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Quality of service, network management and traffic engineering – Traffic engineering – ISDN traffic engineering

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Grade-of-service parameters for B-ISDN signalling

ITU-T Recommendation E.728

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION E.728

GRADE-OF-SERVICE PARAMETERS FOR B-ISDN SIGNALLING

Summary

This Recommendation defines the grade-of-service parameters for B-ISDN signalling for the Network Node-Interface. It considers both link-by-link and edge-to-edge B-ISDN protocol functions. Reference connections for these protocol functions are provided, and grade-of-service target values are given based on these reference connections.

Source

ITU-T Recommendation E.728 was prepared by ITU-T Study Group 2 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 9th of March 1998.

FOREWORD

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NOTE

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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As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

Recommendation E.728

GRADE-OF-SERVICE PARAMETERS FOR B-ISDN SIGNALLING

(Geneva, 1998)

1 Scope

This Recommendation considers Broadband ISDN (B-ISDN) signalling for the Network-Node Interface (NNI). It considers only fixed networks.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

– CCITT Recommendation E.723 (1992), *Grade-of-service parameters for Signalling System No. 7 networks*.

– ITU-T Recommendation Q.701 (1993), *Functional description of the Message Transfer Part (MTP) Signalling System No. 7*.

– ITU-T Recommendation Q.706 (1993), *Message transfer part signalling performance*.

– ITU-T Recommendation Q.766 (1993), *Performance objectives in the integrated services digital network application*.

– ITU-T Recommendation Q.2100 (1994), *B-ISDN Signalling ATM Adaptation Layer (SAAL) overview description*.

– ITU-T Recommendation Q.2761 (1995), *Functional description of the B-ISDN User Part (B-ISUP) of Signalling System No. 7*.

3 Terms and Definitions

The terms and definitions in this Recommendation are as applied in the above references.

4 Abbreviations

This Recommendation uses the following abbreviations:

ANM	Answer Message
ASE	Application Service Element
ATM	Asynchronous Transfer Mode
B-ISDN	Broadband Integrated Services Digital Network
B-ISUP	Broadband ISDN User Part
ETE	Edge-to-Edge
GOS	Grade-of-Service
IAM	Initial Address Message
LBL	Link-by-Link
MTP	Message Transfer Part
N-ISUP	Narrowband ISDN User Part

NNI Network-Node Interface

SAAL Signalling ATM Adaptation Layer

SCCP Signalling Connection Control Part

SS7 Signalling System No. 7

STP Signalling Transfer Point

TCAP Transaction Capability Application Part

5 Overview of B-ISDN signalling

5.1 B-ISDN signalling protocols

The B-ISDN NNI signalling protocols (Q.2761) support two distinct protocol functions:

- Link-by-link (LBL) protocol functions; and
- Edge-to-Edge (ETE) protocol functions.

LBL protocol functions provide signalling capabilities for setting up and taking down end-to-end connections which require a virtual channel (which corresponds to a narrowband circuit). Broadband-ISDN User Part (B-ISUP) is the SS7 protocol part used by the LBL protocol functions, and it is a new user of the SS7 MTP Level 3. The signalling message flow and signalling messages in B-ISUP are the same as for N-ISUP with the addition of an IAM Acknowledgment/ Reject message in B-ISUP. There is additional content in the B-ISUP messages to handle virtual channel and variable bandwidth characteristics. The network topology of the B-ISDN Network, as it relates to LBL protocol functions, is the same as for circuit-switched functions in the narrowband ISDN network.

ETE protocol functions allow a signalling entity in the SS7 signalling network, in particular an origination or entry point in a network, to communicate with a destination signalling point in the destined network for transaction-type operations. ETE protocol functions are used to provide look-ahead capabilities such as allowing a network to check for called-terminal availability and compatibility, and to perform a negotiation (e.g., for bandwidth or quality) prior to virtual channel setup. The ETE protocol functions are provided using the existing SS7 TCAP and SCCP Class 0 basic connectionless service.

5.2 B-ISDN signalling network architectures

B-ISDN NNI signalling protocol procedures are described in terms of six exchange types in the B-ISDN network:

- Originating exchange (e.g., originating local end office);
- Intermediate national exchange (e.g., toll switch);
- Outgoing international exchange (e.g., outgoing international switching center);
- Intermediate international exchange (e.g., international transit switch);
- Incoming international exchange (e.g., incoming international switching center);
- Destination exchange (e.g. terminating local end office).

The transport of signalling messages between these B-ISDN exchanges is assumed to be over signalling virtual channels on the broadband network. It would be possible to provide signalling transport over a narrowband SS7 network, but that is not viewed as a stable long-term architecture for B-ISDN signalling. A signalling link in the B-ISDN network is

implemented with a Signalling ATM Adaptation Layer (SAAL) protocol stack (see Recommendation Q.2100) on top of the ATM protocol layer at each end of the signalling link. As in narrowband SS7 signalling (Q.701), one can define three modes of signalling: associated mode, non-associated mode and quasi-associated mode. In *associated mode* the signalling messages relating to a particular signalling relation between two signalling points are conveyed over a signalling link set interconnecting those signalling points. In *non-associated mode* the signalling messages relating to a particular signalling relation are conveyed over two or more link sets in tandem passing through one or more signalling points, which are called *Signalling Transfer Points* (STPs), other than those that are the origin and destination of the messages. The *quasi-associated mode* is a special case of non-associated mode in which the path taken by a message is predetermined.

The delay of signalling messages can be expected to be noticeably higher when signalling is done in the non-associated mode as compared with the associated mode. This is because in associated mode the messages travel end-to-end at the ATM level, but in non-associated mode the messages must go through the SAAL and MTP3 protocol layers at each STP, which will add noticeable time to the delays. Therefore, in defining reference connections and establishing GOS target values, the mode of signalling needs to be considered. In B-ISDN networks it is expected that the use of mixtures of associated and non-associated signalling will be frequent.

6 Reference connections for B-ISDN signalling

The reference connections for LBL and ETE are intended to represent (near) worst-case situations; this means that GOS targets based on the reference connections should be satisfied in almost all practical implementations.

6.1 Reference connections for Link-By-Link signalling functions

Recommendation E.723 (Figure 1/E.723) shows a number of example signalling paths for non-associated signalling between two exchanges. From these examples it is clear that the number of signalling links in the signalling path is the number of STPs plus 1 (with no STPs, the signalling mode is associated with one signalling link). Therefore, it follows that if a connection involves N_{exc} exchanges and N_{STP} STPs, the number of signalling links used for the end-to-end signalling is $(N_{exc} + N_{STP} - 1)$. Therefore, reference connections will be characterized by the number of exchanges and the number of STPs, and from that characterization the number of signalling links can be determined.

Reference connections for LBL connections are contained in Table 1 for local, toll, and international connections. Both the number of exchanges and the number of STPs for the different connection types are less than those found in Recommendation E.723. The number of exchanges is less because it is expected in B-ISDN that more direct connectivity will be possible. The number of STPs is less because more associated mode signalling is expected to be used in B-ISDN. It is also expected that as B-ISDN networks mature, the amount of associated mode signalling will increase. The number of STPs in the reference connections given in Table 1 represents expectations for the initial deployment of B-ISDN. As B-ISDN matures it is expected that the number of STPs in a connection would decrease from what is in Table 1.

Table 1/E.728 – Reference connections for B-ISDN LBL connections

	Connection type		
	Local	**Toll**	**International**
Number of exchanges	3	6	9
Number of STPs	2	6	9

6.2 Reference connections for Edge-to-Edge signalling functions

Reference connections for ETE signalling functions are contained in Table 2 for local, toll and international transactions. For ETE transactions the transaction is between the two end points, but a network has an option of implementing screening functions at a network edge (gateway). Therefore, the reference connections for ETE signalling are stated in terms of the number of STPs in the path and the number of gateway screening points.

Table 2/E.728 – Reference connections for B-ISDN ETE transactions

	Connection type		
	Local	**Toll**	**International**
Number of gateways	0	2	4
Number of STPs	1	3	5

7 GOS parameters and target values

The B-ISDN signalling GOS parameters for LBL connections are analogous to those defined in Recommendation E.723 for N-ISDN circuit-switched services, namely Initial Address Message (IAM) and Answer Message (ANM) delay. The IAM delay for a B-ISDN connection is defined as the time interval from when the originating exchange B-ISUP application receives a SETUP message for the connection until the destination exchange B-ISUP application sends a SETUP indication for the connection to the access signalling system. The ANM delay for a B-ISDN connection is defined as the time interval from when the destination exchange B-ISUP application receives a CONNECT indication from the access signalling system until the B-ISUP application at the originating exchange sends a CONNECT indication to the access signalling system.

For ETE transactions, TCAP messages are sent between the originating exchange and the destination exchange transaction Application Service Elements (ASEs). The GOS parameter for ETE transactions is the TCAP message end-to-end delay, which is defined as the time interval from when an ASE at one edge of the network initiates a TCAP message and the ASE at the other edge of the network receives the TCAP message.

Target values for the GOS parameters defined above are specified in Table 3 for local, toll, and international connections in accordance with the reference connections provided in Tables 1 and 2.

Table 3/E.728 – Target values for GOS delay parameters
(Delays in seconds)

Message type	**Local**		**Toll**		**International**	
	Mean	**95%**	**Mean**	**95%**	**Mean**	**95%**
LBL-IAM	0.8	1.5	1.5	3.0	2.5	5.0
LBL-ANM	0.5	1.0	1.0	2.0	1.8	3.5
ETE-TCAP	0.25	0.5	0.75	1.5	1.75	3.5

8 Recommendation history

This is a new Recommendation, first issued in 1998.

Annex A

Explaining the basis for the GOS parameters in this Recommendation

This annex presents the rationale used to derive the GOS target values in this Recommendation. The material in this annex is not intended to provide a means of deriving other target values using different reference connections or partitioning the target values in Table 3.

Reference connections

The number of exchanges was chosen to be one less than in Recommendation E.723. It was assumed for B-ISDN that there would be more direct routing and thus fewer exchanges.

The number of STPs was reduced from what is in Recommendation E.723 by 1 for local, 2 for toll, and 3 for international. One of these reductions results from the elimination of one exchange from the reference connection. The remaining reductions are based on expecting more direct signalling connections in B-ISDN or in some cases the eliminated exchange could have used two STPs for one of its trunks.

Delay calculations

The delays were calculated for the reference connections using the following assumptions:

1) IAM cross-switch mean delay is 200 ms (inspired by Recommendation Q.766 on ISUP performance).

2) ANM cross-switch mean delay is 100 ms (inspired by Recommendation Q.766 on ISUP performance).

3) STP cross-office mean delay is 25 ms (inspired by Recommendation Q.706 on MTP performance).

4) Propagation mean delay in local networks is 1 ms, in toll connections it is 50 ms, and in international connections it is 300 ms (includes one satellite hop).

5) For end-to-end TCAP messages, the STP cross-office mean delay is 25 ms (assumes no global title translation) and the gateway cross-office mean delay is 200 ms. Propagation mean delay is the same as in item 4).

6) 95% values were chosen to be twice the mean delay.

7) For end-to-end TCAP messages, the mean delay experienced between the ASE and signalling link is 100 ms at the originating end and also at the receiving end.

The delay numbers in Table 3 were obtained using the above assumptions and rounding up to get “round” numbers. The above cross-office delay numbers represent expectations for initial deployment of B-ISDN. It is likely that as B-ISDN matures, the cross-office delays will decrease, and for mature B-ISDN networks they could be about half the values given here.

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