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(06/97)

SERIES Q: SWITCHING AND SIGNALLING

Specifications of Signalling System No. 7 – Signalling System No. 7 management

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Guidebook to Operations, Maintenance and Administration Part (OMAP)

ITU-T Recommendation Q.756

(Previously CCITT Recommendation)

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For further details, please refer to ITU-T List of Recommendations.

ITU-T RECOMMENDATION Q.756

GUIDEBOOK TO OPERATIONS, MAINTENANCE AND ADMINISTRATION PART (OMAP)

Summary

This Recommendation "Guidebook to Operations, Maintenance and Administration Part (OMAP)" collects SS7 background knowledge which is important to using the OMAP Recommendations. This is relevant for:

– network operating administration, deciding on their application;

– provider of Operating Systems (OSs) for TMN;

– operator working at non-TMN terminals.

This Guidebook refers to the *White Book* version of OMAP.

Source

ITU-T Recommendation Q.756 was prepared by ITU-T Study Group 11 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 5th of June 1997.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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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As of the date of approval of this Recommendation, the ITU had/had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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Recommendation Q.756

GUIDEBOOK TO OPERATIONS, MAINTENANCE AND ADMINISTRATION PART (OMAP)

(Geneva, 1997)

1 Scope

Whereas Recommendation Q.750 is an overview of OMAP architecture and its functions, the basic idea of this Guidebook to OMAP Q.756 is to collect background knowledge which is important in using the OMAP Recommendations be it as:

– network operating administration, deciding on their application;

– provider of Operating Systems (OSs) for TMN;

– operator working at non-TMN terminals.

This Guidebook refers to the *White Book* version of OMAP.

2 References

The following ITU-T Recommendations, and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

– ITU-T Recommendation A.3 (1996), *Elaboration and presentation of texts for Recommendations of the ITU Telecommunication Standardization Sector*.

– ITU-T Recommendation M.3010 (1996), *Principles for a telecommunications management network.*

– ITU-T Recommendation Q.700 (1993), *Introduction to CCITT Signalling System No. 7*.

– ITU-T Recommendation Q.701 (1993), *Functional description of the Message Transfer Part (MTP) of Signalling System No. 7.*

– CCITT Recommendation Q.702 (1988), *Signalling data link*.

– ITU-T Recommendation Q.703 (1996), *Signalling link*.

– ITU-T Recommendation Q.704 (1996), *Signalling network functions and messages*.

– ITU-T Recommendation Q.705 (1993), *Signalling network structure*.

– CCITT Recommendation Q.707 (1988), *Testing and maintenance.*

– ITU-T Recommendation Q.752 (1997), *Monitoring and measurements for Signalling System No. 7 networks*.

– ITU-T Recommendation Q.753 (1997), *Signalling System No. 7 management functions MRVT, SRVT and CVT and definition of the OMASE-User*.

– ITU-T Recommendation Q.754 (1997), *Signalling System No. 7 management Application Service Element (ASE) definitions.*

– ITU-T Recommendation Q.755 (1993), *Signalling System No. 7 protocol tests*.

– ITU-T Recommendation Q.811 (1997), *Lower layer protocol profiles for the Q3 and X interfaces.*

– ITU-T Recommendation Q.812 (1997), *Upper layer protocol profiles for the Q3 and X interfaces.*

– ITU-T Recommendation X.701 (1997), *Information technology – Open Systems Interconnection – Systems management overview.*

– CCITT Recommendation X.710 (1991), *Common management information service definition for CCITT applications*.

– CCITT Recommendation X.721 (1992), *Information technology – Open Systems Interconnection – Structure of management information: Definition of management information*.

– CCITT Recommendation X.734 (1992), *Information technology – Open Systems Interconnection – Systems Management – Event Report Management Function.*

3 Definitions

This Recommendation makes use of the following terms defined in Recommendation M.3010:

a) performance management;

b) configuration management;

c) fault management;

d) Telecommunications Management Network (TMN).

This Recommendation makes use of the following term defined in Recommendation X.701:

– notification.

This Recommendation makes use of the following term defined in Recommendation X.710:

– attribute.

4 Abbreviations

Abbreviations regarding the MTP are listed in Table 1/Q.704. Additionally, the following abbreviations are used throughout this Recommendation.

ASE Application Service Element

CIC Circuit Identification Code

CVT Circuit Validation Test

MRVT MTP Route Verification Test

MT MTP Tester

NE Network Element

NM Network Management

OMAP Operations, Maintenance and Administration Part

OS Operating System

SP Signalling Point

SRVT SCCP Route Verification Test

SS7 Signalling System No. 7

STP Signalling Transfer Point

TFC Transfer Controlled (Message)

TMN Telecommunications Management Network

5 Guidebook to Q.751 "Signalling System No. 7 Managed Objects"

5.1 Point of view

The Guidebook refers to the definitions on Network Element (NE) layer. It provides SS No. 7 knowledge which can be used in helptexts or warnings against dangerous management activities.

The Guidebook does not define the tasks to be done within the OS (on Network layer), e.g. to combine the NEs of both ends of a link. It only deals with some aspects of OS, e.g. it lists the NE object classes for which coordinated activities are necessary on both ends of a Network Management entity.

It also does not deal with possibly coordinated activities from one OS to several Signalling Points (SPs).

5.2 Functional preconditions

5.2.1 Scope of Recommendation Q.751

Recommendation Q.751 does not describe all aspects of the interface between OS and NE for managing SS7. Recommendation Q.751 does not define the amount of data, which is to be held consistent in the OS and the NEs and which of these data is master, which is slave.

The lower layers of the Q3 Interface can be derived from Recommendations Q.811 and Q.812 by assembling packages of functionalities from their various mandatory and optional aspects ("profiling").

5.2.2 Dynamic aspects

It is assumed that the implementation of the Q3 interface takes into consideration also mass events within the managed Signalling Points (SP). These mass events may cause notifications, for example, about all circuits, all links, all link sets, etc.

It is also assumed that mass events which involve all SPs served by an OS at one time (network outage) are taken into consideration when structuring an OS.

As "mass events" are denoted failures which force many SS7 managed objects to change their states, a massive flow of notifications could go far beyond the capacity of Q3 or the operating systems.

It is assumed that OSI management functions (Recommendation X.734) are applied in NE and OS and used by the operator of the network.

By the "event forwarding discriminator", for example, filters can be defined to discriminate which notifications should be passed to the OS and which should not. But these filters do not take into account how many notifications or if a notification with a specific content has already been sent in the specific situation. Therefore this mechanism is not sufficient to prevent mass events.

5.2.3 Synchronization aspects

5.2.3.1 Synchronization between NE and OS

Support for maintaining consistency between NE and OS are outside the scope of Recommendation Q.751.

5.2.3.2 Synchronization between Network Element and Network Management Level

For the following NE object classes, coordinated activities are necessary on both ends of a NM entity:

– signLinkSetTp;

– signLinkTp;

– signDataLinkTp.

5.2.4 Management on NE level is not always sufficient

In case of failures, analysis might be done as for example to send a service crew to the right place. Then analysis only on network element level could be insufficient.

For example in case of a link failure: If there is no failure within the signalling terminal of the network element, the operationalState of the signDataLinkTp does not reliably indicate, if the reason for the failure lies within the terminal at the other end of the link or within the transmission line between both the terminals. Only together with the analysis of the terminal of the other end is it possible to delimit the failure.

5.2.5 Precautions

Some management activities, especially on SS7, are able to cause a network outage by only one action – possibly done erroneously (example: Administratively blocking a signRouteSetNePart). Therefore, it is assumed that the OS employs a system to prevent damages by management activities such as:

– warnings before executing dangerous commands;

– uneraseable storing of dangerous commands;

– special authorization for special operators for special dangerous commands.

5.2.6 Restrictions in manageability

The Recommendations of the SS7 protocol, Q.700 to Q.706, did not define exactly what entities are to be managed.

For a certain kernel the manageability, e.g. of links, link sets, etc., derives indirectly from the SS7 functions.

Against that in a wide "gray" area implementations differ in the possibilities they offer to management. Some examples are:

– modifications of timers;

– load sharing key;

– change of error correction method for a link.

Thus it may occur that actions are requested from the OS-side which will not be executed on the SS7 node side. The operator should get an indication of this event.

Some network elements might use INITIAL VALUEs for attributes which can be changed from system inside, e.g. for OSI states. In this case a notification is expected, if a value different from the initial value is reached, e.g. as soon as an operational state is reached.

Some network elements might not use INITIAL VALUES. In this case, no, for example, state change notification is expected.

The OS should be prepared to handle both cases.

5.3 Handling prescriptions

An OS is supposed to mask differences between different implementations of NEs as far as possible. Certain implementations might however require a different order of execution than others in cases where this order is not fixed in Recommendation Q.751 by the containment, by DELETE-ONLY-IF-NO-CONTAINED-OBJECTS or by behaviour descriptions, e.g. in configuration changes, and hence this would be visible through the OS. This may result in implementation-dependent handling prescriptions for the operator or in implementation-dependent programmes within the OS.

5.4 First collection of guiding information to Recommendation Q.751

5.4.1 Managing of MTP

5.4.1.1 Routing tables

Errors in routing tables – i.e. in the instances of object classes representing the content of the routing tables (such errors can, for example, be the result of a wrong sequence of creation or deletion of these instances) – may cause circulation of messages and network breakdown.

MTP Route Verification Test (MRVT) may find out errors but the damage could already have happened.

Therefore it is a precondition for large SS7 networks that routing tables have been checked off-line before they are taken into operation within the life SS7 network.

5.4.1.2 Timers

Timers are defined in Recommendations Q.702, Q.703, Q.704 and Q.707 in that way, that they do not need any management; they can use up the full tolerance with which they are specified and no problems with other timers are to be expected.

In case a NE allows the management of timers, this functionality should be handled with great care and only in cases where a clear benefit is gained from changing the time values.

5.4.2 Managing of ISUP

For further study.

5.4.3 Managing of SCCP

For further study.

5.4.4 Managing of TCAP

For further study.

5.4.5 Managing of OMAP

For further study.

6 Guidebook to Q.752 "Monitoring and Measurements for Signalling System No. 7 Networks"

6.1 General

Recommendation Q.752 states what measurements are possible in the SS No. 7 network. The number of measurements defined in Recommendation Q.752 is very large. Most of them are not obligatory, many are not permanent but on activation.

Therefore the influence on measuring by SS7 implementors, by SS7 network providers and by operators working at terminals may be large.

NOTE – Recommendation E.505 is intended to be supportive and complementary to Recommendation Q.752. Most of Recommendation E.505 is considered as the objective for traffic measurements which relate to network operations functions for planning, dimensioning and operational management of common channel signalling system networks. But the SS7 measurements defined in Recommendation E.505 (*White Book)* are not quite in line with those defined in Recommendation Q.752 (*White Book*).

6.2 Impact of measurements

When defining or activating measurements, the following impacts should be considered:

– (small) dynamical impact on SS7 performance by measurements existing but currently not activated;

– (larger) dynamical impact on SS7 performance by measurements activated or permanent running;

– amount of data flow via Q3 interface from every SP served by an OS;

– amount of data to be processed by OS, e.g.:

  • for graphical presentation;

  • for comparison of results on both ends of one link, etc.;

  • for derivation of immediate activities (e.g. start of MRVT, see 7.1);

– amount of data to be stored and post processed;

– resulting information that can be obtained from every single measurement.

6.3 Measurement non-obligatory, resp. notification functionally obligatory

Q.752 on occurrence measurements 1.2, 1.3, 1.4, 1.5 and 1.6 are represented by X.721:communicationsAlarm notifications. To be able to reset such alarms (1.2 is an obligatory measurement), also the notification with the same probableCause and perceived-Severity = Cleared must be supported. This is the case independently of the fact that the measurement which can be represented by this notification – on occurrence measurement for signalling link restoration (Table 1, Item 1.12/Q.752) – is not obligatory in Recommendation Q.752 .

In analogy to this, the notification representing non-obligatory Q.752 measurement 1.11 is functionally needed, if non-obligatory Q.752 measurement 1.10 is used.

6.4 Accounting of MTP and SCCP traffic and data protection

Via processing of the data collected for accounting and remuneration purposes, information about competitors or even subscribers could be analysed by the collecting party.

Examples:

In MTP accounting, the analysis of the service indicator of messages from network A transported by network B to network C allows B to see whether A and C communicate via TUP or ISUP, what partition is SCCP traffic, etc.

In SCCP accounting, the addresses (called/calling) in the messages – which may travel e.g. for international roaming of GSM via many networks and through additional STP nodes – contain a lot of information, e.g. which subscribers are involved, which IN services are used and how often, which mobile subscriber is roaming in which country, etc.

Therefore the following guidelines apply:

- Only those options should be used for accounting which are absolutely necessary for it.
- The collected accounting data are to be handled with respect of data security and protection and fair competition.
- Analysis of the collected data should only be done for the purposes of accounting.

7 Guidebook to Q.753 "Signalling System No. 7 Management Functions MRVT, SRVT and CVT"

This clause refers to the status reached at the meeting in Geneva, September 1994 (there were no changes for these items at the interim meeting in Ipswich).

7.1 MRVT

Before applying MRVT within one network, some correlated optional items described below have to be decided.

(It is an open issue how these items are resolved in networks owing to several Administrations like the international network.)

NOTE – MRVT can be used only within one network, i.e. all SP have the same network indicator.

Due to the large number of possibly different routes in networks employing STP, the MRVT could produce a significant message load, especially by MRVT/MRVA messages near the test destination and MRVR messages near the test origination. Parts of the network will be tested several times (see examples in Figures 1 and 2):

Caution should be given not to start MRVT from several SPs within the same time-frame. This could happen especially in case of a larger network problem which is realized from several points:

– In networks without TMN several operators could act independently in the same way, starting MRVT.
– In networks with TMN an automatic start of MRVT could be used – for all SPs – where a threshold in measuring routing data errors (Recommendation Q.752, measurement 5.5) has been exceeded.

A burst of load on the network could be the effect.

The maximum number of different tests run simultaneously at one SP (attribute maxNumOfTests) should therefore be chosen with utmost care and be low; two may mostly be sufficient.

For these reasons, it is recommended not to start MRVT automatically (triggered by events which could affect several SPs).

7.1.1 Dynamic aspects

The functionality of the MRVT is to test every possible route which could exist between test initiator and test destination. Depending on the structure of a network, the number of possible combinations may be very high. This may lead to a very high number of MRVT/MRVA and MRVR messages, especially near the test destination point and the test initiating point.

Therefore the time D needed within one node to perform one complete MRVT depends not only on the dynamic capability of this implementation to send out many MRVT and receive many MRVA but also on the structure of the network. This time D, which is needed for managing the MRVT, should be chosen with utmost care.

Another influence on the performance of MRVT is given by the maximum number of different tests run simultaneously at one SP. This number is a network option. It should be low; two may mostly be sufficient (see above). Different tests are MRVT relating to different originator/destination combinations. This restriction is also valid at intermediate nodes.

7.1.2 Guardtimer T1

One of the functions of MRVT is to detect when for one route the MRVT message was not answered by a MRVA message. This is supervised by the guardtimer T1. This T1 should give time enough to perform the MRVT but should also produce a waiting time not too long for the operator.

This guardtimer T1 is set specifically within every node involved within one MRVT with a duration corresponding to the number of STP still to be crossed to the test destination. When starting a MRVT, the OS (or the operator) have to define the maximum number N of STP to be crossed for this test.

The guardtimer T1 is calculated using the time D which is needed within one node to execute one MRVT. The exact formulae are given in 2.4/Q.753. (When managing this also the capabilities of the implementation have to be respected.)

7.1.3 Summarization

The MRVT items to be managed are:

per network

– maximum number of different tests simultaneously within one node;

– time D to perform one complete MRVT within one node.

per MRVT initiation

– maximum number N of STP to be crossed.

7.2 SRVT

Up to the *White Book*, SRVT can be used only within one MTP network, i.e. all SPs have the same network indicator. Enhancement is intended.

7.3 CVT

The Circuit Validation Test (CVT) allows to combine:

– the test of correct relationship between Circuit Identification Code (CIC) and circuit with;

– a test of transmission quality of the circuit.

CVT is intended to verify that the exchanges at each end of a circuit agree about it. CVT is not intended specifically as a transmission test.

Basing ideas for defining CVT in Recommendation Q.753 were:

– During the first test, correct relationship between CIC and circuit, it is important that one SP performs only one test at one time. Otherwise confusions may remain undetected.

– For the second test, the test of transmission quality, one test must run up to several days, depending on the bit error rate achieved.

– In order to test exchanges with a large number of circuits within a reasonable time-frame, many tests in parallel are necessary.

– An alternative widely used is to test the transmission systems with separate test equipment for about two weeks before taking them into service, see Recommendations G.721 and O.152.

– CVT then has only to perform the first test, the correct relationship between CIC and circuit.

8 Guidebook to Q.754 "Signalling System No. 7 Management ASE Definitions for MRVT, SRVT and CVT"

For further study.

9 Guidebook to Q.755 "Signalling System No. 7 Protocol tests"

9.1 MTP Tester (MT)

Examples are to be given where advantages of using the MT are shown, including examining effects of link congestion. Some advantages in international networks are that the MT is a standardized tool, that link quality measurements can be made before using a link for service. This is for further study.

Danger for the network by congestion

When integrated into an SP, the MTP tester is available in every SP (exchange or standalone STP) and for every operator.

The option: "ignoring congestion" may endanger the whole SS7 network.

The following two examples will show possible situations within the SS7 network. (Also if controlled from a TMN-OS it would be extremely complicated to precalculate potential consequences of overload tests with "ignoring congestion".)

9.1.1 Several tests running independently

Assume several operators independently start this MTP test with ignoration of congestion:

SP A to SP A'

SP B to SP B'

SP C to SP C'

None of these SPs has any congestion problem, but the STP between them is severely overloaded and the network may break down. See Figure 1.

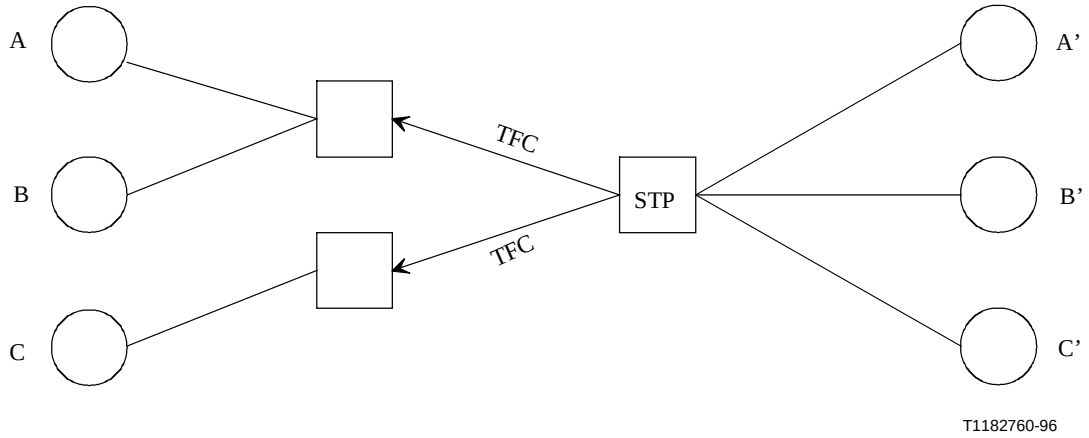

Figure 1/Q.756 – Several tests running independently

9.1.2 MTP Test running end-to-end across the whole SS7 network

- In a network with end-to-end signalling possibility the operator of a very far away OPC may request the testing function via several STPs of the higher levels of the network. This may happen on purpose or by accident due to a typing error within the DPC number.
- Using a fairly high rate of test traffic messages this operator could endanger the whole SS7 network.

See Figure 2.

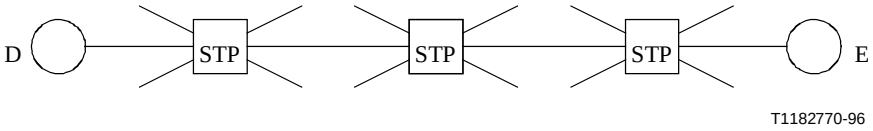

Figure 2/Q.756 – End-to end test

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