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SPECIFICATIONS OF SIGNALLING SYSTEM No. 7

SIGNALLING SYSTEM No. 7 – SIGNALLING CONNECTION CONTROL PART (SCCP) PERFORMANCE

ITU-T Recommendation Q.716

(Previously “CCITT Recommendation”)

FOREWORD

The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the International Telecommunication Union. 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, established the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

ITU-T Recommendation Q.716 was revised by the ITU-T Study Group XI (1988-1993) and was approved by the WTSC (Helsinki, March 1-12, 1993).

NOTES

1 As a consequence of a reform process within the International Telecommunication Union (ITU), the CCITT ceased to exist as of 28 February 1993. In its place, the ITU Telecommunication Standardization Sector (ITU-T) was created as of 1 March 1993. Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.

In order not to delay publication of this Recommendation, no change has been made in the text to references containing the acronyms "CCITT, CCIR or IFRB" or their associated entities such as Plenary Assembly, Secretariat, etc. Future editions of this Recommendation will contain the proper terminology related to the new ITU structure.

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

CONTENTS

Recommendation Q.716

SIGNALLING SYSTEM No. 7 – SIGNALLING CONNECTION CONTROL PART (SCCP) PERFORMANCE

(Melbourne, 1988; modified at Helsinki, 1993)

1 General

1.1 Overview

The Signalling Connection Control Part (SCCP) of Signalling System No. 7 (SS No. 7) is designed as a general message transport system common to the various sub-systems which are using its services. The SCCP is defined in Recommendations Q.711-Q.714.

SCCP must satisfy the requirements of these various sub-systems and therefore the most stringent sub-system requirements are considered when defining a value for a performance parameter (most stringent at the time of the specification). To this end, the requirements of the ISDN User Part (ISUP), the OMAP, and the dialogue between an exchange and a Service Control Point (using the Transaction Capabilities), in particular, were investigated. It is assumed that a SCCP which satisfies the requirements of these users mentioned above will also meet those of future users.

SCCP performances are defined by parameters of two kinds:

- quality of service parameters as seen by a user of the SCCP;
- internal parameters which are not seen by the user but which contribute to a quality of service parameter, for example, the transfer delay in a relay point which contributes to the total transit delay of messages as seen by the user.

The definitions of all these parameters are presented in clause 2. Then the values allowed for the internal parameters are defined in clause 3. Values for the quality of service parameters are given in Recommendation Q.709 which deals with HSRCs.

Consideration is also given in clause 4 to longer messages and other factors that could affect the performance of the SCCP.

1.2 Definitions

Two concepts must be defined when dealing with SCCP performances: SCCP route and SCCP relation. These concepts are similar to the one defined for the MTP (i.e. signalling route and signalling relation). They are defined as follows:

SCCP route: An SCCP route is composed of an ordered list of nodes where the SCCP is used (origin, relay(s), destination) for the transfer of SCCP messages from an originating SCCP user to the destination SCCP user.

SCCP relation: An SCCP relation is a relation between two SCCP users which allows them to exchange data over it. An SCCP relation can consist of one or several SCCP routes.

Five types of nodes where SCCP functions are involved are defined as follows:

originating node: Origin of a UDT message or of a signalling connection.

destination node: Destination of a UDT message or of a signalling connection.

relay point: Signalling point where the translation functions of the SCCP for connectionless classes are implemented.

relay point without coupling: Signalling point where the relay functions of the SCCP connection oriented classes, but without the coupling of signalling connection sections function, are implemented.

relay point with coupling: Signalling point where the relay functions of the SCCP connection oriented classes, including the coupling of signalling connection sections function, are implemented.

2 Definition of performance parameters

Some parameters which are defined in this clause cannot be measured from the outside of a signalling point and therefore no values are attributed to them in clause 3 where only measurable values are given. This is true for some internal parameters such as for example the transit time of a CR message for the relay function at a relay point without coupling: this parameter does not include in its definition the time due to the MTP and therefore in clause 3 values are given to the transit time at a relay point which includes both the time spent in the SCCP and the MTP.

The performance of the SCCP can be adversely affected by long link delays, high error rates and long MSUs. See 4.3/Q.706.

In networks containing implementations from a number of different vendors, it may be necessary where a parameter has a send and receive component to specify that parameter on such a basis. This will then ensure that the overall requirement is satisfied.

2.1 Performance parameter definitions for the connectionless classes

2.1.1 Quality of service parameters

The following parameters define the quality of service as seen by a user of the connectionless classes of the SCCP:

undetected errors: This parameter gives the probability that a UDT message is delivered with user data which is defective.

residual error probability: This parameter gives the probability that a UDT message is lost, duplicated or delivered incorrectly by the set constituted of SCCP and the MTP (called Network Service Part or NSP). An incorrectly delivered UDT message is one in which the user data are delivered in a corrupted condition (see undetected errors above), or the user data are delivered to an incorrect NSAP.

For class 1 only, a UDT message is considered as incorrectly delivered if it is delivered out of sequence by the NSP.

out of sequence probability: This parameter gives the probability that UDT messages are delivered out of sequence to the user by the NSP.

NOTE – This parameter is relevant only for class 1.

total transit delay of a UDT message: This parameter is the elapsed time between a N-UNITDATA request primitive issued by a SCCP user at the originating node and the correponding N-UNITDATA indication primitive issued to the SCCP user at the destination node.

This parameter is composed of several internal parameters:

- sending time of a UDT message by the SCCP;
- MTP overall transfer time;
- transit time of a UDT message for the relay function at a relay point;
- receiving time of a UDT message by the SCCP.

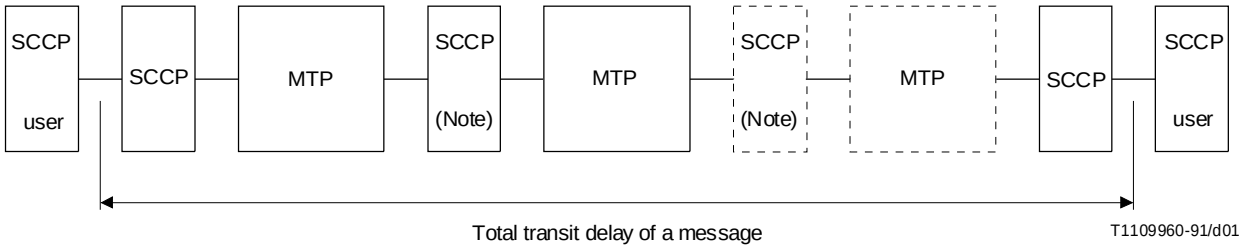
Depending on the configuration, the second parameter could appear one or several times and the third parameter could appear zero, one or several times. This is illustrated in Figure 1.

A probabilistic approach has to be taken to give values to this parameter, considering the various possible SCCP routes and the existence of queues at several points.

unavailability of an SCCP relation: This parameter characterizes the inability for two SCCP users to communicate via the NSP.

This parameter is determined by the unavailability of the individual components of an SCCP relation: SCCP at the two endpoints, one or several signalling relations and zero, one or several relay points.

This unavailability can be reduced by the duplication of routes at the SCCP level.



NOTE – Zero, one or several relay points can be present depending on the network configuration.

FIGURE 1/Q.716

Functional diagram of the total transit delay of a message

2.1.2 Internal parameters

The following parameters are internal to the network service but they contribute to the quality of service as components of a parameter of the previous section for connectionless classes of the SCCP.

sending time of a UDT message by the SCCP: This parameter is the elapsed time between a N-UNIDATA request primitive and the corresponding MTP-TRANSFER request primitive at the originating node.

NOTE – The value of this parameter may differ substantially depending whether or not a translation function is used in the SCCP.

MTP overall transfer time: This parameter is defined in 4.3.3/Q.706 as T_{oa}.

transit time of a UDT message for the relay function at a relay point: This parameter is the elapsed time between a MTP-TRANSFER indication primitive corresponding to an incoming UDT message at a relay point (i.e. a signalling point where are implemented the SCCP translation functions), and the associated MTP-TRANSFER request primitive corresponding to the outgoing UDT message (which may differ from the incoming one by the called party address).

A probabilistic approach has to be taken to give values to this parameter, considering the existence of queues and that it is possible for the translation functions to be congested.

receiving time of a UDT message by the SCCP: This parameter is the elapsed time between a MTP-TRANSFER indication primitive and the corresponding N-UNIDATA indication primitive at the destination node.

unavailability of a relay point: This parameter characterizes the unavailability of the translation functions of the SCCP at a relay point.

2.2 Performance parameter definitions for the connection oriented classes

2.2.1 Quality of service parameters

The following parameters define the quality of service as seen by a user of the connection oriented classes of the SCCP.

signalling connection establishment time: This parameter is the elapsed time between a N-CONNECT request primitive and the corresponding N-CONNECT confirmation primitive for a successful signalling connection establishment.

This delay is composed of two parameters: one which depends on the user at the destination node and one which depends on the NSP. The first one, which is the elapsed time between a N-CONNECT indication primitive and a response primitive at the destination, will be specified for each user. The second one is an internal parameter of the SCCP and is called the SCCP component of the signalling connection establishment time.

Moreover it is possible to specify here the maximum signalling connection establishment time. It is equal to the connection establishment timer (see Recommendation Q.714).

signalling connection establishment failure probability: A signalling connection establishment failure is defined as a connection refusal or a time-out for the connection establishment timer coming from the SCCP.

The dimensioning of the SCCP regarding the number of local reference numbers will impact this signalling connection establishment failure probability. The unavailability of a SCCP relation is also an internal parameter impacting this probability.

The connection refusals coming from the called user must not be taken into account. This also applies for the time-out coming from this called user.

NOTE – It is possible for the connection refusals to distinguish between the one coming from the user and the one coming from the SCCP, but that is impossible for the time-out of the connection establishment timer.

throughput: This parameter is specified independently for each direction of transmission and corresponds to a number of octets of user data (contained in NSDU) transferred per second on a signalling connection.

NOTE – Only successfully transferred user data are taken into account; that means: to the correct destination, error-free and without missequencing.

overall transit time of DT messages: This parameter is the elapsed time between a N-DATA request primitive and the corresponding N-DATA indication primitive.

This parameter is composed of several internal parameters:

- sending time of a DT message by the SCCP;
- MTP overall transfer time;
- transit time of a DT message for the relay function at a relay point with coupling;
- receiving time of a DT message by the SCCP.

Depending of the configuration of the signalling connection, the second parameter could appear one or several times and the third parameter could appear zero, one or several times (see Figure 1).

A probabilistic approach has to be taken to give values to this parameter, considering the various possible SCCP routes and the existence of queues at several points.

undetected errors: This parameter gives the probability that a DT message is delivered with user data which is defective.

residual error rate for DT messages: This parameter gives the probability that a DT message is lost, duplicated, missequenced or incorrectly delivered by the NSP.

A DT message is incorrectly delivered if user data is delivered in a corrupted condition (see undetected errors above), or the user data are delivered to an incorrect NSAP.

out of sequence probability for DT messages: This parameter gives the probability that DT messages are delivered out of sequence to the user by the NSP.

signalling connection unsolicited reset and premature release probability: This parameter gives the probability that a connection release or reinitialization due to the SCCP occurs on a signalling connection during a given time.

The unavailability of an SCCP relation is an internal parameter to be considered when calculating the probability of a connection release occurrence due to the SCCP.

signalling connection reset delay: This parameter is the elapsed time between a N-RESET request primitive and the corresponding N-RESET confirmation primitive for a successful signalling connection reset.

2.2.2 Internal parameters

The following parameters are internal to the network service but they contribute to the quality of service as components of a parameter of the previous section for connection oriented classes of the SCCP.

SCCP component of the signalling connection establishment time: This parameter is composed of two times:

- the elapsed time between a N-CONNECT request primitive at the origin node and the corresponding N-CONNECT indication primitive at the destination node;
- the elapsed time between a N-CONNECT response primitive at the destination node and the corresponding N-CONNECT confirmation primitive at the origin node.

It is composed of several internal parameters:

- sending time of a CR message by the SCCP;
- MTP overall transfer time;
- transit time of a CR message for the relay function at a relay point without coupling;
- transit time of a CR message for the relay function at a relay point with coupling;
- receiving time of a CR message by the SCCP;
- sending time of a CC message by the SCCP;
- transit time of a CC message for the relay function at a relay point with coupling;
- receiving time of a CC message by the SCCP.

Depending on the configuration these parameters can appear zero, one or several times.

A probabilistic approach has to be taken to give values to this parameter, considering the various possible configurations and the existence of queues at several points.

sending time of a CR message by the SCCP: This parameter is the elapsed time between the N-CONNECT request primitive and the corresponding MTP-TRANSFER request primitive (for the transfer of the CR message).

NOTE – The value of this parameter may differ substantially depending wether or not a translation function is used in the SCCP.

MTP overall transfer time: This parameter is already defined in 4.3.3/Q.706.

transit time of a CR message for the relay function at a relay point without coupling: This parameter is the elapsed time between a MTP-TRANSFER indication primitive corresponding to an incoming CR message at a relay point without coupling, and the associated MTP-TRANSFER request primitive corresponding to the outgoing CR message.

transit time of a CR message for the relay function at a relay point with coupling: This parameter is the elapsed time between a MTP-TRANSFER indication primitive corresponding to an incoming CR message at a relay point with coupling, and the associated MTP-TRANSFER request primitive corresponding to the outgoing CR message (which may differ from the incoming one only by the called party address).

receiving time of a CR message by the SCCP: This parameter is the elapsed time between a MTP-TRANSFER indication primitive (for an incoming CR message), and the corresponding N-CONNECT indication primitive.

sending time of a CC message by the SCCP: This parameter is the elapsed time between a N-CONNECT respose primitive and the corresponding MTP-TRANSFER request primitive (for the transfer of the CC message).

transit time of a CC message for the relay function at a relay point with coupling: This parameter is the elapsed time between a MTP-TRANSFER indication primitive corresponding to an incoming CC message at a relay point with coupling, and the associated MTP-TRANSFER request primitive corresponding to the outgoing CR message.

receiving time of a CC message by the SCCP: This parameter is the elapsed time between a MTP-TRANSFER indication primitive (for an incoming CC message), and the corresponding N-CONNECT confirmation primitive.

unavailability of a SCCP relation: This parameter characterizes the inability for two SCCP users to communicate via the NSP.

This parameter is determined by the unavailability of the individual components of a SCCP relation: SCCP at the two endpoints, one or several signalling relations and zero, one or several relay points with coupling and without coupling.

The unavailability can be reduced by the duplication of routes at the SCCP level.

unavailability of a relay point: This parameter characterizes the unavailability of the SCCP at a relay point.

sending time of a DT message by the SCCP: This parameter is the elapsed time between a N-DATA request primitive and the corresponding MTP-TRANSFER request primitive (for the transfer of a DT message).

transit time of a DT message for the relay function at a relay point with coupling: This parameter is the elapsed time between a MTP-TRANSFER indication primitive corresponding to an incoming DT message at a relay point with coupling, and the associated MTP-TRANSFER request primitive corresponding to the outgoing DT message.

receiving time of a DT message by the SCCP: This parameter is the elapsed time between a MTP-TRANSFER indication primitive (for an incoming DT message), and the corresponding N-DATA indication primitive.

2.3 Correspondence between the QOS parameters and the class

The correspondence between the quality of service parameters defined in 2.1.1 and 2.2.1 above and their applicability to the various classes of the SCCP are illustrated in Table 1 below.

TABLE 1/Q.716

Applicability of QOS parameters to SCCP classes

Parameter	Protocol class			
	0	1	2	3
Undected errors	Y	Y	Y	Y
Residual error probability	Y	Y	Y	Y
Out of sequence probability	N	Y	N	Y
Total transit delay of message	Y	Y	Y	Y
Unavailability of a SCCP relation	Y	Y	Y	Y
Signalling connection establishment time	N	N	Y	Y
Signalling connection establishment failure probability	N	N	Y	Y
Throughput	N	N	Y	Y
Signalling connection unsolicited reset and premature release probability	N	N	Y	Y
Signalling connection reset delay	N	N	Y	Y

3 Specified values for internal parameters

3.1 Internal parameters for classes 0 and 1

3.1.1 Transit time of a UDT message in a relay point

The transit time of a UDT message in a relay point is composed of the transit time of a UDT message for the relay function in a relay point and of the time elapsed in the MTP at this relay point for the UDT message. It is measurable externally. It is described in Figure 2 and it should not exceed the values given in Table 2.

The normal traffic load for the translation function is the load for which the point is dimensioned.

These figures assume a message length distribution as given in Table 2 (short messages with a mean message length of 120 bits). Clause 4 considers the effect of longer messages and other factors on the SCCP performance.

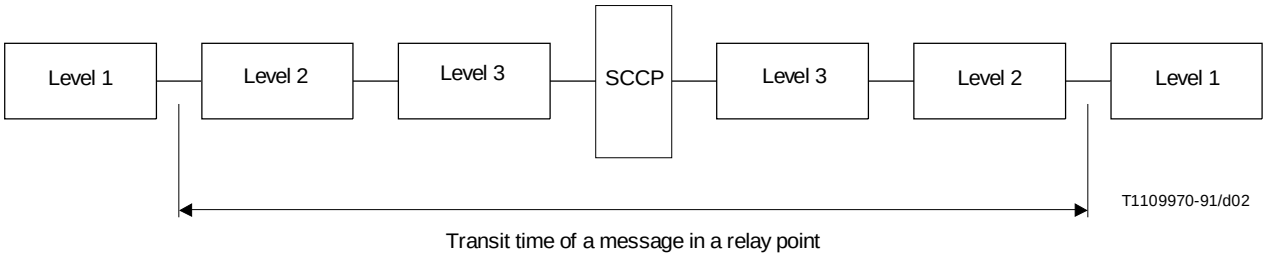


FIGURE 2/Q.716

Functional diagram for the transit time of a message in a relay point

TABLE 2/Q.716

Transit time of a UDT message in a relay point

Traffic load for the translation function	Transit time (ms)	
	Mean	95%
Normal	50-155	100-310
+15%	100-233	200-465
+30%	250-388	500-775
NOTES 1 All values are provisional. 2 See Clause 4.		

3.1.2 Unavailability of a relay point

The unavailability of a relay point should not exceed 10^{-4}.

3.2 Internal parameters for classes 2 and 3

3.2.1 Transit time of a CR message at a relay point without coupling

The transit time of a CR message at a relay point without coupling is composed of the transit time of a CR message for the relay function in a relay point without coupling and of the time elapsed in the MTP at this relay point without coupling for the CR message: it is measurable externally. It should not exceed the values given in Table 3.

The normal traffic load for the relay function is the load for which the point is dimensioned.

These figures assume a message length distribution as given in Table 2/Q.706 (short messages with a mean message length of 120 bits).

TABLE 3/Q.716

Transit time of a CR message in a relay point without coupling

Traffic load for the relay function	Transit time (ms)	
	Mean	95%
Normal	50-155	100-310
+15%	100-233	200-465
+30%	250-388	500-775

NOTES

1 All values are provisional.

2 See Clause 4.

3.2.2 Transit time of a CR message in a relay point with coupling

The transit time of a CR message at a relay point with coupling is composed of the transit time of a CR message for the relay function in a relay point with coupling and of the time elapsed in the MTP at this relay point with coupling for the CR message; it is measurable externally. It should not exceed the values given in Table 4.

The normal traffic load for the relay function is the load for which the point is dimensioned.

These figures assume a message length distribution as given in Table 2/Q.706 (short messages with a mean message length of 120 bits).

3.2.3 Transit time of a CC message in a relay point with coupling

The transit time of a CC message at a relay point with coupling is composed of the transit time of a CC message for the relay function in a relay point with coupling and of the time elapsed in the MTP at this relay point with coupling for the CC message; it is measurable externally. It should not exceed the values given in Table 5.

The normal traffic load for the relay function is the load for which the point is dimensioned.

These figures assume a message length distribution as given in Table 2/Q.706 (short messages with a mean message length of 120 bits).

3.2.4 Transit time of a DT message in a relay point with coupling

The transit time of a DT message (DT1 or DT2) at a relay point with coupling is composed of the transit time of a DT message for the relay function in a relay point with coupling and of the time elapsed in the MTP at this relay point with coupling for the DT message; it is measurable externally. It should not exceed the values given in Table 6.

TABLE 4/Q.716

Transit time of a CR message in a relay point with coupling

Traffic load for the relay function	Transit time (ms)	
	Mean	95%
Normal	75-180	150-360
+15%	150-270	300-540
+30%	375-450	750-900
NOTES 1 All values are provisional. 2 See Clause 4.		

TABLE 5/Q.716

Transit time of a CC message in a relay point with coupling

Traffic load for the relay function	Transit time (ms)	
	Mean	95%
Normal	30-110	60-220
+15%	60-165	120-330
+30%	150-275	300-550
NOTES 1 All values are provisional. 2 See Clause 4.		

The normal traffic load for the relay function is the load for which the point is dimensioned.

These figures assume a message length distribution as given in Table 2/Q.706 (short messages with a mean message length of 120 bits).

3.2.5 Unavailability of a relay point without coupling

The unavailability of a relay point without coupling should not exceed 10^{-4}.

3.2.6 Unavailability of a relay point with coupling

The unavailability of a relay point with coupling is for further study.

4 Influence of new SS No. 7 applications

The tables of transit times in Clause 3 are valid for outgoing terrestrial links with loadings of less than or equal to 0.2 Erlang. If satellite links or terrestrial links with higher link loadings or links with average message lengths of more than 100 bytes are used, additional outgoing link delays as described in 5/Q.706 must be added to the Clause 3 transit time values.

TABLE 6/Q.716

Transit time of a DT message in a relay point with coupling

Traffic load for the relay function	Transit time (ms)	
	Mean	95%
Normal	30-110	60-220
+15%	60-165	120-330
+30%	150-275	300-550

NOTES

1 All values are provisional.

2 See Clause 4.