation M.733.)

The CCITT has already specified certain transmission measuring apparatus, and other apparatus specifications are being studied.

3 Corrective maintenance methods

These methods may apply to certain parts of the plant where it is possible to locate and clear faults solely after they have affected the service. Corrective maintenance, if exclusively practised in the entire plant, can create unsatisfactory service conditions due to extreme variations in functional quality and can cause very irregular application of maintenance effort.

The application of exclusively corrective maintenance methods would presuppose such system design that even if breakdowns of single units or parts of the plant occur, they should have a minor effect on the service quality offered to the subscribers.

4 Controlled maintenance methods

Whereas it has been the practice to undertake programmes of preventive maintenance procedures together with day-to-day corrective maintenance procedures, recent equipment development has made it possible to introduce new maintenance methods. Modern systems can provide immediate information concerning irregularities and of abnormal conditions. Although preventive maintenance gives a comparatively good service, the number of defects caused by interference of preventive operations may be considerable.

A maintenance method utilizing the supervising facilities now available may enable the maintenance organization to considerably reduce preventive routines in the maintenance work. Preventive routine tests may then be replaced by methods of continuous supervision of the function of the plant and by means which check continuously the performance of the equipment and give signals to the maintenance staff when the quality of service is below a preset acceptance limit. Alternatively, when facilities for continuous supervision are not available, a sampling technique could be introduced to determine the number of routine tests necessary to gain a reasonable assurance that all equipments are in proper order.

Introduction of a system of maintenance control of this kind will necessitate a certain degree of centralization of administrative and technical means in the maintenance organization. Rapid and informative indication of the state and performance of the international and concerned parts of the national network is required from the maintenance point of view at strategic points in the network.

Various types of information on operational conditions in the plant can be utilized for maintenance supervision purposes, such as:

- traffic data;
- accounting data;
- maintenance data;
- service performance data.

Such data may be analyzed manually but could also be processed in computers, allowing for a more extensive analysis, for instance, to compare performance statistics with preset standards which are set for particular routes, circuits, etc. Information held in the computer store may be extracted on-line and could be made directly available to those maintenance and management centres where it is required.

Application of computer processing as described necessitates a high degree of centralization, but also other factors support a centralized maintenance organization such as the increasing use of network management signals. The introduction of processor-controlled switching and digital transmission systems is also expected to increase the possibilities to apply remote controlled and centralized maintenance supervision methods in the future.

References

[1] *Methods of quality control*, Green Book, Vol. IV-2, Supplement No. 1.4, ITU, Geneva, 1973.

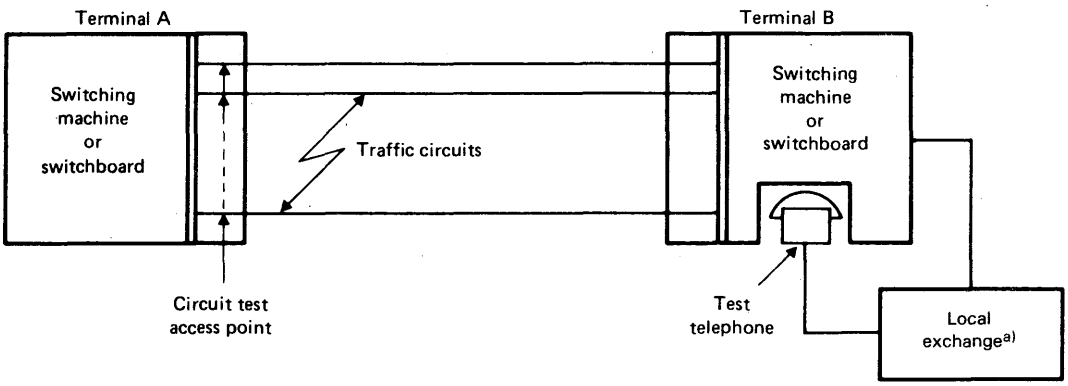
[2] CCITT Recommendation *Specification for the CCITT automatic transmission measuring and signalling testing equipment ATME No.2*, Vol. IV, Fascicle IV.4, Rec. O.22.

[3] CCITT Recommendation *Instruments for checking equipment and measuring signals*, Green Book, Vol. VI-2, Rec. Q.138, ITU, Geneva, 1973.

[4] CCITT Recommendation *Test equipment for checking equipment and signals*, Green Book, Vol. VI-2, Rec. Q.164, ITU, Geneva, 1973.

SUBJECTIVE TESTING

Circuits used for the automatic and semiautomatic telephone service may be tested subjectively to reveal gross faults, by systematic test calls from circuit Terminal A to a telephone located at circuit Terminal B. (See Figure 1/M.731.) Such test calling may be done independently of all other tests or combined with functional signalling test calls as described in the *Second method* in Recommendations Q.139 [1] and Q.163 [2] for Signalling Systems No. 4 and No. 5, respectively. Such test calls may be classed as type 3 test calls as defined in Recommendation E.424 [3]. They may be applied on a periodic basis for systematically checking each trunk in a group for excessive echo, clipping, loss, noise, distortion and crosstalk. Any fault suspected as a result of this subjective check should be investigated in the normal manner. When type 3 test calls are used in this manner a test telephone is assumed to exist at the distant international centre. The test telephone is connected to a local exchange, if possible, not located at the same point as the international centre so as to permit a realistic appraisal of the service quality. The test should be initiated at the outgoing terminal for one-way circuits and at both terminals sequentially on both-way circuits. Such test calls for checking service quality should be scheduled with the distant international centre during light load periods.



[a)] If possible, not located at the same point as Terminal B so as to develop a realistic return loss.

FIGURE 1/M.731

Use of a type 3 test call for systematic circuit evaluation

Another method of subjective testing, that may be alternatively considered involves *type 1 test calls* as defined in Recommendation E.424 [3]. It permits systematic evaluation from Terminal A to a location at Terminal B which would not consist of a test telephone, as shown in Figure 1/M.731, but rather to a test location at Terminal B that is not associated with a local exchange. Such an agreement might not be as effective in detecting echo control problems (since the simulation of a normal connection would be less realistic) but might be useful when the first technique suggested above is impractical due to local conditions.

In order to obtain the greatest value from such tests it might be advantageous to apply them in association with the tests prescribed in Recommendation M.610 and with *in-station* tests such as those for the maintenance of echo suppressors.

References

[1] CCITT Recommendation *Manual testing*, Vol. VI, Fascicle VI.2, Rec. Q.139.

[2] CCITT Recommendation *Manual testing*, Vol. VI, Fascicle VI.2, Rec. Q.163.

[3] CCITT Recommendation *Test calls*, Vol. II, Fascicle II.3, Rec. E.424.

Recommendation M.732

SIGNALLING AND SWITCHING ROUTINE MAINTENANCE TESTS AND MEASUREMENTS

The object of routine maintenance tests and measurements of signalling and switching is to detect changes in the functioning of signalling and switching which are likely to cause a reduction in the quality of service provided. These changes are those which occur in relation to the values indicated in the specifications for the signalling systems concerned (see the pertinent Series Q Recommendations). In the various sections of the Series Q Recommendations, limits are laid down within which:

– no action is necessary,

– action is required by the maintenance service at either of the terminal exchanges.

Routine maintenance measurements and tests have to be made at intervals, according to a routine maintenance programme. Administrations should agree beforehand to the appropriate periods during which the circuits and links between their respective countries shall be tested and measured.

The optimum periodicity for the testing of signalling and switching equipment has not been established and should be determined on the basis of available service observations.

For Signalling Systems No. 4 and No. 5 the minimum frequencies of signalling and switching maintenance tests and measurements are indicated in Recommendations Q.139 [1] and Q.163 [2] respectively. On routes where testing with ATME is in use, these tests and measurements can be provided for by that equipment.

The day and the time at which the tests will be made is agreed between the circuit control station and the terminal circuit sub-control station.

Routine maintenance operations must normally be made at times of light traffic, where staffing arrangements permit.

References

[1] CCITT Recommendation *Manual testing*, Vol. VI, Fascicle VI.2, Rec. Q.139.

[2] CCITT Recommendation *Manual testing*, Vol. VI, Fascicle VI.2, Rec. Q.163.

Recommendation M.733

TRANSMISSION ROUTINE MAINTENANCE MEASUREMENTS ON AUTOMATIC AND SEMIAUTOMATIC CIRCUITS

The object of routine maintenance measurements is to detect changes in transmission conditions before such changes cause a reduction in the quality of service provided. These changes are those which occur relative to the values recorded for maintenance purposes for the circuits or link concerned. In the various sections of the Series M Recommendations limits are laid down within which:

– no readjustment is necessary,

– readjustment may be made at the terminal stations,

– readjustment must be made along the whole circuit or link.

Routine maintenance measurements should be made according to an agreed maintenance schedule (see Recommendation M.150 [1]). The periodicities for the measurements are given in Tables 1/M.610 and 2/M.610. These are to be considered as recommended values and may be increased or reduced if special circumstances require.

Routine maintenance measurements must normally be made at times of light traffic, where staffing arrangements permit. If such measurements have to be made on a large group of circuits, it may nevertheless be necessary to do the measurements on some of the circuits during the busy period, if the operating services are not adversely affected thereby.

Circuits on a given route are generally measured in batches based on the way in which the maintenance schedule has been arranged (see Recommendation M.150 [1]). The advantages are:

- once cooperation has been arranged for routine testing with a distant station, time is saved if test cooperation can be maintained for as long as necessary;
- testing a large number of circuits on one route within a fairly short period enables a more accurate overall notion of the route to be obtained than could be gained from measurements on only a few circuits.

Routine maintenance measurements should be made on a complete circuit and should include measurements of overall loss and levels at one and several frequencies, stability (for 2-wire audio circuits only), and noise.

Reference

[1] CCITT Recommendation *Routine maintenance schedule for international public telephony circuits*, Vol. IV, Fascicle IV.1, Rec. 150.

Recommendation M.734

EXCHANGE OF INFORMATION ON INCOMING TEST FACILITIES AT INTERNATIONAL SWITCHING CENTRES

The attention of Administrations is drawn to the need to exchange information on the incoming test facilities which they have provided at their international switching centres. The exchange of such information has an important bearing on maintenance efficiency since it helps to avoid unnecessary requests for maintenance cooperation and the under utilization of the facilities which have been provided.

The form to be used for this purpose is shown in Figure 1/M.734. It provides, for the international switching centre and signalling system concerned, a description of the available test facilities, their CCITT reference (where applicable), the access code to be used, and any necessary remarks (for example, an outline of the response to be expected where the facility is not specified by CCITT). Figure 2/M.734 shows a hypothetical example of this form completed for a particular international switching centre.

Each Administration should distribute the completed forms to other Administrations as appropriate. Upon receipt, Administrations should arrange that the information be distributed to the appropriate points within their maintenance organization, for example, circuit control station, testing point (transmission).

Reference

[1] CCITT Recommendation *Specification for the CCITT automatic transmission measuring and signalling testing equipment ATME No. 2*, Vol. IV, Fascicle IV.4, Rec. O.22.

PROVISION OF INCOMING TEST FACILITIES

ADMINISTRATION: INTERNATIONAL SWITCHING CENTRE:

DATE: SIGNALLING SYSTEM:

Test facilities	CCITT reference	Access code	Remarks

FIGURE 1/M.734

Form for incoming test facilities

PROVISION OF INCOMING TEST FACILITIES

ADMINISTRATION: United Kingdom

INTERNATIONAL SWITCHING CENTRE: London/Mollison

DATE: November, 1979

SIGNALLING SYSTEM: CCITT No. 5

Test facilities	CCITT reference	Access code	Remarks
Balanced test termination	—	KP1 C7 C12 022 ST	Answer signal, then 600 Ω termination
Reference test tone	—	KP1 C7 C12 031 ST	Answer signal, then 1000 Hz at —10 dBm0
ATME No. 2: responder Type a	Rec. O.22 [1]	KP1 C7 C12 061 ST	
ATME No. 2: responder Type b	Rec. O.22 [1]	KP1 C7 C12 062 ST	
ATME No. 2: responder Type c	Rec. O.22 [1]	KP1 C7 C12 063 ST	

FIGURE 2/M.734

Form for incoming test facilities (hypothetical example only)

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SECTION 4

COMMON CHANNEL SIGNALLING SYSTEMS

Recommendation M.760

TRANSFER LINK FOR COMMON CHANNEL SIGNALLING SYSTEM No. 6

1 General description of the transfer link

1.1 The transfer link for the common channel Signalling System No. 6 and its relationship with the signalling link and signalling data link are depicted in Figure 1/M.760.

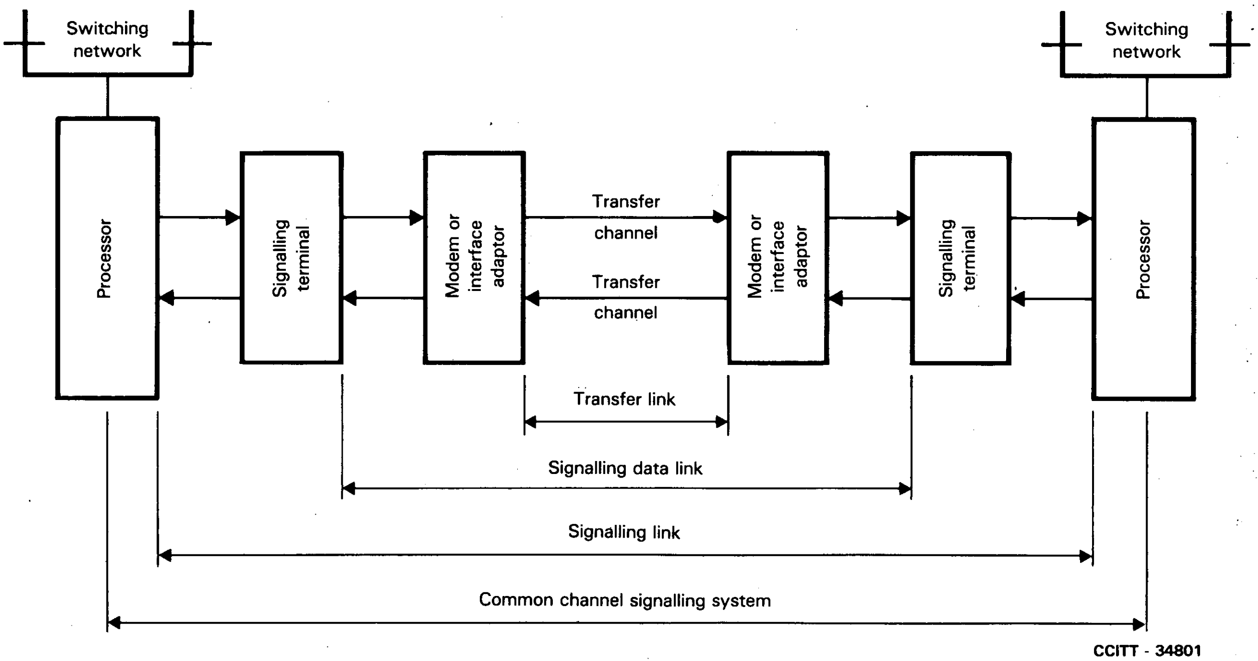


FIGURE 1/M.760

Basic diagram of the common channel Signalling System No. 6

1.2 The signalling link may be operated over either an analogue or a digital transfer link.

Analogue transfer links are used to interconnect data modems located within, or adjacent to, international switching centres, thus forming signalling data links. Analogue transfer links are 4-wire transmission paths having no audio terminating units, signalling equipment or echo suppressors, and normally are constituted entirely on carrier channels. Guidance on the setting-up and lining-up of analogue transfer links is given in Recommendation M.761.

Digital transfer links are used to interconnect interface adaptors to form signalling data links.

For guidance on the testing and maintenance of Signalling System No. 6, reference should be made to Recommendation Q.295 [1].

2 Continuity of service

2.1 Since the signalling link carries the signals for many speech circuits, a failure of the link will affect all speech circuits served. Therefore, arrangements should be made to ensure continuity of service of the signalling link.

2.2 Continuity of service will normally involve the provision of reserve facilities, which may be one or more of the following:

- quasi-associated reserve signalling links,
- full-time reserve transfer links,
- nominated direct circuits.

In the last two cases the transfer links must be equipped with signalling terminals and modems or interface adaptors to form signalling links. Reference should also be made to Recommendation Q.292 [2], which provides a detailed description of the above reserve arrangements.

2.3 Whenever possible, the reserve facility to be used should follow a different route from the route of the regular signalling link.

2.4 In order to reduce the number of interruptions on the signalling link to a minimum, it is recommended that all equipment associated with such links (for example, channel translating equipment, modems, distribution frames, etc.) be positively marked to make them readily identifiable to maintenance staff. Such markings assist maintenance efficiency and help staff to avoid causing inadvertent interruptions to the link when carrying out maintenance work in repeater stations and switching centres.

2.5 The proper functioning of Signalling System No. 6 is essential to the operation of the international network and various means are suggested in order to ensure this operation. If a fault occurs in the normal transfer link, service will continue (see § 2.2). However, a second (or simultaneous) failure would cause a significant impairment in traffic between centres so affected. Therefore, immediate maintenance attention should be given to transfer link faults and they should be returned to their normal configurations as rapidly as possible following a failure.

3 Transfer link designation

The form of designation to be used for the transfer link and its nominated reserve is given in Recommendation M.140 [3].

4 Maintenance organization

4.1 The maintenance organization for common channel Signalling System No. 6 is in two parts:

a) the maintenance of the overall signalling system with respect to delivering necessary signalling information between international centres, and to the functioning of data modems, signalling terminals and related equipment. The overall maintenance requirements is a subject for further study;

b) the maintenance of the transfer link between two centres, from the output of one data modem to the input of another data modem. This link does not include data modems.

4.2 By agreement between Administrations, one terminal international centre, or an equivalent point specified by the Administration concerned, will be designated as the overall maintenance control station. This station will maintain an overview of the performance of Signalling System No. 6 and in general be responsible to ensure that actions are coordinated when responsibility for a particular fault is not clearly identified. Additionally, one terminal international centre should function as the control station for transfer link maintenance activities.

Note – For a signalling system this role may be combined with that of overall maintenance control.

4.3 Organizational points or stations need to be assigned to provide for the following functions:

a) Overall signalling system maintenance

   i) control station

   ii) sub-control station

   iii) fault report point

   iv) testing point

b) Transfer link maintenance

   i) control station

   ii sub-control station

   iii) fault report point

   iv) transmission maintenance point (international line) (TMP-IL)

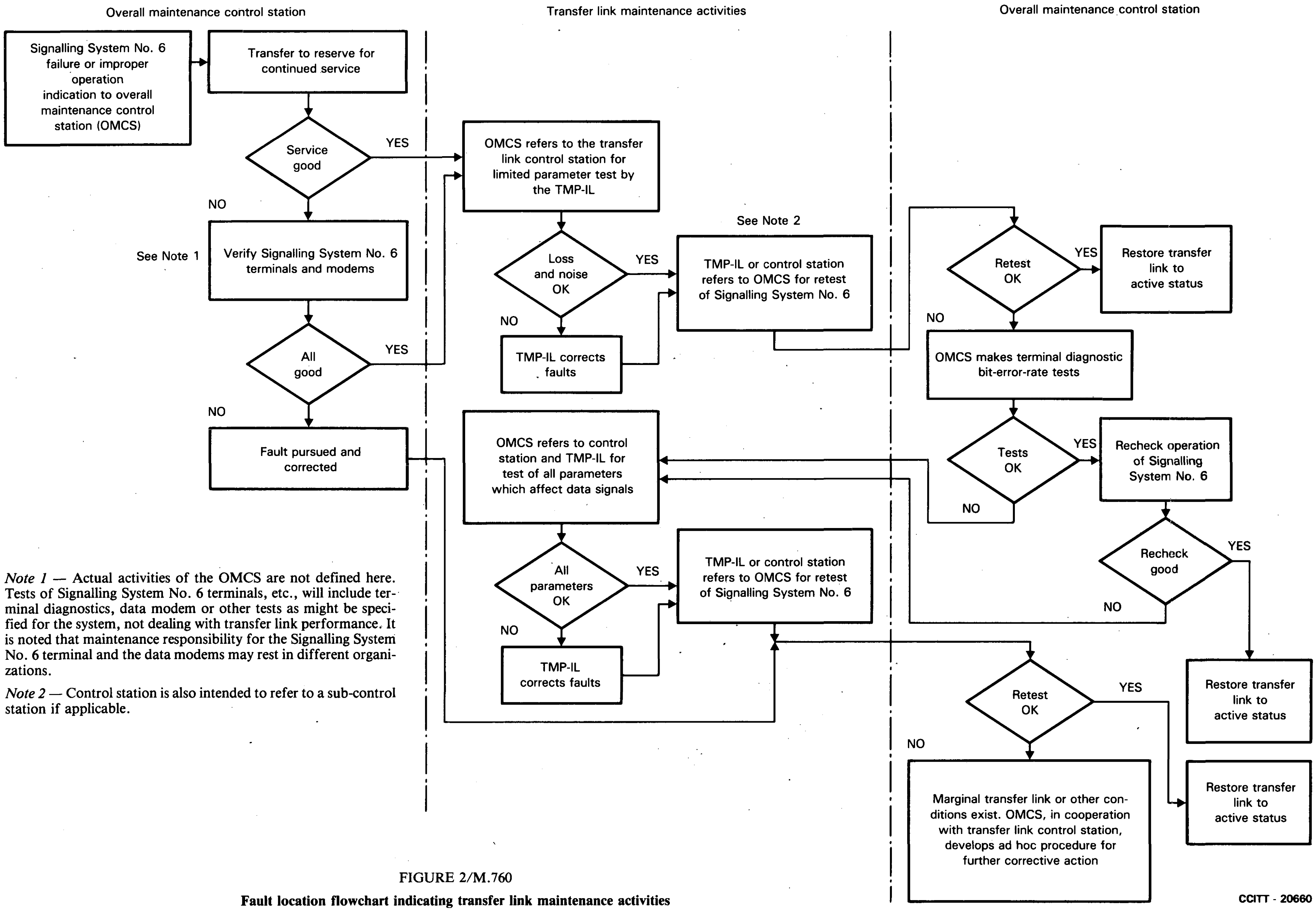
These may be assigned by an Administration as best suited to its individual needs.

It is essential that the appropriate contact point information be exchanged in order to minimize maintenance difficulties. Figure 3/M.728 offers a plan for the exchange of contact point information for the international telephone service and allows for the exchange of contact point information Signalling System No. 6 maintenance.

4.4 This Recommendation relates to the maintenance of the transfer link. However, maintenance activities on the transfer link should be controlled in order to preclude interruption of signalling functions, either during normal service or while tests initiated by the overall maintenance control station are being carried out. Furthermore, the TMP-IL for the transfer link is not likely to be aware of any faults in the signalling system unless advised by the overall signalling maintenance control station or transfer link control station. Therefore, testing of the transfer link will not be undertaken until advice (or concurrence) is received from the overall maintenance control station or the transfer link control station.

4.5 Once a fault is indicated in Signalling System No. 6, a possible series of events is illustrated in Figure 2/M.760. In the presentation of the flowchart it has been necessary to assume a possible organizational arrangement and assignment of responsibilities [see § 4.1, a) above].

This chart does not go into all possibilities. It is intended to depict a process toward fault correction, looking first at the most likely causes of faults in the transfer link with speedy correction in mind, and then toward more detailed and time-consuming tests to discover more elusive faults. It should be noted that some long-term testing may be required in this latter process.



Note 1 — Actual activities of the OMCS are not defined here. Tests of Signalling System No. 6 terminals, etc., will include terminal diagnostics, data modem or other tests as might be specified for the system, not dealing with transfer link performance. It is noted that maintenance responsibility for the Signalling System No. 6 terminal and the data modems may rest in different organizations.

Note 2 — Control station is also intended to refer to a sub-control station if applicable.

FIGURE 2/M.760

Fault location flowchart indicating transfer link maintenance activities

References

[1] CCITT Recommendation *Overall tests of Signalling System No. 6*, Vol. VI, Fascicle VI.3, Rec. Q.295.

[2] CCITT Recommendation *Reserve facilities provided*, Vol. VI, Fascicle VI.3, Rec. Q.292.

[3] CCITT Recommendation *Designation of international circuits, groups, etc.*, Vol. IV, Fascicle IV.1, Rec. M.140.

Recommendation M.761

SETTING UP AND LINING UP A TRANSFER LINK FOR COMMON CHANNEL SIGNALLING SYSTEM No. 6 (ANALOGUE VERSION) [1)]

1 Setting up and lining up a transfer link

1.1 The method to be used and procedure to be followed in setting up and lining up a transfer link are similar to those given in Recommendation M.1050 [1] in so far as it applies. However, in this context, any reference to national sections in Recommendation M.1050 should be ignored since a transfer link exists between terminal international centres and does not include national sections.

1.2 Routing restrictions may be necessary to achieve the loss/frequency and group-delay distortion limits specified below if the need to insert equalizers is to be avoided. Factors that may contribute to difficulties in meeting these limits are the number of through-group filters in group links, the use of edge band channels in group links, etc.

In addition, the number of channel translating equipments should be minimized in order that equalization, if required, may be more easily achieved, and that the effect of other parameters, such as noise, may be minimized.

2 Transmission characteristics of a transfer link

2.1 *General*

The transmission characteristics of the circuit to be used as the signalling data link are based on those for international leased circuits conforming to Recommendation M.1020 [2]. Optionally, the relaxed overall loss/frequency characteristic and group-delay distortion limits specified in the Recommendation cited in [3] may be applied where agreed between the Administrations involved and if tests confirm suitability.

2.2 *Overall loss at reference frequency*

The overall loss at reference frequency of the channels of a transfer link is not specified.

The channels of a transfer link should be set up so that when a test signal at a level of -10 dBm0 is connected to the input of the transfer channel, the level received at the output of the transfer channel at the distant end is as close as possible to -10 dBm0.

2.3 *Variation with time of the overall loss at reference frequency*

The variation with time of the overall loss at reference frequency should be as small as possible but should not exceed the following limits:

- short-term variation (over a period of a few seconds): ± 3 dB
- long-term variation (over long periods including daily and seasonal variations): ± 4 dB

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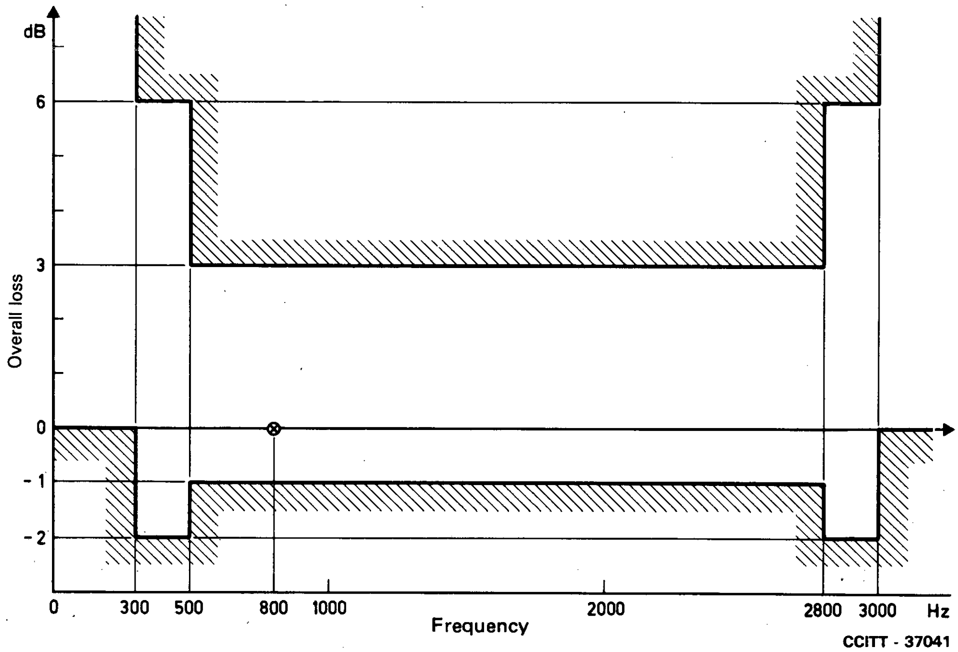
1) A general description of the transfer link for the common channel Signalling System No. 6 may be found in Recommendation M.760.

2.4 *Loss/frequency distortion* [2)]

The variation of overall loss with frequency relative to the loss at reference frequency should not exceed the limits shown in Figure 1/M.761.



Note — Below 300 Hz and above 3000 Hz the loss shall not be less than 0.0 dB but is otherwise unspecified.

FIGURE 1/M.761

Limits for overall loss of the transfer link relative to that at reference frequency

2.5 *Group-delay distortion*

The group-delay distortion relative to the minimum delay, should not exceed the limits shown in Figure 2/M.761.

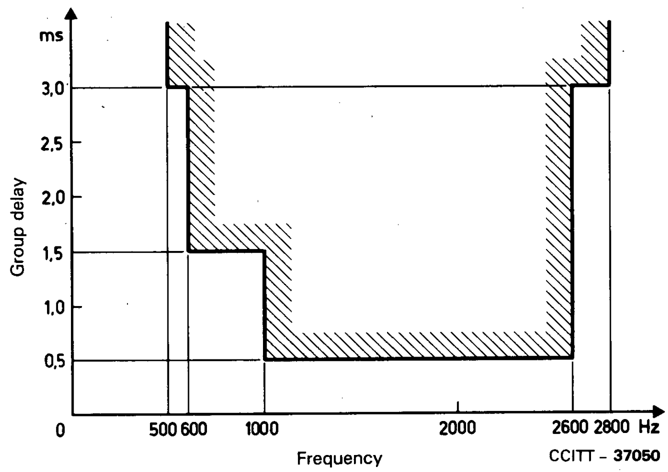


FIGURE 2/M.761

Limits for group delay relative to the minimum measured group delay in the 500-2800 Hz band

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[2)] Provisionally the limits of Recommendation M.1020 [2] have been chosen for the loss/frequency characteristics although these limits are appropriate for a leased circuit extending over national plant including local lines to customers' premises. However, transfer links will only extend between international centres and their routing will not involve any audio line plant with its inherent increasing attenuation with frequency. Therefore, further study is needed concerning the possible need to change the frequency (3000 Hz), from which the zero gain restriction extends, to some higher frequency.

Note 1 – It is believed that in many cases the limits specified in §§ 2.4 and 2.5 may be achieved without the addition of equalizing equipment.

Note 2 – The overall loss/frequency characteristic and group-delay distortion limits are currently under study for the feasibility of more relaxed limits. However, initial experience indicates that the limits specified in §§ 2.4 and 2.5 are necessary for reliable operation of the signalling system data link.

2.6 *Random noise*

The nominal level of the psophometric noise power at the receiving terminal international centre depends upon the actual length and constitution of the transfer link. The provisional limit for transfer links of distances greater than 1000 km is −38 dBm0p. However, transfer links of shorter length will have substantially less random noise, as shown in Figure 3/M.761.

Figure 3/M.761 displays random noise versus length and is presented as a guide to the random noise performance which may be found on a transfer link.

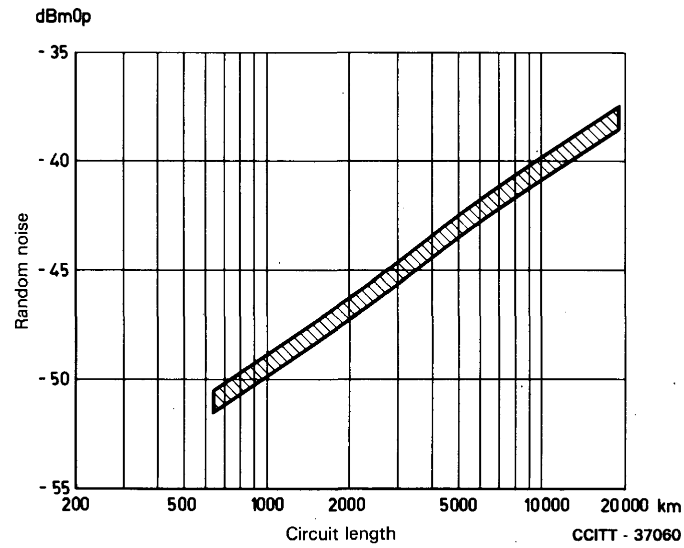

FIGURE 3/M.761

Random noise performance

Note – For transfer links routed via satellite, the satellite section (between earth stations) will contribute approximately 10 000 pWp (−50 dBpm0p) to the overall circuit noise. Therefore, for the purpose of determining the noise limits for the Signalling System No. 6 transfer link, the section of the transfer link provided by the satellite may be considered to be equivalent to a length of 1000 km. The effective noise length of such a transfer link will be 1000 km plus the total length of the terminal routings.

2.7 *Impulsive noise*

Impulsive noise should be measured with an instrument complying with Recommendation O.71 [4]. As a provisional limit, the number of impulsive noise peaks exceeding −21 dBm0 should not be more than 18 in 15 minutes.

2.8 *Phase jitter*

The value of phase jitter depends upon the actual constitution of the transfer link (for example, upon the number of modulation equipments involved). It is expected that any measurement of phase jitter using an instrument complying with Recommendation O.91 [5] will not normally exceed 10° peak-to-peak. However, for transfer links of necessarily complex constitution, and where 10° peak-to-peak cannot be met, a limit of up to 15° peak-to-peak is permitted. These limits are provisional and subject to further study.

2.9 *Quantizing noise*

If any section of the transfer link is routed over a pulse code modulation system, the signal will be accompanied by quantizing noise. The minimum ratio of signal-to-quantizing noise normally expected is 22 dB.

2.10 *Single tone interference*

The level of single tone interference in the band 300 – 3400 Hz shall not exceed a value which is 3 dB below the circuit noise objective indicated in Figure 3/M.761. This limit is provisional pending further study.

2.11 *Frequency error*

The frequency error introduced by the transfer link must not exceed ± 5 Hz. It is expected that in actual practice the frequency errors encountered will be less than 5 Hz.

2.12 *Harmonic distortion*

When a 700-Hz test frequency at – 13 dBm0 is injected at the transmit end of the transfer link, the level of any individual harmonic frequency at the receiving end shall provisionally be at least 25 dB below the received level of the fundamental frequency.

3 Recording of results

All measurements made in completing the line-up of the transfer link are valuable as references. These final measurements should be recorded using an appropriate form.

If subsequent realignment or adjustment is necessary these records should be updated.

References

[1] CCITT Recommendation *Lining up an international point-to-point leased circuit*, Vol. IV, Fascicle IV.2, Rec. M.1050.

[2] CCITT Recommendation *Characteristics of special quality international leased circuits*, Vol. IV, Fascicle IV.2, Rec. M.1020.

[3] CCITT Recommendation *Requirements for the signalling data link*, Vol. VI, Fascicle VI.3, Rec. Q.272, Annex.

[4] CCITT Recommendation *Specification for an impulsive noise measuring instrument for telephone-type circuits*, Vol. IV, Fascicle IV.4, Rec. O.71.

[5] CCITT Recommendation *Essential clauses for an instrument to measure phase jitter on telephone circuits*, Vol. IV, Fascicle IV.4, Rec. O.91.

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