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**INTEGRATED SERVICES DIGITAL
NETWORK (ISDN)**

OVERALL NETWORK ASPECTS AND FUNCTIONS

**NETWORK PERFORMANCE OBJECTIVES
FOR CONNECTION PROCESSING DELAYS
IN AN ISDN**

ITU-T Recommendation I.352

(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 I.352 was revised by the ITU-T Study Group XVIII (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 Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.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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Recommendation I.352**NETWORK PERFORMANCE OBJECTIVES FOR CONNECTION
PROCESSING DELAYS IN AN ISDN***(Melbourne, 1988; revised Helsinki, 1993)***1 General****1.1 Introduction**

This Recommendation provides network performance objectives for connection processing delays. The parameter values specified include the effects of both congestion and network failures and apply for an exclusively ISDN connection established by means of CCITT protocols Q.931 (DSS 1) and Q.764 (ISUP).

The network performance objectives provided in this Recommendation are based on the concept of network performance which is defined in Recommendation I.350 (General aspects of Quality of Service and network performance in digital networks, including ISDN). In addition to Recommendation I.350 the following Recommendations also contain material that either provides background for or are relevant to this Recommendation:

- I.324 ISDN Network Architecture
- I.325 Reference configurations for ISDN connection types
- Q.41 Mean one-way propagation time
- Q.543 Digital exchange performance design objectives
- Q.706 Message transfer part signalling performance
- Q.709 Hypothetical signalling reference connection
- Q.764 Signalling Procedures
- Q.766 Performance objectives in the ISDN applications
- Q.931 ISDN user-network interface layer 3 specification for basic call control
- G.101 The transmission plan
- E.172 ISDN routing plan
- E.721 Network grade of service parameters and target values for circuit-switched services in the evolving ISDN

The relation with Recommendation E.721 is particularly important. The major distinctions between this Recommendation and Recommendation E.721 are:

- This Recommendation identifies network performance objectives observable at specified measurement points which are located at specified measurement points and include the effects of both congestion and network failures. Recommendation E.721 GOS values are intended to be used for network dimensioning and thus consider the network to be in a state where all network components are fully operational.
- Performance objectives of this Recommendation recommend the performance that worst case reference connections should achieve (see NOTE). On the other hand, Recommendation E.721 parameters are used for network dimensioning and therefore traffic weighted averages of the connection type are employed.

NOTE - Connections longer than the worst case reference connection are not covered by this Recommendation. Such very long connections may only apply in very unusual cases.

- The recommended values of this Recommendation apply for an exclusively ISDN connection established by means of CCITT protocols Q.931 (DSS 1) and Q.764 (ISUP). Recommendation E.721 recommended values allow for additional delays from non-ISUP established connections which may be present during the ISDN evolution.

1.2 Reference model

The reference model provided in Recommendation I.325 was used to provide a baseline reference configuration. The network portion boundaries defined in Recommendation I.325 correspond to the measurement points (MPs) used in this Recommendation as follows:

I.325	I.352
$T_1 (S_1)$	MPT_1
IB_1	MPI_1
IB_2	MPI_2
$T_2 (S_2)$	MPT_2

For the determination of values a worst case reference connection was used. Recommendations G.101 and G.709 were considered for this worst case reference connection. Annex A contains examples of worst case reference connections that can be used to test the objectives specified in this Recommendation.

Annex B provides an example for the calculation of the overall connection set-up delay.

NOTES

- 1 All values specified in this Recommendation were rounded after a calculation along that example.
- 2 This Recommendation does not take into account private networks. In case of private networks connected to the ISDN the recommended values refer to the interface at the T reference point. The interface at the S reference point applies when the S and T reference point is coincident.

1.3 Measurement

All parameter values are specified at measurement points. These values are measured at measurement points (exchange interface V_1 or V_4 at the S reference point or exchange interface V_3 at the T reference point and exchange interface A or B located at the national side of an ISC) using call processing performance-significant reference events as defined in this Recommendation for connections established using CCITT protocols Q.931 (DSS 1) and Q.764 (ISUP).

1.4 Network conditions

The values for delay given in this Recommendation include an allowance for the effects on delay that might be introduced by high traffic load during a nominal busy hour (see Note). Consideration was given to the possibility that individual busy hours might not be coincident. The values also include the effects of network component failures. The specified values do not apply under conditions of network unavailability. These delays are expressed in terms of mean and 95% probability values.

NOTE – In cases where the actual traffic load leads to an overload condition in the network, the recommended delay values are not covered by this Recommendation.

1.5 User delay

Values are provided for measurements made at a single measurement point as well as measurements made between two measurement points. This allows for calculations that would avoid inclusion of any delay that might be introduced by users or user equipment.

1.6 Allocation

Overall connection processing delays between interfaces at the S reference point or the T reference point can be divided into sub-values for national and the international network fabric. The national and the international network fabric is defined in Recommendation I.325.

1.7 Basic connection

Connection processing delays are only defined for a basic connection and therefore do not provide for any effects that might be introduced by supplementary services.

1.8 Phases

Connection processing delay values are specified for the connection set-up and disconnection phase.

2 Purpose

The purpose of this Recommendation is to provide values for connection processing delays that can be used as a basis for network planning and system design. Quality of Service information should be provided to the user after mapping network performance into user-oriented expressions.

3 Connection processing delays in ISDN circuit-switched connections

The values for the connection processing delay parameters have been determined, taking into account that:

- the calling access link;
- the connection processing at the originating local exchange;
- the connection processing at transit exchanges;
- the usage of signalling transfer points (STP);
- the internodal links;
- the connection processing at the terminating local exchange; and
- the connected access link

cause delay.

These values are representative for all terrestrial connections and also for connections involving a satellite in an internodal link allowing a smaller number of transit exchanges in that connection.

3.1 Connect phase parameters

3.1.1 Connection set-up delay

Connection set-up delay is defined first based on observations at a single measurement point, MP_i (See Note) as shown in Figure 1, and then between two measurement points (MP_i, MP_j). In the former case, the connection set-up delay includes the delay for all connection elements on the called user side of MP_i and the terminal device. In the latter case, the connection set-up delay includes only the delay between MP_i and MP_j . Connection set-up delay is defined using performance-significant reference events. Table 1 identifies the performance-significant reference events and the

resulting call states for I.451/Q.931 connection processing messages. Table 2 identifies the performance-significant reference events and the resulting call states for the relating Signalling System No. 7 user part messages defined in Recommendation Q.764.

NOTE – MP_i is one of the following measurement points: MPT_1 , MPI_1 , MPI_2 , MPT_2 .

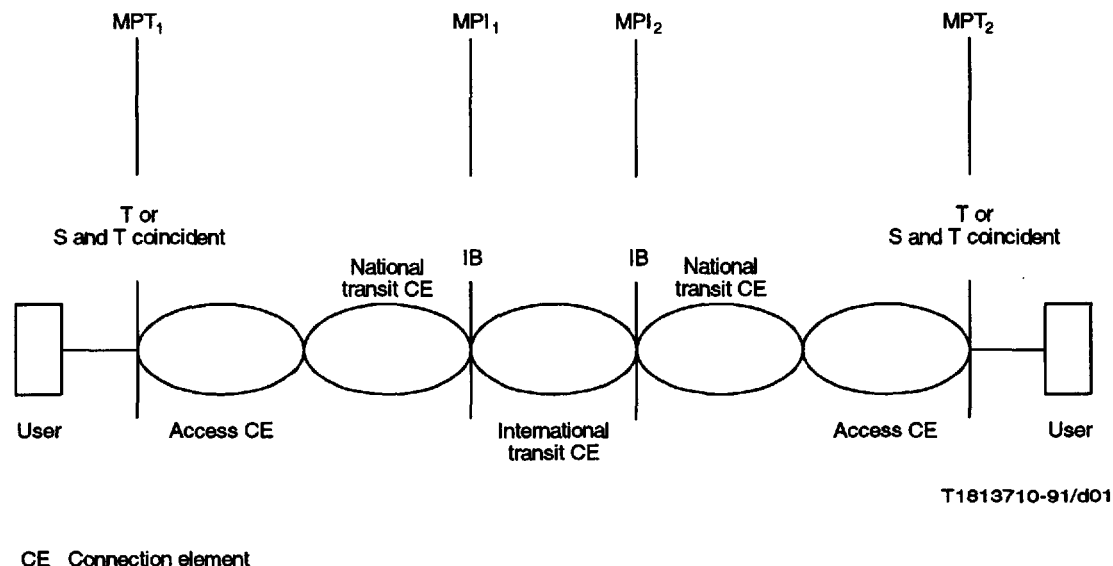


FIGURE 1/I.352
General reference configuration
(based on the International ISDN reference configuration in Recommendation I.325)

3.1.1.1 Definition of connection set-up delay observed at a single measurement point

connection set-up delay at a single measurement point, MP_i , is defined using two call processing performance-significant reference events. Table 1 identifies the performance-significant reference events and the resulting call states for I.451/Q.931 connection processing messages. Table 2 identifies the performance-significant reference events and the resulting call states for the relating Signalling System No. 7 user part messages defined in Recommendation Q.764. Connection set-up delay is the length of time that starts when a SETUP or the last address information message creates a performance-significant reference event at MP_i , and ends when the corresponding CONNECT message returns and creates its performance-significant reference event at MP_i .

Connection set-up delay observed at a single measurement point = $(t_2 - t_1)$

where

t_1 is the time of occurrence starting performance-significant reference event

t_2 is the time of occurrence for the ending performance-significant reference event.

The transfer of the I.451/Q.931 messages and their corresponding user-part messages of Signalling System No. 7 is shown in Figure 2 along with measurement points. The specific performance-significant reference events used in measuring connection set-up delay are shown in Table 1.

NOTE – “Set-up” does not imply a through connection or capability for information transfer has been established.