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CIRCUIT CONTROL STATION

1 Definition of circuit control station

The circuit control station is the point within the general maintenance organization for the international automatic and semi-automatic telephone service that fulfils the control responsibilities for the automatic circuits assigned to it.

The responsibilities, functions and criteria for appointing circuit control stations given in §§ 2 to 4 below apply to circuits provided solely by analogue transmission and switching systems and those involving a mixture of analogue and digital systems

Recommendation M.723

2 Responsibilities

The circuit control station is responsible for ensuring that an automatic circuit assigned to it is set up and maintained to the required standards in both directions of transmission and that, if the circuit fails, the outage time is kept to a minimum.

3 Functions

3.1 Arranging for the setting-up of the circuit, and of the signalling and switching equipment associated directly with the circuit, and the related adjustment.

3.2 Controlling lining-up measurements to within the recommended limits.

3.3 Ensuring that routine maintenance measurements and tests are carried out in accordance with the agreed schedule using the specified methods and in such a way that interruptions to service are limited to the shortest possible duration.

3.4 Requesting that the circuit sub-control station take action as required.

3.5 Arranging for the blocking of circuits as required.

3.6 Ensuring that fault location and clearing is carried out by the responsible testing point and/or maintenance unit in a proper manner.

3.7 Initiating investigation of repeated circuit faults.

3.8 Controlling the withdrawal of circuits from service.

3.9 Controlling the return of circuits to service, after the fault clearance.

3.10 Being continuously informed of the condition of the automatic circuits under its control.

3.11 Keeping up to date records of the routing of the automatic circuits under its control.

3.12 Knowing what are the possibilities of rerouting any faulty circuits and making arrangements for such reroutings where necessary.

4 Appointment of circuit control stations

A circuit control station is appointed for each international circuit used for the automatic and semi- automatic telephone service. When the circuit is operated unidirectionally the circuit control station is

generally at the outgoing end. When the circuit is operated both-way, the circuit control station can be at either end by common agreement between the technical services of the Administrations concerned. In making the choice, special consideration will be given to:

— whether the location to be nominated as the circuit control station is permanently attended,

— the amount of work at each terminal point,

— the length of the circuit within the territory of each terminal country.

Recommendation M.724

CIRCUIT SUB-CONTROL STATION

1 Definition of circuit sub-control station

The circuit sub-control station is a point within the general maintenance organization for the international automatic and semi-automatic telephone service that assists the circuit control station and fulfils the control responsibilities for a circuit section assigned to it.

The responsibilities, functions and criteria for appointing circuit sub-control stations given in §§ 2 to 4 below apply to circuits provided solely by analogue transmission and switching systems and those involving a mixture of analogue and digital systems

2 Responsibilities

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

3 Functions

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

3.2 Cooperating with the circuit control station and other circuit sub-control stations in ensuring that routine maintenance fault location and clearance are carried out by the responsible testing points and/or maintenance units in a proper manner.

3.3 Arranging that all relevant details concerning the location and subsequent clearance of faults are reported to the fault report point (circuit) at the controlling end.

4 Appointment of circuit sub-control stations

For each circuit used for the automatic and semi-automatic telephone service a terminal circuit sub-control station is appointed. This is generally the end of the circuit remote from the circuit control station. In transit countries in which a circuit is brought to audio frequencies, an intermediate circuit sub-control station is appointed at a suitable point for each direction of transmission. It is left to the Administration concerned to choose:

— where this point shall be,

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

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

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

Recommendation M.725

RESTORATION CONTROL POINT

1 Definition of restoration control point (RCP)

The restoration control point (RCP) is an element within the general maintenance organization for the international telecommunication services. It initiates and coordinates service restoration activities in case of failures or planned outages of transmission systems in accordance with plans and *ad hoc* arrangements agreed by the technical services of the Administrations concerned.

Since two or more RCPs are involved in agreed restoration plans, it is practical to nominate one RCP as the Overall RCP which then initiates and controls implementation of the plan. The additional responsibilities and functions of an Overall RCP are given in § 3 below.

2 Responsibilities and functions

The restoration control point (RCP) is responsible for the following set of functions:

2.1 Initiating the implementation of a restoration plan and *ad hoc* arrangements with the other stations involved within its Administration’s boundaries.

2.2 Monitoring the implementation of the restoration plan.

2.3 Coordinating the restoration activities of the repeater stations and other stations involved within its Administration’s boundaries.

2.4 Liaising with restoration control points of other Administrations as necessary and agreeing the times of events with them.

2.5 Exchanging information with the network management (implementation and control point) (see Recommendation E.413 [1]) for coordination purposes as appropriate.

2.6 Monitoring and coordinating the return to normal service conditions after the fault has been cleared or the planned work has been finished.

2.7 Keeping, throughout the period during which the restoration and the return to normal conditions is executed, an accurate log of events, including any circuit, channel, group, supergroup, etc., or baseband patching which takes place.

2.8 Requesting and receiving reports from other RCPs and disseminating this information within its own Administration as required.

2.9 Reporting the events to the responsible authorities of its Administration as desired and advising the system availability information point about the progress of restoration.

2.10 Sending a final restoration report, after the return to normal, containing all relevant data (including agreed times) for accounting purposes to the responsible authorities within its Administration.

2.11 If no restoration plan exists or, for some reason, an existing plan cannot be implemented, advising the responsible authorities in its own Administration and suggesting suitable *ad hoc* arrangements in the light of the information available.

3 Additional responsibilities of an overall RCP

The responsibilities of an overall RCP are much the same as an ordinary RCP but with additional responsibilities as follows:

3.1 Initiating the implementation of a restoration plan with other RCPs concerned.

3.2 Requesting and receiving reports from other RCPs and disseminating this information as necessary.

3.3 Coordinating and controlling all restoration activities including the return to normal conditions.

4 Facilities

The restoration control point should be provided with the following facilities:

4.1 Appropriate communication facilities in order to assume its responsibilities.

4.2 Access to information appropriate to its functions and this includes:

a) status of relevant international transmission systems;

b) current restoration plans;

c) list of the sections of border-crossing transmission traffic routes;

d) routing information for international group, supergroup, etc., links;

e) inventory of spare transmission facilities, in its own and neighbouring countries, lending themselves to restoration.

Reference

[1] CCITT Recommendation *International network management - Planning* , **|** Vol. II, Rec. E.413.

Recommendation M.726

MAINTENANCE ORGANIZATION FOR THE WHOLLY DIGITAL INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC TELEPHONE SERVICE

The recommended maintenance organization for a wholly digital international telephone service is under study by Study Group IV. The detailed development of such an organization cannot be undertaken until such time as Administrations have gained sufficient experience of the operation and maintenance of digital transmission and switching systems — these systems being relatively few in number in the international network at present. However, based on present knowledge and experience, Study Group IV intends that the maintenance organization for the fully digital international telephone service be based on the following principles and concepts:

— That there be a gradual evolution of the current maintenance organization (which is intended to cover the wholly analogue and mixed analogue/digital situations) towards the organization suitable for the wholly digital network. The rate of this evolution will reflect the rate of introduction of digital systems in the international and national networks.

According to this principle, it is recognized that, in the transition from a wholly analogue to a wholly digital network, the maintenance organization of a particular international centre may be responsible for wholly analogue, wholly digital and mixed analogue/digital circuits since the three types may be terminated at a single international centre.

— That the ‘‘element’’ approach to defining a maintenance organization, as currently used in Recommendations M.710 to M.725, be used to define future maintenance organizations.

By the intended adoption of this concept it is recognized that the maintenance element approach offers the means of specifying a maintenance organization which can meet the needs of all Administrations, irrespective of the number of international circuits and international switching centres they operate.

In accordance with the current Study Group IV practice, significant national trends in the area of maintenance organization (for example, the trend towards increased centralization of maintenance) should be reflected in the Series M Recommendations where appropriate.

Recommendation M.729

ORGANIZATION OF THE MAINTENANCE OF INTERNATIONAL PUBLIC SWITCHED TELEPHONE CIRCUITS USED FOR DATA TRANSMISSION

1 General

1.1 Data transmissions may be made over the public switched telephone network in a manner similar to voice transmissions. Such data calls, while expected in most cases to be satisfactory, cannot always be assured success in view of the variety of routing and transmission characteristics that may be found in national extensions between international switching centers and user stations.

1.2 As the exact configuration of an international call is essentially impossible to determine without an extensive and complicated tracing process, some means must be specified to enable each Administration to investigate, as it considers necessary, reports of data transmission difficulties.

2 Fault investigations and maintenance

2.1 Each country agreeing to the transmission of data over the public switched telephone network shall set up a Data Coordinating Point (DCP)

— shall be the contact point between Administrations for referring data transmission difficulties for investigation in respective national networks;

— shall be the point to undertake discussions and agree on a course of action to be taken on public telephone network circuits regarding data transmission difficulties. It should be noted that agreement may be reached to take no actions regarding the international circuits;

— shall initiate any actions related to national network extensions in accordance with its national practices and procedures.

2.2 Fault investigations undertaken should be on the basis of the transmission requirements of public telephone calls. Such investigations, while possibly initiated by a DCP, will be carried out by the maintenance organization (Recommendation M.710) according to standards defined by Recommendation M.580, etc.

The term ‘‘point’’ is used in the same sense as in the M.700 series of Recommendation — see particularly Recommendations M.710.

2.3 Transmission tests *(fault location or scheduled routine measurements)* between subscriber locations, that is, on an end-to-end basis, are not expected to be made. Considering routing complexities and the low probability of duplicating an exact connection, such end-to-end tests would not necessarily be meaningful and would be very difficult to coordinate. However, if end-to-end tests are deemed to be essential by an Administration, then such tests shall be implemented in accordance with agreements reached by the respective DCPs.

2.4 Routine maintenance measurements will be accomplished according to agreements reached in conformity with Recommendation M.605.

Recommendation M.730

MAINTENANCE METHODS

1 General

In order to meet the service demands of a progressive and rapidly expanding international fully automatic telephone network with the best possible quality of service, it is essential that all factors adversely affecting the quality of service should be detected and service restored as quickly as possible. In setting this objective it is recognized that perfect performance is unattainable and that beyond a certain point, costs can rise sharply out of proportion compared with service quality gain.

When choosing a suitable maintenance method or a combination of methods one should consider:

— the reliability of the plant to be maintained;

— the availability of testing and supervisory facilities as well as the availability and quality of manpower in the maintenance organization;

— the availability of facilities in the plant that indicate the existence and frequency of disturbances;

— the availability of arrangements for automatic remedial action;

— the availability of automatic means to process and analyse operational data received from the plant;

— the final objective i.e to ensure a satisfactory overall service quality (subscriber-to-subscriber) in the international connection, giving equal importance to the national and international parts of the chain that constitute the connection.

It is recognized that a combination of maintenance methods may be applied.

2 Preventive maintenance methods

2.1 *General*

The introduction of stored program control (SPC) exchanges and digital transmission systems reduce the need for preventive maintenance. SPC exchanges should in general be provided with functions which supervise the signalling, switching and transmission processes. If a fault occurs or if pre-set disturbance limits are reached, data which indicate the concerned device(s) or circuit(s) should be printed out.

External supervision, testing and fault localization functions should be avoided if internal functions in SPC exchanges or digital transmission systems can provide the same facilities.

2.2 *Functional tests*

2.2.1 In carrying out functional tests, ordinary working conditions apply and the equipment and circuits are taken as found.

They are carried out on a systematic basis to discover faults that would influence the quality of service. The response to each signal may be tested by equipment provided for this purpose. Such tests may be applied to any part of the signalling path.

2.2.2 Functional tests are carried out locally, or from either end of an international circuit to the other.

2.2.3 The organization of the programme for carrying out functional tests locally is left to the discretion of the Administration responsible for the international exchange.

2.2.4 Overall functional tests on an international circuit are such that they can be made from one end of the circuit without cooperation of technical personnel at the other end of the circuit. These tests may utilize the switching equipment at each end of the circuit, but such equipment is not being tested directly, only the circuit.

The verification of satisfactory signalling operation may be done by using various types of tests:

— Certain types of tests not requiring any special equipment, for example checking that a seizing signal is followed by the return of a proceed-to-send signal and that a clear-forward signal is followed by the return of a release-guard signal.

— Other types combining several tests, using special equipment at both ends. Any type which is in general use by Administrations may be used if suitable and agreed between the Administrations concerned

2.3 *Circuit limit tests*

2.3.1 A circuit limit test is made to verify that the international circuit meets specified operating margins. These tests enable the performance of the whole international circuit to be checked. They will be made as required but normally at the following times:

— before putting the circuit into service;

— according to a systematic test programme which may be based on measurement results or fault (trouble) statistics or quality of service observations (see Recommendation M.605).

They may also be made if functional tests indicate a fault, in order to locate such a fault.

Circuit limit tests may be made with respect either to transmission or to signalling conditions.

2.3.2 The frequency of such tests will be determined by the Administrations concerned and the test conditions to be applied will be in conformity with CCITT Recommendations.

2.3.3 The test equipment, the specifications and methods of gaining access to this equipment are described in the specifications of international signalling, switching and transmission equipment.

2.4 *Limit tests on the constituent parts of a circuit*

2.4.1 These limit tests are made to verify that the constituent parts of a circuit meet specified operating margins. They will be made as required but normally at the following times:

— at installation;

— if functional or limit tests on the circuit indicate a fault, if such tests will help in fault location;

— systematic test programmes which may be based on measurement results or trouble statistics or quality of service observations.

See the specification for the CCITT Automatic Transmission Measuring and Signalling Testing Equipment ATME No. 2 (Recommendation O.22 [1]).

2.4.2 The frequency of such tests will be determined by the Administrations concerned and the test conditions to be applied will be in conformity with CCITT Recommendations.

2.4.3 Limit tests on constituent parts may indicate that the latter need to be readjusted; in such a case, measurements are made on those constituent parts and they are then readjusted in accordance with the relevant CCITT Recommendations.

2.4.4 The test equipment, its specification and the provision of access points will be determined by the Administration concerned taking into account the relevant CCITT Recommendations.

2.5 *Maintenance measurements*

2.5.1 *General*

Maintenance measurements are made periodically on complete circuits (and exceptionally, are indicated in Recommendation M.610 on their constituent parts). Their object is to indicate whether the circuits and equipments are maintained to their specified values when first put into service and, if not, to allow the necessary readjustment to be carried out.

Some maintenance measurements are made to check signalling; others are made to check transmission. They are carried out by the respective technical services responsible for signalling and transmission.

2.5.2 *Measurements concerning signalling*

The conditions for carrying out such measurements, the apparatus used and the periodicity of operations are determined by the relevant Series Q Recommendations. Interventions following such measurements are determined by:

a) CCITT Recommendations;

b) equipment specifications when these are not given in detail by the CCITT.

Information on the equipment and functions required are given in the Recommendations listed in Table 1/M.730.

H.T. [T1.730]

TABLE 1/M.730

Signalling System	Recommendation
No. 4	Q.138 [2]
No. 5	Q.164 [3]
No. 6	Q.295 [4]
R2	Q.490 [5]
No. 7	Q.707 [6]

Table 1/M.730 [T1.730], p.

2.5.3 *Measurements concerning transmission*

These measurements include:

— local measurements, for which the Administrations concerned decide the conditions and periodicity;

— circuit and line measurements for which the conditions are generally defined in the Series M Recommendations.

These Series M Recommendations give, in particular, the periodicity of the measurements and the conditions for readjustment of transmission equipment. (See also Recommendation M.733.)

The CCITT has already specified certain transmission measuring apparatus, and other apparatus specifications are being studied.

3 Corrective maintenance methods

These methods may apply to certain parts of the plant where it is possible to locate and clear faults solely after they have affected the service. Corrective maintenance, if exclusively practised in the entire plant, can create unsatisfactory service conditions due to extreme variations in functional quality and can cause very irregular application of maintenance effort.

The application of exclusively corrective maintenance methods would presuppose such system design that even if breakdowns of single units or parts of the plant occur, they should have a minor effect on the service quality offered to the subscribers.

4 Controlled maintenance methods

Whereas it has been the practice to undertake programmes of preventive maintenance procedures together with day-to-day corrective maintenance procedures, recent equipment development has made it possible to introduce new maintenance methods. Modern systems can provide immediate information concerning the existence of irregularities and of abnormal conditions. Although preventive maintenance gives a comparatively good service, the number of defects caused by interference of preventive operations may be considerable.

A maintenance method utilizing the supervising facilities now available may enable the maintenance organization to considerably reduce preventive routines in the maintenance work. Preventive routine tests may then be replaced by methods of continuous supervision of the function of the plant and by means which check continuously the performance of the equipment and give signals to the maintenance staff when the quality of service is

below a preset acceptance limit. Alternatively, when facilities for continuous supervision are not available, a sampling technique could be introduced to determine the number of routine tests necessary to gain a reasonable assurance that all equipments are in proper order.

Introduction of a system of maintenance control of this kind will necessitate a certain degree of centralization of administrative and technical means in the maintenance organization. Rapid and informative indication of the state and performance of the international and concerned parts of the national network is required from the maintenance point of view at strategic points in the network.

Various types of information on operational conditions in the plant can be utilized for maintenance supervision purposes, such as:

— traffic data;

— accounting data;

— maintenance data;

— service performance data.

Such data may be analysed manually but could also be processed in computers, allowing for a more extensive analysis, for instance, to compare performance statistics with preset standards which are set for particular

routes, circuits, etc. Information held in the computer store may be extracted on-line and could be made directly available to those maintenance and management centres where it is required.

Application of computer processing as described necessitates a high degree of centralization, but also other factors support a centralized maintenance organization such as the increasing use of network management signals. The introduction of processor-controlled switching and digital transmission systems is also expected to increase the possibilities to apply remote controlled and centralized maintenance supervision methods in the future.

References

[1] CCITT Recommendation *CCITT automatic transmission measuring and signalling testing equipment ATME No. 2* , Vol. IV, Rec. O.22.

[2] CCITT Recommendation *Instruments for checking equipment and measuring signals* , Vol. VI, Rec. Q.138.

[3] CCITT Recommendation *Test equipment for checking equipment and signals* , Vol. VI, Rec. Q.164.

[4] CCITT Recommendatiion *Testing and maintenance — Overall tests of Signalling System No. 6* , | Vol. VI, Rec. Q.295.

[5] CCITT Recommendation *Testing and maintenance* , Vol. VI, Rec. Q.490.

[6] CCITT Recommendation *Testing and maintenance* , Vol. VI, Rec. Q.707.

Recommendation M.731

SUBJECTIVE TESTING

1 The need for subjective testing of circuits depends to a great extent on whether or not automatic or semi-automatic supervisory, testing and fault localization equipment is already provided. For example, subjective testing of circuits is not necessary on routes where ATME No. 2 (as described in Recommendation O.22 [1]) is available. Also, the supervisory and fault localization functions built into SPC exchanges and digital transmission systems reduce or even remove the need for subjective testing. For those Administrations wishing to use subjective testing, the methods described in §§ 2-4 below are recommended.

2 Circuits used for the automatic and semi-automatic telephone service may be tested subjectively to reveal gross faults, by systematic test calls from circuit Terminal A to a telephone located at circuit Terminal B. (See Figure 1/M.731.) Such test calling may be done independently of all other tests or combined with functional signalling test calls as described in the *Second method* in Recommendations Q.139 [2] and Q.163 [3] for Signalling Systems No. 4 and No. 5, respectively. Such test calls may be classed as type 3 test calls as defined in Recommendation E.424 [4]. They may be applied on a periodic basis for systematically checking each trunk in a group for excessive echo, clipping, loss, noise, distortion and crosstalk. Any fault suspected as a result of this subjective check should be investigated in the normal manner. When type 3 test calls are used in this manner a test telephone is assumed to exist at the distant international centre. The test telephone is connected to a local exchange, if possible, not located at the same point as the international centre so as to permit a realistic appraisal of the service quality. The test should be initiated at the outgoing terminal for one-way circuits and at both terminals sequentially on both-way circuits. Such test calls for checking service quality should be scheduled with the distant international centre during light load periods.

3 Another method of subjective testing, that may be alternatively considered involves *type 1 test calls* as defined in Recommendation E.424 [4]. It permits systematic evaluation from Terminal A to a location at Terminal B which would not consist of a test telephone, as shown in Figure 1/M.731, but rather to a test location at Terminal B that is not associated with a local exchange. Such an agreement might not be as effective in detecting echo control problems (since the simulation of a normal connection would be less realistic) but might be useful when the first technique suggested above is impractical due to local conditions.

Figure 1/M.731, p.

4 In order to obtain the greatest value from subjective tests it might be advantageous to apply them in association with the tests prescribed in Recommendation M.610 and with *in-station* tests such as those for the maintenance of echo suppressors.

References

[1] CCITT Recommendation *Automatic transmission and signalling testing equipment ATME No. 2* , Vol. IV, Rec. O.22.

[2] CCITT Recommendation *Manual testing* , Vol. VI, Rec. Q.139.

[3] CCITT Recommendation *Manual testing* , Vol. VI, Rec. Q.163.

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

Recommendation M.732

SIGNALLING AND SWITCHING ROUTINE MAINTENANCE TESTS AND MEASUREMENTS

The object of routine maintenance tests and measurements of signalling and switching is to detect changes in the functioning of signalling and switching which are likely to cause a reduction in the quality of service provided. These changes are those which occur in relation to the values indicated in the specifications for the signalling systems concerned (see the pertinent Series Q Recommendations). In the various sections of the Series Q Recommendations, limits are laid down within which:

— no action is necessary,

— action is required by the maintenance service at either of the terminal exchanges.

For Signalling Systems Nos. 4, 5, 6, 7 and R2, reference should be made to Recommendations Q.139 [1], Q.163 [2], Q.295 [3], Q.707 [4] and Q.490 [5] respectively which contain guidance on the methods to be used for signalling and switching routine tests, together with the minimum frequencies at which such tests should be carried out. On routes where ATME No. 2 (Recommendation O.22 [6]) is in use, many of the required tests and measurements can be performed by that equipment. Supervision and fault localization functions included in the exchange and/or in the transmission system also reduce or remove the need for routine maintenance tests and measurements.

Where staffing arrangements permit, manual and semi-automatic routine maintenance of signalling and switching equipment should be done at times when traffic is light. Any routines performed during normal working hours must be carried out with great care to ensure that the effect on live traffic is minimized.

In stored program control (SPC) and digital exchanges many of the required checks for correct functioning of signalling and switching equipment are carried out automatically by supervisory functions within the exchange, thus removing the need for the majority of manual and semi-automatic routine tests. One of the characteristics of such supervisory functions is that performance ‘‘thresholds’’ have to be set which, if exceeded, cause appropriate outputs to alert maintenance staff (for example, alarms, printouts, etc.). Maintenance staff should not only ensure that all relevant supervisory functions are invoked, but must regularly review the thresholds set to ensure that faults and problems will be detected before service is unacceptably affected.

Where the outputs to maintenance staff from SPC and digital exchanges indicate that a fault exists or is suspected, suitable action must be taken to localize the problem. Before seeking cooperation from the distant maintenance centre, maintenance staff shall ensure that the problem is not within their own exchange. As examples, ATME No. 2 (Recommendation O.22 [6]) the facilities given in Recommendation O.11 [7] and the internal self-diagnostic routines within the exchange should be used to this end.

In view of the variety of different types of international exchange now in use and the differing facilities offered by these exchanges, it is not possible to specify any particular periodicity for routine maintenance tests on signalling and switching equipment. The most appropriate periodicity must be established by the Administration concerned based on such factors as:

— the availability of staff;

— the technology of the exchange (for example, crossbar, Strowger, digital);

— the incidence of faults and problems within the exchange;

— the possible need for cooperation from distant maintenance centres;

— the periodicities recommended by the manufacturer of the exchange or equipment involved;

— the periodicities given in the Series Q Recommendations cited above.

References

[1] CCITT Recommendation *Manual testing* , Vol. VI, Rec. Q.139.

[2] CCITT Recommendation *Manual testing* , Vol. VI, Rec. Q.163.

[3] CCITT Recommendation *Testing and maintenance — Overall tests of Signalling System No. 6* , Vol. VI, Rec. Q.295.

[4] CCITT Recommendation *Testing and maintenance* , Vol. VI, Rec. Q.707.

[5] CCITT Recommendation *Testing and maintenance* , Vol. VI, Rec. Q.490.

[6] CCITT Recommendation *CCITT automatic transmission measuring and signalling testing equipment ATME No. 2* , Vol. IV, Rec. O.22.

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

Recommendation M.733

TRANSMISSION ROUTINE MAINTENANCE MEASUREMENTS

ON AUTOMATIC AND SEMI-AUTOMATIC TELEPHONE CIRCUITS

The object of routine maintenance measurements is to detect changes in transmission conditions before such changes cause a reduction in the quality of service provided. These changes are those which occur relative to the values recorded for maintenance purposes for the circuits or link concerned. In the various sections of the Series M Recommendations limits are laid down within which:

— no readjustment is necessary,

— readjustment may be made at the terminal stations,

— readjustment must be made along the whole circuit or link.

Routine maintenance measurements should be made according to an agreed maintenance schedule (see Recommendation M.605). The periodicities for the measurements are given in Tables 1/M.610 and 2/M.610. These are to be considered as recommended values and may be increased or reduced if special circumstances require.

Routine maintenance measurements must normally be made at times of light traffic, where staffing arrangements permit. If such measurements have to be made on a large group of circuits, it may nevertheless be necessary to do the measurements on some of the circuits during the busy period, if the operating services are not adversely affected thereby.

Circuits on a given route are generally measured in batches based on the way in which the maintenance schedule has been arranged (see Recommendation M.605). The advantages are:

— once cooperation has been arranged for routine testing with a distant station, time is saved if test cooperation can be maintained for as long as necessary;

— testing a large number of circuits on one route within a fairly short period enables a more accurate overall notion of the route to be obtained than could be gained from measurements on only a few circuits.

Routine maintenance measurements should be made on a complete circuit and should include measurements of overall loss and levels at one and several frequencies, stability (for 2-wire audio circuits only), and noise.

Recommendation M.734

EXCHANGE OF INFORMATION ON INCOMING TEST FACILITIES AT INTERNATIONAL SWITCHING CENTRES

The attention of Administrations is drawn to the need to exchange information on the incoming test facilities which they have provided at their international switching centres. The exchange of such information has an important bearing on maintenance efficiency since it helps to avoid unnecessary requests for maintenance cooperation and the under utilization of the facilities which have been provided.

The form to be used for this purpose is shown in Figure 1/M.734. It provides, for the international switching centre and signalling system concerned, a description of the available test facilities, their CCITT

reference (where applicable), the access code to be used, and any necessary remarks (for example, an outline of the response to be expected where the facility is not specified by CCITT). Figure 2/M.734 shows a hypothetical example of this form completed for a particular international switching centre.

Each Administration should distribute the completed forms to other Administrations as appropriate. Upon receipt, Administrations should arrange that the information be distributed to the appropriate points within their maintenance organization, for example, circuit control station, testing point (transmission).

Reference

[1] CCITT Recommendation *CCITT automatic transmission measuring and signalling testing equipment ATME No. 2* , Vol. IV, Rec. O.22.

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Figure 1/M.734 [T1.734], p. 3

Figure 2/M.734 [T2.734], p. 4

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SECTION 4

COMMON CHANNEL SIGNALLING SYSTEMS

4.1 Maintenance of common channel Signalling System No. 6

Recommendation M.750

INTER-ADMINISTRATION AGREEMENTS ON COMMON CHANNEL SIGNALLING SYSTEM No. 6

1 Introduction

The bringing into service of new telephone circuits and signalling systems requires that a number of agreements be made in advance by the Administrations involved. Examples of such agreements are:

— routing of circuits (cable, satellite, etc.);

— mode of operation (incoming, outgoing, both-way);

— circuit designations;

— order of selection of both-way circuits.

For common channel signalling systems, a number of agreements are needed, in addition to those required for channel-associated signalling systems (e.g. R2).

This Recommendation explains the principal inter-Administration agreements which must be made in advance of opening a Signalling System No. 6 service and is provided as guidance to those Administrations intending to operate such a service.

Many of the aspects covered by this Recommendation relate to matters contained in the specification of Signalling System No. 6, as appearing in the Series Q Recommendations [1]. Where appropriate, cross references to such Recommendations are given.

2 Common channel Signalling System No. 6 (SS No. 6)

The introduction to the specification of SS No. 6 and Recommendation Q.251 [2] provide general and functional descriptions of the signalling system.

Recommendation M.760 contains a basic diagram of SS No. 6 and a general description of the (signalling) transfer link.

3 Aspects of SS No. 6 requiring inter-Administration agreement

3.1 *Signalling links and signalling security arrangements*

Signals for a given group of speech circuits between two exchanges may be ‘‘associated’’ (routed on a signalling link between the two exchanges), ‘‘non-associated’’ (routed on two or more signalling links in tandem, involving one or more signal-transfer-points) or a mixture of both (Recommendation Q.253, § 1.3.1) [3]. The possible modes of operation range from simple arrangements of one signalling link and associated mode of signalling, to more complex arrangements, for example, the fully dissociated mode where signals are transferred via any available path in a signalling ‘‘network’’.

Before entering detailed discussions on the type of signalling security arrangements required, it is desirable that the terminal Administrations exchange information on the type and manufacturer of their international exchanges and the options available within their existing software systems. This information will enable each Administration to have an overall view of available signalling security arrangements; it will avoid misunderstandings and thus enable rapid progress in establishing detailed arrangements. Subsequently, agreement on the following matters will be required:

i) The number of signalling links and reserves to be provided (Recommendations Q.292 and Q.293) [4] [5]. In general, a choice will be made between:

— regular link plus synchronized reserve(s);

— regular link plus non-synchronized reserve(s). Such non-synchronized reserves may be reserve transfer links or nominated speech circuit reserves.

Where the latter is chosen, the measures to be taken to ensure that there is a high probability of one of the chosen speech circuits being free (at both ends) when required should be discussed between Administrations (Recommendation Q.292, § 8.4.3a)) [4];

— load-sharing

ii) The order of selection (ranking order) of regular/reserve signalling links, reserve transfer links and nominated speech circuit reserves, as provided. Where non-synchronized reserves are concerned, the time each terminal exchange will attempt to regain synchronization (5 or 7.5 seconds) must be agreed between Administrations (Recommendation Q.293, § 8.6.3.2) [5].

iii) The order of selection between alternative signalling routes (where more than one has been provided).

iv) The need to specify an ‘‘automatic load transfer’’ procedure (Recommendation Q.293, § 8.6.3.2) [5].

v) Which exchange will act as ‘‘emergency restart control exchange’’ (Recommendation Q.293, § 8.7c)) [5].

3.2 *Signalling link routing and line-up aspects*

Administrations must reach agreement on the physical routing and line-up requirements of the signalling links and reserves. Among the aspects which are important are:

i) diversity of routing for alternative signalling links and reserves, as required for security purposes;

ii) the propagation delay of signalling links and reserves. This should be as low as possible and should not be significantly greater than that of any speech circuit with which it is normally associated. By this means the possibility of the called party being distorted or ‘‘clipped’’ is reduced (Recommendation Q.272) [6];

iii) the existence or absence of restoration plans to restore transmission facilities over which signalling links and reserves are routed;

iv) the transmission characteristics and limits to be used for the transfer links (Recommendation M.761).

3.3 *Method of signalling*

Signalling System No. 6 provides for two basic methods of sending signalling information namely, ‘‘en-bloc’’ or ‘‘overlap’’ (Recommendations Q.262 and Q.265) [7] [8]. The method to be used for each direction of traffic should be discussed between

Administrations.

3.4 *Use of optional facilities*

3.4.1 *Network maintenance signals*

Network maintenance signals are specified as an optional facility in the specification of SS No. 6 (Recommendation Q.295, § 9.5) [9]. Where both terminal exchanges are equipped with these facilities, the involved Administrations may wish to reach agreement on their use, for example to facilitate recovery from major exchange or signalling system disturbances. In making such agreements, it must be ensured that any ‘‘signal-transfer-point’’ involved between the two terminal exchanges is able to transfer the necessary network maintenance signals.

3.4.2 *Automatic repeat attempt*

The specification for SS No. 6 requires that an automatic repeat attempt be made in a number of specified call failure situations. However, the potential exists to use an automatic repeat attempt in circumstances other than those specified. Administrations may wish to discuss the advantages (if any) of additional application of the automatic repeat attempt facility (Recommendation Q.264) [10] and the implications, for example, on the load on the signalling data link, of such additional use.

3.5 *Label assignment*

By agreement between Administrations, each SS No. 6 speech circuit must be assigned a ‘‘label’’, comprising a ‘‘band number’’ and a ‘‘circuit number’’ (Recommendation Q.257) [11]. Any relationship required between the band numbering scheme and the physical routing of the speech circuits (via cable, via satellite, etc.) must also be agreed between Administrations. It may be noted that there need be no relationship between the circuit number part of the label and the circuit designation (which would be in accordance with Recommendation M.140). For convenience, however, it is desirable where possible to retain an orderly and consistent equivalence between circuit number and circuit designation.

3.6 *Double seizure of both-way circuits*

Signalling System No. 6 incorporates a procedure for dealing with a situation where a both-way circuit has been simultaneously seized at both ends (Recommendation Q.263) [12]. This procedure requires that control and

non-control exchanges be appointed for each (both-way) circuit. It may be noted that there need be no relationship between control and non-control exchanges for double seizure and the circuit control and sub-control stations as defined in Recommendations M.723 and M.724 (unless so desired by the involved Administrations). For convenience, however, it is desirable where possible that Administrations exercise both dual seizure control and maintenance control over the same circuits.

3.7 *Signal-transfer-point working*

Among the aspects upon which Administrations may need to reach agreement are:

i) label translation and the need for control of label assignment (Recommendation Q.253, § 1.3.3.2) [3];

ii) financial accounting. Where the non-associated mode of signalling has been adopted, either normally or as a signalling security arrangement, signalling information will be relayed via one or more signal-transfer-points and would typically involve one or more transit Administrations. Arrangements for any

necessary financial accounting may need to be discussed between involved Administrations.

The inter-Administration aspects of signal-transfer-point working require further study based on the experience of Administrations.

3.8 *Engineering test programme*

Details of an engineering test programme, to be carried out prior to the start of the SS No. 6 service, should be agreed between Administrations. This agreement and the resulting test schedule should take account of the relative experience of the participating Administrations. The following aspects should be covered in such a programme:

i) functional and synchronization aspects of the signalling links and reserves;

ii) signalling security arrangements;

iii) call processing. Tests should cover normal, abnormal, transit and signal-transfer-point signalling sequences;

iv) system failure response. Both signalling system and exchange failures should be covered;

v) tests on individual speech circuits, e.g. using ATME No. 2;

vi) limited period, live traffic tests.

Engineering test programmes require further study. Thus the programme suggested above should be considered ‘‘provisional’’ and may not be complete. But in considering the test programme to be implemented, attention is drawn to the detailed and comprehensive publication cited in [13].

3.9 *Maintenance and maintenance organization*

Inter-administration agreements necessary for the maintenance of SS No. 6 are the subject of other Recommendations in the M-Series. Reference should be made to Recommendations M.760, M.761, M.762 and M.93.

4 Timing of inter-administration agreements

Due to the differing practices and procedures of Administrations, no specific timetable for the inter- administration agreements necessary on SS No. 6 can be offered. However, experience indicates that initial discussions between involved Administrations concerning a new SS No. 6 service should preferably commence about two years prior to the required ‘‘ready for service’’ date.

References

[1] CCITT Recommendation *Specification of Signalling System No. 6* , Vol. VI, Recs. Q.251-Q.300.

[2] CCITT Recommendation *General* , Vol. VI, Rec. Q.251.

[3] CCITT Recommendation *Association between signalling and speech networks* , Vol. VI, Rec. Q.253.

[4] CCITT Recommendation *Reserve facilities provided* , Vol. VI, Rec. Q.292.

[5] CCITT Recommendation *Intervals at which security measures are to be invoked* , Vol. VI, Rec. Q.293.

[6] CCITT Recommendation *Requirements for the signalling data link* , Vol. VI, Rec. Q.272.

[7] CCITT Recommendation *Analysis of digital information for routing* , Vol. VI, Rec. Q.262.

[8] CCITT Recommendation *Speed of switching and signal transfer in international exchanges* , Vol. VI, Rec. Q.265.

[9] CCITT Recommendation *Testing and maintenance — Overall tests of Signalling System No. 6* , Vol. VI, Rec. Q.295.

[10] CCITT Recommendation *Potential for automatic repeat attempt* , Vol. VI, Rec. Q.264.

[11] CCITT Recommendation *General* , Vol. VI, Rec. Q.257.

[12] CCITT Recommendation *Double seizing with both-way operation* , Vol. VI, Rec. Q.263.

[13] CCITT publication *CCITT Signalling System No. 6 Test Schedule* , ITU, Geneva, 1982.

Recommendation M.760

TRANSFER LINK FOR COMMON CHANNEL SIGNALLING SYSTEM No. 6

1 General description of the transfer link

1.1 The transfer link for the common channel Signalling System No. 6 and its relationship with the signalling link and signalling data link are depicted in Figure 1/M.760.

Figure 1/M.760, p.

1.2 The signalling link may be operated over either an analogue or a digital transfer link. Analogue transfer links are used to interconnect data modems located within, or adjacent to, international switching centres, thus forming signalling data links. Analogue transfer links are 4-wire transmission channel pairs having no audio terminating units, signalling equipment or echo suppressors. These channels can be derived from purely analogue, a combination analogue and digital, or purely digital transmission systems. Guidance on the setting-up and lining-up of analogue transfer links is given in Recommendation M.761.

Digital transfer links are used to interconnect interface adaptors to form signalling data links

For guidance on the testing and maintenance of Signalling System No. 6, reference should be made to Recommendation Q.295 [1].

2 Continuity of service

2.1 Since the signalling link carries the signals for many speech circuits, a failure of the link will affect all speech circuits served. Therefore, arrangements should be made to ensure continuity of service of the signalling link.

2.2 Continuity of service will normally involve the provision of reserve facilities, which may be one or more of the following:

— quasi-associated reserve signalling links,

— full-time reserve transfer links,

— nominated direct circuits.

In the last two cases the transfer links must be equipped with signalling terminals and modems or interface adaptors to form signalling links. Reference should also be made to Recommendation Q.292 [2], which provides a detailed description of the above reserve arrangements.

2.3 Whenever possible, the reserve facility to be used should follow a different route from the route of the regular signalling link.

2.4 In order to reduce the number of interruptions on the signalling link to a minimum, it is recommended that all equipment associated with such links (for example, channel translating equipment, modems, distribution frames, etc.) be positively marked to make them readily identifiable to maintenance staff. Such markings assist maintenance efficiency and help staff to avoid causing inadvertent interruptions to the link when carrying out maintenance work in operation centres and switching centres.

2.5 The proper functioning of Signalling System No. 6 is essential to the operation of the international network and various means are suggested in order to ensure this operation. If a fault occurs in the normal transfer link, service will continue (see § 2.2). However, a second (or simultaneous) failure would cause a significant impairment in traffic between centres so affected. Therefore, immediate maintenance attention should be given to transfer link faults and they should be returned to their normal configurations as rapidly as possible following a failure.

3 Transfer link designation

The form of designation to be used for the transfer link and its nominated reserve is given in Recommendation M.140.

4 Maintenance organization

4.1 The maintenance organization for common channel Signalling System No. 6 is in two parts:

a) the maintenance of the overall signalling system with respect to delivering necessary signalling information between international centres, and to the functioning of data modems, signalling terminals and related equipment. The overall maintenance requirements is a subject for further study;

b) the maintenance of the transfer link between two centres, from the output of one data modem to the input of another data modem. This link does not include data modems.

4.2 By agreement between Administrations, one terminal international centre, or an equivalent point specified by the Administration concerned, will be designated as the overall maintenance control station. This station will maintain an overview of the performance of Signalling System No. 6 and in general be responsible to ensure that actions are coordinated when responsibility for a particular fault is not clearly identified. Additionally, one terminal international centre should function as the control station for transfer link maintenance activities.

Note — For a signalling system this role may be combined with that of overall maintenance control.

4.3 Organizational points or stations need to be assigned to provide for the following functions:

a) Overall signalling system maintenance

i) control station

ii) sub-control station

iii) fault report point

iv) testing point

b) Transfer link maintenance

i) control station

ii sub-control station

iii) fault report point

iv) transmission maintenance point (international line) (TMP-IL)

These may be assigned by an Administration as best suited to its individual needs.

It is essential that the appropriate contact point information be exchanged in order to minimize maintenance difficulties. Figure B-1/M.93 offers a plan for the exchange of contact point information for the international telephone service and allows for the exchange of contact point information Signalling System No. 6 maintenance.

4.4 This Recommendation relates to the maintenance of the transfer link. However, maintenance activities on the transfer link should be controlled in order to preclude interruption of signalling functions, either during normal service or while tests initiated by the overall maintenance control station are being carried out. Furthermore, the TMP-IL for the transfer link is not likely to be aware of any faults in the signalling system unless advised by the overall signalling maintenance control station or transfer link control station. Therefore, testing of the transfer link will not be undertaken until advice (or concurrence) is received from the overall maintenance control station or the transfer link control station.

4.5 Once a fault is indicated in Signalling System No. 6, a possible series of events is illustrated in Figure 2/M.760. In the presentation of the flowchart it has been necessary to assume a possible organizational arrangement and assignment of responsibilities [see § 4.1, a) above].

This chart does not go into all possibilities. It is intended to depict a process toward fault correction, looking first at the most likely causes of faults in the transfer link with speedy correction in mind, and then toward more detailed and time-consuming tests to discover more elusive faults. It should be noted that some long-term testing may be required in this latter process.

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Figure 2/M.760, p.

References

[1] CCITT Recommendation *Testing and maintenance — Overall tests of Signalling System No. 6* , Vol. VI, Rec. Q.295.

[2] CCITT Recommendation *Reserve facilities provided* , Vol. VI, Rec. Q.292.

Recommendation M.761

SETTING UP AND LINING UP A TRANSFER LINK FOR COMMON CHANNEL SIGNALLING SYSTEM No. 6 (ANALOGUE VERSION)

1 Setting up and lining up a transfer link

1.1 The method to be used and procedure to be followed in setting up and lining up a transfer link are similar to those given in Recommendation M.1050 [1] in so far as it applies. However, in this context, any reference to national sections in Recommendation M.1050 should be ignored since a transfer link exists between terminal international centres and does not include national sections.

1.2 Routing restrictions may be necessary to achieve the loss/frequency and group-delay distortion limits specified below if the need to insert equalizers is to be avoided. Factors that may contribute to difficulties in meeting these limits are the number of through-group filters in group links, the use of edge band channels in group links, etc.

In addition, the number of channel translating equipments should be minimized in order that equalization, if required, may be more easily achieved, and that the effect of other parameters, such as noise, may be minimized.

2 Transmission characteristics of a transfer link

2.1 *General*

The transmission characteristics of the circuit to be used as the signalling data link are based on those for international leased circuits conforming to Recommendation M.1020 [2]. Optionally, the relaxed overall loss/frequency characteristic and group-delay distortion limits specified in the Recommendation cited in [3] may be applied where agreed between the Administrations involved and if tests confirm suitability.

2.2 *Overall loss at reference frequency*

The overall loss at reference frequency of the channels of a transfer link is not specified.

The channels of a transfer link should be set up so that when a test signal at a level of —10 dBm0 is connected to the input of the transfer channel, the level received at the output of the transfer channel at the distant end is as close as possible to —10 dBm0.

A general description of the transfer link for the common channel Signalling System No. 6 may be found in Recommendation M.760.

2.3 *Variation with time of the overall loss at reference frequency*

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

— short-term variation (over a period of a few seconds): ± | dB;

— long-term variation (over long periods including daily and seasonal variations): ± | dB.

2.4 *Loss/frequency distortion*

The variation of overall loss with frequency relative to the loss at reference frequency should not exceed the limits shown in Figure 1/M.761.

Figure 1/M.761, p.

2.5 *Group-delay distortion*

The group-delay distortion relative to the minimum delay, should not exceed the limits shown in Figure 2/M.761.

Provisionally the limits of Recommendation M.1020 [2] have been chosen for the loss/frequency characteristics although these limits are appropriate for a leased circuit extending over national plant including local lines to customers' premises. However, transfer links will only extend between international centres and their routing will not involve any audio line plant with its inherent increasing attenuation with frequency. Therefore, further study is needed concerning the possible need to change the frequency (3000 Hz), from which the zero gain restriction extends, to some higher frequency.

Figure 2/M.761, p.

Note 1 — It is believed that in many cases the limits specified in §§ 2.4 and 2.5 may be achieved without the addition of equalizing equipment.

Note 2 — The overall loss/frequency characteristic and group-delay distortion limits are currently under study for the feasibility of more relaxed limits. However, initial experience indicates that the limits specified in §§ 2.4 and 2.5 are necessary for reliable operation of the signalling system data link.

2.6 *Random noise*

The level of the psophometric noise power at the receiving terminal international centre depends upon the actual length and constitution of the transfer link. The provisional limit for transfer links of distances greater than 10 | 00 km is —38 dBm0p. However, transfer links of shorter length will have substantially less random noise, as shown in Figure 3/M.761.

Figure 3/M.761 displays random noise versus length and is presented as a guide to the random noise performance which may be found on a transfer link.

Figure 3/M.761, p.

Note — For transfer links routed via satellite, the satellite section (between earth stations) will contribute approximately 10 | 00 pW0p (—50 dBm0p) to the overall circuit noise. Therefore, for the purpose of determining the noise limits for the Signalling System No. 6 transfer link, the section of the transfer link provided by the satellite may be considered to be equivalent to a length of 1000 km. The effective noise length of such a transfer link will be 1000 km plus the total length of the terminal routings.

2.7 *Impulsive noise*

Impulsive noise should be measured with an instrument complying with Recommendation O.71 [4]. As a provisional limit, the number of impulsive noise peaks exceeding —21 dBm0 should not be more than 18 in 15 minutes.

2.8 *Phase jitter*

The value of phase jitter depends upon the actual constitution of the transfer link (for example, upon the number of modulation equipments involved). It is expected that any measurement of phase jitter using an instrument complying with Recommendation O.91 [5] will not normally exceed 10° peak-to-peak. However, for transfer links of necessarily complex constitution, and where 10° peak-to-peak cannot be met, a limit of up to 15° peak-to-peak is permitted. These limits are provisional and subject to further study.

2.9 *Quantizing noise*

If any section of the transfer link is routed over a pulse code modulation system or through a digital exchange, the signal will be accompanied by quantizing noise. The minimum ratio of signal-to-quantizing noise normally expected is 22 dB.

2.10 *Single tone interference*

The level of single tone interference in the band 300-3400 Hz shall not exceed a value which is 3 dB below the circuit noise objective indicated in Figure 3/M.761. This limit is provisional pending further study.

2.11 *Frequency error*

The frequency error introduced by the transfer link must not exceed ± | Hz. It is expected that in actual practice the frequency errors encountered will be less than 5 Hz.

2.12 *Harmonic distortion*

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

3 Recording of results

All measurements made in completing the line-up of the transfer link are valuable as references. These final measurements should be recorded using an appropriate form.

If subsequent realignment or adjustment is necessary these records should be updated.

References

[1] CCITT Recommendation *Lining up an international point-to-point leased circuit* , Vol. IV, Rec. M.1050.

[2] CCITT Recommendation *Characteristics of special quality international leased circuits with special bandwidth conditioning* , Vol. IV, Rec. M.1020.

[3] CCITT Recommendation *Requirements for the signalling data link* , Vol. VI, Rec. Q.272, Annex.

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

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

Recommendation M.762

MAINTENANCE OF COMMON CHANNEL SIGNALLING SYSTEM No. 6

1 General

1.1 It is essential that a common channel signalling system perform with very high reliability over the long term. It is also desirable that maintenance staff perform at the highest practical efficiency. In order to achieve both of these objectives with regard to common channel signalling systems, maintenance responsibilities and actions must be clearly defined and controlled. Such objectives make it necessary, in some cases, to place limitations on the freedom of involved maintenance units in performing independent maintenance actions.

1.2 This Recommendation considers the signalling system as an integrated system. It is not intended to replace or impose upon any Recommendation or procedure (national network or otherwise) which might apply to specific components or sub-systems, for example a signalling terminal or the transfer link; rather, it proposes criteria regarding when and how such actions are to be initiated. Moreover, the general administration of the systems is considered and not the detailed interworking of its various equipments.

1.3 Various maintenance organizational units may have functional responsibility for individual sub-systems which comprise a common channel signalling system (for example signalling terminals, processors, etc.). As the activities of any of these units will have an effect on the overall operation of the signalling system, and because in some cases it may not be possible to independently determine a need for maintenance attention, one point should be designated as an overall signalling system control. This point is titled signalling system administrative control the distant terminal is known as the signalling system administrative sub-control

2 Appointment of administrative control and sub-control

2.1 The appointment of administrative control and sub-control will be made by agreement between the Administrations involved. These two points must be assigned for each signalling system which is placed in operation. It is suggested that the most appropriate point to act as administrative control or sub-control is the maintenance unit having responsibility for the signalling terminal and processor. However, this matter is left to the discretion of the Administrations concerned.

2.2 In the case of multiple signalling systems between the same two points, it may be appropriate to divide control and sub-control assignments, therefore sharing the burden of control responsibility. This is a subject for agreement between the Administrations concerned; however, this assignment and that of the control station for the transfer link should be to the same Administration.

3 Functions and responsibilities of the administrative control

These responsibilities fall into four main areas:

i) day-to-day maintenance of working systems;

ii) history and long-term analysis;

iii) operation under signal transfer point (STP) configurations;

iv) implementing a new signalling system, or an existing signalling system modification.

3.1 *Day-to-day maintenance of signalling systems*

3.1.1 Except as noted in § 3.1.2, maintenance activity on any part of a common channel signalling system must only be undertaken with the agreement and knowledge of the administrative control. Such activities might relate to routine maintenance measurements of the transfer link, service affecting reconfigurations of transmission systems over which the transfer link is routed (i.e. planned outages), the temporary removal from service of a signalling terminal, etc.

3.1.2 In the event of total failure of a signalling system due to a malfunction of one of its parts, immediate steps should be taken to remedy the fault condition. As soon as possible, the administrative control should be informed so that the event can be correlated with other reported events or known signalling failures. An example of such a fault event might be the failure of a transmission system over which the transfer link is routed

3.1.3 Faults which are observable only at a signalling system terminal, for example intermittent failures resulting from an apparent high data bit error rate, must be analysed by the administrative control (and sub-control, depending on the direction of the indicated fault) in order to determine where maintenance attention is required. Such dynamic analysis might involve terminal diagnostic tests, error performance tests with the distant terminal, etc. The result of this dynamic analysis and tests will be corrective action, taken either by the administrative control or the sub-control if under either's jurisdiction, or the referral by the administrative control to the indicated part of the maintenance organization, for example the control station for the transfer link.

3.2 *History and long-term analysis*

3.2.1 The administrative control should maintain a record of all recognized or reported faults pertaining to each signalling system for which it is responsible.

This information includes (but is not limited to) the following:

i) date and time a fault was reported or actually occurred;

ii) the nature of the reported fault;

iii) the reporting location;

iv) the location of the fault, when found;

v) the actual fault condition found and the corrective action taken.

This information should become a part of the history record maintained by the administrative control.

3.2.2 History records will enable long-term analysis to identify repeated faults of a signalling system. Such efforts should improve the long-term operation of a signalling system and therefore afford more economical maintenance.

It is suggested that historical records should be retained for at least 12 months. From the provision of a new signalling system, the history record should be initiated and continued until 12 months have passed. After analysis, each succeeding month will permit the discarding of records accrued during that same month of the previous year. Therefore, an administrative control can examine 13 months of (possible) events, which should be adequate to identify persistent faulty conditions.

3.3 *Operations under signal transfer point (STP) configurations*

3.3.1 With two or more signalling systems in tandem used to convey signalling information between two international centres, signal transfer point operation presents possible maintenance complications. Events which occur in one system can affect the functioning between centres which have no control or sub-control responsibility for the faulty signalling system. If an administrative control determines that a fault has occurred in its signalling system which is part of an STP configuration, it must apprise the administrative control of the signalling system not directly involved, that a fault exists that affects (or will affect) signalling processes. The advice should also include an estimate of the time necessary to correct the condition and, when appropriate, the time the condition was actually corrected.

3.3.2 When a condition affecting signalling via an STP warrants coordinated testing in order to determine the faulty part of either signalling system, the administrative control first involved in the fault report should coordinate testing efforts. Once the fault is localized, referrals can be made via normal procedures to achieve maintenance action.

See Recommendation M.760, § 4 and Figure 2/M.760 which illustrate a possible series of events following the failure of a transfer link of the common channel Signalling System No. 6.

When the fault is corrected, the administrative control for each of the signalling systems should be advised and the administrative control which was first involved should confirm proper signalling via the STP.

3.4 *Implementing a new signalling system*

3.4.1 The Administrations involved must reach all of the agreements necessary for the orderly provision of a common channel signalling system, such as label assignments, constitution of the transfer link routing, security arrangements, initial testing, etc. (see also Recommendation M.750).

3.4.2 The administrative control should receive and record for future reference the results of tests carried out prior to putting a new system into service. In the event of subsequent failures, a reference to these test results may be valuable to the fault location process and also a significant factor in assessing signalling system performance and fault occurrences over the long term.

4 Functions and responsibilities of the administrative sub-control

In general, the responsibilities of the administrative sub-control with respect to its own terminal are similar to those of the administrative control. Additionally, the administrative sub-control should:

i) cooperate with the administrative control in fault localization and clearing activities as necessary;

ii) respond with all relevant details of investigations and fault clearance activities to the administrative control;

iii) advise the administrative control of any known present or future event likely to impact on the operation of the signalling system(s) for which it has responsibility.

5 Contact point information

It is essential that contact point information be exchanged between Administrations in order to minimize maintenance difficulties and speed fault localization and clearance activities, (see Recommendation M.93).

4.1 Maintenance of common channel Signalling System No. 7

Recommendation M.770

INTER-ADMINISTRATION AGREEMENTS ON COMMON CHANNEL SIGNALLING SYSTEM No. 7

1 Introduction

The bringing into service of new telephone circuits and signalling systems requires that a number of agreements be made in advance by the Administrations involved. Such agreements may concern, for exemple:

— routing of circuits (cable, satellite, etc.);

— mode of operation (incoming, outgoing, both-way);

— circuit designation;

— order of selection of both-way circuits.

For common channel signalling systems, a number of agreements are needed in addition to those required for channel-associated signalling systems (e.g., Signalling System R2).

This Recommendation explains the principal inter-Administration agreements which must be made in advance of opening a Signalling System No. 7 service and is provided as guidance to those Administrations intending to operate such a service.

2 Common channel Signalling System No. 7 (SS No. 7)

Many of the aspects covered by this Recommendation relate to matters contained in the specifications of Signalling System No. 7, as appearing in the Series Q Recommendations [1]. Where appropriate, cross references to such Recommendations are given.

Recommendations Q.701 [2] and Q.721 [3] provide functional descriptions of the Message Transfer Part (MTP) and Telephone User Part (TUP) respectively.

The Q.780 [4] Series of Recommendations provide guidance on how to test SS No. 7. (Level 1, 2 and 3).

3 Aspects of SS No. 7 requiring inter-Administration agreement

3.1 *Signalling links and signalling security arrangements*

Signals for a given group of speech circuits between two exchanges may be ‘‘associated’’ (routed on a signalling link between the two exchanges), or ‘‘non-associated’’ (routed on two or more signalling links in tandem, involving one or more signal-transfer points) or a mixture of both (Recommendation Q.701, § 3.1.2 [2].

Before entering into detailed discussions on the type of signalling security arrangements required, it is desirable that the terminal Administrations exchange information on the type and manufacturer of their international exchange and the options available within their existing software systems. This information will enable each Administration to have an overall view of available signalling security arrangements. It will avoid misunderstandings and thus enable rapid progress in establishing detailed arrangements. Subsequently, agreement on the following matters will be required:

i) The use of ‘‘associated’’ and/or ‘‘non-associated’’ modes of signalling.

ii) The choice of signalling transfer points (STPs) in the case where the ‘‘non-associated’’ mode of signalling is used.

iii) Security measures against signalling network link failure, e.g., the use of load sharing between link sets. If load sharing between link sets is to be used, agreement must be reached as to the number of link sets involved.

iv) Alternative routing within the signalling network in the event of failure of a link set, i.e., if load sharing is not used, which STPs are available for a given signalling network relation, and the order of selection of these. Due regard must be paid to the limitation of the number of STPs in tandem in a given signalling network relation (see Recommendation Q.705 § 5) [5].

v) The routing of the signalling network links must ensure that the propagation delay of the links is as low as possible, and not significantly higher than that of the speech circuits which are served by Signalling System No. 7. This is to minimize the initial

speech clipping of the verbal answer from the called party. The above factors must also be considered in any restoration plans, although the non-availability of links may force administrations to accept the possibility of clipping under failure conditions.

vi) The nature of the signalling network link to be used, e.g., 4.8 kbit/s analogue or 64 kbit/s digital, transmission routing, etc.

vii) The method of error correction to be employed in a given signalling relation, i.e., basic or preventive cyclic retransmission (see Recommendation Q.703 § 5) [6].

viii) Emergency restart conditions. (If there is automatic allocation of signalling terminals or signalling data links at the end of a signalling link, it must be ensured that the value (T2) of the timeout is different at each end (see Recommendation Q.703, § 7.3 and Q.704, § 3.4.3) [6] and [7]).

3.2 *Mode of signalling*

Signalling System No. 7 provides for two basic modes of sending signalling information namely, ‘‘en-bloc’’ or ‘‘overlap’’ (Recommendation Q.724) [8].

3.3 *Signalling network consideration for cross-border traffic*

For cross-border traffic between signalling points, a bilateral agreement needs to be made for the routing label assignment of signalling point codes.

Two alternative arrangements are described in Recommendation Q.705, § 6 [5]. One arrangement provides for signalling points which are handling cross-border traffic to be given signal point codes taken from the international numbering plan contained in Recommendation Q.708 [9]. The other provides for these signalling points to be identified by common national point codes.

3.4 *Routing label assignment*

The routing label is that part of the message label which contains the information necessary to deliver the message to its destination point. It comprises the following (see Recommendation Q.704, § 2.2) [7]:

— destination point code (DPC);

— originating point code (DPC);

— signalling link selection (SLS) field or signalling link code (SLC).

DPC and OPC labelling will be in accordance with Recommendation Q.708 [9]. However it may be necessary to have a bilateral agreement for the SLS, so that it can be assigned individually to signalling links.

3.5 *Circuit identification code*

The circuit identification code (CIC) indicates one speech circuit among those directly interconnecting the destination and the originating points. The allocation of CICs to individual circuits is determined by bilateral agreement and/or in accordance with predetermined rules. See Recommendation Q.723, § 2.2.3 [10].

3.6 *Reset of circuit and circuit group messages*

In systems which maintain status in memory there may be occasions when the memory becomes mutilated. In such cases the circuits must be reset to the idle condition in both exchanges to make them available for new traffic. Since the exchange with mutilated memory does not know whether the circuits are idle, busy outgoing, busy incoming, blocked, etc., reset-circuit signals or a circuit group reset should be sent as appropriate for the affected circuits (see Recommendation Q.724, § 1.15) [8].

Under certain failure conditions however, where a large number of circuits is involved, it is possible that some realisations of SS No. 7 terminal equipment will be unable to process the volume of reset messages generated. It is necessary, therefore, that Administrations agree bilaterally whether circuit and circuit group messages should both be used.

3.7 *Use of the circuit continuity check procedure*

Because the SS No. 7 signalling does not pass over the speech path, facilities should be provided for making a continuity check of the speech paths (see Recommendation Q.724, § 1.4) [8].

Use of this procedure on a particular circuit will depend on the type of transmission system (e.g., analogue, digital, mixed analogue/digital) which is used for the circuit and whether end-to-end supervision is provided on the transmission system. It should therefore be bilaterally agreed.

3.8 *Choice of the time slot to be used within the primary order digital path for the signalling link*

In the case where time slot 16 is utilized for circuit supervision purposes (see Recommendation Q.33, § A.1) [11], it is necessary to agree bilaterally on which time slot within the primary order digital path should be used for the signalling link.

3.9 *Changing from one specification of the signalling system to another*

If an Administration changes from one version of the specification of the signalling system to another, distant Administrations should be informed as a precautionary measure before the change takes place since potential interworking problems can then be anticipated. It is desirable therefore, that Administrations should be aware of the need for, and agree to, this exchange of information.

4 Timing on inter-Administration agreements

Due to the differing practices and procedures of Administrations no specific timetable for the inter-Administration agreements necessary on SS No. 7 can be offered. However, experience indicates that initial discussions between Administrations concerning the implementation of a new common channel signalling system should preferably commence about two years prior to the required ‘‘ready for service’’ date.

References

[1] CCITT Recommendation *Specification of Signalling System No. 7* , Vol. VI, Recommendations Q.701-Q.795.

[2] CCITT Recommendation *Functional description of the signalling system* (*Message Transfer Part*), Vol. VI, Recommendation Q.701.

[3] CCITT Recommendation *Functional description of the signalling system* (*Telephone User part (TUP)*), Vol. VI, Recommendation Q.721.

[4] CCITT Recommendation *Signalling System No. 7 test specification, general description* , Vol. VI, Recommendation Q.780.

[5] CCITT Recommendation *Signalling network structure* , Vol. VI, Recommendation Q.705.

[6] CCITT Recommendation *Signalling link* , Vol. VI, Recommendation Q.703.

[7] CCITT Recommendation *Signalling network functions and messages* , Vol. VI, Recommendation Q.704.

[8] CCITT Recommendation *Signalling procedures* , Vol. VI, Recommendation Q.724.

[9] CCITT Recommendation *Numbering of international signalling point codes* , Vol. VI, Recommendation Q.708.

[10] CCITT Recommendation *Formats and codes* , Vol. VI, Recommendation Q.723.

[11] CCITT Recommendation *Protection against the effects of faulty transmission on groups of circuits* Vol. VI, Recommendation Q.33.

Recommendation M.782

MAINTENANCE OF COMMON SIGNALLING SYSTEM No. 7

1 General

1.1 It is essential that a channel signalling system perform with very high reliability over the long term. It is also desirable that maintenance staff perform at the highest practical efficiency. In order to achieve both of these objectives with regard to common channel signalling systems, maintenance responsibilities and actions must be clearly defined and controlled. Such objectives make it necessary, in some cases, to place limitations on the freedom of involved maintenance units in performing independent maintenance actions.

1.2 This Recommendation considers the signalling system as an integrated system. It is not intended to replace or supersede any Recommendation or procedure (national network or otherwise) which might apply to specific components or sub-systems, for example a signalling terminal or the signalling data link; rather, it proposes criteria regarding when and how such actions are to be initiated. Moreover, the general administration of the systems is considered and not the detailed interworking of its various equipments.

1.3 Various maintenance organizational units may have functional responsibility for individual sub-systems which comprise a common channel signalling system (for example signalling terminals, processors, etc.). As the activities of any of these units will have an effect on the overall operation of the signalling system, and because in some cases it may not be possible to independently determine a need for maintenance attention, one point should be designated as an overall signalling system control. This point is entitled *signalling system administrative control* . The corresponding point at the distant terminal is known as the *signalling system administrative sub-control* .

2 Appointment of administrative control and sub-control

2.1 The appointment of administrative control and sub-control will be made by agreement between the administrations involved. These two points must be assigned for each signalling system which is placed in operation. It is suggested that the most appropriate point to act as administrative control or sub-control is the maintenance unit having responsibility for the signalling terminal and processor. However, this matter is left to the discretion of the Administrations concerned.

2.2 In the case of multiple signalling systems between the same two points, it may be appropriate to divide control and sub-control assignments, therefore sharing the burden of control responsibility. This is a subject for agreement between the Administrations concerned; however, this assignment and that of the control station for the transfer link should be to the same Administration.

3 Functions and responsibilities of the administrative control

These responsibilities fall into four main areas:

i) day-to-day maintenance of working systems;

ii) history and long-term analysis;

iii) operation under signal transfer point (STP) configurations;

iv) implementing a new signalling system or a change to an existing system.

3.1 *Day-to-day maintenance of signalling systems*

3.1.1 Except as noted in § 3.1.2, maintenance activity on any part of a common channel signalling system must only be undertaken with the agreement and knowledge of the administrative control. Such activities might relate to routine maintenance measurement of the signalling link, services affecting reconfigurations of transmission systems over which signalling links are routed (i.e., planned outages), etc.

3.1.2 In the event of total failure of a signalling system due to a malfunction of one of its parts, immediate steps should be taken to remedy the fault condition. As soon as possible, the administrative control should be informed so that the event can be correlated with other reported events or known signalling failure.

3.1.3 Faults which are observable only at a signalling system terminal, for example intermittent failures resulting from an apparently high data bit error rate, must be analyzed by the administrative control (and sub-control, depending on the direction of the indicated fault) in order to determine where maintenance attention is required. Such dynamic analysis might involve terminal diagnostic tests, error performance tests with the distant terminal, etc. The result of this dynamic analysis and tests will be corrective action, taken either by the administrative control, if under its jurisdiction, or by the sub-control, if under its jurisdiction, or the referral by the administrative control to the indicated part of the maintenance organization, for example the control station for the transfer link.

3.2 *History and long-term analysis*

3.2.1 The administrative control should maintain a record of all recognized or reported faults pertaining to each signalling system for which it is responsible.

This information includes (but is not limited to) the following:

i) date and time a fault was reported or actually occurred,

ii) the nature of the reported fault,

iii) the reported location,

iv) the location of the fault, when found,

v) the actual fault condition found and the corrective action taken.

This information should become a part of the history record maintained by the administrative control.

3.2.2 History records will enable long-term analysis to identify repeated faults of a signalling system. Such efforts should improve the long-term operation of a signalling system and therefore afford more economical maintenance.

It is suggested that historical records should be retained for at least 12 months. From the provision of a new signalling system, the history record should be initiated and continue until 12 months have passed. After analysis, each succeeding month will permit the discarding of records accrued during that same month of the previous year. Therefore, an administrative control can examine 13 months of (possible) events, which should be adequate to identify persistent faulty conditions.

3.3 *Operations under signal transfer point (STP) configurations*

3.3.1 With two or more signalling systems in tandem used to convey signalling information between two international centres, signal transfer point operation presents possible maintenance complications. Events which occur in one system can affect the functioning between centres which have no control or sub-control responsibility for the faulty signalling system. If an administrative control determines that a fault has occurred in its signalling system which is part of an STP configuration, it must apprise the administrative control of the signalling system not directly involved, that a fault exists that affects (or will affect) signalling processes. The advice should also include an estimate of the time necessary to correct the condition and, when appropriate, the time of correction and the condition actually corrected.

3.3.2 When a condition affecting signalling via an STP warrants coordinated testing in order to determine the faulty part of either signalling system, the administrative control first involved in the fault report should coordinate testing efforts. Once the fault is localized, referrals can be made via normal procedures to achieve maintenance action.

When the fault is corrected, the administrative control for each of the signalling systems should be advised, and the administrative control which was first involved should confirm proper signalling via the STP.

3.4 *Implementing a new signalling system or a change to an existing system*

3.4.1 The Administrations involved must reach all the agreements necessary such as circuit identification code (CIC) assignments, label assignment, constitution of the signalling link routing, security arrangements, testing, etc. (see also Recommendation M.750).

3.4.2 It is necessary to conduct tests on those signalling routes which could be affected by such implementations. The purpose of the tests is to provide confidence that the software, hardware and data for a signalling system is correct in that:

— a traffic circuit using that route can enter, or be removed from service;

— changes made to signalling and traffic routes for which circuits are already in service function correctly.

This objective must be achieved without disruption to live traffic.

3.4.3 Prior to tests being made, it should be ensured that:

— exchange data has been loaded;

— diagnostic checks of the signalling terminals in each exchange have been made;

— test equipment and facilities are available. (The precise requirements are a subject for further study.)

3.4.4 The following situations require tests. The list is not exhaustive since combinations of situations may occur.

For each situation it is necessary to consider whether or not traffic circuits are in service and whether they are being added to or ceased or whether there is no change.

i) no signalling route existing between two switching centres:

— signalling transfer point (STP) route to be provided

— direct linkset to be provided

ii) STP signalling route existing between two switching centres:

— STP route to be added

— STP route to be ceased

— direct linkset to be provided

iii) direct signalling route existing between two switching centres:

— STP route to be added

— STP route to be ceased

— direct linkset to be provided

iv) direct linkset to be ceased:

— link to be provided

— link to be ceased.

3.4.5 For the present, tests should be chosen from those specified as compatibility tests in Recommendations Q.781 [1], Q.782 [2] and Q.783 [3] by agreement between the Administrations concerned. The question of whether particular tests can be specified for particular situations remains as a subject of further study. The actual tests chosen will depend on the nature of the changes which have been made to the signalling network and the relative experience of the participating Administrations. However, when implementing a new signalling system, the following aspects should be covered:

— Level 1 and 2 tests which cover normal and failure conditions for synchronization and Message Transfer Part (MTP) functions;

— Level 3 tests which cover the application of failure conditions in order to test single recovery arrangements;

— Level 4 tests which cover Telephone User Part (TUP) call processing functions and normal STP signalling functions. Test should cover normal, abnormal, transit and call failure sequences;

— tests on individual speech circuits, e.g. using ATME No. 2;

— limited period, live traffic tests.

3.4.6 The test equipment and facilities required remain as a subject for further study.

3.4.7 After completion of testing, there should be an increased level of supervision on the route for a period, the duration of which should be agreed by the Administration concerned. Generally it should not be less than one week. During this period traffic signalling performance statistics should be obtained relating to both the Message Transfer Part (MTP) and Telephone User Part (TUP) in order to confirm that the route performance is functioning correctly. These should be chosen by agreement between the Administrations concerned. Those for the MTP should be taken from Recommendation Q.791 [4] (Monitoring and measurements for the MTP).

3.4.8 The administrative control should receive and record for future reference the results of tests carried out. In the event of subsequent failures, a reference to these test results may be valuable to the fault location process and also a significant factor in assessing signalling system performance and fault occurrences over the long term.

4 Functions and responsibilities of the administrative sub-control

In general, the responsibilities of the administrative sub-control with respect to its own terminal are similar to those of the administrative control. Additionally, the administrative sub-control should:

— cooperate with the administrative control in fault localization and clearing activities as necessary;

— respond with all relevant details of investigations and fault clearance activities to the administrative control;

— advise the administrative control of any known present or future event likely to affect the operation of the signalling system(s) for which it has responsibility.

5 Contact point information

It is essential that contact point information be exchanged between Administrations in order to minimize maintenance difficulties and speed fault localization and clearance activities, (see Recommendation M.93).

6 Monitoring requirements for maintenance purposes

This section specifies the monitoring requirements for maintenance of the common channel Signalling System No. 7.

It considers three aspects of monitoring which are as follows:

— a monitoring facility for the signalling system which is realized in the digital exchange software. It would be called into operation by command when required in order to manually observe signalling sequences. It is referred to hereafter as a software monitor ;

— a facility (provided by means of hardware) which allows for the connection of monitoring equipment to the signalling link, i.e. a monitoring point;

— the requirements for testing equipment which is connected at the monitoring point.

6.1 *The software monitor*

6.1.1 A software monitor should be provided which will allow signals handled in the implementation of the signalling system in the SPC exchange, to be selectively output to an input/output terminal for the purpose of manually observing signalling sequences.

It is considered that this facility should be the primary means of manually observing signalling sequences.

6.1.2 The software monitor should meet the following requirements:

— it must be capable of operations without interfering with the operation of the signalling system;

— it must be capable of monitoring Message Transfer Part (MTP) and Telephone User Part (TUP) messages. Other User Parts are the subject of further study;

— it must be capable of displaying all MTP messages which relate to specified linksets or destinations or both. It should record registration time, direction, linkset identity, link identity, signal acronym and any change of signalling link state for all messages. It must be possible to monitor several destinations and linksets simultaneously. The precise number of destinations and linksets will depend upon such factors as the size of the exchange and its position in the network (i.e. local, transit, etc.);

— it must be capable of displaying the contents of all TUP message signal units sent and received for specified speech circuits or groups of circuits. It would also be useful to register the link on which the TUP signals have been sent and record any changes to the link used. It must be possible to monitor several circuits simultaneously. The precise number of circuits will depend on such factors as the size of the exchange and its position in the network (i.e. local, transit, etc.).

6.2 *Monitoring point requirements*

6.2.1 A means of connecting independent monitoring equipment to a 64 kbit/s signalling link should be provided. This facility would be used either when more information is required than the software monitor is able to provide or when verification by an independent means is required of the information supplied by the software monitor.

The means of connection to a 64 kbit/s signalling link should be either at the 64 kbit/s level, in which case interface requirements of Recommendation G.703, § 1 [5] apply, or at the primary order level, in which case the interface requirements of G.703, § 2 (1544 kbit/s) or § 6 (2048 kbit/s) apply.

6.2.2 The means of connection should be such that:

— signals can be monitored in both directions simultaneously;

— the connection of monitoring equipment does not affect the signals present on the link or on other time slots in the primary order path which carried the link;

— signals may be monitored irrespective of the current link status;

— any or all of the protocol levels of any signal units on the link may be observed.

6.3 *Requirements of test equipment used for monitoring purposes*

Requirements for test equipment used for monitoring purposes are:

— that the equipment should be self-contained and independent of the terminal equipment of the system;

— that the equipment should be able to display all signals which are necessary to be examined in order to detect faults at all levels of the signalling system;

— that the form in which signals are displayed should enable them to be easily recognizable to the maintenance staff. In particular it should be possible to display specified fields of a message or all the fields;

— that the equipment should be capable of storing information from the link for later off-line examination (amount and extent of this information has yet to be determined);

— that information should be displayed (and recorded, where applicable) to allow the operator to determine the time when a signal or message was received;

— that the equipment should be able to display and store information on the link at all times;

— that the equipment should have the facility to allow the maintenance staff to determine which categories of signals or messages are to be displayed;

— that the equipment should allow the maintenance staff to specify conditions such as the receipt of messages or signals which would trigger the commencement of display or storage;

— that when triggered, the equipment should display, in chronological order the signals which occurred prior to the triggering and after it. The number of these messages has yet to be determined.

Note — It is intended that a Recommendation in the O series will be developed which will specify this test equipment in detail.

References

[1] CCITT Recommendation *MTP Level 2 test specification* , **|** Vol. VI, Recommendation Q.781.

[2] CCITT Recommendation *MTP Level 3 test specification* , **|** Vol. VI, Recommendation Q.782.

[3] CCITT Recommendation *TUP Test specification* , **|** Vol. VI, Recommendation Q.783.

[4] CCITT Recommendation *Monitoring and measurements for the MTP* , **|** Vol. VI, Recommendation Q.791.

[5] CCITT Recommendation *Physical/electrical characteristics of hierarchical digital interface* , **|** Vol. III, Recommendation G.703.

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