INTERNATIONAL TELECOMMUNICATION UNION

CCITT E.721

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

TELEPHONE NETWORK AND ISDN

QUALITY OF SERVICE, NETWORK MANAGEMENT AND TRAFFIC ENGINEERING

NETWORK GRADE OF SERVICE PARAMETERS AND TARGET VALUES FOR CIRCUIT-SWITCHED SERVICES IN THE EVOLVING ISDN

Recommendation E.721

Geneva, 1991

FOREWORD

The CCITT (the International Telegraph and Telephone Consultative Committee) is a permanent organ of the International Telecommunication Union (ITU). CCITT 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 Plenary Assembly of CCITT which meets every four years, establishes the topics for study and approves Recommendations prepared by its Study Groups. The approval of Recommendations by the members of CCITT between Plenary Assemblies is covered by the procedure laid down in CCITT Resolution No. 2 (Melbourne, 1988).

Recommendation E.721 was prepared by Study Group II and was approved under the Resolution No. 2 procedure on the 23rd of August 1991.

CCITT NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication Administration and a recognized private operating agency.

© ITU 1991

All rights reserved. No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the ITU.

Recommendation E.721

NETWORK GRADE OF SERVICE PARAMETERS AND TARGET VALUES FOR CIRCUIT-SWITCHED SERVICES IN THE EVOLVING ISDN

1 Introduction

This Recommendation provides network Grade of Service (GOS) parameters for circuit-switched services in ISDN, based on the ISDN Grade of Service concept and guidelines for selecting GOS parameters provided in Recommendation E.720. The parameter values assume that the network and the components are fully operational and take account of the evolving nature of the ISDN and Signalling System No. 7 capabilities.

Note – GOS parameters and their target values for such services as point-to-multipoint, multi-slot services and reservation services require further study.

Besides the E.700-Series of Recommendations (ISDN traffic engineering) and Recommendations E.500 and E.502 (Measurement and recording of traffic), the following Recommendations also contain material that either provides background for or is relevant to this Recommendation:

Rec. I.324 – ISDN network architecture

Rec. I.325 – Reference configurations for ISDN connection types

Rec. I.350 – General aspects of Quality of Service and network performance in digital networks, including ISDN

Rec. I.352 – Network performance objectives for connection processing delays in an ISDN

Rec. Q.543 – Digital exchange performance design objectives

Rec. Q.706 – Specifications of Signalling System No. 7 – Message Transfer Part signalling performance

Rec. Q.709 – Specifications of Signalling System No. 7 – Hypothetical signalling reference connection

Rec. Q.766 – Specifications of Signalling System No. 7 – Performance objectives in the ISDN application

Rec. Q.921 – ISDN user-network interface – Data Link Layer specification

Rec. Q.931 – ISDN user-network Interface Layer 3 specification for basic call control

Rec. G.101 – The transmission plan

Rec. E.172 – Call routing in the ISDN era.

The relation with Recommendation I.352 is particularly important. The major distinctions between this Recommendation and Recommendation I.352 are:

– The GOS values of this Recommendation are intended to be used for network dimensioning and thus consider the network to be in a state where all components are fully operational. Recommendation I.352 identifies network performance objectives observable at specified network boundaries and includes the effects of both congestion and network failures.

– Since the parameters of this Recommendation are used for network dimensioning, traffic weighted averages of connection types are employed. On the other hand, I.352 performance objectives characterize the performance any connection should achieve and thus are upper bounds.

– The recommended values of this Recommendation allow for additional delays from connections that may include PSTN components which may be present during ISDN evolution. I.352 values apply for an exclusively ISDN connection.

2 Circuit-switched services

In the current ISDN specifications, call establishment and release for all circuit-switched services provided via B-channels (voice, data, image) will use the out-of-band call control procedures defined by Recommendation Q.931 and Signalling System No. 7 signalling protocols.

The following traffic GOS parameters are recommended for circuit-switched calls in ISDN:

1) pre-selection delay (overlap sending);

2) post-selection delay (overlap sending);

3) post-selection delay (en-bloc sending);

4) answer signal delay;

5) call release delay; and

6) probability of end-to-end blocking.

The definitions of these traffic GOS parameters are given below. The delay GOS parameters are based on the message flows in Recommendation Q.931 and Signalling System No. 7 (ISUP) protocols as indicated, for example, in Figure A-1/E.713. Further, delays or blocking within the customer premises equipment or subscriber terminal are not part of the following definitions for GOS parameters.

2.1 pre-selection delay (overlap sending)

Pre-selection delay (overlap sending) is defined as the time interval from the instant the first bit of the SABME message is passed by the calling terminal to the access signalling system until the last bit of the SETUP ACK message is received by the calling terminal.

2.2 a) post-selection delay (overlap sending)

Post-selection delay (overlap sending) is defined as the time interval from the instant the first bit of the INFORMATION message containing the last selection digit is passed by the calling terminal to the access signalling system until the last bit of the first message indicating call disposition is received by the calling terminal (ALERTING message in case of successful call).

b) **post-selection delay (en-bloc sending)**

Post-selection delay (en-bloc sending) is defined as the time interval from the instant the first bit of the initial SETUP message containing all the selection digits is passed by the calling terminal to the access signalling system until the last bit of the first message indicating call disposition is received by the calling terminal (ALERTING message in case of successful call).

Note – In case of automatic answering terminals the ALERTING message is replaced by the CONNECT message.

2.3 **answer signal delay**

Answer signal delay is defined as the time interval from the instant that the called terminal passes the first bit of the CONNECT message to its access signalling system until the last bit of the CONNECT message is received by the calling terminal.

2.4 **call release delay**

Call release delay is defined as the time interval from the instant the first bit of the DISCONNECT message is passed by the user terminal which terminated the call to the access signalling system, until the last bit of the RELEASE message is received by the same terminal (indicating that the terminals can initiate/receive a new call).

2.5 **probability of end-to-end blocking**

The probability of end-to-end blocking is the probability that any call attempt will be unsuccessful due to a lack of network resources.

Note 1 – Blocking because of lack of B-channels between the customer premises equipment and the network is not part of this definition.

Note 2 – The lack of control plane resources during the call setup phase may also contribute to end-to-end blocking. This aspect is for further study.

3 Target values for GOS parameters

The target values will be specified at the normal and high loads in the same sense as Recommendation E.500. However, additional study is required to ensure their suitability for ISDN. The delay target values will be specified by the mean and percentile levels for both normal and high loads.

3.1 PSTN users distinguish the following three types of service in their performance expectations:

– local service;

– toll (trunk) service within a country; and

– international service.

Local service is provided by networks of one node in the simplest case, two nodes and one inter-office link in the most common case but up to six nodes in extreme and very rare cases. Typical local service can be represented by connections ranging from one to four nodes.

Toll (or trunk) service is normally provided by a connection involving at least four nodes (two local exchanges and two toll exchanges). Much longer connections are possible for the very small portion of traffic that would follow the all final route path in a multi-level hierarchical network. Both unusually short (e.g. combined local-toll exchanges) and unusually long connections should be ignored leading to toll service being represented by connections with five to seven nodes.

Recommendation G.101 gives connections for international service and identifies the extreme cases as a 14-node connection. Recommendation G.101 also provides distributions of connection lengths based on measurements taken a number of years ago. In these measurements, 93% of calls used seven or less nodes and 99.98% used 11 or less nodes. Based on these distributions, connections for international service can be considered to include eight to ten nodes.

The typical connections for ISDN circuit switched calls that have been used to establish the end-to-end GOS targets are summarized in Table 1/E.721.

TABLE 1/E.721

Number of switching nodes in typical end-to-end connections for ISDN circuit-switched calls

	Local connection	Toll connection	International connection
Number of nodes	1-4	5-7	8-10

3.2 The GOS parameters defined in § 2 can be partitioned into two categories. Parameters like Pre-Selection Delay and Call Release Delay are essentially determined by the local exchange performance, i.e. they are not "network" parameters, although these parameters contribute to the end-to-end performance of international connections. On the other hand Post-Selection Delay, Answer Signal Delay and probability of end-to-end blocking are network parameters and their target values need to be specified for the local, toll and international connections given in § 3.1.

The GOS target values for international connections apply to each international traffic relation. The GOS target values for local and toll connections can be applied by individual Administrations as appropriate. For each connection type, the GOS target value is for the weighted average of the GOS of all pairs of originating and terminating nodes (whose connection length is within the typical values of Table 1/E.721) weighted by the traffic between them.

In the case of single node connections the GOS is taken to be internal to the node.

The targeted values for the GOS parameters for ISDN circuit-switched services are given in Table 2/E.721.

These target values take account of the evolving nature of the ISDN and S.S. No. 7 capabilities, user expectation of service quality, technology and network constraints and existing Q-Series Recommendations on ISDN exchange and S.S. No. 7 performance. These factors are taken into account by means of an allowance in the derivation of target values. Some additional assumptions are identified as "Notes" with Table 2/E.721.

TABLE 2/E.721

Target values for GOS parameters for circuit-switched services in the evolving ISDN

GOS parameter	Normal load		High load	
	Mean	95%	Mean	95%
Pre-Selection Delay	0.6 sec	1.0 sec	1.0 sec	2.0 sec
Call Release Delay	0.4 sec	0.6 sec	0.6 sec	1.0 sec
Post-Selection Delay (en bloc sending)				
Local connection	3.0 sec	FS	FS	FS
Toll connection	5.0 sec	FS	FS	FS
International connection	8.0 sec	FS	FS	FS
Answer Signal Delay				
Local connection	0.75 sec	FS	FS	FS
Toll connection	1.5 sec	FS	FS	FS
International connection	2.5 sec	FS	FS	FS
Probability of end-to-end blocking				
Local connection	2%	NA	FS	NA
Toll connection	3%	NA	FS	NA
International connection	5%	NA	FS	NA

FS Further study.

NA Not applicable.

Note 1 – Except for mean delay at normal load all other target values are provisional and require further review.

Note 2 – The concept of "normal load" and "high load" in a network that may be geographically distributed with non-coincident busy hours needs further study.

Note 3 – International connections are assumed to include one satellite link in the user as well as the control (S.S. No. 7) plane.

Note 4 – For calls requiring data base lookup, an additional delay will need to be added to the post-selection delay for each data base lookup. This additional delay will depend on the type of connection used for data base lookup.

Note 5 – The subject of allowable end-to-end blocking for the worst treated traffic relations, for instance an all final route path, is for further study.

Note 6 – The target values in this table are to be interpreted as design objectives.

4 Recommendation history

Recommendation E.721 – First issue 1988.