INTERNATIONAL TELECOMMUNICATION UNION

# CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

**BLUE BOOK**

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**VOLUME IV – FASCICLE IV.2**

# MAINTENANCE OF INTERNATIONAL TELEGRAPH, PHOTOTELEGRAPH AND LEASED CIRCUITS

# MAINTENANCE OF THE INTERNATIONAL PUBLIC TELEPHONE NETWORK

# MAINTENANCE OF MARITIME SATELLITE AND DATA TRANSMISSION SYSTEMS

**RECOMMENDATIONS M.800-M.1375**

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**IXTH PLENARY ASSEMBLY**
MELBOURNE, 14-25 NOVEMBER 1988

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ISBN 92-61-03411-X

Printed in Switzerland

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## MODIFICATIONS TO THE SERIES M RECOMMENDATIONS

*Reorganization within Volume IV of the CCITT Book*

Due to certain re-arrangements within Volume IV of the CCITT *Red Book*, some existing Recommendations have been moved (or re-numbered) and appear now in other sections of the Volume.

For the convenience of the reader of Volume IV of the CCITT *Blue Book* these changes are listed below:

| *CCITT Red Book* (Malaga-Torremolinos, 1984) | *CCITT Blue Book* (Melbourne, 1988) |
|---|---|
| M.22 | M.32 |
| M.24 | M.34 |
| M.25 | M.35 |
| M.465 | M.555 |
| M.480 | M.556 |
| M.700 | included in M.60 |
| O.121 | O.9 |
| O.141 | O.25 |

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## PRELIMINARY NOTES

1 The Questions entrusted to each Study Group for the Study Period 1989-1992 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.

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

FASCICLE IV.2

**Recommendations M.800 to M.1375**

# MAINTENANCE OF INTERNATIONAL TELEGRAPH, PHOTOTELEGRAPH AND LEASED CIRCUITS

# MAINTENANCE OF THE INTERNATIONAL PUBLIC TELEPHONE NETWORK

# MAINTENANCE OF MARITIME SATELLITE AND DATA TRANSMISSION SYSTEMS

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SECTION 5

# INTERNATIONAL TELEGRAPH SYSTEMS AND PHOTOTELEGRAPH TRANSMISSION

## 5.1 Setting up and lining up international voice-frequency telegraph links

### Recommendation M.800 [1]

#### USE OF CIRCUITS FOR VOICE-FREQUENCY TELEGRAPHY

**1 Composition and nomenclature**

Figure 1/M.800 illustrates the composition of an international voice-frequency telegraph system and the nomenclature used.

1.1 *The international voice-frequency telegraph system*

This is the whole of the assembly of apparatus and lines including the terminal voice-frequency telegraph equipment. In Figure 1/M.800 the system illustrated provides 24 duplex telegraph circuits, but other numbers of telegraph circuits can be provided.

1.2 *The international voice-frequency telegraph link* (sometimes referred to as the bearer circuit)

1.2.1 Four-wire telephone-type circuits are used for international voice-frequency telegraph links. The link comprises two unidirectional transmission paths, one for each direction of transmission, between the terminal voice-frequency telegraph equipments.

1.2.2 The international voice-frequency telegraph link consists of an international voice-frequency telegraph line together with any terminal national sections connecting the international telegraph line to the voice-frequency telegraph terminal equipment and may be constituted entirely on carrier channels (on symmetric pairs, coaxial pairs, radio-relay systems, etc.) or on audio-frequency lines or combinations of such lines.

1.2.3 The nominal links for voice-frequency telegraphy have no terminating units, signalling equipment or echo suppressors.

1.3 *The international voice-frequency telegraph line*

1.3.1 The international voice-frequency telegraph line may be constituted by using a channel in a carrier group or channels in tandem on a number of groups. National and international sections can be interconnected to set up an international voice-frequency telegraph line. See Figure 1/M.800, but note that § 1.3.2 below details a preferred method.

The international voice-frequency telegraph line could equally well be set up between, for example, only A and C or between C and D, in which case A and C or C and D would be the terminal international centres.

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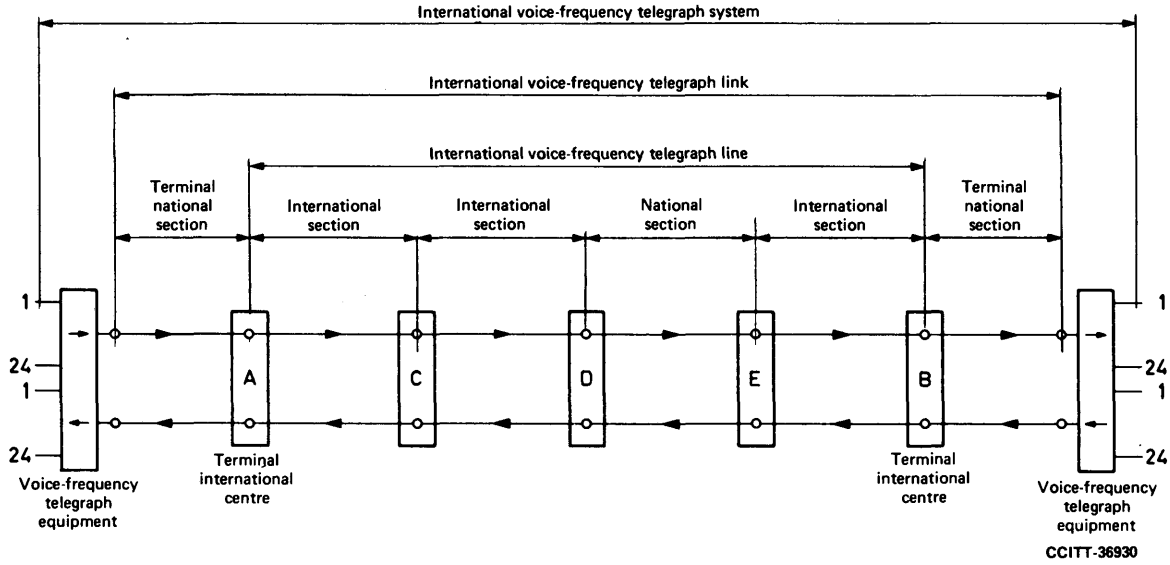
[1] See also Recommendations R.77 [1] and H.21 [2].




(At the intermediate centres C, D and E at the terminal international centres A and B, the signals transmitted are at audio-frequencies. At these points it is possible to make measurements.)

FIGURE 1/M.800

**The components of an international voice-frequency telegraph system**

1.3.2 Wherever possible, an international voice-frequency telegraph line should be provided on a channel of a single carrier group, thereby avoiding intermediate audio-frequency points. In some cases, such a direct group may not exist or, for special routing reasons, it may not be possible to set up the international telegraph line in the preferred way. In such cases, the international telegraph line will consist of channels in tandem on two or more groups with or without audio sections, depending on the line available and the routing requirements.

### 1.4 *Terminal national sections connected to the international voice-frequency telegraph line*

In many cases the voice-frequency telegraph terminal equipment is remote from the terminal international centre of the international voice-frequency telegraph line (Figure 1/M.800), and such cases necessitate the provision of terminal national sections in order to establish international voice-frequency telegraph links. These sections may be in short-distance local audio cables, amplified or unamplified, or may be routed in long-distance carrier groups or on amplifier audio plant.

## 2 Reserve arrangements for international voice-frequency telegraph links

All necessary action should be taken to enable the duration of interruption of international voice-frequency telegraph links to be reduced to a minimum and, for this purpose, it is expedient to standardize some of the methods to be adopted for replacing defective portions in the link.

Although it does not appear necessary for these methods to be the same in detail in every country, it would be advisable to reach agreement regarding the general directives to be followed.

The make-up of a reserve voice-frequency telegraph link will in general be similar to that of the normal voice-frequency telegraph link. However, if the voice-frequency telegraph terminal equipment is not located at the terminal international centres, the line portion of an international telephone circuit can be used to replace only the international voice-frequency telegraph line of the voice-frequency telegraph link.

2.1 *Reserve international lines*

2.1.1 Wherever possible, a reserve international line should be provided between the two terminal international centres by means of the line portion of an international telephone circuit (between A and B in Figure 1/M.800).

2.1.2 The telephone line used as a reserve should be chosen wherever possible so as to follow a different route from that of the normal international telegraph line. Where this cannot be done, as much as possible of the line or its sections should be alternatively routed.

2.1.3 If there is a choice, the use of manually-operated circuits as reserve lines for voice-frequency telegraphy is technically and operationally preferable to the use of automatic circuits.

It should be possible, after prior agreement between the controlling officers at the international terminal exchanges concerned, for an operator to break into a call in progress to advise the correspondents that the circuit is required elsewhere and that the call will have to be transferred to another circuit if it lasts longer than six minutes.

2.1.4 If the telephone circuit used as a reserve is automatic or semiautomatic a direct indication should be given at the changeover point. If it is not available when needed the reserve circuit should be blocked against any further call.

2.2 *Reserve sections for the sections of the international voice-frequency telegraph link*

Where it is not possible to provide a reserve international line or a reserve international voice-frequency telegraph link either because there are no suitable telephone circuits or because the number of telephone circuits does not permit the release of a circuit for reserve purposes, a reserve section should be provided wherever possible for each of the component sections. For these sections, national or international telephone lines or, where they exist, spare channels, circuits, etc., should be used.

2.3 *Reserve arrangements for the terminal national sections connecting the voice-frequency telegraph terminal equipment to the international voice-frequency telegraph line*

For the terminal national sections of an international voice-frequency telegraph link, reserve sections should be constituted using national telephone-type circuits or spare channels, lines, etc.

2.4 *Changeover arrangements from normal to reserve* lines

2.4.1 When an international telephone line (i.e. part of an international telephone circuit) is used to provide a reserve for the international voice-frequency telegraph line (or for one of its sections as mentioned in § 2.2 above), there should be changeover arrangements to enable the changeover from the normal line to the reserve line to be made as rapidly as possible. The changeover arrangements (Figure 2/M.800) should be such that on changeover, all signalling equipment, echo suppressors, etc., associated with the telephone circuit that is used as a reserve for the international voice-frequency telegraph line are disconnected on the line side. When the fault is cleared on the normal line, it should be possible to join it to the signalling equipment, echo suppressors, etc., of the telephone circuit used, until the agreed time for restoration to the normal routing.

It is desirable to introduce as little disturbance as possible when changing back from reserve to normal. Arrangements of cords and parallel jacks can be devised to achieve this.

2.4.2 The changeover arrangements shown in Figure 2/M.800 could be applied to sections of the international voice-frequency telegraph line mentioned under § 2.2 above when it is not possible to obtain an overall reserve for the international voice-frequency telegraph line. Normal sections and the corresponding reserve sections should be routed via suitable changeover arrangements at the stations concerned.

2.4.3 Making manual, automatic or semiautomatic international telephone circuits available for reserve purposes for voice-frequency telegraphy should be in accordance with the instructions issued and the arrangements made by the respective Administrations. Should the normal and reserve lines both be faulty, the technical services of the Administration concerned should take immediate joint action to find a temporary remedy.

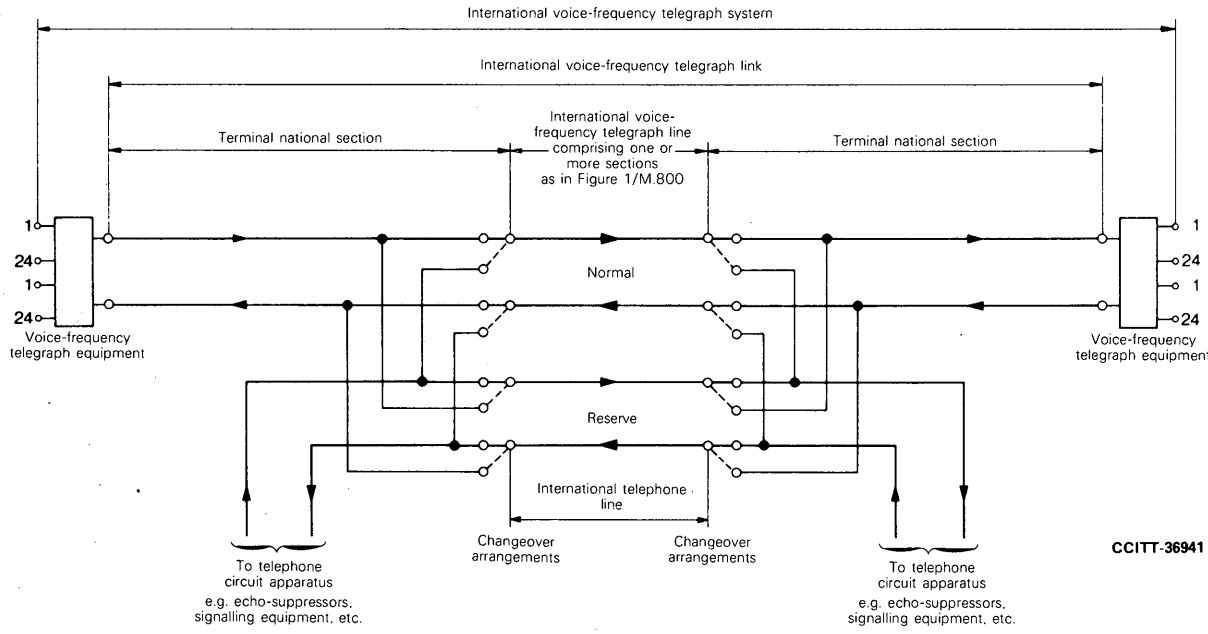



FIGURE 2/M.800

**An example of how an international telephone line can be used as the reserve for the international voice-frequency telegraph line of an international voice-frequency telegraph system**

2.5 *Designation and identifying marks*

Normal and reserve links, etc., should be clearly distinguishable from other circuits both from the point of view of designation (see Recommendation M.140 [3]) and identifying marks (see Recommendation M.810).

**References**

[1] CCITT Recommendation *Use of bearer circuits for voice-frequency telegraphy*, Vol. VII, Rec. R.77.

[2] CCITT Recommendation *Composition and terminology of international voice-frequency telegraph systems*, Vol. III, Rec. H.21.

[3] CCITT Recommendation *Designation of international circuits, groups, group and line links, digital blocks, digital paths, data transmission systems and related information*, Vol. IV, Rec. M.140.

## Recommendation M.810

### SETTING UP AND LINING UP AN INTERNATIONAL VOICE-FREQUENCY TELEGRAPH LINK FOR PUBLIC TELEGRAPH CIRCUITS (FOR 50, 100 AND 200 BAUD MODULATION RATES)

### 1 Designation of control stations

1.1 The designation of the control and sub-control stations should follow the principles given in Recommendations M.80 [1] and M.90 [2].

1.2 By agreement between Administrations, one of the terminal international repeater stations will be designated as the voice-frequency telegraph link control station: the other terminal being the terminal sub-control station for the link.

1.3 In making this choice, the location of the circuit control station for any international circuit designated as a reserve for the international voice-frequency telegraph line should also be taken into account, as it is very desirable that the voice-frequency telegraph link control station should be at the same terminal station as the circuit control station for the nominated reserve circuit.

## 2 Organization

2.1 The maintenance organization arrangements for voice-frequency telegraph links should conform to the general principles given in Recommendation M.70 [3] concerning telephone-type circuits.

## 3 Setting up and lining up a voice-frequency telegraph link

3.1 In setting up and lining up voice-frequency telegraph links, three types of link are concerned, differing mainly in their constitution and they are referred to as type I, type II and type III links:

- Type I are those links which contain 4-kHz sections;
- Type II are those links which contain one or more 3-kHz sections, or contain a mixture of 3-kHz and 4-kHz sections;
- Type III are those links which are routed over audio-frequency line plant.

3.2 The method to be used and the procedure to be followed in setting up and lining up a voice-frequency telegraph link are the same as those given in Recommendation M.580 [4] for public telephone circuits as far as it applies.

The test signals to be used for these three types of link and the limits of the loss/frequency characteristics at intermediate sub-control stations are the same as those given in Recommendation M.580 [4] for public telephone circuits.

3.3 The overall loss/frequency characteristics of types I, II and III voice-frequency telegraph links are given in Tables 1/M.810, 2/M.810 and 3/M.810 respectively.

3.4 The nominal relative power level of the test signals at the input and output of the link will be those normally used by the Administration concerned.

If the voice-frequency telegraph terminal stations are remote from the terminal international centres, the Administration should arrange the nominal transmission loss of the national section so that the levels at the input and output of the voice-frequency telegraph link are respected, and to permit the conventional national levels to be used at terminal international centres.

3.5 For voice-frequency telegraphy the use of the edge-channels of a group should be avoided if at all possible since these may introduce greater distortion than other channels of the group.

## 4 Limits for the overall loss of a voice-frequency telegraph link

4.1 *Nominal overall loss at 1020 Hz*

The nominal relative power levels at the extremities of the voice-frequency telegraph link are those levels normally used in the national network of the countries concerned so that it is not possible to recommend a particular nominal value for the overall loss.

The nominal relative power level at the input to the link and the absolute power level of the telegraph signals at this point must be such that the limits concerning the power level per telegraph channel at a zero relative point on carrier systems are respected (see Annex A).

Some Administrations have bilateral agreements to reduce the total mean power level of frequency-shift voice-frequency telegraph systems to $-13$ dBm0 (50 μW0). The CCITT encourages such reduction where feasible. These Administrations have made their own determination of the feasibility of operating at the reduced level. As a guide, other Administrations may wish to use the line parameters suggested in Annex B.

4.2 *Overall loss/frequency distortion*

The variation with frequency of the overall loss of the link with respect to the loss at 1020 Hz must not exceed the following limits:

4.2.1 *Type I – Links with 4-kHz sections throughout*

TABLE 1/M.810

| Frequency range (Hz) | Overall loss relative to that at 1020 Hz |
|---|---|
| Below 300 | Not less than −2.2 dB; otherwise unspecified |
| 300- 400 | −2.2 to +4.0 dB |
| 400- 600 | −2.2 to +3.0 dB |
| 600-3000 | −2.2 to +2.2 dB |
| 3000-3200 | −2.2 to +3.0 dB |
| 3200-3400 | −2.2 to +7.0 dB |
| Above 3400 | Not less than −2.2 dB; otherwise unspecified |

4.2.2 *Type II – Links with one or more 3-kHz sections or with a mixture of 3-kHz and 4-kHz sections*

TABLE 2/M.810

| Frequency range (Hz) | Overall loss relative to that at 1020 Hz |
|---|---|
| Below 300 | Not less than −2.2 dB; otherwise unspecified |
| 300- 400 | −2.2 to +4.0 dB |
| 400- 600 | −2.2 to +3.0 dB |
| 600-2700 | −2.2 to +2.2 dB |
| 2700-2900 | −2.2 to +3.0 dB |
| 2900-3050 | −2.2 to +6.5 dB |
| Above 3050 | Not less than −2.2 dB; otherwise unspecified |

4.2.3 *Type III – Links on audio-frequency line plant*

TABLE 3/M.810

| Frequency range (Hz) | Overall loss relative to that at 1020 Hz |
|---|---|
| Below 300 | Not less than −1,7 dB; otherwise unspecified |
| 300- 400 | −1.7 to +4.3 dB |
| 400- 600 | −1.7 to +2.6 dB |
| 600-1600 | −1.7 to +1.7 dB |
| 1600-2400 | −1.7 to +4.3 dB |
| 2400-2450 | −1.7 to +5.2 dB |
| 2450-2520 | −1.7 to +7.0 dB |
| Above 2520 | Not less than −1.7 dB; otherwise unspecified |

4.2.4 *Application of Recommendations*

Figure 1/M.810 shows, in respect of loss/frequency distortion, the relationship of the Recommendations relating to international voice-frequency telegraph links. In practice, in the majority of cases, the international line between terminal international centres will be well within the limits of Recommendation M.580 [4] and no additional equalization will be needed to meet the overall requirement of this Recommendation.

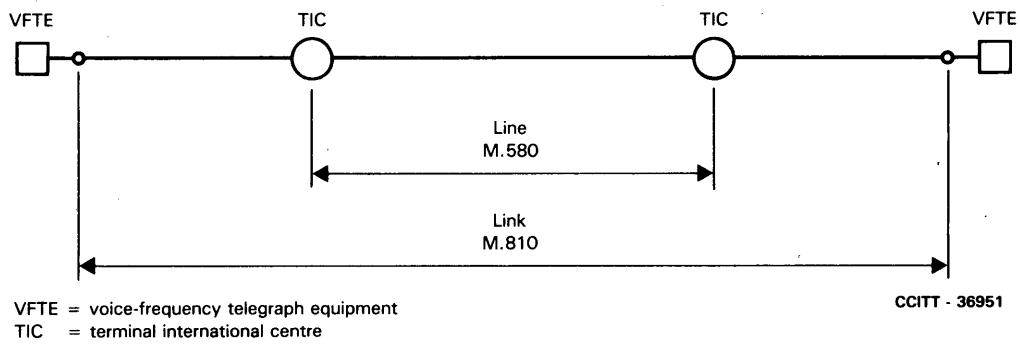



FIGURE 1/M.810

**Relationship of Recommendations which apply to international voice-frequency telegraph links in respect of loss/frequency distortion**

4.3 *Change of overall loss due to a changeover to the reserve line or section*

4.3.1 The nominal relative power level at 1020 Hz of the normal and reserve lines or sections at the changeover points for a particular direction of transmission should be the same. This level will be that normally used in the national network of the country concerned.

4.3.2 *Change in overall loss at 1020 Hz*

Bearing in mind that the overall loss of the normal line (or section) and the reserve line (or section) are both subject to variations with time, these variations being, in general, uncorrelated, it is not possible to assign a limit to the change of insertion loss at 1020 Hz introduced by the changeover procedure.

4.3.3 *Values of overall loss over the frequency band, relative to the value at 1020 Hz*

The overall-loss/frequency distortion characteristic of the link when established over the normal route should be within 2 dB of that of the link when established over the reserve route. This limit applies over the frequency bands 300-3400 Hz, 300-3050 Hz or 300-2520 Hz as appropriate.

There should ordinarily be no difficulty in achieving the limit when only one portion of the link, for example, the international telegraph line, or one section, has a reserve section. However, when two or more portions of the link are separately associated with reserve portions it becomes administratively difficult to ensure that all combinations of normal and reserve portions comply with the limit. In these circumstances the best that can be done is to ensure that the overall-loss/frequency characteristics of corresponding normal and reserve portions are as much alike as possible. Careful attention should be paid to the impedance of normal and reserve sections at the point where they are connected to the changeover apparatus so that errors due to changing mismatch losses are minimized. A suitable target would be for all impedances concerned to have a return loss against 600 ohms, non-reactive, of not less than 20 dB over the appropriate band of frequencies.

## 5 Measurement of noise voltage on a voice-frequency telegraph link

5.1 *Uniform-spectrum random noise*

The psophometrically weighted noise voltage should be measured at the ends of the voice-frequency telegraph link in both directions of transmission. The unweighted noise voltage should also be measured using a CCITT psophometer without the weighting network.

The mean psophometric noise power referred to a point of zero relative level should not exceed 80 000 pW (−41 dBm0p).

*Note 1* – If recourse is made to synchronous operation, a higher noise level might be tolerated (such as −30 dBm0p for a particular telegraph system).

*Note 2* – In principle it would be desirable to specify a value of unweighted noise power level. However, such a value cannot be specified in unqualified terms. If the noise power is uniformly distributed over the band 300-3400 Hz and if there is no significant noise power outside this band then the level of the unweighted noise power will be approximately 2.5 dB higher than the value of the weighted noise power, using the weighting filters specified in Recommendation O.41 [5]. However, on a practical telegraph link neither of these conditions is likely to be met. The overall-loss/frequency distortion will affect the within-band noise distribution and, in a telegraph installation, there is likely to be significant noise power outside the band, particularly at low frequencies.

As a consequence, it is not possible to recommend a limit for the unweighted noise power level and the CCITT psophometer with the telephone weighting networks should continue to be the instrument used for specifying and measuring random noise power levels on international voice-frequency telegraph links.

5.2 *Impulsive noise*

Impulsive noise should be measured with an instrument complying with Recommendation O.71 [6] and H.13 [7]. (See also Recommendation V.55 [8].)

The number of counts of impulsive noise which exceeds −18 dBm0 should not exceed 18 in 15 minutes.

## 6 Crosstalk

6.1 The near-end crosstalk ratio (between the go and return telephone channels) of the link should be at least 43 dB.

6.2 The crosstalk ratio between the link and other carrier circuits is restricted by the Recommendation cited in [9] to not worse than 58 dB.

Crosstalk in any audio cables forming part of the terminal national sections should not normally significantly worsen the crosstalk ratio.

## 7 Group-delay/frequency distortion

Practical experience obtained up to the present shows that it is not necessary to recommend limits for group-delay/frequency distortion for 50-baud voice-frequency telegraph links even when they are composed of several sections each provided on telephone channels of carrier systems. There is little practical experience with higher-speed telegraph systems.

It may happen that under adverse conditions some telephone channels of the link are of insufficient quality to provide 24 telegraph channels. In such a case a better combination of telephone channels must be chosen for the telegraph service.

## 8 Frequency error

The frequency error introduced by the link must not be greater than ± 2 Hz.

## 9 Interference caused by power supply sources

When a sinusoidal test signal is transmitted over the link at a level of 0 dBm0 the level of the strongest unwanted side component should not exceed −45 dBm0.

*Note* – The limit of −45 dBm0 is based on a test-signal level of 0 dBm0, and this level should be used when making this test.

## 10 Variation of overall loss with time

10.1 Before a voice-frequency telegraph link is placed into service it is desirable that a test signal in each direction of transmission should be monitored at the distant end with a level-recording instrument for a minimum of 24 hours. Where possible the instrument should be capable of detecting level variations of duration as short as 5 ms.

10.1.1 The difference between the mean value and the nominal value of the overall transmission loss should not exceed 0.5 dB.

10.1.2 The standard deviation about the mean value should not exceed 1.0 dB.

However in the case of circuits set up wholly or partly on older-type equipment, and where the international line consists of two or more circuit sections, a standard deviation not exceeding 1.5 dB may be accepted.

## 11 Amplitude hits, short interruptions in transmission and phase hits

Such impairments to voice-frequency telegraph links reduce the quality of telegraph transmission. For example, phase hits in excess of 110° will cause errors in telegraph transmission. Amplitude hits, short interruptions in transmission and phase hits should be reduced to the minimum possible, bearing in mind the need to meet the error rate objectives given in Recommendations F.10 [10] and R.54 [11].

## 12 Record of results

All measurements made during the lining-up of the link are reference measurements and should be carefully recorded and a copy sent by the sub-control stations to the control station in accordance with Recommendation M.570 [12].

## 13 Information concerning voice-frequency telegraph terminal equipment

Information concerning international voice-frequency telegraphy is given in Annex A and Annex B.

## 14 Marking of circuits used for voice-frequency telegraphy

Any interruption of a voice-frequency telegraph link, even of very short duration, spoils the quality of the telegraph transmission. It is therefore desirable to take great care when making measurements on circuits used for voice-frequency telegraphy. To draw the attention of staff to this, all equipments used for voice telegraphy links should bear a special identification mark in the terminal exchanges and, where necessary, in repeater stations where the circuits are accessible.

## ANNEX A

(to Recommendation M.810)

### Basic characteristics of telegraph equipments used in international voice-frequency telegraph systems

A.1 *Limiting power per channel*

A.1.1 *Amplitude-modulated voice-frequency telegraph systems at 50 bauds*

Administrations will be able to provide the telegraph services with carrier telephone channels permitting the use of 24 voice-frequency telegraph channels (each capable of 50 bauds) on condition that the power of the telegraph channel signal on each channel, when a continuous marking signal is transmitted, does not exceed 9 microwatts at zero relative level points.

For 18 telegraph channels only, the power so defined may be increased to 15 microwatts per telegraph channel, so that even telephone channels with a relatively high noise level can then be used.

The power per telegraph channel should never exceed 35 microwatts, however few channels there may be.

These limits are summarized in Table A-1/M.810.

TABLE A-1/M.810

**Limiting power per telegraph channel when sending a continuous marking signal in amplitude-modulated voice-frequency telegraph systems at 50 bauds**

| System | Limiting power per telegraph channel when sending a continuous marking signal | |
|---|---|---|
| | μW0 | dBm0 |
| 12 telegraph channels or less | 35 | −14.5 |
| 18 telegraph channels | 15 | −18.3 |
| 24 (or 22) telegraph channels | 9 | −20.5 |

A.1.2 *Frequency-shift voice-frequency telegraph systems at 50 bauds*

The total average power transmitted to the telephone-type circuit is normally dependent on the transmission characteristics and length of the circuit as follows:

a) For circuits with characteristics not exceeding the limits given in Annex B, the total average power transmitted by all channels of a system should preferably be limited to 50 microwatts at a point of zero relative level. This sets, for the average power of a telegraph channel (at a point of zero relative level), the limits given in Table A-2/M.810.

b) For other circuits, the total average power transmitted by all channels of a system is limited to 135 microwatts at a point of zero relative level. This sets, for the average power of a telegraph channel (at a point of zero relative level), the limits given in Table A-3/M.810.

*Note* – The values in Tables A-2/M.810 and A-3/M.810 assume the provision of a pilot channel on the telegraph bearer.

TABLE A-2/M.810

**Normal limits for the power for telegraph channel in FMVFT systems for bearer circuits with caracteristics not exceeding the limits given in Annex B**

| Number of telegraph channels in the FMVFT system | Allowable power per telegraph channel at a point of zero relative level | |
|---|---|---|
| | in microwatts | in absolute power level decibels |
| 12 or less | 4 | −24 |
| 18 | 2.67 | −25.8 |
| 24 | 2 | −27 |

TABLE A-3/M.810

**Normal limits for the power per telegraph channel in FMVFT systems for other bearer circuits**

| Number of telegraph channels in the FMVFT system | Allowable power per telegraph channel at a point of zero relative level | |
|---|---|---|
| | in microwatts | in absolute power level decibels |
| 12 or less | 10.8 | −19.7 |
| 18 | 7.2 | −21.5 |
| 24 | 5.4 | −22.7 |

A.2 *Telegraph channel carrier frequencies*

For international voice-frequency 24-channel, 50-baud, nonsynchronous telegraph systems the frequency series consisting of odd multiples of 60 Hz has been adopted, the lowest frequency being 420 Hz as shown in Table A-4/M.810 below. In the case of frequency-shift systems, these frequencies are the mean frequencies of the telegraph channels, the frequency of the signal sent to line being 30 Hz (or 35 Hz) above or below the mean frequency according to whether A or Z space is being sent.

TABLE A-4/M.810

| Telegraph channel position *n* | Frequency (Hz) *fn* | Telegraph channel position *n* | Frequency (Hz) *fn* |
|---|---|---|---|
| 1 | 420 | 13 | 1860 |
| 2 | 540 | 14 | 1980 |
| 3 | 660 | 15 | 2100 |
| 4 | 780 | 16 | 2220 |
| 5 | 900 | 17 | 2340 |
| 6 | 1020 | 18 | 2460 |
| 7 | 1140 | 19 | 2580 |
| 8 | 1260 | 20 | 2700 |
| 9 | 1380 | 21 | 2880 |
| 10 | 1500 | 22 | 2940 |
| 11 | 1620 | 23 | 3060 |
| 12 | 1740 | 24 | 3180 |

The carrier frecuency *fn* of the channel is given by the expression:

$$fn = 60\,(2n + 5),$$

where $n$ is the number of the channel.

In addition, a pilot channel using a frequency of 300 Hz or 3300 Hz can be used. For details of the normal frequencies used in other types of voice-telegraph systems, see the numbering scheme given in Table 2/R.70 *bis* [13].

ANNEX B

(to Recommendation M.810)

**Limits required by a bearer circuit for FMVFT application if the total power transmitted by all channels is set at 50 microwatts**

B.1 *Loss/frequency distortion*

The variation with frequency of the overall loss of the link with respect to the loss at 1020 Hz must not exceed the limits given in Table B-1/M.810.

TABLE B-1/M.810

| Frequency range (Hz) | Overall loss relative to that at 1020 Hz |
|---|---|
| Below 300 | Not less than −2.0 dB; otherwise unspecified |
| 300- 500 | −2.0 to +4.0 dB |
| 500-2800 | −1.0 to +3.0 dB |
| 2800-3000 | −2.0 to +3.0 dB |
| 3000-3250 | −2.0 to +4.0 dB |
| 3250-3350 | −2.0 to +7.0 dB |
| Above 3350 | Not less than −2.0 dB; otherwise unspecified |

B.2 *Random noise*

The mean psophometric noise power referred to a point of zero relative level should not exceed 32 000 pW0p (−45 dBm0p), using a psophometer in accordance with Recommendation O.41 [5].

B.3 *Impulsive noise*

The number of counts of impulsive noise which exceed −28 dBm0 should not exceed 18 in 15 minutes, when measured with an impulsive noise counter in accordance with Recommendation O.71 [6].

B.4 *Error rates*

The telegraph character error rate which may be caused by interruptions and noise in the bearer circuit should not exceed the limits stated in Recommendations R.54 [11] and F.10 [10].

B.5 *Bearer length*

Reduction of power levels from 135 microwatts to 50 microwatts applies only to bearers of length up to 3000 km (see Note).

*Note* – The study of reduction of levels on longer bearer paths (greater than 3000 km) is continuing.

**References**


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

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

[3] CCITT Recommendation *Guiding principles on the general maintenance organization for telephone-type international circuits*, Vol. IV, Rec. M.70.

[4] CCITT Recommendation *Setting up and lining up an international circuit for public telephony*, Vol. IV, Rec. M.580.

[5] CCITT Recommendation *Psophometer for use on telephone-type circuits*, Table 1/O.41, Vol. IV, Rec. O.41.

[6] CCITT Recommendation *Impulsive noise measuring equipment for telephone-type circuits*, Vol. IV, Rec. O.71.

[7] CCITT Recommendation *Characteristics of an impulsive-noise measuring instrument for telephone-type circuits*, Orange Book, Vol. III-2, Rec. H.13, ITU, Geneva, 1977.

[8] CCITT Recommendation *Specification for an impulsive noise measuring instrument for telephone-type circuits*, Green Book, Vol. VIII, Rec. V.55, Annex, ITU, Geneva, 1973.

[9] CCITT Recommendation *General performance objectives applicable to all modern international circuits and national extension circuits*, Vol. III, Rec. G.151, § 4.1.

[10] CCITT Recommendation *Character error rate objective for telegraph communication using 5-unit start-stop equipment*, Vol. II, Rec. F.10.

[11] CCITT Recommendation *Conventional degree of distortion tolerable for standardized start-stop 50-baud systems*, Vol. VII, Rec. R.54.

[12] CCITT Recommendation *Constitution of the circuit; preliminary exchange of information*, Vol. IV, Rec. M.570.

[13] CCITT Recommendation *Numbering of international VFT channels*, Vol. VII, Rec. R.70 *bis*, Table 2/R.70 *bis*.


**Recommendation M.820**

## PERIODICITY OF ROUTINE TESTS ON INTERNATIONAL VOICE-FREQUENCY TELEGRAPH LINKS

**1** The recommendations concerning the periodicity of routine tests on international telephone circuits given in Recommendation M.610 [1] are applicable to international voice-frequency telegraph links.

**2** In certain cases and by agreement between the Administrations concerned, routine maintenance measurements may be omitted if those Administrations so wish. This applies in particular where the Administrations concerned consider that the telegraph traffic may be seriously disturbed due to the lack of a suitable reserve circuit or reserve sections.

**3** Routine measurements of level at one frequency (1020 Hz) should be made at the intervals recommended for international telephone circuits (see Table 1/M.610 [2]).

Measurements at different frequencies should be made once every 12 months. Some Administrations make an annual reline of the voice-frequency telegraph link instead of routine measurements.

4 It is desirable that the maintenance measurements on the voice-frequency telegraph reserve circuit should be made just before the maintenance measurements on the normal circuit, so that the reserve circuit can replace the normal circuit while the latter is being tested.

5 When several voice-frequency telegraph systems are in use between two repeater stations and if the maintenance measurements on the telephone circuits between these stations are spread over several days, the measurements on the circuits carrying the voice-frequency telegraph systems should also be spread over these days; this makes it easier to carry out the measurements on the voice-frequency telegraph circuits.

6 The periodicity of measurements on telephone circuits used as reserve circuits is as given in Table 1/M.610 [2].

For circuits providing reserve sections for an international voice-frequency telegraph link the periodicity of routine measurements will be agreed upon between the Administrations concerned.

7 A check should be made when suitable opportunities occur, to see that the limits shown in Tables A-1/M.810, A-2/M.810 and A-3/M.810 for the permissible power per telegraph channel are not exceeded.

**References**

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

[2] *Ibid.*, Table 1/M.610.

**Recommendation M.830**

## ROUTINE MEASUREMENTS TO BE MADE ON INTERNATIONAL VOICE-FREQUENCY TELEGRAPH LINKS

1 The routine maintenance measurements to be made in the two directions of transmission are measurements of level and overall loss/frequency distortion using a measurement signal of −10 dBm0 and noise.

The measuring frequencies are as follows:

- circuits providing an 18-channel telegraph system: 300, 400, 600, 800, 1020, 1400, 1900, 2400, 2600 Hz;
- circuits providing a 24-channel telegraph system: 300, 400, 600, 800, 1020, 1400, 1900, 2400, 3000, 3200, 3400 Hz.

2 If the nominal overall loss/frequency distortion exceeds the limits given in Recommendation M.810, any faults existing should first be removed, and the link should then be readjusted to within the limits given in Recommendation M.810.

3 Weighted and unweighted noise measurements should be made on the voice-frequency telegraph link at the time of the routine measurements of level as given in Recommendation M.820.

## 5.2 Setting up and lining up international time division multiplex (TDM) telegraph systems

**Recommendation M.850**

### INTERNATIONAL TIME DIVISION MULTIPLEX (TDM) TELEGRAPH SYSTEMS

### 1 General description of an international TDM system

1.1 Figure 1/M.850 illustrates a basic international TDM telegraph system. The system operates via an international TDM telegraph link operated at 2400 bit/s and has a capacity of 46 telegraph channels at 50 bauds. Other modulation rates up to 300 bauds can be accommodated (with resulting reduction in channel capacity) as shown in Recommendation R.101, Table 1/R.101 [1].

1.2 The international TDM telegraph system may be carried over a dedicated voice-frequency link as shown in Figure 1/M.850 or multiplexed with other TDM systems or other services onto a higher bit rate data transmission system on a voice-frequency or digital data transmission link as shown in Figure 2/M.850.

1.3 International telegraph systems may also be carried on high level (e.g. 50, 56 kbit/s) data transmission links utilizing analogue group band or on digital (64 kbit/s) paths. Examples of such multiplexing arrangements are illustrated in Recommendation M.1300.

### 2 Basic TDM telegraph links (Figure 1/M.850)

2.1 Basic TDM telegraph links may be carried on 4-wire analogue telephone circuits. The link comprises two unidirectional transmission paths, one for each direction of transmission, between the terminal TDM telegraph equipments. The TDM telegraph links are terminated with data modems, usually (but not necessarily) located within the terminal TDM telegraph equipment, which operate at 2.4 kbit/s.

2.2 The international TDM telegraph link consists of an international TDM telegraph line together with any terminal national sections connecting the international line to the terminal TDM telegraph equipment. Where the TDM equipment is located in the terminal international centres, the TDM link consists only of the international TDM telegraph line.

2.3 The international TDM telegraph line (between terminal international centres) may be constituted by using a channel in a carrier group or channels in tandem on a number of groups. National and international sections can be interconnected to set up an international TDM telegraph link.

Wherever possible, an international TDM telegraph line should be provided on a channel of a single carrier group, thereby avoiding intermediate audio-frequency points. However it is recognized that in some cases such a direct group may not exist or, for special routing reasons, it may not be possible to set up the international TDM line in this preferred way.

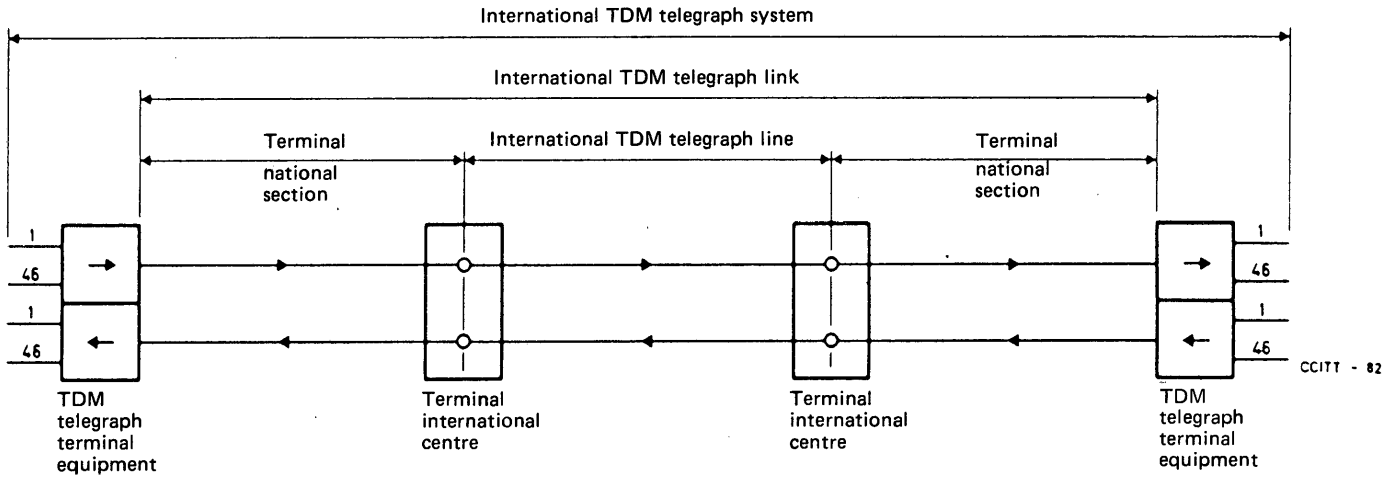
2.4 *Terminal national sections connected to the international TDM telegraph line*

In some cases the TDM telegraph terminal equipment is remote from the terminal international centre of the international TDM telegraph line (Figure 1/M.850), and such cases necessitate the provision of terminal national sections in order to establish international TDM telegraph links. These sections may be routed on channels of carrier groups or on audio plant (amplified or unamplified) or on digital streams.

### 3 TDM telegraph links multiplexed on higher bit rate data systems (Figure 2/M.850)

3.1 When TDM telegraph links are multiplexed onto higher bit rate data transmission systems, the associated analogue voice-frequency data links generally follow the principles outlined in § 2, with the exception that these data links are operated at higher bit rates (usually 4.8, 7.2 or 9.6 kbit/s).

Should a TDM telegraph link be extended from the higher level multiplexer, for example, to a remote point such as a third country or to renters premises, then it is necessary to use an appropriate modem as shown in Figure 2/M.850.




*Note* — It is assumed that the TDM telegraph terminal equipment includes a modem. It should be noted, however, that modems may be provided separately.

FIGURE 1/M.850

**The components of an international TDM telegraph system**

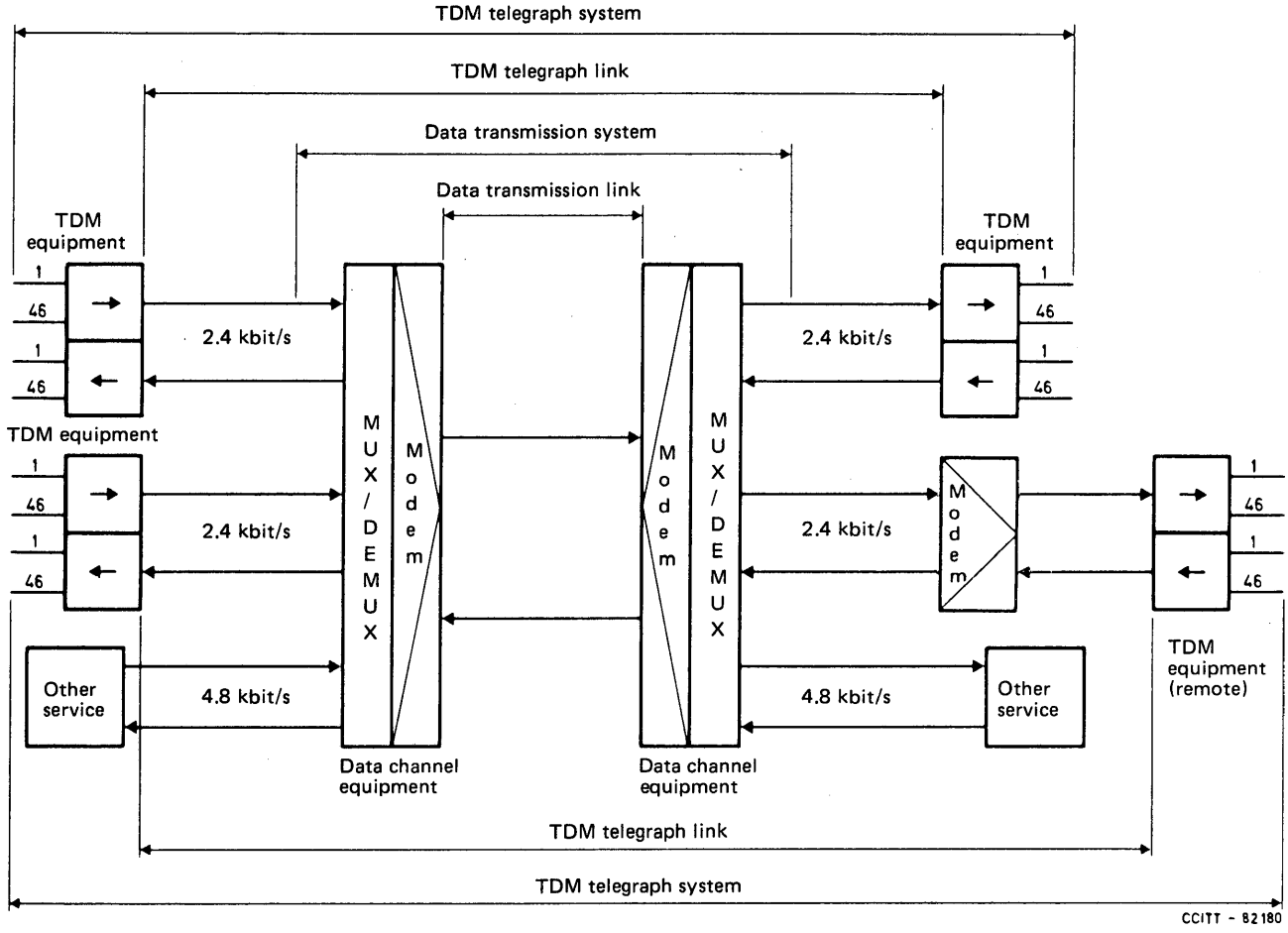



FIGURE 2/M.850

**Example of two international TDM telegraph systems multiplexed onto a higher bit rate data transmission system**

3.2 TDM telegraph links multiplexed onto voice-frequency data transmission systems operated at 4.8, 7.2 or 9.6 kbit/s may be further multiplexed onto higher bit rate data transmission systems operated at 50, 56, 64 kbit/s etc. Examples of such arrangements are shown in Recommendation M.1300.

## 4 Characteristics, line-up, and maintenance of TDM telegraph links and systems

### 4.1 *Characteristics and line-up*

Guidance on the transmission characteristics and line-up procedures for both analogue and digital TDM telegraph links may be found in Recommendation M.1350, §§ 2 and 3. In this regard, the TDM telegraph link is identical to a 2.4 kbit/s data transmission link.

### 4.2 *Maintenance*

Maintenance procedures and limits for both analogue and digital TDM telegraph links may be found in Recommendation M.1355.

Maintenance procedures and limits for TDM telegraph systems are under study. However, guidance on the maintenance of these systems may be found in Recommendations R.75 [2] and V.51 to V.53 [3].

## 5 Reserve arrangements for TDM telegraph links

### 5.1 *General requirements*

All necessary action should be taken to ensure that the number of interruptions on TDM telegraph systems be kept to a minimum, and further that interruptions, when they do occur, be kept as short as possible.

### 5.2 *Basic international telegraph links*

Reserve arrangements for international TDM telegraph systems operated over links at 2.4 kbit/s should be in accordance with the principles and procedures specified for international voice frequency telegraph systems. Refer to Recommendation M.800, § 2. In some instances, it may be desirable to establish dual, diversely routed international TDM telegraph links and to change over from the active link to the reserve link when the international TDM telegraph system fails or becomes degraded. The change over may be done automatically, semi-automatically, or manually, by agreement between Administrations involved. Guidance on changeover arrangements may be found in Recommendations M.800 and R.150 [4].

### 5.3 *TDM telegraph links multiplexed on higher level data transmission systems*

When international TDM telegraph links are multiplexed onto higher bit rate data transmission systems, reserve arrangements will normally depend upon the principles and procedures adopted for the higher level data transmission link. Reserve arrangements for these data transmission links require further study.

## 6 TDM telegraph link designation

The form of designation for the TDM telegraph link and its reserve is given in Recommendation M.140, § 1.2.2 [5].

## 7 Marking of equipment associated with TDM telegraph links

It is recommended that all equipment associated with the TDM telegraph link and nominated reserve circuits (channel translating equipment, distribution frames, etc.) be positively marked to make them readily identifiable to the maintenance staff.

## 8 TDM telegraph link control and sub-control stations

8.1 One control station should be agreed bilaterally between the Administrations involved for each TDM telegraph link prior to setting up the link. Principles concerning the definition, responsibilities, functions, and appointment of control stations may be found in Recommendation M.1012.

8.2 One sub-control station should be agreed bilaterally between Administrations involved for each TDM telegraph link prior to setting up the link. Principles concerning the definition, responsibilities, functions, and appointment of sub-control stations may be found in Recommendation M.1013.

**References**


[1] CCITT Recommendation *Code and speed dependent TDM system for anisochronous telegraph and data transmission using bit interleaving*, Vol. VII, Rec. R.101.

[2] CCITT Recommendation *Maintenance measurements on code independent international sections of international telegraph circuits*, Vol. VII, Rec. R.75.

[3] CCITT Recommendations on the *Maintenance of international telephone – Type circuits used for data transmissions*, Vol. VIII, Recs. V.51 to V.53.

[4] CCITT Recommendation *Automatic protection switching of dual diversity bearers*, Vol. VII, Rec. R.150.

[5] CCITT Recommendation *Designation of international circuits, groups, group and line links, digital blocks, digital paths, data transmission systems and related information*, Vol. IV, Rec. M.140.


## 5.3 Lining up and maintenance of international phototelegraph links

**Recommendation M.880**

### INTERNATIONAL PHOTOTELEGRAPH TRANSMISSION

#### 1 Types of circuits

1.1 Permanent circuits used between phototelegraph stations should be set up and lined up as 4-wire circuits between these stations.

1.2 Circuits used normally (and preferentially) will be nominated international telephone circuits, the international line of which is normally extended to the phototelegraph station on a 4-wire basis, it being ensured that the terminal equipment (line relay sets, terminating sets, echo suppressors, etc.) is disconnected.

#### 2 Line-up

2.1 The same conditions apply to the overall transmission loss of 4-wire circuits used for phototelegraphy as apply in general for telephony.

2.2 If an international telephone circuit is used to provide a phototelegraph circuit and if the international line is extended to the phototelegraph station the levels of the circuit so established should be such as to maintain the levels found on the level diagram of the telephone circuit.

#### 3 Relative levels

If phototelegraph transmissions take place simultaneously from a transmitting station to several receiving stations, arrangements shall be made at the junction point so that, on the circuits following the junction point, the same power levels are maintained as those prescribed for individual transmissions.

#### 4 Loss/frequency distortion

4.1 For phototelegraph transmission using frequency modulation, the use of a telephone circuit having a loss/frequency characteristic as given in Recommendation M.580 [1] will generally make it unnecessary to equalize the loss/frequency distortion of the lines joining the phototelegraph stations to the terminal international repeater stations. Such lines will have characteristics that follow national practice.

4.2 When amplitude modulation is used, the loss/frequency distortion between phototelegraph stations should not exceed 8.7 dB at any frequency in the band of frequencies transmitted. Since the band of frequencies required is less than the full bandwidth of the telephone-type circuit used for the phototelegraph transmission and the loss/frequency distortion over the bandwidth of the telephone-type circuit (see Recommendation M.580 [1]) is nominally much less than 8.7 dB, it will not in general be necessary to compensate for the loss/frequency distortion of the lines joining the phototelegraph stations to the international terminal repeater stations.

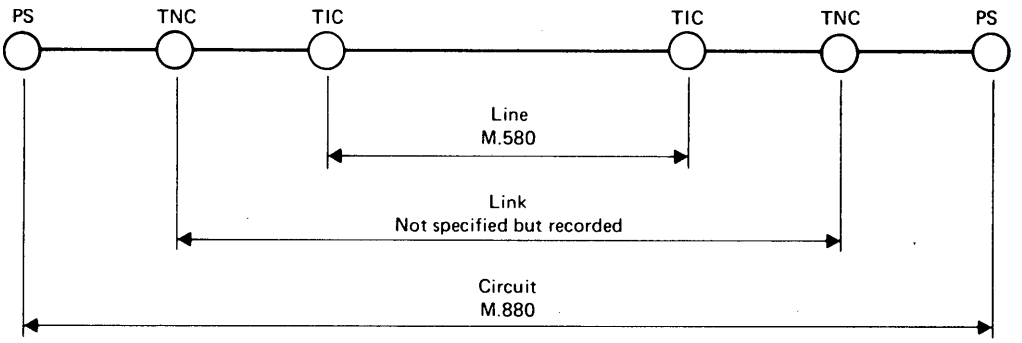
4.3 Figure 1/M.880 shows, in respect of loss/frequency distortion, the relationship of the Recommendations relating to international phototelegraph links.

## 5 Variation of overall loss with time

The overall loss should remain as constant as possible during picture transmissions.

5.1 The difference between the mean value and the nominal value of the transmission loss should not exceed 0.5 dB.

5.2 The standard deviation about the mean value should not exceed 1.0 dB. However, in the case of circuits wholly or partly on older-type equipment, and where the international line consists of two or more circuit sections, a standard deviation not exceeding 1.5 dB may be accepted.




PS = phototelegraph station
TNC = terminal national centre
TIC = terminal international centre

FIGURE 1/M.880
**Relationship between Recommendations which apply to international phototelegraph links in respect of loss/frequency distortion**

## 6 Phase/frequency distortion

Phase/frequency distortion limits the range of satisfactory phototelegraph transmission. The differences in group-delay time of the telephone circuit, over the phototelegraph transmission range, should not exceed:

$$\Delta_t \leqslant \frac{1}{2fp}$$

where *fp* is the maximum modulating frequency for the definition and scanning speed concerned.

(See Recommendation T.12 [2].)

## 7 Sent signal power

The conditions applying to the transmitted power in phototelegraph transmission are as follows:

The sent voltage of the phototelegraph signal at maximum amplitude should be so adjusted that the absolute power of the signal, at a zero relative level point found from the level diagram of the telephone circuit, is for a double sideband amplitude-modulated phototelegraph transmission −3 dBm referred to 1 mW and for a frequency-modulated transmission −13 dBm. With amplitude modulation, the black level is usually 30 dB below the white level.

In order to avoid the risk that phototelegraph signals be disturbed, for example by dial pulses transmitted over adjacent channels or by noise, it is important that the sending level should be as high as permissible; however, it shall not exceed $-13$ dBm0 on the multichannel system and the power at the output of the sending apparatus shall not exceed 1 mW.

This value of $-13$ dBm0 is in accordance with Recommendation V.2 [3], since in all cases the phototelegraph transmissions are operated in simplex. This value may have to be revised if the percentage of circuits used for applications other than telephony should go beyond the assumptions indicated in Recommendation V.2 [3].

## 8 Marking of equipment

When a telephone circuit is specially allocated for phototelegraph transmission (circuit identified by the letter F), the associated equipment should be specially marked to alert staff. All interruptions in a phototelegraph transmission, no matter how short, and all variations of level due to maintenance work should be avoided.

## 9 Organization of maintenance

The maintenance organization arrangements for international phototelegraph links should conform to the general principles given in Recommendation M.70 [4] concerning telephone-type circuits.

The designation of control and sub-control stations should follow the principles given in Recommendations M.1012 and M.1013.

## 10 Routine tests

The recommendations for 4-wire telephone circuits concerning the periodicity of measurements are also applicable to phototelegraph circuits.

Routine measurements should be made at the intervals recommended for international telephone circuits (see Table 1/M.610 [5]).

## 11 Information concerning frequencies transmitted by phototelegraph equipment

### 11.1 *Amplitude modulation*

For audio circuits the recommended carrier frequency is about 1300 Hz.

For circuits routed on carrier systems and effectively transmitting the band of frequencies 300-3400 Hz the recommended carrier frequency is about 1900 Hz.

### 11.2 *Frequency modulation*

| | |
|---|---|
| Mean frequency | 1900 Hz |
| White frequency | 1500 Hz |
| Black frequency | 2300 Hz |
| Phasing signal frequency | 1500 Hz |

**12** Information about the characteristics to be taken into account when choosing the circuit used for phototelegraph transmissions is given in Recommendation T.12 [2].

### References


[1] CCITT Recommendation *Setting up and lining up an international circuit for public telephony*, Vol. IV, Rec. M.580.

[2] CCITT Recommendation *Range of phototelegraph transmissions on a telephone-type circuit*, Vol. VII, Rec. T.12.

[3] CCITT Recommendation *Power levels for data transmission over telephone lines*, Vol. VIII, Rec. V.2.

[4] CCITT Recommendation *Guiding principles on the general maintenance organization for telephone-type international circuits*, Vol. IV, Rec. M.70.

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

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SECTION 6

# INTERNATIONAL LEASED GROUP AND SUPERGROUP LINKS

**Recommendation M.900**

## USE OF LEASED GROUP AND SUPERGROUP LINKS FOR WIDE-SPECTRUM SIGNAL TRANSMISSION (DATA, FACSIMILE, ETC.)

### NOMENCLATURE AND COMPOSITION

This Recommendation assumes that the constitution is such that the terminal national sections are provided by means of plant which is suitable for the transmission of wide-spectrum signals in the frequency band 60-108 kHz and 312-552 kHz respectively and the link is defined as given in § 1.1 below (see also Recommendations H.14 [1] and H.15 [2]).

In the case where the terminal national section uses plant not specifically destined for operation in the basic group or supergroup band, it will be necessary to provide the terminal national centre concerned with equipment to translate such a band of frequencies, i.e. the data base band signals, into the 60-108 kHz or 312-552 kHz band and vice versa.

Where this is done, the link should be regarded as being between defined access points at the two terminal national centres at points as close as possible to such translating equipment.

## 1 Nomenclature

### 1.1 international leased group or supergroup link

The whole of the transmission path – as defined in Recommendation M.300 [3] – provided between defined test access points at an interface at the renter's premises. The renter's terminal equipment is therefore not included in the link (see Figure 1/M.900).

### 1.2 terminal national section

The lines and apparatus between the defined test access points at the interface in the renter's premises and corresponding defined test access points at the terminal national centre.

### 1.3 national main section

The whole of the assembly of national group or supergroup sections connecting the defined test access points at the terminal national centre and defined test access points at the terminal international centre.

### 1.4 international main section

The whole of the assembly of national and international group or supergroup sections, between the defined test access points at the two terminal international centres (see Recommendation M.460 [4]). These access points should be the same points as those for the ends of the national main sections involved in the leased link.

### 1.5 terminal national centre

The nearest national installation (for example, a repeater station) to which the renter's equipment is connected by the terminal national section. This centre will normally be staffed and equipped to make transmission measurements.

### 1.6 terminal international centre

The international centre (for example, an international repeater station) serving the renter in the country in which the renter's installation is situated. There will be two terminal international centres in an international leased group or supergroup link or more in the case of a multiterminal link.

## 2 Composition

2.1 International leased group or supergroup links will be set up on plant that is similar to that used for providing national and international groups or supergroups for public services, that is on symmetric pair, coaxial cable, radio-relay, etc., systems and will follow similar routes.

### 2.2 *The leased group or supergroup link*

2.2.1 Figure 1/M.900 gives an example of the basic composition of a leased group or supergroup link and of the nomenclature used.

In general such a link will consist of a number of national and international sections interconnected by through-connection equipment, but it should be noted that in order to achieve particular transmission characteristics some restriction is placed on the degree of complexity of the routing of the link.

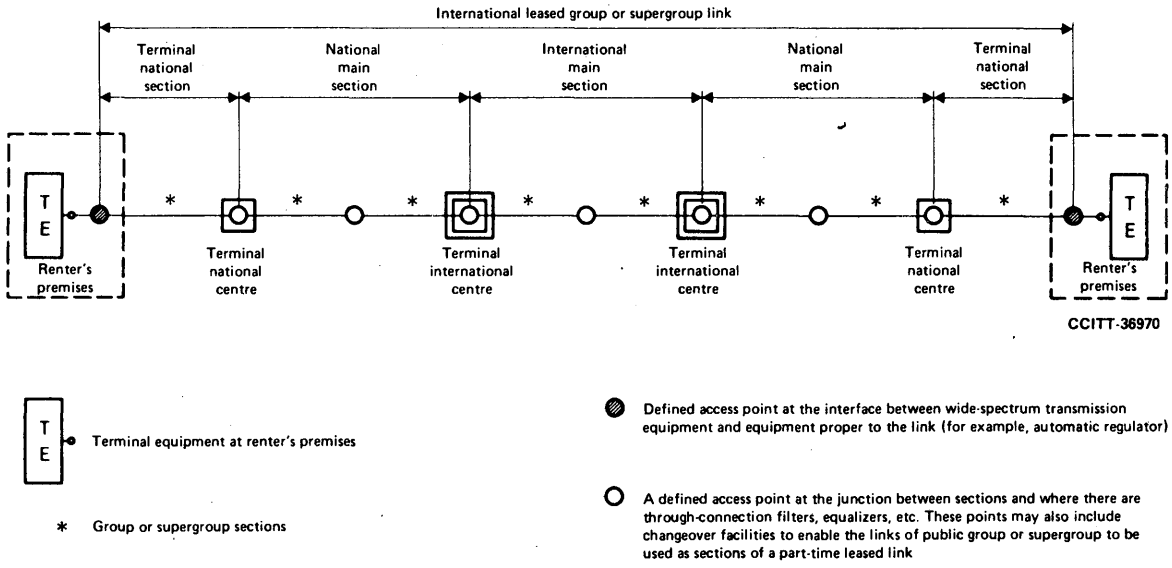



FIGURE 1/M.900

**Example of the basic constitution of an international leased group or supergroup link for wide-spectrum signal transmission**

2.2.2 Two basic types of centre are shown in Figure 1/M.900. These are:

a) the terminal international centre, and

b) the terminal national centre.

These define the limits of the national and international main sections and feature in the overall line-up and subsequent maintenance of the link.

2.3 *National and international main sections*

2.3.1 When establishing the constitution of national and international main sections the number of group sections within each main section should be kept to a minimum. This is necessary to:

- minimize the amount of group-delay distortion correction required;
- to simplify the effort necessary for the satisfactory maintenance of the link.

2.3.2 Where possible, it is desirable that each national and international main section be provided on a single group or supergroup section.

In practice, however, it may not always be possible to satisfy this requirement. Two group or supergroup sections per main section should be considered as the normal limit, to be exceeded in exceptional circumstances only.

2.4 *Terminal national sections*

Terminal national sections will usually be provided on plant which differs from that normally used for national or international groups or supergroups.

In most cases, such terminal sections may be provided on:

- symmetric pair cable specially provided between the terminal national centre (repeater station) and the renter's premises;
- existing local line plant possibly involving intermediate installations (for example, telephone exchanges) in the local network;
- combinations of the above.

The particular routing arrangements and the constitution of such sections are determined by the national practice of the country concerned.

2.5 *Choice of the group position within a supergroup*

It is very desirable, when choosing the routing of a group, to avoid the use of groups 1 and 5 as far as possible because of the difficulties which may be experienced in equalizing for group-delay distortion due to the edge characteristics of such group sections.

## 3 Provision of group or supergroup reference pilots and automatic regulators

3.1 *Pilots*

3.1.1 A group or supergroup reference pilot frequency as recommended by the CCITT (Recommendation M.460 [4]) should be transmitted on all international leased links for maintenance and regulation purposes.

Following national practice, the pilot may be injected either at the sending modem (as provided for in the Recommendation cited in [5], for example), or at the first repeater station (terminal national centre). When a pilot is injected at a renter's premises, it is recommended that the frequency of the pilot shall be one of those mentioned in Recommendation M.460 [4] (preferably 104.080 kHz and 547.920 kHz respectively), and that the pilot signal shall conform in all respects to the requirements in that Recommendation.

3.2 *Group and supergroup link regulation*

An automatic regulator should be provided on an international group or supergroup leased link in order to ensure the necessary overall stability of the link.

The point of insertion of such a regulator may be at the renter's premises or at the terminal national centre depending upon the particular arrangement of the Administration concerned.

**References**


[1] CCITT Recommendation *Characteristics of group links for the transmission of wide-spectrum signals*, Vol. III, Rec. H.14.

[2] CCITT Recommendation *Characteristics of supergroup links for the transmission of wide-spectrum signals*, Vol. III, Rec. H.15.

[3] CCITT Recommendation *Definitions concerning international transmission systems*, Vol. IV, Rec. M.300.

[4] CCITT Recommendation *Bringing international group, supergroup, etc., links into service*, Vol. IV, Rec. M.460.

[5] CCITT Recommendation *Data transmission at 48 kilobits per second using 60-108 kHz group band circuits*, Vol. VIII, Rec. V.35, § 7.


## Recommendation M.910

### SETTING UP AND LINING UP AN INTERNATIONAL LEASED GROUP LINK FOR WIDE-SPECTRUM SIGNAL TRANSMISSION

### 1 General

1.1 The international leased group links in this Recommendation relate to corrected group links in the Recommendation cited in [1].

1.2 The composition of a leased group link and the terminology used for maintenance purposes is given in Recommendation M.900.

1.3 The procedure for setting up an international leased group link should as far as possible follow the principles given in Recommendation M.460 [2].

1.4 For the purpose of this Recommendation, the constitution and subsequent line-up and maintenance practice assumes that the group link between renters' premises is operated throughout in the frequency range 60-108 kHz.

1.5 Where, as in some cases, modems are fitted at the terminal national centres the group link is defined as existing between defined access points at these centres.

In such cases the terminal national section is treated for lining-up and maintenance purposes as a separate section and not part of the group link as defined in Recommendation M.900.

1.6 In some cases, where the wide-spectrum transmission equipment located at the renter's premises is not frequency band restricted, it may be found necessary to include a through-group filter at the terminal national centre in the transmitting direction of transmission, in order to prevent interference by the wide-spectrum signals into adjacent groups in the carrier systems, over which the group is routed.

Also, when measuring at the terminal national centre in the receiving direction of transmission, a through-group filter may be necessary in the measuring circuit, in order to prevent signals from adjacent groups affecting the measurement results.

### 2 Setting-up of an international leased group link

2.1 *National and international main section*

With the exception of the terminal national section, the provisions of Recommendation M.460 [2] shall apply to the setting-up and the interconnection of the group sections constituting the national and international main section.

2.2 *Terminal national sections*

Because of the particular arrangements adopted for providing these sections within the country concerned, the setting-up of such sections will follow the practice determined within the country concerned.

2.3 *Application of the group reference pilot*

The application of a group reference pilot (preferably 104.08 kHz), whether injected into the group path at the renter's premises or whether it is injected at the terminal national centre, should conform to the requirements of Recommendation M.460 [2].

## 3 Lining up an international leased group link

3.1 *Lining up the national and international main sections*

3.1.1 The reference test frequency to be used should be 84 kHz.

3.1.2 The lining-up of these sections should follow the procedure and method given in the Recommendation cited in [3].

3.1.3 The national main sections may be lined up separately from the international main sections since no international cooperation is needed.

3.1.4 The limits given in Table 2/M.460 [4] should apply to these main sections. In addition, the group-delay distortion of the national and international sections should be measured and the results recorded.

3.2 *Terminal national sections*

The lining-up of these sections will follow the national practice of the country concerned.

3.3 *Interconnection of terminal national sections and national main section*

The levels and impedances in the frequency band concerned of the terminal national sections and the national main section at the terminal national centre should be made compatible with the levels and impedances specified for the access point at this centre.

3.4 *Overall line-up of the link*

When the national and international main sections have been lined up and interconnected using the necessary through-group equipment, measurements should be made between the terminal access points, either at the renter's premises or in exceptional cases at the terminal national centres.

In addition to level measurements the group-delay distortion within the frequency band 68-100 kHz should be measured and the values relative to the minimum group-delay distortion within the band should be recorded for subsequent maintenance use. If necessary, group-delay equalizers have to be inserted into the link where appropriate.

The procedure and method to be used for the line-up should follow that given in Recommendation M.460 [2], but the limits to be achieved are those given below.

3.4.1 *Overall loss at the reference frequency*

The overall loss at the reference frequency between the renters' premises cannot normally be specified because of the freedom accorded to Administrations to adopt nominal relative levels which is their national or agency practice.

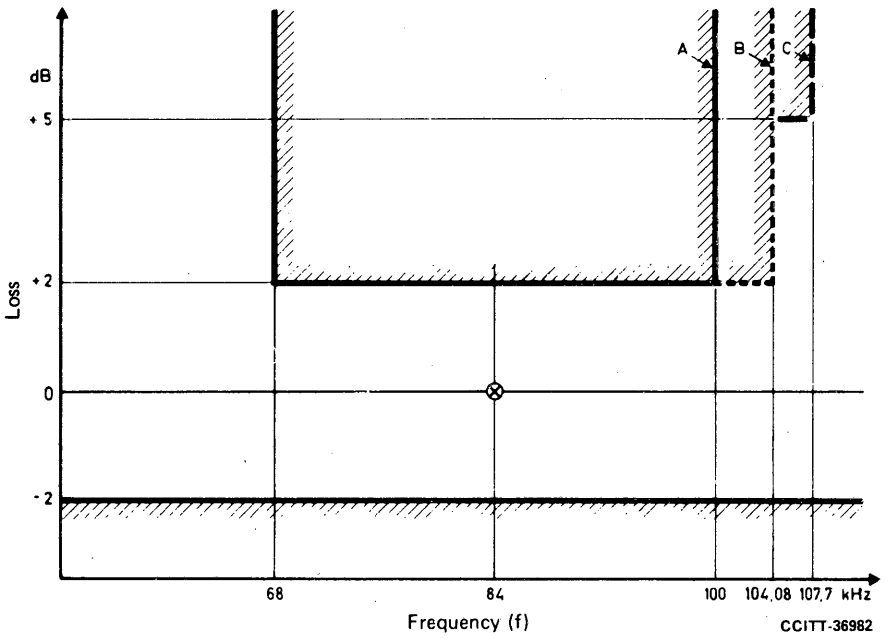
If, however, it is necessary to specify a particular value of overall loss as a result of a request by a renter this may be done only after prior consultation and agreement between the Administrations concerned.

3.4.2 *Loss/frequency distortion*

The loss/frequency distortion of the overall link is shown in Figure 1/M.910. It should be measured over the frequency range 60-108 kHz and equalized with a group link equalizer as necessary to meet the limits with respect to the loss at 84 kHz.

*Note 1* – If the service channel is provided, additional equalization may be needed and there will be no possibility of employing simplified through-group filters.

*Note 2* – 84 kHz is the reference frequency for the purposes of specifying and measuring attenuation distortion. The group reference pilot at 104.08 kHz may still be used as the regulating pilot, however, as required.




A: these limits apply if the group reference pilot (104.08 kHz) is injected at an intermediate point on the link (e.g., the terminal national centre)
B: these limits apply if the group reference pilot is transmitted throughout the link (e.g., if it is injected by the terminal equipment)
C: these limits apply if the service channel is provided

FIGURE 1/M.910
**Limits for loss/frequency distortion**

3.4.3 *Group-delay distortion*[1)]

3.4.3.1 The group-delay distortion of the link should not exceed 45 μs relative to the minimum value within the band of frequencies 68-100 kHz.

3.4.3.2 If the group-delay distortion exceeds the value given in § 3.4.3.1 above, equalization should be provided as agreed by the two terminal Administrations concerned to bring the group-delay distortion of the link within this value and the results recorded.

3.4.3.3 Where the group link terminates at the two terminal national centres, the value of the group-delay distortion given in § 3.4.3.1 above should apply between these two centres.

3.4.4 *Level variations*

Irrespective of whether the group link terminates at the two renters' premises concerned, or at the two terminal national centres the link should be checked in accordance with the Recommendation cited in [5] in order to ensure that no faults exist. The following limits should not be exceeded:

- short-term variations: ± 3 dB,
- long-term variations: ± 4 dB, relative to the nominal value.

[1)] This limit can normally be met without overall link equalization for group links consisting of three group sections in tandem using corrected through-group connection equipment.

3.4.5 *Carrier leak*

The group link should be subjected to measurement of each carrier leak individually at the receiving terminal in both directions of transmission.

The objective for the level of any carrier leak, appearing in the frequency band 60-108 kHz is −40 dBm0.

In some cases, however, because of the composition of the link, which will generally involve the use of both old and new types of equipment it may not be possible to achieve this value.

At all events, no carrier leak in the band 60-108 kHz should exceed −35 dBm0.

*Note* – The attention of users is drawn to the fact that failure to reach the value −40 dBm0 might cause difficulties in cases where links are used for data transmission.

3.4.6 *Impulsive noise*

For the specification of an impulsive-noise measuring instrument for wideband data transmissions, see Recommendation H.16 (O.72) [6]. No limit value can be given at the present time.

3.4.7 *Frequency error*

The frequency error over the group link should not exceed 5 Hz. When this measurement is necessary, it should be made according to bilateral agreement between Administrations.

3.4.8 *Background noise*

At the present time it is not possible to specify a limit value for background noise for this class of group link. However, a check of the background noise should be made and recorded at every line-up.

**References**


[1] CCITT Recommendation *Characteristics of group links for the transmission of wide-spectrum signals*, Vol. III, Rec. H.14, § 2.

[2] CCITT Recommendation *Bringing international group, supergroup, etc., links into service*, Vol. IV, Rec. M.460.

[3] *Ibid.*, § 7.2.

[4] *Ibid.*, Table 2/M.460.

[5] *Ibid.*, § 8.

[6] CCITT Recommendation *Characteristics of an impulsive-noise measuring instrument for wideband data transmission*, Vol. III, Rec. H.16.

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SECTION 7

# INTERNATIONAL LEASED CIRCUITS

## 7.1 General

### Preface

International leased circuits will in most cases be provided over the same sort of transmission lines, cables, systems, etc., as figure in an international telephone connection established over the public switched telephone network. Hence the overall characteristics of international leased circuits from renter to renter can be expected to be similar to those of international telephone connections from subscriber to subscriber (except in so far as there are not intermediate telephone exchanges).

The guiding principle in lining up an international leased circuit (and which is the same that has been adopted for public switched telephony) uses the notion given in Section 1 of the Series G Recommendations, Volume III, of an interface between the national and the international portions of the circuit.

In the case of leased circuits, every Administration has established rules with which a renter's installation must comply before it may be connected to the circuit (for example, the maximum value of the absolute power level of the sent signal is defined). Furthermore, the Administration normally gives some indication of the minimum level it will deliver to the renter in the receive direction of transmission.

The following Recommendations have been drawn up in a way that ensures that in principle the nominal characteristics of an international leased circuit, from the point of view of the renter, are similar to those of any analogous national leased circuit he may operate. In particular, the international leased circuit accepts and delivers nominally the same signal level as that accepted and delivered by an analogous national leased circuit. Hence in principle the renter can use the same type of apparatus for both sorts of leased circuits and the need for special arrangements is minimized.

A necessary consequence is that the nominal transmission loss between renters' premises cannot be specified by the CCITT. (It can, however, in principle, be specified by the pair of terminal Administrations concerned.)

**Recommendation M.1010**

### CONSTITUTION AND NOMENCLATURE OF INTERNATIONAL LEASED CIRCUITS

**1 Some features of the constitution of international leased circuits are:**

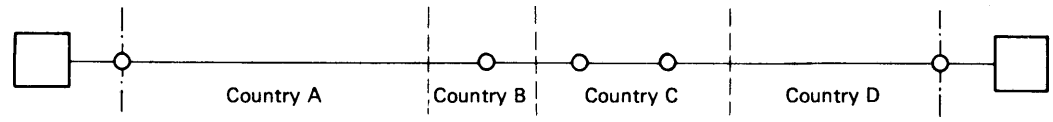
a) the number of locations connected may be two or more;

b) the circuit may be available either 2-wire or 4-wire at a renter's installation [1];

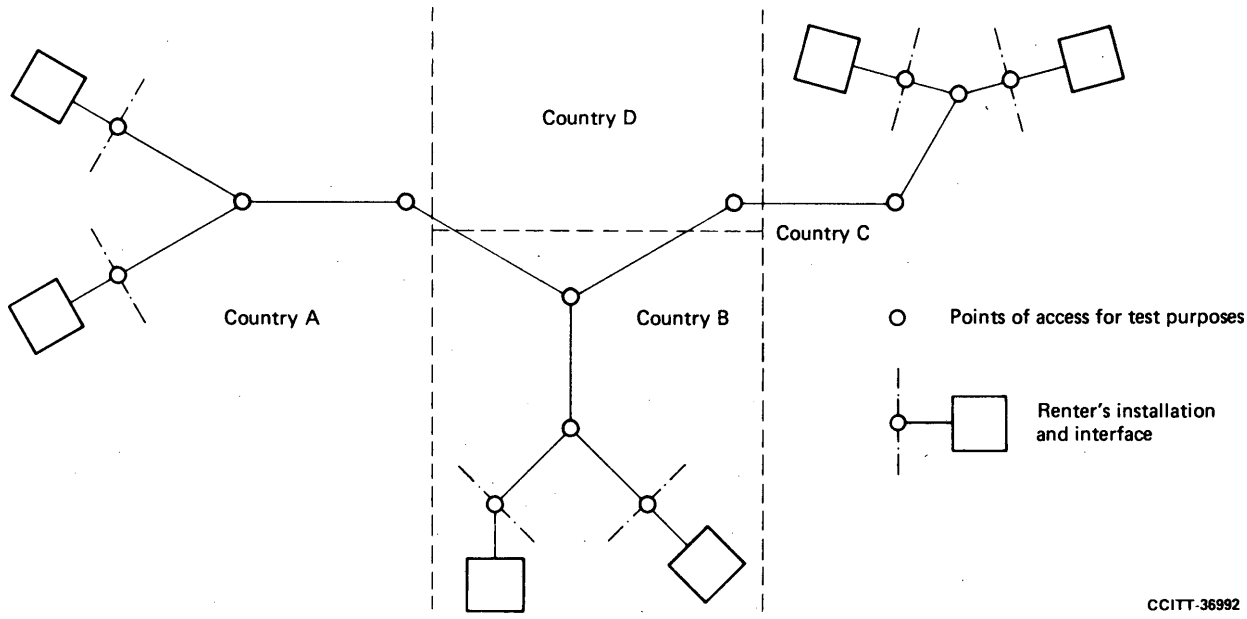
c) the transmission paths may be provided with a combination of unloaded (or loaded) subscribers line plant (in the local network), unloaded or loaded cable pairs (in the junction network) channels in frequency division multiplex carrier systems (in the national long-distance network and in the international network), and channels in time division multiplex transmission systems (in the national or international network).

[1] Some Administrations do not provide the 2-wire facility for special quality international based circuits.

Figure 1/M.1010 illustrates two types of circuits: those which connect two points and those connecting more than two points. These are referred to as point-to-point circuits and multiterminal circuits respectively.




a) *Point-to-point circuit*




b) *Multiterminal leased circuit*

FIGURE 1/M.1010
**Examples of point-to-point and multiterminal international leased circuits**

## 2 Access points

2.1 It is recommended that Administrations establish access points on the various circuit sections analogous to the access points recommended for international telephony circuits in the public service at which the nominal relative levels are fixed and determined by the Administration. At the international centre it would be advantageous if the same relative level as that adopted for public circuits is used for leased circuits. Within the national networks there are very often access points of defined relative level and impedance provided in accordance with national practices and these points, together with the international access points, serve to divide the circuit into circuit sections.

2.2 In principle, an access point is also available at the renter's premises but it is not always convenient to test from there. Accordingly, the procedures recommended in this Section involve also the access points provided by Administrations in repeater stations or telephone exchanges near to the renter's installation for transmission measurements on international leased circuits.

These are points between which it might be expected that measurements could be made, though the staff at such stations concerned do not always have experience in international maintenance procedures. Measurements made by Administrations between renters' installations could encounter particular problems.

## 3 Definitions and nomenclature

The definitions below are illustrated in Figure 2/M.1010.

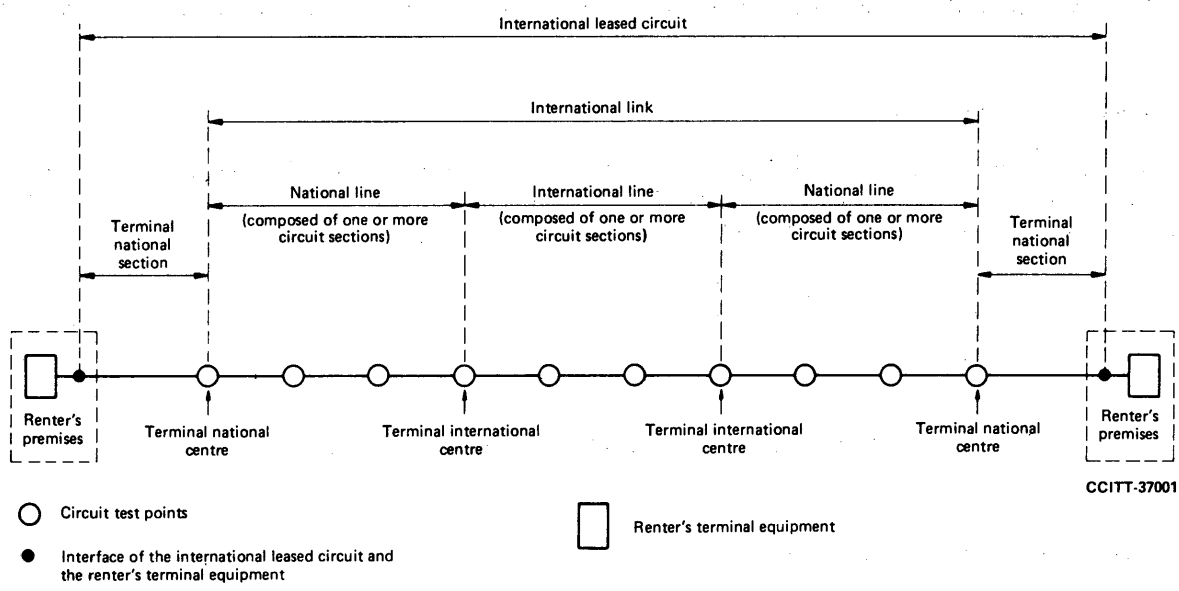



FIGURE 2/M.1010

**Basic constitution of a point-to-point international leased circuit**

### 3.1 international leased circuit

The whole of the assembly of lines and apparatus connecting the renter's terminal equipment (e.g. data modem) in one country to the renter's terminal equipment in another. The interfaces between the circuit and the renter's terminal equipment will be defined by the respective Administrations.

### 3.2 international link

The whole of the assembly of international and national circuit sections between terminal national centres.

### 3.3 international line

The whole of the assembly of international and national circuit sections between terminal international centres.

### 3.4 national line

The whole of the assembly of national circuit sections connecting the terminal national centre to the terminal international centre. When a distinction is needed to indicate the transmission direction in one country the expressions *national sending line*, that is, outgoing from the renter, and *national receiving line*, that is, incoming to the renter, may be used.

### 3.5 terminal international centre

The terminal international centre (TIC) for leased and special circuits is the international centre serving the renter in the country in which the renter's installation is situated. It marks the interface of the international and national lines and is normally located in association with a terminal international centre for international public telephony circuits.

Some Administrations may wish to locate the TIC for international leased and special circuits independently of that for public telephony circuits.

In all cases there will be a transmission maintenance point (international line) (TMP-IL) (see Recommendation M.1014) located at each TIC for leased and special circuits.

There will be two TICs in a point-to-point international circuit. There may be more in a multiterminal circuit.

3.6 **terminal national centre**

The national centre (e.g. repeater station, telephone exchange) that is:

- nearest to the renter's installation,
- provided with a circuit test point, so that transmission measurements can be made by appropriate staff.

3.7 **terminal national section**

The lines and apparatus connecting the renter's installation with the terminal national centre concerned. There may be intermediate installations (e.g. telephone exchanges) in the terminal national section but they are assumed to have no testing facilities normally available.

## Recommendation M.1012

### CIRCUIT CONTROL STATION FOR 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, for example circuits used for voice-frequency telegraphy, facsimile and phototelegraphy.

### 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. The circuit control station carries out this responsibility by directing, and/or coordinating other stations as necessary to ensure that satisfactory service is provided for which it has been assigned control.

### 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.1014);
- sub-control station either directly or via the TMP-II.

When the circuit control station receives a fault report from the circuit sub-control station a unique reference number should be issued and given to the sub-control station. (If national practices already involve the issue of a unique reference number this may be used.)[1] The reference number is recorded with the fault report by both the circuit control and sub-control stations.

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.

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[1] Where no such unique reference number exists, Administrations may wish to consider a format containing the following elements: serial number/day of month/time (e.g. 47/03/1400G).

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 a foreign country.

3.7 Controlling the withdrawal of circuits from service.

3.8 Controlling the return of circuits to service, for example, after fault clearance, routine measurements, etc.

3.9 Arranging for withdrawal of circuits from service with the customer.

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

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

3.12 Advising the customer (or ensuring that this be done) of the progress of fault clearance if appropriate, for example in the case of lengthy outages, and ensuring that the customer is advised when the fault has been corrected.

3.13 Keeping accurate records of circuit outages. The information recorded should be agreed with the circuit sub-control station and should include:

- the reference number mentioned in § 3.3;
- the circuit outage time;
- the location of the fault that is, in a national or international circuit section or in the renter's equipment;
- the general nature of the fault.

## 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.1013

## SUB-CONTROL STATION FOR 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.1014) 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.

When cooperation is requested by the circuit control station to locate and clear a fault the circuit sub-control station issues a unique reference. (If national practices already involve the issue of a unique reference number, this may be used)[1]. This reference number is recorded with the fault report by both the circuit control and sub-control stations.

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.

3.4 Keeping accurate records of any circuit outages with which it becomes involved. The information recorded should be agreed with the circuit control station and should include:

- the reference number mentioned in § 3.2;
- the circuit outage time;
- the location of the fault, that is, in a national or international circuit section or in the renter's equipment;
- the general nature of the fault.

## 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 or 64 kbit/s etc., 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.1014

## 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. The class of circuits considered here are also referred to in Recommendations M.1012 and M.1013 concerning circuit control and sub-control functions for international leased and special circuits.

[1] Where no such unique reference number exists, Administrations may wish to consider a format containing the following elements: serial number/day of month/time (e.g. 47/03/1400G).

## 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.

# Recommendation M.1015

## TYPES OF TRANSMISSION ON LEASED CIRCUITS

1 A leased point-to-point or multiterminal circuit can be provided in some instances for one type of service only, such as:

- telephony (that is, speech transmission),
- voice-frequency telegraphy,
- data transmission,
- facsimile.

(The list is not complete but it includes the most common types of service.)

2 In other instances leased circuits are used for different transmission purposes at different times, in which case the circuit characteristics should in principle be determined by the requirements of the more exacting form of transmission (when there is a difference in requirements).

*Note* – The North American expression for this type of operation is *alternate-use.*

3 Although special quality leased circuits are not provided for normal telephony, it is recognized that they will be used for voice communication for service coordination purposes and for the *alternate-use* type of operation envisaged in § 2 above. The prescribed circuit limits in Recommendations M.1020 and M.1025 are not intended to define a circuit to be used to carry normal telephony, although a circuit which meets these limits will be adequate for voice communication purposes.

4 In some instances the bandwidth provided by the circuit is divided into two or more bands thus providing two or more circuits which may be used for different types of transmission.

If the band is divided among two or more classes of transmission by means of equipment under the control of the Administration, then band-dividing filters should wherever possible be used in preference to hybrid transformers because their use affords the possibility, in some circumstances, of carrying out maintenance operations on one circuit (obtained by frequency division) without affecting another.

In those cases in which the frequency division is effected by the renter's apparatus in the renter's premises the Administrations should make it clear that even though the renter's apparatus must be approved by the Administration, this latter is not responsible for faults or the wrong operation of equipment attributable to the arrangement adopted by the renter.

5 Figures 1/M.1015 to 3/M.1015 illustrate some typical arrangements.

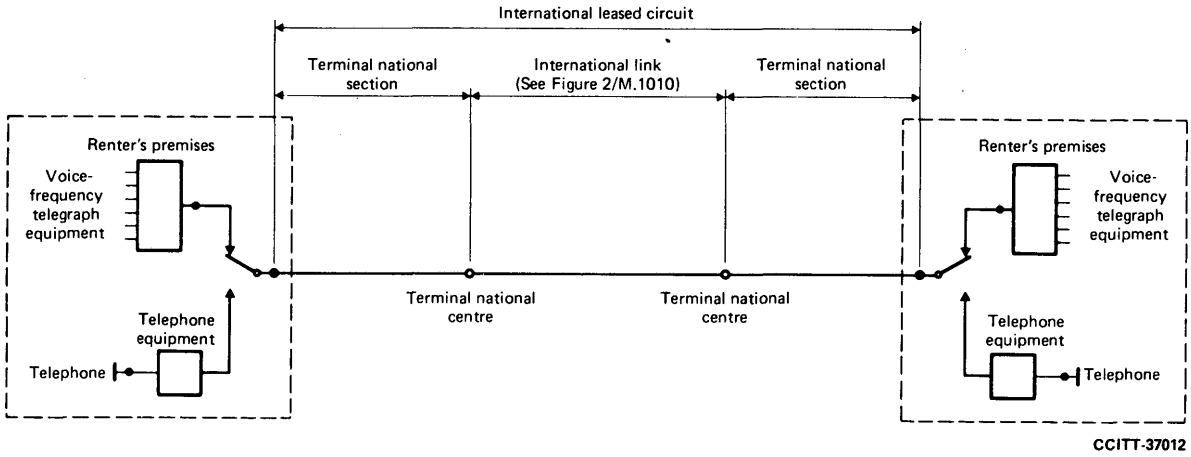


FIGURE 1/M.1015

**Example of a point-to-point leased circuit alternatively used for telegraphy or telephony**

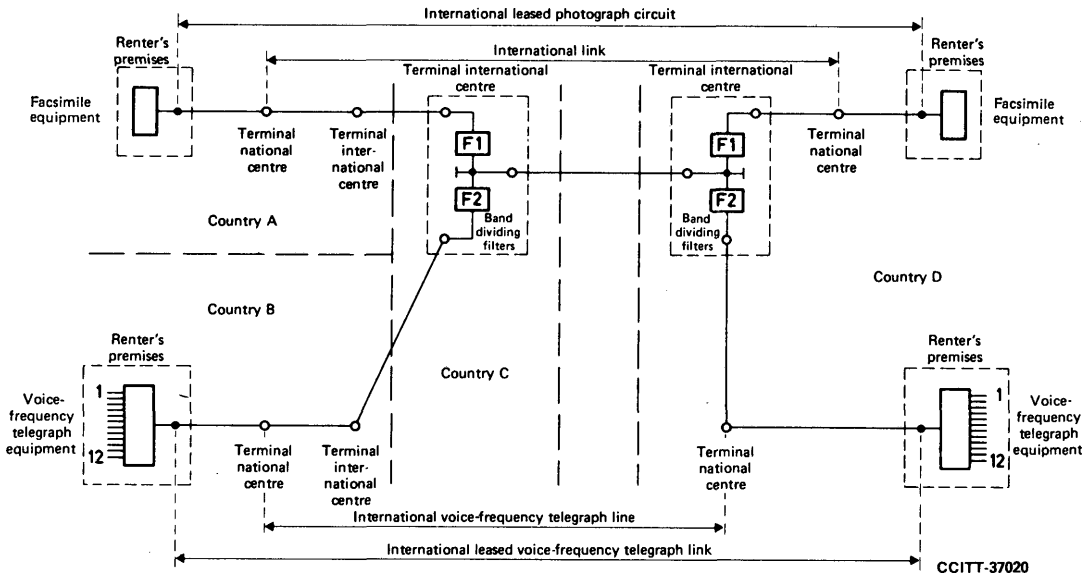


FIGURE 2/M.1015

**Example of a multipoint leased circuit for simultaneous voice-frequency telegraphy and facsimile transmission**

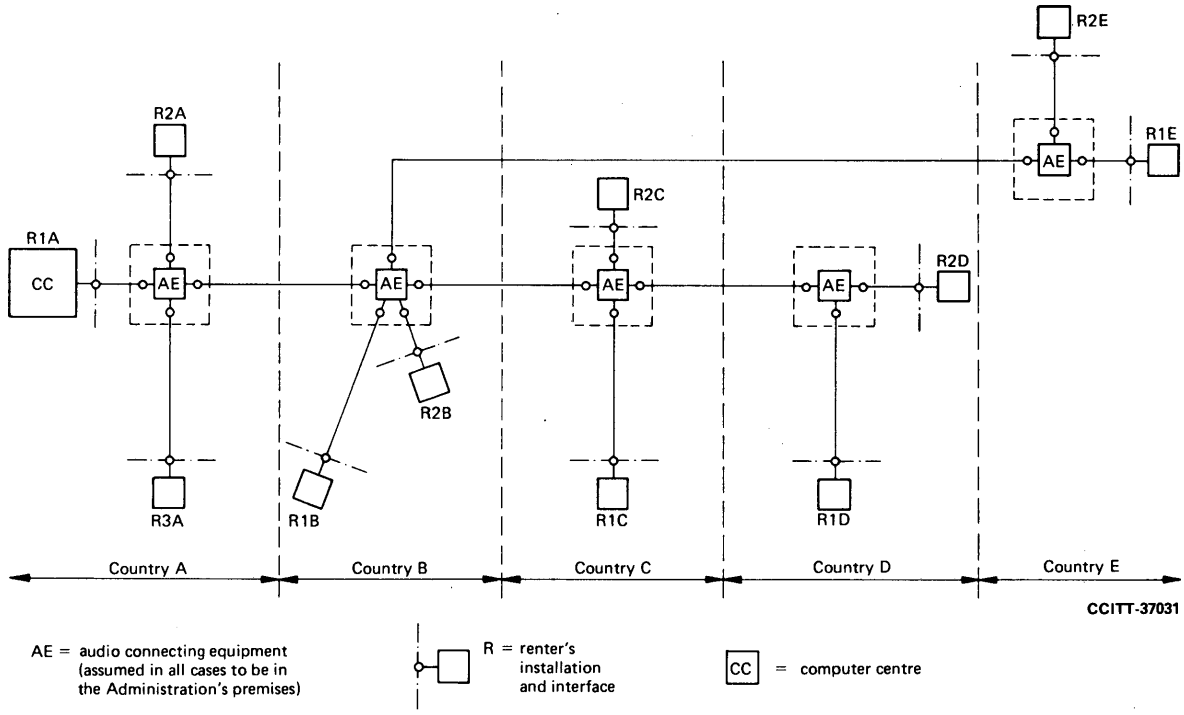


FIGURE 3/M.1015

**Example of an international leased multiterminal data circuit**

## Recommendation M.1016

### ASSESSMENT OF THE SERVICE AVAILABILITY PERFORMANCE OF INTERNATIONAL LEASED CIRCUITS

### 1 General

The attention of Administrations is drawn to the benefits which can be derived from basing assessments of the service availability performance of international leased circuits on internationally agreed practices. Adoption of common practices assists international cooperation in identifying and clearing service difficulties, allows Administrations to compare performance results, and enables Administrations to present a common approach in discussions with customers.

To this end, this Recommendation offers guidance to Administrations on assessing the service availability of international leased circuits[1)] on the performance figures which may be used in such assessments and the method of deriving such performance figures.

Where appropriate, the terms and definitions given in Recommendation E.800 [1] and in Supplement No. 6 to Fascicle II.3[2] have been used in this Recommendation.

### 2 Basis of assessments of service availability performance

In establishing a common method to assess the service availability performance of international leased circuits, the CCITT has been concerned to ensure that the basic information for such an assessment is readily available to all Administrations. To this end, the assessment procedure in this Recommendation is based on a "service orientated" approach. This approach implies that fault reports made by customers and planned interruptions which unacceptably disrupt the customer's service, will play a major role.

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[1)] In this Recommendation only full-time, point-to-point international leased circuits (as defined in Recommendation M.1010 and specified in Recommendations M.1020, M.1025 and M.1040) are considered. The service availability performance of part-time, wide-band, multi-terminal, etc. international leased circuits requires further study.

The adoption of the service orientated approach recognizes that in order to determine the true service availability performance with accuracy it would be necessary, for example, to continuously observe the circuits in some way, and to record the number and duration of all events which affect their performance. This requirement cannot reasonably be met by most Administrations, and the best that can be achieved in practice is an approximation of the true performance.

Another basic factor in the assessment procedure is that, for international leased circuits, no differentiation should be made on the basis of, for example, circuit length, circuit quality (Recommendations M.1020, M.1025 and M.1040), type of routing, etc. Such differentiation may be carried out by an Administration for internal purposes if it so desires.

## 3 Purpose of the assessment procedure

### 3.1 *General*

The assessment procedure specified in this Recommendation may be used for two purposes:

- international purposes;
- national purposes.

### 3.2 *International purposes*

The assessment procedure is used for international purposes when two Administrations wish to assess together the performance of individual international leased circuits (or a group of circuits) as a whole for special investigations, for dealing with customers' complaints or similar situations.

For such assessments it is necessary, as far as practicable, to gather simultaneously all available information on the performance of the circuit(s) from the Administrations involved. Thus, the stations with control responsibilities (Recommendations M.1012 and M.1013) play an essential role.

*Note* – This approach should be followed when investigations of the service availability performance of international leased circuits is undertaken by CCITT, as may be required from time-to-time.

### 3.3 *National purposes*

The assessment procedure is used for national purposes when an individual Administration wishes to provide itself with information for its own internal purposes on the performance of the international leased circuits it operates, for example, to identify adverse trends in performance, or to check the effectiveness of its maintenance procedures. Such evaluations of international leased circuit performance may be based on information already available to the Administration (without the need to gather information from other Administrations), and may be carried out for all circuits whether or not the Administration provides the control station.

*Note* – Assessments of the type mentioned in §§ 3.1 and 3.2 above in no way change the intent that control stations be informed of all faults detected by a sub-control station – see Recommendation M.1013.

## 4 Description of the assessment procedure

### 4.1 *Collection of basic data*

Three fundamental conditions must be taken into account when collecting basic data for assessing the service availability performance of international leased circuits:

a) faults, as reported by the customer and confirmed by tests and investigations carried out by the Administrations;

b) impairments to normal service, as reported by the customer, where the customer chooses to continue to use the circuit in a degraded condition;

c) planned interruptions to service to enable, for example, permanent repair work to be carried out, maintenance routines to be performed, etc. (see Recommendation M.490 [3]).

In determining if and how downtime is to be included in the assessment procedure, the following principles should be applied:

- if tests or investigations reveal that a fault or impairment exists (or has existed), downtime will be taken into account;
- if no fault or impairment is ever observed by the Administration, no downtime will be taken into account;

- the time the Administration returns service to the customer (or the first attempt to do so) is taken as the end of downtime;
- only those planned interruptions which unacceptably disrupt the customers service will be taken into account.

*Note* – Where the bandwidth of the circuit is divided to provide for simultaneous multiple transmission of different services (for example, simultaneous speech plus data), only those faults which affect the entire circuit and partial faults which require the entire circuit to be taken out of service for fault finding and repair should be taken into account in the assessment procedure.

These principles are embodied in Tables A-1/M.1016 and A-2/M.1016, which define those conditions where downtime should be taken into account, and the start and end of downtime, for customer reported faults and planned interruptions of service respectively.

In certain circumstances the assistance of the customer or access to his premises is necessary to locate/clear a fault or an impairment to service. Where the customer denies such assistance, or denies access to his premises, the extra downtime which may result should be excluded from the assessment of performance.

4.2 *Basic data*

The basic data required in connection with the assessment procedure are:

- the number of international leased circuits involved. Guidance on how to determine this number is given in Annex B;
- the designation of each circuit involved, as agreed between Administrations in accordance with Recommendation M.140 [4];
- for each involved circuit, the number of faults and unacceptable planned interruptions of service within the observation period (refer to Annex A);
- for each fault and planned interruption of service:
  - i) the start of downtime (in UTC)[2)]
  - ii) the end of downtime (in UTC)
  - iii) the duration of downtime;
- the address(es) of involved Administrations and, ideally, the name and telephone number of an appropriate contact person within each Administration.

The additional information specified in § 5 below is also considered as basic data for the assessment procedure.

4.3 *Observation period*

For the purpose envisaged in § 3.2 above, the observation period should be three calendar months. For practical reasons it is advisable that the observation period start at 00.00 UTC on the first day of a quarter of the year, and end at 24.00 UTC on the last day of that quarter.

For the purpose envisaged in § 3.3 above, Administrations are free to select an observation period which suits their needs.

4.4 *Exchange of information between terminal Administrations*

At the end of the observation period, the basic data is recorded on forms, examples of which are shown in Appendices I and II to this Recommendation. Examples of completed forms are given in Appendices III and IV to this Recommendation. Appendices I and III relate to information supplied by the control station, while Appendices II and IV relate to the sub-control station. Forms, completed with information from the sub-control station should be sent to the Administration which has control station responsibility.

4.5 *Elaboration of results*

It is the responsibility of the Administration providing the control station to combine the information supplied by the control and sub-control stations. In practice it is found that this information is often different, and the following rules should be used to handle such differences:

a) if a fault (or unacceptable planned interruption) is reported by both control and sub-control stations, then the start of downtime is the earliest time indicated by the control or sub-control station and the end of downtime is that recorded by the control station;

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[2)] UTC = Coordinated universal time (UTC is equal to GMT, but replaces it; see Recommendation B.11 [5]).

b) if a fault (or unacceptable planned interruption) is reported by only one of the stations, then such a fault is deemed to have occurred and the corresponding downtime is taken into account.

For rules used for combining the additional information specified in § 5 below, reference is made to Annex C.

4.6 *Presentation of service availability performance information*

The methods of calculating and presenting service availability performance information for international leased circuits are given in detail in Annex B.

When service availability performance information is to be supplied to other Administrations, and when making international comparisons, the following parameters should be presented:

a) number of circuits involved in the assessment. (Where this is less than the total number of circuits in service, the number of circuits in service should also be supplied),

b) mean downtime per circuit,

c) mean number of faults per circuit,

d) mean time to failure (MTTF),

e) percentage of circuits for which no downtime was recorded,

f) mean time to restore service (MTRS).

In addition, and at the discretion of Administrations, the following parameters may also be presented:

g) long-term mean downtime per circuit (over at least four consecutive observation periods),

h) percentage of circuits with downtime less than the mean,

i) downtime per circuit not exceeded by 95% of the circuits.

For items a) to i) above, reference is made to Annex B.

4.7 *Treatment of events which distort service availability performance figures*

Service availability performance figures for international leased circuits can be significantly influenced (or their meaningfulness destroyed) by catastrophic events, for example, destruction of facilities by hurricane or earthquake. In view of this, the following procedure should be adopted:

Events which, based on previous experience, have noticeably influenced the performance figures should not be excluded. However, in this case, a second calculation should be made to present the performance figures with the catastrophic event(s) excluded.

This procedure attempts to maximize the possibility of all events being included in the performance figures in some manner.

## 5 Considerations for comparing service availability performance information internationally

5.1 Administrations are encouraged to exchange service availability performance information on international leased circuits on a regular basis.

5.2 In order to assist the interpretation of service availability performance information, particularly when exchanged between Administrations, relevant additional information should also be supplied. Such additional information should cover the following aspects:

a) priority maintenance attention to international leased circuits;

b) duplicated circuit sections;

c) fault clearance service;

d) transmission limits which define whether or not a fault exists;

e) information to customers about planned interruptions to service.

Annex C specifies the above information in greater detail, while Appendices III and IV show how the information is to be exchanged between Administrations.

5.3 Detailed maintenance procedures and the methods by which Administrations confirm the existence of faults on international leased circuits are different. Such differences may lead to differences in the service availability performance results obtained by Administrations.

ANNEX A

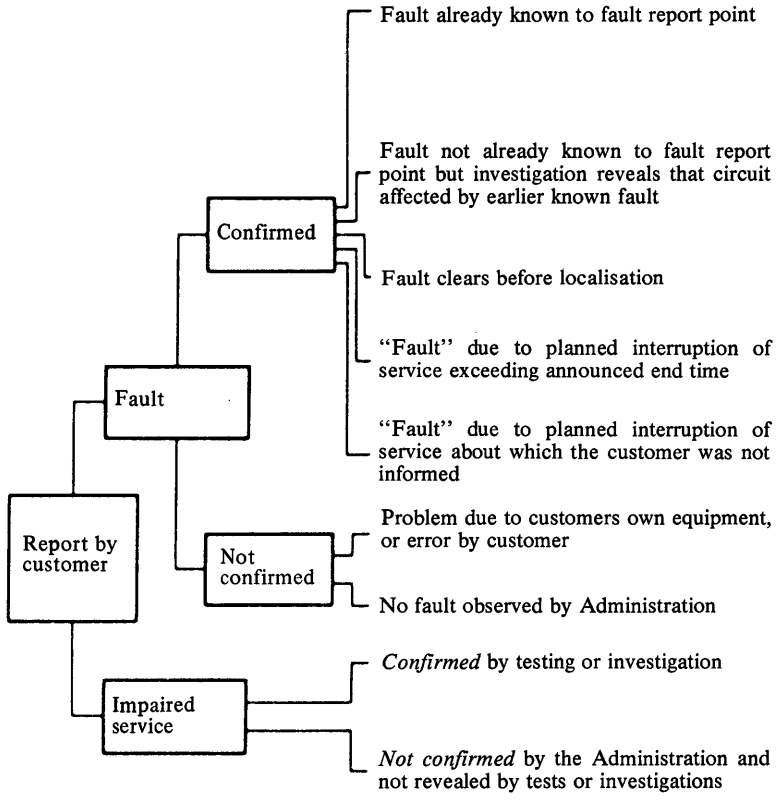
(to Recommendation M.1016)

**Rules for determining the number of faults and the downtime to be taken into account in assessments of the service availability performance of international leased circuits**

A.1 Detailed principles for the determination of the number of faults and impairments affecting service availability performance, and their resulting downtime, are given in Table A-1/M.1016.

TABLE A-1/M.1016

**Determination of downtime due to customer reported faults and service impairments**




| | Downtime | |
|---|---|---|
| Included | Starts | Ends |
| Yes | Customer report time | When service returned to customer (or first attempt to do so) |
| Yes | Customer report time | |
| Yes | Announced end time of planned interruption | |
| Yes | Announced start time of planned interruption (Note 1) | Announced end time of planned interruption (Note 2) |
| No | – | – |
| No | – | – |
| Yes | Downtime = total time the circuit was taken from the customer for testing and fault clearance | |
| No | – | – |

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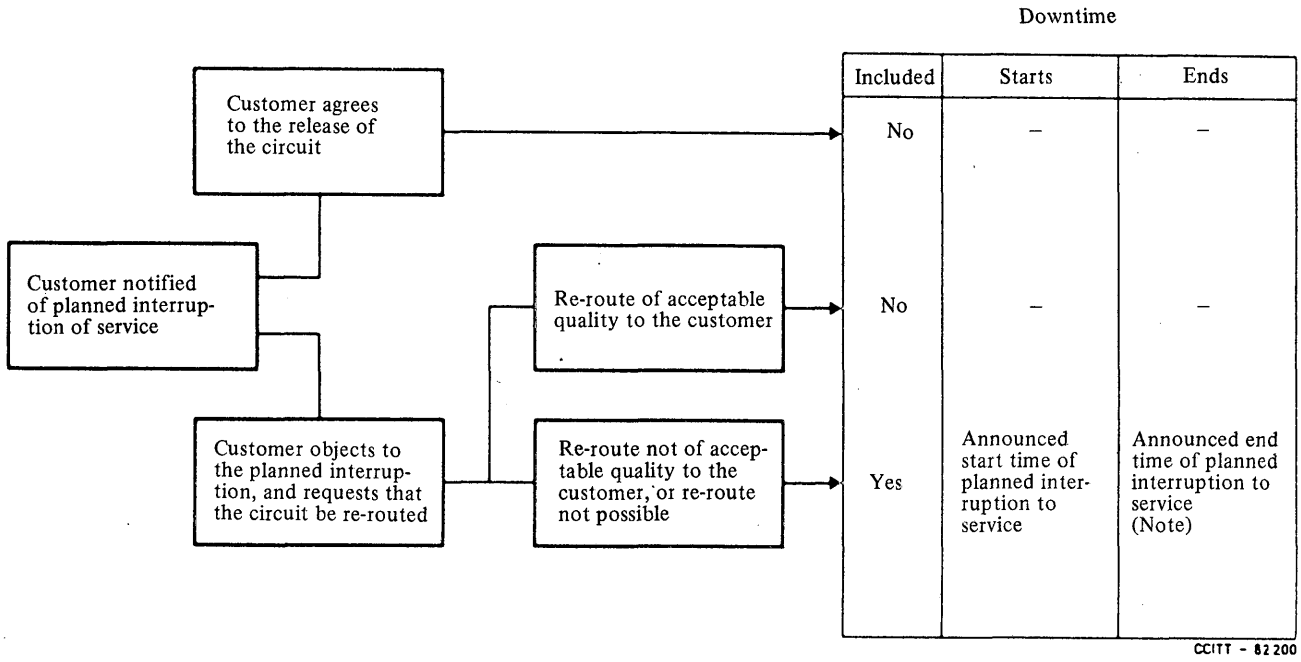
*Note 1* — If the announced start time is not known to the fault report point, the customer report time should be used.

*Note 2* — If the announced end time is not known to the fault report point, the time the service is returned to the customer (or first attempt to do so) should be used.

A.2 Principles to determine the downtime due to planned interruptions of service are given in Table A-2/M.1016.

TABLE A-2/M.1016

**Determination of downtime due to planned interruptions of service**




*Note* — For fault reports which are received because the announced end time is exceeded, see Table A-1/M.1016.

A.3 If a circuit is in a downstate at the beginning of the observation period, the fault or planned interruption of service causing the downstate is *not* taken into consideration. However, downtime is deemed to start at the beginning of the observation period.

A.4 If a circuit is in a downstate at the end of the observation period, the fault or planned interruption of service causing the downstate is taken into consideration. The downstate is deemed to end at the end of the observation period.

## ANNEX B

(to Recommendation M.1016)

## Presentation of service availability performance information for international leased circuits

*Note* – This annex contains additional explanations and rules of calculation for the performance parameters specified in § 4.6. §§ B.1 to B.9 below relate to items a) to i) in § 4.6 respectively.

B.1 *Determination of the number of circuits involved in the assessment*

The calculation of service availability performance figures for international leased circuits requires that the exact number of circuits, *n* involved in the assessment be determined.

For the assessment purposes envisaged in § 3.1, only those circuits existing throughout the observation period should be considered. Thus, circuits provided or ceased within an observation period should be ignored.

For the purpose envisaged in § 3.2, the number of circuits existing at the end of the observation period can be used in the calculation of service availability performance figures.

For both the purposes mentioned above, all full-time, point-to-point international leased circuits should be included in the assessment. However, should the effort and cost of this approach be too great, Administrations may use a randomly selected sample of circuits of suitable size.

B.2 *Mean downtime per circuit*

Mean downtime per circuit should be calculated using the following formula:

$$\text{Mean downtime per circuit } (\mu_{DT}) = \frac{1}{n} \sum \text{Downtime in observation period}$$

where

$n$ is the number of circuits involved (cf. § B.1)

downtime is in hours

$\mu_{DT}$ is in hours.

B.3 *Mean number of faults per circuit*

The mean number of faults per circuit should be calculated using the following formula:

$$\text{Mean number of faults per circuit} = \frac{1}{n} \sum \text{Faults}$$

where

$n$ is the number of circuits involved (cf. § B.1).

B.4 *Mean time to failure*

Mean time to failure (MTTF) should be calculated using the following formula:

$$\text{MTTF} = \frac{(n \times \text{observation period}) - (\sum \text{Downtime})}{\text{Events that contribute to downtime}}$$

where

$n$ is the number of circuits involved (cf. § B.1)

MTTF is in days

Observation period is in days

Downtime is in days

*Note* – The right hand side of the equation above is sometimes called mean time between failures (MTBF).

B.5 *Percentage of circuits for which no downtime was recorded*

$$\text{Percentage of circuits for which no downtime was recorded} = \frac{\text{Number of circuits with no downtime}}{n} \times 100$$

where

$n$ is the number of circuits involved (cf. § B.1)

This percentage corresponds to the point marked "$y_1$" in Figure B-1/M.1016.

B.6 *Mean time to restore service*

Mean time to restore service (MTRS) should be calculated using the following formula:

$$\text{MTRS} = \frac{\sum \text{Downtime}}{\sum \text{Events that contribute to downtime}}$$

where

| | |
|---|---|
| Downtime | is in hours |
| MTRS | is in hours |

B.7 *Long-term mean downtime per circuit*

Long-term mean downtime per circuit should be calculated on the basis of the results of at least four consecutive observation periods, weighted for the number of circuits involved, from the following formula:

(In the case of 4 observation periods)

$$\text{Long-term mean downtime per circuit } (\mu_{DT\Sigma}) = \frac{\sum_{i=1}^{4} \left(n_i \times \mu_{DT_i}\right)}{\sum_{i=1}^{4} n_i}$$

where

| | |
|---|---|
| $n_i$ and $\mu_{DT_i}$ | are the values corresponding to each observation period |
| $\mu_{DT_i}$ | is in hours |
| $\mu_{DT\Sigma}$ | is in hours |

B.8 *Percentage of circuits with downtime less than the mean value* ($\mu_{DT}$)

The percentage of circuits with a total downtime less than the mean downtime per circuit ($\mu_{DT}$) should be determined, for example, by preparing a cumulative frequency distribution graph as shown in Figure B-1/M.1016. (The required percentage of circuits is shown by point "$y_2$" of Figure B-1/M.1016).

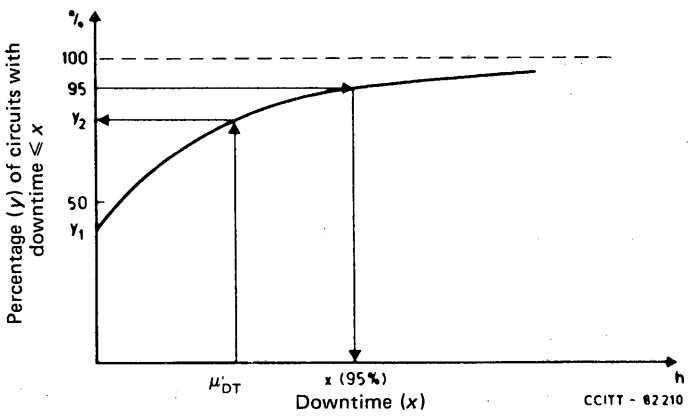



FIGURE B-1/M.1016

**Percentage of circuits with downtime not exceeding a given value**

B.9 *Downtime per circuit not exceeded by 95% of circuits*

The downtime not exceeded by 95% of circuits is shown by the point marked "$x$(95%)" in Figure B-1/M.1016.

## ANNEX C

(to Recommendation M.1016)

### Additional information to be exchanged between Administrations concerning service availability performance

C.1 *Types of information*

Where service availability performance information is exchanged between Administrations, it should be supported by the following additional information:

a) International leased circuits are given priority maintenance attention over public circuits:
   i) YES
   ii) NO

b) Duplicated circuit sections (circuit level only):
   i) SUBSCRIBER LINE (TERMINAL NATIONAL SECTION) AND/OR NATIONAL LINE (WHOLLY OR PARTLY) AND/OR INTERNATIONAL LINE
   ii) NO DUPLICATION

c) Fault clearance service:
   i) OFFICE HOURS ONLY
   ii) 24 HOURS / 7 DAYS PER WEEK

d) Limits applied to determine if a fault exists:
   i) Recommendation M.1040
   ii) Recommendation M.1040 type, but with more stringent limits/additional parameters
   iii) Recommendation M.1040 type, but with less stringent limits/fewer parameters
   iv) Recommendation M.1020
   v) Recommendation M.1020 type, but with more stringent limits/additional parameters
   vi) Recommendation M.1020 type, but with less stringent limits/fewer parameters
   vii) Recommendation M.1025
   viii) Recommendation M.1025 type, but with more stringent limits/additional parameters
   ix) Recommendation M.1025 type, but with less stringent limits/fewer parameters

e) Customer informed about planned interruptions of service:
   i) IN PRINCIPLE ALWAYS
   ii) IN PRINCIPLE NEVER
   iii) SOMETIMES

This additional information should be recorded on the forms shown in Appendices I and II of this Recommendation. Appendices III and IV of this Recommendation show examples of these forms filled out by the control and sub-control stations respectively.

C.2 *Rules for the combination of additional information coming from the control and sub-control stations*

C.2.1 *Rule for priority maintenance [§ C.1a) above]*

Where a circuit gets priority maintenance attention by one terminal Administration and not the other, "priority maintenance attention" shall be deemed to exist on the circuit as a whole.

C.2.2 *Rule for duplicated circuit sections [§ C.1b) above]*

Where at least one Administration states that the circuit is (partly) duplicated, the circuit is considered to be (partly) duplicated. Otherwise, the circuit is "not duplicated".

C.2.3 *Rule for fault clearance service [§ C.1c) above]*

Where one terminal Administration provides "office hours only" fault clearance services while the other provides "24 hours/day" service, the circuit shall be deemed to have "office hours only" service.

C.2.4 *Rule for limits/parameters [§ C.1d) above]*

Where different limits/parameters are applied by the terminal Administrations, the information from the control station Administration will prevail.

C.2.5 *Rule for planned interruptions [§ C.1e) above]*

The rules for combining information on whether or not customers are advised about planned interruptions of service are shown in Table C-1/M.1016.

TABLE C-1/M.1016

**Rules for combining information on planned interruptions of service**

| Control station Administration indicates: | Sub-control station Administration indicates: | Situation for the circuit is deemed to be: |
|---|---|---|
| Customer always informed | Never<br>Sometimes<br>Always | Customer is always informed |
| Customer is sometimes informed | Never<br>Sometimes | Customer is sometimes informed |
| | Always | Customer is always informed |
| Customer is never informed | Never | Never |
| | Sometimes | Sometimes |
| | Always | Always |

INVESTIGATION OF INTERNATIONAL LEASED CIRCUIT PERFORMANCE
DATA FROM THE ADMINISTRATION WITH *CONTROL STATION* RESPONSIBILITY

(Observation period: _____)

Circuits between . . . . . (Control ADMIN) and . . . . . (Sub-control ADMIN)

| Circuit designation | Start of downtime | | End of downtime | | Duration (min) | Additional information (7) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Date | Time (UTC) | Date | Time (UTC) | | | | | | |
| (1) | (2) | (3) | (4) | (5) | (6) | a | b | c | d | e |
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APPENDIX II
(to Recommendation M.1016)

INVESTIGATION OF INTERNATIONAL LEASED CIRCUIT PERFORMANCE
DATA FROM THE ADMINISTRATION WITH *SUB-CONTROL STATION* RESPONSIBILITY

(Observation period: _____)

Circuits between . . . . . (Sub-control ADMIN) and . . . . . (Control ADMIN)

| Circuit designation | Start of downtime | | End of downtime | | Duration (min) | Additional information (7) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Date | Time (UTC) | Date | Time (UTC) | | | | | | |
| (1) | (2) | (3) | (4) | (5) | (6) | a | b | c | d | e |
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INVESTIGATION OF INTERNATIONAL LEASED CIRCUIT PERFORMANCE
DATA FROM THE ADMINISTRATION WITH *CONTROL STATION* RESPONSIBILITY

(Observation period: 1 Jan 1982 – 31 March 1982) Example only

Circuits between United Kingdom (Control ADMIN) and Federal Republic of Germany (Sub-control ADMIN)

| Circuit designation | Start of downtime | | End of downtime | | Duration (min) | Additional information (7) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Date | Time (UTC) | Date | Time (UTC) | | | | | | |
| (1) | (2) | (3) | (4) | (5) | (6) | a | b | c | d | e |
| London-Frankfurt DP7 | 3 Jan | 0810 | 3 Jan | 1100 | 170 | i | i | ii | iv | i |
| | 7 Feb | 1600 | 7 Feb | 1610 | 10 | | | | | |
| | 16 Feb | 0930 | 16 Feb | 1030 | 60 | | | | | |
| | 3 March | 1700 | 4 March | 0810 | 1050 | | | | | |
| London-Dusseldorf DP3 | 17 Jan | 1200 | 17 Jan | 1410 | 130 | i | ii | ii | iv | i |
| London-Dusseldorf DP6 | 1 March | 0825 | 1 March | 0910 | 45 | i | ii | ii | iv | i |
| | 3 March | 0830 | 3 March | 1000 | 90 | | | | | |
| London-Hamburg XP7 | 21 Feb | 1600 | 21 Feb | 1815 | 135 | i | ii | ii | iv | i |
| | 23 Feb | 1105 | 23 Feb | 1120 | 15 | | | | | |
| London-Frankfurt DP2 | No Faults | | | | | i | ii | ii | iv | i |
| London-Frankfurt DP9 | No Faults | | | | | i | ii | ii | iv | i |
| London-Frankfurt XP2 | No Faults | | | | | i | ii | ii | iv | i |
| London-Hamburg DP1 | No Faults | | | | | i | ii | ii | iv | i |
| | | | | | | | | | | |
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INVESTIGATION OF INTERNATIONAL LEASED CIRCUIT PERFORMANCE
DATA FROM THE ADMINISTRATION WITH *SUB-CONTROL STATION* RESPONSIBILITY

(Observation period: 1 Jan 1982 – 31 March 1982) Example only

Circuits between Federal Republic of Germany (Sub-control ADMIN) and United Kingdom (Control ADMIN)

| Circuit designation | Start of downtime | | End of downtime | | Duration (min) | Additional information (7) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Date | Time (UTC) | Date | Time (UTC) | | | | | | |
| (1) | (2) | (3) | (4) | (5) | (6) | a | b | c | d | e |
| Frankfurt-London DP7 | 3 Jan | 0900 | 3 Jan | 1030 | 90 | ii | ii | i | iv | iii |
| | 21 March | 1100 | 21 March | 1110 | 10 | | | | | |
| Dusseldorf-London DP3 | 7 Feb | 0900 | 7 Feb | 0915 | 15 | ii | ii | i | iv | iii |
| Hamburg-London XP7 | 21 Feb | 1625 | 21 Feb | 1800 | 95 | ii | ii | i | iv | iii |
| Dusseldorf-London DP6 | No Faults | | | | | ii | ii | i | iv | iii |
| Frankfurt-London DP2 | No Faults | | | | | ii | ii | i | iv | iii |
| Frankfurt-London DP9 | No Faults | | | | | ii | ii | ii | iv | iii |
| Frankfurt-London XP2 | No Faults | | | | | ii | i | i | iv | iii |
| Hamburg-London DP1 | No Faults | | | | | ii | i | i | iv | iii |
| | | | | | | | | | | |
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Contact person for this data . . . . . .

**References**

[1] CCITT Recommendation *Quality of service and dependability vocabulary*, Vol. II, Rec. E.800.

[2] CCITT Supplement *Terms and definitions for quality of service, network performance, dependability and trafficability studies*, Vol. II, Fascicle II.3, Supplement No. 6.

[3] CCITT Recommendation *Exchange of information for planned outages of transmission systems*, Vol. IV. Rec. M.490.

[4] CCITT Recommendation *Designation of international circuits, groups, group and line links, digital blocks, digital paths, data transmission systems and related information*, Vol. IV, Rec. M.140.

[5] CCITT Recommendation *Legal time; use of the term UTC*, Vol. I, Rec. B.11.

## 7.2 Characteristics of international leased circuits

**Recommendation M.1020**

### CHARACTERISTICS OF SPECIAL QUALITY INTERNATIONAL LEASED CIRCUITS WITH SPECIAL BANDWIDTH CONDITIONING [1]

### 1 Scope

This Recommendation deals with leased circuits for uses other than telephony – for example, data transmission.

The requirements of this Recommendation are intended to ensure the provision of a circuit which will meet the requirements of digital transmission rates higher than those possible on a normal telephone-type circuit. In particular, circuits meeting the requirements of this Recommendation are intended for use with modems that do not contain equalizers.

### 2 Characteristics [2]

2.1 *Nominal overall loss*

Because of the differing nominal level at renters' premises due to the various national practices, it is not normally possible to predict the nominal overall loss of the circuit at the reference frequency. Only exceptionally can a predetermined specified nominal overall loss at the reference frequency between renters' installations be offered to renters and then only after prior consultation among the Administrations concerned.

For 4-wire circuits the value of the receiving relative level at the renters' premises should not be lower than −13 dBr.

For circuits intended to be used for data transmission using modems to Series V Recommendations, higher receiving relative levels may be required in some circumstances. Reference should be made to Supplement No. 2.16 to Volume IV (Fascicle IV.3).

It should be noted that the overall loss in each direction of transmission may not have the same value.

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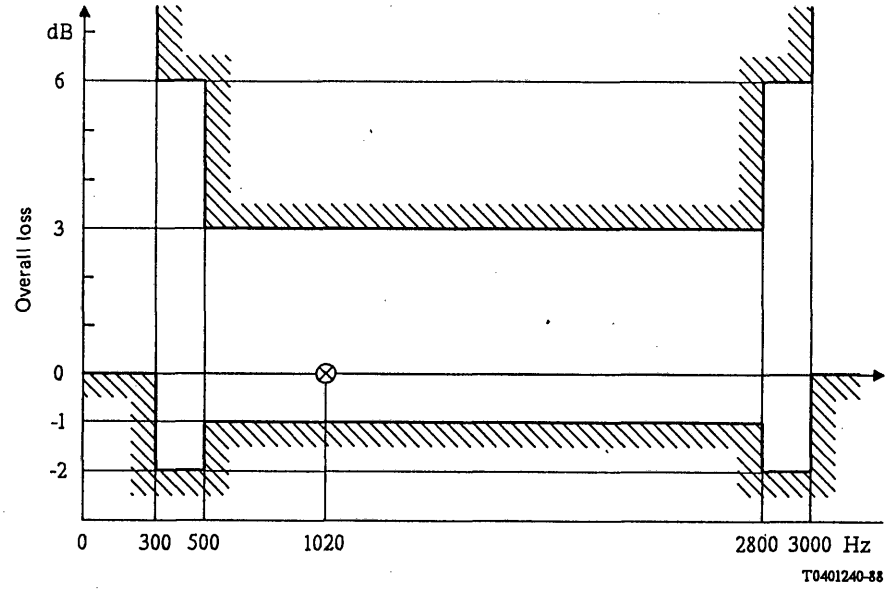
[1] The application of this Recommendation to multiterminal leased circuits is intended only for radial networks in which these specifications are to be met between a designated central station and each of the outlying stations. It does not apply to multiterminal conference networks between any two stations.

[2] Additionally, the characteristics and limits for short interruptions in transmission and phase hits are under study for inclusion in this Recommendation. It may be noted that § 6 of Recommendation M.1060 gives provisional limits for short interruptions in transmission and phase hits as guidance for fault finding purposes.

2.2 *Loss/frequency distortion*

The limits for the overall loss relative to that at 1020 Hz for the circuit between renters' installations are given in Figure 1/M.1020.




*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.1020

**Limits for overall loss of the circuit relative to that at 1020 Hz**

2.3 *Group-delay distortion*

The limits that apply to group-delay distortion are given in Figure 2/M.1020 in which the limiting values over the frequency band are expressed as values relative to the minimum measured group delay.

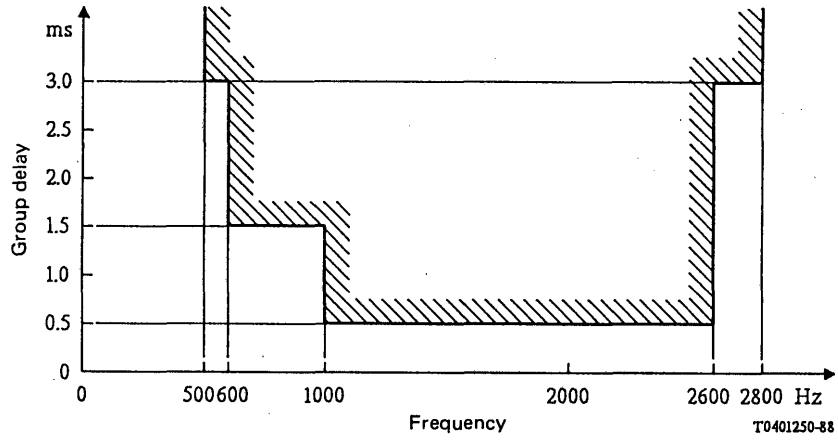



FIGURE 2/M.1020

**Limits for group delay relative to the minimum measured group delay in the 500-2800 Hz band**

2.4 *Variation of overall loss with time*

2.4.1 *Amplitude hits*

Where the circuit is to be used for data transmission using modems employing amplitude modulation techniques, for example, modems to Recommendation V.29 [1], amplitude hits may result in data errors. Using an instrument complying with Recommendation O.95 [2], the number of amplitude hits greater than ± 2 dB should not exceed 10 in any 15 minute mesuring period. The value of ± 2 dB and the number of amplitude hits are provisional and subject to further study.

2.4.2 *Other variations*

For all circuits, variations with time of the overall loss at 1020 Hz (including daily and seasonal variations but excluding amplitude hits) should be as small as possible but should not exceed ± 4 dB.

2.5 *Random circuit noise*

The level of the psophometric noise power at a renter's premises depends upon the actual constitution of the circuit, in particular upon the length of circuit of frequency division multiplex carrier systems in the circuit. The provisional limit for leased circuits of distances greater than 10 000 kilometres is −38 dBm0p. However, circuits of shorter length will have substantially less random noise (see also Annex A to this Recommendation and Recommendation M.1050, § 3.5).

2.6 *Impulsive noise*

Impulsive noise should be measured with an instrument complying with Recommendation O.71 [3]. As a provisional limit, the number of impulsive noise peaks exceeding −21 dBm0 should not be more than 18 in 15 minutes.

2.7 *Phase jitter*

The value of phase jitter measured at a renter's premises depends upon the actual constitution of the circuit (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 [4] will not normally exceed 10° peak-to-peak. However, for circuits of necessarily complex constitution and where 10° peak-to-peak cannot be met, a limit of up to 15° peak-to-peak is permitted. The limits for low frequency phase jitter are under study.

2.8 *Total distortion (including quantizing distortion)*

On a mixed analogue/digital circuit, the signal will be accompanied by quantizing distortion. An end-to-end distortion measurement made using an instrument conforming to Recommendation O.132 [5] will include contributions from random circuit noise, single tone interference and harmonic distortion. The level of random noise power at the renter's premises depends upon the length of circuit of frequency division multiplex carrier systems. The level of quantizing distortion power depends on the number of unintegrated digital processes in the circuit.

The signal-to-total-distortion ratio should be better than 28 dB using a sine wave signal at −10 dBm0 (see also Annex A).

2.9 *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 A-1/M.1020.

2.10 *Frequency error*

The frequency error introduced by the circuit must not exceed ± 5 Hz. It is expected that in practice the error will be within closer limits than these.

2.11 *Harmonic and intermodulation distortion*

When a 700-Hz test frequency of −13 dBm0 is injected at the transmit end of a point-to-point circuit, 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.

The limit of second and third order intermodulation products measured using an instrument complying with Recommendation O.42 [6] is for further study.

ANNEX A

(to Recommendation M.1020)

**Noise and distortion**

A.1 *Random circuit noise*

Figure A-1/M.1020 displays random noise versus length of circuit of FDM carrier systems and is presented as a guide to the random noise performance which may be found on an international leased circuit.

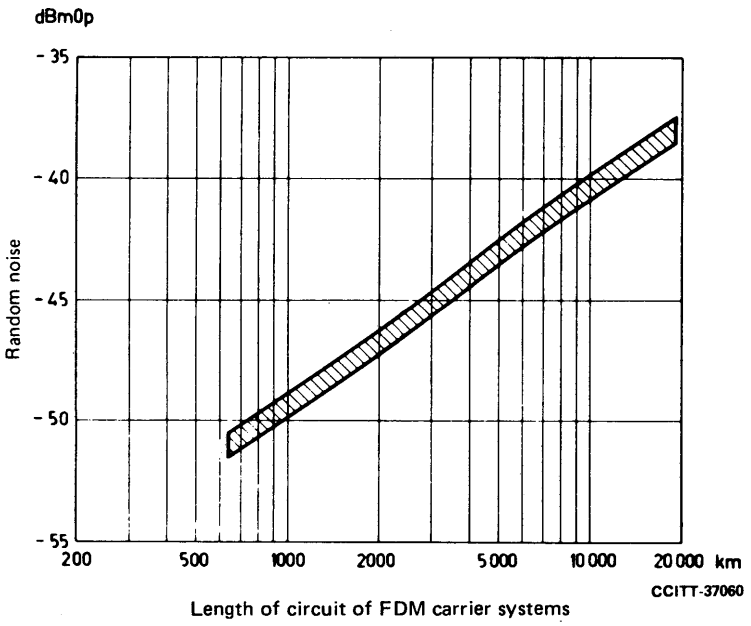



FIGURE A-1/M.1020

**Random circuit-noise performance**

*Note* – At the present time the section of the circuit provided by a satellite (between earth stations) employing FDM techniques contributes approximately 10 000 pW0p (−50 dBm0p) of noise. Therefore, for the purpose of determining maintenance limits for noise measurement on leased circuits, the length of this section may be considered to be equivalent to 1000 km in Figure A-1/M.1020.

The contribution to noise of a circuit section provided by a satellite employing TDM technique remains as a subject for further study.

A.2 *Total distortion*

Table A-2/M.1020 is a guide to the signal-to-total distortion ratio which may be found on circuits with different analogue section lengths and numbers of quantizing distortion units (QDU). When interpreting this table, particularly for circuits with long analogue sections, it should be noted that it may be possible to increase the number of QDUs in a circuit provided by the analogue sections contribute less noise than might be expected from Figure A-1/M.1020.

TABLE A-1/M.1020

**Signal-to-total distortion ratio using a sinusoidal signal at −10 dBm0**

| Type of circuit | Number of QDUs (Note) | Unit | Distance in analogue transmission (km) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | < 320 | 321 to 640 | 641 to 1600 | 1601 to 2500 | 2501 to 5000 | 5001 to 10 000 | 10 001 to 20 000 |
| Analogue | 0 | dB | 43 | 41 | 38 | 36 | 33 | 30 | 28 |
| Composite circuit | 1 | dB | 34 | 34 | 33 | 32 | 31 | 29 | 28 |
| | 2 | dB | 32 | 31 | 31 | 31 | 29 | 28 | 28 |
| | 3 | dB | 30 | 30 | 30 | 29 | 28 | 28 | 28 |
| | 4 | dB | 29 | 29 | 28 | 28 | 28 | 28 | 28 |
| | 5 | dB | 28 | 28 | 28 | 28 | 28 | 28 | 28 |

*Note* – The number of QDUs contributed by various digital processes are given in Table 1/G.113 [7].

## References


[1] CCITT Recommendation *9600 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits*, Vol. VIII, Rec. V.29.

[2] CCITT Recommendation *Phase and amplitude hit counters for telephone-type circuits*, Vol. IV, Rec. O.95.

[3] CCITT Recommendation *Impulsive noise measuring equipment for telephone-type circuits*, Vol. IV, Rec. O.71.

[4] CCITT Recommendation *Phase jitter measuring equipment for telephone circuits*, Vol. IV, Rec. O.91.

[5] CCITT Recommendation *Quantizing distortion measuring equipment using a sinusoidal test signal*, Vol. IV, Rec. O.132.

[6] CCITT Recommendation *Equipment to measure non-linear distortion using the 4-tone intermodulation method*, Vol. IV, Rec. O.42.

[7] CCITT Recommendation *Transmission impairments*, Vol. III, Rec. G.113.

# CHARACTERISTICS OF SPECIAL QUALITY INTERNATIONAL LEASED CIRCUITS WITH BASIC BANDWIDTH CONDITIONING [1]

## 1 Scope

This Recommendation deals with leased circuits for uses other than telephony – for example, data transmission.

The requirements of this Recommendation are intended to ensure the provision of a circuit which will meet the requirements of digital transmission rates higher than those possible on a normal telephone-type circuit. [2] In particular, circuits meeting the requirements of this Recommendation are intended for use with modems which contain equalizers. Circuits conforming to Recommendation M.1025 may not always support satisfactory operation of modems to Recommendation V.29 [1]. This is dependent upon the equalization capability of the particular modems used.

## 2 Characteristics [3]

### 2.1 *Nominal overall loss*

Because of the differing nominal level at renters' premises due to the various national practices, it is not normally possible to predict the nominal overall loss of the circuit at the reference frequency. Only exceptionally can a predetermined specified nominal overall loss at the reference frequency between renters' installations be offered to renters and then only after prior consultation among the Administrations concerned.

For 4-wire circuits the value of the receiving relative level at the renters' premises should not be lower than −13 dBr.

For circuits intended to be used for data transmission using modems to Series V Recommendations, higher receiving relative levels may be required in some circumstances. Reference should be made to Supplement No. 2.16 to Volume IV (Fascicle IV.3).

It should be noted that the overall loss in each direction of transmission may not have the same value.

### 2.2 *Loss/frequency distortion* [4], [5]

The limits for the overall loss relative to that at 1020 Hz for the circuit between renters' installations are given in Figure 1/M.1025.

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[1] The application of this Recommendation to multiterminal leased circuits is intended only for radial networks in which these specifications are to be met between a designated central station and each of the outlying stations. It does not apply to multiterminal conference networks between any two stations.

[2] In order to ensure the proper operation of certain Series V modems operating at data signalling rates greater than 4800 bit/s, it is necessary to specify improved and/or modified values for the following transmission system characteristics: random circuit noise, quantizing noise, harmonic distortion (intermodulation distortion). This subject is for further study.

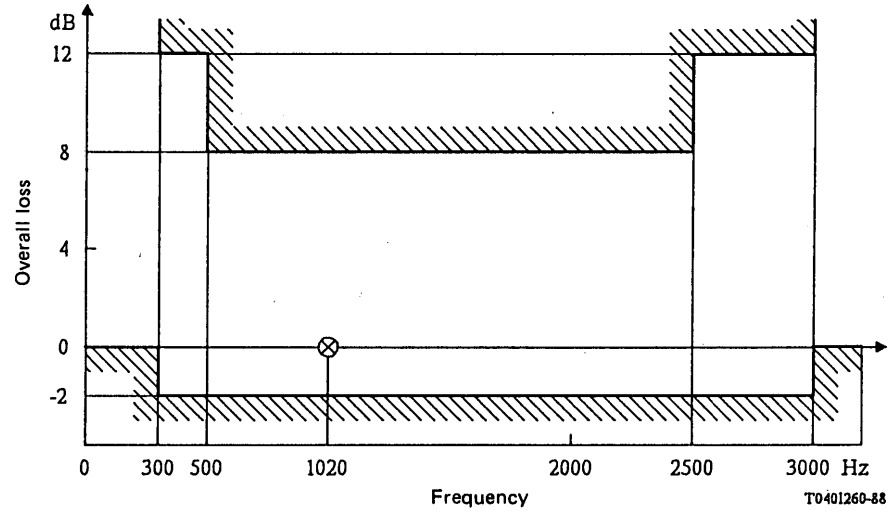
[3] Additionally, the characteristics and limits for short interruptions in transmission and phase hits are under study for inclusion in this Recommendation. It may be noted that § 6 of Recommendation M.1060 gives provisional limits for short interruptions in transmission and phase hits as guidance for fault finding purposes.

[4] It is expected that, in most cases, these "basic bandwidth" characteristics may be available without the addition of loss/frequency and/or group-delay equalization equipment.

[5] The values of loss/frequency and group-delay distortion are provisional and should be confirmed or amended after further study.

2.3 *Group-delay distortion* [6], [7]

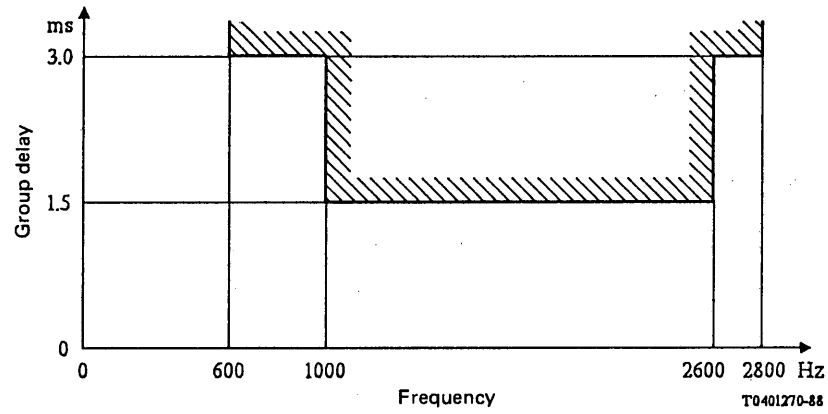
The limits that apply to group-delay distortion are given in Figure 2/M.1025 in which the limiting values over the frequency band are expressed as values relative to the minimum measured group delay.




*Note* – Below 300 Hz and above 3000 Hz the loss shall not be less than 0.0 dB, but is otherwise unspecified. These frequencies should be confirmed or amended after further study.

FIGURE 1/M.1025

**Limits for overall loss of the circuit relative to that at 1020 Hz**




*Note* – It should be noted that the value of 3.0 ms between 600 and 1000 Hz should be confirmed or amended after further study, to ensure that equalization would not be necessary in the majority of cases and that proper modem operation is achieved.

FIGURE 2/M.1025

**Limits for group delay relative to the minimum measured group delay in the 600-2800 Hz band**

[6] It is expected that, in most cases, these "basic bandwidth" characteristics may be available without the addition of loss/frequency and/or group-delay equalization equipment.

[7] The values of loss/frequency and group-delay distortion are provisional and should be confirmed or amended after further study.

2.4 *Variation of overall loss with time*

2.4.1 *Amplitude hits*

Where the circuit is to be used for data transmission using modems employing amplitude modulation techniques, for example modems to Recommendation V.29 [1], amplitude hits may result in data errors. Using an instrument complying with Recommendation O.95 [2], the number of amplitude hits greater than ± 2 dB should not exceed 10 in any 15 minute measuring period. The value of ± 2 dB and the number of amplitude hits are provisional and subject to further study.

2.4.2 *Other variations*

For all circuits, variations with time of the overall loss at 1020 Hz (including daily and seasonal variations but excluding amplitude hits) should be as small as possible but should not exceed ± 4 dB.

2.5 *Random circuit noise*

The level of the psophometric noise power at a renter's premises depends upon the actual constitution of the circuit, in particular upon the length of circuit of frequency division multiplex carrier systems. The provisional limit for leased circuits of distances greater than 10 000 kilometres is −38 dBm0p. However, circuits of shorter length will have substantially less random noise (see also Annex A to this Recommendation and Recommendation M.1050, § 3.5).

2.6 *Impulsive noise*

Impulsive noise should be measured with an instrument complying with Recommendation O.71 [3]. As a provisional limit, the number of impulsive noise peaks exceeding −21 dBm0 should not be more than 18 in 15 minutes.

2.7 *Phase jitter*

The value of phase jitter measured at a renter's premises depends upon the actual constitution of the circuit (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 [4] will not normally exceed 10° peak-to-peak. However, for circuits of necessarily complex constitution and where 10° peak-to-peak cannot be met, a limit of up to 15° peak-to-peak is permitted. The limits for low frequency phase jitter are under study.

2.8 *Total distortion (including quantizing distortion)*

On a mixed analogue/digital circuit, the signal will be accompanied by quantizing distortion. An end-to-end distortion measurement made using an instrument conforming to Recommendation O.132 [5] will include contributions from random circuit noise, single tone interference and harmonic distortion. The level of random noise power at the renter's premises depends upon the length of circuit of frequency division multiplex carrier systems. The level of quantizing distortion power depends on the number of unintegrated digital processes in the circuit.

The signal-to-total-distortion ratio should be better than 28 dB using a sine wave signal at −10 dBm0 (see also Annex A).

2.9 *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 A-1/M.1025.

2.10 *Frequency error*

The frequency error introduced by the circuit must not exceed ± 5 Hz. It is expected that in practice the error will be within closer limits than these.

2.11 *Harmonic and intermodulation distortion*

When a 700-Hz test frequency of −13 dBm0 is injected at the transmit end of a point-to-point circuit, 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.

The limit of second and third order intermodulation products measured using an instrument complying with Recommendation O.42 [6] is for further study.

ANNEX A

(to Recommendation M.1025)

**Noise and distortion**

A.1 *Random circuit noise*

Figure A-1/M.1025 displays random noise versus length of circuit of FDM carrier systems and is presented as a guide to the random noise performance which may be found on an international leased circuit.

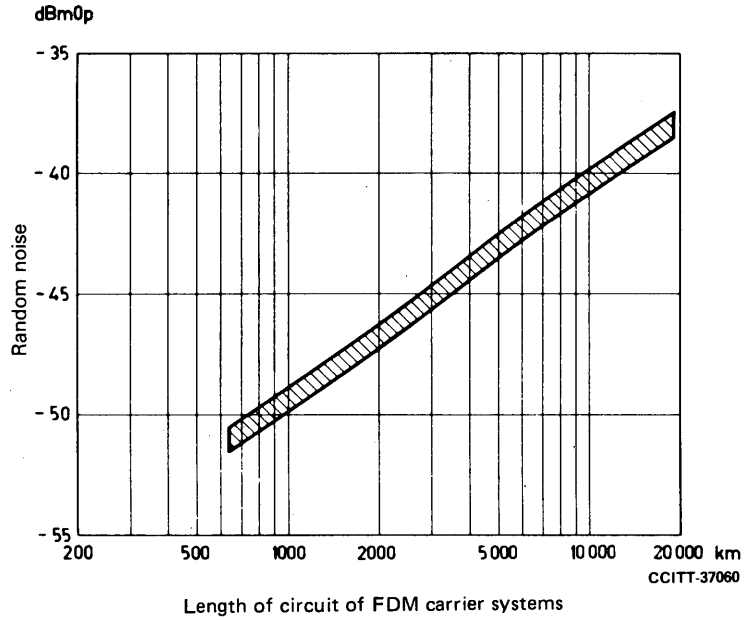



FIGURE A-1/M.1025
**Random circuit-noise performance**

*Note* – At the present time the section of the circuit provided by a satellite (between earth stations) employing FDM techniques contributes approximately 10 000 pW0p (– 50 dBm0p) of noise. Therefore, for the purpose of determining maintenance limits for noise measurement on leased circuits, the length of this section may be considered to be equivalent to 1000 km in Figure A-1/M.1025.

The contribution to noise of a circuit section provided by a satellite employing TDM technique remains as a subject for further study.

A.2 *Total distortion*

Table A-1/M.1025 is a guide to the signal-to-total-distortion ratio which may be found on circuits with different analogue section lengths and numbers of quantizing distortion units (QDU). When interpreting this table, particularly for circuits with long analogue sections, it should be noted that it may be possible to increase the number of QDUs in a circuit provided by the analogue sections contribute less noise than might be expected from Figure A-1/M.1025.

TABLE A-1/M.1025

**Signal-to-signal distortion ratio using a sinusoidal signal at −10 dBm0**

| Type of circuit | Number of QDUs (Note) | Unit | Distance in analogue transmission (km) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | < 320 | 321 to 640 | 641 to 1600 | 1601 to 2500 | 2501 to 5000 | 5001 to 10 000 | 10 001 to 20 000 |
| Analogue | 0 | dB | 43 | 41 | 38 | 36 | 33 | 30 | 28 |
| Composite circuit | 1 | dB | 34 | 34 | 33 | 32 | 31 | 29 | 28 |
| | 2 | dB | 32 | 31 | 31 | 31 | 29 | 28 | 28 |
| | 3 | dB | 30 | 30 | 30 | 29 | 28 | 28 | 28 |
| | 4 | dB | 29 | 29 | 28 | 28 | 28 | 28 | 28 |
| | 5 | dB | 28 | 28 | 28 | 28 | 28 | 28 | 28 |

*Note* – The number of QDUs contributed by various digital processes ar given in Table 1/G.113 [7].

**References**


[1] CCITT Recommendation *9600 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits*, Vol. VIII, Rec. V.29.

[2] CCITT Recommendation *Phase and amplitude hit counters for telephone-type circuits*, Vol. IV, Rec. O.95.

[3] CCITT Recommendation *Impulsive noise measuring equipment for telephone-type circuits*, Vol. IV, Rec. O.71.

[4] CCITT Recommendation *Phase jitter measuring equipment for telephone circuits*, Vol. IV, Rec. O.91.

[5] CCITT Recommendation *Quantizing distortion measuring equipment using a sinusoidal test signal*, Vol. IV, Rec. O.132.

[6] CCITT Recommendation *Equipment to measure non-linear distortion using the 4-tone intermodulation method*, Vol. IV, Rec. O.42.

[7] CCITT Recommendation *Transmission impairments*, Vol. III, Rec. G.113.

# CHARACTERISTICS OF ORDINARY QUALITY INTERNATIONAL LEASED CIRCUITS FORMING PART OF PRIVATE SWITCHED TELEPHONE NETWORKS

## 1 General

### 1.1 *Scope*

This Recommendation details the characteristics of an international leased circuit intended to form part of a private switched telephone network. The requirements of this Recommendation are intended to ensure the provision of a circuit suitable for telephony purposes. Such circuits may be used either singly, and thus provide for speech communication between two private telephone exchanges in different countries, or as part of a connection within a private switched telephone network covering two or more countries.

It should be noted that not all Administrations provide circuits of the type covered by this Recommendation.

Recommendation G.171 [1] contains the transmission planning considerations upon which the characteristics given in § 2 below are based, and specifies the maximum number of circuits in tandem which the transmission plan permits.[1)]

### 1.2 *Terminology*

#### 1.2.1 *Circuit access points*

The term "circuit access points" is used in this Recommendation with the same meaning as that given in Recommendation M.565 [2]. The precise location of, and relative levels at, the circuit access points are determined by the involved Administrations in collaboration with the renter concerned.

#### 1.2.2 *Four-wire circuits*

This term is intended to cover circuits which are switched on a 4-wire basis, are available via 4-wire circuit access points, and do not contain 2-wire circuit sections.

#### 1.2.3 *Two-wire presented circuits*

This term is used to cover circuits which do not meet the criteria set out in § 1.2.2 above, for example, circuits between exchanges using 2-wire switching.

## 2 Characteristics

### 2.1 *Nominal overall loss*

It is not possible to specify the nominal overall loss between actual switching points, or between circuit access points, because of the freedom afforded Administrations in choosing the relative transmission level at these points.

In order to ensure satisfactory loss and stability performance on end-to-end connections within private switched networks, the overall loss of interconnecting international leased circuits may need to be the subject of bilateral discussion between the terminal Administrations. In this connection, see also § 3 below.

### 2.2 *Loss/frequency distortion*

The limits for overall loss relative to that at 1020 Hz are given in Figure 1/M.1030 and Figure 2/M.1030 for 4-wire and 2-wire presented circuits respectively. It may be noted that the limits in Figure 2/M.1030 are the same as those appearing in Recommendation M.1040, § 2.2.

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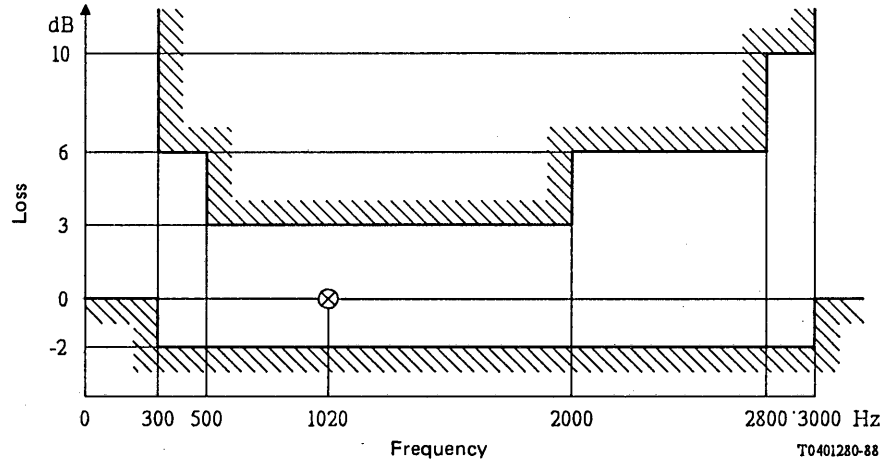
[1)] Recommendation G.171, § 1 [1] states that for connections between private telephone networks and the public network, when permitted, "assurance cannot always be given that transmission performance to CCITT standards will be obtained." The same may be said for connections achieved by a user over which an Administration has no control, for example, between two or more private networks by virtue of user provided private automatic branch exchanges (PABXs).

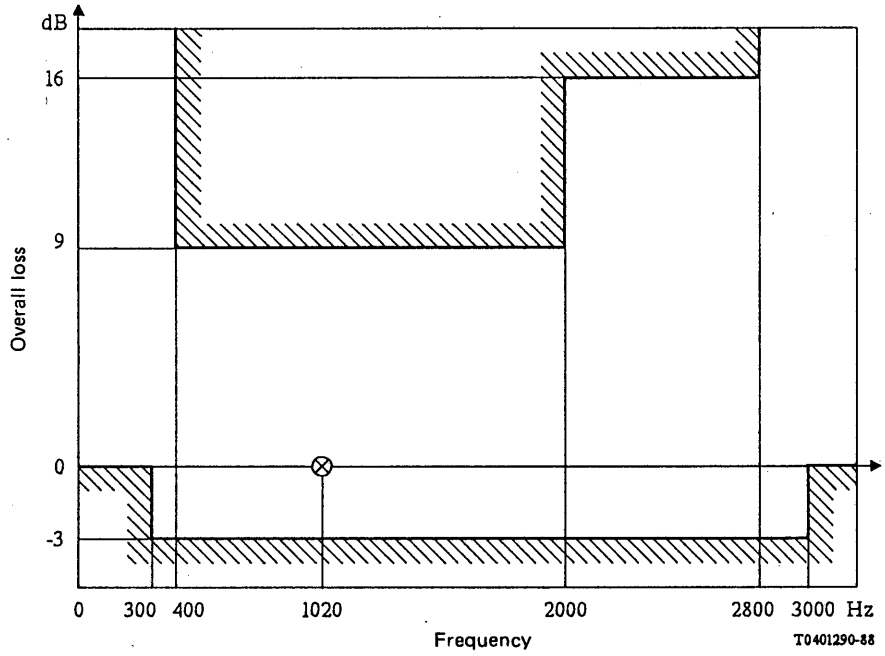
Exceptionally, where a 2-wire private telephone exchange originates and terminates traffic in an otherwise 4-wire network, the 4-wire section of an international leased circuit terminated on that exchange should meet the requirements of Figure 1/M.1030.




*Note* – Below 300 Hz and above 3000 Hz the loss shall not be less than 0.0 dB but is otherwise unspecified. These frequencies should be confirmed or amended after further study.

FIGURE 1/M.1030

**Limits for overall loss of the circuit relative to that at 1020 Hz for 4-wire circuits**




*Note* – Below 300 Hz and above 3000 Hz the loss shall not be less than 0.0 dB, but is otherwise unspecified. These frequencies should be confirmed or amended after further study.

FIGURE 2/M.1030

**Limits for overall loss of the circuit relative to that at 1020 Hz for 2-wire presented circuits**

2.3 *Variations of overall loss with time*

For all circuits, variation with time of the overall loss at 1020 Hz (including daily and seasonal variations but excluding amplitude hits) should be as small as possible but should not exceed ± 4 dB.

2.4 *Random circuit noise*

The nominal level of psophometric noise power depends upon the actual constitution of the circuit, in particular upon the length of circuit of frequency division multiplex systems involved. The provisional limit for circuits of lengths greater than 10 000 km is −38 dBm0p. However, circuits of shorter length will have substantially less random noise (see Annex A to this Recommendation and Recommendation M.1050, § 3.5).

2.5 *Echo*

The provisions of Recommendations G.122 [3] and G.131 [4] concerning echo control should be observed in so far as they are applicable.

## 3 Stability

National systems interfacing with the international leased circuits dealt with in this Recommendation should comply with the stability requirements of Recommendation G.122 [3].

Recognizing that national private switched networks (planned in accordance with national transmission standards) may ultimately be interconnected by international leased circuits, involved Administrations may need to discuss the actions necessary to ensure adequate stability of the resulting international private switched network.

ANNEX A

(to Recommendation M.1030)

**Random circuit noise**

Figure A-1/M.1030 displays random noise versus length of circuit of FDM carrier systems and is presented as a guide to the random noise performance which may be found on an international leased circuit.

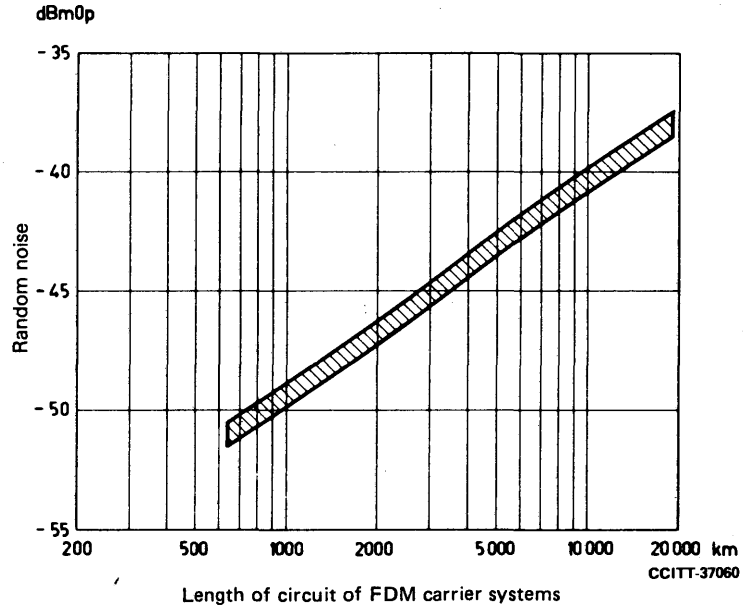



FIGURE A-1/M.1030

**Random circuit-noise performance**

*Note* – At the present time the section of the circuit provided by satellite (between earth stations) employing FDM techniques contributes approximately 10 000 pW0p (−50 dBm0p) of noise. Therefore, for the purpose of determining maintenance limits for noise measurement on leased circuits, the length of the section provided by satellite may be considered to be equivalent to 1000 km in Figure A-1/M.1030.

The contribution to noise of a circuit section provided by satellite employing TDM techniques remains as a subject for further study.

**References**


[1] CCITT Recommendation *Transmission plan aspects of private operated networks*, Vol. III, Rec. G.171.

[2] CCITT Recommendation *Access points for international telephone circuits*, Vol. IV, Rec. M.565.

[3] CCITT Recommendation *Influence of national systems on stability, talker echo and listener echo in international connections*, Vol. III, Rec. G.122.

[4] CCITT Recommendation *Stability and echo*, Vol. III, Rec. G.131.


**Recommendation M.1040**

## CHARACTERISTICS OF ORDINARY QUALITY INTERNATIONAL LEASED CIRCUITS[1)]

### 1 Scope

This Recommendation details the characteristics of international leased circuits for telephony and other purposes that do not require the use of special quality leased circuits conforming to either Recommendation M.1020 or Recommendation M.1025.

### 2 Characteristics

#### 2.1 *Nominal overall loss*

Because of the differing nominal level at renters' premises due to the various national practices, it is not normally possible to predict the nominal overall loss of the circuit at the reference frequency. Only exceptionally can a predetermined specified nominal overall loss at the reference frequency between renters' installations be offered to renters and then only after prior consultation among the Administrations concerned.

For 4-wire circuits the receiving relative level at the renters' premises should not be lower than −15 dBr. If a mean sending signal power of −15 dBm0 is assumed, the resulting minimum received power (−30 dBm) is sufficient for telephony and the other purposes for which circuits to this Recommendation are intended. Should these circuits be used for other purposes, higher receiving relative levels may be required in some circumstances. Reference should be made to Supplement No. 2.16 to Volume IV (Fascicle IV.3).

It should be noted that the overall loss in each direction of transmission may not have the same value.

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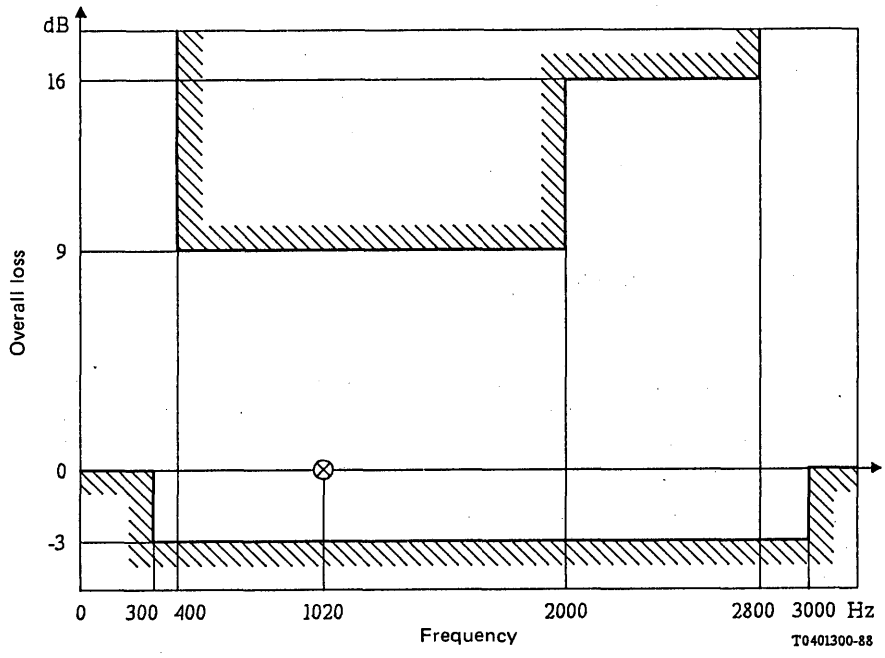
[1)] The application of this Recommendation to multiterminal leased circuits is intended only for radial networks in which these specifications are to be met between a designated central station and each of the outlying stations. It does not apply to multiterminal conference networks between any two stations.

2.2 *Loss/frequency distortion*

The provisional limits for the overall loss relative to that at 1020 Hz for the circuit between renters' installations are given in Figure 1/M.1040.

2.3 *Random circuit noise*

The level of the psophometric noise power at a renter's premises depends upon the actual constitution of the circuit, in particular upon the length of frequency division multiplex carrier systems in the circuit. The provisional limit for leased circuits of distances greater than 10 000 km is −38 dBm0p. However, circuits of shorter length will have substantially less random noise (see also Annex A to this Recommendation and Recommendation M.1050, § 3.5).




*Note* – At frequencies below 300 Hz and above 3000 Hz the loss shall not be less than 0.0 dB but is unspecified. These frequencies should be confirmed or amended after further study.

FIGURE 1/M.1040

**Limits for the overall loss of the circuit relative to that at 1020 Hz**

ANNEX A

(to Recommendation M.1040)

**Random circuit noise**

Figure A-1/M.1040 displays random noise versus length of circuit of FDM carrier systems and is presented as a guide to the random noise performance which may be found on an international leased circuit.

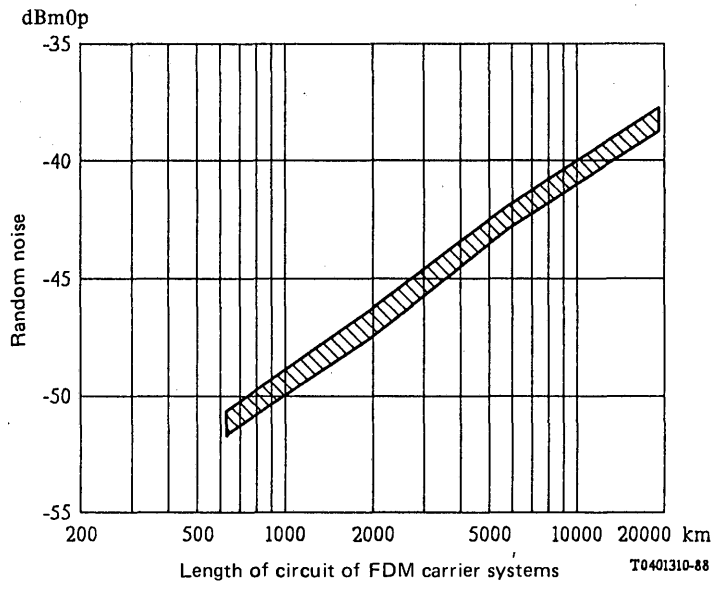



FIGURE A-1/M.1040

**Random circuit-noise performance**

*Note* – At the present time the section of the circuit provided by satellite (between earth stations) employing FDM techniques contributes approximately 10 000 pW0p (−50 dBm0p) of noise. Therefore, for the purpose of determining maintenance limits for noise measurement on leased circuits, the length of this section may be considered to be equivalent to 1000 km in Figure A-1/M.1040.

The contribution to noise of a circuit section provided by a satellite employing TDM techniques remains as a subject for further study.

## 7.3 Bringing an international leased circuit into service

**Recommendation M.1045**

### PRELIMINARY EXCHANGE OF INFORMATION FOR THE PROVISION OF INTERNATIONAL LEASED CIRCUITS

In view of the need for close coordination and cooperation between Administrations during the provision and line-up of international leased circuits, and the importance which Administrations attach to such circuits, it is essential for the appropriate authorities in the Administrations involved to exchange relevant information at the earliest possible time after the prospective renter at one end has requested the provision of a leased circuit.

Such preliminary exchanges of information, which should preferably be by telex, should include:

a) the names and addresses of the renter at both ends of the circuit;

b) the circuit characteristics, for example, Recommendation M.1020;

c) the telephone and telex number of the contact points within the Administration for discussing and agreeing:

   – the date and time for overall line-up,

   – the ready-for-service (RFS) date;

d) any special considerations that may apply, for example, restricted access to the renter's premises, type of service to be carried, location of any necessary equalizers;

e) proposals concerning:

   – the circuit designation (which is covered by Recommendation M.140, § 3) and additional information contained in related information as defined in Recommendation M.140, § 4,

   – the control and sub-control stations,

   – the date and time for overall line-up,

   – the ready-for-service (RFS) date.

In order to avoid any delay, the information in points 1, 2, 3 and 4 of Figure 1/M.1045 should, as far as it is available at that time, be sent to the distant Administration as soon as the request is received. On receiving this message, the distant Administration, after consulting the local renter, may then confirm the request for a connection.

The above information may be the responsibility of one or more sources within a particular country. The telex examples below reflect the situation where all the preliminary information is normally sent from a single source.

So that the necessary staffing and other arrangements can be made, it is particularly important that early agreement be reached between the involved Administrations on the RFS date, and the date and time of the overall line-up. For this and other purposes, the contact point information (items 7 and 8 in the telex example, Figure 1/M.1045) is essential and should always be exchanged. Adequate time should be allowed between lining up the national and international circuit sections, the overall circuit line-up and the RFS date to permit the RFS date to be met in the event that the first overall circuit line-up attempt fails and a new date and time for a second attempt needs to be agreed. Where the involved Administrations are unable to agree on dates for the RFS or overall line-up at the time of the preliminary exchange of information, these matters should be discussed and agreed between the contact points at the earliest possible time.

Figure 2/M.1045 shows an example of a telex reply to the telex in Figure 1/M.1045.

NETWORK CONTROL DIVISION LONDON A TELEGLOBE CANADA
21031030G/IN3.2.2.1/LB
WE HAVE RECEIVED ORDERS TO PROVIDE A NEW INTERNATIONAL LEASED CIRCUIT AS FOLLOWS:

1 UK RENTER: AB SMITH & CO 15-19 NEW FETTER LANE, LONDON
2 DISTANT RENTER: AB SMITH & CO 680 SHERBROOKE ST WEST/MONTREAL

WE MAKE THE FOLLOWING PROPOSALS:

3 DESIGNATION: LONDON / M-MONTREAL DP 41
4 RELATED INFORMATION

| | | |
|---|---|---|
| IA | 1. URGENCY FOR RESTORATION | 1. 1; |
| IA | 2. TERMINAL COUNTRIES | 2. GBR, CAN; |
| IA | 3. CARRIER'S NAMES | 3. BIT, TELGL; |
| IA | 4. CONTROL AND SUBCONTROL STATION(S) | 4. CS: LONDON/M;<br>SCS1: MONTREAL; |
| IA | 5. FAULT REPORT POINTS | 5. LONDON/M, MONTREAL; |
| IA | 6. ROUTING | 6. LONDON – MONTREAL 1608/14; |
| IA | 7. ASSOCIATION | 7. –; |
| IA | 8. EQUIPMENT INFORMATION | 8. –; |
| IA | 9. USE | 9. D; |
| IA | 10. TRANSMISSION MEDIAN INFORMATION | 10. –; |
| IA | 11. COMPOSITION OF TRANSMISSION | 11. A; |
| IA | 12. BANDWIDTH OR BIT RATE | 12. 3.4 kHz |
| IA | 13. SIGNALLING INFORMATION | 13. –; |
| IA | 14. APPLICABLE CCITT RECOMMENDATIONS | 14. REC.M.1020; |

5 READY-FOR-SERVICE DATE/TIME: 16 MAY 1979, 1200G (TARGET).
6 OVERALL LINE-UP-DATE/TIME: 12 MAY 1979, 1400G (TARGET)

PLEASE NOTE THE FOLLOWING:

7 ADMINISTRATIVE CONTACT POINT FOR DISCUSSING/AGREEING RFS DATE:
PHONE +44 1 236 4262 X190, TELEX 888610 GMITP G
8 ADMINISTRATIVE CONTACT POINT FOR DISCUSSING/AGREEING LINE-UP DATES AND TIMES:
(AS IN 10)
9 ACCES TO UK RENTERS PREMISES RESTRICTED TO 1200-1700G, MONDAY-FRIDAY
10 ANY EQUALIZERS WILL BE FITTED AT LONDON WOOD STREET REPEATER STATION

WE AWAIT YOUR COMMENTS, REGARDS

FIGURE 1/M.1045

**Example 1: Telex message concerning the provision of a new international leased circuit**

TELEGLOBE CANADA TO NETWORK CONTROL DIVISION LONDON
24/03/1700 G/DOC/2/KH
NEW LEASED CIRCUIT FOR AB SMITH & CO
YOUR REFERENCE 0721030G/IN3.2.2.1/LB
1-2 NOTED
3-6 AGREED
7-10 NOTED. OUR CONTACT POINT IS: PHONE +1514 281 5328
TELEX 9100 TGLOBE CA

REGARDS

FIGURE 2/M.1045

**Example 2: Telex message in reply to telex in Example 1, Figure 1/M.1045**

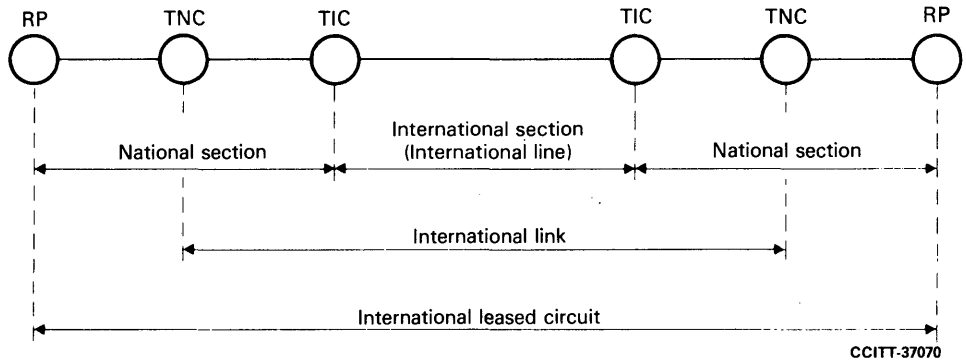
## LINING UP AN INTERNATIONAL POINT-TO-POINT LEASED CIRCUIT

### 1 General

This Recommendation deals with the lining-up of both ordinary quality point-to-point leased circuits (the characteristics of which are specified in Recommendation M.1040), and special quality point-to-point leased circuits (the characteristics of which are specified in Recommendations M.1020 and M.1025), which are provided by analogue transmission systems or by a mixture of analogue and digital systems.

Figure 1/M.1050 shows the constituent parts of an international point-to-point leased circuit.

Test signals transmitted over the international section and link should be applied at a level of −10 dBm0.




RP = renter's premises
TNC = terminal national centre
TIC = terminal international centre

FIGURE 1/M.1050
**The constituent parts of an international point-to-point leased circuit**

The method of line-up described in §§ 2 and 3 below requires that appropriate personnel be present at the renter's premises in the two terminal countries to carry out overall, end-to-end tests of the characteristics of international leased circuits. The cooperation of staff at the terminal international centres may also be required to overcome language or technical difficulties.

Recognizing that differing national practices may mean that the required degree of international coordination is difficult to achieve, and acknowledging that it may not be possible to arrange simultaneous attendance at the two renter's premises because of time zone differences or restricted access to those premises, § 4 below describes a method of circuit line-up using a section-by-section approach.

It should be noted that the end-to-end line-up approach (§§ 2 and 3) and the section-by-section approach (§ 4) are not compatible. Thus, Administrations must agree, on a bilateral basis, which approach they will adopt.

### 2 Lining up the constituent parts of the circuit

After the circuit has been set up the following lining-up procedure should be followed in each direction of transmission.

#### 2.1 *National sections*

When analogue access to the circuit is available at the terminal international centre, the following tests should be performed regardless of whether the national section is provided by analogue circuit sections or a combination of analogue, mixed and digital circuit sections.

2.1.1 *Overall loss at reference frequency*

Each national section should be lined up at the reference frequency according to national practices between the terminal national centre and international centre. Note should be taken of the requirement concerning the receiving relative level in § 2.1 of Recommendations M.1020, M.1025 and M.1040. For international leased circuits forming part of a private switched network, the loss of the national section must be consistent with meeting the required overall loss of the circuit as agreed between Administrations (refer to §§ 2.1 and 3 of Recommendation M.1030). A record should be kept of the levels received (including any measurements made at intermediate national test points). National sections beyond the terminal national centre must also be lined up.

2.1.2 *Loss/frequency distortion* (special quality circuits only)

The loss/frequency distortion should be measured at several frequencies. The limits of Table 1/M.580 [1] (column headed "between circuit access points") have to be met, if necessary, by means of an equalizer.

2.1.3 *Group-delay distortion* (special quality circuits only)

For circuits in conformity with Recommendation M.1020, the limits to be applied are those given in Figure 2/M.1020. In the case of circuits in conformity with Recommendation M.1025, the group-delay distortion should be measured and recorded for subsequent maintenance purposes. Any obvious abnormal condition shall be cleared.

2.2 *International section*

When analogue access to the circuit is available at the terminal international centres, the following tests should be performed regardless of whether the international national section is provided by analogue circuit sections or a combination of analogue, mixed and digital circuit sections.

2.2.1 *Overall loss at reference frequency*

The sections comprising the international line (see Figure 2/M.1010) should be lined up so that when, at the sending terminal international centre, a test signal at a level of $-10$ dBm0 is connected to the input of the international line, the level received at the other terminal international centre is as close as possible to $-10$ dBm0. The level at intermediate test points should also be as close as possible to $-10$ dBm0.

2.2.2 *Loss/frequency distortion*

The loss/frequency distortion should be measured at several frequencies. The appropriate limits of Tables 1/M.580, 2/M.580 and 3/M.580 [1] (column headed "between circuit access points") have to be met, if necessary, by means of an equalizer.

2.2.3 *Group-delay distortion* (special quality circuits only)

For circuits in conformity with Recommendation M.1020, the limits to be applied are those given in Figure 2/M.1020. In the case of circuits in conformity with Recommendation M.1025, the group-delay distortion should be measured and recorded for subsequent maintenance purposes. Any obvious abnormal condition shall be cleared.

2.3 *International link*

If it is possible, after the national and international sections have been lined up and connected together at the terminal international centres, measurements should be made of the international link between terminal national centres. These measurements should be of overall loss at reference frequency and loss/frequency distortion and should be recorded for subsequent maintenance purposes.

## 3 Lining up the overall circuit

The constituent parts of the circuit having been satisfactorily lined up, the line-up of the overall circuit between renter's premises should now be made.

It should be noted that satisfactory impulsive noise performance on a circuit is unlikely to be achieved if the circuit is routed via a primary digital path on which the bit error ratio exceeds $1 \cdot 10^{-6}$ (see Note). It is not intended that this digital parameter be measured.

*Note* – This digital parameter is used provisionally and further study is required to assess whether other parameters (e.g. those in Recommendation G.821 [2] would be more suitable for relating the performance of transient analogue impairments to the performance of the digital paths on which the circuits are routed.

Where loop facilities exist these may be used to obtain reference measurements, for subsequent maintenance. Care must be taken to avoid simultaneous operation of loop facilities should they exist at both terminals.

3.1 *Overall loss*

The loss at 1020 Hz should be measured and recorded. Note should be taken of § 2.1 of Recommendations M.1020, M.1025 and M.1040. For international leased circuits forming part of a private switched network, the overall loss of the circuit should be adjusted to the value agreed between Administrations (refer to §§ 2.1 and 3 of Recommendation M.1030).

If 2-wire operation is intended, the curve in Recommendation G.131 [3] may be used to determine if an echo suppressor is necessary. Where appropriate the stability of the circuit should be checked against the requirements of Recommendation G.122 [4]. Inasmuch as the same sort of plant is used for leased circuits as is used to provide the "national system" of Recommendation G.101 [5], this should ordinarily present no problem. References to virtual switching points (*extrémités virtuelles* in French) in the Series G Recommendations should be interpreted as "points in the two directions of transmission on the international line at equal relative level".

3.2 *Loss/frequency distortion*

3.2.1 *Ordinary quality circuits*

The loss/frequency distortion should meet the limits of § 2.2 of Recommendations M.1030 or M.1040 as appropriate. Equalization should not normally be required to meet these limits.

3.2.2 *Special quality circuits*

The loss/frequency distortion should be measured at several frequencies and recorded. To meet the limits given in Figure 1/M.1020 or Figure 1/M.1025, as appropriate, *mop-up* equalization may be necessary (see Notes 1 and 2).

3.3 *Group-delay distortion* (special quality circuits only)

The group-delay distortion should be measured using a measuring set in accordance with Recommendation O.81 [6].

3.3.1 In the case of circuits to Recommendation M.1020, the limits to be met are given in Figure 2/M.1020. The maximum unequalized group-delay distortion to be expected at the receiving end is three times that of Figure 2/M.1020 (see Notes 1 and 2).

3.3.2 In the case of circuits to Recommendation M.1025, the limits to be met are given in Figure 2/M.1025 (see Notes 1 and 3).

*Notes concerning §§ 3.2.2 and 3.3* (Equalization of loss/frequency distortion and group-delay distortion on special quality leased circuits).

*Note 1* – The precise location of any necessary equalizers is left to Administrations to decide according to national practices. Equalizers built into the modems are not part of the international leased circuit as it is defined in Recommendation M.1010.

The Administration at the receiving end of the circuit is responsible for seeing that the circuit meets the overall distortion limits in the receiving transmission direction.

Routing restrictions may be necessary to achieve the loss/frequency and group-delay distortion limits specified. Factors that may contribute to difficulties in meeting these limits are the number of through-group filters in group links, the number of channel translating equipments, the use of edge channels, heavily loaded cable, etc.

*Note 2* – Equal distortion limits have been allocated to the national circuit section at the transmitting end, the international line and the national circuit section at the receiving end.

Individual cases of section limits being slightly exceeded can be accepted if the other sections do not attain their limits, so that the admissible overall unequalized distortion of three times the section limits at the receiving end is met.

*Note 3* – Any necessary equalization to bring the overall group-delay distortion within the specified limits should be carried out at one location only for each direction of transmission.

### 3.4 *Variation with time of the overall loss at 1020 Hz*

#### 3.4.1 *Amplitude hits* (special quality circuits only)

Amplitude hits should be measured with an instrument complying to Recommendation O.95 [7] and recorded. The limits specified in Recommendations M.1020 and M.1025, as appropriate, should not be exceeded.

#### 3.4.2 *Other variations*

The variation of overall loss at 1020 Hz should be measured over a period of a few hours to check that the limits specified in Recommendations M.1020, M.1025 and M.1030 are not exceeded. If the results are not satisfactory the check should be continued to allow the trouble to be investigated and cleared.

### 3.5 *Random circuit noise*

Random circuit noise may be measured with a psophometer complying with Recommendation O. 41 [8].

With the circuit correctly terminated the psophometric noise power at the end of the circuit should be measured and recorded. The measured noise power should meet the requirements of Recommendations M.1020, M.1025, M.1030 or M.1040, as appropriate[1]. Where the measured noise is higher by 5 dB or more than the appropriate value in these Recommendations or is higher than −38 dBm0p, whichever is the more stringent requirement, a fault should be suspected and action taken to locate and remedy it where possible. It may be useful to compare noise measurements on circuits of identical or similar constitution to help locate a possible fault.

### 3.6 *Impulsive noise* (special quality circuits only)

Impulsive noise should be measured with an instrument complying with Recommendation O.71 [9] and recorded. It should meet the limits given in Recommendation M.1020 or M.1025 as appropriate.

A method of measurement is described in the Recommendations H.13 [10] and V.55 [11].

### 3.7 *Phase jitter* (special quality circuits only)

Phase jitter should be measured using an instrument complying with Recommendation O.91 [12] and recorded.

The limits given in Recommendation M.1020 or M.1025, as appropriate, should not be exceeded, and routing restrictions (for example, minimizing the number of modulating equipments) may be necessary to achieve the objective limit.

### 3.8 *Total distortion (special quality circuits only)*

When the circuit includes any digital circuit sections, a measurement of total distortion should be made using an instrument complying with Recommendation O.132 [13]. Such a measurement will include contributions from quantizing line distorion, random noise, harmonic distortion and single tone interference. The minimum signal-to-total distortion ratio is given in Recommendations M.1020 and M.1025. However, if this minimum ratio is satisfied, it should not be assumed that all the parameters which contribute to the measurement are satisfactory. The total distortion measurement is not a substitute for the individual measurements specified in this Recommendation.

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[1] Recommendation O.41 [8] specifies a flat filter of 3.1 kHz bandwidth for unweighted noise measurements on data circuits. If this filter is used, the noise values given in Recommendations M.1020 to M.1060 do not apply because they are based on the use of psophometric weighting. Therefore, further study is required to determine the appropriate values for unweighted circumstances.

3.9 *Single tone interference* (special quality circuits only)

The method of measurement is under study.

3.10 *Frequency error* (special quality circuits only)

The frequency error introduced by the circuit should be measured and recorded. A method of measurement is given in Recommendation O.111 [14].

The limits specified in Recommendation M.1020 or M.1025, as appropriate, should be met.

3.11 *Harmonic and intermodulation distortion* (special quality circuits only)

Harmonic distortion should be measured by injecting a 700 Hz test frequency of −13 dBm0 at the transmit end of the circuit. The level of any individual harmonic at the receiving end should not exceed the limit given in Recommendation M.1020 or M.1025 as appropriate.

Alternatively, by bilateral agreement between Administrations, a measurement of second and third order intermodulation products using an instrument complying with Recommendation O.42 [15] should be performed. The limits are for further study.

The results should be recorded.

## 4 Section-by-section line-up

The section-by-section approach to the line-up of international leased circuits has been devised to minimize the need for international coordination and to overcome those situations where end-to-end line-up is not practical or possible.

Loss/frequency and group-delay distortion limits are apportioned to the international and national sections as follows (see Figure 2/M.1050):

International section: one third;

National sections: one third.

The resulting limits for the international and national sections are given in Table 1/M.1050 and Table 2/M.1050 for loss/frequency and group-delay respectively.

### 4.1 *National sections*

When analogue access to the circuit is available at the terminal international centres, the following tests should be performed regardless of whether the national section is provided by analogue circuit sections or a combination of analogue, mixed and digital circuit sections.

#### 4.1.1 *Overall loss*

Each national section should be lined up at the reference frequency according to national practices between the terminal national centre and international centre. Note should be taken of the requirement concerning the receiving relative level in § 2.1 of Recommendations M.1020, M.1025 and M.1040. For circuits forming part of a private switched network, the loss of the national section must be consistent with meeting the required overall loss as agreed between Administrations – refer to §§ 2.1 and 3 of Recommendation M.1030. A record should be kept of the levels received (including any measurements made at intermediate national test points). National sections beyond the terminal national centre must also be lined up.

#### 4.1.2 *Loss/frequency distortion*

The loss/frequency distortion should be measured at several frequencies. The limits in Table 1/M.1050 (column headed "National sections") have to be met, if necessary, by means of an equalizer (Note 1).

#### 4.1.3 *Group-delay distortion* (special quality circuits only)

The limits in Table 2/M.1050 (column headed "National sections") have to be met, if necessary, by means of an equalizer (Note 1).

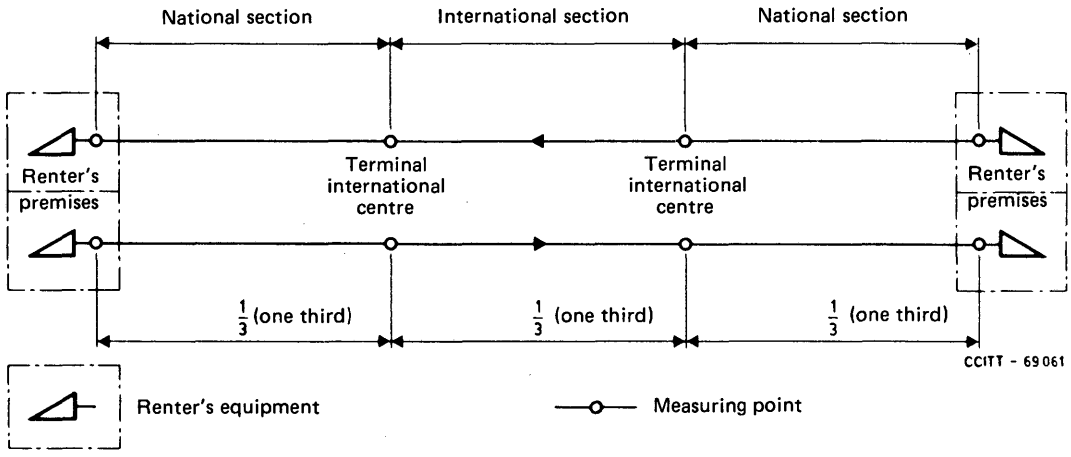



FIGURE 2/M.1050

**Apportionment of overall distortion limits to national and international sections of international leased circuits**

TABLE 1/M.1050

**Apportionment of loss/frequency distortion limits**

| Frequency range | Overall loss relative to that at 1020 Hz (dB) | | | | | |
|---|---|---|---|---|---|---|
| | National sections (As per Recommendations:) | | | International section (As per Recommendations:) | | |
| | M.1020 | M.1025 | M.1040 | M.1020 | M.1025 | M.1040 |
| Below 300 Hz | Loss shall not be less than 0 dB, otherwise unspecified | | | | | |
| 300-400 Hz | – | – | Ø to −1.0 | – | – | Ø to −1.0 |
| 300-500 Hz | +2.0 to −0.7 | +4.0 to −0.7 | – | +2.0 to −0.7 | +4.0 to −0.7 | – |
| 400-2000 Hz | – | – | +3.0 to −1.0 | – | – | +3.0 to −1.0 |
| 500-2500 Hz | – | +2.7 to −0.7 | – | – | +2.7 to −0.7 | – |
| 500-2800 Hz | +1.0 to −0.3 | – | – | +1.0 to −0.3 | – | – |
| 2000-2800 Hz | – | – | +5.3 to −1.0 | – | – | +5.3 to −1.0 |
| 2500-3000 Hz | – | +4.0 to −0.7 | – | – | +4.0 to −0.7 | – |
| 2800-3000 Hz | +2.0 to −0.7 | – | Ø to −1.0 | +2.0 to −0.7 | – | Ø to −1.0 |
| Above 3000 Hz | Loss shall not be less than 0 dB, otherwise unspecified | | | | | |

Ø unspecified.

TABLE 2/M.1050

**Apportionment of group-delay distortion limits**

| Frequency range | Limits for group delay relative to the minimun measured group delay in the 500-2800 Hz ( ms) | | | |
|---|---|---|---|---|
| | National sections (As per Recommendations:) | | International section (As per Recommendation:) | |
| | M.1020 | M.1025 | M.1020 | M.1025 |
| Below 500 Hz | Unspecified | – | unspecified | – |
| Below 600 Hz | – | Unspecified | – | Unspecified |
| 500-600 Hz | 1.0 | – | 1.0 | – |
| 600-1000 Hz | 0.5 | 1.0 | 0.5 | 1.0 |
| 1000-2600 Hz | 0.17 | 0.5 | 0.17 | 0.5 |
| 2600-2800 Hz | 1.0 | 1.0 | 1.0 | 1.0 |
| Above 2800 Hz | Unspecified | | | |

4.1.4 *Other characteristics* (special quality circuits only)

The remaining characteristics of special quality international leased circuits (§§ 2.4-2.11 of Recommendations M.1020 and M.1025) should be treated in accordance with the national practices of the Administrations concerned, bearing in mind the constitution of the national sections involved. Note that it may not be necessary to measure all such characteristics. For example, quantizing distortion need only be checked when a PCM system is involved, while phase jitter and frequency error might be omitted where the national section is provided solely by audio line plant.

It should be noted that satisfactory impulsive noise performance on a circuit is likely to be achieved if the circuit is routed via a primary digital path on which the bit error ratio exceeds $1 \cdot 10^{-6}$ (see Note). It is not intended that this digital parameter be measured.

*Note* – This digital parameter is used provisionally and further study is required to assess whether other parameters (e.g. those in Recommendation G.821 [2]) would be more suitable for relating the performance of transient analogue impairments to the performance of the digital paths on which the circuits are routed.

The limits given in §§ 2.4-2.11 of Recommendations M.1020 and M.1025, as appropriate, apply to the overall circuit, and cannot therefore be exceeded by either national section.

4.2 *International section*

When analogue access to the circuit is available at the terminal international centres, the following tests should be performed regardless of whether the international national section is provided by analogue circuit sections or a combination of analogue, mixed and digital circuit sections.

4.2.1 *Overall loss*

The sections comprising the international line (see Figure 2/M.1010) should be lined up so that when, at the sending terminal international centre, a test signal at a level of −10 dBm0 is connected to the input of the international line, the level received at the other terminal international centre is as close as possible to −10 dBm0. The level at intermediate test points should also be as close as possible to −10 dBm0.

4.2.2 *Loss/frequency distortion*

The loss/frequency distortion should be measured at several frequencies. The limits in Table 1/M.1050 (column headed "International section") have to be met, if necessary, by means of an equalizer (Notes 1 and 2).

4.2.3 *Group-delay distortion* (special quality circuits only)

The limits in Table 2/M.1050 (column headed "International section") have to be met, if necessary, by means of an equalizer (Notes 1 and 2).

4.2.4 *Other characteristics* (special quality circuits only)

Bearing in mind the constitution of the international section, the remaining characteristics of special quality circuits (as specified in Recommendations M.1020 and M.1025, §§ 2.4-2.11) should be checked using the measuring instruments and methods of measurement mentioned in § 3 above.

The limits given in §§ 2.4-2.11 of Recommendations M.1020 and M.1025 apply to the overall circuit, and cannot therefore be exceeded by the international section. Staff responsible for the line-up of international leased circuits at the terminal international centres should assess, based on the measured values for the international and national sections, whether or not the overall limits will be met.

It should be noted that satisfactory impulsive noise performance on a circuit is unlikely to be achieved if the circuit is routed via a primary digital path on which the bit error ratio exceeds $1 \cdot 10^{-6}$ (see Note). It is not intended that this digital parameter be measured.

*Note* – This digital parameter is used provisionally and further study is required to assess whether other parameters (e.g. those in Recommendation G.821 [2]) would be more suitable for relating the performance of transient analogue impairments to the performance of the digital paths on which the circuits are routed.

4.3 *Overall circuit*

The constituent sections of the circuit having been satisfactorily lined up, the international and national sections should be connected together and, where appropriate and possible, the overall circuit should be checked for satisfactory operation – refer to § 6 below.

*Notes concerning §§ 4.1.2, 4.1.3 and 4.2.2, 4.2.3* (Equalization of loss/frequency distortion and group-delay distortion on special quality leased circuits).

*Note 1* – The precise location of any necessary equalizers is left to Administrations to decide according to national practices. Equalizers built into the modems are not part of the international leased circuit as it is defined in Recommendation M.1010.

Routing restrictions may be necessary to achieve the loss/frequency and group-delay distortion limits specified. Factors that may contribute to difficulties in meeting these limits are the number of through-group filters in group links, the number of channel translating equipments, the use of edge channels, heavily loaded cable, etc.

*Note 2* – The Administration at the receiving end of the circuit is responsible for seeing that the international section meets the distortion limits in the receive direction of transmission.

## 5 Additional reference measurements

As part of the lining-up procedure it may be considered useful to make reference measurements at intermediate points by high-impedance bridging methods, and/or measurements made on a loop-basis. Such measurements should be carried out under the direction of the circuit control station.

## 6 Functional checks

Where appropriate and possible the complete circuit should be checked for satisfactory operation as follows:

a) Circuit signalling should be checked for satisfactory operation. When the signalling current is transmitted at the level permitted by national regulations, the limits given in the relevant Q Recommendations should not be exceeded at the input to the international line.

b) Tests should be made to determine if excessive echo, instability or other impediments to satisfactory operation are present. For example, by means of a bilateral agreement, the additional characteristics mentioned in Recommendation M.1060, § 6 may be checked.

## 7 Transmission level checks

It should be verified by direct measurement if possible (otherwise by calculation) that when the renter's apparatus is transmitting signals at the level permitted by national regulations the following limits (Note 3) are not exceeded at the input to the international line:

- Data transmission (Recommendation V.2 [16]) — −13 dBm0
- Voice-frequency telegraphy
  - amplitude-modulated
  - frequency-modulated

  } See Recommendation M.810, § 4.1
- Phototelegraph or facsimile
  - amplitude modulation (white level) — − 3 dBm0
  - frequency modulation — −13 dBm0
- Simultaneous transmission of various signals
  - total power — −13 dBm0

*Note 1* – The above limits apply when the whole of the bandwidth is devoted to one particular transmission at any one time. When the band is divided among two or more types of transmission the power levels permitted by the various Recommendations mentioned above should be reduced by the quantity 10 log (3100/$x$) dB, where $x$ is the nominal bandwidth in hertz occupied by the transmission concerned.

*Note 2* – In addition to the above specification, discrete frequency signals must comply with the requirements of Recommendation G.224 [17].

*Note 3* – These are considered too high by some Administrations and additional study of these limits is anticipated in the future.

## 8 Level limiters

Where level limiting devices are fitted on the circuit they should not introduce distortion when the levels transmitted are within the permitted limits.

## 9 Marking of equipment associated with special quality circuits

In order to reduce to a minimum interruptions on the circuits, it is necessary that all equipment associated with such circuits (e.g. amplifiers, channel translating equipment, distribution frames, etc.) be positively marked so that the maintenance staff can readily identify it and can therefore avoid causing interruptions to the circuit inadvertently when they carry out maintenance work in repeater stations and exchanges.

## 10 Short-time rerouting of special quality leased circuits

The *make good* of a special quality circuit in case of a breakdown or planned outage needs special attention in order to keep the circuit characteristics within the required limits.

If there is a breakdown or planned interruption of a transmission system, rerouting should be carried out as far as possible at group, supergroup, etc., or digital path level. This would normally not seriously affect the attenuation and group-delay distortion. When such a rerouting of transmission links cannot be effected or when only the circuit concerned is faulty, a reroute circuit or circuit section of similar constitution as that in service should be chosen, in particular with regard to the number of FDM carrier sections and the relative number of analogue and digital circuit sections. The procedure of short-time rerouting at audio level can be facilitated if nominated reroute circuit sections having the same characteristics as the circuit sections of the regular route are available. This consideration also applies to the local line sections.

The circuit control station, if not directly involved, should be apprised of short-time rerouting which might affect the operation of the circuit. If a complete line-up is not practical, e.g. due to the expected short duration of the rearrangement, it is a minimum requirement that at least a check of the circuit overall loss at reference frequency and a measurement of the random circuit noise should be made.

**References**


[1] CCITT Recommendation *Setting up and lining up an international circuit for public telephony*, Vol. IV, Rec. M.580, Table 1/M.580, Table 2/M.580, Table 3/M.580.

[2] CCITT Recommendation *Error performance of an international digital connection forming part of an integrated services digital network*, Vol. III, Rec. G.821.

[3] CCITT Recommendation *Stability and echo*, Vol. III, Rec. G.131, § 2.

[4] CCITT Recommendation *Influence of national systems on stability, talker echo and listener echo in international connections*, Vol. III, Rec. G.122.

[5] CCITT Recommendation *The transmission plan*, Vol. III, Rec. G.101.

[6] CCITT Recommendation *Group-delay measuring equipment for telephone-type circuits*, Vol. IV, Rec. O.81.

[7] CCITT Recommendation *Phase and amplitude hits counters for telephone-type circuits*, Vol. IV, Rec. O.95.

[8] CCITT Recommendation *Psophometer for use on telephone-type circuits*, Vol. IV, Rec. O.41.

[9] CCITT Recommendation *Impulsive noise measuring equipment for telephone-type circuits*, Vol. IV, Rec. O.71.

[10] CCITT Recommendation *Characteristics of an impulsive-noise measuring instrument for telephone-type circuits*, Orange Book, Vol. III-2, Rec. H.13, Annex, ITU, Geneva, 1977.

[11] CCITT Recommendation *Impulsive noise measuring instrument for data transmission*, Green Book, Vol. VIII, Rec. V.55, Annex, ITU, Geneva, 1973.

[12] CCITT Recommendation *Phase jitter measurement equipment for telephone circuits*, Vol. IV, Rec. O.91.

[13] CCITT Recommendation *Quantizing distortion measuring equipment using a sinusoidal test signal*, Vol. IV, Rec. O.132.

[14] CCITT Recommendation *Frequency shift measuring equipment for use on carrier channels*, Vol. IV, Rec. O.111.

[15] CCITT Recommendation *Equipment to measure nonlinear distortion using the 4-tone intermodulation method*, Vol. IV, Rec. O.42.

[16] CCITT Recommendation *Power levels for data transmission over telephone lines*, Vol. VIII, Rec. V.2.

[17] CCITT Recommendation *Maximum permissible value for the absolute power level (power referred to one milliwatt) of a signalling pulse*, Vol. III, Rec. G.224.


**Recommendation M.1055**

## LINING UP AN INTERNATIONAL MULTITERMINAL LEASED CIRCUIT

These circuits are usually arranged in one of the following ways:

*Unidirectional*

One station may transmit to every other and receive from every other, but the other stations have no communication among themselves. That is, the circuit is in effect a combination of a distribution network and a contribution network. This arrangement is used to interconnect, for example, a computer centre with outlying user stations.

*Conference*

Any station may have two-way transmission with any other. This usually implies that any station may in principle have two-way transmission with every other station simultaneously, and for telephony, some sort of selective signalling is employed. An example of this arrangement is the multiterminal speaker facilities provided for stations on important submarine cable schemes.

A systematic procedure is needed to line up this class of circuit if needless readjustment of interdependent apparatus is to be avoided.

## 1 Multiterminal unidirectional circuits

### 1.1 *Distribution network*

The explanation of the principle is given in terms of Figure 1/M.1055 which illustrates part of the distribution network (i.e. the sending direction of transmission) emanating from station A. (There may be similar networks also emanating from station A, but these can be treated as this one, thus there is no loss of generality in assuming that station A is at one end of the network.)

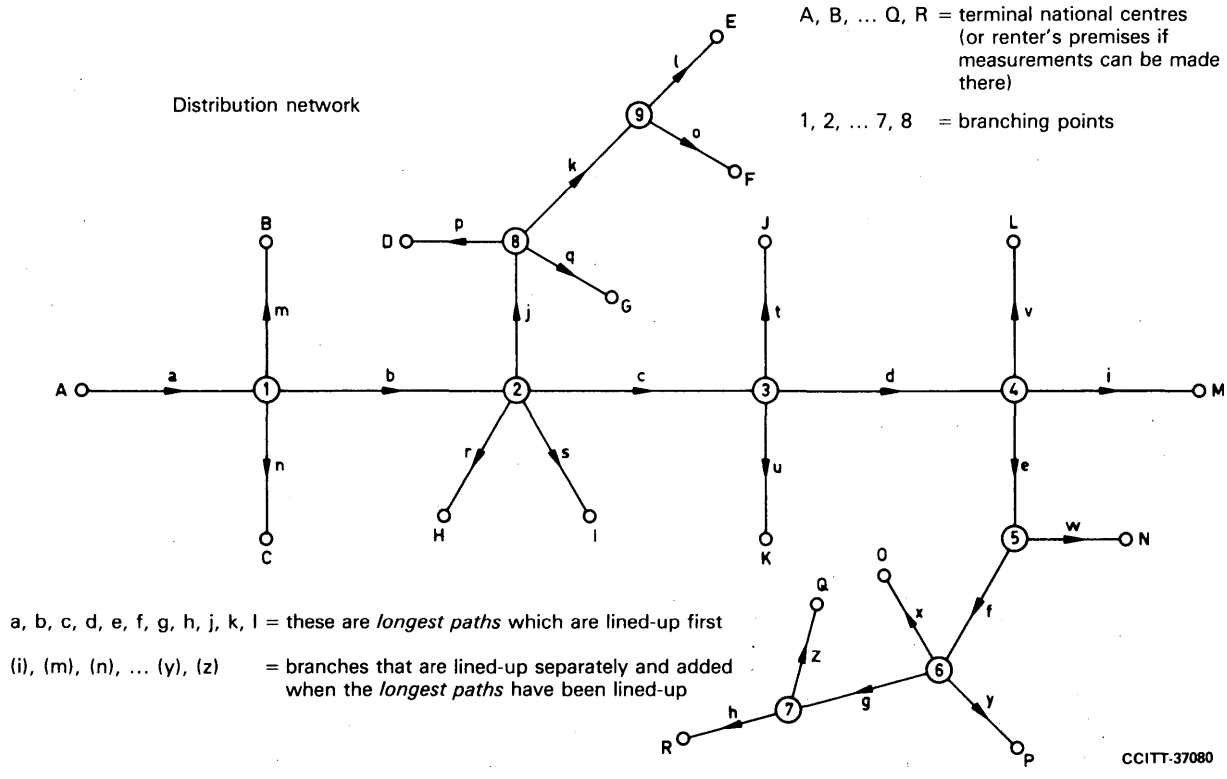



FIGURE 1/M.1055
**To illustrate the lining-up of a multiterminal unidirectional circuit**

The sections a to z are point-to-point circuits or circuit sections, each of which may be composed of national or international sections.

The order in which the distribution network is lined up and connected together is as follows:

a) Identify the path with the greatest number of sections: in the example, this is a-b-c-d-e-f-g-h.

(*Note* – A-M may be longer geographically, but has only 5 sections, whereas A-R has 8 sections.)

b) Identify the next longest path remaining (i.e. imagine the path A-R to be removed with its branching points. This is taken to be j-k-l (the distance 2-E is assumed to be greater than the distance 2-F though both of them have three sections).

c) Identify the remaining paths in order of length. In the example, these are all the single sections i, m, n, . . . y, z.

d) When the network is separated in this fashion, the paths

a-b-c-d-e-f-g-h,

j-k-l,

i,

m,

n,

.

.

.

y,

z

may all be lined up concurrently according to the principle of Recommendation M.1050.

e) With a measurement-tone at a suitable level connected to A, add on the following branches (concurrently, if possible):

- at 1 the branches m and n;
- at 2 the branches j-k-l, r and s;
- at 3 the branches t and u;
- at 4 the branches v and i;

making any necessary adjustments.

f) Stations 8 and 9 now add on branches p, q, and o, adjustments being made if necessary.

1.2 *Contribution network*

This is much more difficult to organize because the outstations may only send one at a time. The problem is eased if the network is divided into more manageable portions. A possible scheme related to Figure 1/M.1055 (with all the arrows assumed to be reversed) would be as follows:

a) The longest paths h-g-f-e-d-c-b-a and o-k-j are lined up concurrently as before.

b) Keeping e disconnected at 4, stations N, O, P and Q send to 4 in turn, stations 5, 6 and 7 making any necessary adjustments to branches w, x, y and z.

c) Concurrently with b) above, stations D, G and E send to 2 in turn (j disconnected) with 8 and 9 making any necessary adjustments to sections p, q and l.

d) Concurrently with b) and c) above, stations M, L, J and K send to station 3 (c disconnected) with stations 3 and 4 making any necessary adjustments to sections i, v, t and u.

e) Concurrently with b), c) and d), stations B, C, H and I send in turn to station A with stations 1 and 2 making any necessary adjustment to sections m, n, r and s.

1.3 It is recommended that the Administration of the country in which the focal station is situated should be responsible for drawing up the schedule showing the order in which the various circuit sections should be lined up.

1.4 If the circuit requires to be equalized then a very precise order in which the sections are to be equalized and connected together will be necessary if needless readjustment is to be avoided.

1.5 In order to apply the principles of equalizing outlined in Recommendation M.1050 it will be necessary to identify paths in the circuit connecting the focal station to each of the outstations and to treat each path as a point-to-point circuit bearing in mind § 1.4 above.

## 2 Multiterminal conference circuits

2.1 These are usually provided by means of bidirectional branching units which are inserted into the two directions of transmission of a 4-wire circuit and derive a send and receive pair.

2.2 It is recommended that the branching units are designed to enable a branch to be added without affecting the levels of the main circuit.

2.3 The line-up should be organized so as to avoid needless readjustment of circuit sections. This principle outlined for multiterminal unidirectional circuits gives guidance in this matter.

2.4 Four-wire telephones should be used whenever possible to avoid instability problems.

There should be some limit to the number of locations joined together (for example: 12).

# 7.4 Maintenance of international leased circuits

**Recommendation M.1060**

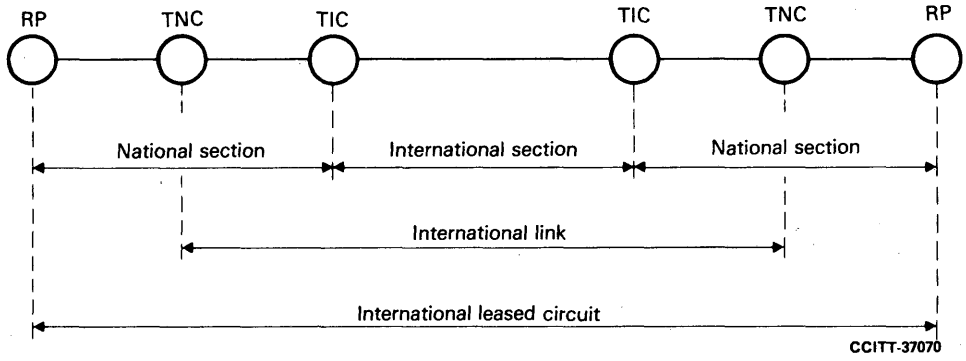
MAINTENANCE OF INTERNATIONAL LEASED CIRCUITS

## 1 General

This Recommendation deals with the maintenance procedures applicable to both ordinary and special quality international leased circuits which are provided by analogue transmission systems or by a mixture of analogue and digital systems.

Figure 1/M.1060 shows the constituent parts of an international leased point-to-point circuit.

Test signals transmitted over the international section and link should be applied at a level of $-10$ dBm0.




RP = renter's premises
TNC = terminal national centre
TIC = terminal international centre

FIGURE 1/M.1060
**The constituent parts of an international point-to-point leased circuit**

## 2 Fault reporting procedures

As far as possible the provisions of Recommendations M.1012, M.1013 and M.1014 apply. Any additional special procedures, for example for international leased circuits forming part of a private switched network, must be devised by the parties concerned.

## 3 Fault localization

3.1 Upon receipt from the customer of a complaint concerning the performance of an international leased circuit the circuit control station should obtain from the customer specific assurance that all terminal equipment has been tested and is working correctly. Once this assurance has been received then efforts should be made to locate the fault.

3.2 Unless the control station has been informed of some condition which may be affecting the working of the international leased circuit, such as a major system failure or local failures involving the international leased circuit, then efforts should be made to localize and clear the fault condition.

3.3 In order to localize the fault, the leased circuit should be tested in sections in such a way as to minimize the requirement for international cooperation and allow rapid progress, i.e.:

- the section between the terminal national centre and the terminal international centre;
- the section between the terminal national centre and the interface at the customer's premises. In the case of 4-wire circuits it may be possible to check the continuity of both directions of transmission by utilizing the loop facility available at the interface point. To this end the customer may be requested to cooperate in the utilization of this facility;
- the national system, i.e. between the terminal international centre and the interface at the customer's premises. For 4-wire circuits a check of the continuity of the national system, in both directions of transmission, may be achieved by utilizing the loop facility which may be available at the interface for the customer as previously mentioned;
- the international section, i.e., from terminal international centre to distant terminal international centre.

Care must be taken to avoid simultaneous operation of loop facilities should they exist at both terminals.

3.4 For special quality circuits to M.1020 and M.1025 certain limits may be apportioned while others are not (see M.1050, § 4). When a fault investigation indicates that the fault can be possibly attributed to one or more unallocated parameters, sectional measurements should be made of these parameters. The section not meeting stated standards (for example, according to national practice), or that is significantly changed from readings recorded at the time of initial line-up, shall be carefully investigated in an effort to isolate a fault condition.

End-to-end measurements on a coordinated basis may still be required in order to fully isolate the fault, and in this case the section making the greatest contribution to the total readings should be first investigated and improvement sought.

## 4 Overall circuit check

Depending on the nature of the fault and/or any adjustments that are made, there may be need to check the performance of the overall circuit.

## 5 Special care with multiterminal circuits

In the case of multiterminal leased circuits care should be taken that fault localization and clearance procedures on one branch should not affect the availability or performance of other branches or the main body of the circuit involved.

In the case of circuits conforming to Recommendation M.1030, such a check may take the form of test calls.

## 6 Maintenance parameters

Maintenance measurements should normally be evaluated by comparison with those made during the line-up of the circuit and with the specified limits.

In the case of random noise, any substantial deterioration in performance from the original line-up value may serve to indicate a fault but with the overriding requirement that a noise level of −38 dBm0p should not be exceeded.

In addition to those specified in Recommendations M.1020 and M.1025, the following characteristics and limits may be employed for fault finding purposes on special quality leased circuits:

- go-to-return crosstalk ratio of −43 dB;
- short interruptions in transmission. Short interruptions in transmission should be measured with an instrument complying with Recommendation O.61 [1] or O.62 [2], with the threshold level set at 10 dB and the instrument dead time set at 125 ms. The objective is that there should be no short interruptions in transmission, of durations 3 ms-1 min, in any 15 minute measurement period. However, where a short interruption is detected, the measuring period should be extended to 30 min for which the total number of short interruptions should not exceed one (see Notes 1-4 below);
- number of phase hits greater than 15° should not exceed 10 in 15 minutes. Phase hits should be counted using an instrument complying with Recommendation O.95 [3] (see Notes 2-4 below).

*Note 1* – Where a particular circuit is used primarily for data transmission, a more precise threshold level may be used. Such a threshold level should be established with reference to the actual overall loss of the circuit involved and the "line signal detector" levels of the modems being employed. For example, refer to the Recommendation cited in [4].

*Note 2* – The limits for short interruptions in transmission, and phase hits are provisional and subject to further study.

*Note 3* – Administrations should note that short interruptions in transmission, phase hits and amplitude hits are interrelated such that, for example, a short interruption in transmission may result in a count on phase hit and amplitude hit measuring instruments. This must be taken into account in the application of the respective limits for short interruptions, phase hits and amplitude hits.

*Note 4* – To determine if the long-term performance of a leased circuit is satisfactory, it is highly desirable to check for transient impairments over a protracted period, for example, 24 hours.

## 7 Preventive maintenance measurements

In principle, the Recommendations concerning routine tests for international telephone circuits and voice-frequency telegraph links apply, as far as they can, to international leased circuits.

It will be necessary for Administrations to agree with the renters concerned upon the times at which the circuit may be released for test purposes.

The periodicities shown in Table 1/M.1060 for measurements should be used as a guide as far as is practicable and as is appropriate to the type of circuit.

TABLE 1/M.1060

| Type of test | Periodicity |
|---|---|
| Overall loss at 1020 Hz | As given in Recommendation M.610 [5] |
| Overall loss/frequency distorsion | Annually |
| Noise power level (see note) | As 1020 Hz test |
| Impulsive noise | 6-monthly |
| Group-delay distorsion | Annually |
| Total distorsion | Annually |

*Note* – See Recommendation M.1050, § 3.5.

All the measurements above would normally be made only between the installations of Administrations closest to the renters' installations, that is, between terminal national centres, and normally equipped with the necessary test equipment.

If measurements are required to be made at renters' installations then special arrangements must be made between the parties concerned.

## 8 Signal transmission level

The signal transmitted by the renters' apparatus should not exceed the limits (Note 3) shown below at the input to the international section:

- Data transmission (Recommendation V.2 [6]) — −13 dBm0
- Voice-frequency telegraphy
  - amplitude-modulated
  - frequency-modulated

  } See Recommendation M.810, § 4.1
- Phototelegraph or facsimile
  - amplitude modulation (white level) — − 3 dBm0
  - frequency modulation — −13 dBm0
- Simultaneous transmission of various signals
  - total power — −13 dBm0

*Note 1* – The above recommendations apply when the whole of the bandwidth is devoted to one particular transmission at any one time. When the band is divided among two or more types of transmission, the power levels permitted by the various Recommendations mentioned above should be reduced by the quantity 10 log (3100/$x$) dB, where $x$ is the nominal bandwidth in hertz occupied by the transmission concerned.

*Note 2* – In addition to the above specification, discrete frequency signals must comply with the requirements of Recommendation G.224 [7].

*Note 3* – These are considered too high by some Administrations and additional study of these limits is anticipated in the future.

## 9 Level limiter

Where level limiting devices are fitted on the circuit, they should not introduce distortion when the levels transmitted are within the permitted limits.

## 10 Short-time rerouting of special quality leased circuits

The *make good* of a special quality circuit in case of a breakdown or planned outage needs special attention in order to keep the circuit characteristics within the required limits.

If there is a breakdown or planned interruption of a transmission system, rerouting should be carried out as far as possible at group, supergroup, etc., or digital path level. This would normally not seriously affect the attenuation and group-delay distortion. When such a rerouting of transmission links cannot be effected or when only the circuit concerned is faulty, a reroute circuit or circuit section of similar constitution as that in service should be chosen, in particular with regard to the number of FDM carrier sections and the relative number of analogue and digital circuit sections. The procedure of short-time rerouting at audio level can be facilitated if nominated reroute circuit sections having the same characteristics as the circuit sections of the regular route are available. This consideration also applies to the local line sections.

The circuit control station, if not directly involved, should be apprised of short-time rerouting which might affect the operation of the circuit. If a complete line-up is not practical, e.g., due to the expected short duration of the rearrangement, it is a minimum requirement that at least a check of the circuit overall loss at the reference frequency and a measurement of the random circuit noise should be made.

**References**


[1] CCITT Recommendation *Simple equipment to measure interruptions on telephone-type circuits*, Vol. IV, Rec. O.61.

[2] CCITT Recommendation *Sophisticated equipment to measure interruptions on telephone-type circuits*, Vol. IV, Rec. O.62.

[3] CCITT Recommendation *Phase and amplitude hit counters for telephone-type circuits*, Vol. IV, Rec. O.95.

[4] CCITT Recommendation *9600 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits*, Vol. VIII, Rec. V.29, § 6.1.

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

[6] CCITT Recommendation *Power levels for data transmission over telephone lines*, Vol. VIII, Rec. V.2.

[7] CCITT Recommendation *Maximum permissible value for the absolute power level (power referred to one milliwatt) of a signalling pulse*, Vol. III, Rec. G.224.

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SECTION 8

# MARITIME SYSTEMS

**Recommendation M.1100**

## GENERAL MAINTENANCE ASPECTS OF MARITIME SATELLITE SYSTEMS

### 1 Purpose

The purpose of this Recommendation is to describe the special maintenance procedures and facilities that are required for the maintenance of maritime satellite systems. Wherever possible the standard maintenance procedures and facilities specified in the Series M and O Recommendations should be followed for the maintenance of these systems.

### 2 Definitions

The following are definitions of terms used in the maintenance of maritime satellite systems.

#### 2.1 maritime satellite system

In the Maritime Mobile-Satellite Service, all of the temporary connection between a telephone at a ship earth station and the maritime virtual switching point at a coast earth station. It comprises a *maritime satellite circuit* and a *maritime local system.* The general arrangement is shown in Figure 1/M.1100.

#### 2.2 maritime satellite circuit

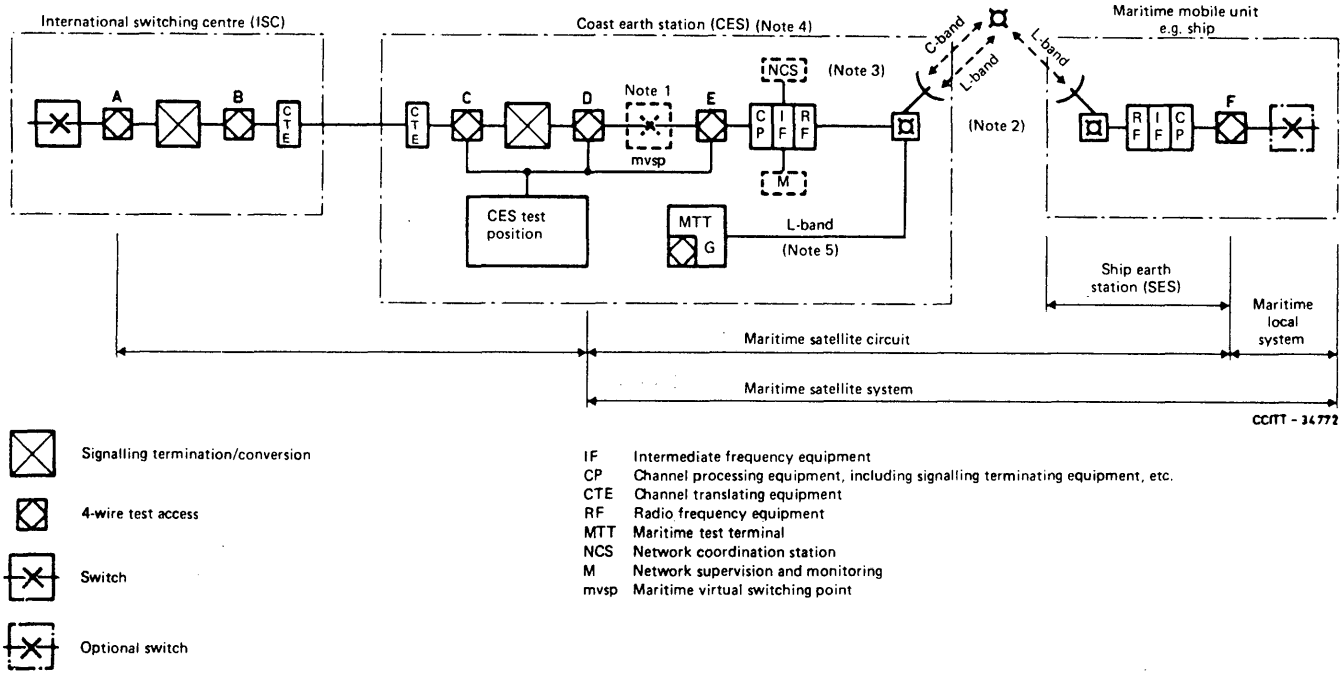
A 4-wire circuit between a maritime virtual switching point at a *coast earth station* and the 4-wire circuit test access point at a *ship earth station,* via a satellite repeater.

#### 2.3 maritime local system

All the equipment between the 4-wire test circuit access point on a *ship earth station* and a 2-wire or 4-wire telephone served by that ship earth station. It may include 4-wire to 2-wire termination sets, echo control equipment, data interfaces, and 4-wire or 2-wire switching devices.

#### 2.4 ship earth station (SES)

In the Maritime Mobile-Satellite Service, a mobile earth station which provides a 4-wire analogue interface for connection of a *maritime satellite circuit* to a *maritime local system* and a 4-wire circuit test access point.




*Note 1* — A maritime virtual switching point should always be established for transmission planning purposes. However, a switch at the coast earth station is optional.

*Note 2* — The actual frequencies used are 4/6 GHz (C-band) and 1.5/1.6 GHz (L-band).

*Note 3* — Certain coast earth stations are also network coordination stations; their functions are described in Recommendation M.1110.

*Note 4* — Coast earth station functions are described in Recommendation M.1120.

*Note 5* — 4-wire test access point G is equivalent to 4-wire test access point F.

FIGURE 1/M.1100

**Constitution of a maritime satellite system**

## 2.5 coast earth station (CES)

In the Maritime Mobile-Satellite Service, an earth station, which provides a 4-wire analogue interface for connection of a *maritime satellite circuit* to the international public switched telephone network. It also provides circuit test access points and test facilities. (See Recommendation M.1120 for the functions of a coast earth station.)

## 2.6 maritime test terminal (MTT)

A *ship earth station* and a *maritime local system* installed at a coast earth station and used for test purposes.

## 2.7 network coordination station (NCS)

A station in the Maritime Mobile-Satellite Service that maintains a pool of frequencies, assigns frequencies on demand from a coast earth station for use in a maritime satellite circuit, and supervises and monitors the use of the frequencies. The network coordination station is normally located at a coast earth station which is designated by the satellite system operator to fulfill these functions. (See Recommendation M.1110 for the functions of a network coordination station.)

## 2.8 coast earth station test position

A position in a coast earth station that can be used to originate test calls over the maritime satellite system to the maritime test terminal and to receive test calls from the maritime test terminal.

## 3 General maintenance principles

### 3.1 *Responsibilities*

In an international connection which includes a ship earth station, the maritime satellite system may be regarded from a transmission point of view as analogous to a national network and the maritime local system as somewhat analogous to a subscriber terminal within that network. Nevertheless, it should be noted that the maritime satellite circuit is set up between the coast earth station and the ship earth station on a demand assignment basis. Therefore, a coast earth station in the maritime satellite system may not have the direct responsibility for the maintenance of a particular maritime satellite circuit and a particular ship earth station all of the time. The operation and maintenance of the overall maritime satellite system is the responsibility of the maritime satellite system operator, e.g. INMARSAT.

The maintenance organization in each participating country is in general responsible for the maintenance of the maritime satellite circuits.

### 3.2 *Available services*

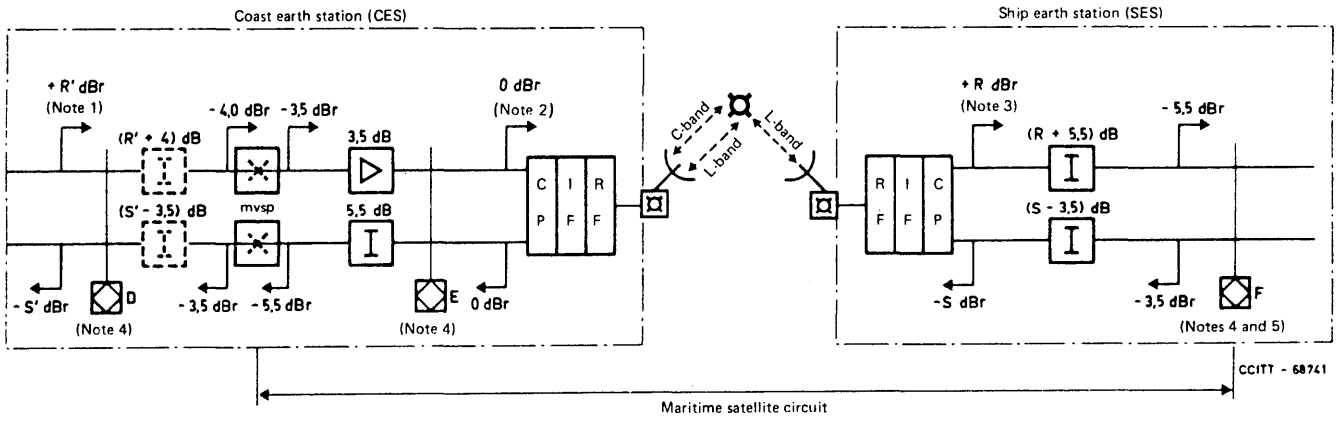
The maritime satellite systems in service provide telex services to maritime mobile units in addition to telephone and data services. When instituting maintenance procedures, Administrations should consider the utilization of these services for communication, diagnostic and maintenance purposes, and should also consider that trained technical staff are generally available at the ship earth station only at the time the ship earth station is commissioned; however, the ship earth station is usually operated by a qualified radio officer who may be able to assist in carrying out simple test procedures.

Special services, e.g. facsimile and high speed data services, are being provided over the maritime satellite systems. The development of new maintenance procedures to support these services will be the subject of future study.

## 4 Interconnection with the international public switched telephone network

Interconnection arrangements are considered with reference to Figure 1/M.1100.

The maritime virtual switching point at the coast earth station is considered to be the interface between test access points D and E (see Figure 2/M.1100). The circuit between the international switching centre (ISC) and coast earth station is considered as equivalent to an international public switched telephone circuit.




*Note 1* — $+R'$ dBr and $-S'$ dBr in the coast earth station correspond to the levels $+R'$ dBm and $-S'$ dBm using a modulation signal with a level of 0 dBm0.

*Note 2* — The levels of 0 dBr are given as an example.

*Note 3* — $+R$ dBr and $-S$ dBr in the ship earth station correspond to the levels of $+R$ dBm and $-S$ dBm using a modulation signal with a level of 0 dBm0.

*Note 4* — See Figure 1/M.1100 for 4-wire test access points.

*Note 5* — The levels at test access point F are those given in Recommendation G.473 [3].

*Note 6* — For the abbreviations used in this figure see Figure 1/M.1100.

FIGURE 2/M.1100

**Levels at the coast earth station and ship earth station**

## 5 Lining-up and maintaining international public switched telephone circuits

The circuit between the international switching centre and the coast earth station in Figure 1/M.1100 should be lined up and maintained in accordance with those Series M Recommendations appropriate to international public switched telephone circuits, e.g. Recommendations M.580 [1] and M.610 [2].

## 6 Lining-up and maintaining maritime satellite circuits

### 6.1 *Control, sub-control and respective responsibilities*

#### 6.1.1 *General*

The assignment of control and sub-control stations and respective responsibilities must address the configuration of the maritime satellite system. In every case a control station must be assigned as regards circuits, and, in addition, sub-control stations are required for efficient maintenance.

#### 6.1.2 *Assignment of control stations*

The coast earth station will be the control station for the maritime satellite circuit.

#### 6.1.3 *Assignment of sub-control stations*

6.1.3.1 In principle, the ship earth station should act as the maritime satellite circuit sub-control station. However, the required staff and facilities may not be available to meet the circuit sub-control responsibilities, and special measures may need to be developed.

6.1.3.2 A maritime test terminal may be used to enhance fault location and maintenance in the maritime satellite system. In this regard the maritime test terminal may carry out some tests normally considered to be within the province of a sub-control station on behalf of a ship earth station. Whether or not a maritime test terminal should be assigned as a sub-control station is left for further study when the operation of a maritime test terminal is further defined.

#### 6.1.4 *Responsibilities of control and sub-control stations*

Control stations dealing with maritime satellite circuits should fulfill the responsibilities of control stations as defined in the Series M Recommendations in general. The same will apply to sub-control stations. However, the maritime satellite systems present new concepts which require guidelines inasmuch as a maritime mobile unit is essentially a subscriber location. See Recommendation M.1120.

### 6.2 *Transmission characteristics*

The transmission design characteristics for maritime satellite circuits are given in Recommendation G.473 [3].

The setting-up, lining-up and maintenance limits of the maritime satellite circuit between test access points E and F of Figure 2/M.1100 should be as defined in Table 1/M.1100 both for the case where no switch is located at the coast earth station and where a switch is located at the coast earth station.

The loss/frequency limits in Table 1/M.1100 are those which should be met with the compandors disabled. The measurements to be carried out with the compandors in circuit are a subject for further study.

The relative levels at the coast earth station and the ship earth station are shown in Figure 2/M.1100.

TABLE 1/M.1100

**Provisional setting-up, lining-up and maintenance limits**

| Transmission parameters | Maintenance limits (dB) |
|---|---|
| Loss/frequency relative to the loss at reference frequency | (See Note) |
| Below 300 Hz | Not specified |
| 300-400 Hz | −1.2 to +4.4 |
| 400-600 Hz | −1.2 to +2.6 |
| 600-2400 Hz | −1.2 to +1.2 |
| 2400-2700 Hz | −1.2 to +2.6 |
| 2700-3000 Hz | −1.2 to +4.4 |
| 3000-3400 Hz | −1.2 to not specified |
| Idle noise | Not yet specified. See Annex A for further information |

*Note* – To avoid distortion introduced by clippers and the gain variations due to compandors, the 1020 Hz reference tone used for measuring the loss shall be set at −10 dBm0 and the compandors shall be disabled.

## 6.3 *Lining-up procedures*

### 6.3.1 *Measurement of the loss at the reference frequency*

The control station (coast earth station) sends a reference frequency from 4-wire test access E in Figure 2/M.1100 at a level of −10 dBm0. The sub-control station (ship earth station) measures the level at 4-wire test access point F in Figure 2/M.1100 (the −5.5 dBr point). The receive level should be −15.5 dBm.

The sub-control station (ship earth station) applies a reference frequency at the 4-wire test access F in Figure 2/M.1100 (the −3.5 dBr point) at a level of −13.5 dBm, i.e. −10 dBm0. The control station (coast earth station) measures the level at the 4-wire test access point. This should be −10 dBm0 at 4-wire test access point E in Figure 2/M.1100.

The tolerance of the loss measurements shall be as specified in Recommendation M.580 [1].

### 6.3.2 *Measurement of loss/frequency response*

The loss/frequency characteristic should be measured and recorded at the following frequencies to check that the objectives contained in Table 1/M.1100 are met:

420, 1020, 2500, 2800, 3000 Hz.

The loss/frequency measurements are taken with the compandors disabled. The measurements to be carried out with the compandors in circuit are a subject for further study.

### 6.3.3 *Measurement of circuit noise*

The method of measurement of noise is not yet specified and is under study.

6.3.4 *Measurement of circuit stability*

This test should be performed on maritime satellite circuits which are 2-wire terminated at the ship earth station.

With the echo suppressor disabled and the 2-wire portion of the circuit unterminated (open circuit), a reference frequency is applied at a level −10 dBm0 to the test access point E in the transmit direction at the coast earth station. The level measured at the test access point E in the receive direction should not be more than −17 dBm0.

6.4 *Fault reporting procedures*

Fault report points (circuit) should be identified in accordance with Recommendation M.715 [4].

Fault report points (network) should be identified in accordance with Recommendation M.716 [5]. One such point is required for the maritime satellite system and in the INMARSAT system is assigned to the INMARSAT operations control centre (see Recommendation M.1110 for the responsibilities of the operations control centre). However, general international networking problems should in the first instance be referred to the fault report points (network) concerned.

Exchange of contact point information should be in accordance with Recommendation M.93 [6].

6.5 *Maintenance procedures*

Routine measurements on the maritime satellite circuits should be performed to confirm that the transmission parameter limits listed in Table 1/M.1100 continue to be maintained. These maintenance procedures are particularly important with respect to the coast earth station transmission performance.

The periodicity of the routine measurements is under study.

## 7 Test facilities at ship earth stations

7.1 *Automatic testing*

Maritime mobile units operating in marine environments would not in general have personnel with adequate expertise for testing and maintaining equipment connected to the international network. Therefore, remote automatic testing of a ship earth station would be possible by including automatic test equipment at the coast earth station and the ship earth station. The required facilities include quiet termination test line and loop around test line as given in Recommendation O.11 [7].

7.2 *Manual testing*

It should be possible to undertake manual testing of the transmission performance of ship earth stations. This type of test is essential when a ship earth station is being lined up after it has been repaired. It should be possible to initiate the test either from the coast earth station or from the ship earth station.

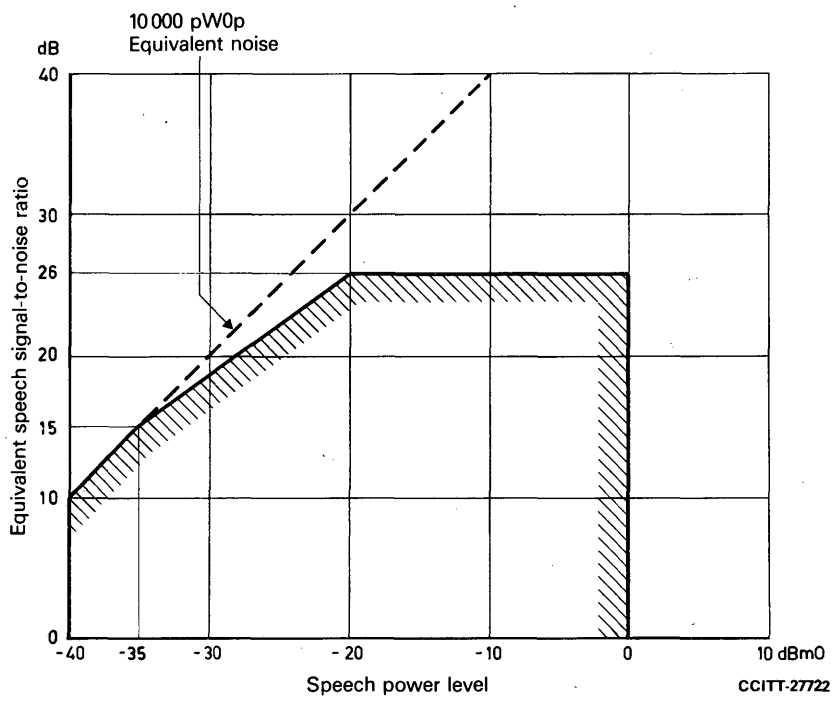
In order to meet these objectives, the ship earth station should, as a minimum, be equipped with a tone generator and level meter.

## ANNEX A

(to Recommendation M.1100)

### Signal-to-noise ratios of a maritime satellite circuit containing speech dependent devices

As a maritime satellite circuit may contain speech dependent devices (e.g. compandors), the customary specification of idle-circuit-noise is inadequate. The near-term and long-term "objectives" of required speech-signal-to-psophometrically-weighted-noise ratio as a function of mean speech power (dBm0, time-average while active), as proposed by Study Group XVI are shown in Figure A-1/M.1100. The maintenance limits and method of measurement are under study.




Dashed curve: long-term objective
Solid curve: near-term objective

*Note 1* — Below −40 dBm0 and above 0 dBm0 the characteristic is not specified.

*Note 2* — The near-term objective is given by the solid lines which relate subjectively equivalent speech signal-to-noise ratio, in dB (see the manual cited in [8]), to mean speech power (dBm0, time average while active).

The long-term objective is given by the dashed lines expressing the performance likewise in terms of equivalent signal-to-noise ratio. It is recognized that it might be difficult with the maritime mobile satellite facilities of today to comply with the long-term objective. When practicable, however, it is expected that the system(s) in the future will comply with this objective.

FIGURE A-1/M.1100

**Signal-to-noise ratios of a maritime satellite circuit containing speech dependent devices**

## References


[1] CCITT Recommendation *Setting up and lining up an international circuit for public telephony*, Vol. IV, Rec. M.580.

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

[3] CCITT Recommendation *Interconnection of a maritime mobile satellite system with the international automatic switched telephone service; transmission aspects*, Vol. III, Rec. G.473.

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

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

[6] CCITT Recommendation *Exchange of contact point information for the maintenance of international services and the international network*, Vol. IV, Rec. M.93.

[7] CCITT Recommendation *Maintenance access lines*, Vol. IV, Rec. O.11.

[8] CCITT Manual *Transmission planning of switched telephone networks*, Chapter III, Annex 4, ITU, Geneva, 1976.

**Recommendation M.1110**

## MAINTENANCE ORGANIZATION FOR THE MARITIME SATELLITE SERVICE

### 1 General

In order to ensure satisfactory interworking between the maritime satellite network and the international public-switched telephone network, it is necessary to define the interrelationship between the maintenance organization for the maritime satellite telephone service and the maintenance organization for the international automatic and semi-automatic telephone service as defined in the Series M.700 Recommendations. The general maintenance aspects of maritime satellite systems are contained in Recommendation M.1100.

### 2 Maintenance organization as applicable to INMARSAT

The maintenance responsibility within a maritime satellite network is divided among the ship earth station, the coast earth station, the network coordination station, and the operations control centre.

#### 2.1 *Ship earth station (SES)*

The ship earth station must be capable of communicating reliably with the coast earth station and may act as a sub-control station with responsibilities to the coast earth station (see Recommendation M.1100, § 6.1). As a sub-control station, it is responsible for reporting noticeable degradations in the maritime satellite circuits to the coast earth station and for reporting ship earth station problems to the manufacturer's or ship's maintenance agent.

#### 2.2 *Coast earth station (CES)*

The coast earth station provides communication functions and has the overall coordination responsibility between the ship earth station and the international public switched telephone network, and the responsibility of reporting problems to the network coordination station and the operations control centre as required. The maintenance functions of the coast earth station are further described in draft Recommendation M.1120.

#### 2.3 *Network coordination station (NCS)*

The network coordination station provides communication and maintenance functions within the maritime satellite system.

a) Communication functions such as:
   - transmitting the signalling channel to the ship earth stations;
   - assigning telephone channels on demand;
   - maintaining a list of busy ship earth stations.

b) Maintenance functions such as:
   - assisting in performing routine system tests;
   - monitoring the performance of coast earth stations;
   - monitoring, identifying and clearing of unauthorized transmissions.

#### 2.4 *Operations control centre (OCC)*

The operations control centre provides administrative, operational and maintenance functions within the maritime satellite network.

a) Administrative functions such as:
   - acting as the fault report point (network);
   - preparing, controlling and disseminating system information;
   - providing a focal point for ships (or their agents, etc.), Administrations or others.

b) Routine and normal operational tasks such as:

- liaising with the various space segment suppliers;
- scheduling and coordinating type approval and commissioning of ship earth stations;
- scheduling and coordinating the bringing into service of coast earth stations and network coordination stations;
- carrying out some limited monitoring of transmission parameters;
- analyzing traffic and performance data provided by network coordination stations and coast earth stations.

c) Emergency and/or corrective actions, including as required the issue of broadcast network advisory messages to ship earth stations, in case of:

- space segment failures;
- extended network coordination stations failures;
- failures of individual coast earth stations;
- incorrect operation of ship earth stations;
- interference in the network.

## 3 Cooperation between the general maintenance organization (Recommendation M.710 [1]) and the maritime satellite maintenance organization

Figure 1/M.1110 illustrates the interrelationship between the general maintenance organization and the maritime satellite maintenance organization (INMARSAT).

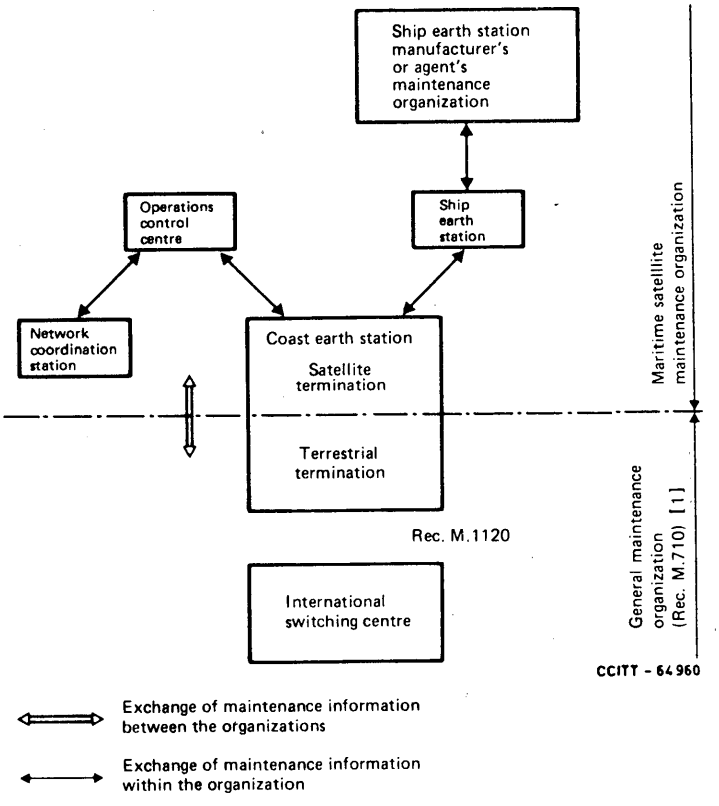



FIGURE 1/M.1110

**Interrelationship between the general maintenance organization (Recommendation M.710 [1]) and the maritime satellite maintenance organization (INMARSAT)**

The relationship between the coast earth station and the international switching centre is defined in Recommendation M.1120. The relationship between the elements within the maritime satellite maintenance organization is a matter for that organization.

Cooperation in the maintenance of the maritime satellite service should comprise the following elements in each organization, each of which represents a set of functions:

- fault report point (network) (see Recommendation M.716 [2]);
- network analysis point (see Recommendation M.720 [3]);
- system availability information point (see Recommendation M.721 [4]);
- network management (see Recommendation E.413 [5]);
- restoration control point (see Recommendation M.725 [6]).

**References**


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

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

[3] CCITT Recommendation *Network analysis point*, Vol. IV, Rec. M.720.

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

[5] CCITT Recommendation *International network management – Planning*, Vol. II, Rec. E.413.

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


**Recommendation M.1120**

## FUNCTIONS, MAINTENANCE RESPONSIBILITIES AND MAINTENANCE FACILITIES OF A COAST EARTH STATION FOR TELEPHONY SERVICES

### 1 General functions

A coast earth station will include the following basic functions:

- the provision of reliable communications with ship earth stations in the basic telephony modes (other services provided by maritime satellite networks are not addressed in this Recommendation);
- the provision of an interworking point between the international public switched telephone network signalling systems and the maritime satellite signalling system;
- the commissioning and testing of ship earth stations within the maritime satellite system as requested by the operations control centre (OCC). (See Recommendation M.1110.);
- the handling of safety and distress services;
- the maintenance of a list of ship earth stations authorized to have access to the system;
- the collection of data to assist managerial functions, e.g. accounting, traffic records.

### 2 Maintenance responsibilities

The general maintenance aspects of maritime satellite systems are contained in Recommendation M.1100.

2.1 *Coast earth station*

A coast earth station is responsible for the following functions defined in the Series M Recommendations:

- fault report point (circuit) (see Recommendation M.715 [1]);
- testing point (transmission) (see Recommendation M.717 [2]);
- testing point (line signalling) (see Recommendation M.718 [3]);
- testing point (switching and inter-register signalling) if applicable (see Recommendation M.719 [4]).

These responsibilities apply to both the maritime satellite system and the public switched telephone network.

2.2 *Circuit control and sub-control stations*

In all cases the control station responsibilities given in Recommendation M.723 [5] shall be assigned to a coast earth station for maritime satellite circuits. Although the ship earth station is a customer's installation, it may act as a sub-control station with responsibilities to the coast earth station (see Recommendation M.1100 § 6.1).

2.3 *Advice of ship earth station fault conditions*

A coast earth station shall be responsible for advising the appropriate maintenance point within the maritime satellite network of fault conditions suspected to be located at a ship earth station and which affect the Maritime Satellite Service.

## 3 Test facilities

3.1 *Access points*

Test access points shall be provided at a coast earth station, and should desirably include all those described in Recommendation M.1100, i.e. points C, D, E and G in Figure 1/M.1100.

3.2 *Test facilities for the maritime satellite circuit*

3.2.1 *Test equipment requirements*

Test equipment is required at a coast earth station to permit:

- tracing of faults in the coast earth station equipment;
- checking of transmission characteristics of maritime satellite circuits;
- testing of maritime signalling procedures;
- testing of channel assignment procedures.

In many cases the test equipment may be manually connected.

3.2.2 *Coast earth station test position* (see Figure 1/M.1100)

Each coast earth station shall contain a test position that can be used to originate test calls over the maritime satellite system to the maritime test terminal and to receive calls from the maritime test terminal. It should be equipped to perform the tests listed in § 3.2.1.

3.2.3 *Maritime test terminal (MTT)* (see Figure 1/M.1100)

It is a requirement that each coast earth station shall be provided with a maritime test terminal which includes similar facilities to a normal ship earth station. It may be used to originate test calls to, and to receive test calls from, the coast earth station test position via a maritime satellite circuit, as well as originating test calls into the terrestrial network. It should also be equipped to perform the tests listed in § 3.2.1.

3.2.4 *Automatic test facilities*

a) When a switch is included at the coast earth station, test lines as defined in Recommenda- tion O.11 [1] [6] should be provided at the coast earth station for access by ship earth station via maritime satellite circuits.

b) When a switch is not included at the coast earth station, test lines as defined in Recommendation O.11 [6] are desirable at the international switching centre to which a ship earth station may gain access.

3.3 *Test facilities for circuits to the international switching centre*

The test facilities should be provided in accordance with Series M and O Recommendations, and may be accessible from the international switching centre through the coast earth station test position.

## 4 Telecommunication facilities for maintenance purposes

For further study.

### References


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

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

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

[4] CCITT Recommendation *Testing point (switching and interregister signalling)*, Vol. IV, Rec. M.719.

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

[6] CCITT Recommendation *Maintenance access lines*, Vol. IV, Rec. O.11.


[1] Test lines as defined in Recommendation O.11 [6] may be limited to the quiet termination test line and the loop-around test line.

SECTION 9

# INTERNATIONAL PUBLIC TELEPHONE NETWORK MAINTENANCE

## 9.1 International public telephone network information

**Recommendation M.1220**

### NETWORK MAINTENANCE INFORMATION

1 Maintenance of the international network is fundamentally concerned with ensuring that the automatic and semi-automatic telephone network (transmission and switching equipment) is functioning in such a way that it may successfully provide a switched connection of good transmission quality whenever required. To achieve this objective it is important that network maintenance forces have access to relevant information that may assist in identifying network impairments and to direct corrective action. Such information goes beyond basic fault reporting and is indicated in Table 1/M.1220.

Some of the information indicated in Table 1/M.1220 is already exchanged between Administrations in accordance with other Recommendations, for example, see Recommendation E.149 [1]. An Administration wishing to make bilateral agreements to exchange all or some of the remaining items (from Table 1/M.1220), should designate the point in its Administration which is to receive such information.

2 This Recommendation considers the transfer and use of information from a maintenance standpoint. The purpose of transferring information is to assist maintenance elements in determining circuits and equipment that are not performing to specified standards.

3 The analysis and investigation of network problems require two types of information:

a) background information generally available within the Administration. In this case the intent is not to establish another information channel but to use data already exchanged between Administrations;

b) more detailed information relating to particular problems or conditions which should be exchanged between the appropriate maintenance elements as required (refer to Series M.700 Recommendations).

4 Typical background information [§ 3, a) above] is listed in Table 1/M.1220 and can be applied in maintenance activities as follows:

i) Fault report data:

- can identify faults which contribute to both transmission impairments and poor network utilization;
- can identify deficient network components and direct corrective action;
- can identify trends.

ii) National and international network call completion information, including the observation of real traffic as per Recommendation E.426 [2]:

- can be used for comparative purposes to identify abnormalities that may be caused by faults in the network.

iii) Routing data and changes thereto as per Recommendation E.149 [1]:

- can reduce the following results of misrouting of traffic due to invalid dialling:

  a) calls to fail;

  b) calls to be switched more than necessary;

  c) calls to contribute to congestion on improper routes;

  d) poor circuit utilization.

iv) Circuit order of selection. Selection of circuits not in the sequence agreed upon can cause:

- uneven distribution of traffic among the circuits involved;
- increased probability of simultaneous seizures which lead to initial call failure and subsequent re-attempts.

**5** The more detailed information can be obtained from real time tests, or from near real time reports from traffic monitoring equipment, and if required from off-line reports using historical data stored on magnetic tape. Any distribution of maintenance information should clearly indicate how and where the information was obtained, a full description of the data presented, and the period of time during which it was gathered.

**6** Experience has shown that the detailed investigation of particular problems is more efficiently handled by discussion and cooperation between the appropriate maintenance elements.

**7** Account will need to be taken of unique national or international events, e.g. earthquakes, which could influence international telephone traffic.

TABLE 1/M.1220

| Item | Typical information needed for network maintenance | Source |
|---|---|---|
| 1a | Fault report patterns [a] | Fault reports |
| 1b | Fault report trend data | Fault reports |
| 2a | National network call completion information or the results of observations carried out on real traffic. [b], [c], [d], [e], [f], [g] | Administration |
| 2b | International network call completion information including results by individual route where available or the results of observations carried out on real traffic. [c], [d], [e], [f], [g], [h], [i], [j] | Rec. E.426 [2] |
| 3a | Routing data | Rec. E.149 [1] |
| 3b | Routing data changes [k] | Rec. E.149 [1] |
| 4a | Circuit order of selection | Administration |
| 4b | Circuit order of selection changes | Administration |

[a] When individual subscribers and/or operator reports are compiled by common fault types, randomness often gives way to an obvious configuration (sometimes called a "pattern") to indicate the existence and nature of the network fault. The analysis for patterns may well be subdivided into originating, international and terminating network categories wherein the international domain includes both international switching centres. A network analysis point could use such information to identify suspected network components and make referrals or notifications to the appropriate maintenance forces for corrective actions.

[b] Information to reflect the national network call completion ratio, if available, would act as a reference with which to compare completion rates experienced from distant countries.

[c] Abnormal trends or conditions identified should be promptly brought to the attention of those who can take corrective actions.

[d] It should be stated whether the call completion information was obtained by sampling over a period or whether all calls over a period were taken into account. If sampling is used, the size of the sample and the total population of calls should be stated so that the statistical tolerances which should be assigned to the results may be determined. If all calls are taken into account, the total number of calls should be stated.

[e] The data collection period should be stated, e.g. weekday, busy period, 24 hours of a weekday or during a weekend, etc. This is useful in the assessment of the performance differences between business and social traffic.

[f] It should be stated whether the data has been subjected to any filtering process and if so, which process, e.g. code screening and/or number length validation.

[g] It should be stated whether the information was supplied from processors in an SPC switching unit and if so, the periods for which processors were not supplying this data due to overload, etc.

[h] It is desirable that information be taken from the outgoing side of the originating international switching centre. If it was not collected from this point, the location in the network from where the data was collected and what losses are included in the data should be stated. The overall use of this informtion is also under study in Study Group II.

[i] Depending on the location from where the data was collected, it should be stated either in terms of answer seizure ratio (if the data is collected from the outgoing side of the originating exchange) or answer bid from ratio if it is collected from any other point.

[j] The proportion of calls failed due to distant network congestion should be stated. This is particularly useful if it can be related to individual area codes. It is appreciated that the ability to classify calls failures is dependant on the signalling system used.

[k] Information on routing data changes should be exchanged as soon as it is identified.

**References**

[1] CCITT Recommendation *Presentation of routing data*, Vol. II, Rec. E.149.

[2] CCITT Recommendation *General guide to the percentage of effective attempts which should be observed for international telephone calls*, Vol. II, Rec. E.426.

## 9.2 Assessment of the international public telephone network performance

**Recommendation M.1230**

### ASSESSMENT OF THE PERFORMANCE OF THE INTERNATIONAL TELEPHONE NETWORK

### 1 General

The quality of the international automatic and semiautomatic telephone service (being studied by Study Group II) as experienced by customers, is of great importance to Administrations. The quality of service experienced by customers is determined by a number of factors, including some which are not the direct responsibility of maintenance personnel, for example:

- customer behaviour,
- planning and provision of the network and whether sufficient circuits and switching equipment exist to meet the call attempts made by customers,
- the degree to which network management is employed.

However, it is recognized that maintenance activities and the maintenance organization can have a considerable influence on the performance of the international telephone network and, therefore, on the quality of service experienced by customers. In view of this, the assessment of network performance is necessary for the efficient maintenance of the international telephone network.

From the point of view of maintenance, the assessment of international network performance involves a measurement of the capability of the overall network (i.e. international section plus two national sections) to establish a switched connection of good transmission quality whenever required. Such a connection may result from customer calls or test calls.

### 2 Methods of network performance assessment

To meet the needs of network maintenance, information on the performance of the international telephone network can be obtained from a number of sources, for example, from subscriber-to-subscriber test calls as detailed in Recommendation M.1235, but also from service quality observations as detailed in Recommendations E.420 [1][1], E.421 [2], E.422 [3] and E.423 [4], and from monitoring of live traffic.[2]

The nature of information obtained (for example verification of call completion rate, transmission quality, influence of international and national sections) will depend on the method of network performance assessment employed.

While there is a recognized need to continuously assess the performance of the international telephone network, the actual method by which this is achieved depends upon the arrangements within and between Administrations and on the switching technology employed. The choice of method is left to individual Administrations, to decide on the basis of their own particular circumstances.

**References**


[1] CCITT Recommendation *Checking the quality of the international telephone service*, Vol. II, Rec. E.420.

[2] CCITT Recommendation *Service quality observations*, Vol. II, Rec. E.421.

[3] CCITT Recommendation *Observations on outgoing telephone calls for Quality of Service*, Vol. II, Rec. E.422.

[4] CCITT Recommendation *Observations on traffic set up by operators*, Vol. II, Rec. E.423.


[1] Recommendation E.420 in its *general considerations* lists the main sources of information on Quality of Service as observed by the customer, and defines the principal methods for measuring Quality of Service. Annex A to this Recommendation illustrates an approach to integrating service quality observations into an overall problem-investigating process.

[2] Monitoring of live traffic is under study by Study Group II in connection with assessing the Quality of Service experienced by customers, and by Study Group IV for network maintenance purposes.

**Recommendation M.1235**

## USE OF AUTOMATICALLY GENERATED TEST CALLS FOR ASSESSMENT OF NETWORK PERFORMANCE

### 1 General

1.1 This Recommendation describes the use of automatic subscriber-to-subscriber test calls as one of the methods for assessing overall network performance [1]. It is intended as a basis for bilateral or multilateral agreements between Administrations interested in this method of investigating network performance.

1.2 In correspondence with the objectives of efficient maintenance methods as described in Recommendation M.730 [2] and, in particular, in line with the application of controlled maintenance methods as explained in § 4 of Recommendation M.730 [2], there is a recognized need to continuously assess network performance.

1.3 Considering the fact that an international call engages both national and international links, any method for assessing overall network performance should cover the entire chain of national and international links.

1.4 Modern switching and transmission systems may have built-in facilities for checking the overall network performance by means of test calls set up automatically from the exchange of origin to the exchange of destination of international calls. Similar facilities may be provided by independent test call generators having access to the switching multiple at the exchange of origin and making test calls to various test call responders in distant countries. Such test call responders may be connected to test numbers in various terminal exchanges in the distant country.

1.5 Automatic subscriber-to-subscriber test calls performed either by system-independent test call generators and test call responders, or by built-in facilities performing the same functions, can be applied in bilateral test call programmes involving the networks of two Administrations or regional programmes involving more than two Administrations. It is important that such programmes are well planned and not interfered with by the use of the same test number for other purposes as well.

1.6 In order to reflect the real network performance, test call programmes should be carried out both during non-busy and busy periods. The number of test calls to be generated on each selected route will depend on the frequency of difficulties encountered on the route and is independent of the traffic load carried on the route, or the size of the route. In other words, the higher the fault frequency, the fewer test calls will be required to arrive at statistically significant results. Considering that most of a test generator's occupation time is used for sending address information to its own national switching equipment, international links and national links in the distant country are only occupied for a very short time by a test call. The additional load created by test call generators on international traffic routes is therefore normally negligible even on very small routes.

1.7 It should be stressed that test call programmes of the type described here always necessitate an agreement between Administrations concerned.

### 2 Methods of assessment

2.1 *Distribution of test call facilities*

For practical purposes it is quite sufficient to generate, and observe, test calls from a few major traffic points in the originating country to a few major points in the distant country.

2.2 *Programming of test call traffic*

In order to avoid interference with other test calls, test call programmes should be carefully planned and agreed upon by the parties concerned. It might be advisable to prepare periodical test call programmes for bilateral exchange between Administrations. Test calls should, if possible, also be evenly distributed over a period of time including both non-busy and busy periods of traffic.

2.3 *Number of test calls*

The number of test calls to be generated to each selected destination is only dependent on the frequency of difficulties encountered and is independent of the traffic load carried to that destination. Fewer test calls are needed to identify the network performance level when the rate of difficulty encountered is high.

The number of test calls to be generated in a test call programme for a defined period of time can normally be divided between all destinations to be tested. It is recommended, however, that a certain proportion of the total test call production capacity be utilized for special fault investigations on certain indicated destinations.

2.4 *Result of test call programmes*

Network performance may be expressed as the ratio of successful to total test call attempts to a certain international destination during a period of time. The accuracy of the results of the test calls may be judged by ordinary statistical methods.

The definition of a successful or nonsuccessful call is, to some extent, dependent on the range of tests being interchanged between the test call generator and the responder. In general, the following criteria must be met by a successful test call:

i) the called party answers,

ii) acceptable general transmission quality,

iii) correct charging,

iv) correct disconnection of the call.

Furthermore, certain test facilities may be designed to carry out more stringent test programmes under the network performance concept.

The nonsuccessful calls should be specified with regard to the type of fault which occurred.

2.5 *Reports and exchange of information*

Administrations involved in test call programmes are urged to exchange test results regularly.

An unusually high number of network difficulties encountered in a test call programme should be treated as a fault report and be dealt with according to fault reporting procedures, without interrupting the test call programme.

It is recommended that the Administration making test calls should be responsible for the compilation of the results of those tests.

## 3 Equipment

As tone signals and other local conditions vary from one national network to another, test call generators and responders must be specifically designed for each international application. Furthermore, test call generators may be designed to interwork with responders in the distant country, which regenerate test calls back to the country of origin.

Until such time as Recommendations are available giving the specifications for test call generating and responding equipments, it is recommended that Administrations initiating test call programmes supply the responders required.

**References**

[1] CCITT Recommendation *Test calls*, Vol. II, Rec. E.424.

[2] CCITT Recommendation *Maintenance methods*, Vol. IV, Rec. M.730.

SECTION 10

# INTERNATIONAL DATA TRANSMISSION SYSTEMS

## Recommendation M.1300

### INTERNATIONAL DATA TRANSMISSION SYSTEMS OPERATING AT 2400 bit/s AND ABOVE

### 1 General description

1.1 Figure 1/M.1300 illustrates the composition of an international data transmission system and the nomenclature used.

International data transmission systems may operate at the following typical bit rates: 2.4, 4.8, 7.2, 9.6, 14.4, 48, 50, 56, 64, 128, 192, 256, 384, 768 kbit/s and above.

Several independent data transmission channels may be multiplexed together to form a transmission system operating at an aggregate bit rate of, for example, 9.6, 56, 1544, 2048 kbit/s and above (see Figure 2/M.1300).

Other bit rates or ranges of bit rates are the subject of further study and may be addressed in other M.1300-Series Recommendations and/or Recommendation M.1300.

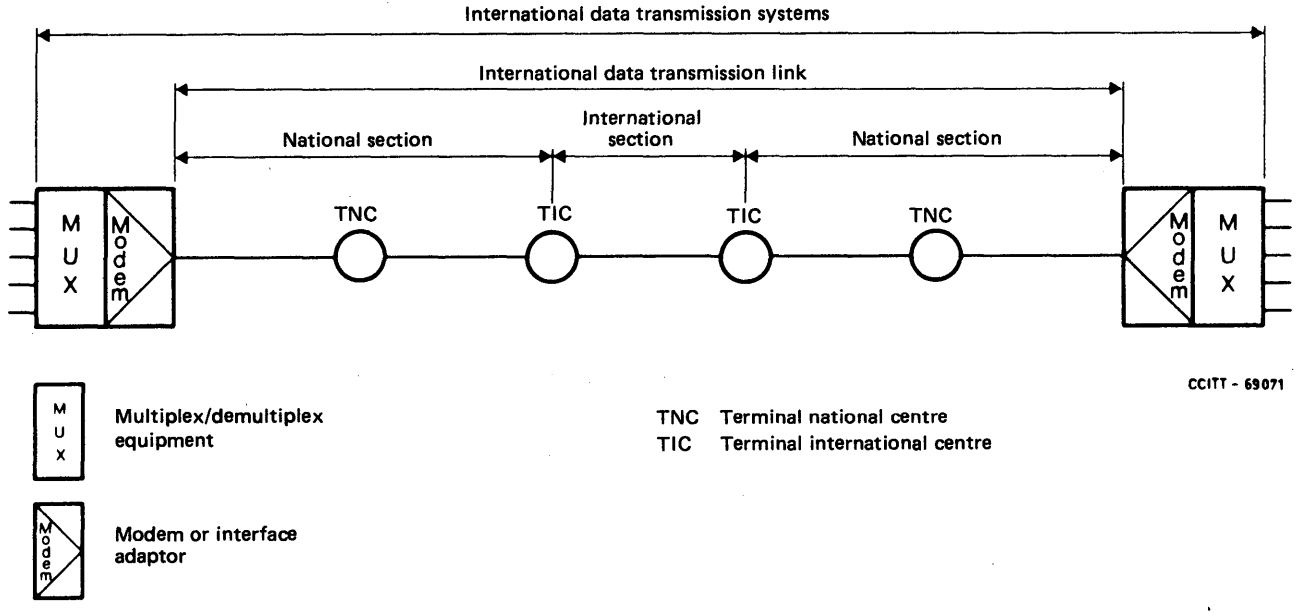



FIGURE 1/M.1300

**Basic configuration of an international data transmission system**

1.2 International data transmission links can be provided on a variety of transmission media in various combinations:

- local line plant;
- FDM carrier systems operating at a basic group band of 60-108 kHz (e.g. symmetric pair or coaxial cables, microwave radio links, satellites);
- voice grade analogue or digital channels;
- digital links (coaxial or optical fibre systems, microwave radio links, satellite systems).

Appropriate modems or interface adapters are used to provide signals suitable to the transmission medium being used.

1.3 For data transmission links routed via a mixture of transmission media (for example, analogue, digital, satellite single-channel-per-carrier), the term "circuit section" is used to refer to a section of the overall link routed wholly on one type of transmission medium.

1.4 International data transmission systems can be established between Administrations to provide channels for various services. Figure 2/M.1300 illustrates an example of an international 56 kbit/s data transmission system used for such purposes.

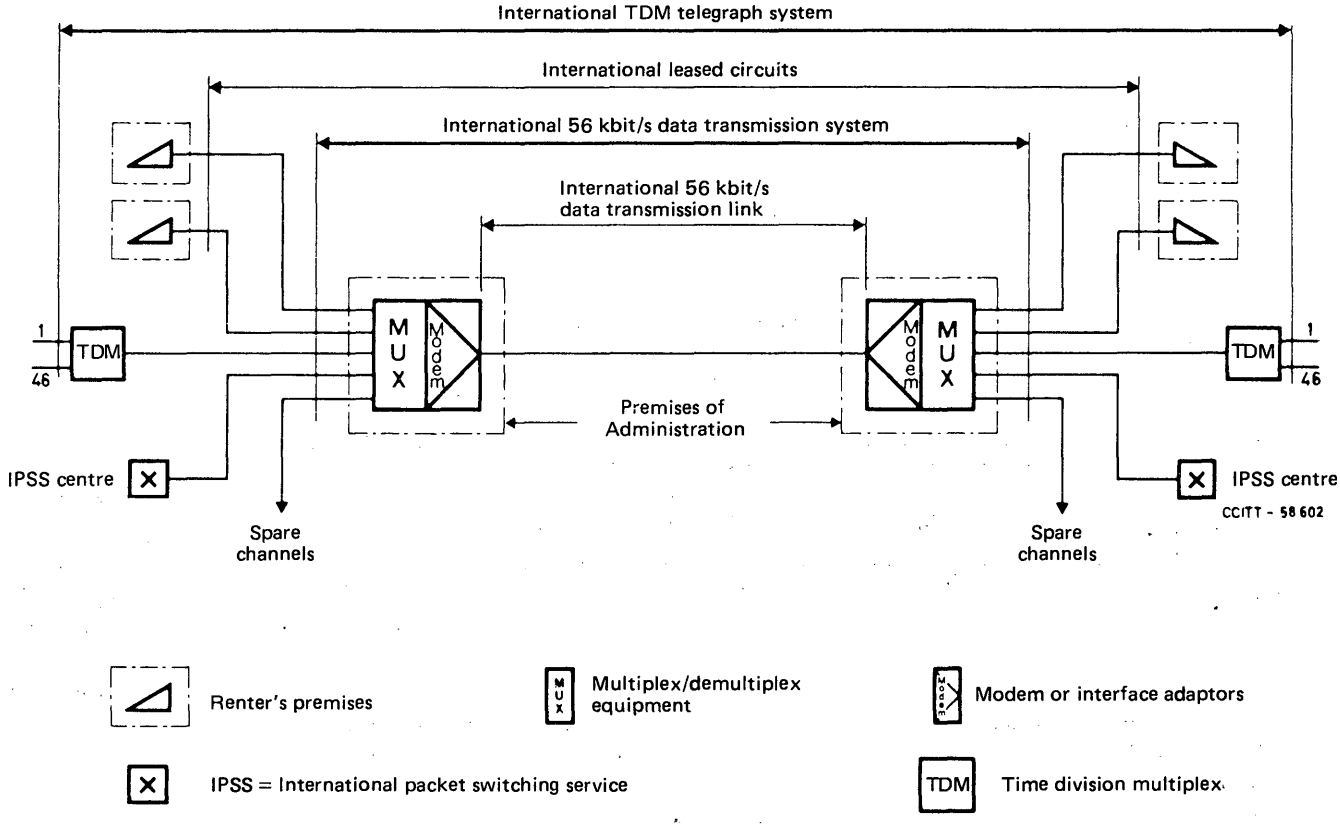



FIGURE 2/M.1300

**An example of an international 56 kbit/s data transmission system between two Administrations**

## 2 Data transmission link control and sub-control stations

2.1 One control station for each data transmission link should be agreed bilaterally between the Administrations involved prior to setting up the link. Principles concerning the definition, responsibilities, functions and appointment of control stations may be found in Recommendation M.1012.

2.2 One sub-control station for each data transmission link should be agreed bilaterally between Administrations involved prior to setting up the link. Principles concerning the definition, responsibilities, functions and appointment of sub-control stations may be found in Recommendation M.1013.

## 3 Reserve arrangements

3.1 Since data transmission links of this nature often carry private leased data systems and/or TDM telegraph systems, some Administrations find it useful to provide a nominated reserve link for restoration purposes in the event of failure of the normal link. This should be decided by bilateral agreement between Administrations at the time of setting up the link. Such reserve links must be lined up to meet the requirements of the normal data transmission link.

3.2 Wherever possible, such reserve links should follow a different route from the route of the normal link.

## 4 Designations

4.1 The form of designation for the data transmission system and the data transmission link and its nominated reserve may be found in Recommendation M.140, § 11 [1].

4.2 Where the situation illustrated in Figure 2/M.1300 applies, the numbering scheme for derived channels should be in accordance with Recommendation M.1320[1)].

## 5 Line-up and maintenance of data transmission systems and links operating in the range 48 kbit/s and above

5.1 For guidance on the setting up and lining up of the higher speed international data transmission systems and links operating within this range, reference should be made to Recommendation M.1370.

5.2 For the maintenance methods, procedures and limits that apply to such data transmission systems and links, reference should be made to Recommendation M.1375.

## 6 Line-up and maintenance of data transmission systems and links operating in the range 2.4 kbit/s to 14.4 kbit/s[2)]

6.1 For guidance on the setting up and lining up of international data transmission systems and links operating within this range, refer to Recommendation M.1350.

6.2 For the maintenance methods, procedures and limits that apply to such data transmission systems and links, refer to Recommendation M.1355.

### Reference

[1] CCITT Recommendation *Designation of international circuits, groups, group and line links, digital blocks, digital paths, data transmission systems and related information*, Vol. IV, Rec. M.140.

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1) Recommendation M.1320 is currently limited to data transmission of systems operating up to 9.6 kbit/s. Further study is required to derive a suitable numbering scheme for data transmission systems operating at 14.4 kbit/s and above.

2) Data transmission systems operating at 19.2 kbit/s requires further study.

## NUMBERING OF CHANNELS IN DATA TRANSMISSION SYSTEMS

Using suitable modems and multiplexers it is possible to provide for a combination of data channels multiplexed together to form an aggregate bit rate for transmission purposes.

The principle shown in Annex A and Figure 1/M.1320 may be applied to higher bit rates as modems, etc., are developed and deployed.

The numbering of data channels is obtained by indicating the multiplex channel followed by the sub-channel data rate assigned number in accordance with the scheme contained in Table A-1/M.1320.

As an example, Figure 1/M.1320 shows a data transmission system, London-Montreal 96H001, employing equipment providing for 2 channels at 2400 bit/s and one channel at 4800 bit/s forming an aggregate bit rate of 9600 bit/s.

For this system the channel numbering would be:

London-Montreal 96H001/A2

London-Montreal 96H001/B1

London-Montreal 96H001/C1

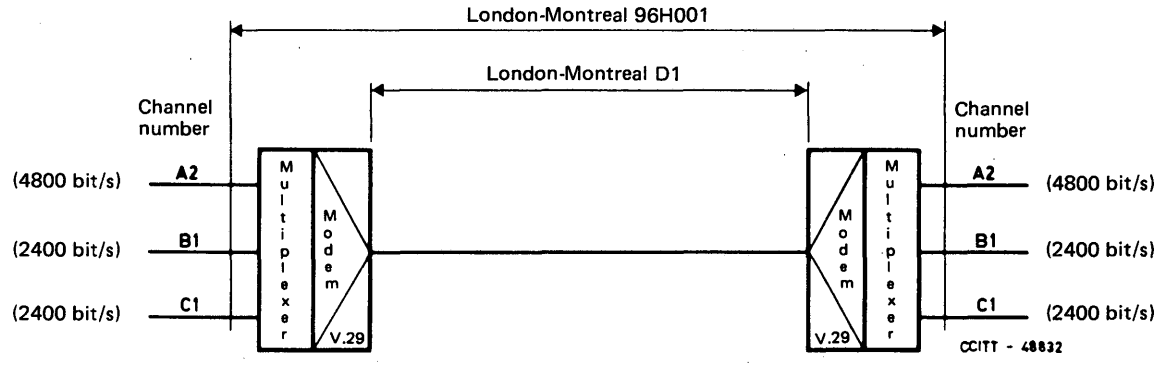



FIGURE 1/M.1320

**Example of the channel numbering scheme for data transmission systems**

ANNEX A

(to Recommendation M.1320)

Table A-1/M.1320 shows the channel numbering scheme for data transmission systems operated at an aggregate data rate of 9600 bit/s. The table also shows the channel numbering scheme for systems using 9600 bit/s modems operated at reduced data rates of 7200 bit/s or 4800 bit/s.

TABLE A-1/M.1320

**Channel numbering scheme for data transmission systems using 9600 bit/s data modems conforming to Recommendation V.29 [1]**

| Sub-channel data rate | Assigned number |
|---|---|
| 9600 | 4 |
| 7200 | 3 |
| 4800 | 2 |
| 2400 | 1 |

| Aggregate data rate | Multiplex configuration | Sub-channel data rate | Multiplex channel | Channel number |
|---|---|---|---|---|
| 9600 bit/s | 1 | 9600 | A | A4 |
| | 2 | 7200<br>2400 | A<br>B | A3<br>B1 |
| | 3 | 4800<br>4800 | A<br>B | A2<br>B2 |
| | 4 | 4800<br>2400<br>2400 | A<br>B<br>C | A2<br>B1<br>C1 |
| | 5 | 2400<br>2400<br>2400<br>2400 | A<br>B<br>C<br>D | A1<br>B1<br>C1<br>D1 |
| 7200 bit/s | 6 | 7200 | A | A3 |
| | 7 | 4800<br>2400 | A<br>B | A2<br>B1 |
| | 8 | 2400<br>2400<br>2400 | A<br>B<br>C | A1<br>B1<br>C1 |
| 4800 bit/s | 9 | 4800 | A | A2 |
| | 10 | 2400<br>2400 | A<br>B | A1<br>B1 |

**Reference**

[1] CCITT Recommendation *9600 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits*, Vol. VIII, Rec. V.29.

# SETTING UP, LINING UP AND CHARACTERISTICS OF INTERNATIONAL DATA TRANSMISSION SYSTEMS OPERATING IN THE RANGE 2.4 kbit/s TO 14.4 kbit/s

## 1 General

This Recommendation deals with the setting up, lining up and characteristics of international data transmission systems operating at speeds in the range 2.4 to 14.4 kbit/s. The system may be a single connection operating at 2.4, 4.8, 7.2, 9.6 or 14.4 kbit/s, or a combination of the lower speed systems, multiplexed onto the 9.6 or 14.4 kbit/s system.

These systems may be carried on data links comprised of voice grade circuits (either analogue or digital), or multiplexed onto higher bit rate data transmission systems as described in Recommendation M.1300.

The system may terminate at terminal international centres, terminal national centres or, when multiplexing is employed to derive several channels, a combination of several termination configurations may be provided. See Figure 1/M.1300 and Figure 2/M.1300 for further information.

When an international data transmission system is assigned its designation (according to Recommendation M.140, §§ 3.2.15 and 11 [1]), the Administration with control station responsibility will assemble the necessary technical and operational information. This should be entered into the list of Related Information (as defined in Recommendation M.140, § 12 [1]) which consists of the items shown in Annex A to this Recommendation.

## 2 Characteristics of data links

### 2.1 *Analogue data links*

The transmission characteristics of analogue circuits to be used as data links are based upon Recommendation M.1020 where these links utilize modems without in-built equalizers. Alternatively, the relaxed loss/frequency and group-delay distortion limits specified in Recommendation M.1025 may be applied for those systems utilizing modems with built-in equalizers where agreed between the Administrations involved and if tests confirm suitability.

### 2.2 *Digital data links*

Where the data systems are multiplexed onto higher bit rate data transmission systems, the data link is set up in accordance with the requirements of the higher bit rate system, see Recommendation M.1370.

## 3 Setting up and lining up the data transmission system

### 3.1 *Setting up and testing an analogue data link*

The analogue data link is set up and tested in accordance with the principles and procedures detailed in Recommendation M.1050. In this regard the data link is to be considered as a special circuit.

Suitable adjustments may be made to the procedures stated in Recommendation M.1050 where the system terminates in terminal international centres or terminal national centres, rather than in renters premises.

3.2 *Setting up and testing a digital data link*

(Under study).

3.3 *Overall system tests*

3.3.1 When the various sections have been set up and lined up and interconnected using any necessary equipment to form an end-to-end system, overall system data tests shall be made. The objectives for these tests are as shown in Table 1/M.1350.

TABLE 1/M.1350

| Data rate bit/s | Error ratio | Error in 15 min | % error-free seconds |
|---|---|---|---|
| 2 400 | $1 \times 10^{-5}$ | 22 | Better than 92% |
| 4 800 | $1 \times 10^{-5}$ | 43 | Better than 92% |
| 7 200 | $1 \times 10^{-5}$ | 65 | Better than 92% |
| 9 600 | $1 \times 10^{-5}$ | 86 | Better than 92% |
| 14 400 | (under study) | (under study) | (under study) |

3.3.2 Where agreed between Administrations involved, or when end-to-end tests indicate less than satisfactory performance, sectionalizing tests may be performed (see Recommendation M.1355, § 3.5).

3.3.3 Bit error ratio and/or error free seconds tests are to be performed utilizing a 511 bit pseudorandom test pattern as described in Recommendation V.52 [2]. Alternatively, other patterns such as the 2047 bit pseudorandom pattern may be used when agreed between Administrations.

## 4 Recording of results

All measurement results are to be recorded for later reference during maintenance measurements.

## 5 Limits for bit error ratio and error free seconds

Provisional limits for bit error ratio and error free seconds are given in Table 1/M.1350. These limits are subject to further study. For further information see Recommendation G.821 [3].

## 6 Allocation of overall objectives

The allocation of the error performance objectives indicated in Table 1/M.1350 for the end-to-end system is under study.

ANNEX A

(to Recommendation M.1350)

**Designation information on international data transmission systems**

A.1 *Designation*

The designation is according to Recommendation M.140 [1], § 11 (for use between Administrations) or § 3.2.15 (for private use).

A.2 *Related information*

RI 1. Urgency for restoration;
RI 2. Terminal countries;
RI 3. Administrations', carriers' or broadcasting companies' names;
RI 4. Control and sub-control station(s);
RI 5. Fault report points;
RI 6. Routing;
RI 7. Association;
RI 8. Equipment information;
RI 9. Use;
RI 10. Transmission medium information;
RI 11. Composition of transmission;
RI 12. (Empty item, use: "–;");
RI 13. Occupancy.

The various items will be dealt with in § 12 of Recommendation M.140 [1].

**References**


[1] CCITT Recommendation *Designation of international circuits, groups and line links, digital blocks, digital paths, data transmission systems and related information*, Vol. IV, Rec. M.140.

[2] CCITT Recommendation *Characteristics of distortion and error-rate measuring apparatus for data transmission*, Vol. VIII, Rec. V.52.

[3] CCITT Recommendation *Error performance on an international digital connection forming part of an integrated services digital network*, Vol. III, Rec. G.821.


**Recommendation M.1355**

**MAINTENANCE OF INTERNATIONAL DATA TRANSMISSION SYSTEMS OPERATING IN THE RANGE 2.4 TO 14.4 kbit/s**

## 1 General

1.1 This Recommendation deals with maintenance procedures applicable to international data systems in the range 2.4 to 14.4 kbit/s.

1.2 The constituent parts of the data system are shown in Figures 1/M.1300 and 2/M.1300.

1.3 In some instances it may be necessary to provide modems at a centre, for testing purposes only, to achieve adequate performance in fault localization.

## 2 Fault reporting procedures

2.1 As far as possible, the provisions of Recommendations M.1012, M.1013 and M.1014 apply. Any additional special procedures must be devised by the Administrations concerned.

## 3 Fault localization

3.1 Upon receipt of a complaint about the performance of an international data transmission system the control or sub-control station should obtain specific assurance that all terminal equipment has been tested and is working correctly.

3.2 The control station should first ensure that all major systems are performing normally, then efforts should be made to localize and clear the fault.

3.3 It is essential that the control and sub-control stations inform each other of all relevant information and significant actions taken which may assist their efforts.

3.4 Control and sub-control stations should arrange that a suitable test pattern is transmitted in each direction. Then, if the fault is not cleared, suitable modems and test equipment can be applied at intermediate points as appropriate in order to isolate the fault to a particular section.

3.5 To localize the fault, the data transmission system should normally be tested in sections so that the need for international cooperation is reduced and rapid progress is made. In some instances loops may be utilized in order to isolate the faulty section. Care must be taken to avoid the simultaneous operation of loops if the system configuration is such that erroneous results would occur.

3.6 The purpose of the initial fault localization process is to identify as quickly as possible whether the fault lies in one of the national sections or the international section. This allows the Administrations to begin the detailed investigation necessary to clear the fault.

3.7 See Figure 1/M.1375 for a guide to fault localization.

## 4 Overall data system check

4.1 When the fault has been localized to the international or a national section and cleared, that section should be tested to ensure that its bit error ratio meets the requirements of § 5 below.

4.2 The overall data transmission system should also meet the requirements of § 5, and the data transmission performance should be tested before the system is offered back to the renter.

## 5 Maintenance parameters

5.1 Maintenance measurements should normally be evaluated by comparison with those made during the line-up of the system and with the specified limits given in Recommendation M.1350.

5.2 For data transmission performance, it will normally be sufficient to check the bit error ratio over 15 minutes. Alternatively, error free seconds may be used as a measure of performance, where agreed between Administrations concerned. The maintenance standards are given in Table 1/M.1350.

# Recommendation M.1370

## SETTING UP AND LINING UP OF INTERNATIONAL DATA TRANSMISSION SYSTEMS OPERATING AT 48 kbit/s AND ABOVE

## 1 Scope

1.1 This Recommendation deals with the setting up and lining up of international data transmission systems operating at 48 kbit/s and above as described in Recommendation M.1300.

## 2 General setting-up and lining-up procedures

2.1 The procedure described in this Recommendation follow the general setting-up and lining-up principles adopted by Study Group IV throughout the Series M Recommendations.

2.2 Associated equipment should be correctly set up. Individual circuit sections (for definition, see § 1.3 of Recommendation M.1300) should be lined up as separate entities in accordance with the Recommendations and procedures appropriate to the transmission medium involved.

2.3 Where a circuit section exists wholly within the territory of a single Administration, national practices may be used for lining up that circuit section providing the requirements for data transmission performance of the complete national section are met.

2.4 The individual circuit sections, should be lined up and interconnected to form the national or international section. This section should then be lined up overall and checked for data transmission performance. When the international and national sections have been checked and found to be satisfactory they should then be interconnected to form the overall system and end-to-end data performance tests made.

2.5 When an international data transmission system is assigned its designation (according to Recommendation M.140, §§ 3.2.15 and 11 [1]), the Administration with control station responsibility will assemble the necessary technical and operational information. This should be entered into the list of Related Information (as defined in Recommendation M.140, § 12 [1]) which consists of the items shown in Annex A to this Recommendation.

## 3 Line-up procedures

### 3.1 *Links that involve an international single-channel-per-carrier (SCPC) satellite section*

3.1.1 The line-up of such links can only be performed on a circuit section-by-circuit section basis as described in §§ 2.2 to 2.4 above.

3.1.2 The single-channel-per-carrier section is lined up in accordance with the procedures provided by the Satellite System Operations Guide (SSOG) [2].

3.1.3 When dealing with circuit sections carried by satellite it should be borne in mind that some Administrations use one polarity for transmission whilst others use the opposite polarity. For this reason associated test equipments normally have a normal/inverted polarity switch. It is necessary to establish the polarity convention being used and to set the test equipment accordingly.

### 3.2 *Links that include an international group band section*

3.2.1 Where the international data transmission link consists entirely of a single basic group band link, the procedures and limits given in Recommendation M.910 should be used. However, it should be noted that the terminology used in that Recommendation applies to international leased group links, and may not necessarily apply to international data transmission links.

3.2.2 Where the international data transmission link involves a frontier crossing basic group band link together with other types of transmission media, the line-up should be performed on a circuit section-by-circuit section basis, as described in §§ 2.2 to 2.4 above.

3.2.2.1 The frontier crossing basic group band link should be lined up in accordance with the procedures in Recommendation M.910, §§ 1.2 and 1.3 and using the limits for the overall link given in §§ 1.5 to 1.11 of that Recommendation.

3.2.2.2 Remaining circuit sections may be lined up in accordance with national practices, providing the requirements for data transmission performance are met.

### 3.3 *Links that include an international digital section*

3.3.1 Digital circuit sections should normally be set up and tested in accordance with procedures and performance requirements given in Recommendation M.555 [3].

3.3.2 If the digital circuit section exists wholly within the territory of a single Administration then the national practices of that Administration may be used.

## 4 Data tests

4.1 Once the various circuit sections have been set up, lined up and interconnected using any necessary equipment (e.g. modems, transmultiplexers) to form the overall link, the data transmission performance of the two national sections and the international section should be separately measured and recorded. It should be noted that for sections routed entirely at basic group band it will be necessary to provide interception facilities and dedicated modems in order to perform the data tests described.

4.2 The tests and measurements should be made using an appropriate pseudorandom bit pattern. The bit patterns currently in use or proposed are:

4.2.1 511 bits specified in Recommendation V.52 [4];

2047 bits specified in Recommendation V.57 [5];

1 048 575 bits specified in Recommendations V.35 [6] and V.57 [5].

The actual pseudorandom bit pattern to be used should be agreed between the Administrations involved.

4.2.2 Other tests may be performed by bilateral agreement.

4.2.3 As an alternative to bit error ratio (BER) tests some Administrations prefer the use of error free seconds to measure data link performance. Suitable test equipment is required in order to utilize this parameter.

Administrations may use this parameter by bilateral agreement.

Care should be taken to ensure that test equipment methods and parameters are compatible at each end of the link such that the measured results would be identical if either equipment was used.

4.3 *Measurements on national and international sections*

4.3.1 Data test measurements should be made on the separate national and international sections and in both directions of transmission to ensure that each section meets the specified performance standards. A test period of one hour for each section is desirable.

*Note* – Data test results are possibly affected by the traffic load of the routes in question and where practicable, Administrations may wish to take this into account when scheduling data tests.

4.3.2 Measurements of national sections should be made between the link access points at the customer's premises and the line access points at the terminal international centre (TIC). Additionally measurements may be made by providing a circuit loopback at either the customer's premises or at the TIC. This will allow checks around the loop from either location as convenient.

When an international section includes a satellite link then it may be possible to perform RF loopback measurements, including the up/down link of the satellite, if such measurements are allowed by the satellite transponder configuration, i.e., if the earth station can monitor its own transmission. Such loopback measurements made from the customer premises, the TIC or from the earth station should be kept for reference purposes.

Loopback measurements must be additional to unidirectional measurements and should not be substituted for, or compared directly with, the end-to-end measurements.

4.3.3 The test access arrangements should be such that no part of the link is excluded from the test.

4.3.4 The exact point of access to the link for the tests will depend on the particular terminating equipment used on each section.

4.3.5 For the international section, measurements are made between the terminal international centres (TIC).

4.3.6 For the case of a satellite single-channel-per-carrier (SCPC) section in which the SCPC modems provide forward error correction (FEC), line-up and maintenance measurements should normally be carried out with the FEC facility switched out. This will ensure that the section meets basic requirements without protection and that the FEC facility is not masking transmission impairments.

4.3.7 It may be necessary to switch in the FEC facility to meet the international section and the end-to-end limits specified in Tables 1/M.1370 to 4/M.1370, but during initial line-up, it is desirable to obtain a measure of data transmission performance with the FEC facility switched both in and out. However, due to modem design, it may not always be possible to obtain measurements with the FEC facility disabled. In other cases it may be necessary to artificially degrade the link to obtain a measure of the difference in link performance with the FEC facility switched in and out. Measurements and measurement methods should be retained as benchmarks for subsequent comparisons with results obtained during maintenance.

4.3.8 The limits that apply to the section measurements are given in the Tables 1/M.1370 and 2/M.1370.

TABLE 1/M.1370

**Limits for bit error ratio on national or international sections of international 48-64 kbit/s data transmission links** [a]

| Data rate (kbit/s) | Each national section | | International section | |
|---|---|---|---|---|
| | Bit error ratio | Permitted number of errors in 15 min | Bit error ratio | Permitted number of errors in 15 min |
| 48 | $1 \times 10^{-6}$ | 43 | $1 \times 10^{-7}$ | 4 |
| 50 | $1 \times 10^{-6}$ | 45 | $1 \times 10^{-7}$ | 4 |
| 56 | $1 \times 10^{-6}$ | 50 | $1 \times 10^{-7}$ | 5 |
| 64 | $1 \times 10^{-6}$ | 58 | $1 \times 10^{-7}$ | 6 |

[a] The performance limits for data transmission systems operating at bit rates above 64 kbit/s require further study.

*Note* – See Note to Table 4/M.1370.

TABLE 2/M.1370

**Limits for error free seconds (EFS) on national or international sections of international 48-64 kbit/s data transmission links** [a]

| Performance classification | Errors in 1 second | Permitted percentage of measurement time | Permitted number of seconds in measurements time of one hour |
|---|---|---|---|
| Errored seconds | > 0 | Less than 8% | < 288 |
| Error-free seconds | 0 | More than 92% | > 3312 |

[a] The performance limits for data transmission systems operating at bit rates above 64 kbit/s require further study.

*Note* – See Note to Table 4/M.1370.

4.4 *End-to-end system tests*

4.4.1 Following the satisfactory testing of the national and international sections an end-to-end performance test between renter's premises should be made. It is essential that the operational conditions for the tests are the same as when the circuit is in service.

4.4.2 The test pattern should be applied simultaneously at both of the renter's premises and measured at the opposite ends. A minimum test period of 24 hours should be the objective.

4.4.3 The bit error ratio (BER) limits to be achieved are given in Table 3/M.1370. The error free second (EFS) limits are given in Table 4/M.1370.

TABLE 3/M.1370

**End-to-end bit error ratio limits for the system** [a]

| Data rate (kbit/s) | Error ratio | Errors in 15 min |
|---|---|---|
| 48 | $2.1 \times 10^{-6}$ | 90 |
| 50 | $2.1 \times 10^{-6}$ | 95 |
| 56 | $2.1 \times 10^{-6}$ | 105 |
| 64 | $2.2 \times 10^{-6}$ | 122 |

[a] The performance limits for data transmission systems operating at bit rates above 64 kbit/s require further study.

*Note* – See Note to Table 4/M.1370.

4.4.4 It should be the objective that all 15 minute periods of the tests meet the required bit error ratio limit. The circuit control station and sub-control station should together consider the results of the performance tests to decide if the circuit is acceptable for service. Thus, one or two 15 minute periods not meeting the standard may not preclude the circuit from being put into service whereas a regular pattern of 15 minute periods only just meeting the standard may indicate a need for investigation. If such is the case, the additional parameters listed in § 5.1 may offer some assistance.

4.4.5 The end-to-end error performance objectives for a measuring period of 24 hours are shown in Table 4/M.1370. These objectives are based on those defined in Recommendation G.821, § 2 [7].

TABLE 4/M.1370

**System end-to-end error performance objectives for EFS measurements** [a]

| Performance classification | Errors in 1 second | Permitted percentage of measurement time (24 hours) | Permitted number of seconds in measurements time of 24 hours |
|---|---|---|---|
| Errored seconds | > 0 | Less than 8% | 6 912 |
| Error free seconds | 0 | More than 92% | 79 488 |

[a] The performance objectives for data transmission systems operating at bit rates above 64 kbit/s require further study.

*Note* – The limits presented in the tables for error-free seconds (EFS) are based on those given in Recommendation G.821 [7] and those for bit error ratio (BER) on the experience of Administrations. These limits are provisional and are subject for further study.

## 5 Measurements of other parameters

5.1 If after applying the procedures described or identified in §§ 2 to 4 the appropriate bit error ratio or error free seconds limits cannot be met, then measurement of the additional parameters, clock frequency, clock slip, short interruptions in transmission and buffer overflow, may offer some indications as to why the limits are not met and to what action should be taken.

## ANNEX A

(to Recommendation M.1370)

### Designation information on international data transmission systems

A.1 *Designation*

The designation is according to Recommendation M.140 [1], § 11 (for use between Administrations) or § 3.2.15 (for private use).

A.2 *Related information*

RI 1. Urgency for restoration;
RI 2. Terminal countries;
RI 3. Administrations', carriers' or broadcasting companies' names;
RI 4. Control and sub-control station(s);
RI 5. Fault report points;
RI 6. Routing;
RI 7. Association;
RI 8. Equipment information;
RI 9. Use;
RI 10. Transmission medium information;
RI 11. Composition of transmission;
RI 12. (Empty item, use: "–;");
RI 13. Occupancy.

The various items will be dealt with in § 12 of Recommendation M.140 [1].

### References


[1] CCITT Recommendation *Designation of international circuits, groups and line links, digital blocks, digital paths, data transmission systems and related information*, Vol. IV, Rec. M.140.

[2] Intelsat Satellite Systems Operations Guide (INTELSAT-SSOG).

[3] CCITT Recommendation *Bringing international digital blocks, paths and sections into service*, Vol. IV, Rec. M.555.

[4] CCITT Recommendation *Characteristics of distortion and error-rate measuring apparatus for data transmission*, Vol. VIII, Rec. V.52.

[5] CCITT Recommendation *Comprehensive data test set for high data signalling rates*, Vol. VIII, Rec. V.57.

[6] CCITT Recommendation *Data transmission at 48 kbit/s using 60-108 kHz group band circuits*, Vol. VIII, Rec. V.35.

[7] CCITT Recommendation *Error performance on an international digital connection forming part of an integrated services digital network*, Vol. III, Rec. G.821.

# MAINTENANCE OF INTERNATIONAL DATA TRANSMISSION SYSTEMS OPERATING AT 48 kbit/s AND ABOVE

## 1 General

1.1 This Recommendation describes the maintenance procedures to be applied to international data transmission systems having aggregate bit rates of 48 kbit/s and above.

1.2 The constituent parts of some typical systems are shown in Figures 1/M.1300 and 2/M.1300.

1.3 For some link configurations, it may be necessary to provide modems at centres for fault location and testing purposes only.

## 2 Fault reporting procedures

2.1 As far as possible, the provisions of Recommendations M.1012, M.1013 and M.130 [1] apply. Any additional special procedures must be devised by the parties concerned.

## 3 Fault localization

3.1 Upon receipt of a complaint about the performance of an international data transmission system the control or sub-control station should obtain specific assurance that all terminal equipment has been tested and is working correctly.

3.2 Unless the control station is already aware of some condition which may be affecting the working of the international data transmission system such as a major system failure or local failures involving the link, then efforts should be made to localize and clear the fault.

3.3 It is essential that during the localization and clearance of a fault, the control and sub-control stations inform each other of all relevant information and of significant actions taken which may assist their efforts.

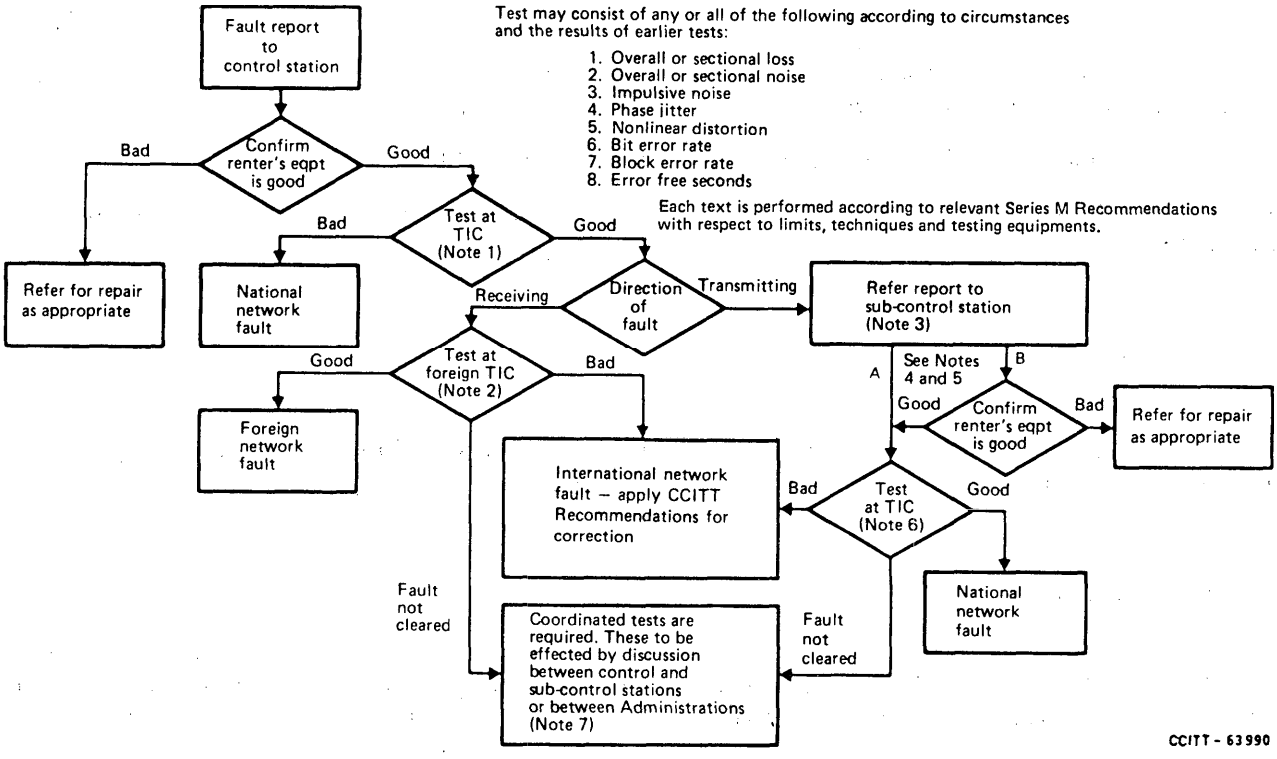
3.4 The purpose of the initial fault localization process is to identify as quickly as possible whether the fault lies in either of the national sections or the international section. The suggested sequence is shown in diagramatic form in Figure 1/M.1375. This sequence is expected to minimize the time required to locate the faulty section.

3.5 The appropriate control/sub-control stations should arrange for each national section to be tested between the terminal international centre (TIC) and the access points at the renter's premises.

3.6 A data transmission performance test may be made by utilizing a loopback at the interface with the renter's terminal equipment or by testing from the renter's premises via a loopback at the TIC where such a loopback facility is available. It should be borne in mind when considering the results of such tests that the line-up and maintenance limits are for a single direction of transmission only, so that no direct comparison with recorded values will be possible, except where loopback measurements were made and recorded during line-up. (See Recommendation M.1370, § 4.3.2).

3.7 When an international section includes a satellite link, then it may be possible to perform RF loopback measurements, including the up/down link of the satellite, if such measurements are allowed by the satellite transponder configuration, i.e. if the earth station can monitor its own transmission. Such loopback measurements, made from the customer premises, the TIC or from the earth station should be compared with similar loopback measurements made when the circuit functions normally.

Loopback measurements should be made before international cooperation is sought to test the international section, but should not be substituted for, or compared directly with, unidirectional measurements.




*Note 1* — Test between domestic renter's location and TIC serves to isolate fault between national and international sections relative to the recipient of the fault report.

*Note 2* — Test between TICs to isolate into, or out of, the international section.

*Note 3* — Control of fault isolation process shifted to the sub-control station according to the receive direction of the fault. The national section of the recipient of the fault report is first cleared.

*Note 4* — Either process A or B may be effected in the sequence deemed useful by the station.

*Note 5* — In the event that the initial fault report is received by the sub-control station, process B should be effected and, if necessary, corrective action applied in the national network. The control station should be apprised of all information. Faults not determined to be in the sub-control's national section should be referred to the control station for further action.

*Note 6* — Test between domestic renter's location and TIC to isolate the fault, between international or national sections relative to sub-control.

*Note 7* — To be effected when earlier steps do not conclusively isolate the fault for correction.

FIGURE 1/M.1375

**Fault location sequence for international data transmission systems**

3.8 Care must be taken to avoid the simultaneous operation of loopbacks if the system configuration is such that erroneous results would occur. Once the need for a loopback no longer exists then care should be taken to ensure that the link is restored and the loopback removed.

3.9 If the nature of the fault report indicates that there may not be a fault on the link but that there may be a problem with the interworking of terminal equipment, or if the testing of the sections has not located the fault, then end-to-end monitoring and testing should be performed.

The control and sub-control stations should arrange for a test pattern to be transmitted in each direction from both ends of the system.

Both terminal international centres should monitor the test pattern in both directions of transmission and advise the control station (via the sub-control station if necessary) of the measured error performance (bit error ratio or error-free seconds) for each direction of transmission.

## 4 Overall data circuit check

4.1 When the fault has been located to the international or to a national section and has been cleared, then that section should be tested to ensure that its bit error free second performance meets the maintenance limits identified in § 5.

4.2 A short end-to-end performance test of the system should be made to ensure that the overall limits specified in § 5 are also met. The actual period of the test will depend upon the nature of the fault that has been cleared.

## 5 Maintenance parameters

5.1 Maintenance measurements of system characteristics should normally be evaluated by comparison with those made during the line-up and with the specified limits given in any relevant Recommendation.

5.2 For measuring data transmission performance it will normally be sufficient to check bit error ratio or error free second performance for 15 minutes. The maintenance limits to be achieved are shown in Tables 1/M.1375, 2/M.1375 and 3/M.1375.

TABLE 1/M.1375

**Bit error ratio (BER) maintenance limits for sections of international data transmission systems** [a]

| Data rate (kbit/s) | Each national section | | International section | |
|---|---|---|---|---|
| | Bit error ratio | Number of errors in 15 min | Bit error ratio | Number of errors in 15 min |
| 48 | $1 \times 10^{-5}$ | 432 | $1 \times 10^{-6}$ | 43 |
| 50 | $1 \times 10^{-5}$ | 450 | $1 \times 10^{-6}$ | 45 |
| 56 | $1 \times 10^{-5}$ | 504 | $1 \times 10^{-6}$ | 50 |
| 64 | $1 \times 10^{-5}$ | 580 | $1 \times 10^{-6}$ | 60 |

[a] The performance limits for data transmission systems operating at bit rates above 64 kbit/s require further study.

*Note* – See Note to Table 3/M.1375.

TABLE 2/M.1375

**Overall bit error ratio maintenance limits for the system (end-to-end)** [a]

| Data rate (kbit/s) | Bit error ratio | Number of errors in 15 min |
|---|---|---|
| 48 | $2.1 \times 10^{-5}$ | 910 |
| 50 | $2.1 \times 10^{-5}$ | 950 |
| 56 | $2.1 \times 10^{-5}$ | 1060 |
| 64 | $2.2 \times 10^{-5}$ | 1220 |

[a] The performance limits for data transmission systems operating at bit rates above 64 kbit/s require further study.

*Note* – See Note to Table 3/M.1375.

TABLE 3/M.1375

**Overall error-free seconds (EFS) maintenance limits for the system (end-to-end)** [a]

(Provisionally the limits contained in the table apply to all measurements whether made on a section or end-to-end basis)

| Performance classification | Errors in 1 second | Permitted percentage of measured time (15 minutes) | Permitted number of seconds in 15 minute period |
|---|---|---|---|
| Errored seconds | > 0 | Less than 8% | 72 |
| Error-free seconds | 0 | More than 92% | 828 |

[a] The performance limits for data transmission systems operating at bit rates above 64 kbit/s require further study.

*Note* – The limits presented in the tables for error free seconds (EFS) are based on those given in Recommendation G.821 [2] for bit error ratio on the experience of Administrations. These limits are provisional and are subject for further study.

## References


[1] CCITT Recommendation *Operational procedures in locating and clearing transmission faults*, Vol. IV, Rec. M.130.

[2] CCITT Recommendation *Error performance on an international digital connection forming part of an integrated services digital network*, Vol. III, Rec. G.821.

ISBN 92-61-03411-X