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SECTION 8

MARITIME SYSTEMS

Recommendation M.1100

GENERAL
MAINTENANCE ASPECTS OF MARITIME SATELLITE SYSTEMS

1 Purpose

The purpose of this Recommendation is to describe the special maintenance procedures and facilities that are required for the maintenance of maritime satellite systems. Wherever possible the standard maintenance procedures and facilities specified in the Series M and O Recommendations should be followed for the maintenance of these systems.

2 Definitions

The following are definitions of terms used in the maintenance of maritime satellite systems.

2.1 **maritime satellite system**

In the Maritime Mobile-Satellite Service, all of the temporary connection between a telephone at a ship earth station and the maritime virtual switching point at a coast earth station. It comprises a *maritime satellite circuit* and a *maritime local system* . The general arrangement is shown in Figure 1/M.1100.

2.2 **maritime satellite circuit**

A 4-wire circuit between a maritime virtual switching point at a *coast earth station* and the 4-wire circuit test access point at a *ship earth station* , via a satellite repeater.

2.3 **maritime local system**

All the equipment between the 4-wire test circuit access point on a *ship earth station* and a 2-wire or 4-wire telephone served by that ship earth station. It may include 4-wire to 2-wire termination sets, echo control equipment, data interfaces, and 4-wire or 2-wire switching devices.

2.4 **ship earth station (SES)**

In the Maritime Mobile-Satellite Service, a mobile earth station which provides a 4-wire analogue interface for connection of a *maritime satellite circuit* to a *maritime local system* and a 4-wire circuit test access point.

Figure 1/M.1100, p.

2.5 **coast earth station (CES)**

In the Maritime Mobile-Satellite Service, an earth station, which provides a 4-wire analogue interface for connection of a *maritime satellite circuit* to the international public switched telephone network. It also provides circuit test access points and test facilities. (See Recommendation M.1120 for the functions of a coast earth station.)

2.6 **maritime test terminal (MTT)**

A *ship earth station* | nd a *maritime local system* | nstalled at a coast earth station and used for test purposes.

2.7 **network coordination station (NCS)**

A station in the Maritime Mobile-Satellite Service that maintains a pool of frequencies, assigns frequencies on demand from a coast earth station for use in a maritime satellite circuit, and supervises and monitors the use of the frequencies. The network coordination station is normally located at a coast earth station which is designated by the satellite system operator to fulfill these functions. (See Recommendation M.1110 for the functions of a network coordination station.)

2.8 **coast earth station test position**

A position in a coast earth station that can be used to originate test calls over the maritime satellite system to the maritime test terminal and to receive test calls from the maritime test terminal.

3 General maintenance principles

3.1 *Responsibilities*

In an international connection which includes a ship earth station, the maritime satellite system may be regarded from a transmission point of view as analogous to a national network and the maritime local system as somewhat analogous to a subscriber terminal within that network. Nevertheless, it should be noted that the maritime satellite circuit is set up between the coast earth station and the ship earth station on a demand assignment basis. Therefore, a coast earth station in the maritime satellite system may not have the direct responsibility for the maintenance of a particular maritime satellite circuit and a particular ship earth station all of the time. The operation and maintenance of the overall maritime satellite system is the responsibility of the maritime satellite system operator , e.g. INMARSAT.

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

3.2 *Available services*

The maritime satellite systems in service provide telex services to maritime mobile units in addition to telephone and data services. When instituting maintenance procedures, Administrations should consider the utilization of these services for communication, diagnostic and maintenance purposes, and should also consider that trained technical staff are generally available at the ship earth station only at the time the ship earth station is commissioned; however, the ship earth station is usually operated by a qualified radio officer who may be able to assist in carrying out simple test procedures.

Special services, e.g. facsimile and high speed data services, are being provided over the maritime satellite systems. The development of new maintenance procedures to support these services will be the subject of future study.

4 Interconnection with the international public switched telephone network

Interconnection arrangements are considered with reference to Figure 1/M.1100.

The maritime virtual switching point at the coast earth station is considered to be the interface between test access points D and E (see Figure 2/M.1100). The circuit between the international switching centre (ISC) and coast earth station is considered as equivalent to an international public switched telephone circuit.

Figure 2/M.1100, p.

5 Lining-up and maintaining international public switched telephone circuits

The circuit between the international switching centre and the coast earth station in Figure 1/M.1100 should be lined up and maintained in accordance with those Series M Recommendations appropriate to international public switched telephone circuits, e.g. Recommendations M.580 [1] and M.610 [2].

6 Lining-up and maintaining maritime satellite circuits

6.1 *Control, sub-control and respective responsibilities*

6.1.1 *General*

The assignment of control and sub-control stations and respective responsibilities must address the configuration of the maritime satellite system. In every case a control station must be assigned as regards circuits, and, in addition, sub-control stations are required for efficient maintenance.

6.1.2 *Assignment of control stations*

The coast earth station will be the control station for the maritime satellite circuit.

6.1.3 *Assignment of sub-control stations*

6.1.3.1 In principle, the ship earth station should act as the maritime satellite circuit sub-control station the circuit sub-control responsibilities, and special measures may need to be developed.

6.1.3.2 A maritime test terminal may be used to enhance fault location and maintenance in the maritime satellite system. In this regard the maritime test terminal may carry out some tests normally considered to be within the province of a sub-control station on behalf of a ship earth station. Whether or not a maritime test terminal should be assigned as a sub-control station is left for further study when the operation of a maritime test terminal is further defined.

6.1.4 *Responsibilities of control and sub-control stations*

Control stations dealing with maritime satellite circuits should fulfill the responsibilities of control stations as defined in the Series M Recommendations in general. The same will apply to sub-control stations. However, the maritime satellite systems present new concepts which require guidelines inasmuch as a maritime mobile unit is essentially a subscriber location. See Recommendation M.1120.

6.2 *Transmission characteristics*

The transmission design characteristics for maritime satellite circuits are given in Recommendation G.473 [3].

The setting-up, lining-up and maintenance limits of the maritime satellite circuit between test access points E and F of Figure 2/M.1100 should be as defined in Table 1/M.1100 both for the case where no switch is located at the coast earth station and where a switch is located at the coast earth station.

The loss/frequency limits in Table 1/M.1100 are those which should be met with the compandors disabled. The measurements to be carried out with the compandors in circuit are a subject for further study.

The relative levels at the coast earth station and the ship earth station are shown in Figure 2/M.1100.

H.T. [T1.1100]

TABLE 1/M.1100

Provisional setting-up, lining-up and maintenance limits

Transmission parameters	Maintenance limits (dB)
{ Loss/frequency relative to the loss at reference frequency }	(See Note)
Below 300 Hz	Not specified
300-400 Hz	—1.2 to +4.4
400-600 Hz	—1.2 to +2.6
600-2400 Hz	—1.2 to +1.2
2400-2700 Hz	—1.2 to +2.6
2700-3000 Hz	—1.2 to +4.4
3000-3400 Hz	—1.2 to not specified
Idle noise Not yet specified. See Annex A for further information }	{

Note — To avoid distortion introduced by clippers and the gain variations due to compandors, the 1020 Hz reference tone used for measuring the loss shall be set at —10 dBm0 and the compandors shall be disabled.

Table 1/M.1100 [T1.1100], p.

6.3 *Lining-up procedures*

6.3.1 *Measurement of the loss at the reference frequency*

The control station (coast earth station) sends a reference frequency from 4-wire test access E in Figure 2/M.1100 at a level of —10 dBm0. The sub-control station (ship earth station) measures the level at 4-wire test access point F in Figure 2/M.1100 (the —5.5 dBr point). The receive level should be —15.5 dBm.

The sub-control station (ship earth station) applies a reference frequency at the 4-wire test access F in Figure 2/M.1100 (the —3.5 dBr point) at a level of —13.5 dBm, i.e. —10 dBm0. The control station (coast earth station) measures the level at the 4-wire test access point. This should be —10 dBm0 at 4-wire test access point E in Figure 2/M.1100.

The tolerance of the loss measurements shall be as specified in Recommendation M.580 [1].

6.3.2 *Measurement of loss/frequency response*

The loss/frequency characteristic should be measured and recorded at the following frequencies to check that the objectives contained in Table 1/M.1100 are met:

420, 1020, 2500, 2800, 3000 Hz.

The loss/frequency measurements are taken with the compandors disabled. The measurements to be carried out with the compandors in circuit are a subject for further study.

6.3.3 *Measurement of circuit noise*

The method of measurement of noise is not yet specified and is under study.

6.3.4 *Measurement of circuit stability*

This test should be performed on maritime satellite circuits which are 2-wire terminated at the ship earth station.

With the echo suppressor disabled and the 2-wire portion of the circuit unterminated (open circuit), a reference frequency is applied at a level —10 dBm0 to the test access point E in the transmit direction at the coast earth station. The level measured at the test access point E in the receive direction should not be more than —17 dBm0.

6.4 *Fault reporting procedures*

Fault report points (circuit) should be identified in accordance with Recommendation M.715 [4].

Fault report points (network) should be identified in accordance with Recommendation M.716 [5]. One such point is required for the maritime satellite system and in the INMARSAT system is assigned to the INMARSAT operations control centre (see Recommendation M.1110 for the responsibilities of the operations control centre). However, general international networking problems should in the first instance be referred to the fault report points (network) concerned.

Exchange of contact point information should be in accordance with Recommendation M.93 [6].

6.5 *Maintenance procedures*

Routine measurements on the maritime satellite circuits should be performed to confirm that the transmission parameter limits listed in Table 1/M.1100 continue to be maintained. These maintenance procedures are particularly important with respect to the coast earth station transmission performance.

The periodicity of the routine measurements is under study.

7 Test facilities at ship earth stations

7.1 *Automatic testing*

Maritime mobile units operating in marine environments would not in general have personnel with adequate expertise for testing and maintaining equipment connected to the international network. Therefore, remote automatic testing of a ship earth station would be possible by including automatic test equipment at the coast earth station and the ship earth station. The required facilities include quiet termination test line and loop around test line as given in Recommendation O.11 [7].

7.2 *Manual testing*

It should be possible to undertake manual testing of the transmission performance of ship earth stations. This type of test is essential when a ship earth station is being lined up after it has been repaired. It should be possible to initiate the test either from the coast earth station or from the ship earth station.

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

ANNEX A
(to Recommendation M.1100)

Signal-to-noise ratios of a maritime satellite

circuit containing speech dependent devices

As a maritime satellite circuit may contain speech dependent devices (e.g. compandors), the customary specification of idle-circuit-noise is inadequate. The near-term and long-term ‘‘objectives’’ of required speech-signal-to-psophometrically-weighted-noise ratio as a function of mean speech power (dBm0, time-average while active), as proposed by Study Group XVI are shown in Figure A-1/M.1100. The maintenance limits and method of measurement are under study.

Figure A-1/M.1100, p.

References

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

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

[3] CCITT Recommendation *Interconnection of a maritime mobile satellite system with the international automatic switched telephone service; transmission aspects* , Vol. III, Rec. G.473.

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

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

[6] CCITT Recommendation *Exchange of contact point information for the maintenance of international services and the international network* , Vol. IV, Rec. M.93.

[7] CCITT Recommendation *Maintenance access lines* , Vol. IV, Rec. O.11.

[8] CCITT Manual *Transmission planning of switched telephone networks* , Chapter III, Annex 4, ITU, Geneva, 1976.

Recommendation M.1110

MAINTENANCE ORGANIZATION FOR THE MARITIME SATELLITE SERVICE

1 General

In order to ensure satisfactory interworking between the maritime satellite network and the international public-switched telephone network, it is necessary to define the interrelationship between the maintenance organization for the maritime satellite telephone service and the maintenance organization for the international automatic and semi-automatic telephone service as defined in the Series M.700 Recommendations. The general maintenance aspects of maritime satellite systems are contained in Recommendation M.1100.

2 Maintenance organization as applicable to INMARSAT

The maintenance responsibility within a maritime satellite network is divided among the ship earth station, the coast earth station, the network coordination station, and the operations control centre.

2.1 *Ship earth station (SES)*

The ship earth station must be capable of communicating reliably with the coast earth station and may act as a sub-control station with responsibilities to the coast earth station (see Recommendation M.1100, § 6.1). As a sub-control station, it is responsible for reporting noticeable degradations in the maritime satellite circuits to the coast earth station and for reporting ship earth station problems to the manufacturer's or ship's maintenance agent.

2.2 *Coast earth station (CES)*

The coast earth station provides communication functions and has the overall coordination responsibility between the ship earth station and the international public switched telephone network, and the responsibility of reporting problems to the network coordination station and the operations control centre as required. The maintenance functions of the coast earth station are further described in draft Recommendation M.1120.

2.3 *Network coordination station (NCS)*

The network coordination station provides communication and maintenance functions within the maritime satellite system.

a) Communication functions such as:

— transmitting the signalling channel to the ship earth stations;

— assigning telephone channels on demand;

— maintaining a list of busy ship earth stations.

b) Maintenance functions such as:

— assisting in performing routine system tests;

— monitoring the performance of coast earth stations;

— monitoring, identifying and clearing of unauthorized transmissions.

2.4 *Operations control centre (OCC)*

The operations control centre provides administrative, operational and maintenance functions within the maritime satellite network.

a) Administrative functions such as:

— acting as the fault report point (network);

— preparing, controlling and disseminating system information;

— providing a focal point for ships (or their agents, etc.), Administrations or others.

b) Routine and normal operational tasks such as:

— liaising with the various space segment suppliers;

— scheduling and coordinating type approval and commissioning of ship earth stations;

— scheduling and coordinating the bringing into service of coast earth stations and network coordination stations;

— carrying out some limited monitoring of transmission parameters;

— analyzing traffic and performance data provided by network coordination stations and coast earth stations.

c) Emergency and/or corrective actions, including as required the issue of broadcast network advisory messages to ship earth stations, in case of:

— space segment failures;

— extended network coordination stations failures;

— failures of individual coast earth stations;

— incorrect operation of ship earth stations;

— interference in the network.

3 Cooperation between the general maintenance organization (Recommendation M.710 [1]) and the maritime satellite maintenance organization

Figure 1/M.1110 illustrates the interrelationship between the general maintenance organization and the maritime satellite maintenance organization (INMARSAT).

Figure 1/M.1110, p.

The relationship between the coast earth station and the international switching centre is defined in Recommendation M.1120. The relationship between the elements within the maritime satellite maintenance organization is a matter for that organization.

Cooperation in the maintenance of the maritime satellite service should comprise the following elements in each organization, each of which represents a set of functions:

— fault report point (network) (see Recommendation M.716 [2]);

— network analysis point (see Recommendation M.720 [3]);

— system availability information point (see Recommendation M.721 [4]);

— network management (see Recommendation E.413 [5]);

— restoration control point (see Recommendation M.725 [6]).

References

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

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

[3] CCITT Recommendation *Network analysis point* , Vol. IV, Rec. M.720.

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

[5] CCITT Recommendation *International network management — Planning* , Vol. II, Rec. E.413.

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

Recommendation M.1120

FUNCTIONS, MAINTENANCE RESPONSIBILITIES AND MAINTENANCE FACILITIES OF A COAST EARTH STATION FOR TELEPHONY SERVICES

1 General functions

A coast earth station will include the following basic functions:

— the provision of reliable communications with ship earth stations in the basic telephony modes (other services provided by maritime satellite networks are not addressed in this Recommendation);

— the provision of an interworking point between the international public switched telephone network signalling systems and the maritime satellite signalling system;

— the commissioning and testing of ship earth stations within the maritime satellite system as requested by the operations control centre (OCC). (See Recommendation M.1110.);

— the handling of safety and distress services;

— the maintenance of a list of ship earth stations authorized to have access to the system;

— the collection of data to assist managerial functions, e.g. accounting, traffic records.

2 Maintenance responsibilities

The general maintenance aspects of maritime satellite systems are contained in Recommendation M.1100.

2.1 *Coast earth station*

A coast earth station is responsible for the following functions defined in the Series M Recommendations:

— fault report point (circuit) (see Recommendation M.715 [1]);

— testing point (transmission) (see Recommendation M.717 [2]);

— testing point (line signalling) (see Recommendation M.718 [3]);

— testing point (switching and inter-register signalling) if applicable (see Recommendation M.719 [4]).

These responsibilities apply to both the maritime satellite system and the public switched telephone network.

2.2 *Circuit control and sub-control stations*

In all cases the control station responsibilities given in Recommendation M.723 [5] shall be assigned to a coast earth station for maritime satellite circuits. Although the ship earth station is a customer's installation, it may act as a sub-control station with responsibilities to the coast earth station (see Recommendation M.1100 § 6.1).

2.3 *Advice of ship earth station fault conditions*

A coast earth station shall be responsible for advising the appropriate maintenance point within the maritime satellite network of fault conditions suspected to be located at a ship earth station and which affect the Maritime Satellite Service.

3 Test facilities

3.1 *Access points*

Test access points shall be provided at a coast earth station, and should desirably include all those described in Recommendation M.1100, i.e. points C, D, E and G in Figure 1/M.1100.

3.2 *Test facilities for the maritime satellite circuit*

3.2.1 *Test equipment requirements*

Test equipment is required at a coast earth station to permit:

— tracing of faults in the coast earth station equipment;

— checking of transmission characteristics of maritime satellite circuits;

— testing of maritime signalling procedures;

— testing of channel assignment procedures.

In many cases the test equipment may be manually connected.

3.2.2 *Coast earth station test position* | see Figure 1/M.1100)

Each coast earth station shall contain a test position that can be used to originate test calls over the maritime satellite system to the maritime test terminal and to receive calls from the maritime test terminal. It should be equipped to perform the tests listed in § 3.2.1.

3.2.3 *Maritime test terminal (MTT)* | see Figure 1/M.1100)

It is a requirement that each coast earth station shall be provided with a maritime test terminal which includes similar facilities to a normal ship earth station. It may be used to originate test calls to, and to receive test calls from, the coast earth station test position via a maritime satellite circuit, as well as originating test calls into the terrestrial network. It should also be equipped to perform the tests listed in § 3.2.1.

3.2.4 *Automatic test facilities*

a) When a switch is included at the coast earth station, test lines as defined in Recommenda- tion O.11 [6] should be provided at the coast earth station for access by ship earth station via maritime satellite circuits.

b) When a switch is not included at the coast earth station, test lines as defined in Recommendation O.11 [6] are desirable at the international switching centre to which a ship earth station may gain access.

3.3 *Test facilities for circuits to the international switching centre*

The test facilities should be provided in accordance with Series M and O Recommendations, and may be accessible from the international switching centre through the coast earth station test position.

4 Telecommunication facilities for maintenance purposes

For further study.

References

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

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

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

[4] CCITT Recommendation *Testing point (switching and interregister signalling)* , Vol. IV, Rec. M.719.

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

[6] CCITT Recommendation *Maintenance access lines* , Vol. IV, Rec. O.11.

Test lines as defined in Recommendation O.11 [6] may be limited to the quiet termination test line and the loop-around test line.

SECTION 9

INTERNATIONAL PUBLIC TELEPHONE NETWORK MAINTENANCE

9.1 International public telephone network information

Recommendation M.1220

NETWORK MAINTENANCE INFORMATION

1 Maintenance of the international network is fundamentally concerned with ensuring that the automatic and semi-automatic telephone network (transmission and switching equipment) is functioning in such a way that it may successfully provide a switched connection of good transmission quality whenever required. To achieve this objective it is important that network maintenance forces have access to relevant information that may assist in identifying network impairments and to direct corrective action. Such information goes beyond basic fault reporting and is indicated in Table 1/M.1220.

Some of the information indicated in Table 1/M.1220 is already exchanged between Administrations in accordance with other Recommendations, for example, see Recommendation E.149 [1]. An Administration wishing to make bilateral agreements to exchange all or some of the remaining items (from Table 1/M.1220), should designate the point in its Administration which is to receive such information.

2 This Recommendation considers the transfer and use of information from a maintenance standpoint. The purpose of transferring information is to assist maintenance elements in determining circuits and equipment that are not performing to specified standards.

3 The analysis and investigation of network problems require two types of information:

a) background information generally available within the Administration. In this case the intent is not to establish another information channel but to use data already exchanged between Administrations;

b) more detailed information relating to particular problems or conditions which should be exchanged between the appropriate maintenance elements as required (refer to Series M.700 Recommendations).

4 Typical background information [§ 3, a) above] is listed in Table 1/M.1220 and can be applied in maintenance activities as follows:

i) Fault report data:

— can identify faults which contribute to both transmission impairments and poor network utilization;

— can identify deficient network components and direct corrective action;

— can identify trends.

ii) National and international network call completion information, including the observation of real traffic as per Recommendation E.426 [2]:

— can be used for comparative purposes to identify abnormalities that may be caused by faults in the network.

iii) Routing data and changes thereto as per Recommendation E.149 [1]:

— can reduce the following results of misrouting of traffic due to invalid dialling:

a) calls to fail;

b) calls to be switched more than necessary;

c) calls to contribute to congestion on improper routes;

d) poor circuit utilization.

iv) Circuit order of selection. Selection of circuits not in the sequence agreed upon can cause:

— uneven distribution of traffic among the circuits involved;

— increased probability of simultaneous seizures which lead to initial call failure and subsequent re-attempts.

5 The more detailed information can be obtained from real time tests, or from near real time reports from traffic monitoring equipment, and if required from off-line reports using historical data stored on magnetic tape. Any distribution of maintenance information should clearly indicate how and where the information was obtained, a full description of the data presented, and the period of time during which it was gathered.

6 Experience has shown that the detailed investigation of particular problems is more efficiently handled by discussion and cooperation between the appropriate maintenance elements.

7 Account will need to be taken of unique national or international events, e.g. earthquakes, which could influence international telephone traffic.

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H.T. [T1.1220]

TABLE 1/M.1220

Item Typical information needed for network maintenance }	{ Source	
1a Fault report patterns | ua) } 1b 2a National network call completion information or the results of observations carried out on real traffic. | ub), | uc), | ud), | ue), | uf), | ug) } 2b International network call completion information including results by individual route where available or the results of observations carried out on real traffic. | uc), | ud), | ue), | uf), | ug), | uh), | ui), | uj) } 3a 3b Routing data changes k) } 4a 4b Circuit order of selection changes }	{ Fault reports Fault report trend data { Administration { Rec. E.426 [2] Routing data { Rec. E.149 [1] Circuit order of selection { Administration	 Fault reports Rec. E.149 [1] Administration

a) When individual subscribers and/or operator reports are compiled by common fault types, randomness often gives way to an obvious configuration (sometimes called a ‘‘pattern’’) to indicate the existence and nature of the network fault. The analysis for patterns may well be subdivided into originating, international and terminating network categories wherein the international domain includes both international switching centres. A network analysis point could use such information to identify suspected network components and make referrals or notifications to the appropriate maintenance forces for corrective actions.

b) Information to reflect the national network call completion ratio, if available, would act as a reference with which to compare completion rates experienced from distant countries.

c) Abnormal trends or conditions identified should be promptly brought to the attention of those who can take corrective actions.

d) It should be stated whether the call completion information was obtained by sampling over a period or whether all calls over a period were taken into account. If sampling is used, the size of the sample and the total population of calls should be stated so that the statistical tolerances which should be assigned to the results may be determined. If all calls are taken into account, the total number of calls should be stated.

e) The data collection period should be stated, e.g. weekday, busy period, 24 hours of a weekday or during a weekend, etc. This is useful in the assessment of the performance differences between business and social traffic.

f) It should be stated whether the data has been subjected to any filtering process and if so, which process, e.g. code screening and/or number length validation.

g) It should be stated whether the information was supplied from processors in an SPC switching unit and if so, the periods for which processors were not supplying this data due to overload, etc.

h) It is desirable that information be taken from the outgoing side of the originating international switching centre. If it was not collected from this point, the location in the network from where the data was collected and what losses are included in the data should be stated. The overall use of this informtion is also under study in Study Group II.

i) Depending on the location from where the data was collected, it should be stated either in terms of answer seizure ratio (if the data is collected from the outgoing side of the originating exchange) or answer bid from ratio if it is collected from any other point.

j) The proportion of calls failed due to distant network congestion should be stated. This is particularly useful if it can be related to individual area codes. It is appreciated that the ability to classify calls failures is dependant on the signalling system used.

k) Information on routing data changes should be exchanged as soon as it is identified.

H.T. [T1.1320]

TABLE A-1/M.1320

{
Channel numbering scheme for data transmission systems using 9600 bit/s data modems conforming to Recommendation V.29 [1]
}

Aggregate data rate	Multiplex configuration	Sub-channel data rate	Multiplex channel	Channel number
9600 bit/s	1 2	9600 7200 2400	A A B	A4 A3 B1
	6 7	7200 4800 2400	A A B	A3 A2 B1
	9 10	4800 2400 2400	A A B	A2 A1 B1
	Assigned number			
	4			
	3			
4800	2			
2400	1			

tableau 1/M.1220 [T1.1220], p. 6

References

[1] CCITT Recommendation *Presentation of routing data* , Vol. II, Rec. E.149.

[2] CCITT Recommendation *General guide to the percentage of effective attempts which should be observed for international telephone calls,* Vol. II, Rec. E.426.

9.2 Assessment of the international public telephone network performance

Recommendation M.1230

ASSESSMENT OF THE PERFORMANCE OF THE INTERNATIONAL TELEPHONE NETWORK

1 General

The quality of the international automatic and semiautomatic telephone service (being studied by Study Group II) as experienced by customers, is of great importance to Administrations. The quality of service experienced by customers is determined by a number of factors, including some which are not the direct responsibility of maintenance personnel, for example:

— customer behaviour,

— planning and provision of the network and whether sufficient circuits and switching equipment exist to meet the call attempts made by customers,

— the degree to which network management is employed.

However, it is recognized that maintenance activities and the maintenance organization can have a considerable influence on the performance of the international telephone network and, therefore, on the quality of service experienced by customers. In view of this, the assessment of network performance is necessary for the efficient maintenance of the international telephone network.

From the point of view of maintenance, the assessment of international network performance involves a measurement of the capability of the overall network (i.e. international section plus two national sections) to establish a switched connection of good transmission quality whenever required. Such a connection may result from customer calls or test calls.

2 Methods of network performance assessment

To meet the needs of network maintenance, information on the performance of the international telephone network can be obtained from a number of sources, for example, from subscriber-to-subscriber test calls as detailed in Recommendation M.1235, but also from service quality observations as detailed in Recommendations E.420 [1] , E.421 [2], E.422 [3] and E.423 [4], and from monitoring of live traffic.

The nature of information obtained (for example verification of call completion rate, transmission quality, influence of international and national sections) will depend on the method of network performance assessment employed.

While there is a recognized need to continuously assess the performance of the international telephone network, the actual method by which this is achieved depends upon the arrangements within and between Administrations and on the switching technology employed. The choice of method is left to individual Administrations, to decide on the basis of their own particular circumstances.

References

Recommendation E.420 in its *general considerations* lists the main sources of information on Quality of Service as observed by the customer, and defines the principal methods for measuring Quality of Service. Annex A to this Recommendation illustrates an approach to integrating service quality observations into an overall problem-investigating process.

Monitoring of live traffic is under study by Study Group II in connection with assessing the Quality of Service experienced by customers, and by Study Group IV for network maintenance purposes.

[1] CCITT Recommendation *Checking the quality of the international telephone service* , Vol. II, Rec. E.420.

[2] CCITT Recommendation *Service quality observations* , Vol. II, Rec. E.421.

[3] CCITT Recommendation *Observations on outgoing telephone calls for Quality of Service* , Vol. II, Rec. E.422.

[4] CCITT Recommendation *Observations on traffic set up by operators* , Vol. II, Rec. E.423.

Recommendation M.1235

USE OF AUTOMATICALLY GENERATED TEST CALLS FOR ASSESSMENT OF NETWORK PERFORMANCE

1 General

1.1 This Recommendation describes the use of automatic subscriber-to-subscriber test calls as one of the methods for assessing overall network performance [1]. It is intended as a basis for bilateral or multilateral agreements between Administrations interested in this method of investigating network performance.

1.2 In correspondence with the objectives of efficient maintenance methods as described in Recommendation M.730 [2] and, in particular, in line with the application of controlled maintenance methods as explained in § 4 of Recommendation M.730 [2], there is a recognized need to continuously assess network performance.

1.3 Considering the fact that an international call engages both national and international links, any method for assessing overall network performance should cover the entire chain of national and international links.

1.4 Modern switching and transmission systems may have built-in facilities for checking the overall network performance by means of test calls set up automatically from the exchange of origin to the exchange of destination of international calls. Similar facilities may be provided by independent test call generators having access to the switching multiple at the exchange of origin and making test calls to various test call responders in distant countries. Such test call responders may be connected to test numbers in various terminal exchanges in the distant country.

1.5 Automatic subscriber-to-subscriber test calls performed either by system-independent test call generators and test call responders, or by built-in facilities performing the same functions, can be applied in bilateral test call programmes involving the networks of two Administrations or regional programmes involving more than two Administrations. It is important that such programmes are well planned and not interfered with by the use of the same test number for other purposes as well.

1.6 In order to reflect the real network performance, test call programmes should be carried out both during non-busy and busy periods. The number of test calls to be generated on each selected route will depend on the frequency of difficulties encountered on the route and is independent of the traffic load carried on the route, or the size of the route. In other words, the higher the fault frequency, the fewer test calls will be required to arrive at statistically significant results. Considering that most of a test generator's occupation time is used for sending address information to its own national switching equipment, international links and national links in the distant country are only occupied for a very short time by a test call. The additional load created by test call generators on international traffic routes is therefore normally negligible even on very small routes.

1.7 It should be stressed that test call programmes of the type described here always necessitate an agreement between Administrations concerned.

2 Methods of assessment

2.1 *Distribution of test call facilities*

For practical purposes it is quite sufficient to generate, and observe, test calls from a few major traffic points in the originating country to a few major points in the distant country.

2.2 *Programming of test call traffic*

In order to avoid interference with other test calls, test call programmes should be carefully planned and agreed upon by the parties concerned. It might be advisable to prepare periodical test call programmes for bilateral exchange between Administrations. Test calls should, if possible, also be evenly distributed over a period of time including both non-busy and busy periods of traffic.

2.3 *Number of test calls*

The number of test calls to be generated to each selected destination is only dependent on the frequency of difficulties encountered and is independent of the traffic load carried to that destination. Fewer test calls are needed to identify the network performance level when the rate of difficulty encountered is high.

The number of test calls to be generated in a test call programme for a defined period of time can normally be divided between all destinations to be tested. It is recommended, however, that a certain proportion of the total test call production capacity be utilized for special fault investigations on certain indicated destinations.

2.4 *Result of test call programmes*

Network performance may be expressed as the ratio of successful to total test call attempts to a certain international destination during a period of time. The accuracy of the results of the test calls may be judged by ordinary statistical methods.

The definition of a successful or nonsuccessful call is, to some extent, dependent on the range of tests being interchanged between the test call generator and the responder. In general, the following criteria must be met by a successful test call:

i) the called party answers,

ii) acceptable general transmission quality,

iii) correct charging,

iv) correct disconnection of the call.

Furthermore, certain test facilities may be designed to carry out more stringent test programmes under the network performance concept.

The nonsuccessful calls should be specified with regard to the type of fault which occurred.

2.5 *Reports and exchange of information*

Administrations involved in test call programmes are urged to exchange test results regularly.

An unusually high number of network difficulties encountered in a test call programme should be treated as a fault report and be dealt with according to fault reporting procedures, without interrupting the test call programme.

It is recommended that the Administration making test calls should be responsible for the compilation of the results of those tests.

3 Equipment

As tone signals and other local conditions vary from one national network to another, test call generators and responders must be specifically designed for each international application. Furthermore, test call generators may be designed to interwork with responders in the distant country, which regenerate test calls back to the country of origin.

Until such time as Recommendations are available giving the specifications for test call generating and responding equipments, it is recommended that Administrations initiating test call programmes supply the responders required.

References

[1] CCITT Recommendation *Test calls* , Vol. II, Rec. E.424.

[2] CCITT Recommendation *Maintenance methods* , Vol. IV, Rec. M.730.

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SECTION 10

INTERNATIONAL DATA TRANSMISSION SYSTEMS

Recommendation M.1300

INTERNATIONAL DATA TRANSMISSION SYSTEMS OPERATING

AT 2400 bit/s AND ABOVE

1 General description

1.1 Figure 1/M.1300 illustrates the composition of an international data transmission system and the nomenclature used.

International data transmission systems may operate at the following typical bit rates: 2.4, 4.8, 7.2, 9.6, 14.4, 48, 50, 56, 64, 128, 192, 256, 384, 768 kbit/s and above.

Several independent data transmission channels may be multiplexed together to form a transmission system operating at an aggregate bit rate of, for example, 9.6, 56, 1544, 2048 kbit/s and above (see Figure 2/M.1300).

Other bit rates or ranges of bit rates are the subject of further study and may be addressed in other M.1300-Series Recommendations and/or Recommendation M.1300.

Figure 1/M.1300, p.

1.2 International data transmission links can be provided on a variety of transmission media in various combinations:

— local line plant;

— FDM carrier systems operating at a basic group band of 60-108 kHz (e.g. symmetric pair or coaxial cables, microwave radio links, satellites);

— voice grade analogue or digital channels;

— digital links (coaxial or optical fibre systems, microwave radio links, satellite systems).

Appropriate modems or interface adapters are used to provide signals suitable to the transmission medium being used.

1.3 For data transmission links routed via a mixture of transmission media (for example, analogue, digital, satellite single-channel-per-carrier), the term ‘‘circuit section’’ is used to refer to a section of the overall link routed wholly on one type of transmission medium.

1.4 International data transmission systems can be established between Administrations to provide channels for various services. Figure 2/M.1300 illustrates an example of an international 56 kbit/s data transmission system used for such purposes.

Figure 2/M.1300, p.

2 Data transmission link control and sub-control stations

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

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

3 Reserve arrangements

3.1 Since data transmission links of this nature often carry private leased data systems and/or TDM telegraph systems, some Administrations find it useful to provide a nominated reserve link for restoration purposes in the event of failure of the normal link decided by bilateral agreement between Administrations at the time of setting up the link data transmission link.

3.2 Wherever possible, such reserve links should follow a different route from the route of the normal link.

4 Designations

4.1 The form of designation for the data transmission system and the data transmission link and its nominated reserve may be found in Recommendation M.140, § 11 [1].

4.2 Where the situation illustrated in Figure 2/M.1300 applies, the numbering scheme for derived channels should be in accordance with Recommendation M.1320

5 Line-up and maintenance of data transmission systems and links operating in the range 48 kbit/s and above

5.1 For guidance on the setting up and lining up of the higher speed international data transmission systems and links operating within this range, reference should be made to Recommendation M.1370.

5.2 For the maintenance methods, procedures and limits that apply to such data transmission systems and links, reference should be made to Recommendation M.1375.

6 Line-up and maintenance of data transmission systems and links operating in the range 2.4 kbit/s to 14.4 kbit/s

6.1 For guidance on the setting up and lining up of international data transmission systems and links operating within this range, refer to Recommendation M.1350.

Recommendation M.1320 is currently limited to data transmission of systems operating up to 9.6 kbit/s. Further study is required to derive a suitable numbering scheme for data transmission systems operating at 14.4 kbit/s and above.

Data transmission systems operating at 19.2 kbit/s requires further study.

6.2 For the maintenance methods, procedures and limits that apply to such data transmission systems and links, refer to Recommendation M.1355.

Reference

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

Recommendation M.1320

NUMBERING OF CHANNELS IN DATA TRANSMISSION SYSTEMS

Using suitable modems and multiplexers it is possible to provide for a combination of data channels multiplexed together to form an aggregate bit rate for transmission purposes.

The principle shown in Annex A and Figure 1/M.1320 may be applied to higher bit rates as modems, etc., are developed and deployed.

The numbering of data channels is obtained by indicating the multiplex channel followed by the sub-channel data rate assigned number in accordance with the scheme contained in Table A-1/M.1320.

As an example, Figure 1/M.1320 shows a data transmission system, London-Montreal 96H001, employing equipment providing for 2 channels at 2400 bit/s and one channel at 4800 bit/s forming an aggregate bit rate of 9600 bit/s.

For this system the channel numbering would be:

London-Montreal 96H001/A2

London-Montreal 96H001/B1

London-Montreal 96H001/C1

Figure 1/M.1320, p.

ANNEX A

(to Recommendation M.1320)

Table A-1/M.1320 shows the channel numbering scheme for data transmission systems operated at an aggregate data rate of 9600 bit/s. The table also shows the channel numbering scheme for systems using 9600 bit/s modems operated at reduced data rates of 7200 bit/s or 4800 bit/s.

H.T. [T1.1320]

TABLE A-1/M.1320

Channel numbering scheme for data transmission systems using 9600 bit/s data modems conforming to Recommendation V.29 [1]

Aggregate data rate	Multiplex configuration	Sub-channel data rate	Multiplex channel	Channel number
9600 bit/s	1 2	9600 7200 2400	A A B	A4 A3 B1
	6 7	7200 4800 2400	A A B	A3 A2 B1
	9 10	4800 2400 2400	A A B	A2 A1 B1
	Assigned number			
	4			
	3			
4800	2			
2400	1			

Table A-1/M.1320 [T1.1320], p.

Reference

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

Recommendation M.1350

SETTING UP, LINING UP AND CHARACTERISTICS OF INTERNATIONAL DATA TRANSMISSION SYSTEMS OPERATING IN THE RANGE 2.4 kbit/s TO 14.4 kbit/s

1 General

This Recommendation deals with the setting up, lining up and characteristics of international data transmission systems operating at speeds in the range 2.4 to 14.4 kbit/s. The system may be a single connection operating at 2.4, 4.8, 7.2, 9.6 or 14.4 kbit/s, or a combination of the lower speed systems, multiplexed onto the 9.6 or 14.4 kbit/s system.

These systems may be carried on data links comprised of voice grade circuits (either analogue or digital), or multiplexed onto higher bit rate data transmission systems as described in Recommendation M.1300.

The system may terminate at terminal international centres, terminal national centres or, when multiplexing is employed to derive several channels, a combination of several termination configurations may be provided. See Figure 1/M.1300 and Figure 2/M.1300 for further information.

When an international data transmission system is assigned its designation (according to Recommendation M.140, §§ 3.2.15 and 11 [1]), the Administration with control station responsibility will assemble the necessary technical and operational information. This should be entered into the list of Related Information (as defined in Recommendation M.140, § 12 [1]) which consists of the items shown in Annex A to this Recommendation.

2 Characteristics of data links

2.1 *Analogue data links*

The transmission characteristics of analogue circuits to be used as data links are based upon Recommendation M.1020 where these links utilize modems without in-built equalizers loss/frequency and group-delay distortion limits specified in Recommendation M.1025 may be applied for those systems utilizing modems with built-in equalizers where agreed between the Administrations involved and if tests confirm suitability.

2.2 *Digital data links*

Where the data systems are multiplexed onto higher bit rate data transmission systems, the data link is set up in accordance with the requirements of the higher bit rate system, see Recommendation M.1370.

3 Setting up and lining up the data transmission system

3.1 *Setting up and testing an analogue data link*

The analogue data link is set up and tested in accordance with the principles and procedures detailed in Recommendation M.1050. In this regard the data link is to be considered as a special circuit.

Suitable adjustments may be made to the procedures stated in Recommendation M.1050 where the system terminates in terminal international centres or terminal national centres, rather than in renters premises.

3.2 *Setting up and testing a digital data link*

(Under study).

3.3 *Overall system tests*

3.3.1 When the various sections have been set up and lined up and interconnected using any necessary equipment to form an end-to-end system, overall system data tests shall be made. The objectives for these tests are as shown in Table 1/M.1350.

H.T. [T1.1350]
TABLE 1/M.1350

Data rate bit/s	Error ratio	Error in 15 min	% error-free seconds
2 | 00	1 × 10^{D}lF261^{5}	22	Better than 92%
4 | 00	1 × 10^{D}lF261^{5}	43	Better than 92%
7 | 00	1 × 10^{D}lF261^{5}	65	Better than 92%
9 | 00	1 × 10^{D}lF261^{5}	86	Better than 92%
14 | 00	(under study)	(under study)	(under study)

Table 1/M.1350 [T1.1350], p.

3.3.2 Where agreed between Administrations involved, or when end-to-end tests indicate less than satisfactory performance, sectionalizing tests may be performed (see Recommendation M.1355, § 3.5).

3.3.3 Bit error ratio and/or error free seconds tests are to be performed utilizing a 511 bit pseudorandom test pattern as described in Recommendation V.52 [2]. Alternatively, other patterns such as the 2047 bit pseudorandom pattern may be used when agreed between Administrations.

4 Recording of results

All measurement results are to be recorded for later reference during maintenance measurements.

5 Limits for bit error ratio and error free seconds

Provisional limits for bit error ratio and error free seconds are given in Table 1/M.1350. These limits are subject to further study. For further information see Recommendation G.821 [3].

6 Allocation of overall objectives

The allocation of the error performance objectives indicated in Table 1/M.1350 for the end-to-end system is under study.

ANNEX A
(to Recommendation M.1350)

Designation information on international data transmission systems

A.1 *Designation*

The designation is according to Recommendation M.140 [1], § 11 (for use between Administrations) or § 3.2.15 (for private use).

A.2 *Related information*

RI 1. Urgency for restoration;

RI 2. Terminal countries;

RI 3. Administrations’, carriers’ or broadcasting companies’ names;

RI 4. Control and sub-control station(s);

RI 5. Fault report points;

RI 6. Routing;

RI 7. Association;

RI 8. Equipment information;

RI 9. Use;

RI 10. Transmission medium information;

RI 11. Composition of transmission;

RI 12. (Empty item, use: ‘‘—;’’);

RI 13. Occupancy.

The various items will be dealt with in § 12 of Recommendation M.140 [1].

References

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

[2] CCITT Recommendation *Characteristics of distortion and error-rate measuring apparatus for data transmission* , Vol. VIII, Rec. V.52.

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

Recommendation M.1355

MAINTENANCE OF INTERNATIONAL DATA TRANSMISSION SYSTEMS OPERATING

IN THE RANGE 2.4 TO 14.4 kbit/s

1 General

1.1 This Recommendation deals with maintenance procedures applicable to international data systems in the range 2.4 to 14.4 kbit/s.

1.2 The constituent parts of the data system are shown in Figures 1/M.1300 and 2/M.1300.

1.3 In some instances it may be necessary to provide modems at a centre, for testing purposes only, to achieve adequate performance in fault localization.

2 Fault reporting procedures

2.1 As far as possible, the provisions of Recommendations M.1012, M.1013 and M.1014 apply. Any additional special procedures must be devised by the Administrations concerned.

3 Fault localization

3.1 Upon receipt of a complaint about the performance of an international data transmission system the control or sub-control station should obtain specific assurance that all terminal equipment has been tested and is working correctly.

3.2 The control station should first ensure that all major systems are performing normally, then efforts should be made to localize and clear the fault.

3.3 It is essential that the control and sub-control stations inform each other of all relevant information and significant actions taken which may assist their efforts.

3.4 Control and sub-control stations should arrange that a suitable test pattern is transmitted in each direction. Then, if the fault is not cleared, suitable modems and test equipment can be applied at intermediate points as appropriate in order to isolate the fault to a particular section.

3.5 To localize the fault, the data transmission system should normally be tested in sections so that the need for international cooperation is reduced and rapid progress is made. In some instances loops may be utilized in order to isolate the faulty section. Care must be taken to avoid the simultaneous operation of loops if the system configuration is such that erroneous results would occur.

3.6 The purpose of the initial fault localization process is to identify as quickly as possible whether the fault lies in one of the national sections or the international section. This allows the Administrations to begin the detailed investigation necessary to clear the fault.

3.7 See Figure 1/M.1375 for a guide to fault localization.

4 Overall data system check

4.1 When the fault has been localized to the international or a national section and cleared, that section should be tested to ensure that its bit error ratio meets the requirements of § 5 below.

4.2 The overall data transmission system should also meet the requirements of § 5, and the data transmission performance should be tested before the system is offered back to the renter.

5 Maintenance parameters

5.1 Maintenance measurements should normally be evaluated by comparison with those made during the line-up of the system and with the specified limits given in Recommendation M.1350.

5.2 For data transmission performance, it will normally be sufficient to check the bit error ratio over 15 minutes. Alternatively, error free seconds may be used as a measure of performance, where agreed between Administrations concerned. The maintenance standards are given in Table 1/M.1350.

Recommendation M.1370

SETTING UP AND LINING UP OF INTERNATIONAL DATA | TRANSMISSION SYSTEMS

OPERATING AT | 48 kbit/s AND ABOVE

1 Scope

1.1 This Recommendation deals with the setting up and lining up of international data transmission systems operating at 48 kbit/s and above as described in Recommendation M.1300.

2 General setting-up and lining-up procedures

2.1 The procedure described in this Recommendation follow the general setting-up and lining-up principles adopted by Study Group IV throughout the Series M Recommendations.

2.2 Associated equipment should be correctly set up. Individual circuit sections (for definition, see § 1.3 of Recommendation M.1300) should be lined up as separate entities in accordance with the Recommendations and procedures appropriate to the transmission medium involved.

2.3 Where a circuit section exists wholly within the territory of a single Administration, national practices may be used for lining up that circuit section providing the requirements for data transmission performance of the complete national section are met.

2.4 The individual circuit sections, should be lined up and interconnected to form the national or international section. This section should then be lined up overall and checked for data transmission performance. When the international and national sections have been checked and found to be satisfactory they should then be interconnected to form the overall system and end-to-end data performance tests made.

2.5 When an international data transmission system is assigned its designation (according to Recommendation M.140, §§ 3.2.15 and 11 [1]), the Administration with control station responsibility will assemble the necessary technical and operational information. This should be entered into the list of Related Information (as defined in Recommendation M.140, § 12 [1]) which consists of the items shown in Annex A to this Recommendation.

3 Line-up procedures

3.1 *Links that involve an international single-channel-per-carrier (SCPC) satellite section*

3.1.1 The line-up of such links can only be performed on a circuit section-by-circuit section basis as described in §§ 2.2 to 2.4 above.

3.1.2 The single-channel-per-carrier section is lined up in accordance with the procedures provided by the Satellite System Operations Guide (SSOG) [2].

3.1.3 When dealing with circuit sections carried by satellite it should be borne in mind that some Administrations use one polarity for transmission whilst others use the opposite polarity. For this reason associated test equipments normally have a normal/inverted polarity switch. It is necessary to establish the polarity convention being used and to set the test equipment accordingly.

3.2 *Links that include an international group band section*

3.2.1 Where the international data transmission link consists entirely of a single basic group band link, the procedures and limits given in Recommendation M.910 should be used. However, it should be noted that the terminology used in that Recommendation applies to international leased group links, and may not necessarily apply to international data transmission links.

3.2.2 Where the international data transmission link involves a frontier crossing basic group band link together with other types of transmission media, the line-up should be performed on a circuit section-by-circuit section basis, as described in §§ 2.2 to 2.4 above.

3.2.2.1 The frontier crossing basic group band link should be lined up in accordance with the procedures in Recommendation M.910, §§ 1.2 and 1.3 and using the limits for the overall link given in §§ 1.5 to 1.11 of that Recommendation.

3.2.2.2 Remaining circuit sections may be lined up in accordance with national practices, providing the requirements for data transmission performance are met.

3.3 *Links that include an international digital section*

3.3.1 Digital circuit sections should normally be set up and tested in accordance with procedures and performance requirements given in Recommendation M.555 [3].

3.3.2 If the digital circuit section exists wholly within the territory of a single Administration then the national practices of that Administration may be used.

4 Data tests

4.1 Once the various circuit sections have been set up, lined up and interconnected using any necessary equipment (e.g. modems, transmultiplexers) to form the overall link, the data transmission performance of the two national sections and the international section should be separately measured and recorded. It should be noted that for sections routed entirely at basic group band it will be necessary to provide interception facilities and dedicated modems in order to perform the data tests described.

4.2 The tests and measurements should be made using an appropriate pseudorandom bit pattern

4.2.1 511 bits specified in Recommendation V.52 [4];

2047 bits specified in Recommendation V.57 [5];

1 | 48 | 75 bits specified in Recommendations V.35 [6] and V.57 [5].

The actual pseudorandom bit pattern to be used should be agreed between the Administrations involved.

4.2.2 Other tests may be performed by bilateral agreement.

4.2.3 As an alternative to bit error ratio (BER) tests some Administrations prefer the use of error free seconds to measure data link performance. Suitable test equipment is required in order to utilize this parameter.

Administrations may use this parameter by bilateral agreement.

Care should be taken to ensure that test equipment methods and parameters are compatible at each end of the link such that the measured results would be identical if either equipment was used.

4.3 *Measurements on national and international sections*

4.3.1 Data test measurements should be made on the separate national and international sections and in both directions of transmission to ensure that each section meets the specified performance standards. A test period of one hour for each section is desirable.

Note — Data test results are possibly affected by the traffic load of the routes in question and where practicable, Administrations may wish to take this into account when scheduling data tests.

4.3.2 Measurements of national sections should be made between the link access points at the customer's premises and the line access points at the terminal international centre (TIC). Additionally measurements may be made by providing a circuit loopback at either the customer's premises or at the TIC. This will allow checks around the loop from either location as convenient.

When an international section includes a satellite link then it may be possible to perform RF loopback measurements, including the up/down link of the satellite, if such measurements are allowed by the satellite transponder configuration, i.e., if the earth station can monitor its own transmission. Such loopback measurements made from the customer premises, the TIC or from the earth station should be kept for reference purposes.

Loopback measurements must be additional to unidirectional measurements and should not be substituted for, or compared directly with, the end-to-end measurements.

4.3.3 The test access arrangements should be such that no part of the link is excluded from the test.

4.3.4 The exact point of access to the link for the tests will depend on the particular terminating equipment used on each section.

4.3.5 For the international section, measurements are made between the terminal international centres (TIC).

4.3.6 For the case of a satellite single-channel-per-carrier (SCPC) section in which the SCPC modems provide forward error correction (FEC), line-up and maintenance measurements should normally be carried out with the FEC facility switched out. This will ensure that the section meets basic requirements without protection and that the FEC facility is not masking transmission impairments.

4.3.7 It may be necessary to switch in the FEC facility to meet the international section and the end-to-end limits specified in Tables 1/M.1370 to 4/M.1370, but during initial line-up, it is desirable to obtain a measure of data transmission performance with the FEC facility switched both in and out. However, due to modem design, it may not always be possible to obtain measurements with the FEC facility disabled. In other cases it may be necessary to artificially degrade the link to obtain a measure of the difference in link performance with the FEC facility switched in and out. Measurements and measurement methods should be retained as benchmarks for subsequent comparisons with results obtained during maintenance.

4.3.8 The limits that apply to the section measurements are given in the Tables 1/M.1370 and 2/M.1370.

H.T. [T1.1370]

TABLE 1/M.1370

Limits for bit error ratio on national or international sections of international 48-64 kbit/s data transmission links | fR a)

Data rate (kbit/s)	**Each national section**	**International section**		
Bit error ratio **Permitted number of errors in 15 min** **}** **Permitted number of errors in 15 min** **}**	**{** **Bit error ratio**	**{**		
48 **50** **56** **64** **6** **}**	**1 × 10DlF2616** **1 × 10DlF2616** **1 × 10DlF2616** **1 × 10DlF2616**	**43** **45** **50** **58**	**1 × 10DlF2617** **1 × 10DlF2617** **1 × 10DlF2617** **1 × 10DlF2617**	**4** **4** **5** **{**

a) The performance limits for data transmission systems operating at bit rates above 64 kbit/s require further study.

Note — See Note to Table 4/M.1370.

Table 1/M.1370 [T1.1370], p.

H.T. [T2.1370]

TABLE 2/M.1370

Limits for error free seconds (EFS) on national or international sections of international 48-64 kbit/s data transmission links

| ua)

Performance classification Permitted percentage of measurement time } Permitted number of seconds in measurements time of one hour }	Errors in 1 second {	{	
Errored seconds	> 0	Less than 8%	< 288
Error-free seconds	> 0	More than 92%	> 3312

a) The performance limits for data transmission systems operating at bit rates above 64 kbit/s require further study.

Note — See Note to Table 4/M.1370.

Table 2/M.1370 [T2.1370], p.

4.4 *End-to-end system tests*

4.4.1 Following the satisfactory testing of the national and international sections an end-to-end performance test between renter’s premises should be made. It is essential that the operational conditions for the tests are the same as when the circuit is in service.

4.4.2 The test pattern should be applied simultaneously at both of the renter’s premises and measured at the opposite ends. A minimum test period of 24 hours should be the objective.

4.4.3 The bit error ratio (BER) limits to be achieved are given in Table 3/M.1370. The error free second (EFS) limits are given in Table 4/M.1370.

H.T. [T3.1370]

TABLE 3/M.1370

End-to-end bit error ratio limits for the system

| ua)

Data rate (kbit/s)	Error ratio	Errors in 15 min
48	2.1×10^{-6}	90
50	2.1×10^{-6}	95
56	2.1×10^{-6}	105
64	2.2×10^{-6}	122

a) The performance limits for data transmission systems operating at bit rates above 64 kbit/s require further study.

Note — See Note to Table 4/M.1370.

Table 3/M.1370 [T3.1370], p.

4.4.4 It should be the objective that all 15 minute periods of the tests meet the required bit error ratio limit. The circuit control station and sub-control station should together consider the results of the performance tests to decide if the circuit is acceptable for service. Thus, one or two 15 minute periods not meeting the standard may not preclude the circuit from being put into service whereas a regular pattern of 15 minute periods only just meeting the standard may indicate a need for investigation. If such is the case, the additional parameters listed in § 5.1 may offer some assistance.

4.4.5 The end-to-end error performance objectives for a measuring period of 24 hours are shown in Table 4/M.1370. These objectives are based on those defined in Recommendation G.821, § 2 [7].

H.T. [T4.1370]

TABLE 4/M.1370

System end-to-end error performance objectives for EFS measurements

| ua)

Performance classification Permitted percentage of measurement time (24 hours) } Permitted number of seconds in measurements time of 24 hours }	Errors in 1 second {	{	
Errored seconds	> 0	Less than 8%	6 | 12
Error free seconds	> 0	More than 92%	79 | 88

a) The performance objectives for data transmission systems operating at bit rates above 64 kbit/s require further study.

Note — The limits presented in the tables for error-free seconds (EFS) are based on those given in Recommendation G.821 | 7] and those for bit error ratio (BER) on the experience of Administrations. These limits are provisional and are subject for further study.

Table 4/M.1370 [T4.1370], p.

5 Measurements of other parameters

5.1 If after applying the procedures described or identified in §§ 2 to 4 the appropriate bit error ratio or error free seconds limits cannot be met, then measurement of the additional parameters, clock frequency, clock slip, short interruptions in transmission and buffer overflow, may offer some indications as to why the limits are not met and to what action should be taken.

ANNEX A
(to Recommendation M.1370)

Designation information on international data transmission systems

A.1 *Designation*

The designation is according to Recommendation M.140 [1], § 11 (for use between Administrations) or § 3.2.15 (for private use).

A.2 *Related information*

RI 1. Urgency for restoration;

RI 2. Terminal countries;

RI 3. Administrations', carriers' or broadcasting companies' names;

RI 4. Control and sub-control station(s);

RI 5. Fault report points;

RI 6. Routing;

RI 7. Association;

RI 8. Equipment information;

RI 9. Use;

RI 10. Transmission medium information;

RI 11. Composition of transmission;

RI 12. (Empty item, use: ‘‘—;’’);

RI 13. Occupancy.

The various items will be dealt with in § 12 of Recommendation M.140 [1].

References

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

[2] Intelsat Satellite Systems Operations Guide (INTELSAT-SSOG).

[3] CCITT Recommendation *Bringing international digital blocks, paths and sections into service* , Vol. IV, Rec. M.555.

[4] CCITT Recommendation *Characteristics of distortion and error-rate measuring apparatus for data transmission* , Vol. VIII, Rec. V.52.

[5] CCITT Recommendation *Comprehensive data test set for high data signalling rates* , Vol. VIII, Rec. V.57.

[6] CCITT Recommendation *Data transmission at 48 kbit/s using 60-108 kHz group band circuits* , Vol. VIII, Rec. V.35.

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

Recommendation M.1375

MAINTENANCE OF INTERNATIONAL DATA TRANSMISSION SYSTEMS

OPERATING AT 48 kbit/s AND ABOVE

1 General

1.1 This Recommendation describes the maintenance procedures to be applied to international data transmission systems having aggregate bit rates of 48 kbit/s and above.

1.2 The constituent parts of some typical systems are shown in Figures 1/M.1300 and 2/M.1300.

1.3 For some link configurations, it may be necessary to provide modems at centres for fault location and testing purposes only.

2 Fault reporting procedures

2.1 As far as possible, the provisions of Recommendations M.1012, M.1013 and M.130 [1] apply. Any additional special procedures must be devised by the parties concerned.

3 Fault localization

3.1 Upon receipt of a complaint about the performance of an international data transmission system the control or sub-control station should obtain specific assurance that all terminal equipment has been tested and is working correctly.

3.2 Unless the control station is already aware of some condition which may be affecting the working of the international data transmission system such as a major system failure or local failures involving the link, then efforts should be made to localize and clear the fault.

3.3 It is essential that during the localization and clearance of a fault, the control and sub-control stations inform each other of all relevant information and of significant actions taken which may assist their efforts.

3.4 The purpose of the initial fault localization process is to identify as quickly as possible whether the fault lies in either of the national sections or the international section. The suggested sequence is shown in diagramatic form in Figure 1/M.1375. This sequence is expected to minimize the time required to locate the faulty section.

3.5 The appropriate control/sub-control stations should arrange for each national section to be tested between the terminal international centre (TIC) and the access points at the renter’s premises.

3.6 A data transmission performance test may be made by utilizing a loopback at the interface with the renter’s terminal equipment or by testing from the renter’s premises via a loopback at the TIC where such a loopback facility is available. It should be borne in mind when considering the results of such tests that the line-up and maintenance limits are for a single direction of transmission only, so that no direct comparison with recorded values will be possible, except where loopback measurements were made and recorded during line-up. (See Recommendation M.1370, § 4.3.2).

3.7 When an international section includes a satellite link, then it may be possible to perform RF loopback measurements, including the up/down link of the satellite, if such measurements are allowed by the satellite transponder configuration, i.e. if the earth station can monitor its own transmission. Such loopback measurements, made from the customer premises, the TIC or from the earth station should be compared with similar loopback measurements made when the circuit functions normally.

Loopback measurements should be made before international cooperation is sought to test the international section, but should not be substituted for, or compared directly with, unidirectional measurements.

Figura 1/M.1375, p.

3.8 Care must be taken to avoid the simultaneous operation of loopbacks if the system configuration is such that erroneous results would occur. Once the need for a loopback no longer exists then care should be taken to ensure that the link is restored and the loopback removed.

3.9 If the nature of the fault report indicates that there may not be a fault on the link but that there may be a problem with the interworking of terminal equipment, or if the testing of the sections has not located the fault, then end-to-end monitoring and testing should be performed.

The control and sub-control stations should arrange for a test pattern to be transmitted in each direction from both ends of the system.

Both terminal international centres should monitor the test pattern in both directions of transmission and advise the control station (via the sub-control station if necessary) of the measured error performance (bit error ratio or error-free seconds) for each direction of transmission.

4 Overall data circuit check

4.1 When the fault has been located to the international or to a national section and has been cleared, then that section should be tested to ensure that its bit error free second performance meets the maintenance limits identified in § 5.

4.2 A short end-to-end performance test of the system should be made to ensure that the overall limits specified in § 5 are also met. The actual period of the test will depend upon the nature of the fault that has been cleared.

5 Maintenance parameters

5.1 Maintenance measurements of system characteristics should normally be evaluated by comparison with those made during the line-up and with the specified limits given in any relevant Recommendation.

5.2 For measuring data transmission performance it will normally be sufficient to check bit error ratio or error free second performance for 15 minutes. The maintenance limits to be achieved are shown in Tables 1/M.1375, 2/M.1375 and 3/M.1375.

H.T. [T1.1375]

TABLE 1/M.1375

Bit error ratio (BER) maintenance limits for sections of international data transmission systems

| ua)

Data rate (kbit/s)	Each national section	International section		
Bit error ratio	Number of errors in 15 min	Bit error ratio	Number of errors in 15 min	
48	1 × 10^{D}lF261^{5}	432	1 × 10^{D}lF261^{6}	43
50	1 × 10^{D}lF261^{5}	450	1 × 10^{D}lF261^{6}	45
56	1 × 10^{D}lF261^{5}	504	1 × 10^{D}lF261^{6}	50
64	1 × 10^{D}lF261^{5}	580	1 × 10^{D}lF261^{6}	60

a) The performance limits for data transmission systems operating at bit rates above 64 kbit/s require further study.

Note — See Note to Table 3/M.1375.

Table 1/M.1375 [T1.1375], p.

H.T. [T2.1375]
TABLE 2/M.1375
Overall bit error ratio maintenance limits for the system (end-to-end)
| ua)

Data rate (kbit/s)	Bit error ratio	Number of errors in 15 min
48	2.1×10^{D}lF261^{5}	910
50	2.1×10^{D}lF261^{5}	950
56	2.1×10^{D}lF261^{5}	1060
64	2.2×10^{D}lF261^{5}	1220

a) The performance limits for data transmission systems operating at bit rates above 64 kbit/s require further study.

Note — See Note to Table 3/M.1375.

Table 2/M.1375 [T2.1375], p.

H.T. [T3.1375]
TABLE 3/M.1375
Overall error-free seconds (EFS) maintenance limits for the system (end-to-end)
| ua)
(Provisionally the limits contained in the table apply to all measurements
whether made on a section or end-to-end basis)

Performance classification Permitted percentage of measured time (15 minutes) } Permitted number of seconds in 15 minute period }	Errors in 1 second {	{	
Errored seconds	> 0	Less than 8%	72
Error-free seconds	> 0	More than 92%	828

a) The performance limits for data transmission systems operating at bit rates above 64 kbit/s require further study.

Note — The limits presented in the tables for error free seconds (EFS) are based on those given in Recommendation G.821 [2] for bit error ratio on the experience of Administrations. These limits are provisional and are subject for further study.

Table 3/M.1375 [T3.1375], p.

References

[1] CCITT Recommendation *Operational procedures in locating and clearing transmission faults* , Vol. IV, Rec. M.130.

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