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Integrated Services Digital Network (ISDN); CCITT Signalling System No. 7 Message Transfer Part (MTP) to support international interconnection

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Foreword

This European Telecommunication Standard (ETS) has been produced by the Signalling Protocols and Switching (SPS) Technical Committee of the European Telecommunications Standards Institute (ETSI), as working document T/S 43-01), and was adopted having passed through the ETSI standards approval procedure.

This ETS is based on CCITT Recommendations Q.701 to Q.708 as given in the CCITT Blue Book, 1988. The requirements of these CCITT Recommendations shall apply unless modified by the statements provided in Clauses 4 and 5 of this ETS and, in addition, shall include the specific requirements contained in Clause 6.

The CEPT Recommendation for the Message Transfer Part (MTP), see CEPT T/S 43-01, April 1987, may continue to be used for the early introduction of services e.g. GSM, GAP Phase 2 and the ISDN MOU.

Where CEPT Recommendation T/S 43-01 does not already conform with the CCITT Blue Book MTP, the appropriate sections of CCITT Recommendation Q.701 together with the additions contained in this ETS shall resolve any interworking problems between this ETS and CEPT Recommendation T/S 43-01.

CCITT Recommendations Q.709 [9] and Q.791 apply as appropriate, unmodified, since they have no impact on interworking and are considered for guidance only.

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1 Scope

The scope of this ETS is the further development of the CCITT Signalling System No. 7 protocols for both the Integrated Services Digital Network (ISDN) and Public Switched Telephone Network (PSTN) following the publication of CCITT Recommendations Q.701 to Q.708 [1] to [8].

This ETS is applicable to the international network and is not meant to restrict national networks.

2 Normative references

This ETS incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] CCITT Recommendation Q.701 (1988): "Functional description of the message transfer part (MTP) of Signalling System No.7".

[2] CCITT Recommendation Q.702 (1988): "Signalling data link".

[3] CCITT Recommendation Q.703 (1988): "Signalling link".

[4] CCITT Recommendation Q.704 (1988): "Signalling network functions and messages".

[5] CCITT Recommendation Q.705 (1988): "Signalling network structure".

[6] CCITT Recommendation Q.706 (1988): "Message transfer part signalling performance".

[7] CCITT Recommendation Q.707 (1988): "Testing and maintenance".

[8] CCITT Recommendation Q.708 (1988): "Numbering of international signalling point codes".

[9] CCITT Recommendation Q.709 (1988): "Hypothetical signalling reference connection".

[10] CCITT Recommendation Q.791 (1988): "Monitoring and measurements for Signalling System No.7 networks".

[11] CEPT Recommendation T/S 43-01 (April 1987): "CCITT No.7 Message Transfer Part (MTP)".

3 Symbols and abbreviations

For the purposes of this ETS, the following abbreviations apply.

DPC	Destination Point Code
ISDN	Integrated Services Digital Network
LSSU	Link Status Signal Unit
MSU	Message Signal Unit
MTP	Message Transfer Part
PSTN	Public Switched Telecommunications Network

SIF	Signalling Information Field
SIO	Service Information Field
STP	Signalling Transfer Point
SP	Signalling Point
TFP	transfer-prohibited signal
TRA	transfer-restart-allowed signal
UPU	User Part Unavailable

4 Exceptions to CCITT Recommendations Q.701 to Q.708

The following exceptions to CCITT Recommendations Q.701 to Q.708 [1] to [8], as specified in the Blue Book, 1988, shall apply.

4.1 National options

No national options, or remarks, with regard to national options shall apply to this ETS.

4.2 Signalling data links

A standard bit rate of 64 kbit/s on signalling data links shall apply.

If signalling data links are to be provided over an analogue transmission path, any necessary digital to analogue or analogue to digital conversion shall be on the multiplexed transmission link after interface point C, as defined in figure 2 of CCITT Recommendation Q.702 [2].

4.3 Timer values

The timer values included in CCITT Recommendations Q.703 [3], Q.704 [4] and Q.707 [7] shall apply, with the following exceptions.

4.3.1 CCITT Recommendation Q.703

These timers shall not apply: T1 (4,8 kbit/s), T2 low, T2 high, T4n (4,8 kbit/s), T4e (4,8 kbit/s), T6 (4,8 kbit/s) and T7 (4,8 kbit/s).

4.3.2 CCITT Recommendation Q.704

These timers shall not apply: T7, T11, T15, T16 and T24.

Timer values to be modified in CCITT Recommendation Q.704 [4], § 16.8:

- T18 Timer within a signalling point whose MTP restarts, for supervising link and linkset activation as well as the receipt of routing information. The value is implementation and network dependent. Criteria to choose T18 are given in CCITT Recommendation Q.704 [4], § 9.2.

- T19 Supervision timer during MTP restart to avoid possible ping-pong of transfer-prohibited signal (TFP) and traffic-restart-allowed signal (TRA) messages: 67 to 69 seconds.

- T20 Overall MTP restart timer at the signalling point whose MTP restarts: 59 to 61 seconds.

- T21 Overall MTP restart timer at a signalling point adjacent to one whose MTP restarts: 63 to 65 seconds.

NOTE: The values of the MTP restart timers (T18 to T21) defined above are for use during normal operation. It might be advantageous for the network operator(s) to define an alternative value for each timer for use in potential network failures. Such an emergency might be recognised by an abnormally large number of outages, and it would be at the discretion of the operator(s) to use the emergency set of timer values within the network. Thus, the selection of the appropriate timer set is within the responsibility of the network administration.

4.4 Signalling link management

Of the requirements in CCITT Recommendation Q.704 [4], only the basic signalling link management functions of § 12.2 shall apply and § 12.3, § 12.4, § 12.5 and § 12.6 shall not apply.

4.5 Procedures to prevent unauthorised use of a signalling transfer point

While CCITT Recommendation Q.705 [5] is intended as a guidance document only, it should be noted that the optional procedure for the prevention of unauthorised use of a Signalling Transfer Point (STP) as specified in CCITT Recommendation Q.705 [5], § 8, shall not be essential.

4.6 Network Indicator

Only the value 00 shall be used for the Network Indicator.

4.7 Signalling Point (SP) restart

CCITT Recommendation Q.704 [4], § 9, shall be replaced by the following.

9 MTP restart

9.1 General

When a signalling point is isolated from the network for some time, it cannot be sure that its routing data are still valid (note that circumstances might cause the management entity to isolate the node, i.e. make all links unavailable, in order to facilitate recovery from a partial isolation). Thus, problems could be present when the sending of User traffic is resumed, due to wrong routing data as well as due to many parallel activities (e.g. link activation, changebacks, etc.) which have to be performed within the node whose MTP is restarting.

The objective of the MTP restart procedure is to protect both the node whose MTP is restarting, and the network. This is done by giving the restarting MTP time to activate sufficient links, and to exchange enough routing data with the network, before User traffic is restarted. Note that in this context "sufficient" and "enough" mean that potential remaining problems should not cause the node to fail again.

A central part of the restart procedure is the exchange of network status information between the restarting MTP and the adjacent nodes. In order for the procedure to make sense, the network status should not change significantly during this information exchange. As a consequence there is an overall restart time defined for the node whose MTP is restarting as well as for the adjacent nodes. During this time, all activities within the node whose MTP is restarting as well as the adjacent nodes should be completed. This requires that the time available is used in an efficient way.

As a basis of the restart procedure it is assumed that most of the signalling points within the network are accessible. Thus, at the beginning of the restart procedure, all concerned routes are considered to be allowed, and the update of the network status is performed by the exchange of transfer-prohibited signal (TFP) messages.

The MTP restart procedure uses the traffic-restart-allowed signal (TRA) message which contains:

- the label, indicating the originating signalling point and the adjacent destination signalling point;

- the traffic restart allowed signal.

The format and coding of this message appear in CCITT Recommendation Q.704, § 15.

When an adjacent node has finished sending all relevant TFP messages to the node with the restarting MTP, it finally sends a TRA message which indicates that all relevant routing information has been transferred. Thus, at the node with the restarting MTP, the number of received TRA messages is an indication of the completeness of the routing data.

When the restarting MTP has completed all actions or when the overall restart time is over, it sends TRA messages directly to all of its adjacent nodes accessible via a direct linkset. These messages indicate that the restart procedure is terminated and User traffic should be started.

9.2 Actions in a signalling point whose MTP is restarting

9.2.1 A signalling point starts the MTP restart procedure when its first link is in service at level 2. The restarting MTP:

- if it has the transfer function, starts a timer T18;

- starts an overall restart timer T20; and

- continues activating or unblocking all of its signalling links by means of the basic signalling link management procedures (see CCITT Recommendation Q.704, § 12.2).

NOTE: In order to use the overall restart time in an efficient way, it is preferable to make all linksets available at nearly the same time, by activating first one link per linkset, and by applying emergency alignment for at least the first link in each linkset. Because of this measure, the routing data update can be started for all routes at the very beginning of the restart procedure.

9.2.2 If the signalling point's restarting MTP has the transfer function, the MTP restart procedure consists of two phases. Within the first phase, supervised by timer T18, links are activated and the routing tables within the restarting MTP are updated according to the transfer prohibited and transfer allowed messages (see CCITT Recommendation Q.704, § 15) received from the adjacent nodes. In addition, the restarting MTP takes into account any traffic restart allowed messages received from adjacent nodes. Timer T18 is implementation and network dependent, and is stopped when:

(1) sufficient links and linksets are available to carry the expected signalling traffic; and

(2) enough TRA messages (and therefore routing data) have been received to give a high level of confidence in the MTP routing tables.

NOTE: In normal circumstances the restarting MTP should wait for TRA messages from all adjacent nodes. There are, however, other situations where this might not be useful, e.g. for a long-term equipment failure.

When T18 is stopped or expires, the second phase begins, which includes as a major part a broadcast of non-preventive transfer prohibited messages (i.e. those TFPs according to CCITT Recommendation Q.704, § 13.2.2, v), taking into account signalling linksets which are not available and any TFP and TFA messages received during phase 1.

Note that timer T18 is determined such that during phase 2 the broadcast of TFP messages may be completed in normal situations. TRA messages received during phase 2 should be ignored. If during phase 2 a destination has been declared to be inaccessible by sending of a TFP message, and afterwards, but still within phase 2, this destination becomes accessible to the restarting MTP by reception of a TFA message or the availability of a corresponding link, this new accessibility is a late event and should be treated outside the restart procedure.

The handling of the new accessibility of the said destination before the sending of a TFP referring to that destination is an implementation dependent matter.

When all TFP messages have been sent, the overall restart timer T20 is stopped and phase 2 is finished.

Note that preventive TFP messages (i.e. those according to CCITT Recommendation Q.704, § 13.2.2, i), except possibly those for highest priority routes, must have been sent before normal User traffic is carried. This might be done during or after phase 2.

9.2.3 If the restarting MTP has no transfer function, phase 1 (see CCITT Recommendation Q.704, § 9.2.2) but not phase 2 is present. In this case, the whole restart time is available for phase 1. The overall restart timer T20 is stopped when:

(1) sufficient links and linksets are available to carry the expected signalling traffic; and

(2) enough TRA messages (and therefore routing data) have been received to give a high level of confidence in the MTP routing tables.

9.2.4 When T20 is stopped or expires, the restarting MTP of the signalling point or signalling transfer point sends traffic restart allowed messages to all adjacent signalling points via corresponding available direct linksets, and an indication of the end of MTP restart is sent to all local MTP Users showing each signalling point's accessibility or inaccessibility. The means of doing the latter is implementation dependent.

In addition, timer T19 is started (see CCITT Recommendation Q.704, § 9.5.2) for all signalling points to which a TRA message has just been sent. Normal operation is then resumed.

When T20 expires the transmission of TFP messages is stopped. However, preventive TFP messages (i.e. those according to CCITT Recommendation Q.704, § 13.2.2, i), except possibly those for highest priority routes, must have been sent before MTP User traffic is restarted.

9.3 Actions in a signalling point X, adjacent to a signalling point Y whose MTP restarts.

9.3.1 A signalling point X considers that the MTP of an inaccessible adjacent signalling point Y is restarting when:

- the first link in a direct linkset is in the "in service" state at level 2; or

- another route becomes available due either to reception of a corresponding TFA or TRA message, or by the corresponding linkset becoming available (see CCITT Recommendation Q.704, § 3.6.2.2).

9.3.2 When the first link in a direct linkset towards signalling point Y, whose MTP is restarting, is in the "in service" state at level 2, signalling point X starts a timer T21 and takes account of any TFP and TFA messages received from signalling point Y. In addition X takes the following action:

- if X has the transfer function, when the direct linkset is available at level 3, X sends any necessary TFP messages to Y; then

- X sends a traffic restart allowed message to signalling point Y.

If a signalling point, previously declared to be inaccessible, becomes available again before T21 is stopped or expires, a corresponding TFA message is sent to the signalling point Y whose MTP is restarting.

If a signalling point becomes prohibited to signalling point X after a TRA message has been sent by X to Y, X sends a corresponding TFP message to Y.

When a traffic restart allowed message has been received by X from signalling point Y, and a TRA message has been sent by X to Y, X stops timer T21. Note that preventive TFP messages according to CCITT Recommendation Q.704, § 13.2.2, i) must be sent before MTP User traffic is restarted.

NOTE: This includes the case where the MTP of Y is restarting as well as the case that both X and Y start the adjacent signalling point MTP restart procedure at the new availability of the interconnecting direct linkset. In the latter case, one side will receive a TRA message from the other while still sending TFP messages, so that it has not yet sent its TRA message. The transmission of routing information should be completed before this TRA message is sent to the adjacent node and timer T21 stopped.

When T21 is stopped or expires, signalling point X sends an MTP-RESUME primitive concerning Y, and all signalling points made available via Y, to all local MTP Users. If X has the transfer function, it broadcasts to adjacent available signalling points transfer allowed messages concerning Y and all signalling points made accessible via Y. Note that preventive TFPs according to CCITT Recommendation Q.704, § 13.2.2, i) must be sent before MTP User traffic is restarted.

In the abnormal case where transfer prohibited messages are still being sent to Y when T21 expires (and hence no TRA message has yet been sent to Y), such routing data transmission is stopped and no TRA message is sent to Y. Note that preventive TFPs according to CCITT Recommendation Q.704, § 13.2.2, i) must still be sent during the changeback procedure.

9.3.3 When signalling point Y becomes accessible by means other than via a direct linkset between X and Y, X sends an MTP-RESUME primitive concerning Y to all local MTP Users. In addition, if signalling point X has the transfer function, X sends to Y any required transfer prohibited messages on the available route. X then broadcasts TFA messages (see CCITT Recommendation Q.704, § 13) concerning Y.

NOTE: X should not in this case alter any routing data other than that for Y.

9.4 Short term isolations

9.4.1 In the case where a signalling point is isolated due to a short term processor outage (lasting less than T1 {see CCITT Recommendation Q.704, § 16.8}) occurring on some or all of its links at nearly the same time, the restart procedure should not be started. If an isolation lasts longer than T1, the restart procedure must be performed.

9.4.2 When a destination Y becomes inaccessible, and routing control finds an inhibited link within the routeset to Y, a signalling routing control initiated uninhibiting action is performed (see CCITT Recommendation Q.704, § 10.3). If at least one inhibited link is in the level 2 "in service" state, and uninhibiting is successful, the isolation will be of short-term and no restart procedure should be performed on either side of the link.

9.5 TRA messages and timer T19

9.5.1 If a signalling point X receives an unexpected TRA message from an adjacent node Y and no associated T19 timer is running, X sends to Y any necessary TFP messages if X has the transfer function, and a TRA message to Y. In addition, X starts a timer T19 associated with Y.

9.5.2 If a signalling point receives a TRA message from an adjacent node and an associated timer T19 is running, this TRA is discarded and no further action is necessary.

9.6 General rules

9.6.1 When the MTP of a signalling point restarts, it considers at the beginning of the MTP restart procedure all signalling routes to be allowed.

9.6.2 After the MTP of an adjacent node X has restarted, and if T21 has been started (see CCITT Recommendation Q.704, § 9.3.2) all routes using X are considered to be available unless corresponding TFP messages have been received whilst T21 was running.

9.6.3 A signalling route set test message received in a restarting MTP is ignored during the MTP restart procedure. Signalling route set test messages received in a signalling point adjacent to signalling point Y whose MTP is restarting before T21 expires are handled, but the replies assume that all signalling routes using Y are prohibited.

9.6.4 Late events, i.e. link restorations or reception of TFA messages, occurring in phase 2 at a node whose MTP is restarting after the node has sent out TFPs referring to the concerned signalling points, are treated outside the restart procedure as normal events.

Handling of late events in phase 2 before sending out TFPs referring to the concerned signalling points is an implementation dependent matter. In addition, it is an implementation dependent matter whether the reception of TFPs or linkset failures during phase 2 are handled within or after the termination of the restart procedure.

9.6.5 When an adjacent signalling point Y becomes accessible on receipt of a TFA or TRA message (see CCITT Recommendation Q.704, § 3.6.2) the concerned signalling point performs controlled rerouting towards Y.

9.6.6 All messages to another destination received at a signalling point whose MTP is restarting are discarded.

All messages received during the restart procedure concerning a local MTP User (service indicator not equal to 0000 and not equal to 0001) are discarded. All messages received with service indicator equal to 0000 in a restarting MTP for the signalling point itself are treated as described in the MTP restart procedure. Those messages not described elsewhere in the procedure are discarded and no further action is taken on them (message groups CHM, ECM, FCM, RSM, UFC, MIM and DLM).

9.6.7 In adjacent signalling points during the restart procedure, messages not part of the restart procedure but which are destined to or through the signalling point whose MTP is restarting, are discarded.

Messages received with service indicator equal to 0001 are handled normally during the restart procedure.

9.6.8 If a gateway node's MTPs are restarting in multiple networks, it may be of advantage to co-ordinate their restarting procedures (implementation dependent).

4.8 User flow control

CCITT Recommendation Q.704 [4], § 11.2.7 shall be replaced by the following:

11.2.7 User Part availability control

11.2.7.1 If the MTP is unable to distribute a received message to a local user because that user is unavailable (User Part unavailability is an implementation dependent notion - it can include unavailability for management reasons, the user might even be unequipped), the MTP sends a User Part Unavailable (UPU) message to the MTP at the originating signalling point.

11.2.7.2 When the originating signalling point's MTP receives a UPU message, it:

a) informs the management process;

b) sends an indication (MTP-STATUS with parameters identity of the signalling point containing the unavailable User Part, and cause "Remote User Unavailable"), to the local user designated in the message, if it is available.

NOTE The MTP does not maintain status information regarding the availability of the remote User Part.

11.2.7.3 The user should then take appropriate action in order to stop generation of normal signalling information for the unavailable User Part.

11.2.7.4 It is the responsibility of the User Part to determine when the remote User Part is again available (User Part availability is an implementation dependent notion). This might be done, for example, by the user testing periodically, or by using the reception of a message from the remote user as an implicit indication of availability, or both.

11.2.7.5 The UPU message contains:

- the label, indicating the destination and originating points;
- the UPU signal;
- the identity of the unavailable User Part.

The format and coding of this message appear in § 15.

11.2.7.6 When the MTP is again able to distribute received messages to a previously unavailable local User Part (local User Part availability is an implementation dependent notion), the MTP delivers the received messages to that user.

11.2.7.7 If a UPU message is received by the MTP referring to a remote User Part whose local peer is unequipped, the MTP informs the management process[(1)] and discards the UPU message.

11.2.8 User Part congestion

There are no specific User Part congestion control procedures defined in the MTP.

[(1)] Whether or not the management process is informed is implementation dependent.

5 Modifications to texts taken from the CCITT Blue Book (1988)

5.1 Interworking between SPs to the CEPT Recommendation T/S 43-01 and this ETS

The text in § 7.2.1 of CCITT Recommendation Q.701 [1] shall be replaced by the following paragraph:

> An SP/STP according to CEPT Recommendation T/S 43-01 [11] should ignore any traffic restart allowed (TRA) message if received.

As a consequence of interworking between MTPs according to CEPT Recommendation T/S 43-01 [11] and to this ETS, problems arise in the form of message loss and loss of bidirectionality during the MTP restart procedure. If these problems cannot be ignored, the MTP restart procedure in this ETS should be introduced within the CEPT SP/STP's MTP. In the case of CEPT STPs, as an alternative, the actions defined for receipt of TRA messages in CCITT Recommendation Q.704 [4], § 9.5 of the MTP restart procedure may be introduced (see subclause 4.7).

5.2 Changes to CCITT Recommendation Q.701, § 7.2.4

The following text shall be added to that in CCITT Recommendation Q.701 [1], § 7.2.4.

A Red Book/Blue Book 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 CCITT Recommendation Q.704, § 9.2). It is not explicitly stated that both sides have to perform the transition to the processor outage state. Thus, there may be the case that neither the Red Book side performs the transition to the processor outage state 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.

5.3 Changes to CCITT Recommendation Q.701, § 7.2.7

The following new section shall be added to that in CCITT Recommendation Q.701 [1].

7.2.7 Processor Outage

NOTE: An interworking problem exists in the case 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 due to the fact that the received changeover order is not acknowledged resulting in an out of service of the link. Thus, a changeover acknowledgement must be returned to the Red Book side. If the changeover order is received during time T1 (see CCITT Recommendation Q.704, § 16.8) it is advantageous to switch to the normal changeover procedure including retrieval, because unnecessary message loss or sending of old messages is 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 shall be sent to the remote end.

5.4 Changes to CCITT Recommendation Q.701, § 8.5

The text in § 8.5 of CCITT Recommendation Q.701 [1] shall be replaced by the following:

8.5 MTP restart

When the MTP restart procedure is terminated, (i.e. when the TRA messages have been broadcast) 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 CCITT Recommendation Q.704, § 9).

5.5 Changes to CCITT Recommendation Q.703, § 8

The text in § 8 of CCITT Recommendation Q.703 [3] shall be replaced by the following:

8 Processor outage

The procedure for dealing with local and/or remote processor outage is described in figure 10 of CCITT Recommendation Q.703.

A processor outage situation occurs when, due to factors at a functional level higher than level 2, use of the link is precluded.

In this context, processor outage refers to a situation when signalling messages cannot be transferred to functional levels 3 and/or 4. This may be because of, for example, a central processor failure. A processor outage condition may not necessarily affect all signalling links in a signalling point, nor does it exclude the possibility that level 3 is able to control the operation of the signalling link.

When level 2 identifies a local processor outage condition, either by receiving an explicit indication from level 3, (i.e. local signalling link blocking), or by recognizing a failure of level 3, it shall transmit link status signal units indicating processor outage and discard message signal units received. Provided that the level 2 function at the far end of the signalling link is in its normal operating state (i.e. transmitting message signal units or fill-in signal units), upon receiving link status signal units indicating processor outage it shall notify level 3 and shall begin to continuously transmit fill-in signal units.

Note, in the case that processor outage is long-term, i.e. when Timer T1 in MTP Level 3 (See CCITT Recommendation Q.704) has expired, problems exist with old messages, which are those messages stored within level 2 buffers after the switch of new traffic on the alternative link(s) has been performed. This is because, in general, the level 2 buffers on both sides of the link contain some Message Signal Units (MSUs). If normal operation of the link is resumed (re) transmission of these messages would result in message mis-sequencing. Furthermore, it is very likely that these messages are related to calls that have already been torn down or to network management situations that have long since passed. Thus, in order to avoid sending of old messages, the level 2 buffers on both sides should be flushed immediately when the local/remote processor outage state terminates. In addition, the synchronisation of the level 2 sequence numbers has to be assured. This is necessary for the correct operation of the link. It is understood that each side is responsible for the flushing and synchronisation concerning its own level 2 and that the specific actions concerning the synchronisation of the level 2 buffers must not rely on the actions of the other side. How these measures are performed is considered to be implementation dependent.

When the local processor outage condition ceases, normal transmission of MSUs and Fill-in Signal Units (FISUs) is resumed (provided that no local processor outage condition has arisen also at the remote end); as soon as the level 2 function at the remote end has correctly received a MSU or FISU[1)], it notifies level 3 and returns to the In Service state. However, in order to avoid problems with the flushing of old messages, it is recommended that level 2 on both sides should wait to resume its normal operation until it is explicitly notified by level 3 that it may again do so.

Format and code of link status signal units indicating processor outage (status indication "PO") appear in CCITT Recommendation Q.703, § 11.

5.6 Change to CCITT Recommendation Q.704, § 3.6.2.2

Signalling point availability

The text in § 3.6.2.2 of CCITT Recommendation Q.704 [4] shall be replaced by:

3.6.2.2 Availability of an adjacent signalling point

A signalling point considers that an adjacent signalling point Y becomes available when:

1) at least one signalling link connected to Y becomes available at level 3 and the MTP restart procedure (see CCITT Recommendation Q.704, § 9) has been completed; or

2) the adjacent signalling point Y becomes accessible:

- on the receipt of a transfer allowed message;
- if an alternative route becomes available again via the corresponding local linkset; or
- if a traffic restart allowed message from another adjacent signalling point Z, whose MTP is restarting, is received so that a route towards Y using Z becomes available.

5.7 Change to CCITT Recommendation Q.704, § 5.6.2

The following text shall be added at the end of § 5.6.2 of CCITT Recommendation Q.704 [4]:

If time-controlled changeover has been initiated according to case (ii) above and if a changeover order is received from the remote end during the time T1, it is advantageous to switch to the normal changeover procedure including retrieval because unnecessary message loss or sending of old messages is avoided in a simple way. The ability to perform this switch is considered to be implementation dependent. A changeover acknowledgement, however, must be returned in any case in order to assure the normal completion of the changeover procedure at the remote end. 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.

In the case that processor outage is of long term, the remote side completes the time-controlled changeover procedure. In order to avoid sending of old messages (see CCITT Recommendation Q.703, § 8) the level 2 buffers on both sides of the link should be flushed immediately when the local/remote processor outage state terminates. How the flushing is performed is implementation dependent. The decision whether processor outage is of long term is a local one. At the remote side long term processor outage occurs when the time-controlled changeover timer T1 expires. At the local side an equivalent timer is used in the same way.

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1) Whether the just received MSU/FISU and a limited number of following ones are discarded or not is an implementation dependent decision.

5.8 Change to CCITT Recommendation Q.704, § 6.3

The following cautionary note shall be added to the end of § 6.3 of CCITT Recommendation Q.704 [4]:

NOTE: The sequence control procedure during changeback can only guarantee correct sequencing of MSUs in all cases if the alternative link terminates in the same signalling point (i.e. the destination of the changeback declaration) as the newly available one.

5.9 Change to CCITT Recommendation Q.704, § 11.2.3.1

The text in § 11.2.3.1 of CCITT Recommendation Q.704 [4] shall be replaced by the following:

11.2.3.1 When the congestion status of a signalling routeset changes to congested, the following actions shall be taken:

i) When a MSU from a local User Part is received for a congested route set the following actions are performed:

a) the MSU is passed to level 2 for transmission;

b) a congestion indication primitive will be returned to each level 4 User Part for the initial message, or alternatively for the first octet, and for at least every n messages (n=8), or alternatively every N octets (see NOTE) (N=279-300 provisional value), received for the congested route set, or for any link of the congested route set, or for any linkset of the congested route set, or for any congested link of the congested route set. The congestion indication primitive contains as a parameter the Destination Point Code (DPC) of the affected destination.

ii) When a MSU is received at a STP for a congested route set, the following actions take place:

a) the MSU is passed to level 2 for transmission;

b) a transfer controlled message is sent to the originating point of the initial message, or alternatively the first octet, and for every n messages (n=8), or alternatively N octets (1) (N=279-300 provisional value), received from any originating point for the congested route set, or for any link of the congested route set, or for any linkset of the congested route set, or for any congested link of the congested route set.

NOTE: Where the measured length is the full MSU level 2 length.

6 Specific requirements

6.1 Signalling link loading

The following subclauses detail the requirements for signalling link loading that shall apply.

6.1.1 Basic definition

Signalling Link Load: the signalling link load is defined as the ratio of the number of MSU bits transferred per second on one link at level 2, measured in one direction, including the necessary level 2 fields but excluding retransmitted MSUs as well as FISUs and Link Status Signal Units (LSSUs), to the bit rate at level 2.

The signalling link load is a value for the occupancy of a signalling link, during the period of observation.

6.1.2 Maximum signalling link load during normal operation

The maximum signalling link load is a value of the signalling link load during normal operation of the signalling link, which is specified for the purpose of signalling network dimensioning and planning.

Normal operation of the signalling link means that there is no changeover or rerouting in the signalling network which has any impact on the signalling link under consideration.

The maximum signalling link load is the maximum value of the signalling link load which is transferred via a signalling link at normal operation as an average value over a long period of time during the period of maximum signalling traffic (e.g. busy hour) and for which the signalling link should be able to transfer complying with the transfer time requirements.

The maximum signalling load should not exceed 0,2 erlang in the European signalling network for interconnections, but the actual signalling link load can be much higher or much lower during short periods of time and may, in general, be lower outside the period of maximum signalling traffic.

6.1.3 Minimum signalling link load handling capability

The minimum signalling link load handling capability shall be specified as a minimum requirement in order to support the design of equipment and the planning of the signalling routing during periods of abnormal conditions in the signalling network.

The minimum signalling link load handling capability shall be that value of the signalling link load which the equipment shall be able to handle as a minimum during abnormal conditions in the signalling network. This load shall be seen during network dimensioning as the maximum value of signalling link load to be carried by one signalling link during periods of abnormal conditions, with the guarantee of not being in conflict with the appropriate transfer time requirements (see CCITT Recommendation Q.706 [6]) and not triggering any congestion control measures in this section of the signalling network.

For this ETS the value of 0,4 erlangs is agreed in the European signalling network for the minimum signalling link load handling capacity. As a long term objective the value of 0,6 erlang for the minimum signalling load handling capacity is anticipated.

This value of minimum signalling load handling capability is specified with respect to abnormal conditions in the signalling network and therefore to be seen as a medium term average. For short periods of time (in the order of one second) when large queues of signal units are contained in the buffers (e.g. immediately after a changeover), the signalling link load can be higher.

6.1.4 Message length influence

The definition of the signalling link load does not refer intentionally to any particular value of the mean message length. In fact the network planning and the specification of equipment shall be based on stable concepts, whereas it is likely that with the introduction of new or modified MTP Users the mean message length in the signalling network may change. So the definitions of the maximum load and of the minimum handling capability are considered as valid for any value of mean message length between the minimum and maximum values.

6.1.5 Graphic representation

In figure 1 of this ETS the number of messages per second transferred in one direction at the interface between level 2 and level 3, for one signalling link is represented horizontally. The Signalling Information Field (SIF) + Service Information Field (SIO) load, in number of kbit transferred per second, in the same direction at the same interface is represented vertically. In figure 1, the limits of the message length are two straight lines starting from point O. The line "OGACE" is the minimum value of 6 octets per message. The line "OHBDF" is the maximum value of 273 octets per message.

The different values of the signalling link load, as defined in subclause 6.1.1, are represented by parallel lines: line GH for 0,1 erlang, line AB for 0,2 erlang, line CD for 0,4 erlang, line EF for 0,6 erlang.

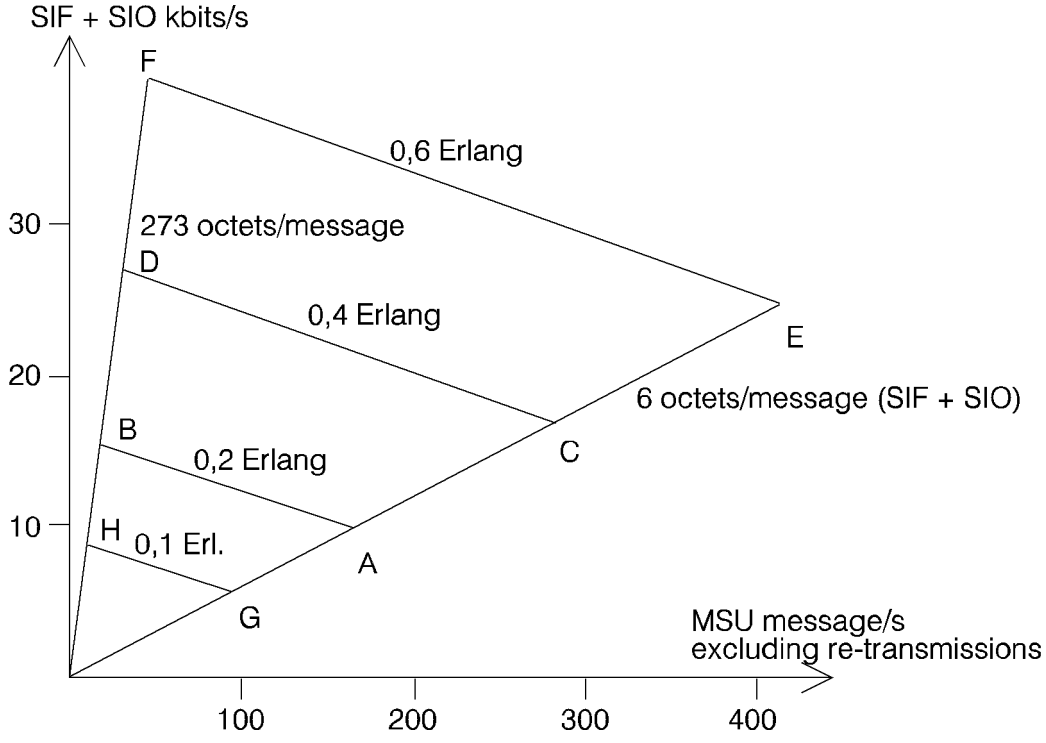

Figure 1: Signalling link loading

History

Document history	
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