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**SPECIFICATIONS OF SIGNALLING
SYSTEM No. 7**

**SIGNALLING SYSTEM No. 7 –
SIGNALLING NETWORK STRUCTURE**

ITU-T Recommendation Q.705

(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.705 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 Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.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.

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Recommendation Q.705

SIGNALLING SYSTEM No. 7 – SIGNALLING NETWORK STRUCTURE

(Geneva, 1980; modified at Helsinki, 1993)

1 Introduction

This Recommendation describes aspects which are pertinent to and should be considered in the design of international Signalling System No. 7 (SS No. 7) signalling networks. Some or all of these aspects may also be relevant to the design of national networks. Some aspects are dealt with for both international and national networks (e.g. availability), others are discussed in the context of the international network only (e.g. the number of *signalling transfer points* in a signalling relation). A number of aspects require further study for national networks. This Recommendation also gives in Annex A examples of how the signalling network procedures may be applied to the mesh network representation.

The national and international networks are considered to be structurally independent and, although a particular *signalling point* may belong to both networks, signalling points are allocated *signalling point codes* according to the rules of each network.

The signalling network procedures are provided in order to effectively operate a signalling network having different degrees of complexity. They provide for reliable message transfer across the network and for reconfiguration of the network in the case of failures.

The most elementary signalling network consists of *originating and destination signalling points* connected by a single *signalling link*. To meet availability requirements this may be supplemented by additional links in parallel which may share the signalling load between them. If, for all signalling relations, the originating and destination signalling points are directly connected in this way in a network, then the network operates in the *associated mode*.

For technical or economic reasons a simple associated network may not be suitable and a *quasi-associated network* may be implemented in which the information between originating and destination signalling points may be transferred via a number of signalling transfer points. Such a network may be represented by a *mesh network* such as that given in Annex A, as other networks are either a subset of the mesh network or are structured using this network or its subsets as components.

2 Network components

2.1 Signalling links

Signalling links are basic components in a signalling network connecting together signalling points. The signalling links encompass the *level 2* functions which provide for message error control (detection and subsequent correction). In addition, provision for maintaining the correct message sequence is provided (see Recommendation Q.703).

2.2 Signalling points

Signalling links connect signalling points at which signalling network functions such as message routing are provided at *level 3* and at which the user functions may be provided at *level 4* if it is also an originating or destination point (see 2.4/Q.704).

A signalling point that only transfers messages from one signalling link to another at level 3 serves as a signalling transfer point (STP).

The signalling links, signalling transfer points, and signalling (originating or destination) points may be combined in many different ways to form a *signalling network*.

3 Structural independence of international and national signalling networks

The worldwide signalling network is structured into two functionally independent levels, namely the international and national levels, as illustrated in Figure 1. This structure makes possible a clear division of responsibility for signalling network management and allows numbering plans of signalling points of the international network and the different national networks to be independent of one another.

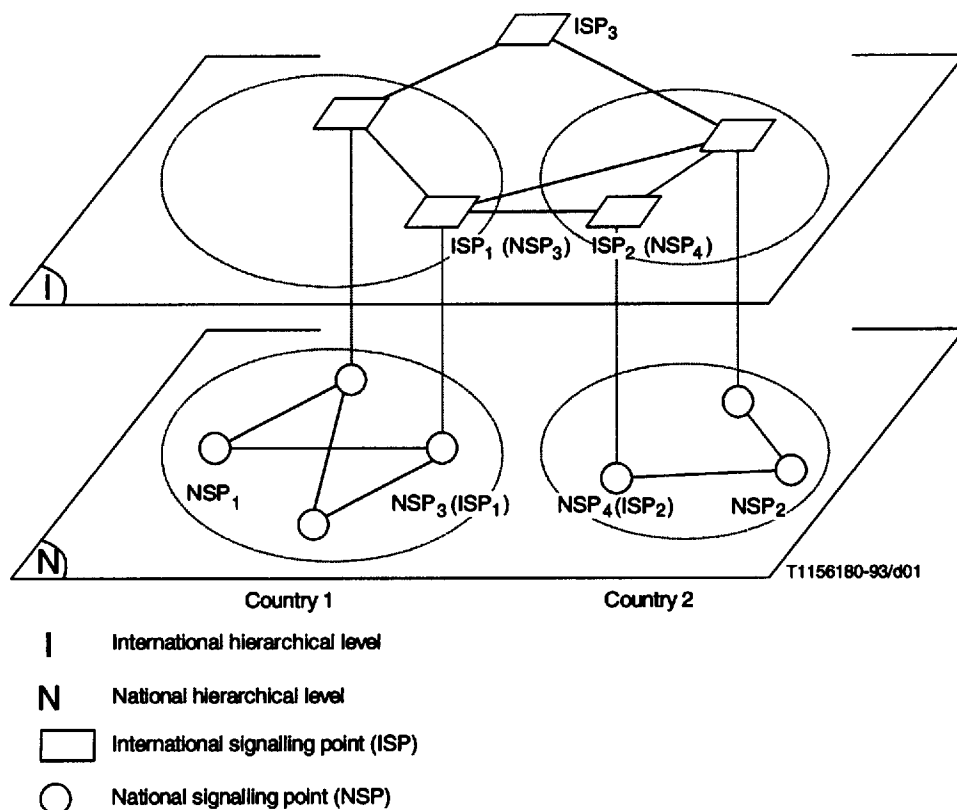


FIGURE 1/Q.705
International and national signalling networks

A signalling point (SP), including a signalling transfer point (STP), may be assigned to one of three categories:

- national signalling point (NSP) (signalling transfer point) which belongs to the national signalling network only (e.g. NSP₁) and is identified by a signalling point code (OPC or DPC) according to the national numbering plan of signalling points;
- international signalling point (ISP) (signalling transfer point) which belongs to the international signalling network only (e.g. ISP₃) and is identified by a signalling point code (OPC or DPC) according to the international numbering plan of signalling points;
- a node that functions both as an international signalling point (signalling transfer point) and a national signalling point (signalling transfer point) and therefore belongs to both the international signalling network and a national signalling network and accordingly is identified by a specific signalling point code (OPC or DPC) in each of the signalling networks.

If a discrimination between international and national signalling point codes is necessary at a signalling point, the network indicator is used (see 14.2/Q.704).

4 Considerations common to both international and national signalling networks

4.1 Availability of the network

The signalling network structure must be selected to meet the most stringent availability requirements of any User Part served by a specific network. The availability of the individual components of the network signalling links (signalling points and signalling transfer points) must be considered in determining the network structure (see Recommendation Q.709).

Considerable attention is required to STP routing tables to ensure that circular routing does not occur. (See Annex A/Q.780 – Testing and Planning Tools.)

4.2 Message transfer delay

In order to take account of signalling message delay considerations, regard should be given, in the structuring of a particular signalling network, to the overall number of signalling links (where there are a number of signalling relations in tandem) related to a particular user transaction (e.g. to a specific call in the telephone application) (see Recommendation Q.709).

4.3 Message sequence control

For all messages for the same transaction (e.g. a telephone call) the MTP will maintain the same routing provided that the same *signalling link selection* code is used in the absence of failure. However, a transaction does not necessarily have to use the same signalling route for both forward and backward messages.

4.4 Number of signalling links used in load sharing

The number of signalling links used to share the load of a given flow of signalling traffic typically depends on

- the total traffic load;
- the availability of the links;
- the required availability of the path between the two signalling points concerned; and
- the bit rate of the signalling links.

Load sharing requires at least two signalling links for all bit rates, but more may be needed at lower bit rates.

When two links are used, each of them should be able to carry the total signalling traffic in case of failure of the other link. When more than two links are used, sufficient reserve link capacity should exist to satisfy the availability requirements specified in Recommendation Q.706.

4.5 Satellite working

The service performance criteria and network operation aspects require balanced consideration in structuring SS No. 7 networks. Despite the relatively long delay of satellite connections, these connections can also be suitable for providing signalling data links.

Especially for long distance international operation, transmission diversity (including satellites) is an important criterion in structuring SS No. 7 networks from a network availability and reliability point of view.

In international operation, a terrestrial signalling data link using the basic error correction method may be restored, in exceptional circumstances and with bilateral agreement, by using a satellite data link. If this is done, the following precautions should be taken into account:

- in order to ensure in these circumstances the correct operation of the basic error correction method over the satellite data link, timer T7 (12.3/Q.703), at both ends of the restored signalling link, should have a value of at least 800 ms;
- in order to take into account the additional delay caused by the satellite data link, the minimum values of the timers T1–T6, specified in 16.8/Q.704, should take the specified values for routes with long propagation delays;
- the bit error rate guaranteed by the satellite link used is of significant influence. If the bit error rate is worse than 10^{-7} , the dimensioning of the link loads should consider from the beginning the possibly lower loading potential of a satellite link (see 5/Q.706).

The calculation of the value N2 (the number of message signal unit octets available for retransmission in the PCR error correction method (see 6.4.2/Q.703) should take a signalling loop delay T_L range, depending on the geographical conditions, between a minimum of 480 ms and a maximum of 600 ms.

5 International signalling network

5.1 General

The international signalling network will use the procedures to be defined in the SS No. 7 Recommendations. The international network structure to be defined can also serve as a model for the structure of national networks.

5.2 Number of signalling transfer points in signalling relations

In the international signalling network the number of signalling transfer points between an originating and a destination signalling point should not exceed two in a normal situation. In failure situations, this number may become three or even four for a short period of time. This constraint is intended to limit the complexity of the administration of the international signalling network.

5.3 Numbering of signalling points

A 14-bit code is used for the identification of signalling points. The allocation scheme of international signalling point codes is defined in Recommendation Q.708.

5.4 Routing rules

5.4.1 In order to ensure full flexibility for the routing of signalling in the SS No. 7 international signalling network it appears desirable that at least one signalling point in each country should provide means for the international STP function. Such an approach should ease the use of SS No. 7 on small traffic routes.

5.4.2 Other routing rules

For further study.

5.5 Structures

Requires further study.

5.6 Procedures

Requires further study.

6 Signalling network for cross-border traffic

6.1 General

For cross-border traffic between signalling points, the need for a special signalling network configuration is identified, because their common interests are such as to generate a considerable volume of traffic between them.

Two alternative arrangements of the signalling network for cross-border traffic are provided so that Administrations may adopt either alternative upon a bilateral agreement.

6.2 Use of international hierarchical level

6.2.1 This arrangement could be applied in the case that there are only a relatively small number of signalling points in a country which serve for cross-border traffic.

6.2.2 The signalling points and the signalling transfer points which are involved in a signalling of cross-border traffic should belong to the international hierarchical level described in 3. When those signalling points or signalling transfer points are also involved in signalling of national traffic, they should belong to their national hierarchical level as well. Therefore the double numbering of signalling point codes based on both the international and national numbering schemes should be required.

6.2.3 A discrimination between international and national point codes is made by the network indicator in the service information octet (see 14.2/Q.704).

6.2.4 Signalling network management procedures in this network arrangement require further study.

6.3 Integrated numbering of national signalling networks

6.3.1 By this arrangement the signalling points, which serve cross-border traffic, should be identified by common national signalling point codes.

6.3.2 Common block of national signalling point codes is provided by bilateral agreement (further study is required).

6.4 Interworking of national signalling networks

At the cross-border signalling network interface, the international specification of SS No. 7 should be preferred without exclusion of bilateral agreements.

7 National signalling network

No specific structures for national signalling networks are included in this Recommendation; however, Administrations should cater for the requirements imposed on a national network for the protection of international services in terms of network related user requirements, such as availability and performance of the network perceived by users (see Recommendation Q.709).

8 Procedures prevent unauthorized use of an STP (optional)

8.1 General

Administrations may make bilateral agreements to operate SS No. 7 between their networks. These agreements may place restrictions on the SS No. 7 messages authorized for one Administration to send to the other. Restrictions could be made, for example, in the interest of network security or as a result of service restrictions. Unauthorized signalling traffic may be, for example, STP traffic for calls set-up via networks other than that containing the STP, which has not been agreed bilaterally.