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TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

SPECIFICATIONS OF SIGNALLING SYSTEM No. 7

FUNCTIONAL DESCRIPTION OF THE MESSAGE TRANSFER PART (MTP) OF SIGNALLING SYSTEM No. 7

ITU-T Recommendation Q.701

(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.701 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 Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.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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FUNCTIONAL DESCRIPTION OF THE MESSAGE TRANSFER PART (MTP) OF SIGNALLING SYSTEM No. 7

(Geneva, 1980; modified at Helsinki, 1993)

1 Introduction

1.1 General

The Message Transfer Part (MTP) provides the functions that enable User Part significant information passed to the MTP to be transferred across the Signalling System No. 7 network to the required destination. In addition, functions are included in the MTP to enable network and system failures that would affect the transfer of signalling information to be overcome. This constitutes a sequenced connectionless service for the MTP user.

The Message Transfer Part together with one of its "users", the Signalling Connection Control Part (SCCP), described in Recommendations Q.711-Q.716, forms the Network Service Part (NSP).

The Network Service Part meets the requirement for Layer 3 services as defined in the OSI Reference Model (Recommendation X.200). The relationship of the MTP with this model and to other parts of SS No. 7 is described in Recommendation Q.700.

1.2 Objectives

The overall objectives of the Message Transfer Part are to provide the means for

a) the reliable transport and delivery of "User Part" signalling information across the SS No. 7 network;

b) the ability to react to system and network failures that will affect a), and take the necessary action to ensure that a) is achieved.

The "Users" of MTP are the SCCP, Telephone User Part (TUP) (Recommendation Q.721-Q.725) Data User Part (DUP) (Recommendation Q.741) and ISDN User Part (ISUP) (Recommendation Q.761-Q.766). The MTP Testing User Part is for further study.

1.3 General characteristics

1.3.1 Method of description

– functions provided by each level within the MTP;

– services provided by the MTP;

– interaction with the signalling network;

– interaction with the MTP "User";

– the message transfer capability of the MTP.

The functions of each level of the MTP are performed by means of the level protocol between two systems which provides a "level service" to the upper levels (i.e. level 1 Signalling Data Link, level 2 Signalling Link and level 3 Signalling network) as described in Recommendations Q.702, Q.703 and Q.704 respectively.

The service interface to the level 4 "User" of MTP is described by means of primitives and parameters.

1.3.2 Primitives

Primitives consist of commands and their respective responses associated with the services requested of the SCCP and of the MTP (see Figure 1). The general syntax of a primitive is shown below:

X	Generic name	Specific name	Parameter

- "X" designates the functional block providing the service ("MTP" for MTP).
- "Generic name" describes the action that should be performed by the addressed layer.
- "Specific name" indicates the direction of the primitive flow.
- "Parameters" are the elements of information which are to be transmitted between layers.

Four specific names exist in general:

- request;
- indication;
- response[1)];
- confirmation[1)].

Primitives and parameters of the Messsage Transfer Part service are listed and described in 8.

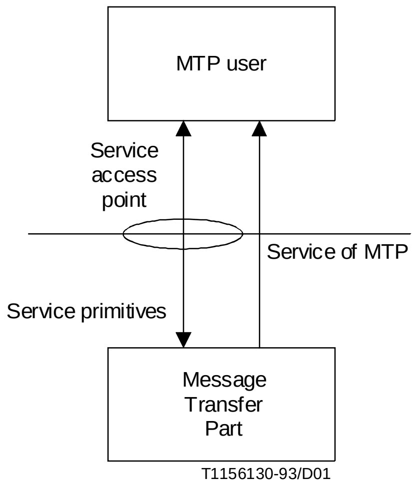

FIGURE 1/Q.701

Service primitives

1.3.3 Peer-to-peer communication

Exchange of information between two peers of the MTP is performed by means of a protocol. The protocol is a set of rules and formats by which the control information and MTP "User" data is exchanged between the two peers. The protocol caters for

- the transfer of "User" data in Message Signal Units (MSUs);
- level 2 control by use of Link Status Signal Units (LSSUs);
- testing and maintenance of signalling links by means of the signalling link test message carried in an MSU.

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1) Not all generic names contain all four specific names (see Figure 2).

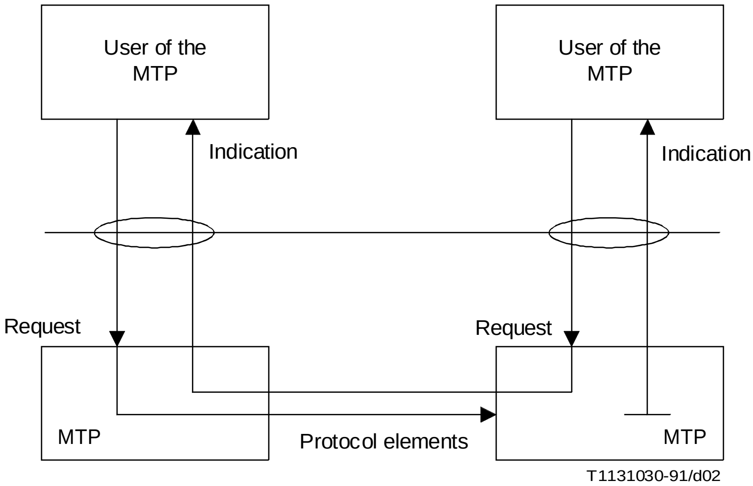

FIGURE 2/Q.701

Specific name of primitives and peer-to-peer communications

1.3.4 Contents of Recommendations Q.701 to Q.707-Series relating to the MTP

Recommendation Q.701 contains a functional description and overview of the Message Transfer Part of SS No. 7.

Recommendation Q.702 details the requirements of a signalling data link to support SS No. 7.

Recommendation Q.703 describes the signalling link functions.

Recommendation Q.704 describes signalling network functions and messages.

Recommendation Q.706 defines and specifies values for MTP performance parameters.

Recommendation Q.707 describes the testing and maintenance functions applicable to the MTP.

2 Signalling system structure

2.1 Basic functional division

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 3.

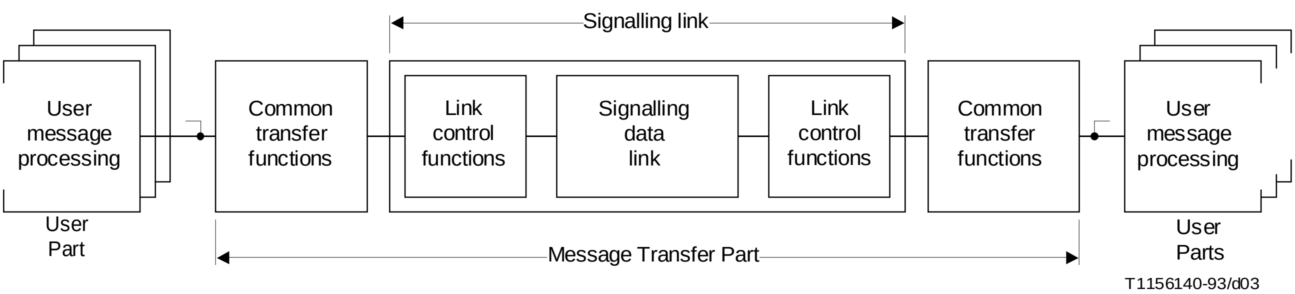

FIGURE 3/Q.701

Functional diagram for the common channel signalling system

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.

The term *user* in this context refers to any functional entity that utilizes 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 basic commonality in signalling for different services resulting from this concept is the use of a common transport system, i.e. the Message Transfer Part. Also, a degree of commonality exists between certain User Parts, e.g. the Telephone User Part (TUP) and the Data User Part (DUP).

2.2 Functional levels

2.2.1 General

As a further separation, the necessary elements of the signalling system are specified in accordance with a level concept in which

– the functions of the Message Transfer Part are separated into three functional levels; and

– the User Parts constitute parallel elements at the fourth functional level.

The level structure is illustrated in Figure 4. The system structure shown in Figure 4 is not a specification of an implementation of the system. The functional boundaries B, C and D may or may not exist as interfaces in an implementation. The interactions by means of controls and indications may be direct or via other functions. However, the structure shown in Figure 4 may be regarded as a possible model of an implementation.

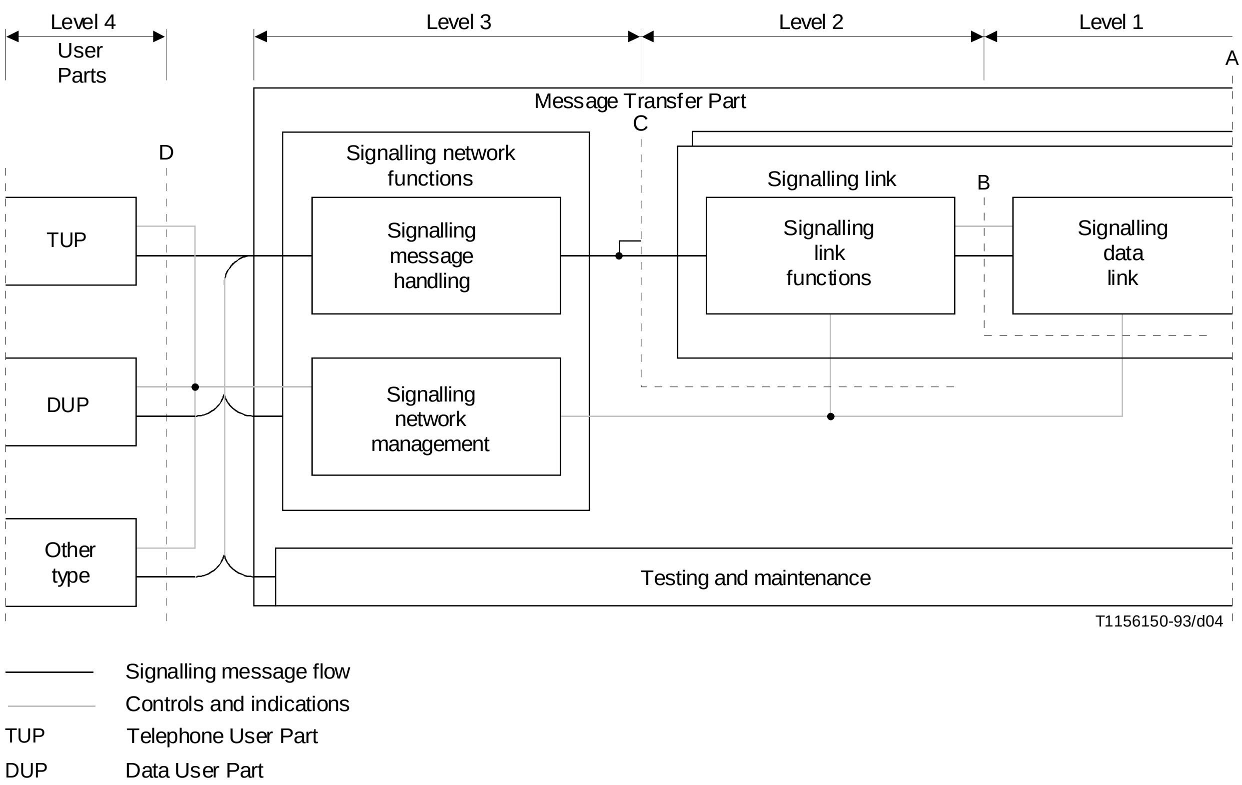

FIGURE 4/Q.701

General structure of signalling system functions

2.2.2 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 element provides a bearer for a signalling link.

In a digital environment, 64 kbit/s digital paths will normally be used for the signalling data link. The signalling data link may be accessed via a switching function, providing a potential for automatic reconfiguration of signalling links. Other types of data links, such as analogue links with modems, can also be used.

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

2.2.3 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 provide a signalling link for reliable transfer of signalling messages between two points.

A signalling message delivered by the higher levels is transferred over the signalling link in variable length *signal units*. For proper operation of the signalling link, the signal unit comprises transfer control information in addition to the information content of the signalling message.

The signalling link functions include:

- delimitation of signal unit by means of flags;
- flag imitation prevention by bit stuffing;
- error detection by means of check bits included in each signal unit;
- error correction by retransmission and signal unit sequence control by means of explicit sequence numbers in each signal unit and explicit continuous acknowledgements;
- signalling link failure detection by means of signal unit error rate monitoring and signalling link recovery by means of special procedures.

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

2.2.4 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. As illustrated in Figure 4 these functions fall into two major categories:

a) *Signalling message handling functions* – These are functions that, at the actual transfer of a message, direct the message to the proper signalling link or User Part.

b) *Signalling network management functions* – These are functions that, on the basis of predetermined data and information about the status of the signalling network, control the current message routing and configuration of signalling network facilities. In the event of changes in the status, they also control reconfigurations and other actions to preserve or restore the normal message transfer capability.

The different level 3 functions interact with each other and with the functions of other levels by means of indications and controls as illustrated in Figure 4. This figure also shows that the signalling network management, as well as the testing and maintenance actions may include exchange of signalling messages with corresponding functions located at other signalling points. Although not User Parts these parts of level 3 can be seen as serving as "User Parts of the Message Transfer Part". As a convention in these specifications, for each description, general references to User Parts as sources or sinks of a signalling message implicitly include these parts of level 3 unless the opposite is evident from the context or explicitly stated.

A description of the level 3 functions in the context of a signalling network is given in 3 below. The detailed requirements for signalling network functions are given in Recommendation Q.704. Some means for testing and maintenance of the signalling network are provided and the detailed requirements are given in Recommendation Q.707.

2.2.5 User Part functions (level 4)

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 extent of the User Part functions may differ significantly between different categories of users of the signalling system, such as:

- Users for which most user communication functions are defined within the signalling system. Examples are telephone and data call control functions with their corresponding Telephone and Data User Parts.
- Users for which most user communication functions are defined outside the signalling system. An example is the use of the signalling system for transfer of information for some management or maintenance purpose. For such an "external user", the User Part may be seen as a "mailbox" type of interface between the external user system and the message transfer function in which, for example, the user information transferred is assembled and disassembled to/from the applicable signalling message formats.

2.3 Signalling message

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 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 and through a signalling network to its destination; and
- to be directed at the receiving User Part to the particular circuit, call, management or other transaction to which the message is related.

On the signalling link, each signalling message is packed into Message Signal Units (MSUs) which also includes transfer control information related to the level 2 functions of the link.

2.4 Functional interface

The following functional interface between the Message Transfer Part and the User Parts can be seen as a model illustrating the division of functions between these parts. The interface (see Figure 5) is purely functional and need not appear as such in an implementation of the system.

The main interaction between the Message Transfer Part and the User Parts is the transfer of signalling messages across the interface, each message consisting of service information and signalling information as described above. Message delimitation information is also transferred across the interface with the message.

In addition to the transfer of messages and associated information, the interaction may also include flow control information, e.g. an indication from the Message Transfer Part that it is unable to serve a particular destination.

A description of the characteristics of the Message Transfer Part as seen from the functional interface and the requirements to be met by potential users of the message transfer function is given in 4.

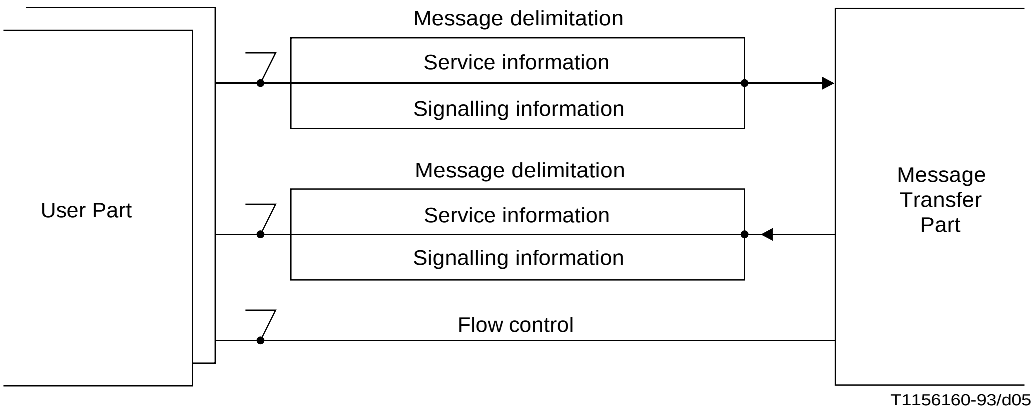

FIGURE 5/Q.701

Functional interface between the Message Transfer Part and the User Parts

3 Message Transfer Part and the signalling network

3.1 General

Since the Message Transfer Part forms the interface at a node with the rest of the signalling network, the signalling network will have significant impact on the MTP. The MTP must however be independent of the signalling network in that it has to be capable of performing its set functions and attaining its objectives, no matter what network structure or status prevails.

The MTP has therefore to contain the necessary functions to ensure any impact that the network has does not impair MTP performance.

3.1.1 Signalling network components

A full description of signalling network components is contained in Recommendation Q.700, the components that must be considered by the MTP are:

- signalling points (including signalling transfer points);
- signalling relations between two signalling points;
- signalling links;
- signalling link sets (including link groups);
- signalling routes;
- signalling route-sets.

3.1.2 Signalling modes

Signalling modes are described in Recommendations Q.700 and Q.705 (signalling network structures). The modes applicable to SS No. 7 MTP are:

- associated mode;
- quasi-associated mode.

3.1.3 Signalling point modes

A signalling point can be an originating point, a destination point or a signalling transfer point in a signalling relation. All three modes must be considered in the MTP.

3.1.4 Message labelling

Each message contains a label. In the standard label, the portion that is used for routing is called the *routing label*. This routing label includes:

a) explicit indications of destination and originating points of the message, i.e. identification of the signalling relation concerned;

b) a code used for load sharing which may be the least significant part of a label component that identifies a user transaction at level 4.

The standard routing label assumes that each signalling point in a signalling network is allocated a code according to a code plan, established for the purpose of labelling, that is unambiguous within its domain. Messages labelled according to international and national code plans are discriminated by means of an indication in the service information octet included in each message.

The standard routing label is suitable for national applications also. However, the signalling system includes the possibility for using different routing labels nationally.

3.2 Signalling message handling functions

Figure 6 illustrates the signalling message handling functions.

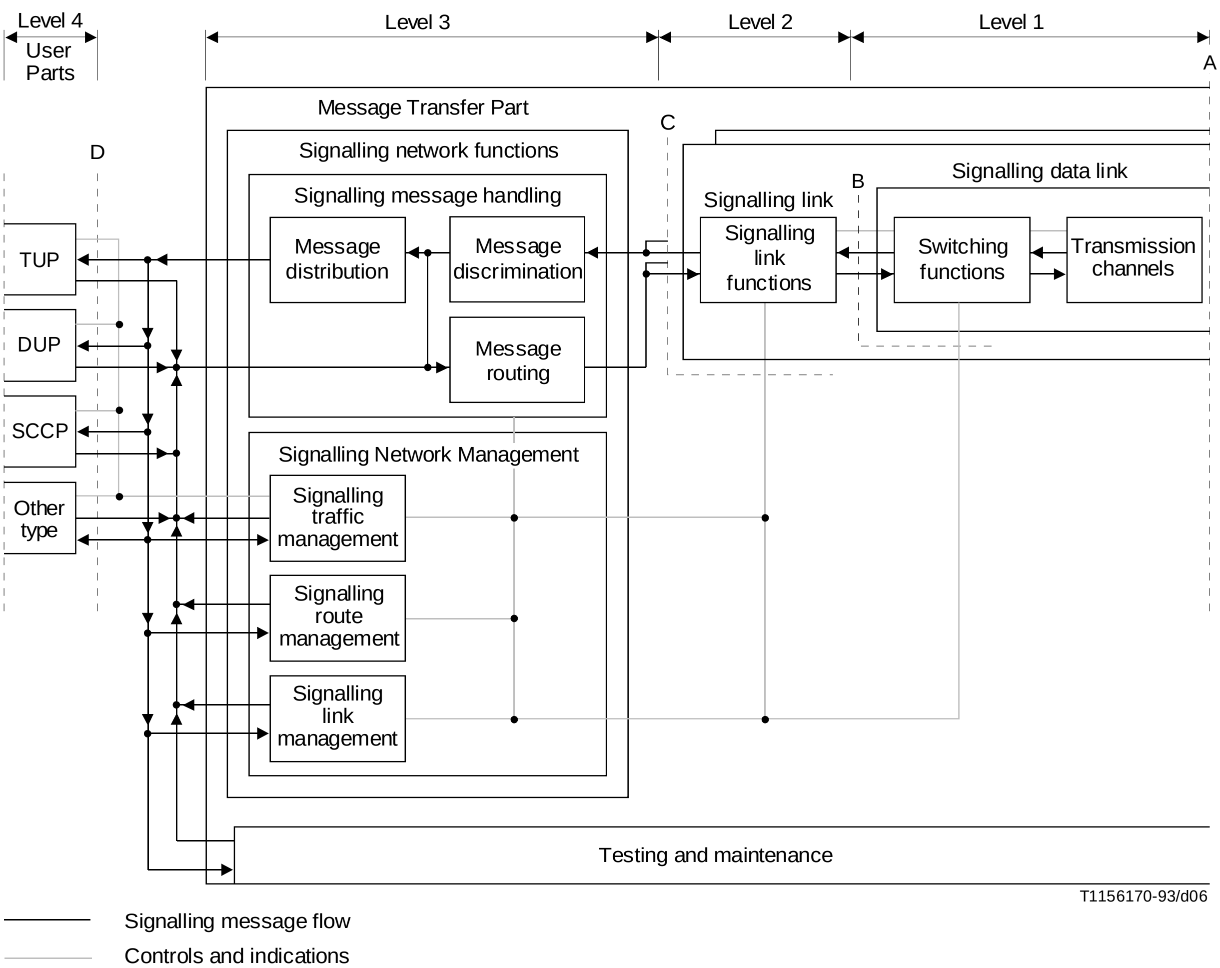

FIGURE 6/Q.701

Detailed structure of signalling system functions

3.2.1 Message routing

Message routing is the process of selecting, for each signalling message to be sent, the signalling link to be used. In general, message routing is based on analysis of the routing label of the message in combination with predetermined routing data at the signalling point concerned.

Message routing is destination-code dependent with typically an additional load-sharing element allowing different portions of the signalling traffic to a particular destination to be distributed over two or more signalling links. This traffic distribution may be limited to different links within a link set or applied to links in different link sets.

Each succession of signalling links that may be used to convey a message from the originating point to the destination point constitutes a *message route*. A signalling route is the corresponding concept for a possible path referring to a succession of link sets and signalling transfer points, between a given signalling point and the destination point.

In Signalling System No. 7, message routing is made in a manner by which the message route taken by a message with a particular routing label is predetermined and, at a given point in time, fixed. Typically, however, in the event of failures in the signalling network, the routing of messages, previously using the failed message route, is modified in a predetermined manner under control of the signalling traffic management function at level 3.

Although there are in general advantages in using a uniform routing of messages belonging to different User Parts, the service indicator included in each message provides the potential for using different routing plans for different User Parts.

3.2.2 Message distribution

Message distribution is the process which, upon receipt of a message at its destination point, determines to which User Part or level 3 function the message is to be delivered. This choice is made on analysis of the service indicator.

3.2.3 Message discrimination

Message discrimination is the process which, upon receipt of a message at a signalling point, determines whether or not the point is the destination point of that message. This decision is based on analysis of the destination code in the routing label in the message. If the signalling point is the destination point, the message is delivered to the message distribution function. If it is not the destination point, and the signalling point has the transfer capability, the message is delivered to the routing function for further transfer on a signalling link.

3.3 Signalling network management functions

Figure 6 illustrates the signalling network management functions.

3.3.1 Signalling traffic management

The tasks of the *signalling traffic management* function are

a) to control message routing; this includes modification of message routing to preserve, when required, accessibility of all destination points concerned or to restore normal routing;

b) in conjunction with modifications of message routing, to control the resulting transfer of signalling traffic in a manner that avoids irregularities in message flow;

c) flow control.

Control of message routing is based on analysis of predetermined information about all allowed potential routing possibilities in combination with information, supplied by the *signalling link management* and *signalling route management* functions, about the status of the signalling network (i.e. current availability of signalling links and routes).

Changes in the status of the signalling network typically result in modification of current message routing and thus in transfer of certain portions of the signalling traffic from one signalling link to another. The transfer of signalling traffic is performed in accordance with specific procedures. These procedures – *changeover, changeback, forced rerouting and controlled rerouting* – are designed to avoid, as far as the circumstances permit, such irregularities in message transfer as loss, missequencing or multiple delivery of messages.

The changeover and changeback procedures involve communication with other signalling point(s). For example, in the case of changeover from a failing signalling link, the two ends of the failing link exchange information (via an alternative path) that normally enables retrieval of messages that otherwise would have been lost on the failing link. However, as further explained later, these procedures cannot guarantee regular message transfer in all circumstances.

A signalling network has to have a signalling traffic capacity that is higher than the normal traffic offered. However, in overload conditions (e.g. due to network failures or extremely high traffic peaks) the signalling traffic management function takes flow control actions to minimize the problem. An example is the provision of an indication to the local user functions concerned that the Message Transfer Part is unable to transport messages to a particular destination in the case of total breakdown of all signalling routes to that destination point. If such a situation occurs at a signalling transfer point, a corresponding indication is given to the signalling route management function for further dissemination to other signalling points in the signalling network.

3.3.2 Signalling link management

The task of the signalling link management function is to control the locally connected link sets. In the event of changes in the availability of a local link set, it initiates and controls actions aimed at restoring the normal availability of that link set.

The signalling link management function also supplies information about the availability of local links and link sets to the signalling traffic management function.

The signalling link management function interacts with the signalling link function at level 2 by receipt of indications of the status of signalling links. It also initiates actions at level 2 such as, for example, initial alignment of an out-of-service link.

The signalling system can be applied with different degrees of flexibility in the method of provision of signalling links. A signalling link may for example consist of a permanent combination of a signalling terminal device and a signalling data link. It is also possible to employ an arrangement in which any switched connection to the remote end may be used in combination with any local signalling terminal device. It is the task of the signalling link management function in such arrangements to initiate and control reconfigurations of terminal devices and signalling data links to the extent such reconfigurations are automatic. In particular, this involves interaction, not necessarily direct, with a switching function at level 1.

3.3.3 Signalling route management

Signalling route management is a function that relates to the quasi-associated mode of signalling only. Its task is to transfer information about changes in the availability of signalling routes in the signalling network to enable remote signalling points to take appropriate signalling traffic management actions. Thus a signalling transfer point may, for example, send messages indicating inaccessibility of a particular signalling point via that signalling transfer point, thus enabling other signalling points to stop routing messages to an incomplete route.

3.4 Testing and maintenance functions

Figure 6 illustrates that the signalling system includes some standard testing and maintenance functions that use level 3 messages. Furthermore, any implementation of the system typically includes various implementation-dependent means for testing and maintenance of equipment concerned with the other levels.

3.5 Use of the signalling network

3.5.1 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. International signalling is an example of an application for which this approach is suitable.

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 need for redundancy for reliability, 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.

Further considerations about the use of a signalling network are given in Recommendation Q.705.

3.5.2 Provision of signalling facilities

In general, the most important factor in the dimensioning of the signalling network is the need for reliability by means of redundancy. Depending on the signalling network structure and the potential for reconfiguration of signalling equipment, the required redundancy may be provided by different combinations of

- redundancy in signalling data links (e.g. nominated reserves or switched connections);
- redundancy in signalling terminal devices (e.g. a common pool of terminals for the whole signalling point);
- redundancy of signalling links within a link set (typically operating with load sharing);
- redundancy in signalling routes for each destination (possibly operating with load sharing).

The loading capacity of a digital signalling link is high in relation to the signalling traffic generated for call control signalling. Therefore, in many typical applications the links will be lightly loaded and signalling traffic volume will be a secondary factor in the dimensioning of the signalling network. However, in high signalling traffic applications or when analogue links with lower speeds are used, it may be necessary to dimension the traffic capacity by provision of additional signalling links. The message routing principles adopted for the signalling system allow partitioning of the total signalling traffic into different portions based on load sharing, destination point code and service information. Such partitioning provides a useful means of controlling the load and dimensioning of the capacity of different sections of a signalling network as it allows distribution of different portions of the signalling traffic. It can also be used to dedicate certain parts of a signalling network to signalling traffic related to a particular user.

3.5.3 Application of signalling network functions

The signalling network functions provided by the signalling system are designed to cater for a range of signalling network configurations. It is not necessary that all of those functions be present at all signalling points. The necessary functional content at level 3 at a particular signalling point depends for example on what signalling mode(s) are used, whether or not it is a signalling transfer point, what type of signalling equipment redundancy is employed, etc. It is thus feasible to implement level 3 functions with modularity for different capabilities corresponding to different signalling network configurations. As a special case, it is even possible to apply the signalling system without using the level 3 element at all, e.g. in a small exchange or private automatic branch exchange which can only be reached via one primary pulse code modulation system.

4 Message transfer capability

4.1 General

The Message Transfer Part Recommendations specify methods by which different forms of signalling networks can be established. The requirements for the Message Transfer Part have been determined primarily by the requirements of call control signalling for the telephone and circuit switched data transmission services. However, the Message Transfer Part is also intended to have the ability to serve as a transport system for other types of information transfer. The following summarizes the typical characteristics of the transport service that may be offered by the Message Transfer Part to a potential user of this ability.

All information to be transferred by the Message Transfer Part must be assembled into messages. The linking of the source and sink of a message is inherent in the label in combination with the signalling routes existing between the two locations. From a transportation point of view each message is self-contained and handled individually. The nature of the transport service offered by the Message Transfer Part is therefore similar to that offered by a packet switched network. In addition, all messages containing the same label constitute a set of messages that is handled in a uniform manner by the Message Transfer Part, thus ensuring, in normal circumstances, regular delivery in the correct sequence.

4.2 User location in system structure

A potential user of the transport service is typically included in the system structure by provision of a separate User Part. This requires allocation of a service indicator code, the specification of which is part of both the Message Transport Part and User Part concerned.

As an alternative, a potential user may be catered for, together with other similar users, by an already existing or new User Part. In such a case the discrimination between messages belonging to this potential user and the other similar users is an internal matter within the User Part concerned. It then follows that all messages belonging to such a User Part are necessarily handled, e.g. as regards routing, in a uniform manner by the Message Transfer Part.

4.3 Message content

4.3.1 Code transparency

Information with any code combination generated by a user can be transferred by the Message Transfer Part provided that the message respects the requirements described below.

4.3.2 Service information

Each message must contain service information coded in accordance with the rules specified in 14/Q.704.

4.3.3 Message label

Each message must contain a label consistent with the routing label of the signalling network concerned. See also 2/Q.704.

4.3.4 Message length

The information content of a message should be an integral number of octets.

The total amount of signalling information transferable in one message is limited by some parameters of the signalling system; the signalling system can accept transfer of user information blocks in the order of 256 octets in single messages.

Depending on the signalling traffic characteristics of a user and of other users sharing the same signalling facilities, there may be a need to limit message lengths below the system limit based on queueing delay considerations.

In the case when information blocks generated by a user function exceed the allowed message length, it is necessary to implement means for segmentation and blocking of such information blocks within the User Part concerned.

4.4 User accessibility

The accessibility of user functions through a signalling network depends on the signalling modes and routing plan employed in that network.

In the case when only the associated mode of signalling is employed, only user functions located at adjacent signalling points may be accessed.

In the case when quasi-associated signalling is employed, user functions located at any signalling point may be accessed provided that the corresponding message routing data is present.

4.5 Transport service performance

Further detailed information is provided in Recommendation Q.706.

4.5.1 Message transfer delay

The normal delay for transfer of messages between user locations depends on factors such as distance, signalling network structure, signalling data link type and bit rate and processing delays.

A small proportion of messages will be subject to additional delay because of transmission disturbances, network failures, etc.

4.5.2 Message transfer failures

The Message Transfer Part has been designed to enable it to transfer messages in a reliable and regular manner even in the presence of network failures. However, inevitably some failures will occur the consequences of which cannot be avoided with economic measures. The types of failures that may occur and some typical probabilities of their occurrence are described below. Recommendation Q.706 provides further detailed information that can be used to estimate failure rates for particular cases.

In the case when a potential user function requires a reliability of the transport service that cannot be guaranteed by the Message Transfer Part, the reliability of that user may be enhanced by adoption of appropriate level 4 procedures, possibly including some means of supplementary end-to-end error control.

The following types of message transfer failures are possible, and the expected probabilities for such failures in typical applications are indicated (see also Recommendation Q.706).

a) *Unavailability of the transport service to one or more locations* – The availability of the message transfer capability depends on the redundancy provided in the signalling network; the availability can therefore be dimensioned.

b) *Loss of messages* – The probability of loss of messages mainly depends on the reliability of signalling equipment; typically it is expected to be lower than 10^{-7}.

c) *Missequencing of messages* – May in certain configurations of quasi-associated signalling occur with rare combinations of independent failures and disturbances. The probability, in such configurations, of a message being delivered out-of-sequence depends on many factors but is expected to be lower than 10^{-10}.

d) *Delivery of false information* – Undetected errors may lead to the delivery of false information; the possibility of an error in a message delivered is expected to be lower than 10^{-10}.

5 Differences from the Blue Book

The ongoing development of the MTP during this study period has resulted in a number of differences occurring between the MTP Recommendations as documented in the *Blue Book* and the ones as contained in this present version (March, 1993). The specific changes made with respect to the *Blue Book* are summarized in this clause. Note that merely the finalization of the processor outage procedure has resulted in level 2 changes. All interworking problems are covered and the related specific measures to be taken are summarized in 7. In this clause, finally, editorial corrections have not been considered.

5.1 Processor outage

The processor outage procedure 8/Q.703 has been clarified in regards to handling of old messages, differentiating between long and short processor outage, and synchronization of level 2 sequence numbers. It has been recommended that level 2 waits for an explicit notification before it resumes normal operations. Changes also relate to the emergency changeover procedure in 5.6/Q.704. No interworking problems are foreseen.

5.2 Availability of adjacent signalling point

The definition of the availability of an adjacent signalling point has been clarified. See 3.6.2/Q.704. The criteria for transferring traffic back to available signalling links addresses load balancing concerns. See 4.4/Q.704. No interworking problems are foreseen.

5.3 Handling of level 3 messages

A load sharing of level 3 messages, which are not related to a specific signalling link, has been introduced (see 2.3.4/Q.704).

5.4 Transferred controlled messages

The handling of transfer controlled messages has been changed. See 3.8.4/Q.704. No interworking problems are foreseen.

5.5 Load balancing during changeback

In order to allow load balancing between signalling links within a linkset during changeback, it is now possible to change the assignment of the normal traffic to a signalling link during the changeback process. This change resulted in modifications in 4.4/Q.704 signalling link availability and in 6.2/Q.704 changeback initiation and actions.

5.6 Time-controlled changeover procedure

The time-controlled changeover procedure has been enhanced to consider the actions of the remote side that receives the processor outage indication. See 5.6.2/Q.704. No interworking problems are foreseen.

5.7 Changeback

The actions of changeback have been modified (see 6.2.4/Q.704) and the applicability of time-controlled diversion procedure have been specified (see 6.2.5/Q.704). No interworking problems are foreseen.

5.8 MTP restart

The MTP restart procedure, formerly titled signalling point restart 9/Q.704, has been elaborated to provide the restarting signalling point sufficient time to activate its links and to update its routing data before receiving traffic. An overall restart time has been defined for the restarting MTP and its adjacent nodes. In addition to changes in 9/Q.704, the corresponding timers and their values have been changed in 16.8/Q.704 and the definition of the availability of an adjacent signalling point in 3.6.2/Q.704 has been expanded.

5.9 Signalling traffic flow control

The signalling traffic flow control procedure has been changed with regard to signalling route set congestion so that a better handling of asymmetric loaded link sets or route sets in case of congestion is allowed. In addition, the situation has been improved when bulk data user will contribute to a congestion situation (see 11.2.3/Q.704).

5.10 User part availability control

Subclause 11.2.7/Q.704, formerly titled MTP user flow control, has been retitled to "user part availability control" to appropriately reflect the responsibility of each user part to take proper action to stop traffic destined to the unavailable user part. Furthermore, the reasons for unavailability, "unavailable because of management reasons" and "unavailable because of unequipped user," are distinguished. New cause values for unequipped user is contained in the user part unavailable (UPU) message (see 15.17.2/Q.704) and the MTP STATUS primitive. No interworking problems are foreseen.

5.11 Signalling route management

Some clarifications to the transfer prohibited, transfer allowed and transfer restricted procedures have resulted in minor changes of 13/Q.704 signalling route management.

6 Compatibility in the Message Transfer Part

To enable implementations of Signalling System No. 7 of a given colour issue to achieve compatibility with implementations to other issues, a set of appropriate procedures and guidelines has been included in Recommendation Q.1400. This clause identifies the action that is required within the Message Transfer Part to ensure both forward and backwards compatibility. The areas considered are the treatment of spare fields, spare values, lack of acknowledgements and unreasonable information.

6.1 Unreasonable information

The following actions occur in the MTP when messages are received containing unreasonable information.

6.1.1 Messages containing an unallocated SIO value

When messages containing an unallocated SIO value are received at either a terminating Signalling Point or an STP that employs message routing based on both DPC and SIO, they should be discarded. If required, a report should be made to management.

6.1.2 Messages containing an unallocated H0/H1 code

When messages containing an unallocated H0/H1 code are received at the appropriate functional block within the MTP, they are discarded. There should be no impact on any protocol and, if required, a report should be made to management.

6.1.3 Messages containing an unallocated value in a recognized field

When messages are received at an owning function within the MTP containing a field with an unallocated value they are discarded and, if required, a report made to management. There should be no impact on any current protocol.

(An owning function is a function to which a received message pertains.)

6.2 Treatment of spare fields

The MTP will handle spare fields in MTP messages in the following manner:

- i) Spare fields are set to zero on message creation, and are not examined on reception at the destination owning function.
- ii) Spare subfields are set to zero on message creation, and are not examined on reception at the destination owning function.
- iii) Implementations of the STP function should transit all messages unchanged, including spare fields and spare subfields.

6.3 Lack of acknowledgement

Should a message that requires an acknowledgement not receive one within a specified time, the message will be repeated, unless the protocol specifies otherwise. However, subsequent failures to receive the acknowledgement should not cause indefinite repeat attempts.

7 Interworking of yellow, red and blue MTP implementations

There have been a number of changes introduced into the MTP Recommendations Q.701-Q.707 during the different study periods. The major changes have been identified in 5/Q.701 of the *Blue Book* and clause 5 above. Although in the majority of cases there will be no interworking problems, some instances have been identified where problems will arise. This clause gives guidance on the appropriate action that should be taken in the MTP to overcome the interworking problems.

7.1 Yellow Book to Red Book interworking

There were four areas where changes from the *Yellow Book* to the *Red Book* introduced interworking problems:

i) Level 2 flow control, LSSU SIB introduced.

ii) Transfer Restricted (TFR) and Transfer Controlled (TFC) messages and procedures were introduced into the *Red Book*.

iii) Transfer Allowed Acknowledgement (TAA) and Transfer Prohibited Acknowledgement (TPA) were deleted in the *Red Book*.

iv) Management inhibiting procedures were introduced into the *Red Book*.

The suggested action required at the *Yellow Book* and/or *Red Book* SP/STP to enable interworking is contained in the following point items.

7.1.1 Level 2 flow control

The *Red Book* SP/STP should apply normal level 2 flow control action (i.e. acknowledgements are withheld and SIBs sent). The *Yellow Book* SP/STP should ignore the LSSU SIB when received. It is recognized that although flow control is not performed in this case, interworking is possible. However, a possible option would be to set the congestion threshold at the *Red Book* SP/STP, such that flow control is not triggered on that signalling relation.

7.1.2 Transfer restricted and Transfer controlled procedures

The *Yellow Book* SP/STP should ignore TFR and TFC messages when received.

7.1.3 Transfer allowed/Transfer prohibited acknowledgements

The *Yellow Book* SP/STP should limit the repetition of the TFA/TFP message to once only. The *Red Book* SP/STP should ignore the acknowledgement messages when they are received.

7.1.4 Management inhibiting procedure

The *Yellow Book* SP/STP should ignore the Link Inhibit (LIN) and Link Uninhibit (LUN) messages when received. The *Red Book* SP/STP should limit the repetition of the LIN/LUN message.

7.2 Red Book to Blue Book interworking

The changes from the *Red Book* to the *Blue Book* Q.701-Q.707 Recommendations are identified in 5. There are six areas where changes have resulted in interworking problems:

i) Signalling Point Restart procedure;

ii) Timer values have been confirmed;

iii) User Flow Control procedure;

iv) Signalling Information Field length increase;

v) Management-inhibiting test procedure;

vi) Processor outage.

The suggested actions required at the *Red Book* and/or *Blue Book* SP/STP to enable interworking are contained in the following point items.

7.2.1 Signalling Point Restart

The *Red Book* SP/STP should ignore the Traffic Restart Allowed messages when received.

In addition, due to the introduction of the signalling point restart procedure into the *Blue Book*, interworking between *Red Book* and *Blue Book* MTPs might result in message loss and a loss of bi-directionality during the restart procedure. If these problems cannot be ignored, they should be avoided by the introduction of this present version MTP restart procedure in both, the *Red Book* and the *Blue Book* MTPs.

7.2.2 Q.703 and Q.704 timer values

Where possible, an SP/STP implemented to the *Red Book* should adopt the timer values specified in the *Blue Book* when interworking with a *Blue Book* SP/STP. For timer values, see 12/Q.703 and 16/Q.704.

7.2.3 User flow control

The *Red Book* SP/STP should ignore the User Part Unavailable (UPU) message if received.

7.2.4 Management inhibit test procedure

An interworking problem is present if the *Blue Book* end of an inhibited link performs a restart. This is due to the fact that the *Blue Book* side deletes the inhibiting status of the link, so that it is available for user generated traffic while the *Red Book* side is “not aware” of the restart and does not change the inhibiting status of the link. If the *Red Book* side, in addition, is the remote inhibited end this inhibition status may last a very long time and will only be removed due to a forced uninhibit request due to the unavailability of a destination detected by the routing control on the *Red Book* side. This interworking problem should be solved by appropriate measures at the *Red Book* side. Due to these measures, a possible restart of the *Blue Book* side should be detected and an uninhibiting of the concerned link be initiated.

Another RB-BB interworking problem is present which is based on the fact that, according to the *Red Book* specification, management blocking of the link “may be performed at either side of the link” (see 9.2 f)/Q.703). It is not explicitly stated that both sides have to perform the blocking. Thus, there may be the case that neither the *Red Book* side performs the blocking of the link nor the *Blue Book* side which performs the time-controlled changeover procedure. As a consequence, traffic might not be diverted at the *Red Book* side. To solve this interworking problem each side must be responsible for the diversion of its own traffic.

Concerning the inhibit test procedure, the *Red Book* SP/STP should ignore the Link Local inhibit test (LLT) and Link Remote inhibit test (LRT) messages. A report to local management should also be made.

7.2.5 SIF length increase

The SP/STP with 272 octet SIF length handling capability should prevent overlength messages from being routed over signalling links that only have a 62 octet SIF handling capability.

7.2.6 SIF length increase (National networks option)

In the international Signalling System No. 7 network, it should be possible to identify signalling links/routes with a limited SIF length handling capability and prevent overlength messages being transmitted over them by administrative action based on the exchange of operational data. However, with some national networks due to the rapid change in status of SP/STP implementation level (e.g. 62 to 272 SIF capability) and the number of SP/STPs in the network, this administrative action and data exchange may not be adequate. In this situation, a mechanism based on the following MTP activities may be more appropriate.

i) Detection of a link with 272 SIF capability may be achieved by coding the “D” bit of LSSUs sent during alignment as 1 (with 62 octet SIF links it would be 0). On receipt of this LSSU, a *Blue Book* SP/STP would mark the link/route as having 272 SIF capability. A *Red Book* SP/STP would ignore the coding of the “D” bit and treat the LSSU in the normal manner.

ii) When a *Blue Book* SP/STP receives a message for onward routing, it will check if the message (SIF) is greater than 62 octets. If the SIF is greater than 62 octets, it will verify that the link/route can handle a message of this length. Should the link/route not have the SIF length capability, the message will be discarded and an indication sent to the message origin. A *Red Book* SP/STP should not receive a message with an SIF > 62 octets.

iii) If the message originator is a local MTP User, an MTP-PAUSE primitive will be returned by the MTP in response to an overlength message (see 8). Should the originator be at a remote SP, a TFA coded to indicate that only 62 octet SIF messages can be transferred will be returned by the MTP in response to an overlength message (see 15/Q.704).

iv) On receipt of TFA (62 octets only), an SP should attempt to use an alternative 272 octet route to the affected destination. If this is not possible, then MTP-PAUSE should be sent from the MTP to the local users.

v) When a 272 octet route capability is re-established at a STP, it should inform any local users by means of MTP-RESUME and remote SPs by means of a TFA (272 octets allowed). The remote SP should inform its local users with an MTP-RESUME primitive.

In national networks using a SIF compatibility mechanism, the two spare bits in the TFA (see 15.8.2/Q.704) and in the RST (see 15/Q.704) may be coded as a SIF compatibility indicator as follows:

bit	B A	
0	0	Allow 62 octet SIFs/Prohibit 272, X and Y octet SIFs
0	1	Allow 62 and 272 octet SIFs/Prohibit X and Y octet SIFs
1	0	Allow 62, 272 and X octet SIFs Prohibit Y octet SIFs
1	1	Allow 62, 272, X and Y octet SIFs

NOTE – 272 < X < Y octets, the values of X and Y are for further study.

7.2.7 Processor outage

Note that an interworking problem exists in the cases where a *Red Book* node is performing management inhibiting or management blocking and, according to the *Blue Book* specification, the remote side performs time-controlled changeover in order to divert traffic from the link.

This is because the received changeover order is not acknowledged, resulting in the link being taken out of service. Thus, a changeover acknowledgement must be returned to the *Red Book* side. If the changeover order is received during time T1 (see 16.8/Q.704) it is advantageous to switch to the normal changeover procedure including retrieval, so that unnecessary message loss or sending of old messages can be avoided in a simple way. The ability to perform this switch is considered to be implementation dependent. If a changeover order is received after timer T1 has expired time-controlled changeover is completed (if not yet done) and an emergency changeover acknowledgement is sent to the remote end.

7.3 Yellow Book to Blue Book interworking

The changes between *Yellow Book* and *Blue Book* have taken place in two stages: Yellow to Red and Red to Blue. Therefore, to achieve interworking between *Yellow* and *Blue Books* implementations, the actions specified in 7.1 and 7.2 should be applied. In 7.1, *Red Book* SP/STP should be read as *Blue Book* SP/STP and in 7.2, *Red Book* SP/STP should be read as *Yellow Book* SP/STP.

There is one change from the *Red Book* in the *Blue Book* that will have an additional impact on interworking with the *Yellow Book*, and that is the deletion of the blocking procedure. This means that while a *Yellow Book* implementation can block a signalling link, a *Blue Book* node can neither inhibit nor block the link in the opposite direction.

7.4 Blue Book to the present version interworking

7.4.1 MTP restart

Due to the improvements concerning the MTP restart procedure, as described in clause 5, interworking problems between the *Blue Book* and the present version MTPs may arise in the form of message loss and loss of bi-directionality during the restart procedure. If these problems cannot be ignored, the present version restart procedure should be introduced within the *Blue Book* MTP.

7.4.2 Processor outage

In the case where a *Blue Book* level 3 has to interwork with the present version level 2, a problem exists because no message is sent by level 3 to flush the buffers and synchronize the sequence numbers. The solution of this problem is implementation dependent, but the problem might be solved, for example, if the level 3 were changed to take the link out of service when processor outage occurs.

7.5 Red Book to the present version interworking

The changes between the *Red Book* and the present version have taken place in two stages: *Red Book* to *Blue Book* and *Blue Book* to the present version. Therefore, to achieve interworking between *Red Book* and the present version implementations, the actions specified in 7.2 and 7.4 should be applied.

In addition, the following information might be useful to achieve interworking.

7.5.1 MTP restart

As a consequence of the interworking between the *Red Book* and the present version MTPs, problems arise in the form of message loss and loss of bi-directionality during the restart procedure. If these problems cannot be ignored, the present version MTP restart procedure should be introduced within the *Red Book* node. In the case of *Red Book* SEPs, as an alternative, the actions on the receipt of an unexpected TRA message (see 9.5/Q.704) may be introduced.

8 Primitives and parameters of the Message Transfer Part

The primitives and parameters are shown in Table 1.

8.1 Transfer

The primitive "MTP-TRANSFER" is used between level 4 and level 3 (SMH) to provide the MTP message transfer service.

8.2 Pause

The primitive "MTP-PAUSE" indicates to the "Users" the total inability of providing the MTP service to the specified destination[2)].

NOTE – The signalling point is inaccessible via the MTP. The MTP will determine when the signalling point is again accessible and send MTP-RESUME indication. The user should wait for such an indication and, meanwhile is not allowed to send messages to that signalling point. If the remote peer user is thought to be unavailable, that condition may be maintained or cancelled at the local user's discretion.

8.3 Resume

The primitive "MTP-RESUME" indicates to the "User" the ability of providing the MTP service to the specified destination[2)].

This primitive corresponds to the destination accessible state as defined in Recommendation Q.704.

NOTE – When the MTP-RESUME indication is given to each user, the MTP does not know whether the remote peer user is available. This is the responsibility of each user.

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2) See 7.2.6.

TABLE 1/Q.701

Message Transfer Part service primitives

Primitives		Parameters
Generic name	Specific name	
MTP-TRANSFER	Request Indication	OPC (see 2.2/Q.704) DPC (see 2.2/Q.704) SLS (see 2.2/Q.704) (Note 1) SIO (see 14.2/Q.704) User data (see 2.3.8/Q.703)
MTP-PAUSE (Stop)	Indication	Affected DPC[a)]
MTP-RESUME (Start)	Indication	Affected DPC[a)]
MTP-STATUS	Indication	Affected DPC Cause (Note 2)

a) See 7.2.6.

NOTES

1 The MTP users should take into account that this parameter is used for load sharing by the MTP, therefore, the SLS values should be distributed as equally as possible. The MTP guarantees (to a high degree of probability) an in-sequence delivery of messages which contain the same SLS code.

2 The Cause parameter has, at present, four values:

i) Signalling network congested (plus optional level)

The level value is included if national options with congestion priorities or multiple signalling link states without congestion priorities as in Recommendation Q.704 are implemented.

ii) User Part Unavailability: unknown.

iii) User Part Unavailability: unequipped remote user.

iv) User Part Unavailability: inaccessible remote user.

8.4 Status

The primitive “MTP-STATUS” indicates to the “Users” the partial inability of providing the MTP service to the specified destination. The primitive is also used to indicate to a User that a remote corresponding User is unavailable and the cause for unavailability (see 11.2.7/Q.704).

In the case of national option with congestion priorities or multiple signalling link congestion states without priorities as in Recommendation Q.704 are implemented, this “MTP-STATUS” primitive is also used to indicate a change of congestion level.

This primitive corresponds to the destination congested/User Part unavailable state as defined in Recommendation Q.704.

NOTE – In the case of remote user unavailability, the user is responsible for determining the availability of this peer user. The user is cautioned not to send normal traffic to the peer user because, while such peer is unavailable, no message will be delivered but each will result in a repeated MTP-STATUS indication. The MTP will not send any further indications about the unavailability or availability of this peer user unless the local user continues to send messages to the peer user.

8.5 Restart

When the MTP restart procedure is terminated, the MTP indicates the end of MTP restart to all local MTP Users showing each signalling point’s accessibility or inaccessibility. The means of doing this is implementation dependent (see 9/Q.704).