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MAINTENANCE

COMMON CHANNEL SIGNALLING SYSTEMS

MAINTENANCE OF COMMON CHANNEL SIGNALLING SYSTEM No. 7

ITU-T Recommendation M.4100

(Previously “CCITT Recommendation”)

FOREWORD

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The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation M.4100 was revised by ITU-T Study Group 4 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 12th of May 1996.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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ABSTRACT

This Recommendation considers the general administration of Common Channel Signalling System No. 7. It defines the administrative control and sub-control, their respective functions and responsibilities, contact point information and monitoring requirements for maintenance purposes.

KEYWORDS

Administrations, Agreements, Assignment, CIC code, Common Channel Signalling System No. 7, Continuity check, Label, Links, Linkset, Maintenance, Mode, Routing, Signalling-transfer-point.

Recommendation M.4100

MAINTENANCE OF COMMON CHANNEL SIGNALLING SYSTEM No. 7

(Melbourne, 1988; revised in 1993, 1996)

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 supersede any Recommendation or procedure (national network or otherwise) which might apply to specific components or subsystems, 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 subsystems 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 two Administrations (e.g. Administration No. 1 and Administration No. 2) 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.

Routine maintenance activities

a) It is recommended that all routine maintenance and scheduled work activities be performed during hours of minimum traffic so that any inadvertent failure impacts the least number of customers.

b) At a minimum, high risk, potentially service affecting maintenance and growth procedures should be scheduled during weekend and off-hour. The overall methods, procedures and scheduling of these work activities should be reviewed by a sub-control maintenance organization.

c) The activities that may affect other network service providers must be coordinated, which includes both intra- and inter-Administration networks.

d) Non-scheduled work activities – if customer service is being impacted, the minimum work activity will occur to restore the system to a stable performance state. Complete system recovery activity will be scheduled for the next minimum traffic period.

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.

In this scenario, when a total CCSS No. 7 failure is experienced, some means of communication between personnel in interconnecting Administration networks, may be required. The Administration should determine what emergency communications are already available and/or what alternative methods, if any, will be provided.

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 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, 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. These records provide an ability to identify and correct potential problems before they become serious enough to cause a fault. 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. The following types of information should be exchanged at the time of the trouble referral:

- circuit identification number for circuit specific troubles;
- date and time of referral;
- nature of the trouble and any other information that may be of assistance in resolving the trouble;
- trouble ticket number(s) or equivalent and the name or initial of the person accepting the trouble.

When the fault is corrected, the administrative control for each of the signalling systems should be advised that the trouble has been cleared, the nature of the trouble found and the action taken. 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

Conversion from in-band signalling to CCSS No. 7 cannot be accomplished without a thoroughly planned process. Two interconnecting Administrations implementation team should meet to discuss and identify all of the steps necessary for a successful trunk conversion. Each administration should establish a Cutover Committee consisting of permanent members from the Ordering, Provisioning, Engineering, Operations, CCSS No. 7 Administration Control Centre and Billing disciplines. The responsibility of the committee is to ensure a smooth conversion through scheduling and addressing, taking into consideration the concerns listed below.

3.4.1 The following guidelines are offered as a starting point for discussion between two interconnecting Administrations. They are not all inclusive.

– TIME OF THE CONVERSION – On what day will the actual conversion start? What time during the day will it take place? If it is out of hours, there may be expense related concerns of work force adjustments. Times may have to be correlated with traffic volumes dependent upon trunk capacity.

– TRUNK OPERATIONS TEST – Is this the first time a specific configuration has been tested? If so, a comprehensive test plan is suggested. If not, a substantially abbreviated test procedure may be appropriate. Will transmission test be performed?

– TRANSITION TRUNK REQUIREMENTS – Will a transition trunk group need to be built? It should also be determined how the trunks will be converted with minimal service interruption. One method is to create a new trunk group for the CCSS No. 7 trunks and overflow the MF trunk group to the CCSS No. 7 Group (or vice versa). Converting in this manner allows all trunks to be in service with the exception of those which are actively in the conversion process.

– MAXIMUM NUMBER OF TRUNKS FOR CONVERSION – During that time that the trunks are actually being converted, they will be out of service. It must be determined how many trunks can be removed from service without adversely affecting traffic. Dependencies are the size of the trunk group, spare capacity and the time of conversion. Specific identification of trunks must be coordinate between the Administrations to ensure that both Administrations are converting the same trunks at the same time.

– MANUAL VS AUTOMATIC – Will any one of the two interconnecting Administrations be using a mechanized procedure for converting the trunks? This information may be useful in scheduling the work.

– FACILITY CHANGES – It is not anticipated that there will be facility changes associated with the conversion of trunks. If they are required, the information should be conveyed at the pre-conversion meeting.

– EQUIPMENT CHANGES – Most trunk equipment used for in-band signalling should also work with CCSS No. 7. However, some manufacturers may have designed their trunk equipment to work properly in the off-hook state only. This equipment, when used for CCSS No. 7, would provide degraded transmission since, in relation to E&M signalling, the circuit will always be on-hook.

– SWITCH TYPES – The switch types involved in the conversion should be identified to address special needs of specific switches. For example, a switch may require that the Trunk Circuit Identification Code (TCIC) and the trunk number be of the same value. Identification of the switches will also allow the companies to determine the extent of testing that will take place.

– NMC NOTIFICATION – The Network Management Centre should be notified of the conversion to enable the centre to monitor the trunk group, especially during the time of conversion/reduced capacity. The NMC may also be able to inform the Conversion Team of any special calling events which may be occurring at the time of the conversion.

– TIMER VALUES – The two interconnecting Administrations switches and STPs have many timers associated with link operation and call set-up. Since only parameters and not the actual values are stated in technical references, it is likely that the Administrations will have different time settings for the same timer. Although there is no requirement that the value of specific timers be the same in both Administrations, the sharing of the values will provide each company with additional information for trouble resolution.

– POINT CODES – If an Administration is contemplating interconnecting, it is essential that point code range information be known well in advance to enable the Administration control centre to update the STP during the scheduled split mode operation. Point codes include those of the STP, the interconnecting switches and any alias point codes.

– FREQUENCY OF CONTINUITY TESTS – When in-band signalling is used, continuity of the trunk selected is assured by call set-up. Continuity testing is also available on CCSS No. 7 trunks. The switch will automatically send, receive and measure tones placed on the trunk prior to setting up a call. The switch will perform continuity on a circuit at a variable rate (e.g. 1 out of *n* times where *n* has a value of 1 to 16). The Administrations need to agree on the value of *n* for the continuity tests.

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], Q.783 [3], Q.767 [4] and Q.750 [5] by agreement between the Administrations concerned. The question of whether particular tests can be specified for particular situations is a matter for bilateral agreement between Administrations. 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) and ISDN User Part (ISUP) 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 Administrations 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.752 [6] (Monitoring and measurements for Signalling System No. 7 networks).

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 to minimize maintenance difficulties and speed fault localization and clearance activities (see Recommendation M.1510 [9]).

6 Monitoring requirements for maintenance purposes

This clause specifies the monitoring requirements for maintenance of 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 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), Telephone User Part (TUP), Signalling Channel Control Part (SCCP) and ISDN User Part (ISUP) 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.).
- Must be capable of displaying the contents of all TUP and ISUP message signal units sent and received for specified circuits or groups of circuits. It would also be useful to register the link on which the 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 clause 1/G.703 [7] apply, or at the primary order level, in which case the interface requirements of clause 2/G.703 [7] (1544 kbit/s) or clause 6/G.703 [7] (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 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:

- The equipment should be self-contained and independent of the terminal equipment of the system.
- 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.
- 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.
- 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).

– Information should be displayed (and recorded, where applicable) to allow the operator to determine the time when a signal or message was received.

– The equipment should be able to display and store information on the link at all times.

– The equipment should have the facility to allow the maintenance staff to determine which categories of signals or messages are to be displayed.

– 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.

– 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] ITU-T Recommendation Q.781 (1993), *Signalling System No. 7 – MTP level 2 test specification.*

[2] ITU-T Recommendation Q.782 (1993), *Signalling System No. 7 – MTP level 3 test specification.*

[3] CCITT Recommendation Q.783 (1988), *TUP test specification.*

[4] CCITT Recommendation Q.767 (1991), *Application of the ISDN user part of CCITT Signalling System No. 7 for international ISDN interconnections.*

[5] ITU-T Recommendation Q.750 (1993), *Overview of Signalling System No. 7 management.*

[6] ITU-T Recommendation Q.752 (1993), *Monitoring and measurements for Signalling System No. 7 networks.*

[7] CCITT Recommendation G.703 (1991), *Physical/electrical characteristics of hierarchical digital interfaces.*

[8] CCITT Recommendation M.4010 (1992), *Inter-Administration agreements on common channel Signalling System No. 6.*

[9] CCITT Recommendation M.1510 (1992), *Exchange of contact point information for the maintenance of international services and the international network.*