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SECTION 1

GENERAL PRINCIPLES OF MAINTENANCE AND MAINTENANCE ORGANIZATION

Recommendation M.70

GUIDING PRINCIPLES ON THE GENERAL MAINTENANCE ORGANIZATION FOR TELEPHONE-TYPE INTERNATIONAL CIRCUITS

1 General

In order to furnish guiding principles to Administrations, the CCITT recommends the following principles for the general maintenance organization for international circuits.

1.1 Definitions relating to the various maintenance elements, each representing a set of functions, are given in Recommendations M.710 to M.725 for automatic circuits, and in Recommendations M.1012 [1], M.1013 [2], M.1014 [3] for leased and special circuits.

1.2 The size and complexity of the maintenance organization will depend on the particular case and the particular country concerned. In some instances it may be possible to carry out all sets of functions from a single location; in others only some of the functions might be combined and carried out from one location. The precise arrangement will depend on the Administration concerned, and the CCITT limits itself to defining the functions of the separate elements, leaving the manner in which the elements are grouped to be determined by the Administration.

1.3 If a country so desires and/or if it judges that the complexity of its international telecommunications so requires, the international maintenance organization can be responsible for all types of circuit for which Study Group IV makes recommendations.

2 Types of circuits to be catered for

The types of circuits to be catered for are as follows:

public circuits:

— telephone circuits,

— voice-frequency telegraph circuits,

— phototelegraph circuits,

— sound-programme circuits, etc.;

leased circuits:

— telephone circuits: point-to-point and multiterminal,

— voice-frequency telegraph circuits,

— data circuits: point-to-point and multiterminal,

— multi-facility circuits, that is, phototelegraph plus voice-frequency telegraph; speech plus voice-frequency telegraph; simultaneous or alternative transmission,

— phototelegraph circuits,

— sound-programme circuits, etc.

3 Maintenance organization

The maintenance of international public telephone circuits relies upon the ability of each Administration to fulfil the various functions and responsibilities noted in the Series M Recommendations. Where such circuits are manual, as opposed to automatic, it is assumed that the Administration will select and provide the relevant elements such as the *fault report point (circuit)* and the *testing point (transmission)* together with *circuit control* and *sub-control station* assignments as appropriate.

For automatic circuits all the elements noted in Recommendation M.710 apply.

Leased and special international circuits require the services of a Transmission Maintenance Point (International Line) (TMP-IL) which is described in Recommendation M.1014 [3]. The circuit control and sub-control functions and responsibilities on leased and special international circuits are noted in Recommendations M.1012 [1] and M.1013 [2] and include a close cooperation with the TMP-IL.

For operations at other levels (group, supergroup, etc.), specific responsibilities are allotted to particular repeater stations. At each level, maintenance is based on the appointment of a *control station* and one or more *sub-control stations* Additional information concerning control and sub-control stations follows in Recommendations M.80 and M.90 and is supplemented by that contained in Recommendations M.1012 [1] and M.1013 [2], M.723, M.724, N.5 [4] and N.55 [5].

The attention of Administrations is drawn to the need for exchanging contact forms (similar to those for maintenance units for automatic circuits as described in Recommendation M.93) which give telephone numbers, staffing hours, etc. for units involved in the maintenance of leased circuits and the higher order transmission systems.

References

[1] CCITT Recommendation *Circuit control station for leased and special circuits* , Vol. IV, Rec. M.1012.

[2] CCITT Recommendation *Sub-control station for leased and special circuits,* Vol. IV, Rec. M.1013.

[3] CCITT Recommendation *Transmission maintenance point (international line) (TMP-IL)* , Vol. IV, Rec. M.1014.

[4] CCITT Recommendation *Sound programme control, sub-control and send reference stations* , Vol. IV, Rec. N.5.

[5] CCITT Recommendation *Organization, responsibilities and functions of control and sub-control stations for international television connections, links, circuits and circuit sections* , Vol. IV, Rec. N.55.

Recommendation M.75

TECHNICAL SERVICE

1 General

1.1 The term ‘‘technical service’’ (sometimes ‘‘technical services’’) is used throughout the Series M Recommendations. The term is used to indicate the appropriate authorities within an Administration which have responsi bility for: making international agreements on technical and engineering aspects of provision and maintenance, allocating responsibilities to maintenance units within the same Administration, specifying provision and maintenance facilities, and determining provision and maintenance policy and overseeing its implementation. Thus it can be seen that the responsibilities of the technical service are at a higher administrative level than those of the staff concerned with day-to-day operation of international services.

1.2 The staff of the technical service is generally part of the central headquarters of the Administration. However, Administrations sometimes delegate some or all of their technical service responsibilities to regional centres or even operational maintenance units. In such cases the technical service remains responsible for ensuring that the delegated responsibilities are satisfactorily carried out.

2 Outline of responsibilities

As far as international cooperation and coordination are concerned, the responsibilities of the technical service are specified in various Series M Recommendations. The following list, which is not exhaustive, serves to illustrate the type of functions normally performed by the technical service of an Administration:

— making international agreements on the appointment of control and sub-control stations, and ensuring that the stations so appointed are advised accordingly;

— reaching international agreements on all matters relating to the engineering provision of new and rearranged telephone circuits, leased circuits, etc.; digital blocks, paths, etc.; groups, supergroups, etc.; and so on;

— exchanging contact point and other maintenance information between Administrations;

— the escalation procedure in Recommendation M.711 acting as a centralized escalation point for those faults and problems which cannot be cleared by staff at maintenance units, even after discussions between the managers of such units. For example, escalation may be required where special test equipment or specialized expertise is needed;

— ensuring the satisfactory preparation and execution of routine maintenance schedules;

— developing and keeping up to date plans for the restoration of service in the event of the failure of international transmission systems;

— ensuring that other Administrations are advised of planned interruptions to transmission systems in its own country, and ensuring that steps are taken to minimize their effect on international services.

The functions mentioned above are based on responsibilities imposed on the technical service by Series M Recommendations.

3 Contact point information

Contact point information for the technical service should be exchanged between Administrations in accordance with Recommendation M.93. If the responsibilities of the technical service have been split on a functional basis, contact point information for each separate function should be exchanged. If technical service responsibilities have been delegated (as envisaged in § 1.2 above), contact point information for the responsible central headquarters staff should be exchanged.

Recommendation M.80

CONTROL STATIONS

1 Definition of control station

A control station is that point within the general maintenance organization which fulfils the control responsibilities for the circuit, group, supergroup, digital section, etc., assigned to it.

2 Appointment of control stations

The following principles for control stations apply to:

— every international circuit (circuit control station),

— every international group, supergroup, digital block, digital path, etc. (group control station, supergroup control station, digital block control station, digital path control station, etc.),

— every line link, every regulated line section and every digital section (line link control station, regulated line section control station, digital section control station) using a symmetric pair line, a coaxial line, an optical fibre or a radio-relay link.

2.1 *Circuit control station*

A circuit control station is nominated for each international circuit used for public telephony or for leased or special purposes in accordance with Recommendations M.723 and M.1012 [1] as appropriate. In the case of sound-programme or television circuits, the terminal ISPC

(International Sound-Programme Centre) or ITC (International Television Centre) at the receiving end should be nominated as the control station. (See Recommendations N.1 [2], N.5 [3] and N.55 [4].)

2.2 *Group, supergroup, digital block, etc. control stations*

For each international group, supergroup, digital block, etc., the terminal repeater station is a control station for its incoming direction of transmission. There are thus two control stations, one for each direction of transmission.

2.3 *Regulated line section control station*

The procedure is the same as for groups, supergroups, digital blocks, etc., that is to say, each of the terminal repeater stations is a control station for the incoming direction of transmission.

2.4 *Digital path control station*

For each digital path, each terminal station is a control station for its incoming direction of transmission. There are thus two control stations, one for each direction of transmission.

3 Responsibilities of circuit control stations

See Recommendations M.723 and M.1012 [1] concerning public automatic telephone circuits, leased circuits and special circuits, respectively. See Recommendations N.5 [3] and N.55 [4] in connection with sound-programme and television circuits.

4 Responsibilities of control stations for groups, supergroups, digital paths, etc.

4.1 Group, supergroup, digital block, digital path, regulated line section, line link, etc. control stations are responsible for the incoming direction of transmission only.

4.2 Each control station is responsible for ensuring that the group, supergroup, digital block, digital path, link, line, etc. with which it is concerned is set up and maintained to the required standards. In particular, it is responsible for:

a) controlling lining-up measurements to within the recommended limits and keeping records of reference measurements (initial measurements) for *analogue transmission systems* ;

b) ensuring that the performance of digital transmission systems is kept within recommended limits and keeping records of initial measurements;

c) ensuring that routine maintenance measurements are carried out on the due dates, using the specified methods and in such a way that interruptions to service are limited to the shortest possible duration;

d) ensuring that the stations concerned take action when a fault occurs, and controlling the various tests or investigations necessary in clearing the fault. It must be possible to report faults discovered at any time of the day or night;

e) informing the circuit control station of any condition which might affect the operation of the circuits under its control;

f) seeking the authority of the circuit control station for any action which will take a circuit, or circuits, out of service;

g) knowing what are the possibilities of rerouting any faulty groups, supergroups, etc.;

h) recording, on forms provided for the purpose, all incidents which arise, giving the time of occurrence of the incident, the exact location if known, the action taken if any, and the time of restoration to service.

4.3 Thus, for technical purposes (maintenance, lining-up) the control function for digital paths, groups, supergroups, mastergroups, supermastergroups and regulated line sections are divided between the two directions of transmission, the station at the incoming end being the control station in each case. However, it is considered desirable to have a single routing form for each, giving information about both directions of transmission, and in order that this and similar documentation may be prepared and distributed on a methodical basis, these documentary functions shall be added to the responsibilities of one of the control stations, this *control station for documentary purposes* being chosen by agreement between the Administrations concerned.

References

[1] CCITT Recommendation *Circuit control station for leased and special circuits* , Vol. IV, Rec. M.1012.

[2] CCITT Recommendation *Definitions for application to international sound-programme transmissions* , Vol. IV, Rec. N.1.

[3] CCITT Recommendation *Control and subcontrol stations for sound-programme circuits, connections, etc.* , Vol. IV, Rec. N.5.

[4] CCITT Recommendation *Organization, responsibilities and functions of control and sub-control ITCs and control and sub-control stations for international television connections, links, circuits and circuit sections* , Vol. IV, Rec. N.55.

Recommendation M.90

SUB-CONTROL STATIONS

1 Definition of sub-control station

A sub-control station is a point within the general maintenance organization which fulfils the sub-control responsibilities of the circuit, group, supergroup, etc. digital section, assigned to it.

2 Appointment of sub-control stations

The following principles apply to:

— every international circuit (circuit sub-control station), for whatever purpose (telephony, telegraphy, sound-programme, data transmission, etc.). (See in particular

Recommendations N.5 [1] in connection with sound-programme circuits and N.55 [2] in connection with television circuits);

— every international digital block, digital path, group, supergroup, mastergroup or supermastergroup (digital block sub-control station, digital path sub-control station, group sub-control station, supergroup sub-control station, etc.);

— every line link, every regulated line section and every digital line section (line link sub-control station, regulated line section sub-control station, digital line section sub-control station) using a symmetric pair line, a coaxial line, an optical fibre or a radio-relay link.

The technical service of the Administration concerned designates the station that is to act as a sub-control station in its country and informs the technical service of the country responsible for the control station accordingly.

2.1 *Terminal sub-control stations*

2.1.1 *Terminal sub-control stations for circuits*

For each circuit a terminal circuit sub-control station is appointed in accordance with Recommendations M.724 and M.1013 [3] as appropriate.

For unidirectional constituted circuits the terminal station at the sending end should be the terminal circuit sub-control station. In particular, in the case of sound-programme or television circuits, the terminal ISPC or ITC at the sending end should be the terminal sub-control station. (See Recommendations N.5 [1] and N.55 [2].)

2.1.2 *Terminal sub-control stations for digital blocks, digital paths, groups, supergroups, etc.*

At the two ends of a digital block, digital path, group, supergroup, etc., the terminal stations are designated as terminal digital block, digital path, group, supergroup, etc., sub-control stations for the direction of transmission for which they are not the digital block, digital path, group, supergroup, etc., control station.

2.1.3 *Terminal sub-control station for a digital section, line link or a regulated line section*

At the two ends of a digital section, line link or a regulated line section, the terminal stations are designated as terminal digital section, line link or regulated line section sub-control station for the direction of transmission for which they are not the digital section, line link or regulated line section control station.

2.2 *Intermediate sub-control stations*

2.2.1 *Intermediate sub-control stations for circuits*

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

— where this point shall be;

— whether the sub-control functions for the two directions of transmission are vested in one station or two stations (see Figure 1/M.90);

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

FIGURE 1/M.90, p.

2.2.2 *Intermediate sub-control stations for paths and links*

In general, for digital paths and analogue links, in transit countries in which the path or link concerned appears in its characteristic bit rate or in its basic frequency range, an intermediate sub-control station is appointed for each direction of transmission. The countries concerned have the same prerogatives as those indicated above for circuits (see § 2.2.1 and Figure 1/M.90).

2.2.3 *Intermediate sub-control stations for regulated line sections*

In transit countries, a regulated line section intermediate sub-control station is appointed for each direction of transmission, the same discretion as for circuits being given to the country concerned (see § 2.2.1 above and Figure 1/M.90).

2.3 *Combination of functions*

Any, or all, of the above functions may be vested in one station, depending on the arrangements in the country concerned.

3 Responsibilities of sub-control stations for circuits

See Recommendations M.724 and M.1013 [3] concerning automatic public telephone circuits, leased circuits and special circuits, respectively. See also Recommendations N.5 [1] and N.55 [2] in connection with sound-programme and television circuits.

4 Responsibilities of sub-control stations for groups, supergroups, digital blocks, digital paths, etc.

The responsibilities of sub-control stations are, for the sections which they control, similar to those given in Recommendation M.80 for control stations, but in addition they include:

— cooperating with the control stations and other sub-control stations in locating and clearing faults;

— setting up and maintaining that part of the digital path, group link, supergroup link, mastergroup link, or regulated line link between the through-connection stations nearest to the two frontiers;

— seeing that the transmission on the national section with which they are concerned is within the prescribed limits;

— reporting to the control station all relevant details concerning the location and subsequent clearance of faults;

— keeping the necessary records on lining-up (analogue transmission) or initial measurements (digital transmission), fault location and fault clearing for the section for which they are responsible.

In addition to the above responsibilities, an intermediate sub-control station (in a transit country) is responsible for initiating fault localization tests on the sections it controls in response to reports from other control or sub-control stations.

References

[1] CCITT Recommendation *Control and sub-control stations for sound-programme circuits, connections, etc.*, Vol. IV, Rec. N.5.

[2] CCITT Recommendation *Organization, responsibilities and functions of control and sub-control ITCs and control and sub-control stations for international television connections, links, circuits and circuit sections* , Vol. IV, Rec. N.55.

[3] CCITT Recommendation *Circuit sub-control station for leased and special circuits* , Vol. IV, Rec. M.1013.

Recommendation M.93

EXCHANGE OF CONTACT POINT INFORMATION FOR THE MAINTENANCE OF INTERNATIONAL SERVICES

AND THE INTERNATIONAL NETWORK

1 General

The attention of Administrations is drawn to the need for exchanging information about telephone numbers, telex numbers, staffing hours, etc., for units involved in the maintenance of international telecommunication services. The exchange of such information is of great assistance to international cooperation and has an important bearing on maintenance efficiency.

This Recommendation lists services for which information should be exchanged. The list is not exhaustive and Administrations are asked to consider, when intending to introduce a new service, what contact point information will be required.

2 Aspects to be covered by the exchange of information

2.1 *Technical service*

The general functions and responsibilities of the ‘‘technical service’’ are given in Recommendation M.75.

Where technical service responsibility within an Administration has been divided on a functional basis, contact point information relating to each function (for example, maintenance of telephone circuits, provision of leased circuits, exchange of information for changes in national numbering plans and circuit order of selection) should be supplied.

2.2 *Automatic and semi-automatic telephone service*

For each international centre, contact point information for each of the maintenance elements in Recommendations M.715 to M.725 should be exchanged.

2.3 *Manual telephone circuits*

For each international centre which has responsibility for manually operated international telephone circuits, appropriate maintenance contact point information should be exchanged.

2.4 *Other international services*

Contact point information, which should at least include information for fault reporting purposes, should be exchanged for the following international services:

— circuit-switched public data communication service;

— packet-switched public data communication service;

— public telegram service;

— teletex service;

— telex service;

— public facsimile service (bureau and telefax);

— store and forward facsimile switching service;

— phototelegraph service.

2.5 *Common channel signalling systems*

For each international centre where common channel signalling is employed, contact point information should be exchanged for the maintenance units which have responsibility for the following:

— signalling system No. 6 transfer link (Recommendation M.760);

— signalling system administrative control (Recommendations M.762 and M.782).

Where an Administration has subdivided the maintenance functions of the SS No. 6 transfer link (for example, into fault reporting, control station, etc.), appropriate contact point information should be supplied.

2.6 *Leased and special circuits*

For each international centre which has responsibility for leased and special circuits, contact point information should be exchanged for the following:

- fault report point;
- testing point;
- transmission maintenance point (international line) (Recommendation M.1014 [1]);
- circuit control/sub-control station (Recommendations M.1012 [2] and M.1013 [3]);
- restoration point for individual circuits.

2.7 *Sound programme and television*

Contact point information for the following centres concerned with sound and television should be exchanged:

— international sound-programme centre (ISPC) (Recommendation N.1 [4]);

— international television centre (ITC) (Recommendation N.51 [5]);

— programme booking centre (PBC) (Recommendation D.180 [6]).

2.8 *Groups, supergroups, etc., digital paths and blocks and transmission systems*

For each international centre, contact point information should be exchanged for the following:

— fault report point (Recommendation M.130);

— testing point (for routines, functional tests and fault localization);

— control/sub-control station (Recommendations M.80 and M.90);

— restoration control point (Recommendation M.725);

— restoration implementation point.

2.9 *Setting-up and lining-up activities*

Where staff separate from those concerned with day-to-day maintenance are used for setting-up and lining-up new or rearranged telephone circuits, leased circuits, groups, supergroups, etc., relevant contact point information should be exchanged.

3 Exchange and distribution of contact point information

Annexes A, B, C, D and E to this Recommendation contain ‘‘forms’’ to be used for the purpose of exchanging contact point information.

For convenience, the form in Annex B covers contact points for the automatic, semi-automatic and manual telephone service, and SS No. 6.

Each form provides for specific telephone numbers, telex numbers and answerback codes, together with the hours of staffing for each contact point and the name of the maintenance unit involved. The *remarks* columns on the forms should be used to supply other useful information, such as languages spoken, telephone number of the supervising officer of the maintenance unit.

Each contact point is afforded two horizontal lines. If the maintenance unit normally responsible for a particular contact point is staffed during restricted hours only, alternative contact point information should be supplied in the lower line for use outside those hours.

In some situations a single telephone number, telex number, etc., will cover all contact points for, say, leased and special circuits at an international centre. In other situations, each contact point may have its own number. The actual arrangements will depend upon the particular organization existing within the Administration concerned.

The name to be used is that by which the maintenance unit is known within the Administration and should ideally be the name used by maintenance staff when answering the telephone.

Each Administration should distribute completed forms (Annexes A to E) to all Administrations likely to have use of the contact point information involved. Furthermore, revised issues of the forms should be distributed as required, for example, to reflect organizational changes, because a new international centre has been put into service.

Copies of contact point information distributed to, and received from, other Administrations should be made readily available to all staff at maintenance centres involved in international services or the international network. In this way, such staff are made aware of both their own functions and responsibilities and those of the maintenance organizations of other Administrations.

ANNEX A
(to Recommendation M.93)

Figure A-1/M.93 [T1.93], p.

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ANNEX B
(to Recommendation M.93)

Figure B-1/M.93 [T2.93], p. 3

ANNEX C

(to Recommendation M.93)

Figure C-1/M.93 [T3.93], p. 4 A L'ITALIENNE

ANNEX D
(to Recommendation M.93)

Figure D-1/M.93 [T4.93], p. 5   A L'ITALIENNE

ANNEX E
(to Recommendation M.93)

Figure E-1/M.93 [T5.93], p. 6   A L'ITALIENNE

References

[1] CCITT Recommendation *Transmission maintenance point international line (TMP-IL)* , Vol. IV, Rec. M.1014.

[2] CCITT Recommendation *Circuit control station for leased and special circuits* , Vol. IV, Rec. M.1012.

[3] CCITT Recommendation *Sub-control station for leased and special circuits* , Vol. IV, Rec. M.1013.

[4] CCITT Recommendation *Definitions for application to international sound-programme transmissions* , Vol. IV, Rec. N.1.

[5] CCITT Recommendation *Definitions for application to international television transmissions* , Vol. IV, Rec. N.51.

[6] CCITT Recommendation *International sound- and television-programme transmissions* , Vol. II, Rec. D.180.

Recommendation M.100

SERVICE CIRCUITS

To facilitate the general maintenance of the international telephone network, *service circuits* should be set up as may be necessary between relevant maintenance units taking part in the international service.

For the purposes of this Recommendation, a distinction is made between the following types of service circuit:

— **Direct service circuit** : a telephone or teleprinter (teletypewriter) service circuit serving only two stations and linking them directly.

Note — It will also be necessary to consider the communications required by technical staff for setting up and maintaining very long circuits routed over a number of major systems in tandem, e.g. London—Singapore circuits. These may require service circuits to be interconnected.

— **Omnibus service circuit** (see Figure 1/M.100 below): a telephone or teleprinter (teletypewriter) service circuit serving more than two stations connected in series, any or all of which may make connection to the service circuit simultaneously.

— **Multiterminal service circuit** (see Figure 2/M.100 below): a telephone or teleprinter (teletypewriter) service circuit serving more than two stations and having at least one branching point. On each *branch* of this circuit a certain number of stations can be connected in series. Every station served can enter the circuit individually.

Note — Attention is drawn to the possible use of selective signalling on omnibus and multiterminal service circuits and to the problems that may arise in achieving the necessary stability on such circuits.

It is recommended that for the maintenance of international circuits:

1) all attended stations should be connected direct to the public telephone network;

2) the terminal stations of an international system should be provided with a direct telephone service circuit;

3) terminal and intermediate stations on an international system should be provided with an omnibus telephone service circuit;

4) where the provision of direct teleprinter (teletypewriter) service circuits is impracticable or uneconomical, important repeater stations on international routes should be provided with international telex facilities;

The equipment of the telegraph local end used on service telegraph circuits must be capable of transmitting and receiving signals conforming to International Telegraph Alphabet No. 2 and must be in accordance with the provisions of CCITT Recommendations;

5) maintenance staff responsible for international circuits should have authority to make priority calls in the international telephone service [1];

Figure 1/M.100 p.10

Figure 2/M.100, p.11

6) all service circuits should in general conform to the Recommendations of the CCITT in respect of their quality and maintenance. However, service circuits may have a restricted quality which must nevertheless be such as to provide efficient communication when maintenance personnel have to use languages other than their mother tongue;

7) in the event of a major interruption involving service circuits, these should be accorded priority in restoration;

8) the terminal stations of a long international submarine cable system should be provided with a direct teleprinter (teletypewriter) service circuit;

9) terminal and intermediate stations on a long international submarine cable system should be provided with an omnibus teleprinter (teletypewriter) service circuit.

The CCIR has issued Recommendation 400-2 concerning service circuits for radio-relay links. (For the convenience of readers, this Recommendation is reproduced below. CCIR Report 444 [2] also applies.)

CCIR RECOMMENDATION 400-2

SERVICE CHANNELS TO BE PROVIDED FOR THE OPERATION

AND MAINTENANCE OF RADIO-RELAY SYSTEMS

(Question 4/9, Geneva, 1982)

(1956 | | 959 | | 963 | | 966 | | 970)

The CCIR,

CONSIDERING

a) that service channels are required for the maintenance, supervision and control of radio-relay systems;

b) that if, for any reason, the radio-relay system itself fails to function, communication between various stations along the route, and from those stations to other points is likely to assume special importance;

c) that agreement is desirable on the number and function of the service channels to facilitate the planning of radio-relay systems;

d) that service channels will be used to provide:

— omnibus voice circuits,

— express voice circuits,

— supervisory circuits,

— control and operational circuits;

e) that service channels will not be connected to the public telephone network,

UNANIMOUSLY RECOMMENDS

that, on international radio-relay systems:

1. all staffed stations should be connected directly to the public telephone network;

2. when a radio-relay link is extended by means of short cable sections, and these cable sections and the radio-relay link taken together constitute a regulated line section, the terminal stations of the radio-relay link itself should have speaker circuits to the stations at the ends of the regulated line section;

3. a telephone service channel (omnibus voice circuit) should be set up to connect together all the stations on the system, whether staffed or not;

4. a second telephone service channel (express voice circuit) should be provided for direct telephonic communication between the staffed stations receiving supervisory signals;

5. provisions for the transmission of supervisory and control signals should be subject to agreement between the Administrations concerned;

This Recommendation applies to radio-relay systems which will transmit at least 60 telephone channels or a television signal and comprise two staffed terminal stations, in which the signals are demodulated to baseand, and any number of unstaffed intermediate stations. This Recommendation applies, where appropriate, to trans-horizon radio-relay systems.

6. the telephone service channels should possess, whenever possible, the characteristics (excluding noise power) recommended by the CCITT for international telephone circuits and, in particular, should be able to transmit the frequency band 300 to 3400 Hz;

7. all telephone service channels (including those used for supervisory and control circuits) up to a length of 280 km should, whenever possible, not exceed a mean noise power in any hour of 20 | 00 pW0p psophometrically weighted, at a point of zero relative level.

Note — Service channels may be provided over an auxiliary radio-relay system, over the main radio-relay system, or by other unrelated means, either on a primary or stand-by basis. In the case of express voice circuits, the use of regular multiplex channels within the telephony baseband is acceptable, where this is possible.

References

[1] CCITT, *Instructions for the International Telephone Service,* Articles 46 to 49, ITU, Geneva, 1985.

[2] CCIR Report *Service channels for analogue radio-relay systems* , Vol. IX, Report 444, ITU, Geneva, 1986.

Recommendation M.110

CIRCUIT TESTING

1 Access points for testing purposes

Access points are required to enable lining-up and subsequent maintenance operations to be performed on international circuits. The required access points are as follows:

1.1 Recommendation M.565 describes and defines the access points needed for international public telephone circuits, these points being referred to as ‘‘ circuit access points ’line access points

Line access points and circuit access points (or appropriate means for reaching the circuit access points) should be provided for testing all circuits which are used for the provision of international telecommunication services.

Where a circuit uses channel associated signalling, it should be possible to identify and measure at the circuit access points, the signal-transmission parameters, e.g., type of signal, sequence, timing, duration, level and frequency.

1.2 Test access points should also be provided for circuits connected through a repeater station in transit from one country to another. Such access points are known as ‘‘ intermediate access points

1.3 On a leased circuit, the circuit access points are regarded as being located in the renter’s premises, at the demarcation point where connections are made to the terminal equipment used on the circuit

1.4 Test access points should also be available at the terminal international centre for circuits terminating within the country at a place remote from the international centre, for example, in the premises of the users of leased circuits or in a voice-frequency telegraph terminal station, etc. Such access points, known as line access points, should be available directly or indirectly to the transmission maintenance point (international line) as defined in Recommendation M.1014 [1] for such circuits.

1.5 In addition to those mentioned in §§ 1.1 to 1.4 above, access points should be provided on the audio input and output of FDM channel multiplex and primary PCM multiplex equipments.

1.6 Access points for testing purposes should be provided on all primary order digital paths. Such access points, known as digital path access points , should be located as near to the ends of the digital path as possible.

With suitable digital test equipment, such digital path access points enable in-service circuit monitoring to be carried out when, for example, digital paths are directly interfaced with digital exchanges or transmultiplexers.

When the digital path is out of service, this same point can be used to transmit and receive signals for both digital path and circuit testing.

1.7 Figure 1/M.110 shows an example of the basic access points for international telephone circuits terminated on an analogue exchange, and for a variety of other telephone-type circuits. Figure 2/M.110 shows the basic access points

The access points required for digital leased circuits have yet to be specified. This matter is for further study by Study Group IV, in association with Study Group XV.

for telephone circuits terminated on a digital exchange. Figures 1/M.110 and 2/M.110 both show that remote access has been provided to the ‘‘circuit access points’’ of automatic telephone circuits.

1.8 Series M Recommendations relating to the various types of international circuits specify how the above-mentioned access points should be used for line-up and maintenance purposes.

Figure 1/M.110, p. 9

Figure 2/M.110, p. 10

2 Measuring and testing equipment

2.1 The basic types of measuring equipment needed in an analogue environment are:

— signal generators (fixed and variable frequency oscillators and calibrated sending units),

— level-measuring sets,

— calibration units,

— psophometers,

— standard frequency source (or access to such a source),

— equipment for signalling tests.

In addition, delay distortion measuring equipment, frequency counters, interruption recorders, programme meters, impulsive noise counters, phase jitter meters, automatic transmission measuring equipment, and equipment for non-linear and total distortion measurement may be required.

2.2 The basic types of test and measuring equipment needed in a digital environment are as mentioned in § 2.1 above. This need can be met by equivalent digital test/measuring equipment, or by analogue equipment and the use of a ‘‘test coder/decoder’’ to convert digital access points to analogue access points. In some situations, testers for the following will prove useful:

— bit error ratio;

— error-free or errored seconds;

— code violations;

— timing jitter;

— frame alignment.

2.3 The actual requirements for a particular testing centre will depend upon the types of circuit existing at that centre, and the range of tests and measurements that are specified for those circuits in the relevant Series M Recommendations. Reference should also be made to the ‘‘facility’’ requirements specified for the testing points defined in Recommendations M.717, M.718 and M.719.

2.4 The implementation of the worldwide transmission and switching plans makes it necessary for international circuits to be lined up and maintained to a very high degree of accuracy.

It is essential, therefore, to use measuring equipment of high accuracy and stability in order that the maintenance requirements given in the relevant Series M Recommendations for circuits are met, and to ensure uniformity of measurement results.

To this end it is desirable that measuring equipment provided for lining-up and maintaining all classes of circuits should, wherever possible, conform to the measuring instrument specifications given in the Series O Recommendations. Where no CCITT specification is available, the best order of accuracy and stability should be provided, consistent with cost and type of measurement to be made.

Reference

[1] CCITT Recommendation *Transmission maintenance point international line (TMP-IL)* , Vol. IV, Rec. M.1014.

Recommendation M.120

ACCESS POINTS FOR MAINTENANCE

For lining-up and fault localization it is proposed to define access points at boundaries such as between switching and transmission. A division of maintenance responsibilities can be achieved with the aid of line access points, digital path access points and analogue link access points. The following concepts are compatible with the division shown in Recommendations Q.45 (Figure 1/Q.45) [1] and Q.502 (Figure 1/Q.502) [2].

a) A line access point separates an analogue exchange from analogue or digital transmission [see a) and b) of Figure 1/M.120].

Location and interfaces of line access points are defined in Recommendation M.565.

b) A digital path access point separates a digital exchange from analogue or digital transmission [see c) and d) of Figure 1/M.120].

Digital path access points are located at the input and output ports of digital paths. Interfaces are defined in Recommendation G.703 [3].

c) A line access point separates the digital exchange from the analogue transmission [see e) of Figure 1/M.120].

d) An analogue link access point separates a digital exchange from an analogue transmission if line access or digital path access is not provided. f) of Figure 1/M.120 shows as an example the collocation of a transmultiplexer with a digital exchange.

Analogue link access points are located at the input and output ports of analogue links. Interfaces are defined in Recommendation G.233 [4].

Normally line access points, digital path access points and analogue link access points are provided as equipment interface, e.g. accessible at distribution frames.

Figure 1/M.120, p.

References

[1] CCITT Recommendation *Transmission Characteristics of an International Exchange* , Vol. VI, Rec. Q.45.

[2] CCITT Recommendation *Interfaces* , Red Book, Vol.VI, Rec. Q.502, ITU, Geneva, 1985.

[3] CCITT Recommendation *Physical/Electrical Characteristics of Hierarchical Digital Interfaces* , Vol. III, Rec. G.703.

[4] CCITT Recommendation *Recommendations Concerning Translating Equipment* , Vol III, Rec. G.233.

Recommendation M.125

DIGITAL LOOPBACK MECHANISMS

1 General

Loopback can be one of the mechanisms which may be applied to fault localization and failure detection. This Recommendation provides digital loopback definitions and describes loopback applications related to the maintenance phases of Recommendation M.20.

2 Digital loopback definitions

A **digital loopback** is a mechanism incorporated into a piece of equipment whereby a bidirectional communication path may be connected back upon itself so that some or all of the information contained in the bit stream sent on the transmit path is returned on the receive path.

The **loopback point** is the location of the loopback.

The **loopback control mechanism** is the means by which the loopback is operated and released from the loopback control point.

The **loopback control point** is the point which has the ability to directly control loopbacks.

The loopback control point may receive requests for loopback operation from several loopback requesting points.

The **loopback requesting point** is the point which requests the loopback control point to operate loopbacks.

Note 1 — Loopback requests should be subject to identification and authorization.

Note 2 — Possible locations of loopback requesting points are: the network, or a telecommunications management network (TMN), or a maintenance service provider (MSP).

The **loopback test pattern** is the test information transmitted during the operation of the loopback in the channel or channels which are to be redirected by the loopback.

Note 1 — The generation of the test pattern used over the loopback may or may not take place at the control point.

The **loopback application** is the maintenance phase for which the loopback operation is used, as defined in Recommendation M.20.

2.1 *Loopback types*

The following three types of loopback mechanisms are defined:

a) **complete loopback** — A complete loopback is a physical layer [1] mechanism which operates on the full bit stream. At the loopback point, the received bit stream shall be transmitted back towards the transmitting station without modification.

Note — The use of the term ‘‘complete loopback’’ is not related to implementation since such a loopback may be provided by means of active logic elements or controlled unbalance of hybrid transformer, etc. At the control point only the information channels may be available.

b) **partial loopback** — A partial loopback is a physical layer [1] mechanism which operates on one or more specified channels multiplexed within the full bit stream. At the loopback point, the received bit stream associated with the specified channel(s) shall be transmitted back towards the transmitting station without modification.

c) **logical loopback** — A logical loopback acts selectively on certain information within a specified channel or channels and may result in some specified modification of the looped information. Logical loopbacks may be defined to apply at any layer [1], depending on the detailed maintenance procedures specified.

For each of the above three types of loopback mechanisms, the loopback may be further categorized as either transparent or non-transparent:

i) A **transparent loopback** is one in which the signal transmitted beyond the loopback point (the forward signal) when the loopback is activated, is the same as the received signal at the loopback point. See Figure 1 |)/M.125.

ii) A **non-transparent loopback** is one in which the signal transmitted beyond the loopback point (the forward signal) when the loopback is activated is not the same as the received signal at the loopback point. The forward signal may be defined signal or unspecified. See Figure 1 |)/M.125.

Note — Whether or not a transparent loopback is used, the loopback should not be affected by facilities connected beyond the point at which the loop is provided, e.g., by the presence of short circuits, open circuits or foreign voltages.

Annex A to this Recommendation shows some examples of loopbacks.

Figure 1/M.125, p.

3 Loopback applications

3.1 *Failure detection*

In order to detect failures related to networks maintained by different maintenance organizations, loopbacks should be applied at the borderline separating the maintenance responsibilities. Loopbacks should be located in the maintenance entities (ME) adjacent to the borderline and as close as possible to the borderline. Part of the bit stream can be involved in failure detection. Figure 2/M.125 shows an example with failure detection originated in locations A and B.

Figure 2/M.125, p.

3.2 *Fault localization*

The localization of faults in networks consisting of *n* maintenance entities requires at least $n + 1$ loopback mechanisms. The loopback point should be as close as possible to the in- and output ports of the ME in order to include as much as possible of the ME in the loopback mechanism. (See example in Figure 3/M.125.) Part of the bit stream or the complete bit stream can be involved in fault localization, originated in locations A or B.

Figure 3/M.125, p.

3.3 *Verification*

Verification can require performance tests and measurements of the complete bit stream.

The same loopback location can be used as for fault localization.

4 Loopback operation and release

Loopbacks can be operated/released locally or remotely. Remote operation/release can be based on in-service addressing (e.g., layer 1 protocols) or it can require separate loopbacks addressing systems.

5 **Loopback examples** (under study — see Annex A)

ANNEX A

(to Recommendation M.125)

Figure A-1/M.125, p.

Reference

[1] CCITT Recommendation *Reference model of open system interconnection for CCITT applications* , Vol. VIII, Recommendation X.200.

Recommendation M.130

OPERATIONAL PROCEDURES IN LOCATING AND CLEARING TRANSMISSION FAULTS

1 The reporting of faults on automatic circuits is dealt with in Recommendations M.715 and M.716; for leased and special circuits in Recommendations M.1012 [1], M.1013 [2] and M.1014 [3] and for Signalling System No. 6 in Recommendation M.762. These principles should likewise be applied to the reporting of faults on groups, supergroups, etc., to the *fault report point* in a repeater station.

2 Basic principles for locating a fault on a circuit

2.1 The following principles apply to all types of circuit, however constituted:

i) The fault report is received by the relevant fault report point and passed on to the circuit control station.

ii) The circuit control station should immediately arrange for the circuit to be withdrawn from service.

iii) Appropriate overall measurements and tests should be made to verify the existence of the fault.

iv) Measurements should be made on the sections of the circuit between the *end* of the circuit (circuit access point, voice-frequency telegraph terminal or renter's termination, etc.) and the international line access point at the terminal international centre to find whether the fault is on these sections in either of the terminal countries concerned.

v) If the fault is proved in these sections, national practices should be applied to locate and clear the fault.

vi) If the fault is proved to be on the international line, maintenance personnel at the terminal international centres involved should make tests and measurements appropriate to the type of fault in cooperation with any intermediate sub-control station until the fault has been located between two adjacent sub-control stations, that is, to a circuit section. These two stations should then control the detailed location of the fault and its subsequent clearance within their section.

Note — Some types of circuit may be routed via a circuit multiplication system (CMS). The terminal Administrations must bilaterally agree on a detailed fault localization procedure for circuits routed via the particular circuit multiplication system in use between them. Annex A to this Recommendation contains an outline of a fault location procedure upon which detailed arrangements could be based.

vii) As soon as possible, the use of any permitted rerouting possibilities that there may be for the line or sections thereof should be made, in order to restore service on the circuit.

viii) If the circuit section is routed on the channel of an FDM group or a primary digital block, the group *or* digital block control should be informed of the fault in order to take the necessary action.

ix) When the fault has been cleared the sub-control station in whose country the fault was located should immediately notify the control station either directly or via the appropriate maintenance unit of the nature of the fault and the time and details of its clearance.

x) The controlling end should cooperate with the noncontrolling end and should make overall measurements, requesting further adjustments if necessary.

xi) When the circuit meets the specified requirements, the control station arranges to restore the circuit to service.

2.2 Figure 1/M.130 shows a sequence of operations that may be followed applying the principles given in § 2.1 above.

2.3 A typical sequence of operations covering transmission faults on transfer links of Signalling System No. 6 is shown in Figure 2/M.760.

2.4 When a fault in a circuit section is proved to be due to an analogue group or a digital block fault, the basic fault procedures for the group or block are the same as those given for faults on an international line (see § 2.1, vi and vii above).

The sequence of operations followed by the group control station and the group sub-control station in locating faults on a group is shown in Figure 2/M.130. Associated operations by other control and sub-control functions are shown in Figures 3/M.130 and 4/M.130.

2.5 The operations mentioned above can sometimes be modified according to special circumstances. For example, if there is a cable fault in a terminal country and if this fault affects a large number of circuits, it will not generally be necessary to carry out all the operations given in § 2.1 above and Figure 1/M.130 in the order shown. (See also Supplement No. 3.6 [4])

3 Faults observed at repeater stations as a result of local or extended alarms

All fault conditions affecting transmission that are observed at repeater stations as a result of local or extended alarms should be reported to the relevant fault report points of the country concerned, so that arrangements can be made to apply the fault clearing procedure.

4 Special faults

In the case of unusual faults, or faults which are difficult to locate with the testing equipment that is available, or faults of a similar kind occurring very frequently on a particular section, the appropriate control station should inform its technical service without delay. This service, in cooperation with other technical services involved, will take the necessary action to locate such faults or, where appropriate, prevent such faults in the future by rearrangement of the circuit layout or equipment involved. The circuit control station should be kept informed of the progress of the action taken or proposed, the prospects of clearance and other pertinent details.

5 Escalation procedure

Normally cooperation between maintenance elements in different Administrations will result in the satisfactory identification and correction of faults. There may be circumstances, however, where the fault escalation procedure defined in Recommendation M.711 may be required.

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Figure 1/M.130 p. 16

Figure 2/M.130 p. 17

Figure 3/M.130 p. 18

Figure 4/M.130 p. 19

ANNEX A

(to Recommendation M.130)

Outline procedure for
locating faults on circuits routed

via a circuit multiplication system

Introductory Notes — In this Annex, the term, ‘‘circuit multiplication system (CMS)’’ is used for convenience. It is intended to cover all systems which increase the number of circuits available from a transmission link by taking advantage of the fact that only one direction of transmission is used at any one time in a telephone conversation (one talker; one listener), and that normal speech patterns involve pauses, hesitations and silent intervals. Examples of such systems are TASI-E and CELTIC.

Reduced bit rate coding systems, e.g. transcoders, are not presently included in the description of CMSs found in this Recommendation.

A.1 *General*

A circuit multiplication system consists of a transmit and receive equipment for each direction of transmission, interconnected by a number of ‘‘channels’’ (sometimes known as connect- or connection-channels).

Inputs and outputs of the CMS take the form of ‘‘trunks’’, the number of which typically exceeds the number of channels by a factor of two. That is, a typical CMS provides an advantage of two trunks (and therefore, two circuits) per CMS channel.

Figure A-1/M.130 depicts a generalized CMS, in this case interfaced at basic circuit level. Other circuit multiplication systems are interfaced by primary order digital paths (operated at 1544 or 2048 kbit/s) on both trunk and channel sides of the CMS terminal equipment. Other interface arrangements are also possible.

When the CMS is taken out of service, due to a fault or on a planned basis, CMS trunks are switched through to CMS channels on a predetermined basis, one trunk per channel. The circuits routed on such trunks are called ‘‘CMS-and-through’’ circuits trunks derived by the CMS are called ‘‘CMS-only’’ circuits

A.2 *Fault localization procedure for circuits routed via CMS*

A.2.1 *Impact of CMS operation*

At the time a fault is detected on a circuit routed via a CMS, a particular CMS trunk-to-CMS channel association existed. The fault localization procedures must recognize that the probability of reproducing this trunk-channel association under testing conditions is very remote, particularly in modern circuit multiplication systems. In older systems (for example, those interfaced at basic circuit level), there is the possibility of reproducing the original trunk-channel association, especially if both fault detection and testing occur during light traffic periods. This possibility should not be overlooked in the fault localization procedures for circuits routed via such systems.

An important feature of many modern circuit multiplication systems is that they include self-diagnostic procedures which continuously switch trunk/channel connections even when the traffic load does not necessitate interpolation. Such self diagnostic procedures include the monitoring of the

transmission performance of CMS channels thresholds (for example, of loss and noise) are exceeded, the CMS establishes a permanent trunk/channel connection (a so-called ‘‘trunk/channel lock manner.

In some systems, minor loss variations are also automatically compensated for.

To take account of these operating characteristics, the localization of faults on circuits assigned to a CMS follows a technique that is different from that used for normal (non-CMS) circuits. Furthermore, the test procedures to be used differ slightly depending on whether the circuit under test is a CMS-and-through circuit or a CMS-only circuit.

Figure A-1/M.130, p. 8

A.2.2 *CMS-and-through circuits*

If it is known that the CMS was out of service at the time the circuit fault was identified, and remains out of service during fault localization, the procedures employed for normal (non-CMS) circuits can be used.

Tests made when the CMS is in service are carried out without regard to the CMS channel used. The existence of a fault is first verified

(or otherwise) by an initial test. If no fault is detected on the initial test, it is safe to assume that the fault may have been due to the CMS equipment or the interconnecting channel at the time the fault was observed. The circuit should be returned to service. A record of the fault should be given to the maintenance unit responsible for the CMS for their information and use when CMS and CMS channel tests are carried out. The fault report point (circuit) should keep a record of the fault and the action taken for future reference purposes.

If the fault is confirmed by the initial test and repeat tests, fault localization procedures depend upon the particular CMS involved. In modern systems a check should be made for the existence of a trunk/channel lock. If such a lock exists, normal fault localization procedures used for non-CMS circuits may be used. On older systems, or if no trunk/channel lock exists on a modern system, it can be assumed the fault is external to the CMS and its interconnecting channels. Further tests should be made to identify the exact location of the fault, which should then be referred to the appropriate maintenance unit for attention.

When localizing faults on circuits routed via older CMSs, especially during periods of light traffic, there is a chance that the CMS channel is faulty if identical fault conditions are observed on initial and repeat tests — the CMS may not have switched channels. In this event, further localization tests must include the CMS channel associated with the circuit under test and the CMS terminal equipment.

A.2.3 *CMS-only circuits*

Again, tests are made on the circuit without regard to the CMS channel being used.

The procedures for dealing with verified and unverified faults specified in § A.2.2 above can be used for CMS-only circuits. However, trunk/channel locks are not generally possible on CMS-only circuits, and thus verified faults can be assumed to be external to the CMS and its interconnecting channels. Similar precautions to those in § A.2.2 should be taken when localizing faults on circuits routed via older CMSs.

When CMSs are out of service, this type of circuit is removed from service and is not therefore available for testing purposes. Fault localization tests must await the return to service of the CMS.

A.3 *CMS signalling channel faults*

Faults and service problems observed on circuits routed via a CMS may be due to problems on the CMS signalling channel causing, for example, incorrect trunk-channel switching. Many CMSs monitor the performance of the signalling channel(s) continuously. The information made available by such monitoring should be used by maintenance staff to help eliminate signalling channel problems as a source of circuit faults.

References

[1] CCITT Recommendation *Circuit control station for leased and special circuits* , Vol. IV, Rec. M.1012.

[2] CCITT Recommendation *Sub-control station for leased and special circuits* , Vol. IV, Rec. 1013.

[3] CCITT Recommendation *Transmission maintenance point international line (TMP-IL)* , Vol. IV, Rec. M.1014.

[4] CCITT Supplement No. 3.6 to Volume IV *Crosstalk test device for carrier-transmission systems on coaxial systems* .

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