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Recommendation M.1020

CHARACTERISTICS OF SPECIAL QUALITY INTERNATIONAL LEASED CIRCUITS WITH SPECIAL BANDWIDTH CONDITIONING

7.2 Characteristics of international leased circuits

1 Scope

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

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

2 Characteristics

2.1 *Nominal overall loss*

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

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

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

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

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

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

2.2 *Loss/frequency distortion*

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

Figure 1/M.1020 p.

2.3 *Group-delay distortion*

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

Figure 2/M.1020, p.

2.4 *Variation of overall loss with time*

2.4.1 *Amplitude hits*

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

2.4.2 *Other variations*

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

2.5 *Random circuit noise*

The level of the psophometric noise power at a renter's premises depends upon the actual constitution of the circuit, in particular upon the length of circuit of frequency division multiplex carrier systems in the circuit. The provisional limit for leased circuits of distances greater than 10 | 00 kilometres is —38 dBm0p. However, circuits of shorter length will have substantially less random noise (see also Annex A to this Recommendation and Recommendation M.1050, § 3.5).

2.6 *Impulsive noise*

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

2.7 *Phase jitter*

The value of phase jitter measured at a renter's premises depends upon the actual constitution of the circuit (for example, upon the number of modulation equipments involved). It is expected that any measurement of phase jitter using an instrument complying with Recommendation O.91 [4] will not normally exceed 10° peak-to-peak. However, for circuits of necessarily complex constitution and where 10° peak-to-peak cannot be met, a limit of up to 15° peak-to-peak is permitted. The limits for low frequency phase jitter are under study.

2.8 *Total distortion (including quantizing distortion)*

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

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

2.9 *Single tone interference*

The level of single tone interference in the band 300-3400 Hz shall not exceed a value which is 3 dB below the circuit noise objective indicated in Figure A-1/M.1020.

2.10 *Frequency error*

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

2.11 *Harmonic and intermodulation distortion*

When a 700-Hz test frequency of —13 dBm0 is injected at the transmit end of a point-to-point circuit, the level of any individual harmonic frequency at the receiving end shall provisionally be at least 25 dB below the received level of the fundamental frequency.

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

ANNEX A

(to Recommendation M.1020)

Noise and distortion

A.1 *Random circuit noise*

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

Figure A-1/M.1020 p.

Note — At the present time the section of the circuit provided by a satellite (between earth stations) employing FDM techniques contributes approximately 10 | 00 pW0p (—50 dBm0p) of noise. Therefore, for the purpose of determining maintenance limits for noise measurement on leased circuits, the length of this section may be considered to be equivalent to 1000 km in Figure A-1/M.1020.

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

A.2 *Total distortion*

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

H.T. [T1.1020]

TABLE A-1/M.1020

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

Type of circuit	Number of QDUs (Note)	Unit	{						
			< | 20	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5001 to 10 | 00	10 | 01 to 20 | 00
Analogue	0	dB	43	41	38	36	33	30	28
1	dB	34	34	33	32	31	29	28	
2	dB	32	31	31	31	29	28	28	
Composite circuit	3	dB	30	30	30	29	28	28	28
4	dB	29	29	28	28	28	28	28	
5	dB	28	28	28	28	28	28	28	

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

Table A-1/M.1020 [T1.1020], p.

References

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

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

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

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

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

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

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

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Recommendation M.1025

CHARACTERISTICS OF SPECIAL QUALITY INTERNATIONAL LEASED CIRCUITS WITH BASIC BANDWIDTH CONDITIONING

1 Scope

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

The requirements of this Recommendation are intended to ensure the provision of a circuit which will meet the requirements of digital transmission rates higher than those possible on a normal telephone-type circuit. In particular, circuits meeting the requirements of this Recommendation are intended for use with modems which contain equalizers support satisfactory operation of modems to Recommendation V.29 [1]. This is dependent upon the equalization capability of the particular modems used.

2 Characteristics

2.1 *Nominal overall loss*

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

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

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

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

It is expected that, in most cases, these ''basic bandwidth'' characteristics may be available without the addition of loss/frequency and/or group-delay equalization equipment.
The values of loss/frequency and group-delay distortion are provisional and should be confirmed or amended after further study.

2.2 *Loss/frequency distortion* |'

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

The application of this Recommendation to multiterminal leased circuits is intended only for radial networks in which these specifications are to be met between a designated central station and each of the outlying stations. It does not apply to multiterminal conference networks between any two stations.
In order to ensure the proper operation of certain Series V modems operating at data signalling rates greater than 4800 bit/s, it is necessary to specify improved and/or modified values for the following transmission system characteristics: random circuit noise, quantizing noise, harmonic distortion (intermodulation distortion). This subject is for further study.
Additionally, the characteristics and limits for short interruptions in transmission and phase hits are under study for inclusion in this Recommendation. It may be noted that § 6 of Recommendation M.1060 gives provisional limits for short interruptions in transmission and phase hits as guidance for fault finding purposes.

2.3 *Group-delay distortion* |’

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

Figure 1/M.1025 p.

Figure 2/M.1025 p.

2.4 *Variation of overall loss with time*

2.4.1 *Amplitude hits*

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

2.4.2 *Other variations*

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

2.5 *Random circuit noise*

The level of the psophometric noise power at a renter's premises depends upon the actual constitution of the circuit, in particular upon the length of circuit of frequency division multiplex carrier systems. The provisional limit for leased circuits of distances greater than 10 | 00 kilometres is —38 dBm0p. However, circuits of shorter length will have substantially less random noise (see also Annex A to this Recommendation and Recommendation M.1050, § 3.5).

2.6 *Impulsive noise*

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

2.7 *Phase jitter*

The value of phase jitter measured at a renter's premises depends upon the actual constitution of the circuit (for example, upon the number of modulation equipments involved). It is expected that any measurement of phase jitter using an instrument complying with Recommendation O.91 [4] will not normally exceed 10° peak-to-peak. However, for circuits of necessarily complex constitution and where 10° peak-to-peak cannot be met, a limit of up to 15° peak-to-peak is permitted. The limits for low frequency phase jitter are under study.

2.8 *Total distortion (including quantizing distortion)*

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

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

2.9 *Single tone interference*

The level of single tone interference in the band 300 | (hy | 400 Hz shall not exceed a value which is 3 dB below the circuit noise objective indicated in Figure A-1/M.1025.

2.10 *Frequency error*

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

2.11 *Harmonic and intermodulation distortion*

When a 700-Hz test frequency of —13 dBm0 is injected at the transmit end of a point-to-point circuit, the level of any individual harmonic frequency at the receiving end shall provisionally be at least 25 dB below the received level of the fundamental frequency.

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

ANNEX A

(to Recommendation M.1025)

Noise and distortion

A.1 *Random circuit noise*

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

Figure A-1/M.1025 p.

Note — At the present time the section of the circuit provided by a satellite (between earth stations) employing FDM techniques contributes approximately 10 | 00 pW0p (—50 dBm0p) of noise. Therefore, for the purpose of determining maintenance limits for noise measurement on leased circuits, the length of this section may be considered to be equivalent to 1000 km in Figure A-1/M.1025.

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

A.2 *Total distortion*

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

H.T. [T1.1025]

TABLE A-1/M.1025

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

Type of circuit	Number of QDUs (Note)	Unit	{						
			< | 20	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5001 to 10 | 00	10 | 01 to 20 | 00
Analogue	0	dB	43	41	38	36	33	30	28
1	dB	34	34	33	32	31	29	28	
2	dB	32	31	31	31	29	28	28	
Composite circuit	3	dB	30	30	30	29	28	28	28
4	dB	29	29	28	28	28	28	28	
5	dB	28	28	28	28	28	28	2	

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

Table A-1/M.1025 [T1.1025], p.

References

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

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

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

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

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

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

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

Recommendation M.1030

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

1 General

1.1 *Scope*

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

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

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

1.2 *Terminology*

1.2.1 *Circuit access points*

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

1.2.2 *Four-wire circuits*

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

1.2.3 *Two-wire presented circuits*

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

2 Characteristics

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

2.1 *Nominal overall loss*

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

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

2.2 *Loss/frequency distortion*

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

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

Figure 1/M.1030, p.

Figure 2/M.1030, p.

2.3 *Variations of overall loss with time*

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

2.4 *Random circuit noise*

The nominal level of psophometric noise power depends upon the actual constitution of the circuit, in particular upon the length of circuit of frequency division multiplex systems involved. The provisional limit for circuits of lengths greater than 10 | 00 km is —38 dBm0p. However, circuits of shorter length will have substantially less random noise (see Annex A to this Recommendation and Recommendation M.1050, § 3.5).

2.5 *Echo*

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

3 **Stability**

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

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

ANNEX A

(to Recommendation M.1030)

Random circuit noise

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

Figure A-1/M.1030, p.

Note — At the present time the section of the circuit provided by satellite (between earth stations) employing FDM techniques contributes approximately 10 | 00 pW0p (—50 dBm0p) of noise. Therefore, for the purpose of determining maintenance limits for noise measurement on leased circuits, the length of the section provided by satellite may be considered to be equivalent to 1000 km in Figure A-1/M.1030.

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

References

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

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

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

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

Recommendation M.1040

CHARACTERISTICS OF ORDINARY QUALITY INTERNATIONAL LEASED CIRCUITS

1 Scope

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

2 Characteristics

2.1 *Nominal overall loss*

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

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

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

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

2.2 *Loss/frequency distortion*

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

2.3 *Random circuit noise*

The level of the psophometric noise power at a renter's premises depends upon the actual constitution of the circuit, in particular upon the length of frequency division multiplex carrier systems in the circuit. The provisional limit for leased circuits of distances greater than 10 | 00 km is —38 dBm0p. However, circuits of shorter length will have substantially less random noise (see also Annex A to this Recommendation and Recommendation M.1050, § 3.5).

Figure 1/M.1040, p.

ANNEX A
(to Recommendation M.1040)

Random circuit noise

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

Figure A-1/M.1040 p.

Note — At the present time the section of the circuit provided by satellite (between earth stations) employing FDM techniques contributes approximately 10 | 00 pW0p (—50 dBm0p) of noise. Therefore, for the purpose of determining maintenance limits for noise measurement on leased circuits, the length of this section may be considered to be equivalent to 1000 km in Figure A-1/M.1040.

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

7.3 Bringing an international leased circuit into service

Recommendation M.1045

PRELIMINARY EXCHANGE OF INFORMATION FOR THE PROVISION

OF INTERNATIONAL LEASED CIRCUITS

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

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

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

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

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

— the date and time for overall line-up,

— the ready-for-service (RFS) date;

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

e) proposals concerning:

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

— the control and sub-control stations,

— the date and time for overall line-up,

— the ready-for-service (RFS) date

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

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

So that the necessary staffing and other arrangements can be made, it is particularly important that early agreement be reached between the involved Administrations on the RFS date, and the date and time of the overall line-up. For this and other purposes, the contact point information (items 7 and 8 in the telex example, Figure 1/M.1045) is essential and should always be exchanged. Adequate time should be allowed between lining up the

national and international circuit sections, the overall circuit line-up and the RFS date to permit the RFS date to be met in the event that the first overall circuit line-up attempt fails and a new date and time for a second attempt needs to be agreed. Where the involved Administrations are unable to agree on dates for the RFS or overall line-up at the time of the preliminary exchange of information, these matters should be discussed and agreed between the contact points at the earliest possible time.

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

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Figure 1/M.1045 [T1.1045], p. 14 (à traiter comme tableau MEP)

Figure 2/M.1045 [T2.1045], p. 15 (à traiter comme Tableau MEP)

Recommendation M.1050

LINING UP AN INTERNATIONAL POINT-TO-POINT LEASED CIRCUIT

1 General

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

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

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

Figure 1/M.1050 p.

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

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

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

2 Lining up the constituent parts of the circuit

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

2.1 *National sections*

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

2.1.1 *Overall loss at reference frequency*

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

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

The loss/frequency distortion should be measured at several frequencies. The limits of Table 1/M.580 [1] (column headed ‘‘between circuit access points equalizer

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

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

2.2 *International section*

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

2.2.1 *Overall loss at reference frequency*

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

2.2.2 *Loss/frequency distortion*

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

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

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

2.3 *International link*

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

3 Lining up the overall circuit

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

It should be noted that satisfactory impulsive noise performance on a circuit is unlikely to be achieved if the circuit is routed via a primary digital path on which the bit error ratio exceeds 1 | (mu | 0^{D}lF261^{6} (see Note). It is not intended that this digital parameter be measured.

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

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

3.1 *Overall loss*

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

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

3.2 *Loss/frequency distortion*

3.2.1 *Ordinary quality circuits*

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

3.2.2 *Special quality circuits*

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

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

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

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

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

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

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

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

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

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

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

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

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

3.4.1 *Amplitude hits* | special quality circuits only)

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

3.4.2 *Other variations*

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

3.5 *Random circuit noise*

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

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

3.6 *Impulsive noise* | special quality circuits only)

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

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

3.7 *Phase jitter* | special quality circuits only)

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

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

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

3.8 *Total distortion* | fI(special quality circuits only)

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

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

The method of measurement is under study.

3.10 *Frequency error* | special quality circuits only)

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

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

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

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

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

The results should be recorded.

4 Section-by-section line-up

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

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

International section: one third;

National sections: one third.

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

4.1 *National sections*

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

4.1.1 *Overall loss*

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

4.1.2 *Loss/frequency distortion*

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

4.1.3 *Group-delay distortion* | special quality circuits only)

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

Figure 2/M.1050, p. 17

H.T. [T1.1050]

TABLE 1/M.1050

Apportionment of loss/frequency distortion limits

Frequency range	{					
	{ { M.1020	M.1025	M.1040	M.1020	M.1025	M.1040
Below 300 Hz Loss shall not be less than 0 dB, otherwise unspecified }	{					
300-400 Hz	—	—	∅ to —1.0	—	—	∅ to —1.0
300-500 Hz	+2.0 to —0.7	+4.0 to —0.7	—	+2.0 to —0.7	+4.0 to —0.7	—
400-2000 Hz	—	—	+3.0 to —1.0	—	—	+3.0 to —1.0
500-2500 Hz	—	+2.7 to —0.7	—	—	+2.7 to —0.7	—
500-2800 Hz	+1.0 to —0.3	—	—	+1.0 to —0.3	—	—
2000-2800 Hz	—	—	+5.3 to —1.0	—	—	+5.3 to —1.0
2500-3000 Hz	—	+4.0 to —0.7	—	—	+4.0 to —0.7	—
2800-3000 Hz	+2.0 to —0.7	—	∅ to —1.0	+2.0 to —0.7	—	∅ to —1.0
Above 3000 Hz Loss shall not be less than 0 dB, otherwise unspecified ∅ unspecified. }	{					

TABLEAU 1/M.1050 [T1.1050], p. 18

H.T. [T2.1050]

TABLE 2/M.1050

Apportionment of group-delay distortion limits

Frequency range	{			
	{ { M.1020	M.1025	M.1020	M.1025
Below 500 Hz	Unspecified	—	unspecified	—
Below 600 Hz	—	Unspecified	—	Unspecified
500-600 Hz	1.0	—	1.0	—
600-1000 Hz	0.5	1.0	0.5	1.0
1000-2600 Hz	0.17	0.5	0.17	0.5
2600-2800 Hz	1.0	1.0	1.0	1.0
Above 2800 Hz	Unspecified			

TABLEAU 2/M.1050 [T2.1050], p. 19

4.1.4 *Other characteristics* | special quality circuits only)

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

It should be noted that satisfactory impulsive noise performance on a circuit is likely to be achieved if the circuit is routed via a primary digital path on which the bit error ratio exceeds 1 | (mu | 0^{D}lF261^{6} (see Note). It is not intended that this digital parameter be measured.

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

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

4.2 *International section*

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

4.2.1 *Overall loss*

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

4.2.2 *Loss/frequency distortion*

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

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

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

4.2.4 *Other characteristics* | (special quality circuits only)

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

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

It should be noted that satisfactory impulsive noise performance on a circuit is unlikely to be achieved if the circuit is routed via a primary digital path on which the bit error ratio exceeds 1 | (mu | 0^{D}lF261^{6} (see Note). It is not intended that this digital parameter be measured.

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

4.3 *Overall circuit*

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

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

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

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

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

5 Additional reference measurements

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

6 Functional checks

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

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

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

7 Transmission level checks

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

— Data transmission (Recommendation V.2 [16]) —13 dBm0

— Voice-frequency telegraphy

amplitude-modulated ?04

?05 See Recommendation M.810, § 4.1

frequency-modulated ⌡

— Phototelegraph or facsimile

amplitude modulation (white level) — 3 dBm0

frequency modulation —13 dBm0

— Simultaneous transmission of various signals

total power —13 dBm0

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

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

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

8 Level limiters

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

9 Marking of equipment associated with special quality circuits

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

10 Short-time rerouting of special quality leased circuits

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

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

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

References

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Recommendation M.1055

LINING UP AN INTERNATIONAL MULTITERMINAL LEASED CIRCUIT

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

Unidirectional

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

Conference

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

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

1 Multiterminal unidirectional circuits

1.1 *Distribution network*

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

Figure 1/M.1055 p.

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

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

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

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

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

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

d) When the network is separated in this fashion, the paths

a-b-c-d-e-f-g-h,

j-k-l,

i,

m,

n,

|

|

|

y,

z

may all be lined up concurrently according to the principle of Recommendation M.1050.

e) With a measurement-tone at a suitable level connected to A, add on the following branches (concurrently, if possible):

— at 1 the branches m and n;

— at 2 the branches j-k-l, r and s;

— at 3 the branches t and u;

— at 4 the branches v and i;

making any necessary adjustments.

f) Stations 8 and 9 now add on branches p, q, and o, adjustments being made if necessary.

1.2 *Contribution network*

This is much more difficult to organize because the outstations may only send one at a time. The problem is eased if the network is divided into more manageable portions. A possible scheme related to Figure 1/M.1055 (with all the arrows assumed to be reversed) would be as follows:

a) The longest paths h-g-f-e-d-c-b-a and o-k-j are lined up concurrently as before.

b) Keeping e disconnected at 4, stations N, O, P and Q send to 4 in turn, stations 5, 6 and 7 making any necessary adjustments to branches w, x, y and z.

c) Concurrently with b) above, stations D, G and E send to 2 in turn (j disconnected) with 8 and 9 making any necessary adjustments to sections p, q and l.

d) Concurrently with b) and c) above, stations M, L, J and K send to station 3 (c disconnected) with stations 3 and 4 making any necessary adjustments to sections i, v, t and u.

e) Concurrently with b), c) and d), stations B, C, H and I send in turn to station A with stations 1 and 2 making any necessary adjustment to sections m, n, r and s.

1.3 It is recommended that the Administration of the country in which the focal station is situated should be responsible for drawing up the schedule showing the order in which the various circuit sections should be lined up.

1.4 If the circuit requires to be equalized then a very precise order in which the sections are to be equalized and connected together will be necessary if needless readjustment is to be avoided.

1.5 In order to apply the principles of equalizing outlined in Recommendation M.1050 it will be necessary to identify paths in the circuit connecting the focal station to each of the outstations and to treat each path as a point-to-point circuit bearing in mind § 1.4 above.

2 Multiterminal conference circuits

2.1 These are usually provided by means of bidirectional branching units which are inserted into the two directions of transmission of a 4-wire circuit and derive a send and receive pair.

2.2 It is recommended that the branching units are designed to enable a branch to be added without affecting the levels of the main circuit.

2.3 The line-up should be organized so as to avoid needless readjustment of circuit sections. This principle outlined for multiterminal unidirectional circuits gives guidance in this matter.

2.4 Four-wire telephones should be used whenever possible to avoid instability problems.

There should be some limit to the number of locations joined together (for example: 12).

7.4 Maintenance of international leased circuits

Recommendation M.1060

MAINTENANCE OF INTERNATIONAL LEASED CIRCUITS

1 General

This Recommendation deals with the maintenance procedures applicable to both ordinary and special quality international leased circuits which are provided by analogue transmission systems or by a mixture of analogue and digital systems.

Figure 1/M.1060 shows the constituent parts of an international leased point-to-point circuit.

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

Figure 1/M.1060, p.

2 Fault reporting procedures

As far as possible the provisions of Recommendations M.1012, M.1013 and M.1014 apply. Any additional special procedures, for example for international leased circuits forming part of a private switched network, must be devised by the parties concerned.

3 Fault localization

3.1 Upon receipt from the customer of a complaint concerning the performance of an international leased circuit the circuit control station should obtain from the customer specific assurance that all terminal equipment has been tested and is working correctly. Once this assurance has been received then efforts should be made to locate the fault.

3.2 Unless the control station has been informed of some condition which may be affecting the working of the international leased circuit, such as a major system failure or local failures involving the international leased circuit, then efforts should be made to localize and clear the fault condition.

3.3 In order to localize the fault, the leased circuit should be tested in sections in such a way as to minimize the requirement for international cooperation and allow rapid progress, i.e.:

— the section between the terminal national centre and the terminal international centre;

— the section between the terminal national centre and the interface at the customer's premises. In the case of 4-wire circuits it may be possible to check the continuity of both directions of transmission by utilizing the loop facility available at the interface point. To this end the customer may be requested to cooperate in the utilization of this facility;

— the national system, i.e. between the terminal international centre and the interface at the customer's premises. For 4-wire circuits a check of the continuity of the national system, in both directions of transmission, may be achieved by utilizing the loop facility which may be available at the interface for the customer as previously mentioned;

— the international section, i.e., from terminal international centre to distant terminal international centre.

Care must be taken to avoid simultaneous operation of loop facilities should they exist at both terminals.

3.4 For special quality circuits to M.1020 and M.1025 certain limits may be apportioned while others are not (see M.1050, § 4). When a fault investigation indicates that the fault can be possibly attributed to one or more unallocated parameters, sectional measurements should be made of these parameters. The section not meeting stated standards (for example, according to national practice), or that is significantly changed from readings recorded at the time of initial line-up, shall be carefully investigated in an effort to isolate a fault condition.

End-to-end measurements on a coordinated basis may still be required in order to fully isolate the fault, and in this case the section making the greatest contribution to the total readings should be first investigated and improvement sought.

4 Overall circuit check

Depending on the nature of the fault and/or any adjustments that are made, there may be need to check the performance of the overall circuit.

5 Special care with multiterminal circuits

In the case of multiterminal leased circuits care should be taken that fault localization and clearance procedures on one branch should not affect the availability or performance of other branches or the main body of the circuit involved.

In the case of circuits conforming to Recommendation M.1030, such a check may take the form of test calls.

6 Maintenance parameters

Maintenance measurements should normally be evaluated by comparison with those made during the line-up of the circuit and with the specified limits.

In the case of random noise, any substantial deterioration in performance from the original line-up value may serve to indicate a fault but with the overriding requirement that a noise level of —38 dBm0p should not be exceeded.

In addition to those specified in Recommendations M.1020 and M.1025, the following characteristics and limits may be employed for fault finding purposes on special quality leased circuits:

— go-to-return crosstalk ratio of —43 dB;

— short interruptions in transmission. Short interruptions in transmission should be measured with an instrument complying with Recommendation O.61 [1] or O.62 [2], with the threshold level set at 10 dB and the instrument dead time set at 125 ms. The objective is that there should be no short interruptions in

transmission, of durations 3 ms-1 min, in any 15 minute measurement period. However, where a short interruption is detected, the measuring period should be extended to 30 min for which the total number of short interruptions should not exceed one (see Notes 1-4 below);

— number of phase hits greater than 15° should not exceed 10 in 15 minutes. Phase hits should be counted using an instrument complying with Recommendation O.95 [3] (see Notes 2-4 below).

Note 1 — Where a particular circuit is used primarily for data transmission, a more precise threshold level may be used. Such a threshold level should be established with reference to the actual overall loss of the circuit involved and the ‘‘line signal detector’’ levels of the modems being employed. For example, refer to the Recommendation cited in [4].

Note 2 — The limits for short interruptions in transmission, and phase hits are provisional and subject to further study.

Note 3 — Administrations should note that short interruptions in transmission, phase hits and amplitude hits are interrelated such that, for example, a short interruption in transmission may result in a count on phase hit and amplitude hit measuring instruments. This must be taken into account in the application of the respective limits for short interruptions, phase hits and amplitude hits.

Note 4 — To determine if the long-term performance of a leased circuit is satisfactory, it is highly desirable to check for transient impairments over a protracted period, for example, 24 hours.

7 Preventive maintenance measurements

In principle, the Recommendations concerning routine tests for international telephone circuits and voice-frequency telegraph links apply, as far as they can, to international leased circuits.

It will be necessary for Administrations to agree with the renters concerned upon the times at which the circuit may be released for test purposes.

The periodicities shown in Table 1/M.1060 for measurements should be used as a guide as far as is practicable and as is appropriate to the type of circuit.

H.T. [T1.1060]

TABLE 1/M.1060

Type of test	Periodicity
Overall loss at 1020 Hz	{
As given in Recommendation M.610 [5]	
}	
{	
Overall loss/frequency distorsion	
}	Annually
Noise power level (see note)	As 1020 Hz test
Impulsive noise	6-monthly
Group-delay distorsion	Annually
Total distorsion	Annually

Note — See Recommendation M.1050, § 3.5.

Table 1/M.1060 [T1.1060], p.

All the measurements above would normally be made only between the installations of Administrations closest to the renters' installations, that is, between terminal national centres, and normally equipped with the necessary test equipment.

If measurements are required to be made at renters' installations then special arrangements must be made between the parties concerned.

8 Signal transmission level

The signal transmitted by the renters' apparatus should not exceed the limits (Note 3) shown below at the input to the international section:

— Data transmission (Recommendation V.2 [6]) —13 dBm0

— Voice-frequency telegraphy

amplitude-modulated ?04

?05 See Recommendation M.810, § 4.1

frequency-modulated ⌡

— Phototelegraph or facsimile

amplitude modulation (white level) — 3 dBm0

frequency modulation —13 dBm0

— Simultaneous transmission of various signals

total power —13 dBm0

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

Note 2 — In addition to the above specification, discrete frequency signals must comply with the requirements of Recommendation G.224 [7].

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

9 Level limiter

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

10 Short-time rerouting of special quality leased circuits

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

If there is a breakdown or planned interruption of a transmission system, rerouting should be carried out as far as possible at group, supergroup, etc., or digital path level. This would normally not seriously affect the attenuation and

group-delay distortion. When such a rerouting of transmission links cannot be effected or when only the circuit concerned is faulty, a reroute circuit or circuit section of similar constitution as that in service should be chosen, in particular with regard to the number of FDM carrier sections and the relative number of analogue and digital circuit sections. The procedure of short-time rerouting at audio level can be facilitated if nominated reroute circuit sections having the same characteristics as the circuit sections of the regular route are available. This consideration also applies to the local line sections.

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

References

[1] CCITT Recommendation *Simple equipment to measure interruptions on telephone-type circuits* , Vol. IV, Rec. O.61.

[2] CCITT Recommendation *Sophisticated equipment to measure interruptions on telephone-type circuits* , Vol. IV, Rec. O.62.

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

[4] CCITT Recommendation *9600 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits* , Vol. VIII, Rec. V.29, § 6.1.

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

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

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

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