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FASCICLE IV.2

Recommendations M.800 to M.1375

MAINTENANCE OF INTERNATIONAL TELEGRAPH,

PHOTOTELEGRAPH AND LEASED CIRCUITS

MAINTENANCE OF THE INTERNATIONAL

PUBLIC TELEPHONE NETWORK

MAINTENANCE OF MARITIME SATELLITE

AND DATA TRANSMISSION SYSTEMS

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SECTION 5

INTERNATIONAL TELEGRAPH SYSTEMS

AND PHOTOTELEGRAPH TRANSMISSION

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

Recommendation M.800

USE OF CIRCUITS FOR VOICE-FREQUENCY TELEGRAPHY

1 Composition and nomenclature

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

1.1 *The international voice-frequency telegraph system*

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

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

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

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

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

1.3 *The international voice-frequency telegraph line*

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

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

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

FIGURE 1/M.800, p. 1

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

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

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

2 Reserve arrangements for international voice-frequency telegraph links

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

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

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

2.1 *Reserve international lines*

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

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

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

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

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

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

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

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

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

2.4 *Changeover arrangements from normal to reserve* lines

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

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

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

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

Figure 2/M.800 p.2

2.5 *Designation and identifying marks*

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

References

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

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

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

Recommendation M.810

SETTING UP AND LINING UP AN INTERNATIONAL VOICE-FREQUENCY TELEGRAPH LINK FOR PUBLIC TELEGRAPH CIRCUITS

(FOR 50, 100 AND 200 BAUD MODULATION RATES)

1 Designation of control stations

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

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

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

2 Organization

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

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

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

— Type I are those links which contain 4-kHz sections;

— Type II are those links which contain one or more 3-kHz sections, or contain a mixture of 3-kHz and 4-kHz sections;

— Type III are those links which are routed over audio-frequency line plant.

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

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

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

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

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

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

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

4.1 *Nominal overall loss at 1020 Hz*

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

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

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

4.2 *Overall loss/frequency distortion*

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

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

H.T. [T1.810]
TABLE 1/M.810

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

Table 1/M.810 [T1.810],p.

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

H.T. [T2.810]
TABLE 2/M.810

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

Table 2/M.810 [T2.810], p.

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

H.T. [T3.810]
TABLE 3/M.810

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

Table 3/M.810 [T3.810], p.

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, p.

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

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

4.3.2 *Change in overall loss at 1020 Hz*

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

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

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

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

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

5.1 *Uniform-spectrum random noise*

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

The mean psophometric noise power referred to a point of zero relative level should not exceed 80 | 00 pW (—41 dBm0p).

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

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

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

5.2 *Impulsive noise*

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

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

6 Crosstalk

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

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

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

7 Group-delay/frequency distortion

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

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

8 Frequency error

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

9 Interference caused by power supply sources

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

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

10 Variation of overall loss with time

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

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

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

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

11 Amplitude hits, short interruptions in transmission and phase hits

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

12 Record of results

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

13 Information concerning voice-frequency telegraph terminal equipment

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

14 Marking of circuits used for voice-frequency telegraphy

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

ANNEX A
(to Recommendation M.810)

Basic characteristics of telegraph equipments used

in international voice-frequency telegraph systems

A.1 *Limiting power per channel*

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

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

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

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

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

H.T. [T4.810]

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	{	
	µW0	dBm0
12 telegraph channels or less	35	—14.5
18 telegraph channels	15	—18.3
24 (or 22) telegraph channels	9	—20.5

Table A-1/M.810 [T4.810], p.

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

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

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

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

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

H.T. [T5.810]

TABLE A-2/M.810

Normal limits for the power for telegraph channel in FMVFT systems

for bearer circuits with caracteristics not exceeding the limits given in Annex B

{	{ in microwatts	{
12 or less	4**.67**	—24**.8**
18 or less	2.67	—25.8
24 **or less**	2**.67**	—27**.8**

Table A-2/M.810 [T5.810], p.

H.T. [T6.810]

TABLE A-3/M.810

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

{	{ in microwatts	{
12 or less	10.8	—19.7
18 **or less**	7.2	—21.5
24 **or less**	5.4	—22.7

Table A-3/M.810 [T6.810], p.

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.

H.T. [T7.810]

TABLE A-4/M.810

Unable to convert table **Table A-4/M.810 [T7.810], p.**

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 | fIbis [13].

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ANNEX B
(to Recommendation M.810)

Limits required by a bearer circuit for FMVFT application if the

total power transmitted by all channels is set at 50 microwatts

B.1 *Loss/frequency distortion*

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

H.T. [T8.810]
TABLE B-1/M.810

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

Table B-1/M.810 [T8.810], p.

B.2 *Random noise*

The mean psophometric noise power referred to a point of zero relative level should not exceed 32 | 00 pW0p (—45 dBm0p), using a psophometer in accordance with Recommendation O.41 [5].

B.3 *Impulsive noise*

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

B.4 *Error rates*

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

B.5 *Bearer length*

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

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

References

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

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

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

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

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

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

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

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

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

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

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

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

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

Recommendation M.820

PERIODICITY OF ROUTINE TESTS ON INTERNATIONAL VOICE-FREQUENCY TELEGRAPH LINKS

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

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

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

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

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

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

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

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

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

References

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

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

Recommendation M.830

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

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

The measuring frequencies are as follows:

— circuits providing an 18-channel telegraph system: 300, 400, 600, 800, 1020, 1400, 1900, 2400, 2600 Hz;

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

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

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

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

Recommendation M.850

INTERNATIONAL TIME DIVISION MULTIPLEX (TDM)

TELEGRAPH SYSTEMS

1 General description of an international TDM system

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

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

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

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

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

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

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

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

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

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

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

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

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

FIGURE 1/M.850 + Remarque, p. 12

FIGURE 2/M.850, p. 13

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

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

4.1 *Characteristics and line-up*

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

4.2 *Maintenance*

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

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

5 Reserve arrangements for TDM telegraph links

5.1 *General requirements*

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

5.2 *Basic international telegraph links*

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

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

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

6 TDM telegraph link designation

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

7 Marking of equipment associated with TDM telegraph links

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

8 TDM telegraph link control and sub-control stations

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

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

References

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

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

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

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

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

5.3 Lining up and maintenance of international phototelegraph links

Recommendation M.880

INTERNATIONAL PHOTOTELEGRAPH TRANSMISSION

1 Types of circuits

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

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

2 Line-up

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

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

3 Relative levels

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

4 Loss/frequency distortion

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

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

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

5 Variation of overall loss with time

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

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

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

Figure 1/M.880, p.

6 Phase/frequency distortion

Phase/frequency distortion limits the range of satisfactory phototelegraph transmission the phototelegraph transmission range, should not exceed:

$$\frac{\Delta}{t}$$

[Unable to Convert Formula]

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

(See Recommendation T.12 [2].)

7 Sent signal power

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

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

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

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

8 Marking of equipment

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

9 Organization of maintenance

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

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

10 Routine tests

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

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

11 Information concerning frequencies transmitted by phototelegraph equipment

11.1 *Amplitude modulation*

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

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

11.2 *Frequency modulation*

Mean frequency 1900 Hz

White frequency 1500 Hz

Black frequency 2300 Hz

Phasing signal frequency 1500 Hz

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

References

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

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

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

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

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

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SECTION 6

INTERNATIONAL LEASED GROUP AND SUPERGROUP LINKS

Recommendation M.900

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

NOMENCLATURE AND COMPOSITION

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

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

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

1 Nomenclature

1.1 **international leased group or supergroup link**

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

1.2 **terminal national section**

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

1.3 **national main section**

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

1.4 **international main section**

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

1.5 **terminal national centre**

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

1.6 **terminal international centre**

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

2 Composition

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

2.2 *The leased group or supergroup link*

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

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

Figure 1/M.900, p.

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

a) the terminal international centre, and

b) the terminal national centre.

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

2.3 *National and international main sections*

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

— minimize the amount of group-delay distortion correction required;

— to simplify the effort necessary for the satisfactory maintenance of the link.

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

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

2.4 *Terminal national sections*

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

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

— symmetric pair cable specially provided between the terminal national centre (repeater station) and the renter's premises;

— existing local line plant possibly involving intermediate installations (for example, telephone exchanges) in the local network;

— combinations of the above.

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

2.5 *Choice of the group position within a supergroup*

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

3 Provision of group or supergroup reference pilots and automatic regulators

3.1 *Pilots*

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

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

3.2 *Group and supergroup link regulation*

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

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

References

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

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

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

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

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

Recommendation M.910

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

1 General

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

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

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

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

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

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

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

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

2 Setting-up of an international leased group link

2.1 *National and international main section*

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

2.2 *Terminal national sections*

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

2.3 *Application of the group reference pilot*

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

3 Lining up an international leased group link

3.1 *Lining up the national and international main sections*

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

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

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

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

3.2 *Terminal national sections*

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

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

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

3.4 *Overall line-up of the link*

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

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

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

3.4.1 *Overall loss at the reference frequency*

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

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

3.4.2 *Loss/frequency distortion*

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

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

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

Figure 1/M.910, p.

3.4.3 *Group-delay distortion*

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

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

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

3.4.4 *Level variations*

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

— short-term variations: ± | dB,

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.

— long-term variations: ± | dB, relative to the nominal value.

3.4.5 *Carrier leak*

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

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

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

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

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

3.4.6 *Impulsive noise*

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

3.4.7 *Frequency error*

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

3.4.8 *Background noise*

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

References

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

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

[3] *Ibid.* , § 7.2.

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

[5] *Ibid.* , § 8.

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

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SECTION 7

INTERNATIONAL LEASED CIRCUITS

7.1 General

Preface

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

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

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

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

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

Recommendation M.1010

CONSTITUTION AND NOMENCLATURE OF INTERNATIONAL LEASED CIRCUITS

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

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

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

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

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

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

Figure 1/M.1010 p.

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 p.

3.1 international leased circuit

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

3.2 international link

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

3.3 international line

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

3.4 national line

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

3.5 terminal international centre

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

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

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

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

3.6 **terminal national centre**

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

— nearest to the renter's installation,

— provided with a circuit test point, so that transmission measurements can be made by appropriate staff.

3.7 **terminal national section**

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

Recommendation M.1012

CIRCUIT CONTROL STATION FOR LEASED AND SPECIAL CIRCUITS

1 Definition of circuit control station

The circuit control station is that point within the general maintenance organization which fulfils the control responsibilities for leased and special circuits, for example circuits used for voice-frequency telegraphy, facsimile and phototelegraphy.

2 Responsibilities

The circuit control station is responsible for ensuring that the circuit assigned to it is set up and maintained to the required end-to-end standards in both directions of transmission and that, if the circuit fails, the outage time is kept to a minimum. The circuit control station carries out this responsibility by directing, and/or coordinating other stations as necessary to ensure that satisfactory service is provided for which it has been assigned control.

3 Functions

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

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

3.3 Receiving fault reports from the:

— circuit user or his representative, either directly or via nominated fault report points;

— staff at the maintenance entities;

— transmission maintenance point (international line) (TMP-IL) (see Recommendation M.1014);

— sub-control station either directly or via the TMP-II.

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

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

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

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

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

3.7 Controlling the withdrawal of circuits from service.

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

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

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

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

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

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

— the reference number mentioned in § 3.3;

— the circuit outage time;

— the location of the fault that is, in a national or international circuit section or in the renter's equipment;

— the general nature of the fault.

4 Appointment of control stations

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

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

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

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

— availability of staff;

— availability of adequate staff expertise;

— availability of communication with user and other pertinent locations;

— ability to fulfil the functions indicated in this Recommendation.

Recommendation M.1013

SUB-CONTROL STATION FOR LEASED AND SPECIAL CIRCUITS

1 Definition of circuit sub-control station

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

2 Responsibilities

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

3 Functions

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

3.2 Cooperating with the circuit control station and other circuit sub-control stations either directly or via the TMP-IL (see Recommendation M.1014) in ensuring that routine maintenance, fault location and clearance are carried out by the responsible testing points and/or maintenance units in a proper manner.

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

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

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

— the reference number mentioned in § 3.2;

— the circuit outage time;

— the location of the fault, that is, in a national or international circuit section or in the renter's equipment;

— the general nature of the fault.

4 Appointment of sub-control stations

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

In transit countries in which a circuit is brought to audio frequencies or 64 kbit/s etc., an intermediate circuit sub-control station is appointed at a suitable point for each direction of transmission. It is left to the Administration concerned to choose:

— where this point shall be,

— whether the sub-control functions for the two directions of transmission are vested in one station or two stations,

— whether, as may be desirable in the case of a large country, each direction of transmission has more than one circuit sub-control station per transit country.

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

Recommendation M.1014

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

1 Definition of transmission maintenance point (international line)

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

The transmission maintenance points (international line) are elements within the general maintenance organization located at the terminals of that part of a leased or special circuit known as the international line. An international line is defined in Recommendation M.1010. The class of circuits considered here are also referred to in Recommendations M.1012 and M.1013 concerning circuit control and sub-control functions for international leased and special circuits.

2 Responsibilities and functions

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

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

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

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

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

3 Facilities

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

3.1 Access to the line access point directly or indirectly.

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

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

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

Recommendation M.1015

TYPES OF TRANSMISSION ON LEASED CIRCUITS

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

— telephony (that is, speech transmission),

— voice-frequency telegraphy,

— data transmission,

— facsimile.

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

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

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

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

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

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

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

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

FIGURE 1/M.1015 p.

FIGURE 2/M.1015 p.

FIGURE 3/M.1015 p.

Recommendation M.1016

ASSESSMENT OF THE SERVICE AVAILABILITY PERFORMANCE OF INTERNATIONAL LEASED CIRCUITS

1 General

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

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

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

2 Basis of assessments of service availability performance

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

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

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

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

3 Purpose of the assessment procedure

3.1 *General*

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

— international purposes;

— national purposes.

3.2 *International purposes*

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

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

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

3.3 *National purposes*

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

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

4 Description of the assessment procedure

4.1 *Collection of basic data*

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

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

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

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

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

— if tests or investigations reveal that a fault or impairment exists (or has existed), downtime will be taken into account;

— if no fault or impairment is ever observed by the Administration, no downtime will be taken into account;

— the time the Administration returns service to the customer (or the first attempt to do so) is taken as the end of downtime;

— only those planned interruptions which unacceptably disrupt the customers service will be taken into account.

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

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

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

4.2 *Basic data*

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

— the number of international leased circuits involved. Guidance on how to determine this number is given in Annex B;

— the designation of each circuit involved, as agreed between Administrations in accordance with Recommendation M.140 [4];

— for each involved circuit, the number of faults and unacceptable planned interruptions of service within the observation period (refer to Annex A);

— for each fault and planned interruption of service:

i) the start of downtime (in UTC)

ii) the end of downtime (in UTC)

iii) the duration of downtime;

— the address(es) of involved Administrations and, ideally, the name and telephone number of an appropriate contact person within each Administration.

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

4.3 *Observation period*

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

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

4.4 *Exchange of information between terminal Administrations*

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

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

4.5 *Elaboration of results*

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

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

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

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

4.6 *Presentation of service availability performance information*

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

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

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

b) mean downtime per circuit,

c) mean number of faults per circuit,

d) mean time to failure (MTTF),

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

f) mean time to restore service (MTRS).

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

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

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

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

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

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

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

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

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

5 Considerations for comparing service availability performance information internationally

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

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

a) priority maintenance attention to international leased circuits;

b) duplicated circuit sections;

c) fault clearance service;

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

e) information to customers about planned interruptions to service.

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

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

ANNEX A
(to Recommendation M.1016)

Rules for determining the number of faults and the downtime

to be taken into account in assessments of the service availability performance of international leased circuits

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

TABLE A-1/M.1016 (à traiter comme figure MEP), p.

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

TABLE A-2/M.1016 (a traiter comme figure MEP), p.

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

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

ANNEX B
(to Recommendation M.1016)

Presentation of service availability performance information for international leased circuits

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

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

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

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

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

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

B.2 *Mean downtime per circuit*

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

Mean downtime per circuit (μ_{DT}) = [Unable to Convert Formula] $\sum_{i}^{f\,Bi}$ Downtime in –v'8p' observation period

where

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

downtime is in hours

$\mu_{D\backslash dT}$ is in hours.

B.3 *Mean number of faults per circuit*

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

Mean number of faults per circuit =
[Unable to Convert Formula]
$\sum_{i}^{f\,Bi}$
Faults

where

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

B.4 *Mean time to failure*

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

$$MTTF = \frac{n \times \text{observation period}) — (\sum_{i}^{f\,Bi} \text{Downtime})}{\textit{vents that contribute downtime}}$$

where

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

MTTF is in days

Observation period is in days

Downtime is in days

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

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

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

where

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

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

B.6 *Mean time to restore service*

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

$$\text{MTRS} = \frac{\sum_{i}^{f\,Bi} \text{Downtime}}{\sum_{i}^{f\,Bi} \text{Events that contribute downtime}}$$

where

Downtime is in hours

MTRS is in hours

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

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

(In the case of 4 observation periods)

Long-term mean downtime per circuit

$$(\mu_{DT\,\sigma''}) = \left(n_i fR \times \mu_{DT\,i}\, fR \right)$$

$$n_i$$

where

n_i and $\mu_{DT\,i}$ are the values corresponding to each observation period

$\mu_{DT\,i}$ is in hours

$\mu_{DT\,\sigma''}$ is in hours

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

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

FIGURE B-1/M.1016, p.

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

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

ANNEX C
(to Recommendation M.1016)

Additional information to be exchanged between

Administrations concerning
service availability performance

C.1 *Types of information*

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

a) International leased circuits are given priority maintenance attention over public circuits:

i) YES

ii) NO

b) Duplicated circuit sections (circuit level only):

i) SUBSCRIBER LINE (TERMINAL NATIONAL SECTION) AND/OR NATIONAL LINE (WHOLLY OR PARTLY) AND/OR INTERNATIONAL LINE

ii) NO DUPLICATION

c) Fault clearance service:

i) OFFICE HOURS ONLY

ii) 24 HOURS / 7 DAYS PER WEEK

d) Limits applied to determine if a fault exists:

i) Recommendation M.1040

ii) Recommendation M.1040 type, but with more stringent limits/additional parameters

iii) Recommendation M.1040 type, but with less stringent limits/fewer parameters

iv) Recommendation M.1020

v) Recommendation M.1020 type, but with more stringent limits/additional parameters

vi) Recommendation M.1020 type, but with less stringent limits/fewer parameters

vii) Recommendation M.1025

viii) Recommendation M.1025 type, but with more stringent limits/additional parameters

ix) Recommendation M.1025 type, but with less stringent limits/fewer parameters

e) Customer informed about planned interruptions of service:

i) IN PRINCIPLE ALWAYS

ii) IN PRINCIPLE NEVER

iii) SOMETIMES

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

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

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

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

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

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

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

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

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

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

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

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

H.T. [T1.1016]

TABLE C-1/M.1016

Rules for combining information on planned interruptions of service

{ Control station Administration indicates: }	{	
Sub-control station Administration indicates: }	{	
Situation for the circuit is deemed to be: }		
Customer always informed	Never Sometimes Always	Customer is always informed
{	Never Sometimes Always	{ Customer is always informed
Customer is never informed	Never Sometimes	Never Sometimes

Tableau C-1/M.1016 [T1.1016], p. 25

BLANC

APPENDIX I

(to Recommendation M.1016)

H.T. [T2.1016]

{
INVESTIGATION OF INTERNATIONAL LEASED CIRCUIT PERFORMANCE DATA FROM THE ADMINISTRATION WITH *CONTROL STATION* RESPONSIBILITY
}
{
(
Observation period:
)
}
{
Circuits between
(Control ADMIN)
and
(Sub-control ADMIN)
}

Circuit designation	Start of downtime		End of downtime		Duration (min)	Additional information (7)
	Date	Time (UTC)	Date	Time (UTC)		

(1)	(2)	(3)	(4)	(5)	(6)	a	b	c	d	e
Contact person for this data										

TABLE A-I/M.1016 [T2.1016], p. (a l'italienne)

APPENDIX II

(to Recommendation M.1016)

H.T. [T3.1016]

{
INVESTIGATION OF INTERNATIONAL LEASED CIRCUIT PERFORMANCE DATA FROM THE ADMINISTRATION WITH *SUB-CONTROL STATION* RESPONSIBILITY
}
{
(
Observation period:
)
}
{
Circuits between
(Sub-control
ADMIN)
and
(Control ADMIN)
}

Circuit designation	Start of downtime		End of downtime		Duration (min)	Additional information (7)
	Date	Time (UTC)	Date	Time (UTC)		

(1)	(2)	(3)	(4)	(5)	(6)	a	b	c	d	e
Contact person for this data										

TABLE A-II/M.1016 [T3.1016], p. (a l'italienne)

APPENDIX III

(to Recommendation M.1016)

H.T. [T4.1016]

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

{
(
Observation period: 1 Jan 1982 — 31 March 1982
)
}

Example only

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

Circuit designation	Start of downtime		End of downtime		Duration (min)	Additional information (7)				
	Date	Time (UTC)	Date	Time (UTC)						
(1)	(2)	(3)	(4)	(5)	(6)	a	b	c	d	e
London-Frankfurt DP7	3 Jan	0810	3 Jan	1100	170	i	i	ii	iv	i
	7 Feb	1600	7 Feb	1610	10					
	16 Feb	0930	16 Feb	1030	60					
	3 March	1700	4 March	0810	1050					
London-Dusseldorf DP3	17 Jan	1200	17 Jan	1410	130	i	ii	ii	iv	i
London-Dusseldorf DP6	1 March	0825	1 March	0910	45	i	ii	ii	iv	i
	3 March	0830	3 March	1000	90					
London-Hamburg XP7	21 Feb	1600	21 Feb	1815	135	i	ii	ii	iv	i
	23 Feb	1105	23 Feb	1120	15					
London-Frankfurt DP2	No Faults	i	ii	ii	iv	i				
London-Frankfurt DP9	No Faults	i	ii	ii	iv	i				
London-Frankfurt XP2	No Faults	i	ii	ii	iv	i				
London-Hamburg DP1	No Faults	i	ii	ii	iv	i				
Contact person for this data										

TABLE A-III/M.1016 [T4.1016], p. (a l'italienne)

APPENDIX IV

(to Recommendation M.1016)

H.T. [T5.1016]

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

{
(
Observation period: 1 Jan 1982 — 31 March 1982
)
}

Example only

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

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

TABLE A-IV/M.1016 [T5.1016], p. (a l'italienne)

References

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

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

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

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

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

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