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INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

YELLOW BOOK

VOLUME IV - FASCICLE IV.2

MAINTENANCE; INTERNATIONAL VOICE-FREQUENCY TELEGRAPHY AND FACSIMILE, INTERNATIONAL LEASED CIRCUITS

RECOMMENDATIONS M.800-M.1235



VIITH PLENARY ASSEMBLY
GENEVA, 10-21 NOVEMBER 1980

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 - FASCICLE IV.4 - Specifications of measuring equipment. Series O Recommendations (Study Group IV).

¹⁾ "Telematic services" is used provisionally.

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¹⁾ “Telematic services” is used provisionally.

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REMARKS

- 1 The Questions entrusted to each Study Group for the Study Period 1981-1984 can be found in Contribution No. 1 to that Study Group.
- 2 Supplements to the Series M and N Recommendations can be found in Fascicle IV.3 and those to the Series O Recommendations in Fascicle IV.4.

CCITT NOTE

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

FASCICLE IV.2

Recommendations M.800 to M.1235

**MAINTENANCE OF INTERNATIONAL
VOICE-FREQUENCY TELEGRAPHY AND
FACSIMILE CIRCUITS AND INTERNATIONAL LEASED CIRCUITS**

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SECTION 5

INTERNATIONAL CIRCUITS FOR VOICE-FREQUENCY TELEGRAPH AND FACSIMILE TRANSMISSION

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

Recommendation M.800¹⁾

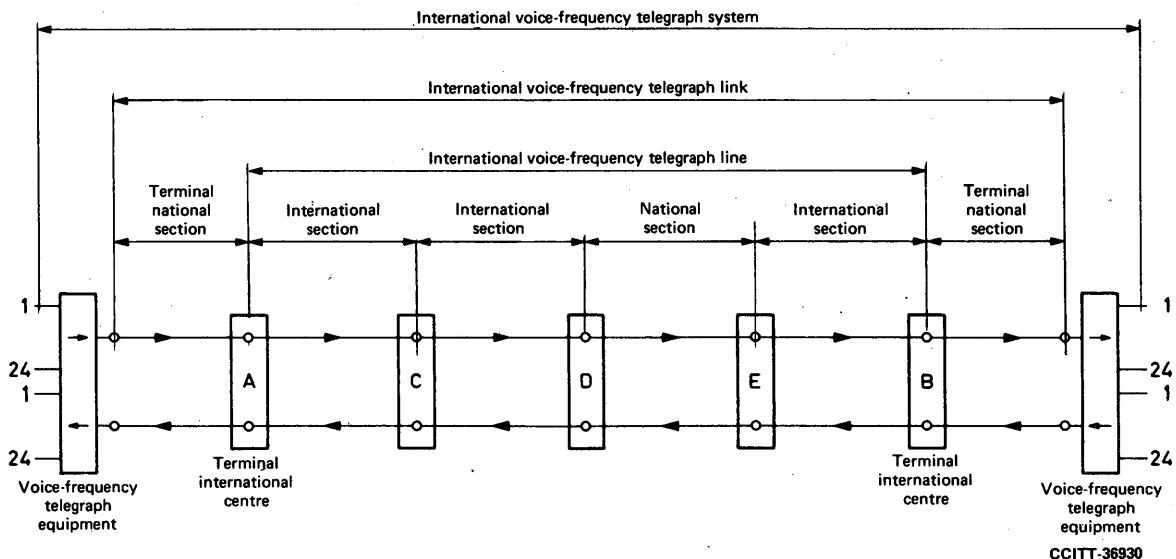
USE OF CIRCUITS FOR VOICE-FREQUENCY TELEGRAPHY

1 Composition and nomenclature (formerly Part A)

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.



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

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 § 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.

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 (formerly Part B)**

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.

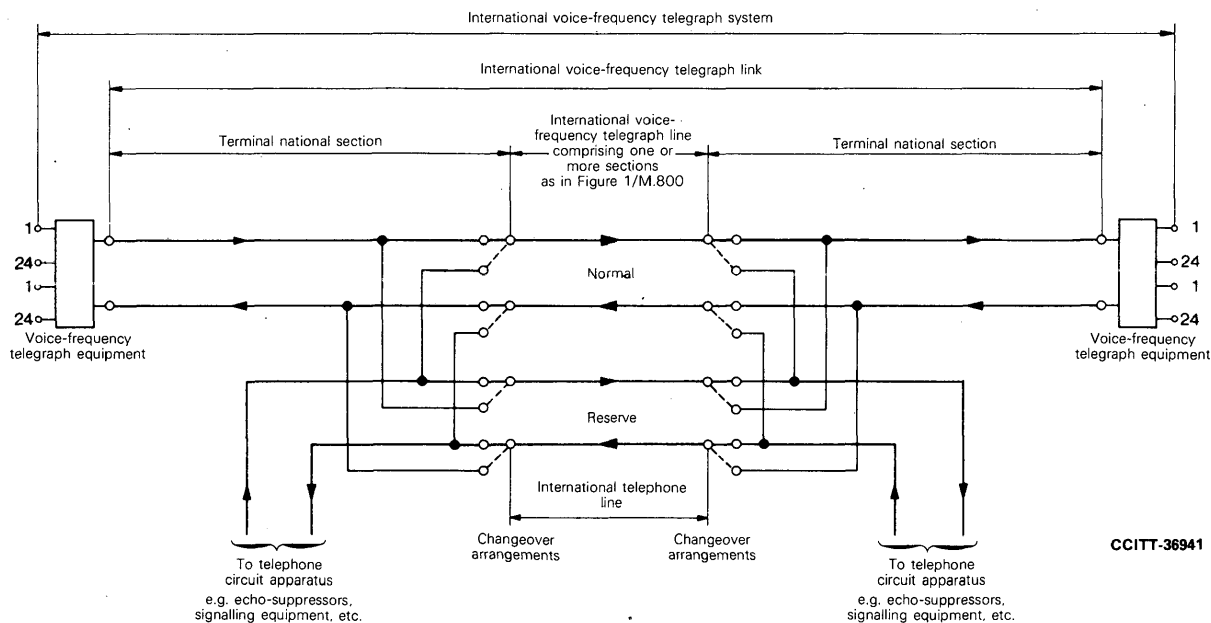


FIGURE 2/M.800

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, Fascicle VII.1, Rec. R.77.
- [2] CCITT Recommendation *Composition and terminology of international voice-frequency telegraph systems*, Vol. III, Fascicle III.4, Rec. H.21.
- [3] CCITT Recommendation *Designation of international circuits, groups, etc.*, Vol. IV, Fascicle IV.1, 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 800 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 ($50 \mu\text{W}_0$). 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 800 Hz must not exceed the following limits:

4.2.1 Type I – Links with 4-kHz sections throughout

TABLE 1/M.810
(Previously table A/M.810)

Frequency range, Hz	Overall loss relative to that at 800 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
(Previously table B/M.810)

Frequency range, (Hz)	Overall loss relative to that at 800 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
(Previously table C/M.810)

Frequency range, (Hz)	Overall loss relative to that at 800 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.

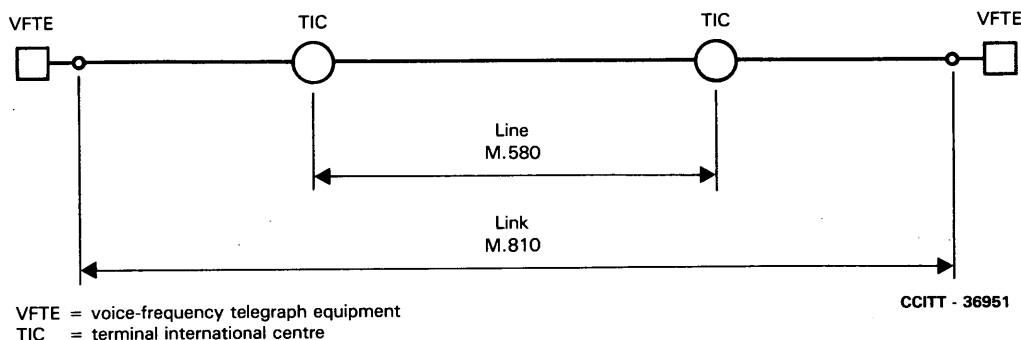


FIGURE 1/M.810

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 800 kHz 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 800 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 800 Hz introduced by the changeover procedure.

4.3.3 Values of overall loss over the frequency band, relative to the value at 800 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 weight value (using the weightings specified in the Recommendation cited in [5]; [6] indicates some essential values). 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 H.13 [7] (see also Recommendation O.71 (V.55) [8]).

The number of counts of impulsive noise which exceeds −18 dBm0 should not exceed 18 in 15 minutes¹⁾.

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 [11] 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.

Reference [12] gives the result of a calculation made by the French Administration regarding the effect of group-delay/frequency distortion on amplitude-modulated telegraph signals.

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.

¹⁾ These values are still under study. See the Recommendations cited in [9] and [10].

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 Sudden variations of overall loss and short interruptions

Such defects of the transmission path spoil the quality of the telegraph transmission and should be reduced to the minimum possible.

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 [13].

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	
	$\mu\text{W}0$	$\text{dBm}0$
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:

- 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.180.
- 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 per telegraph channel in FMVFT systems for bearer circuits with characteristics 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 frequency 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* [14].

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 800 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 800 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 P.53 [15].

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 [8].

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 [16] and F.10 [17].

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, Fascicle IV.1, Rec. M.80.
- [2] CCITT Recommendation *Sub-control stations*, Vol. IV, Fascicle IV.1, Rec. M.90.
- [3] CCITT Recommendation *Guiding principles on the general maintenance organization for telephone-type international circuits*, Vol. IV, Fascicle IV.1, Rec. M.70.
- [4] CCITT Recommendation *Setting up and lining up an international circuit for public telephony*, Vol. IV, Fascicle IV.1, Rec. M.580.
- [5] CCITT Recommendation *Psophometers (apparatus for the objective measurement of circuit noise)*, Vol. V, Rec. P.53, Table 1/P.53.
- [6] *Noise-measuring instruments for telecommunication circuits*, Green Book, Vol. IV.2, Supplement No. 3.2, ITU, Geneva, 1973.
- [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*, Vol. IV, Fascicle IV.4, Rec. O.71 (V.55).
- [9] 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.
- [10] CCITT Recommendation *Specification for an impulsive noise measuring instrument for telephone-type circuits*, Green Book, Vol. VIII, Rec. V.55, Annex, ITU, Geneva, 1973.
- [11] CCITT Recommendation *General performance objectives applicable to all modern international circuits and national extension circuits*, Vol. III, Fascicle III.1, Rec. G.151, § 4.1.
- [12] CCITT *Blue Book*, Vol. III, Annex 44, p. 530, ITU, Geneva, 1964.
- [13] CCITT Recommendation *Constitution of the circuit; preliminary exchange of information*, Vol. IV, Fascicle IV.1, Rec. M.570.
- [14] CCITT Recommendation *Numbering of international VFT channels*, Vol. VII, Fascicle VII.1, Rec. R.70 bis, Table 2/R.70 bis.
- [15] CCITT Recommendation *Psophometers (apparatus for the objective measurement of circuit noise)*, Vol. V, Rec. P.53.
- [16] CCITT Recommendation *Conventional degree of distortion tolerable for standardized start-stop 50-baud systems*, Vol. VII, Fascicle VII.1, Rec. R.54.
- [17] CCITT Recommendation *Character error rate objective for telegraph communication using 5-unit start-stop equipment*, Vol. II, Fascicle II.4, Rec. F.10.

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 (800 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, Fascicle IV.1, 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 dBm₀¹⁾ and noise.

The measuring frequencies are as follows:

- circuits providing an 18-channel telegraph system: 300, 400, 600, 800, 1000, 1400, 2000, 2400, 2600 Hz;
- circuits providing a 24-channel telegraph system: 300, 400, 600, 800, 1000, 1400, 2000, 2400, 3000, 3200, 3400 Hz.

¹⁾ This is the preferred level. However, by agreement between Administrations, a level of 0 dBm₀ may be used.

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 Lining-up and maintenance of international facsimile 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.

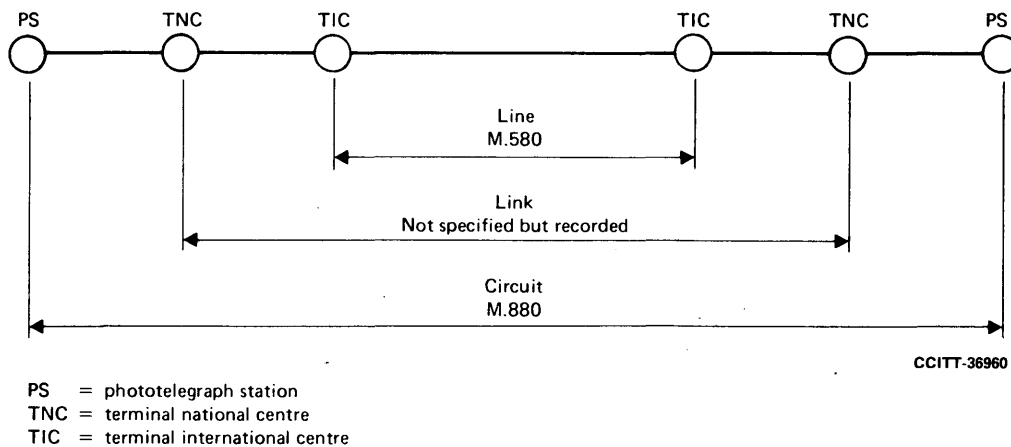


FIGURE 1/M.880
**Relationship between Recommendations which apply to international phototelegraph links
in respect of loss/frequency distortion**

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.

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:

$$\Delta t \leq \frac{1}{2fp}$$

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 0 dB referred to 1 mW and for a frequency-modulated transmission -10 dB referred to 1 mW. 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 -10 dBm0 on the multichannel system and the power at the output of the sending apparatus shall not exceed 1 mW.

This value of -10 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.82 [5] and M.92 [6].

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 [7]).

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, Fascicle IV.1, Rec. M.580.
- [2] CCITT Recommendation *Range of phototelegraph transmissions on a telephone-type circuit*, Vol. VII, Fascicle VII.2, Rec. T.12.
- [3] CCITT Recommendation *Power levels for data transmission over telephone lines*, Vol. VIII, Fascicle VIII.1, Rec. V.2.
- [4] CCITT Recommendation *Guiding principles on the general maintenance organization for telephone-type international circuits*, Vol. IV, Fascicle IV.1, Rec. M.70.
- [5] CCITT Recommendation *Circuit control station – leased and special circuits*, Vol. IV, Fascicle IV.1, Rec. M.82.
- [6] CCITT Recommendation *Subcontrol station – leased and special circuits*, Vol. IV, Fascicle IV.1, Rec. M.92.
- [7] CCITT Recommendation *Periodicity of maintenance measurements on circuits*, Vol. IV, Fascicle IV.1, Rec. M.610, Table 1/M.610.

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 is provided on 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 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 points at the interface in the renter's premises and corresponding defined test 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 points at the terminal national centre and defined test 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.

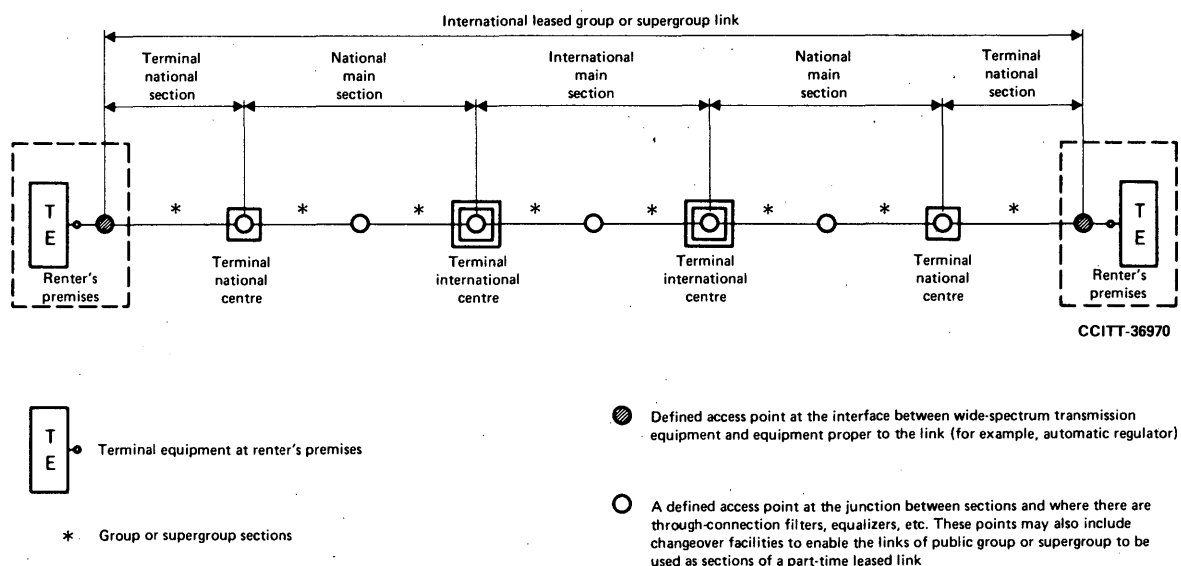


FIGURE 1/M.900
Example of the basic constitution of an international leased group or supergroup link for wide-spectrum signal transmission

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, Fascicle III.4, Rec. H.14.
- [2] CCITT Recommendation *Characteristics of supergroup links for the transmission of wide-spectrum signals*, Vol. III, Fascicle III.4, Rec. H.15.
- [3] CCITT Recommendation *Definitions concerning international carrier systems*, Vol. IV, Fascicle IV.1, Rec. M.300.
- [4] CCITT Recommendation *Bringing international group, supergroup, etc., links into service*, Vol. IV, Fascicle IV.1, Rec. M.460.
- [5] CCITT Recommendation *Data transmission at 48 kilobits per second using 60-108 kHz group band circuits*, Vol. VIII, Fascicle VIII.1, Rec. V.35, § 7.

Recommendation M.910

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

1 Corrected group links

Paragraph 1 relates to the Recommendation cited in [1].

1.1 General

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

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

1.1.3 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.

1.1.4 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.

1.1.5 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.

1.2 Setting-up of an international leased group link

1.2.1 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.

1.2.2 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.

1.2.3 *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].

1.3 *Lining up an international leased group link*

1.3.1 *Lining up the national and international main sections*

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

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

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

1.3.1.4 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.

1.3.2 *Terminal national sections*

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

1.3.3 *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.

1.3.4 *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.

1.4 *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.

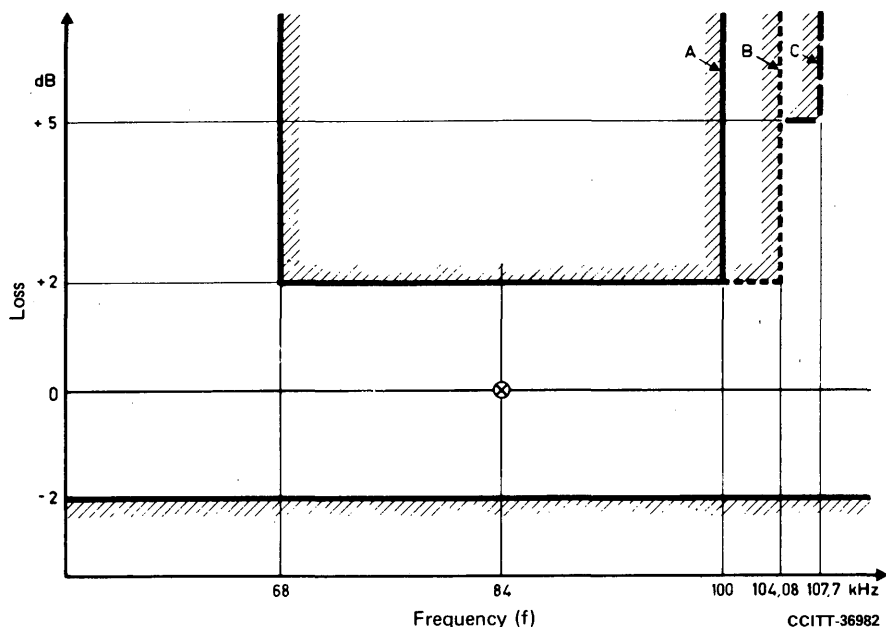
If, however, it is necessary to specify a particular value of overall loss as a result of a request by a renter this may be done only after prior consultation and agreement between the Administrations concerned.

1.5 *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

1.6 *Group-delay distortion*¹⁾

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

1.6.2 If the group-delay distortion exceeds the value given in § 1.6.1 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.

1.6.3 Where the group link terminates at the two terminal national centres, the value of the group-delay distortion given in § 1.6.1 above should apply between these two centres.

1.7 *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.

1.8 *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.

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.

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.

1.9 *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.

1.10 *Frequency error*

The frequency error over the group link should be measured and should not exceed 5 Hz.

The method of measurement should be agreed by the Administrations concerned until such time as the method and measuring equipment to be used has been specified by the CCITT.

1.11 *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.

2 **Uncorrected group links**

Under study. Provisionally, see the Recommendation cited in [7].

References

- [1] CCITT Recommendation *Characteristics of group links for the transmission of wide-spectrum signals*, Vol. III, Fascicle III.4, Rec. H.14, § 2.
- [2] CCITT Recommendation *Bringing international group, supergroup, etc., links into service*, Vol. IV, Fascicle IV.1, 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, Fascicle III.4, Rec. H.16.
- [7] CCITT Recommendation *Characteristics of group links for the transmission of wide-spectrum signals*, Vol. III, Fascicle III.4, Rec. H.14, § 3.

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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 installation¹⁾;

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

- 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). There may also be pulse code modulation systems in some national networks.

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.

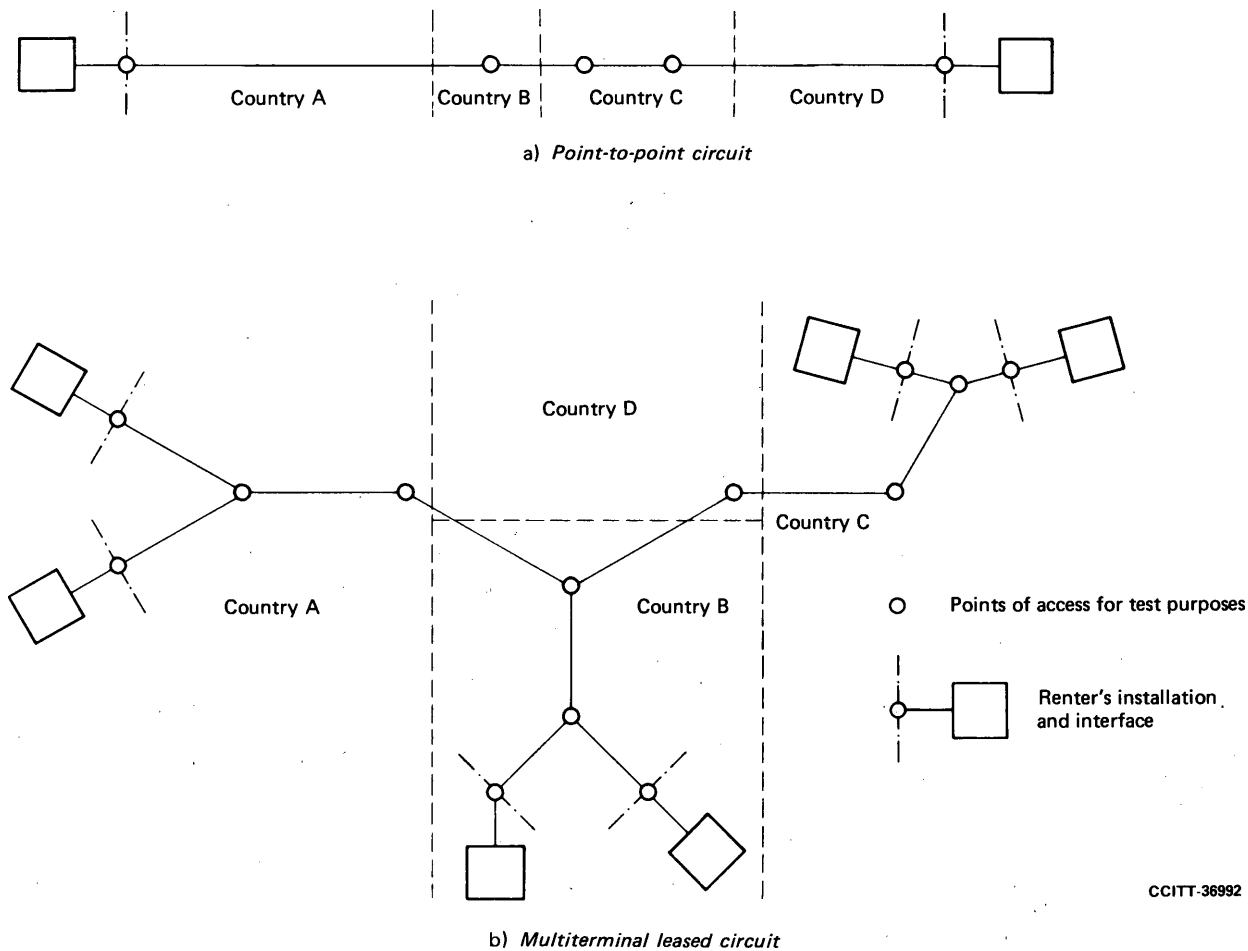


FIGURE 1/M.1010
Examples of point-to-point and multiterminal international leased circuits

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.

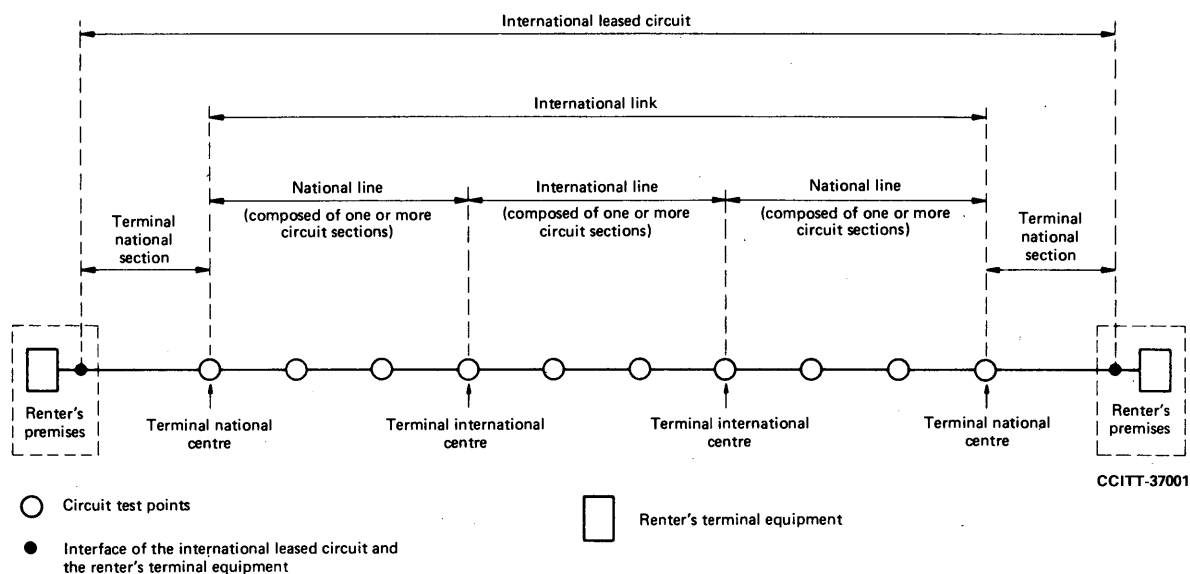


FIGURE 2/M.1010

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.95 [1]) 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.

Reference

- [1] CCITT Recommendation *Transmission maintenance point (international line) (TMP-IL)*, Vol. IV, Fascicle IV.1, Rec. M.95.

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.

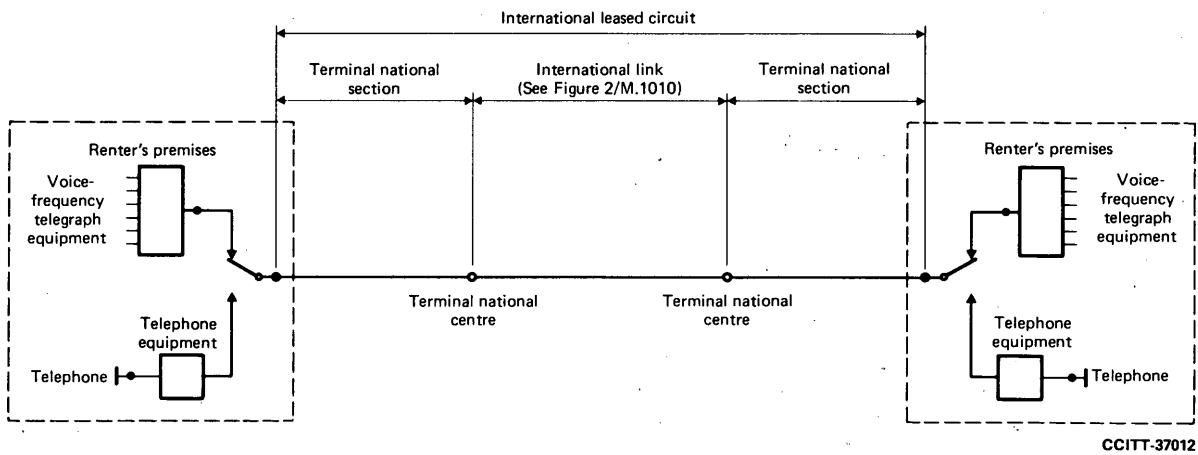


FIGURE 1/M.1015
 Example of a point-to-point leased circuit alternatively used for telegraphy or telephony

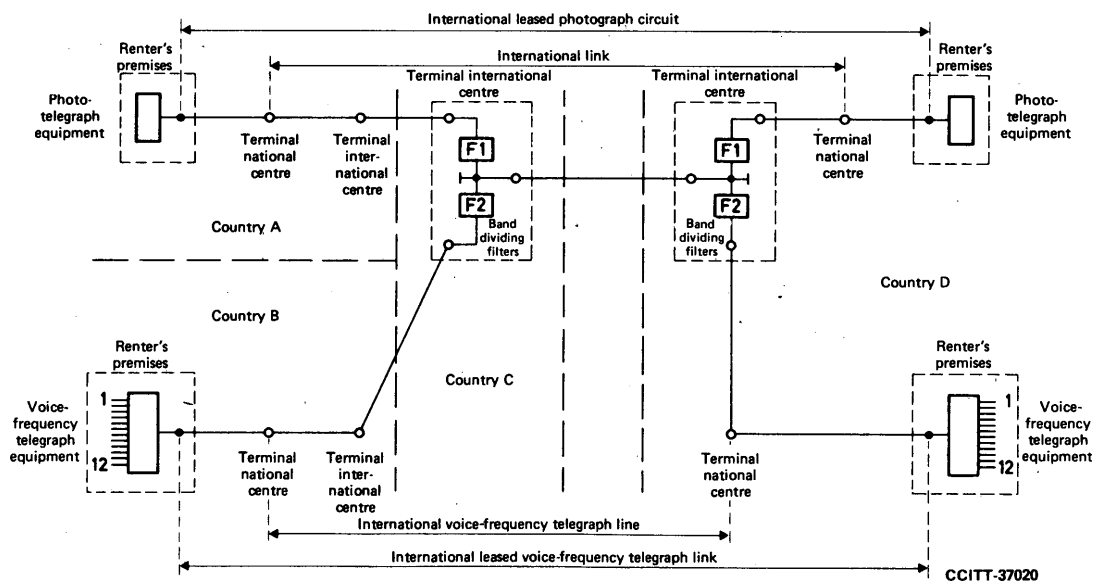


FIGURE 2/M.1015
 Example of a multipoint leased circuit for simultaneous voice-frequency telegraph and facsimile transmission

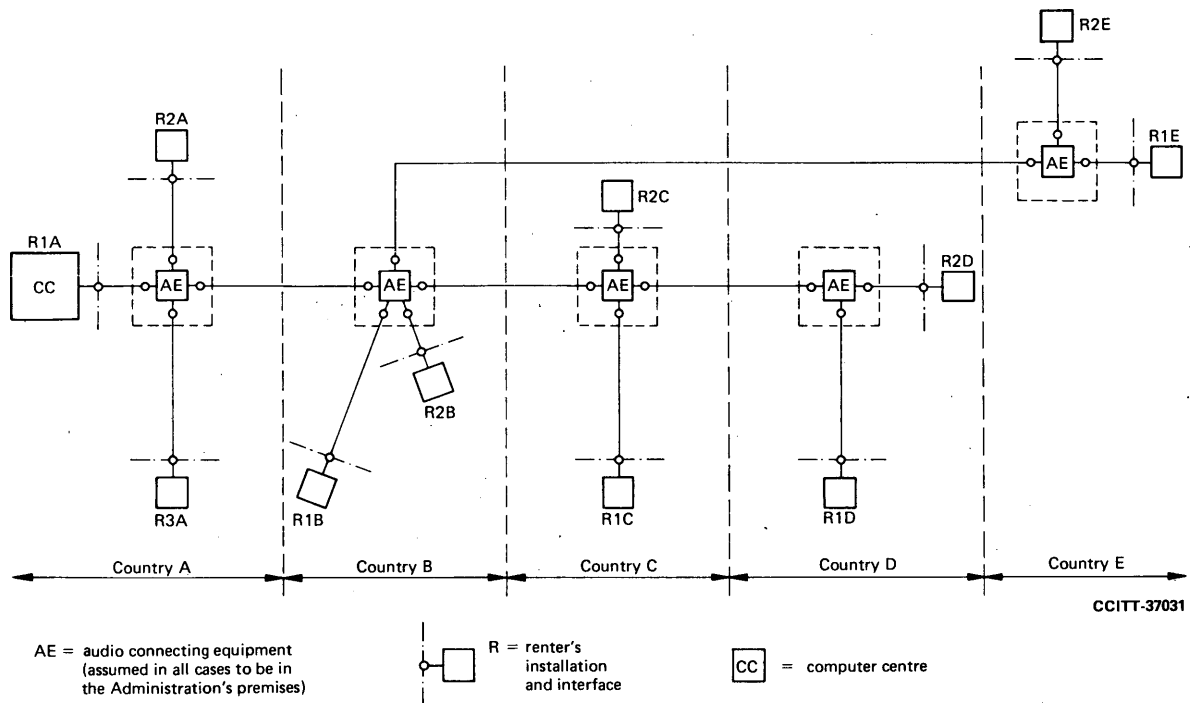


FIGURE 3/M.1015
Example of an international leased multiterminal data circuit

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.

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.

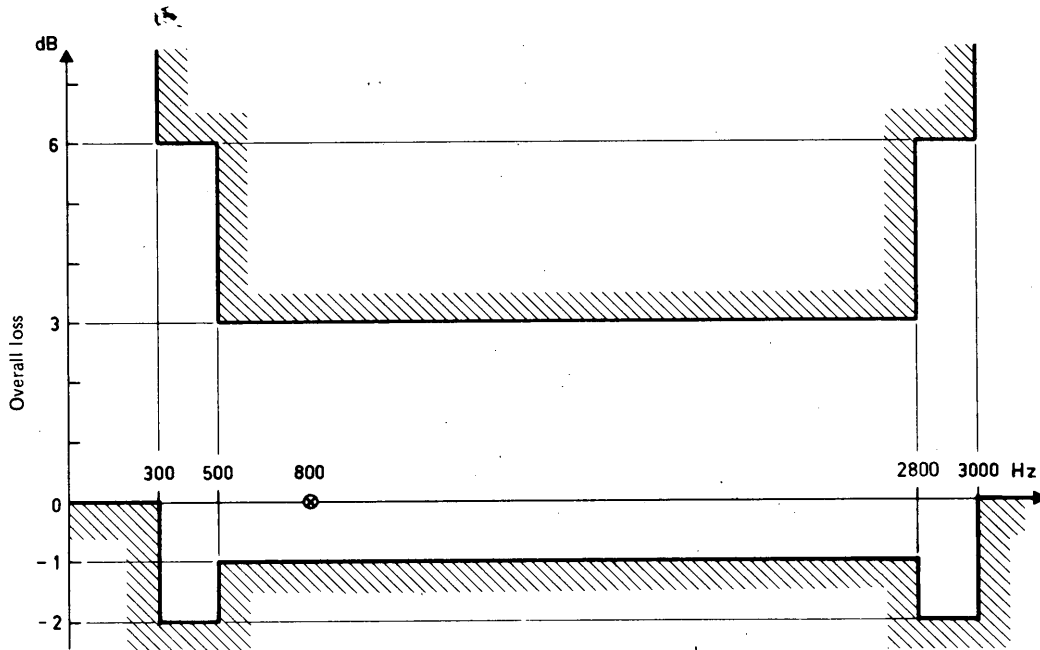
²⁾ Additionally, the characteristics for short breaks in transmission, phase hits, amplitude hits and low-frequency phase jitter are under study.

Generally, however, for 4-wire circuits, the value of the sending relative level at the renter's premises should provisionally not be higher than +13 dBr and the receiving relative level provisionally not lower than -15 dBr³⁾. It can therefore be assumed that the maximum nominal overall loss will not normally exceed 28 dB, and in the majority of cases a nominal overall loss smaller than this can be expected.

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

2.2 *Loss/frequency distortion*

The limits for the overall loss relative to that at 800 Hz for the circuit between renters' installations are given in Figure 1/M.1020.



CCITT-37041

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 800 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.

2.4 *Variation with time of the overall loss at 800 Hz*

The variation with time of the overall loss at 800 Hz should be as small as possible but should not exceed the following limits:

- short-term variations (over a period of a few seconds) ± 3 dB
- long-term variations (over long periods including daily and seasonal variations) ± 4 dB

³⁾ The level of -15 dBr and the resulting maximum loss of 28 dB are incompatible with the threshold signal level specified for leased circuit modems. This question requires further study.

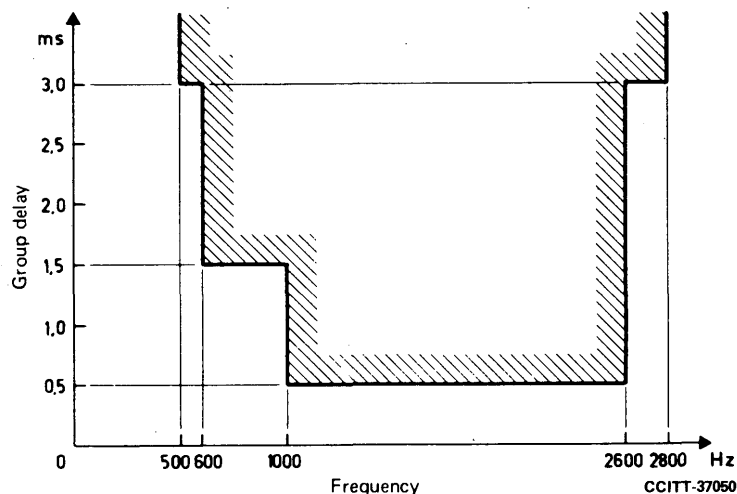


FIGURE 2/M.1020
Limits for group delay relative to the minimum measured group delay in the 500-2800 Hz band

2.5 *Random circuit noise*

The nominal 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 kilometres is -38 dBm0p. However, circuits of shorter length will have substantially less random noise (see also Annex A).

2.6 *Impulsive noise*

Impulsive noise should be measured with an instrument complying with Recommendation O.71 [1]. As a provisional limit, the number of impulsive noise peaks exceeding -21 dBm0 should not be more than 18 in 15 minutes.

A method of measurement is described in the Recommendations cited in [2] and [3]. Final values are under study.

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. These limits are provisional and subject to further study.

2.8 *Quantizing noise (quantizing distortion)*

If any circuit section is routed over a pulse code modulation system the signal will be accompanied by quantizing noise. The minimum ratio of signal/quantizing noise normally expected is 22 dB.

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. This limit is provisional pending further study.

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 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.

ANNEX A

(to Recommendation M.1020)

Random circuit noise

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

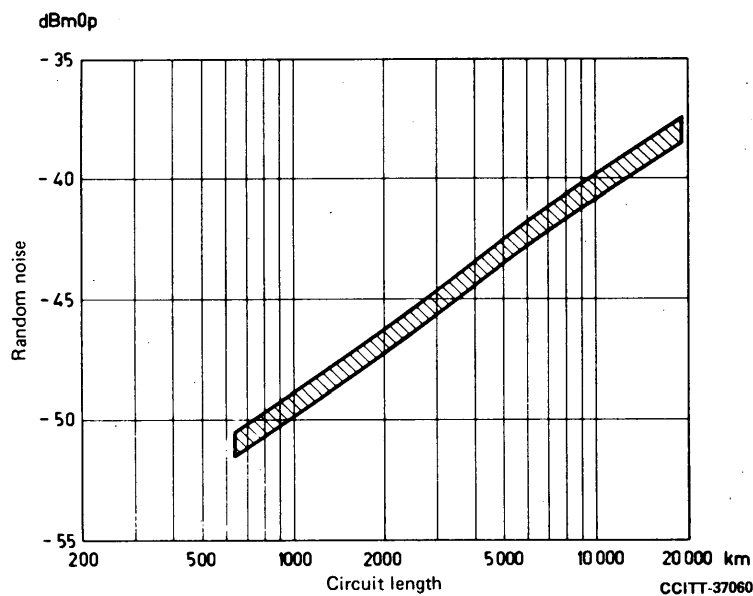


FIGURE A-1/M.1020

Random circuit-noise performance

Note – At the present time the section of the circuit provided by satellite (between earth stations) 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 on Figure A-1/M.1020.

References

- [1] CCITT Recommendation *Specification for an impulsive noise measuring instrument for telephone-type circuits*, Vol. IV, Fascicle IV.4, Rec. O.71.
- [2] 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.
- [3] CCITT Recommendation *Impulsive noise measuring instrument for data transmission*, Green Book, Vol. VIII, Rec. V.55, Annex, ITU, Geneva, 1973.
- [4] CCITT Recommendation *Essential clauses for an instrument to measure phase jitter on telephone circuits*, Vol. IV, Fascicle IV.4, Rec. O.91.

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.

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.

Generally, however, for 4-wire circuits, the value of the sending relative level at the renter's premises should provisionally not be higher than +13 dBr and the receiving relative level provisionally not lower than -15 dBr. ⁴⁾ It can therefore be assumed that the maximum nominal overall loss will not normally exceed 28 dB, and in the majority of cases a nominal overall loss smaller than this can be expected.

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

2.2 *Loss/frequency distortion* ^{5), 6)}

The limits for the overall loss relative to that at 800 Hz for the circuit between renters' installations are given in Figure 1/M.1025.

2.3 *Group-delay distortion* ^{5), 6)}

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.

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.

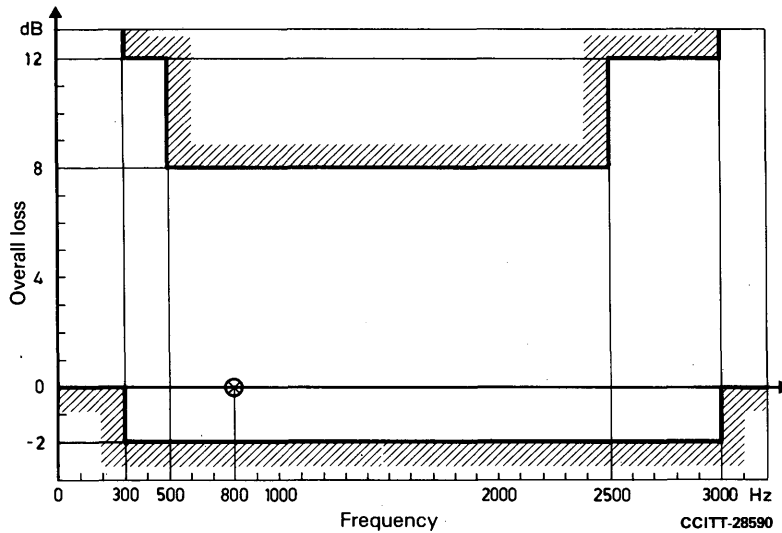
²⁾ In order to ensure the proper operation of certain Series V modems operating at data signalling rates greater than 4800 bit/s, it is necessary to specify improved and/or modified values for the following transmission system characteristics: random circuit noise, quantizing noise, harmonic distortion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

³⁾ Additionally, the characteristics for short breaks in transmission, phase hits, amplitude hits and low frequency phase jitter are under study.

⁴⁾ The level of -15 dBr and the resulting maximum loss of 28 dB are incompatible with the threshold signal level specified for leased circuit modems. This subject requires further study.

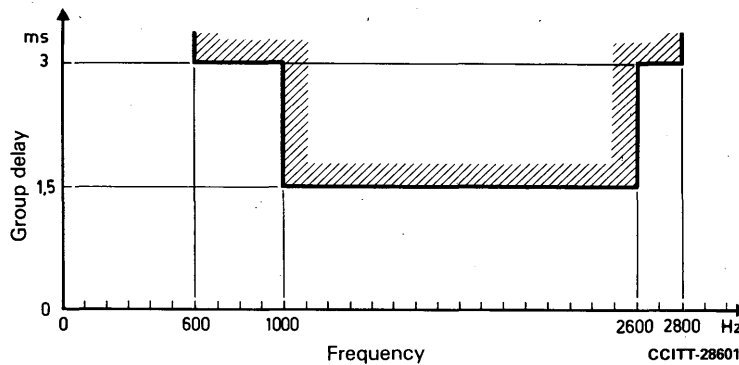
⁵⁾ It is expected that, in most cases, these "basic bandwidth" characteristics may be available without the addition of loss/frequency and/or group-delay equalization equipment.

⁶⁾ The values of loss/frequency and group-delay distortion are provisional and should be confirmed or amended after further study.



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 800 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

2.4 Variation with time of the overall loss at 800 Hz

The variation with time of the overall loss at 800 Hz should be as small as possible but should not exceed the following limits:

- short-term variations (over a period of a few seconds): ± 3 dB
- long-term variations (over long periods including daily and seasonal variations): ± 4 dB

2.5 *Random circuit noise*

The nominal 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 kilometres is -38 dBm0p. However, circuits of shorter length will have substantially less random noise (see also Annex A to this Recommendation).

2.6 *Impulsive noise*

Impulsive noise should be measured with an instrument complying with Recommendation O.71 [1]. As a provisional limit, the number of impulsive noise peaks exceeding -21 dBm0 should not be more than 18 in 15 minutes.

A method of measurement is described in the Recommendations cited in [2] and [3]. Final values are under study.

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. These limits are provisional and subject to further study.

2.8 *Quantizing noise (quantizing distortion)*

If any circuit section is routed over a pulse code modulation system, the signal will be accompanied by quantizing noise. The minimum ratio of signal/quantizing noise normally expected is 22 dB.

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. This limit is provisional pending further study.

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 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.

ANNEX A

(to Recommendation M.1025)

Random circuit noise

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

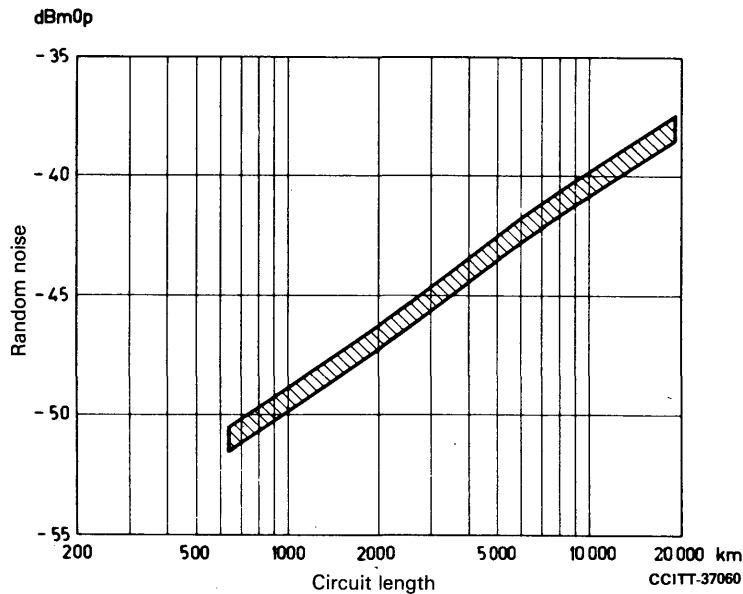


FIGURE A-1/M.1025
Random circuit-noise performance

Note – At the present time the section of the circuit provided by satellite (between earth stations) 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 on Figure A-1/M.1025.

References

- [1] CCITT Recommendation *Specification for an impulsive noise measuring instrument for telephone-type circuits*, Vol. IV, Fascicle IV.4, Rec. O.71.
- [2] 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.
- [3] CCITT Recommendation *Impulsive noise measuring instrument for data transmission*, Green Book, Vol. VIII, Rec. V.55, Annex, ITU, Geneva, 1973.
- [4] CCITT Recommendation *Essential clauses for an instrument to measure phase jitter on telephone circuits*, Vol. IV, Fascicle IV.4, Rec. O.91.

Recommendation M.1040

CHARACTERISTICS OF ORDINARY QUALITY INTERNATIONAL LEASED CIRCUITS¹⁾

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.

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 Characteristics

2.1 Nominal overall loss

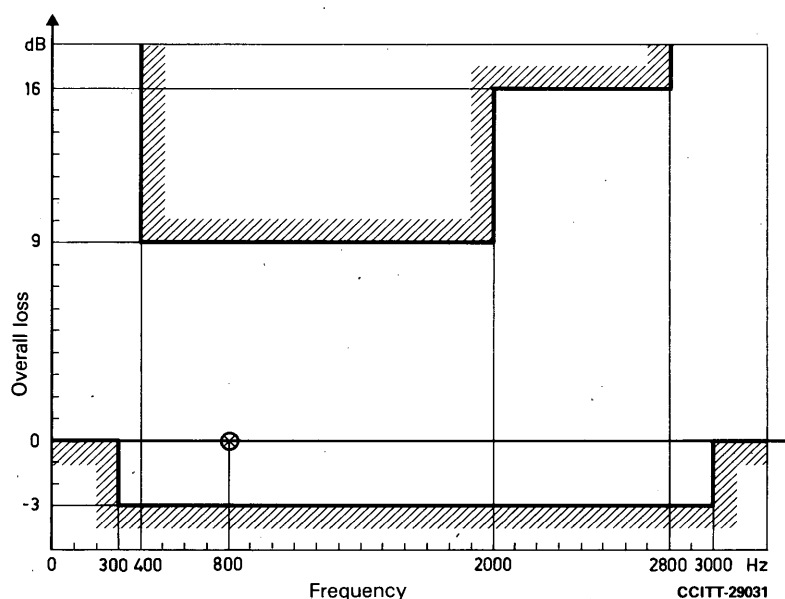
Because of the differing nominal level at renters' premises due to the various national practices, it is not normally possible to predict the nominal overall loss of the circuit at the reference frequency. Only exceptionally can a predetermined specified nominal overall loss at the reference frequency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

Generally, however, for 4-wire circuits, the value of the sending relative level at the renter's premises should provisionally not be higher than +13 dBr and the receiving relative level provisionally not lower than -15 dBr²⁾. It can therefore, be assumed that the maximum nominal overall loss will not normally exceed 28 dB, and in the majority of cases a nominal overall loss smaller than this can be expected.

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

2.2 Loss/frequency distortion

The provisional limits for the overall loss relative to that at 800 Hz for the circuit between renters' installations are given in Figure 1/M.1040.



Note - At frequencies 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.1040

Limits for the overall loss of the circuit relative to that at 800 Hz

2.3 Random circuit noise

The nominal 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 dBm_{0p}. However, circuits of shorter length will have substantially less random noise (see also Annex A to this Recommendation).

²⁾ The level of -15 dBr and the resulting maximum loss of 28 dB are incompatible with the threshold signal level specified for leased circuit modems. This question requires for further study.

ANNEX A

(to Recommendation M.1040)

Random circuit noise

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

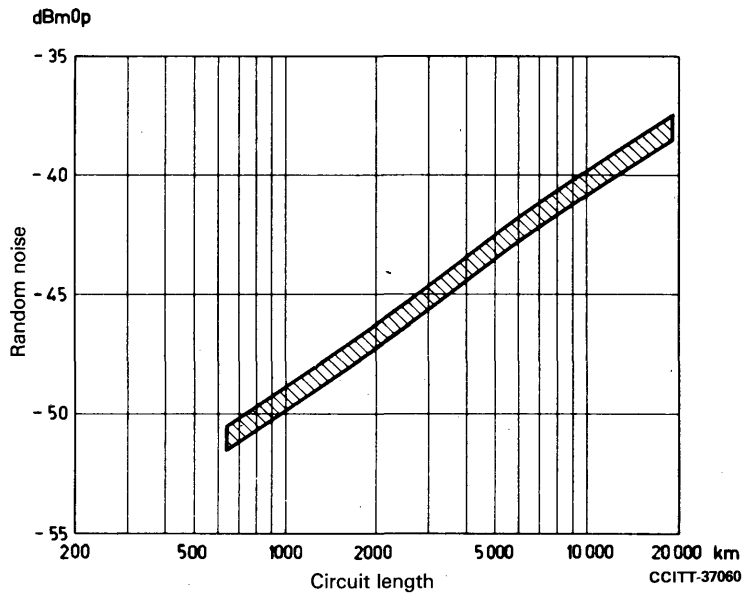


FIGURE A-1/M.1040
Random circuit-noise performance

Note — At the present time the section of the circuit provided by satellite (between earth stations) 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 on Figure A-1/M.1040.

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 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 on the ready-for-service date, and the date and time of the overall circuit line-up;
- 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, circuit routing, and type of signalling (if any) to be used,
 - the control and sub-control stations,
 - the ready-for-service (RFS) and overall line-up dates and times.

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 (ready-for-service) date, and the date and time of the overall line-up. For this and other purposes, the contact point information (items 10 and 11 in the telex example, Figure 1/M.1045) is essential and should always be exchanged. 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.

NETWORK CONTROL DIVISION LONDON TO TELEGLOBE CANADA

07021030G/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
- 3 CHARACTERISTICS: CCITT M. 1020.

WE MAKE THE FOLLOWING PROPOSALS:

- 4 DESIGNATION: LONDON – MONTREAL DP 41
- 5 ROUTE: LONDON – MONTREAL 1608/14
- 6 SIGNALLING: NONE
- 7 CONTROLS: OVERALL – LONDON/WOOD ST/ITMC
SUB – MONTREAL ITMC
- 8 READY-FOR-SERVICE DATE/TIME: 16 MAY 1979, 1200G (TARGET).
- 9 OVERALL LINE-UP-DATE/TIME: 12 MAY 1979, 1400G (TARGET).

PLEASE NOTE THE FOLLOWING:

- 10 ADMINISTRATIVE CONTACT POINT FOR DISCUSSING/AGREEING RFS DATE:
PHONE +44 1 236 4262 X190, TELEX 888610 GMITP G
- 11 ADMINISTRATIVE CONTACT POINT FOR DISCUSSING/AGREEING LINE-UP DATES AND TIMES:
(AS IN 10)
- 12 ACCESS TO UK RENTERS PREMISES RESTRICTED TO 1200-1700G, MONDAY-FRIDAY.
- 13 CIRCUIT TO BE USED FOR 2400 BIT/S DATA. 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
 10/02/78/1700G/DOC/2/KH
 NEW LEASED CIRCUIT FOR AB SMITH & CO
 YOUR REFERENCE 07021030G/IN3.2.2.1/LB
 1- 3 NOTED
 4- 9 AGREED
 10-13 NOTED. OUR CONTACT POINT IS: PHONE +1 514 281 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

Recommendation M.1050

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).

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 dBm_0 ¹⁾.

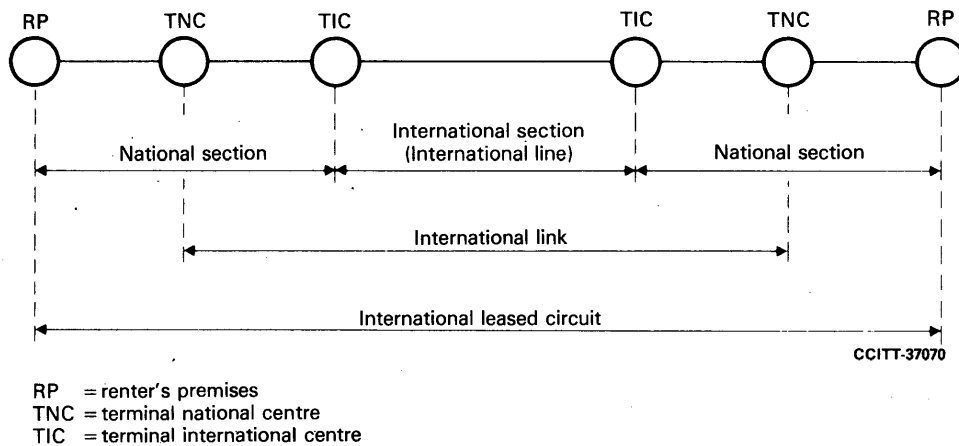


FIGURE 1/M.1050
 The constituent parts of an international point-to-point leased circuit

¹⁾ This is the preferred level. However, by agreement between Administrations a level of 0 dBm₀ may be used.

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

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. 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

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 [2] (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 renters' premises should now be made.

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 800 Hz should be measured and recorded. Note should be taken of § 2.1 of Recommendations M.1020, M. 1025 and M.1040.

If 2-wire operation is intended, the curve in [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 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 Recommendation M.1040. 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.

If under some circumstances the principles of equalizing special quality circuits as laid down in this Recommendation cannot be applied, special arrangements to apportion limits should be agreed bilaterally.

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 800 Hz* (special quality circuits only)

The variation of overall loss at 800 Hz should be measured over a period of a few hours to check that the limits specified in Recommendations M.1020 and M.1025 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*

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 or M.1040, as appropriate. Where the measured noise is higher by 5 dB or more than the appropriate value in these Recommendations or is higher than -38 dBm_{0p}, 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 [7] 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 cited in [8] and [9].

3.7 *Phase jitter* (special quality circuits only)

Phase jitter should be measured using an instrument complying with Recommendation O.91 [10] 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 *Quantizing noise* (quantizing distortion) (special quality circuits only)

The methods of measurement are under study. A specification for a measuring instrument is given in Recommendation O.131 [11].

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 [12].

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

3.11 *Harmonic distortion* (special quality circuits only)

This 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.

The results should be recorded.

4 **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.

5 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.

6 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 [13]) | – 13 dBm0 |
| – Voice-frequency telegraphy | |
| amplitude-modulated | } See Recommendation M.810, § 4.1 |
| frequency-modulated | |
| – Phototelegraph or facsimile (see Note 4) | |
| 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 [14].

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

Note 4 – The levels –3 dBm0 and –13 dBm0 specified in § 6 are provisional and will be studied further by Study Group XIV.

7 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.

8 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.

9 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 carrier system, rerouting should be carried out as far as possible at group, supergroup, etc. level. This would normally not seriously affect the attenuation and group-delay distortion. When such a rerouting of carrier 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 carrier 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, Fascicle IV.1, Rec. M.580, Table 1/M.580.
- [2] *Ibid.*, Tables 1/M.580, 2/M.580 and 3/M.580.
- [3] CCITT Recommendation *Stability and echo*, Vol. III, Fascicle III.1, Rec. G.131, § 2.
- [4] CCITT Recommendation *Influence of national networks on stability and echo losses in national systems*, Vol. III, Fascicle III.1, Rec. G.122.
- [5] CCITT Recommendation *The transmission plan*, Vol. III, Fascicle III.1, Rec. G.101.
- [6] CCITT Recommendation *Specification for a group-delay measuring set for audio circuits*, Vol. IV, Fascicle IV.4, Rec. O.81.
- [7] CCITT Recommendation *Specification for an impulsive noise measuring instrument for telephone-type circuits*, Vol. IV, Fascicle IV.4, Rec. O.71.
- [8] 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.
- [9] CCITT Recommendation *Impulsive noise measuring instrument for data transmission*, Green Book, Vol. VIII, Rec. V.55, Annex, ITU, Geneva, 1973.
- [10] CCITT Recommendation *Essential clauses for an instrument to measure phase jitter on telephone circuits*, Vol. IV, Fascicle IV.4, Rec. O.91.
- [11] CCITT Recommendation *Specification for a quantizing distortion measuring apparatus using a pseudo-random noise stimulus*, Vol. IV, Fascicle IV.4, Rec. O.131.
- [12] CCITT Recommendation *Specification of essential clauses for an instrument to measure frequency shift on a carrier channel*, Vol. IV, Fascicle IV.4, Rec. O.111.
- [13] CCITT Recommendation *Power levels for data transmission over telephone lines*, Vol. VIII, Fascicle VIII.1, Rec. V.2.
- [14] CCITT Recommendation *Maximum permissible value for the absolute power level (power referred to one milliwatt) of a signalling pulse*, Vol. III, Fascicle III.2, 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.

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.)

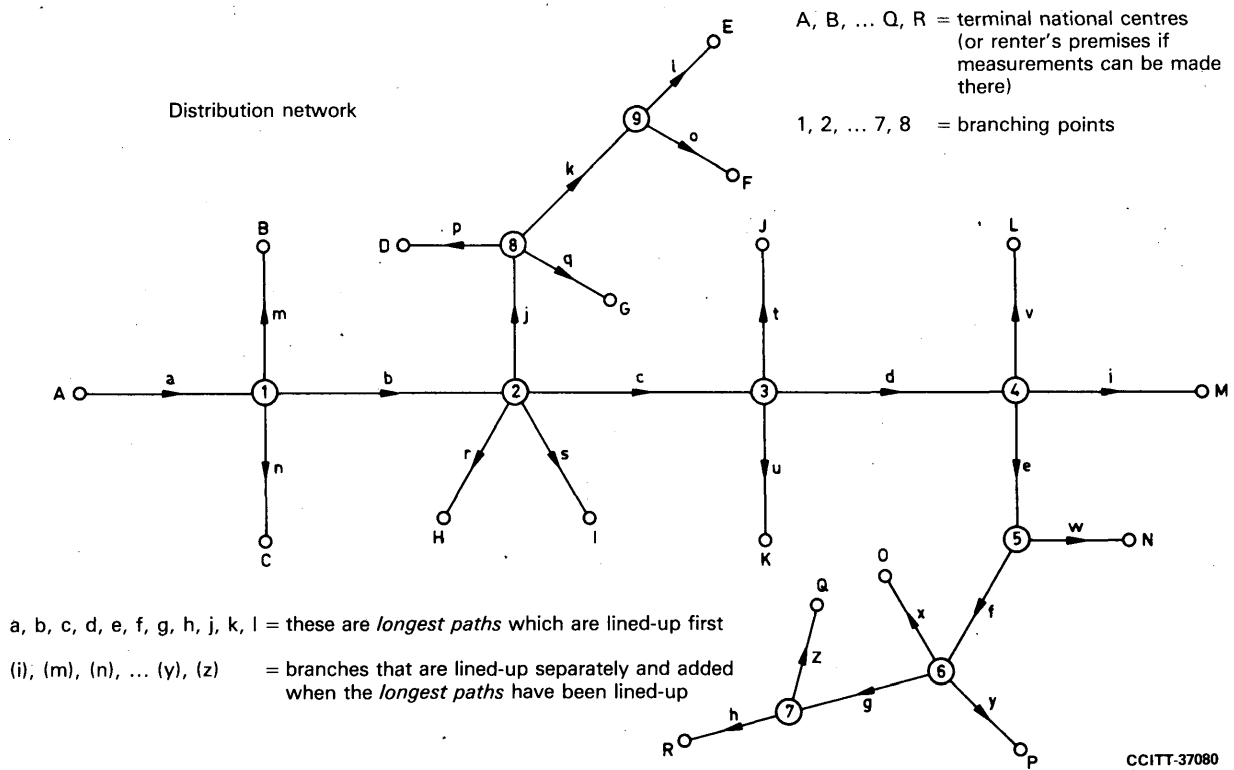


FIGURE 1/M.1055
To illustrate the lining-up of a multiterminal unidirectional circuit

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.

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 dBm_0 ¹⁾.

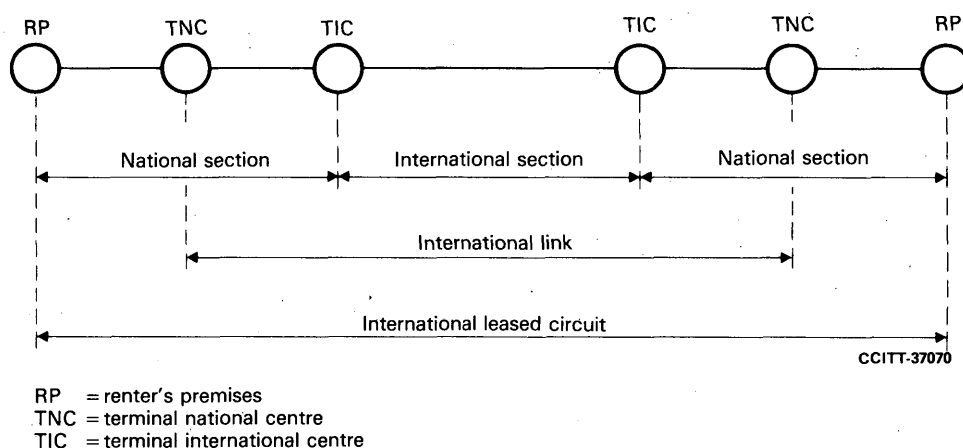


FIGURE 1/M.1060
 The constituent parts of an international point-to-point leased circuit

2 Fault reporting procedures

As far as possible the provisions of Recommendations M.82 [1], M.92 [2] and M.95 [3] apply. Any additional special procedures 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.

¹⁾ This is the preferred level. However, by agreement between Administrations a level of 0 dBm_0 may be used.

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.

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.

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 dBm_{0p} 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 breaks in transmission. Short breaks in transmission should be measured with an instrument complying with Recommendation O.61 [4] or O.62 [5], 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 breaks in transmission, of durations 3 ms-1 min, in any 15 minute measurement period. However, where a short break is detected, the measuring period should be extended to 1 h for which the total number of short breaks should not exceed two (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 [6] (see Notes 2-4 below);
- number of amplitude hits greater than 3 dB should not exceed 10 in 15 minutes. Amplitude hits should be counted using an instrument complying with Recommendation O.95 [6] (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 [7].

Note 2 – The limits for short breaks in transmission, phase hits and amplitude hits are provisional and subject to further study.

Note 3 – Administrations should note that short breaks in transmission, phase hits and amplitude hits are interrelated such that, for example, a short break 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 breaks, 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 800 Hz	As given in Recommendation M.610 [8]
Overall loss/frequency distortion	Annually
Noise power level	As 800 Hz test
Impulsive noise	6-monthly
Group-delay distortion	Annually

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 [9]) – 13 dBm0
- Voice-frequency telegraphy
 - amplitude-modulated
 - frequency-modulated} See Recommendation M.810, § 4.1
- Phototelegraph or facsimile (see Note 4)
 - 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 [10].

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

Note 4 – The levels -3 dBm0 and -13 dBm0 specified in § 8 are provisional and will be studied further by Study Group XIV.

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 carrier system, rerouting should be carried out as far as possible at group, supergroup, etc. level. This would normally not seriously affect the attenuation and group-delay distortion. When such a rerouting of carrier 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 carrier 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 *Circuit control station (leased and special circuits)*, Vol. IV, Fascicle IV.1, Rec. M.82.
- [2] CCITT Recommendation *Sub-control station (leased and special circuits)*, Vol. IV, Fascicle IV.1, Rec. M.92.
- [3] CCITT Recommendation *Transmission maintenance point (international line) (TMP-IL)*, Vol. IV, Fascicle IV.1, Rec. M.95.
- [4] CCITT Recommendation *Essential clauses for a simple instrument to measure interruptions on telephone circuits*, Vol. IV, Fascicle IV.4, Rec. O.61.
- [5] CCITT Recommendation *Essential clauses for a sophisticated instrument to measure interruptions on telephone circuits*, Vol. IV, Fascicle IV.4, Rec. O.62.
- [6] CCITT Recommendation *Specification for an instrument to count phase and amplitude hits*, Vol. IV, Fascicle IV.4, Rec. O.95.
- [7] CCITT Recommendation *9600 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits*, Vol. VIII, Fascicle VIII.1, Rec. V.29, § 6.1.
- [8] CCITT Recommendation *Periodicity of maintenance measurements on circuits*, Vol. IV, Fascicle IV.1, Rec. M.610.
- [9] CCITT Recommendation *Power levels for data transmission over telephone lines*, Vol. VIII, Fascicle VIII.1, Rec. V.2.
- [10] CCITT Recommendation *Maximum permissible value for the absolute power level (power referred to one milliwatt) of a signalling pulse*, Vol. III, Fascicle III.2, Rec. G.224.

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 systems

All of the temporary connection between a telephone at a maritime mobile unit and the 4-wire circuit test access points of an international circuit at an international switching centre. It comprises a *maritime terrestrial circuit*, a *maritime satellite circuit* and a *maritime local system*. The general arrangement is shown in Figure 1/M.1100.

If a switch is included at a *maritime centre*, this may be considered as equal to an *international switching centre* and the maritime satellite system then comprises a maritime satellite circuit and a maritime local system only.

2.2 maritime terrestrial circuit

A 4-wire circuit within a maritime satellite system and in a wholly-terrestrial transmission medium, between the 4-wire circuit test access points at an international switching centre and the 4-wire circuit test access points at a *maritime centre*.

2.3 maritime satellite circuit

A 4-wire circuit between the 4-wire circuit test access points at a *maritime centre*, via a *satellite repeater* to the 4-wire circuit test access points at a *maritime terminal*.

2.4 maritime local system

All the equipment between the 4-wire circuit test access points on a *maritime terminal* and a 2-wire or 4-wire telephone served by that terminal. It may include 4-wire to 2-wire termination sets and 4-wire and 2-wire switching devices using analogue switching.

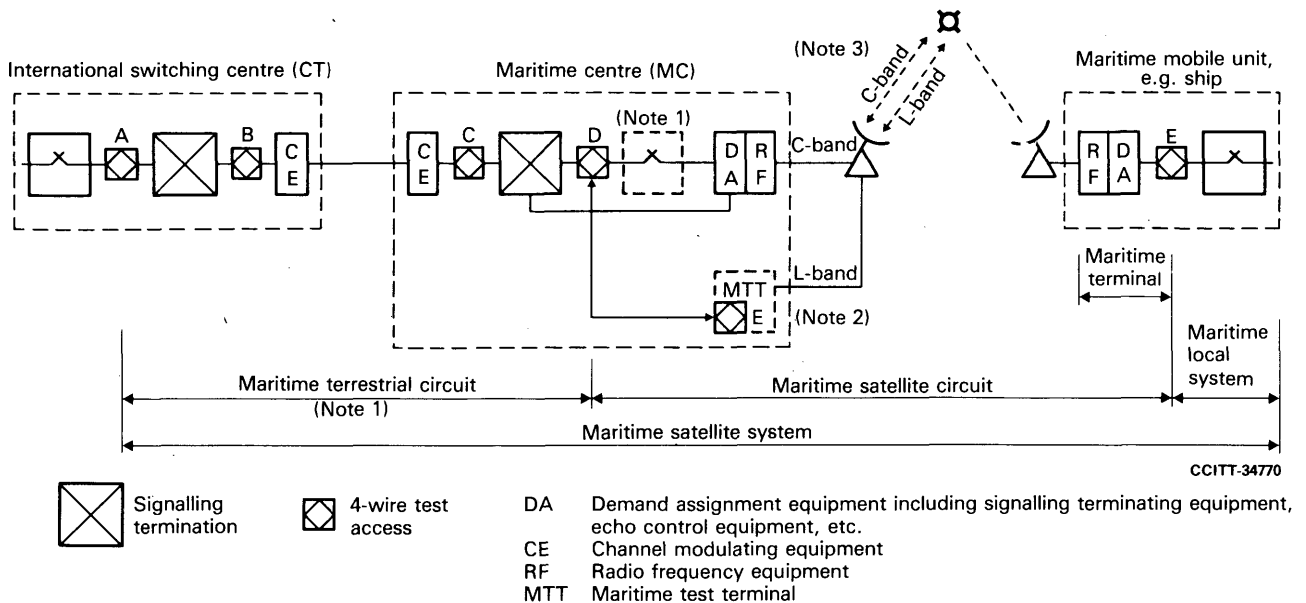


FIGURE 1/M.1100
Constitution of a maritime satellite system

2.5 maritime centre (MC) (shore station ¹⁾)

A satellite earth station which provides a 4-wire analogue interface at a circuit test access point for connection to a *maritime-terrestrial circuit*.

2.6 maritime terminal ²⁾

A terminal station (in a *maritime satellite system*) which provides a 4-wire analogue interface for connection to a *maritime local system* and a 4-wire circuit test access point. Maritime terminals may be located on ships, oil rigs, light ships or other maritime mobile units.

2.7 maritime satellite switching centre (MSSC) ³⁾

The interworking point between the terrestrial telephone network signalling system and the maritime satellite signalling system. The maritime satellite switching centre may be located at the *maritime centre* and operate as an independent international switching centre connected to one or more CTs or national switching centre(s), or it may be remote as a supplement to or as a part of an international switching centre.

¹⁾ This term used for the purpose of this Recommendation is defined as *coast-earth-station* in the Radio Regulations (Article 1, No. 71) [1].

²⁾ This term used for the purpose of this Recommendation is defined as *ship-earth-station* in the Radio Regulations (Article 1, No. 73) [2].

³⁾ The term *maritime satellite switching centre* (MSSC) is not used in this Recommendation at this time. The definition is provided for completeness to provide an indication of the relationship between the *maritime satellite signalling system* and the *maritime satellite system*.

3 General maintenance principles

3.1 In an international connection which includes a maritime mobile unit, the maritime satellite system may be regarded from a transmission point of view as analogous to a national network and the maritime mobile unit as somewhat analogous to a subscriber terminal within that network. Nevertheless, it should be noted that this maritime mobile unit has a "mobile" subscriber terminal and that the maritime satellite circuit is connected to the maritime centre and the maritime mobile unit on a demand assignment basis. Therefore, a maritime centre in the maritime satellite system may not have the direct responsibility for the maintenance of a particular maritime satellite circuit and a particular maritime mobile unit all the time.

The operation and maintenance of the overall maritime satellite system is the responsibility of the maritime satellite system operators, e.g., INMARSAT.

The maintenance organization in each participating country is in general responsible for the maintenance of the maritime terrestrial circuits and the maritime satellite circuits.

3.2 The maritime satellite systems being brought into service provide telex services to maritime mobile units in addition to telephony services. The utilization of these international services for communication, diagnostic and maintenance purposes should be considered by Administrations because of the difficulty for trained technical staff to perform test and repair functions on maritime mobile units in remote areas of the ocean regions.

3.3 Special services, e.g., facsimile and 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 network

Interconnection arrangements are considered with reference to Figure 1/M.1100 and may be divided into two general categories:

- a) The case where no switch exists at the maritime centre (MC);
- b) The case where a switch is located at the maritime centre.

The path between test access points A and D is referred to as the maritime terrestrial circuit in case a) and may be considered as part of the maritime satellite system. Thus, the interface with the international network is considered to be at the switch at the international switching centre at which the maritime terrestrial circuit terminates.

In case b), the switch at the maritime centre is considered to be the interface with the international network, and the circuit between test access points A and D is considered as equivalent to an international public switched telephone circuit. It is noted that optionally in case b), direct circuits may be provided to national switching centres in the country in which the maritime centre is located.

5 Lining up and maintaining maritime terrestrial circuits

The maritime terrestrial circuit is to be lined up and maintained in accordance with Recommendation M.580 [3]. (This is a provisional arrangement pending further study.)

6 Lining up and maintaining maritime satellite circuits

6.1 Transmission characteristics

The setting-up, lining-up and maintenance limits of the maritime satellite circuit (i.e. between test access points D and E) should be as defined in Table 1/M.1100 both for the case where no switch is located at the maritime centre and where a switch is located at the maritime centre.

TABLE 1/M.1100
Provisional setting-up, lining-up and maintenance objectives

Transmission parameters	Maintenance limits (dB)
Loss/frequency relative to the loss at reference frequency	
Below 300 Hz	Not specified
300- 400 Hz	—1.0 to +3.5
400- 600 Hz	—1.0 to +2.0
600-2400 Hz	—1.0 to +1.0
2400-2700 Hz	—1.0 to +2.0 (+3.5) (See Note 1)
2700-3000 Hz	—1.0 to +3.5 (<i>not specified</i>) (See Note 1)
3000-3400 Hz	—1.0 to <i>not specified</i>
Overall loss at reference frequency	2.0 (See Note 2)
Idle noise	Not yet specified. See Annex A for further information.
Signal go-to-return crosstalk	55

Note 1 – When the nominal bandwidth is 300-3000 Hz, the bracketed value supersedes the corresponding upper limit but the remaining values still apply.

Note 2 – If any signal dependent devices (e.g., companders) are involved, the 800-Hz tone used for measuring the loss should be set at the unaffected level (see Recommendation G.162 [4]) of these devices.

6.2 Control, sub-control and respective responsibilities

6.2.1 General

The assignment of control and sub-control stations and respective responsibilities must address the probable configurations of the maritime satellite system, to include the extension to connect to a national network. Such configurations are the responsibility of a participating Administration to meet the needs deemed appropriate by it. In every case a control station(s) must be assigned as regards circuits, and further, sub-control stations may be required for efficient maintenance.

6.2.2 Assignment of control stations (see Figure 1/M.1100)

6.2.2.1 Assignment of the control station in a configuration which provides switching at the maritime centre

Such a configuration is, in effect, two independently operating circuits, one between the international switching centre and the maritime centre and the other between the maritime centre and the maritime terminal.

6.2.2.1.1 The maritime terrestrial circuit will have assigned to it a control station according to the practices and policies of the Administration concerned, with mutual agreement of those responsible for the international switching centre and maritime centre.

6.2.2.1.2 The maritime centre will be the control station for the maritime satellite circuit.

6.2.2.2 Assignment of the control station in a configuration which does not provide switching at the maritime centre

It is proposed that assignments of control stations be as given in § 6.2.2.1 above but this is subject to further study.

6.2.3 Assignment of sub-control stations (see Figure 1/M.1100)

6.2.3.1 It may be appropriate to assign the maritime centre as a sub-control station of the maritime terrestrial circuit; however, this is left to the Administration to decide.

6.2.3.2 In principle, the maritime terminal 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.

6.2.3.3 A maritime test terminal (MTT) may be provided to enhance fault location and maintenance in general, in the maritime satellite system. In this regard the MTT may accomplish some tests normally considered to be within the province of a sub-control station on behalf of a maritime terminal. Whether or not an MTT should be assigned as a sub-control station is left for further study when the operation of an MTT is further defined.

6.2.4 *Responsibilities of control and sub-control stations*

6.2.4.1 Control stations, whether dealing with maritime terrestrial circuits or 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 terminal is essentially a subscriber location.

6.2.4.2 The maritime satellite circuit has a defined circuit access point at both the maritime centre and the maritime terminal. A control or sub-control station is therefore responsible for the circuit between these circuit access points.

6.2.4.3 Additionally, the control or sub-control station may be responsible for apprising the appropriate authority when a situation arises which indicates that a fault may exist at a maritime terminal. This situation requires further study.

6.3 *Fault reporting procedures*

Fault report points (circuit) should be identified in accordance with Recommendation M.715 [5] for the maritime terrestrial and satellite circuits (it is noted that the same point could apply to both circuits particularly if there is no switch at the maritime centre).

Fault report points (network) should be identified in accordance with Recommendation M.716 [6]. One such point is required for the maritime satellite system and may be assigned to the maritime network coordinating station⁴⁾. However, general international networking problems should in the first instance be referred to the nearest fault report point (network) having a responsibility towards an international switching centre to which the maritime system is interconnected.

Exchange of contact point information should be in accordance with Recommendation M.728 [7].

7 **Testing procedures**

7.1 *Use of maritime test terminal (MTT)*

7.1.1 It would be advantageous to incorporate equipment at the maritime centre for automatic testing of the maritime transmitting and receiving equipment of the centre.

This equipment could facilitate:

- tracing of faults in the shore station equipment;
- testing of transmission characteristics of satellite circuits;
- testing of maritime satellite signalling procedures;
- testing of channel assignment procedures.

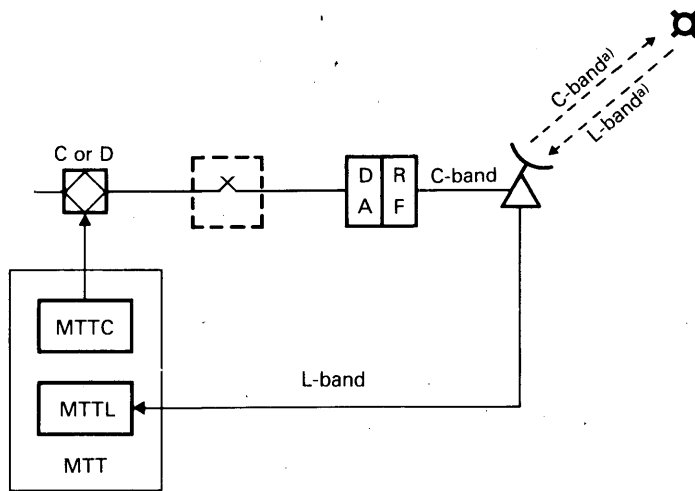
The maritime test terminal (hereafter referred to as MTT) would then enable the shore station staff to undertake complete tests of the maritime satellite circuit without involving the international network.

7.1.2 The MTT would be composed of two parts:

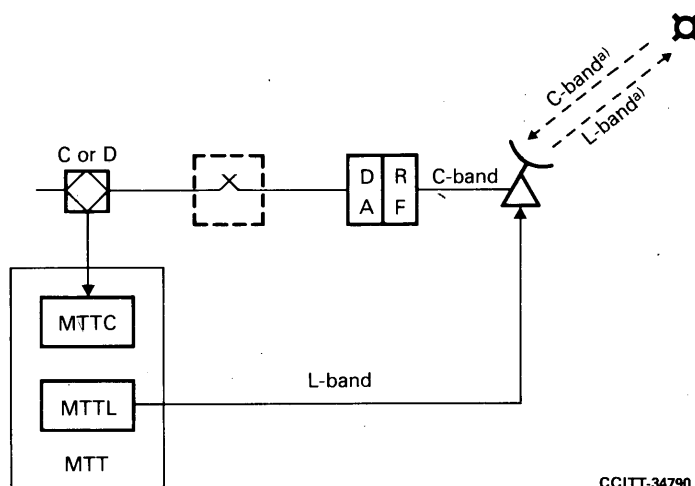
- the MTTC which may be connected to the test points C or D of the maritime centre (Figure 1/M.1100);
- the MTTL which would be connected to the L-band equipment of the maritime centre.

The configurations are shown in Figure 2/M.1100 for test loops set up between the MTTL and the MTTC.

⁴⁾ The *network coordination station* (NCS) is a station in the maritime satellite system with the capability to coordinate the assignment and utilization of the maritime satellite circuits within a satellite coverage area. The network coordination station is designated and operated by the satellite system operators.



a) Test loop set up from MTTC to MTTL



b) Test loop set up from MTTL to MTTC

a) The actual frequencies used are 4/6 GHz (C-band) and 1.5/1.6 GHz (L-band).

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FIGURE 2/M.1100
Interconnection of the MTT with the maritime satellite system

7.1.3 The setting-up of test calls should follow the same procedures as are used for the setting-up of calls between a maritime mobile unit and the MC. The receiving part of the MTT should return the answer signal automatically; thereupon an automatic test cycle could commence or manual testing could be performed. When the test has been completed the connection should be released using ordinary satellite signalling procedures.

7.1.4 It would be advantageous if the MTTL were identified by a number in the ship station number series. Then the format of the call message to the MTTL would be as for calls to a mobile unit.

The MTTC may be addressed from the MTTL either by using a test call category indication in the calling message from the MTTL or by any other convenient number. In the latter case the composition of the calling message and the dialling procedure would be as for ordinary calls.

7.1.5 The maritime satellite circuit will most likely be equipped with compandors. Because of the noise suppression by the compandor, means should be provided to perform noise measurements with the expander disabled. Noise measurements with the expander included may be done as test signal-to-noise ratio measurements; but see Annex A to this Recommendation.

7.2 Automatic testing of maritime terminal equipment

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 maritime terminal should be possible by including automatic test equipment at the maritime terminal. The required facilities should include quiet termination, test line and loop around test line as given in Recommendation O.11 [8].

7.3 Manual testing of maritime terminal equipment

It should be possible to undertake manual testing of the transmission performance of maritime terminals. This type of test is essential when a terminal is being lined up after it has been repaired.

It should be possible to initiate the test either from the MC or from the maritime mobile unit.

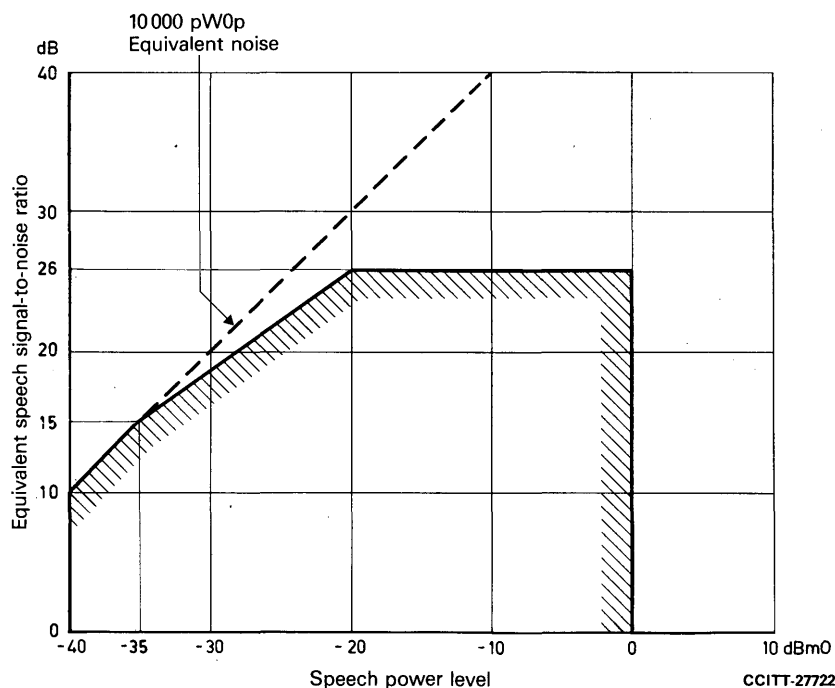
In order to meet these objectives the maritime terminal should, as a minimum, be equipped with a tone generator and level meter.

ANNEX A

(to Recommendation M.1100)

Idle noise objectives of a maritime satellite circuit

As a maritime satellite circuit may contain speech dependent devices (e.g., companders), 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 relates subjectively equivalent speech signal-to-noise ratio, in dB (see the manual cited in [9]), to mean speech power level (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

Idle noise objective of a maritime satellite circuit

References

- [1] *Radio Regulations*, Article 1, No. 71, ITU, Geneva, 1980.
- [2] *Ibid.*, No. 73.
- [3] CCITT Recommendation *Setting up and lining up an international circuit for public telephony*, Vol. IV, Fascicle IV.1, Rec. M.580.
- [4] CCITT Recommendation *Characteristics of compandors for telephony*, Vol III, Fascicle III.1, Rec. G.162.
- [5] CCITT Recommendation *Fault report point (circuit)*, Vol. IV, Fascicle IV.1, Rec. M.715.
- [6] CCITT Recommendation *Fault report point (network)*, Vol. IV, Fascicle IV.1, Rec. M.716.
- [7] CCITT Recommendation *Guidelines for the cooperation between maintenance elements*, Vol. IV, Fascicle IV.1, Rec. M.728.
- [8] CCITT Recommendation *Specifications for manual maintenance access lines*, Vol. IV, Fascicle IV.4, Rec. O.11.
- [9] CCITT manual *Transmission Planning of Switched Telephone Networks*, Chapter III, Annex 4, ITU, Geneva, 1980.

SECTION 9

INTERNATIONAL PUBLIC NETWORK MAINTENANCE

9.1 International public telephone network information

Recommendation M.1220

EXCHANGE OF NETWORK MAINTENANCE INFORMATION

1 Maintenance of the international network is fundamentally concerned with ensuring that the automatic and semiautomatic 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 necessary that network maintenance forces receive relevant information that may assist in identifying network impairments and directing corrective action. Such information goes beyond basic fault reporting and is indicated in Table 1/M.1220.

TABLE 1/M.1220

Item	Type of information to be exchanged	Suggested periodicity
1a	National ^{b)} network call completion information or the results of observations carried out on real traffic	As available ^{a)}
1b	International ^{c)} network call completion information (including results by individual route where available) or the results of observations carried out on real traffic	Quarterly ^{a)}
2a	Fault report patterns ^{d)}	As identified
2b	Fault report trend data	Monthly
3a	National numbering plan review	Annually
3b	National numbering plan changes	As identified
4a	Circuit order of selection	6 months
4b	Circuit order of selection changes	As identified

^{a)} Abnormal trends or conditions identified should not await periodic exchange but should be promptly brought to the attention of those who can take corrective actions. Period of exchange may be, for example, monthly or semiannual, as information is available.

^{b)} Information to reflect the national network call completion rate, if available, would act as a reference with which to compare completion rates experienced from other networks.

^{c)} It is desirable that information be taken from the outgoing side of the origination international switching centre.

^{d)} When individual subscriber 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* (see Recommendation M.720 [1]) could use such information to identify suspected network components and make referrals or notifications to the appropriate maintenance forces for corrective actions.

2 The information listed in Table 1/M.1220 can be used for the maintenance of the international network as follows:

- i) National and international network call completion information, including the observation of real traffic ¹⁾:
 - can be used for comparative purposes to identify abnormalities.
- ii) 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.
- iii) National numbering plan and changes thereto:
 - can reduce misrouting of traffic resulting from lack of information regarding valid numbering and routing. Such misrouting can cause:
 - 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:
 - information necessary for the efficient selection of circuits by the two international exchanges concerned. Selection of circuits not in the sequence agreed upon can cause:
 - a) uneven distribution of traffic among the circuits involved,
 - b) increased probability of simultaneous seizures which lead to initial call failure and subsequent attempts.

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.

3 When considering the information exchanged, account will need to be taken of any known abnormalities in the network since this could influence the interpretation of the information. Among such factors are:

- faulty circuits or equipment,
- excessive loss, noise, crosstalk, etc.,
- insufficient circuits or equipment,
- subscriber dialling irregularities,
- busy or no answer conditions, etc.

When any such abnormalities are known to the Administration supplying network maintenance information, they should be indicated. However, so far as is possible, recognized human errors which influence the information should be eliminated before it is supplied to an Administration.

Reference

- [1] CCITT Recommendation *Network analysis point*, Vol. IV, Fascicle IV.1, Rec. M.720.

¹⁾ Data samples should be of sufficient quantity so as to offer reasonable accuracy in the interpretation and analysis of the results.

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.421 [1] and E.423 [2] and from monitoring of live traffic¹⁾.

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 *Service quality observations*, Vol. II, Fascicle II.3, Rec. E.421.
- [2] CCITT Recommendation *Observations on traffic set up by operators*, Vol. II, Fascicle II.3, Rec. E.423.

¹⁾ 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.

**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. 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 [1] and, in particular, in line with the application of controlled maintenance methods as explained in reference [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 *Maintenance methods*, Vol. IV, Fascicle IV.1, Rec. M.730.
- [2] *Ibid.*, § 4.

