INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Q.700

(03/93)

SPECIFICATIONS OF SIGNALLING SYSTEM No. 7

INTRODUCTION TO CCITT SIGNALLING SYSTEM No. 7

ITU-T Recommendation Q.700

(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.700 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 Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.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.700

INTRODUCTION TO CCITT SIGNALLING SYSTEM No. 7{XE "INTRODUCTION TO CCITT SIGNALLING SYSTEM No. 7"}

(Melbourne 1988; modified at Helsinki 1993)

1 General

This Recommendation provides an overview of the Signalling System by describing the various functional elements of CCITT Signalling System No. 7 (SS No. 7) and the relationship between these functional elements. This Recommendation provides a general description of functions and capabilities of the Message Transfer Part (MTP), Signalling Connection Control Part (SCCP), Telephone User Part, ISDN User Part (ISUP), Transaction Capabilities (TC), and the Operations, Maintenance and Administration Part (OMAP) which are covered elsewhere in the Q.7xx-Series Recommendations. (This includes Recommendations Q.700 to Q.787.) However, in the case of contradiction between a particular specification and Recommendation Q.700, the particular specification shall apply.

The SS No. 7 ISDN supplementary services are described in the Q.73x-Series Recommendations.

In addition to these functions in the SS No. 7 signalling system, the Q.7xx Series Recommendations describes the SS No. 7 network structure, and also specifies the tests and measurements applicable to SS No. 7.

This Recommendation also contains information about other aspects such as SS No. 7 architecture, flow control and general compatibility rule which are not specified in separate Recommendations, and are applicable to the overall scope of SS No. 7. Recommendation Q.1400 also contains information about architecture and compatibility.

The remainder of this Recommendation describes:

- clause 2: Signalling network concepts components and modes;
- clause 3: The functional blocks within SS No. 7 and the services provided by them;
- clause 4: SS No. 7 protocol layering and its relationship to OSI modelling;
- clause 5: Node, application entity and user part addressing;
- clause 6: Operations, administration and maintenance aspects of SS No. 7;
- clause 7: Performance aspects of the functional blocks within SS No. 7;
- clause 8: Flow control for both the signalling network and within nodes;
- clause 9: Rules for evolving SS No. 7 protocols while preserving compatibility with earlier versions;
- clause 10: A cross-reference to a glossary of terms.

1.1 Objectives and fields of application

The overall objective of SS No. 7 is to provide an internationally standardized general purpose common channel signalling (CCS) system:

- optimized for operation in digital telecommunications networks in conjunction with stored program controlled exchanges;
- that can meet present and future requirements of information transfer for inter-processor transactions within telecommunications networks for call control, remote control, and management and maintenance signalling;
- that provides a reliable means for transfer of information in correct sequence and without loss or duplication.

The signalling system meets requirements of call control signalling for telecommunication services such as the telephone, ISDN and circuit switched data transmission services. It can also be used as a reliable transport system for other types of information transfer between exchanges and specialized centres in telecommunications networks (e.g. for

management and maintenance purposes). The system is thus applicable for multipurpose uses in networks that are dedicated for particular services and in multiservices networks. The signalling system is intended to be applicable in international and national networks.

The scope of SS No. 7 encompasses both circuit related and non-circuit related signalling.

Examples of applications supported by SS No. 7 are:

- PSTN;
- ISDN;
- Interaction with Network Databases, Service Control Points for service control;
- Mobiles (Public Land Mobile Network);
- Operations Administration and Maintenance of Networks.

The signalling system is optimized for operation over 64 kbit/s digital channels. It is also suitable for operation over analogue channels and at lower speeds. The system is suitable for use on point-to-point terrestrial and satellite links. It does not include the special features required for use in point-to-multipoint operation but can, if required, be extended to cover such an application.

1.2 General characteristics

Common channel signalling is a signalling method in which a single channel conveys, by means of labelled messages, signalling information relating to, for example, a multiplicity of circuits, or other information such as that used for network management. Common channel signalling can be regarded as a form of data communication that is specialized for various types of signalling and information transfer between processors in telecommunications networks.

The signalling system uses signalling links for transfer of signalling messages between exchanges or other nodes in the telecommunication network served by the system. Arrangements are provided to ensure reliable transfer of signalling information in the presence of transmission disturbances or network failures. These include error detection and correction on each signalling link. The system is normally applied with redundancy of signalling links and it includes functions for automatic diversion of signalling traffic to alternative paths in case of link failures. The capacity and reliability for signalling may thus be dimensioned by provision of a multiplicity of signalling links according to the requirements of each application.

1.3 Components of SS No. 7{XE "Components of SS No. 7"}

SS No. 7 consists of a number of components or functions which are defined in the Q.7xx-Series Recommendations.

SS No. 7 function	*Recommendations*
Message Transfer Part (MTP)	Q.701-Q.704, Q.706, Q.707
Telephone User Part (TUP) (including some supplementary services)	Q.721-Q.725
Supplementary services	Q.73x Series
Data User Part (DUP)	Q.741 (see Note)
ISDN User Part (ISUP)	Q.761-Q.764, Q.766
Signalling Connection Control Part (SCCP)	Q.711-Q.714, Q.716
Transaction Capabilities (TC)	Q.771-Q.775
Operations Maintenance and Administration Part (OMAP)	Q.750-Q.755

NOTE – Functions of the DUP are fully specified in Recommendation X.61.

Other Q.7xx-Series Recommendations which describe other aspects of the signalling system which are not part of the SS No. 7 signalling interfaces are:

Title	*Recommendations*
Signalling Network Structure	Q.705
Numbering of International Signalling Point Codes	Q.708
Hypothetical signalling reference connection	Q.709
PABX application	Q.710
SS No. 7 Test Specification (General)	Q.780
MTP Level 2 Test Specification	Q.781
MTP Level 3 Test Specification	Q.782
TUP Test Specification	Q.783
ISUP Test Specification	Q.784
ISUP Supplementary Service Test Specification	Q.785
SCCP Test Specification	Q.786
TCAP Test Specification	Q.787

Clause 3 describes the relationship between these components.

1.4 Description techniques in the Q.7xx-Series Recommendations{XE "Description techniques in the Q.7xx-Series Recommendations"}

The SS No. 7 Recommendation Series defines the signalling system using prose description which is complemented by SDL diagrams and state transition diagrams. Should any conflict arise between the text and the SDL definition, the textual description is taken as definitive.

Message sequence charts or arrow diagrams are used to illustrate examples of signalling procedures, but are not considered definitive.

Data description are increasingly using ASN.1 method of description.

2 SS No. 7 signalling network{XE "SS No. 7 signalling network"}

2.1 Basic concepts

A telecommunications network served by common channel signalling is composed of a number of switching and processing nodes interconnected by transmission links. To communicate using SS No. 7, each of these nodes requires to implement the necessary “within node” features of SS No. 7 making that node a signalling point within the SS No. 7 network. In addition, there will be a need to interconnect these signalling points such that SS No. 7 signalling information (data) may be conveyed between them. These data links are the signalling links of SS No. 7 signalling network.

The combination of signalling points and their interconnecting signalling links form the SS No. 7 signalling network.

2.2 Signalling network components{XE "Signalling network components"}

2.2.1 Signalling points{XE "Signalling points"}

In specific cases there may be a need to partition the common channel signalling functions at such a (physical) node into logically separate entities from a signalling network point of view; i.e. a given (physical) node may be defined as more than one signalling point. One example is an exchange at the boundary between international and national signalling networks.

Any two signalling points, for which the possibility of communication between their corresponding User Part function exists, are said to have a signalling relation.

The corresponding concept for a given User Part is called a user signalling relation.

An example is when two telephone exchanges are directly connected by a bundle of speech circuits. The exchange of telephone signalling relating to these circuits then constitutes a user signalling relation between the Telephone User Part functions in those exchanges in their role as signalling points.

Another example is when administration of customer and routing data in a telephone exchange is remotely controlled from an operation and maintenance centre by means of communication through a common channel signalling system.

Examples of nodes in a signalling network that constitutes signalling points are:

- exchanges (switching centres);
- service control points;
- signalling transfer points;
- operation, administration and maintenance centres.

All signalling points in a SS No. 7 network are identified by a unique code known as a point code (Recommendation Q.704 refers).

2.2.2 Signalling links{XE "Signalling links"}

The common channel signalling system uses signalling links to convey the signalling messages between two signalling points. A number of signalling links that directly interconnect two signalling points which are used as a module constitute a signalling link-set. Although a link set typically includes all parallel signalling links, it is possible to use more than one link set in parallel between two signalling points. A group of links within a link set that have identical characteristics (e.g. the same data link bearer rate) is called a link group.

Two signalling points that are directly interconnected by a signalling link are, from a signalling network structure point of view, referred to as adjacent signalling points. Correspondingly, two signalling points that are not directly interconnected are non-adjacent signalling points.

2.2.3 Signalling modes{XE "Signalling modes"}

The term “signalling mode” refers to the association between the path taken by a signalling message and the signalling relation to which the message refers.

In the associated mode of signalling, the messages relating to a particular signalling relation between two adjacent points are conveyed over a link set, directly interconnecting those signalling points.

In the non-associated mode of signalling, the messages relating to a particular signalling relation are conveyed over two or more linksets in tandem passing through one or more signalling points other than those which are the origin and the destination of the messages.

The quasi-associated mode of signalling is a limited case of the non-associated mode where the path taken by the message through the signalling network is pre-determined and, at a given point in time, fixed.

SS No. 7 is specified for use in the associated and quasi-associated modes. The Message Transfer Part does not include features to avoid out-of-sequence arrival of messages or other problems that would typically arise in a fully non-associated mode of signalling with dynamic message routing.

Examples of signalling modes are illustrated in Figure 1.

2.3 Signalling point modes{XE "Signalling point modes"}

A signalling point at which a message is generated, i.e. the location of the source User Part function, is the originating point of that message.

A signalling point to which a message is destined, i.e. the location of the receiving User Part function, is the destination point of that message.

For a particular signalling relation, the two signalling points thus function as originating and destination points for the messages exchanged in the two directions between them.

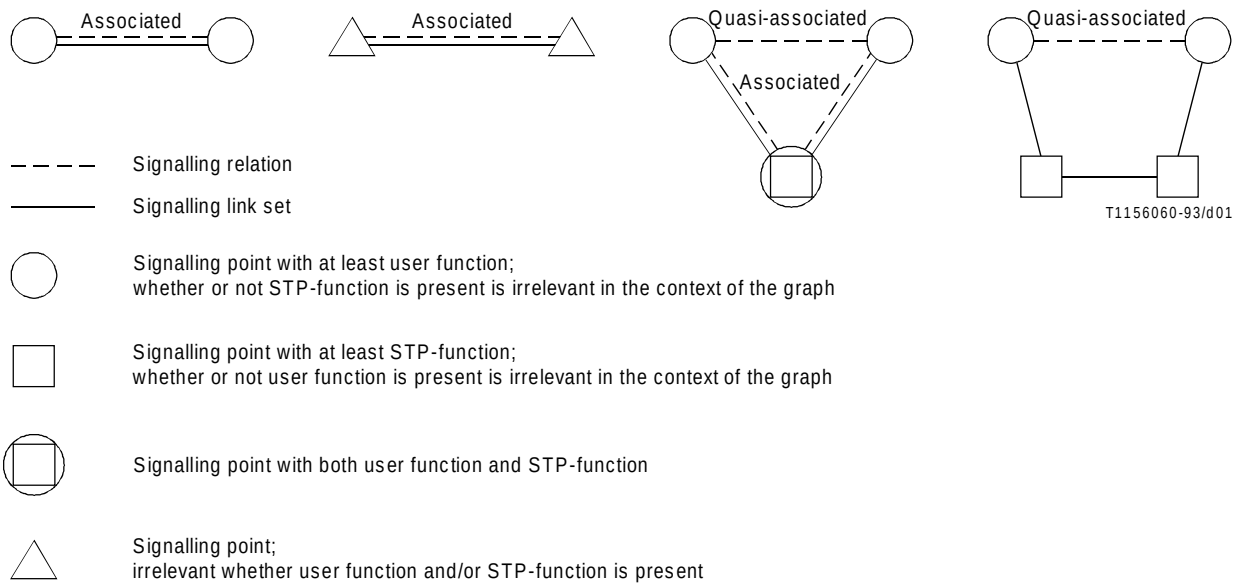


FIGURE 1/Q.700

Example of associated and quasi-associated signalling modes and definition of signalling network graph symbols

A signalling point at which a message is received on one signalling link and is transferred to another link, i.e. neither the location of the source nor the receiving User Part function, is a Signal Transfer Point (STP).

In the quasi-associated mode, the function of a signalling transfer point is typically located in a few signalling points which may be dedicated to this function, or may combine this function with some other (e.g. switching) function. A signalling point serving as a signalling transfer point functions as an originating and destination point for the messages generated and received by the level 3 function of the MTP also in cases when no user functions are present.

2.4 Signalling routes{XE "Signalling routes"}

The pre-determined path, consisting of a succession of signalling points/signalling transfer points and the interconnecting signalling links, that a message takes through the signalling network between the origination point and the destination point is the signalling route for that signalling relation.

All the signalling routes that may be used between an originating point and a destination point by a message traversing the signalling network is the signalling route set for that signalling relation.

2.5 Signalling network structure{XE "Signalling network structure"}

The signalling system may be used with different types of signalling network structures. The choice between different types of signalling network structures may be influenced by factors such as the structure of the telecommunication network to be served by the signalling system and administrative aspects.

In the case when the provision of the signalling system is planned purely on a per signalling relation basis, the likely result is a signalling network largely based on associated signalling, typically supplemented by a limited degree of quasi-associated signalling for low volume signalling relations. The structure of such a signalling network is mainly determined by the patterns of the signalling relations.

Another approach is to consider the signalling network as a common resource that should be planned according to the total needs for common channel signalling. The high capacity of digital signalling links in combination with the needs for redundancy for reliability then typically leads to a signalling network based on a high degree of quasi-associated signalling with some provision for associated signalling for high volume signalling relations. The latter approach to signalling network planning is more likely to allow exploitation of the potential of common channel signalling to support network features that require communication for purposes other than the switching of connections.

The worldwide signalling network is structured into two functionally independent levels, namely the international and national levels. 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.

Further considerations about the structure of the signalling network are given in Recommendation Q.705, and the impact on the message transfer part in Recommendation Q.701.

3 SS No. 7 functional blocks{XE "SS No. 7 functional blocks"}

3.1 Basic functional division

The SS No. 7 comprises the following functional blocks:

- Message Transfer Part (MTP)
- Telephone User Part (TUP)
- ISDN User Part (ISUP)
- Signalling Connection Control Part (SCCP)
- Transaction Capabilities (TC)
- Application-Entity (AE) (see Note)
- Application-Service-Elements (ASEs) (see Note)

NOTE – The glossary shows these as hyphenated terms but the usual convention used in this Recommendation will be unhyphenated.

The fundamental principle of the signalling system structure is the division of functions into a common Message Transfer Part (MTP) on one hand, and separate User Parts for different users on the other. This is illustrated in Figure 2.

The overall function of the Message Transfer Part is to serve as a transport system providing reliable transfer of signalling messages between the locations of communicating user functions.

User functions in SS No. 7 MTP terms are:

- the ISDN User Part (ISUP)
- the Telephone User Part (TUP)
- the Signalling Connection Control Part (SCCP)
- the Data User Part (DUP)

The term “User” in this context refers to any functional entity that utilises the transport capability provided by the Message Transfer Part.

A User Part comprises those functions of, or related to, a particular type of user that are part of the common channel signalling system, typically because those functions need to be specified in a signalling context.

The SCCP also has Users. These are:

- the ISDN User Part (ISUP)
- Transaction Capabilities (TC)
- Operations Maintenance and Administration Part (OMAP)

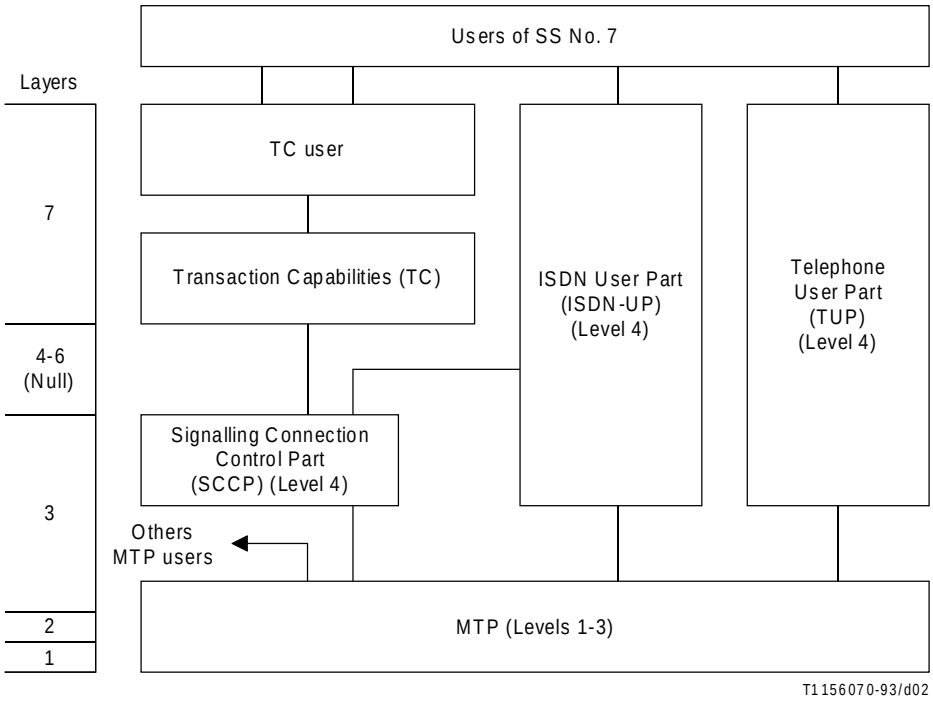


FIGURE 2/Q.700

Architecture of SS No. 7

3.2 SS No. 7 architecture{XE "SS No. 7 architecture"}

3.2.1 General

From the perspective of an end user, the service provided by a telecommunications network may be regarded as a Network Layer service. However, from a signalling network perspective, the service may be provided at a different layer/level.

Figure 2 shows the Architecture of SS No. 7 and illustrates the functional relationship between the various functional blocks of the SS No. 7 and between the SS No. 7 levels and the OSI Reference Model Layers. This level/layer relationship is described in the following subclauses.

The initial specification of SS No. 7 was based on circuit-related telephony control requirements. To meet these requirements, SS No. 7 was specified in four functional levels, the Message Transfer Part comprising levels 1-3, and the User Parts as level 4.

Figure 3 shows the Functional Levels of SS No. 7. As new requirements have emerged, e.g. for non-circuit related information transfer, SS No. 7 has also evolved to meet these new requirements. There has been a need to align certain elements in SS No. 7 to the OSI 7 Layer Reference Model (see 4.2).

3.2.2 Message Transfer Part (MTP) levels 1-3{XE "Message Transfer Part (MTP) levels 1-3"}

An overview of the MTP is given in Recommendation Q.701. The MTP is defined in Recommendations Q.701-Q.704, Q.706 and Q.707.

3.2.2.1 Signalling data link functions (level 1){XE "Signalling data link functions (level 1)"}

Level 1 defines the physical, electrical and functional characteristics of a signalling data link and the means to access it. The level 1 function provides a bearer for a signalling link.

The detailed requirements for signalling data links are specified in Recommendation Q.702.

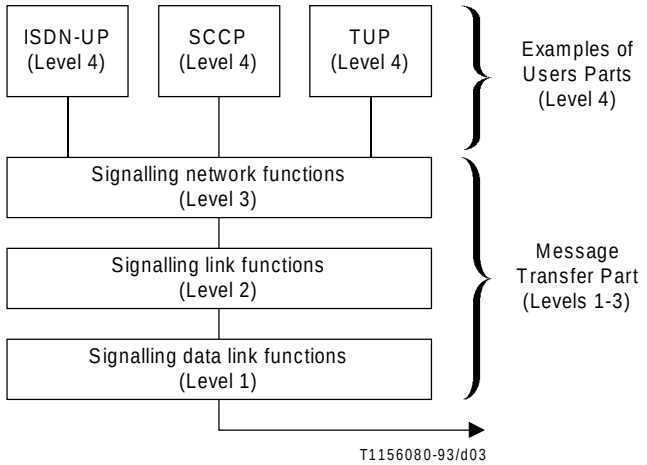


FIGURE 3/Q.700

SS No. 7 functional levels

3.2.2.2 Signalling link functions (level 2){XE "Signalling link functions (level 2)"}

Level 2 defines the functions and procedures for and relating to the transfer of signalling messages over one individual signalling data link. The level 2 functions together with a level 1 signalling data link as a bearer, and provides a signalling link for reliable transfer of signalling messages between two points.

The detailed requirements for signalling functions are given in Recommendation Q.703.

3.2.2.3 Signalling network functions (level 3){XE "Signalling network functions (level 3)"}

Level 3 in principle defines those transport functions and procedures that are common to and independent of the operation of individual signalling links. These functions fall into two major categories:

a) *Signalling message handling function*s – These transfer the message to the proper signalling link or User Part.

b) *Signalling network management functions* – These control the current message routing and configuration of the signalling network facilities and in the case of signalling network failures, control the reconfigurations and other actions to preserve or restore the normal message transfer capability.

The detailed requirements for signalling network functions are given in Recommendation Q.704.

3.2.3 Level 4: MTP User functions{XE "Level 4: MTP User functions"}

Level 4 consists of the different User Parts. Each User Part defines the functions and procedures of the signalling system that are particular to a certain type of user of the system. The following entities are defined as User Parts in SS No. 7.

3.2.3.1 Signalling Connection Control Part (SCCP){XE "Signalling Connection Control Part (SCCP)"}

The SCCP is defined in Recommendations Q.711-Q.716. The SCCP provides additional functions to the Message Transfer Part to provide connectionless and connection-oriented network services to transfer circuit-related, and non-circuit-related signalling information.

The SCCP provides the means to

– control logical signalling connections in a SS 7 network;

– transfer Signalling Data Units across the SS 7 network with or without the use of logical signalling connections.

SCCP provides a routing function which allows signalling messages to be routed to a signalling point based on, for example, dialled digits. This capability involves a translation function which translates the global title (e.g. dialled digits) into a signalling point code and a sub-system number.

SCCP also provides a management function, which controls the availability of the “sub-systems”, and broadcasts this information to other nodes in the network which have a need to know the status of the “sub-system”. An SCCP sub-system is an SCCP User.

3.2.3.2 Telephone User Part (TUP){XE "Telephone User Part (TUP)"}

The SS No. 7 Telephone User Part is defined in Recommendations Q.721-725. The TUP Recommendations define the international telephone call control signalling functions for use over SS No. 7.

3.2.3.3 Data User Part (DUP){XE "Data User Part (DUP)"}

The Data User Part is referenced in Recommendation Q.741, and the functionality fully defined in Recommendation X.61. It defines the protocol to control interexchange circuits used on data calls, and data call facility registration and cancellation.

3.2.3.4 ISDN User Part (ISUP){XE "ISDN User Part (ISUP)"}

The ISDN User Part is defined in Recommendations Q.761-Q.764 and Q.766. This Recommendation Series deals with the basic services only.

The ISUP encompasses signalling functions required to provide switched services and user facilities for voice and non-voice applications in the ISDN.

The ISUP is also suited for application in dedicated telephone and circuit-switched data networks and in analogue, and mixed analogue/digital networks.

The ISUP has an interface to the SCCP (which is also a level 4 User Part) to allow the ISUP to use the SCCP for end-to-end signalling.

Supplementary Services handled by the SS No. 7 ISDN application are described in the Q.730-Series Recommendations. These supplementary services embody ISUP signalling messages and procedures. In some cases these services may include an application protocol which uses TC and SCCP.

3.2.3.5 Transaction Capabilities{XE "Transaction Capabilities"}

Transaction Capabilities are defined in Recommendations Q.771-Q.775.

TC provides the means to establish non-circuit-related communication between two nodes in the signalling network.

3.2.3.6 Applications

Applications are modelled in layer 7. They are the process which provide the end user of the telephone or ISDN network with the basic and supplementary telecommunication services. They comprise the users of TC.

For details of the architecture of applications, see 3/Q.1400.

4 OSI layering and SS No. 7{XE "OSI layering and SS No. 7"}

4.1 OSI Layering{XE "OSI Layering"}

The purpose of the Reference Model of Open Systems Interconnection for CCITT Applications (see Recommendation X.200) is to provide a well-defined structure for modelling the interconnection and exchange of information between users in a communications system. This approach allows standardized procedures to be defined not only to provide an open systems interconnection between users over a single network, but also to permit interworking between networks to allow communication between users over several networks in tandem.

The approach taken in the OSI reference model is to partition the model used to describe this interconnection and exchange information between users in a communications system into seven layers.

From the point of view of a particular layer, the lower layers provide a “transfer service” with specific features. The way in which a lower layer is realized is immaterial to the next higher layers. Correspondingly, the lower layers are not concerned with the meaning of the information coming from higher layers or the reasons for its transfer.

The characteristics of each layer are described in 3a)/Q.1400 - 3g)/Q.1400.

4.2 Relationship between SS No. 7 layering and the OSI model{XE "Relationship between SS No. 7 layering and the OSI model"}

Evolution of the SS No. 7 architecture since the *Red Book* (1984) increasingly has been based on the Open Systems Interconnection (OSI) reference Model (see 3). OSI considers primarily connection-oriented protocols, that is, protocols that establish a logical connection before transferring data. The Network Service Part (NSP) of SS 7 provides both connectionless and connection oriented protocols.

The OSI layer 1-3 services are provided by the SCCP together with the MTP. The combination of the MTP and the SCCP is called the NSP. Layers 1-3 comprise functions for the transportation of information from one location to another, possibly via a number of communication links in tandem. These functions provide the basis on which a communication network can be built.

There are no protocols currently used in the SS No. 7 architecture that map into layers 4-6. Protocols may be included in these layers in the future if the need for such services arises.

Transaction Capabilities (TC) are defined as a protocol which directly accesses the connectionless SCCP services.

Figure 2 shows the relationship between SCCP and TC, to the OSI 7 Layer Reference Model. Recommendation Q.1400 provides further information about this relationship.

4.3 Primitive Interfaces between SS No. 7 Functions{XE "Primitive Interfaces between SS No. 7 Functions"}

4.3.1 General

Interfaces between the functional elements of SS No. 7 are specified using interface primitives. Primitive interface definition does not assume any specific implementation of a service.

4.3.2 OSI service primitives{XE "OSI service primitives"}

Where the functional element of SS No. 7 is modelled on the OSI 7 layer reference model, e.g. SCCP, TC, service primitives are defined in line with Recommendation X.210.

In line with Recommendation X.210, Figure 4 illustrates the relationship between the terms “service”, “boundary”, “service primitives”, “peer protocol” and “peer entities”. The term “boundary” applies to boundaries between layers, as well as to boundaries between sub-layers.

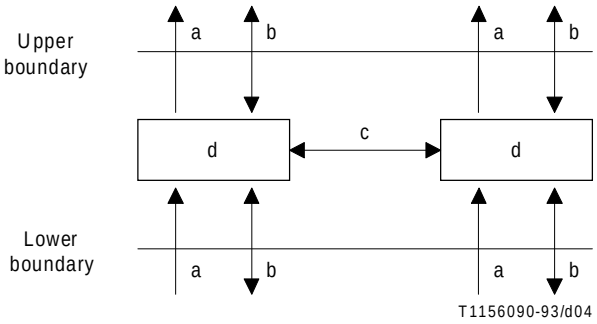
4.3.2.1 Service primitives{XE "Service primitives"}

The use of primitives as a modelling tool does not imply any specific implementation of a service in terms of interface primitives.

Four types of service primitive are identified (see Figure 5):

- request: A primitive issued by a service user to invoke a service element.
- indication: A primitive issued by a service provider to advise that a service element has been invoked by the service user at the peer service access point or by the service provider.
- response: A primitive issued by the service user to complete at a particular service access point some service element whose invocation has been previously indicated at that service access point.
- confirmation: A primitive issued by a service provider to complete at a particular service access point some service element previously invoked by a request at that service access point.

Not all four types of service primitives have to be associated with all services.



a Service
b Service primitive
c Peer protocol
d Peer entities

FIGURE 4/Q.700

Types of service primitives

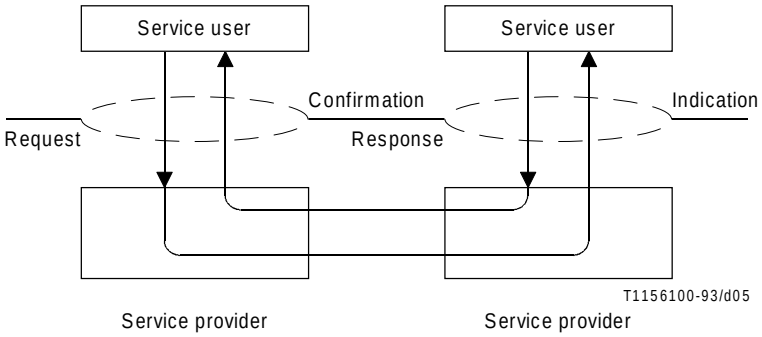


FIGURE 5/Q.700

Types of service primitives

5 Addressing{XE "Addressing"}

Addressing of SS No. 7 messages has to be considered on a number of levels. For example, the message transfer part uses the destination point code to route the message to the appropriate signalling point. The TUP called party address field, or ISUP called party number field, in an Initial Address Message is used to route the call to the appropriate called destination. The capabilities of the various SS No. 7 addressing mechanisms are illustrated by the signalling message structure.

5.1 Signalling message structure{XE "Signalling message structure"}

A signalling message is an assembly of information, defined at level 3 or 4, pertaining to a call, management transaction, etc., that is transferred as an entity by the message transfer function.

Each message contains service information including a service indicator identifying the source User Part and possibly additional information such as an indication whether the message relates to international or national application of the User Part.

The signalling information of the message includes the actual user information, such as one or more ISDN telephone or data call control signals, management and maintenance information, etc., and information identifying the type and format of the message. It also includes a label that provides information enabling the message to be

- Routed by the level 3 functions through a signalling network to its destination. (This part of the label is known as the Routing label. This is shown in Figure 6.)
- Directed at the receiving User Part to the particular circuit, call, management or other transaction to which the message is related.

Further details are given in 5.2.

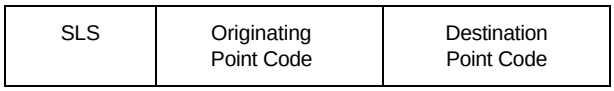


FIGURE 6/Q.700

SS No. 7 Routing Label

There are four types of label:

- type A for MTP management messages;
- type B for TUP;
- type C for ISUP (circuit related) messages;
- type D for SCCP messages.

These are shown in Figure 7.

The circuit identification code is used as a label for circuit related signalling messages, e.g. TUP or ISUP. The least significant 4 bits of this field (in the TUP) is the Signalling Link Selection (SLS) field, which is used, where appropriate, to perform load sharing (see Recommendation Q.704). In the ISUP, the SLS is a separate field to the circuit identification code.

The SS No. 7 MTP signalling messages at level 2, which carry user information, are called Message Signal Units (MSUs). Figure 8 shows the basic format of the MSU (refer also to Recommendation Q.703) and the breakdown of the MSU. The Signalling Information Field (SIF) is used to carry level 3 or level 4 messages that may be circuit-related (e.g. ISUP, TUP messages) or non-circuit-related (e.g. SCCP). Further details are given on message formats in Recommendations Q.704, Q.713, Q.723, Q.763 and Q.773.

5.2 MTP addressing{XE "MTP addressing"}

There is a two part addressing mechanism in the MTP, one part of the mechanism uses the point code which is incorporated in the routing label of every message signal unit, the other part of the mechanism makes use of the service indicator and network indicator within the service information octet.

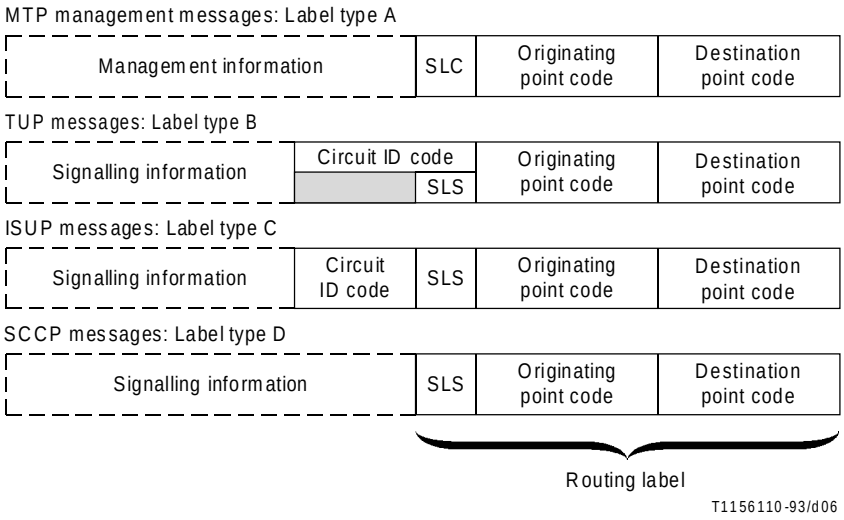


FIGURE 7/Q.700

SS No. 7 message label types

5.2.1 Point codes{XE "Point codes"}

Every signalling point (SP) and signalling transfer point (STP), when integrated in an SP, will be allocated its own unique point code. This is used by the MTP routing function to direct outgoing messages towards their destination in the network as indicated by the inclusion of the appropriate point code in the routing label. This point code is known as the destination point code (DPC). The routing label also contains the point code of the SP originating the message signal unit, therefore, the combination of this originating point code (OPC) and DPC will determine the signalling relation (i.e. the network points between which MTP "User" information is exchanged). The DPC is used by the receiving SP/STP discrimination function to determine whether the message is addressed to that SP or requires to be onward routed by means of the signal transfer capability of the STP.

The DPC will always be determined and inserted in the routing label by the level 4 MTP "User". This will also generally be the same for the OPC but it is possible that since the OPC might be constant it could be inserted by the MTP.

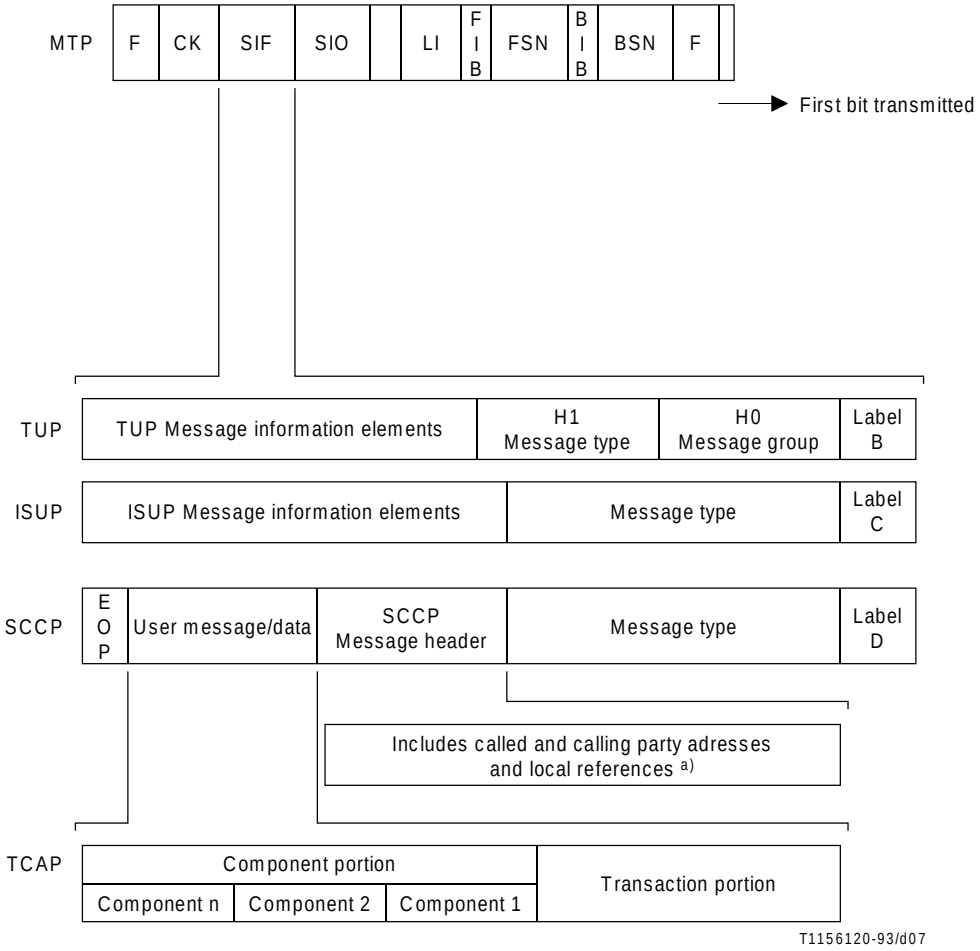
5.2.2 Service indicator and network indicator{XE "Service indicator and network indicator"}

The 4-bit service indicator (SI) and 2-bit network indicator (NI) are included in the service information octet (SIO) and are used within an SP's distribution function to determine the "User" the incoming message should be delivered to.

The SI will determine the "User", e.g. TUP, SCCP, ISUP and the NI will determine which network is concerned, e.g. international or national.

The NI will also in conjunction with the OPC/DPC determine whether a national or international signalling relation/routing is involved.

The NI, together with the standard 14-bit point code, allows for four signalling networks each with up to 16 384 point codes.



a) CO only.

BIB Backward indicator bit
BSN Backward sequence number
CK Check bits
F Flag
FIB Forward indicator bit
FSN Forward sequence number
LI Length indicator
SF Status field
SIF Signalling information field
SIO Service information octet

FIGURE 8/Q.700

SS No. 7 signalling message structure

5.3 SCCP addressing{XE "SCCP addressing"}

Addressing within the SCCP of SS No. 7 makes use of three separate elements:

- DPC;
- Global Title (GT);
- Sub-System Number (SSN);

One, two or all of the elements may be present in the Called and Calling Party Address, the main options are:

GT DPC + SSN	When transferring SCCP messages
SSN GT SSN + GT	When receiving messages from MTP
DPC DPC + (SSN or GT or both) GT GT + SSN	When receiving messages from connectionless or connection-oriented control for SCCP routing

The form of address used will depend on the service, application and underlying network.

5.3.1 Global Title (GT){XE "Global Title (GT)"}

The Global Title (GT) may comprise of dialled digits or another form of address that will not be recognized in the SS No. 7 network. Therefore, if the associated message requires to be routed over the SS No. 7 network, translation is required.

Translation of the GT will result in a DPC being produced and possibly also a new SSN and GT. A field is also included in the address indicator to identify the format of the global title.

5.3.2 Destination Point Code (DPC){XE "Destination Point Code (DPC)"}

The DPC in an address requires no translation and will merely determine if the message is destined for that SP (incoming message) or requires to be routed over the SS No. 7 signalling network via the MTP. For outgoing messages this DPC should be inserted in the MTP routing label.

5.3.3 Sub-system Number (SSN){XE "Sub-system Number (SSN)"}

The SSN will identify a sub-system accessed via the SCCP within a node and may be a User Part, e.g. ISUP, SCCP management or an AE via TC. TC, however, will be invisible to the SCCP.

When examination of the DPC in an incoming message has determined that the message is for that SP, examination of the SSN will identify the concerned SCCP “User”. The presence of an SSN without a DPC will also indicate a message which is addressed to that SP.

The SSN field has an initial capacity of 255 codes with an extension code for future requirements.

5.4 User Part addressing{XE "User Part addressing"}

5.4.1 Telephone User Part addressing{XE "Telephone User Part addressing"}

The Telephone User Part is capable of handling E.164 (incorporating E.163) addresses in the calling and called party address information elements.

5.4.2 ISDN User Part addressing{XE "ISDN User Part addressing"}

The ISDN User Part address structure is capable of handling E.164 addresses in the calling and called number, and redirecting address information elements.

5.4.3 Signalling connection control part addresses{XE "Signalling connection control part addresses"}

The signalling connection control part is capable of handling E.164 (incorporating E.163), X.121, F.69, E.210, E.211, E.212, E.213 addresses, and the mobile hybrid E.214 address in the calling and called party address information elements.

The handling of OSI NSAP addresses in SCCP is described in Recommendation Q.711 and 3.2/Q.1400.

5.5 Labelling{XE "Labelling"}

A variety of methods to label signalling messages is used to allow the signalling system and users of the signalling system to relate a received message to a particular call or transaction.

For circuit-related messages, (e.g. on a simple telephone call), the TUP (and the ISUP) use the circuit identification code (CIC) to label the message.

For certain ISUP procedures, call references are used to associate messages with calls.

SCCP also uses local references on connection-oriented protocols.

Transaction capabilities use transaction identities and invoke identities to associate transaction messages and components respectively.

6 Operations administration and maintenance{XE "Operations administration and maintenance"}

6.1 Management{XE "Management"}

Management within SS No. 7 is partitioned into two main areas:

- Signalling network management;
- Signalling system management.

6.1.1 Signalling network management{XE "Signalling network management"}

These are functions contained within the MTP and SCCP which, by means of automatic procedures, maintain the required signalling network performance (e.g. changeover of faulty links, forced re-routing, sub-system availability, etc.).

6.1.2 Signalling system management{XE "Signalling system management"}

This may be considered as the actions taken by the operator (or by an external automatic mechanism) such as TMN-OS via the Q3 interface to maintain the signalling system performance when problems are identified.

6.2 Maintenance and testing{XE "Maintenance and testing"}

Some of the maintenance, administration and management functions of the signalling system themselves use the signalling system as a data carrying mechanism.

Testing within SS No. 7 is:

- initiated automatically as a part of a signalling system management procedures (e.g. signalling route set test in MTP); or
- applied as a result of external activity, e.g. man-machine interface (MMI) or TMN.

The first form is described in the appropriate Q.7xx Recommendation dealing with MTP or SCCP, etc. The second form includes some MMI or TMN initiated procedures [initiation of MRVT (Recommendation Q.753)], and also pre-in service testing using test cases specified in Recommendations for SS No. 7 tests (Q.78x-Series).

6.2.1 Operations Maintenance and Administration Part (OMAP){XE "Operations Maintenance and Administration Part (OMAP)"}

Recommendation Q.75x provides procedures and protocols related to operations, maintenance and administration.

OMAP is situated in the TMN-OS as well as in SS No. 7 SPs of all kinds, OMAP functions include measurement initiation and collection as well as initiation of tests within the SS No. 7 network like MRVT.

6.2.2 Testing{XE "Testing"}

Test specifications for SS No. 7 are contained in Q.78x-Series Recommendations and cover MTP level 2, MTP level 3, TUP, ISUP, SCCP and TCAP together with an overview of testing.

6.3 SS No. 7 measurements{XE "SS No. 7 measurements"}

Recommendation Q.752 specifies the monitoring and measurements appropriate to the MTP, SCCP, ISUP and TCAP.

7 Signalling system performance{XE "Signalling system performance"}

The performance requirements of SS No. 7 must take account of the performance requirements of the services that are being supported. Each functional component of SS No. 7 has its performance criteria specified in a self-contained Recommendation. An overall performance target is specified in the form of a Hypothetical Signalling Reference Connection (HSRC).

7.1 Hypothetical Signalling Reference Connection (HSRC){XE "Hypothetical Signalling Reference Connection (HSRC)"}

The HSRC for SS No. 7 (Recommendation Q.709), identifies components that are used in a signalling relation between signalling end points, signalling points, signalling transfer points, and signalling points with SCCP relay functions, and gives the values for the signalling delays and unavailability parameters. The values used are derived from the figures contained in the individual performance Recommendations for MTP, TUP, SCCP and ISUP. Service performance Recommendations E.721 and I.352 also apply.

7.2 MTP{XE "MTP"}

The MTP signalling performance requirements are specified in Recommendation Q.706. This Recommendation includes

- the parameters for route-set unavailability, MTP malfunction (loss of messages and mis-sequencing), and message transfer times;
- factors affecting performance, for example signalling traffic characteristics (e.g. message sizes, loading potential, security, etc.) and parameters related to transmission characteristics (e.g. bit rates of signalling data links, propagation delays);
- those parameters which have greatest influence on the signalling network queueing delays for example, error control, security arrangements, failures and priorities.

It should be noted that some functions may affect MTP performance.

7.3 SCCP{XE "SCCP"}

The SCCP signalling performance requirements are contained in Recommendation Q.716. Parameters identified are signalling connection delays (establishment, unsolicited reset, reset and release signal connection, reset and release failure probability, data message transmit delay, data message delay failure and error probability and SCCP unavailability).

It should be noted that management functions affect SCCP performance.

7.4 TUP{XE "TUP"}

The TUP signalling performance requirements are contained in Recommendation Q.725. Parameters contained in this Recommendation are cross-office performance for TUP supported circuit connection control under normal and abnormal traffic loads. Also specified is the probability of failure of calls due to signalling malfunction.

7.5 ISUP{XE "ISUP"}

The ISUP signalling performance requirements are contained in Recommendation Q.766. Parameters contained in this Recommendation are cross-office performance for ISUP supported circuit connection control under normal and abnormal traffic loads. Also specified is the probability of failure of an ISDN call due to signalling function.

8 Flow control{XE "Flow control"}

SS No. 7, in common with other transport mechanisms, needs to limit the input of data when congestion onset is detected. The nature of SS No. 7 will lead to SP/STP overload congestion being spread through the signalling network if no action is taken. This will result in impaired signalling performance and message loss. In addition to signalling network congestion within a node, congestion will also require action to prevent signalling performance from deteriorating. There is thus a need for flow control within the signalling system to maintain the required signalling performance.

8.1 Signalling network flow control{XE "Signalling network flow control"}

This is achieved by incorporating a flow control mechanism in the MTP. On detection of congestion, MTP “Users Parts” are informed by the means of a primitive. The “User Part” should then reduce signalling traffic towards the congested part of the network. If the User is at a remote SP, the information is carried across the network in an appropriate signalling network management message.

8.2 Signalling node (congestion) flow control{XE "Signalling node (congestion) flow control"}

In addition to network congestion, nodal congestion also requires the remedial action of flow control to prevent the signalling performance from being impaired. Nodal congestion can occur both within the MTP and the MTP “User Part”.

8.2.1 MTP nodal flow control{XE "MTP nodal flow control"}

If MTP node overload is detected similar action to that used to combat signalling network congestion is required. On detection of that overload, the “User Parts” are informed so that traffic can be reduced.

8.2.2 “User Part” flow control{XE "“User Part” flow control"}

As well as taking action to reduce MTP congestion, mechanisms are also required within each User Part to detect the onset of congestion and to take appropriate action.

The ISUP and TUP provide signalling procedures which aim to reduce the new calls offered to an exchange which is experiencing processor overload.

Automatic congestion control provides the means to inform adjacent exchanges of the current workload, and to request that only priority calls are offered to the exchange experiencing overload.

9 Compatibility mechanisms and rules in SS No. 7{XE "Compatibility mechanisms and rules in SS No. 7"}

9.1 Background

The wide scope of the signalling system requires that the total system include a large diversity of functions and that further functions can be added to cater for extended future applications. As a consequence only a subset of the total system may need to be used in an individual application.

A major characteristic of the signalling system is that it is specified with a functional structure to ensure flexibility and modularity for diverse applications within one system concept. This allows the system to be realized as a number of functional modules which could ease adaptation of the functional content of an operating SS No. 7 to the requirements of particular applications.

The CCITT specifications of the signalling system specify functions and their use for international operation of the system. Many of those functions are also required in typical national applications. Furthermore, the system to some extent includes features that are particular to national applications. The CCITT specifications thus form an internationally standardized base for a wide range of national applications of common channel signalling.

SS No. 7 is a common channel signalling system. However, as a consequence of its modularity and its intended use as a standard base for national applications the system may be applied in many forms. In general, to define the use of the system in a given national application, a selection of the CCITT specified functions must be made and the necessary additional national functions must be specified depending on the nature of the application.

SS No. 7 is an evolutionary signalling system which has undergone a number of enhancements. To allow ease of evolution it has been necessary to incorporate a number of compatibility mechanisms in various functional elements of SS No. 7, and to apply a number of compatibility rules to protocol enhancement. Detailed specification of the compatibility mechanisms in each functional element of SS No. 7 are given in the appropriate Q.7xx Recommendation.

Compatibility rules which apply to all functional elements of SS No. 7 are detailed in the following text.

9.2 Evolutionary requirements

In application protocols (e.g. ISUP, ASEs), the main evolutionary requirement is the ability to add new subscriber services, and new administration and network services to the protocol.

In the SCCP and MTP, the evolutionary requirements are different in that initial versions provide basic transport functions which are generally stable. The main enhancements have been in the management aspects of protocols.

Although the evolutionary requirements are different across the elements of SS No. 7, it is possible to incorporate certain common mechanisms in the various functional elements.

9.3 Forward and backward compatibility{XE "Forward and backward compatibility"}

Compatibility mechanisms can be considered as being either

- forward compatibility mechanisms; or
- backward compatibility rules.

Forward compatibility mechanisms are defined as a scheme to enable a version of a protocol to communicate effectively and interwork with future versions of the protocol. That is, a version of a protocol should not restrict future protocols from providing extra capabilities.

Backward compatibility rules are defined as a scheme to ensure that future versions of the protocol will be able to send protocol messages to the previous version which will be understood and fully processed by the node supporting the previous version. That is, future versions of a protocol must allow earlier versions to operate with it and not reduce the earlier versions' service level.

9.4 Compatibility rules for SS No. 7{XE "Compatibility rules for SS No. 7"}

Compatibility rules for SS No. 7 protocol evolution are contained in 9/Q.1400.

Note that the 1992 ISUP Recommendations (Q.76x-Series Recommendations) contain a special compatibility procedure. It uses an instruction indicator, which includes information about the handling of a parameter or message that is not recognized (e.g. discard, pass-on, send Confusion). It is sent with every new message or parameter. For parameters

containing new values, it is assumed that the instruction indicator for the whole parameter can be used for all values within the parameter. For existing messages, parameters and parameter values, the required action if unrecognized information is received is given in tabular form.

10 Glossary

A Glossary of terms in SS No. 7 is contained at the back of the Fascicles VI.7, VI.8 and VI.9 of the *Blue Book*.

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