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INTEGRATED SERVICES DIGITAL NETWORK (ISDN) OVERALL NETWORK ASPECTS AND FUNCTIONS

NETWORK PERFORMANCE OBJECTIVES FOR PACKET MODE COMMUNICATION IN AN ISDN

ITU-T Recommendation I.354

(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.354 was prepared 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 Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.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.

Recommendation I.354

NETWORK PERFORMANCE OBJECTIVES FOR PACKET MODE COMMUNICATION IN AN ISDN

(Helsinki, 1993)

1 Introduction

This Recommendation specifies speed, accuracy, and dependability performance parameters and worst-case objectives for packet switched connection types in an ISDN.

The defined parameters and objectives apply to connection establishment, user information transfer, and clearing in switched packet mode calls and to user data transfer in PVCs. Worst case mean and 95% probability values are specified for each virtual connection portion type defined in Table 1. The term "worst case" means that these values should be met during the normal busy hour in the worst performing virtual connection portion used. The busy hour for connection establishment and release and the busy hour for the user information transfer might not be coincident.

NOTE – Cases where the network is in overload condition are not covered by this Recommendation.

This Recommendation does not address the use of circuit mode bearer services to provide access to a PSPDN (case A of Recommendation X.31).

It is recognized that increased integration in the future may allow for a tightening of these specifications.

2 Performance model and reference events

The performance model and reference events (REs) defined in Recommendations X.134 to X.136 apply in this Recommendation with the following interpretations and amendments.

1) The correspondence between Recommendations X.135 and X.136[1)] portion boundaries and the measurement points (MPs) used in this Recommendation is shown in Table 1. This association places the MPIs on the international side of the ISCs.

2) The X.134 incoming call RE, 1(X.25), is replaced with the I.353 Setup entry RE, P1b(Q.931), in cases where the called CEQ; either

   a) subscribes to conditional notification and does not have a B- or D-channel capable of accepting the call connected to the PH; or

   b) subscribes to unconditional notification.

3 Connection processing delays in ISDN packet switched connections

With the above MP/boundary identifications, the reference events specified in Recommendation X.135 apply to the connection processing parameters defined below, with one exception. That exception occurs only in the case of call set-up delay and is detailed in 3.1.1. The variables *X*, *Y* and *Z* used below are defined in 2.3/X.135, 3.2/X.135 and 5.2/X.135 respectively.

[1)] The same performance model applies to both Recommendations X.135 and X.136 though it is only specified in detail in Recommendation X.135.

Two types of national and international portions (A and B defined in Table 1/X.135) are used in this Recommendation. End-to-end connections are built up from combinations of these national and international portions. The concatenation method of the means and 95th percentiles of these national and international portions is given in Annex C/X.135. Annex A contains illustrations of events sequences during call set-up and clearing.

TABLE 1/I.354

MP/boundary correspondence

Rec. I.354	Rec. X.135
MPT_1	B_1
MPI_1	B_5
MPI_2	B_{n-2}
MPT_2	B_n

3.1 Call set-up delay

Call set-up delay is defined first at a single MP, then between a pair of MPs (based on the former definition). Finally end-to-end call set-up delay is defined. Tables 1/X.134 and 2/X.134 define the performance-significant reference events and the resulting states for X.25 and X.75 packets respectively. Table 2 identifies the performance-significant reference events and the resulting states for Q.931 messages.

TABLE 2/I.354

Performance-significant reference event

Measurement point	Performance-significant reference event	
	Starting event code	Ending event code
MPT_1	2(X.25)	3(X.25)
MPT_2	1(X.25)	4(X.25)
MPI_1	1(X.75)	2(X.75)
MPI_2	1(X.75)	2(X.75)

3.1.1 Call set-up delay definition

call set-up delay at a single MP: Call set-up delay at a single MP (MP_i[2)]) is defined as the period of time that starts when a *starting reference event* creates an event at MP_i and ends when the corresponding *ending reference event* returns and creates an event at MP_i.

[2)] MP_i or MP_j is one of MPT_1, MPT_2, MPI_1 or MPI_2.

Call set-up delay at a single MP = $(t_2 - t_1)$

where

t_1 is the time of occurrence of the starting RE;

t_2 is the time of occurrence of the ending RE.

call set-up delay between two MPs: Call set-up delay between two measurement points MP_i and MP_j (with MP_j being further from the calling party than MP_i), is defined as the difference $d_i - d_j$ of the connection set-up delays at MP_i and MP_j respectively.

Call set-up delay between two MPs = $(d_i - d_j)$

where

d_i is the connection set-up delay at MP_i;

d_j is the connection set-up delay at MP_j.

end-to-end call set-up delay: End-to-end call set-up delay is the connection setup delay, $d_1 - d_2$, between the two MPTs, MPT_1 and MPT_2.

The exceptional case (in terms of reference events) occurs when the called user; either

a) subscribes to conditional notification and does not have a B- or D-channel capable of accepting the call connected to the PH; or

b) subscribes to unconditional notification.

In this case the starting RE for call set-up delay at the MPT_2 is based on the receipt of a Q.931 set-up message announcing the packet call. All other starting and ending REs at the other MPs are those in Table 2. Table 3 provides the starting and ending REs for the MPT[2)] in this case.

TABLE 3/I.354

Measurement point	Performance-significant reference event	
	Starting event code	Ending event code
MPT_2	P1b(Q.931)	4(X.25)

3.1.2 Call set-up delay values

Worst-case values for call set-up delay for the various virtual connection portions are given in Table 4.

3.2 Clear indication delay

Clear indication delay is defined as in Recommendation X.135. Worst-case values for clear indication delay for the various virtual connection portions are given in Table 5.

4 Packet information transfer delay parameters

4.1 Data packet transfer delay

Data packet transfer delay is defined as in Recommendation X.135.

Worst-case values for data packet transfer delay for the various virtual connection portions are given in Table 6.

TABLE 4/I.354

Worst-case call set-up delay values for virtual connection portions (ISDN)

Statistic	Virtual connection portion type (ISDN)			
	National		International	
	A	B	A	B
Mean (ms)	1132 + X	1732 + X	250	1600
95% (ms)	1885 + X	2437 + X	250	1800

NOTES

1 These values are based on a scenario with minimal integration between ISDN and X.25. As integration increases, performance is expected to improve.

2 All values are provisional.

TABLE 5/I.354

Worst-case clear indication delay values for virtual connection portions (ISDN)

Statistic	Virtual connection portion type (ISDN)			
	National		International	
	A	B	A	B
Mean (ms)	677 + Z	927 + Z	110	800
95% (ms)	1128 + Z	1380 + Z	110	900

NOTES

1 These values are based on a scenario with minimal integration between ISDN and X.25. As integration increases, performance is expected to improve.

2 All values are provisional.

TABLE 6/I.354

Worst-case data packet transfer delay values for virtual connection portions (ISDN)

Statistic	Virtual connection portion type (ISDN)			
	National		International	
	A	B	A	B
Mean (ms)	492 + Y	792 + Y	215	950
95% (ms)	925 + Y	1164 + Y	215	1125

NOTES

1 These values are based on a scenario with minimal integration between ISDN and X.25. As integration increases, performance is expected to improve.

2 All values are provisional.

4.2 Packet mode throughput parameters

For further study.

5 Packet mode accuracy and dependability parameters

For further study.

Annex A

(to Recommendation I.354)

Illustration of event sequences during call set-up and clearing

(This annex forms an integral part of this Recommendation)

The following two figures illustrate the maximum number of message sequences during call set-up in both the usual case, Figure A.1, and the exceptional case, Figure A.2. Figure A.3 shows the messages observed during call clearing. Not all message sequences confined to the MPTs will always occur, but those associated with d_1 and d_2 will always occur.

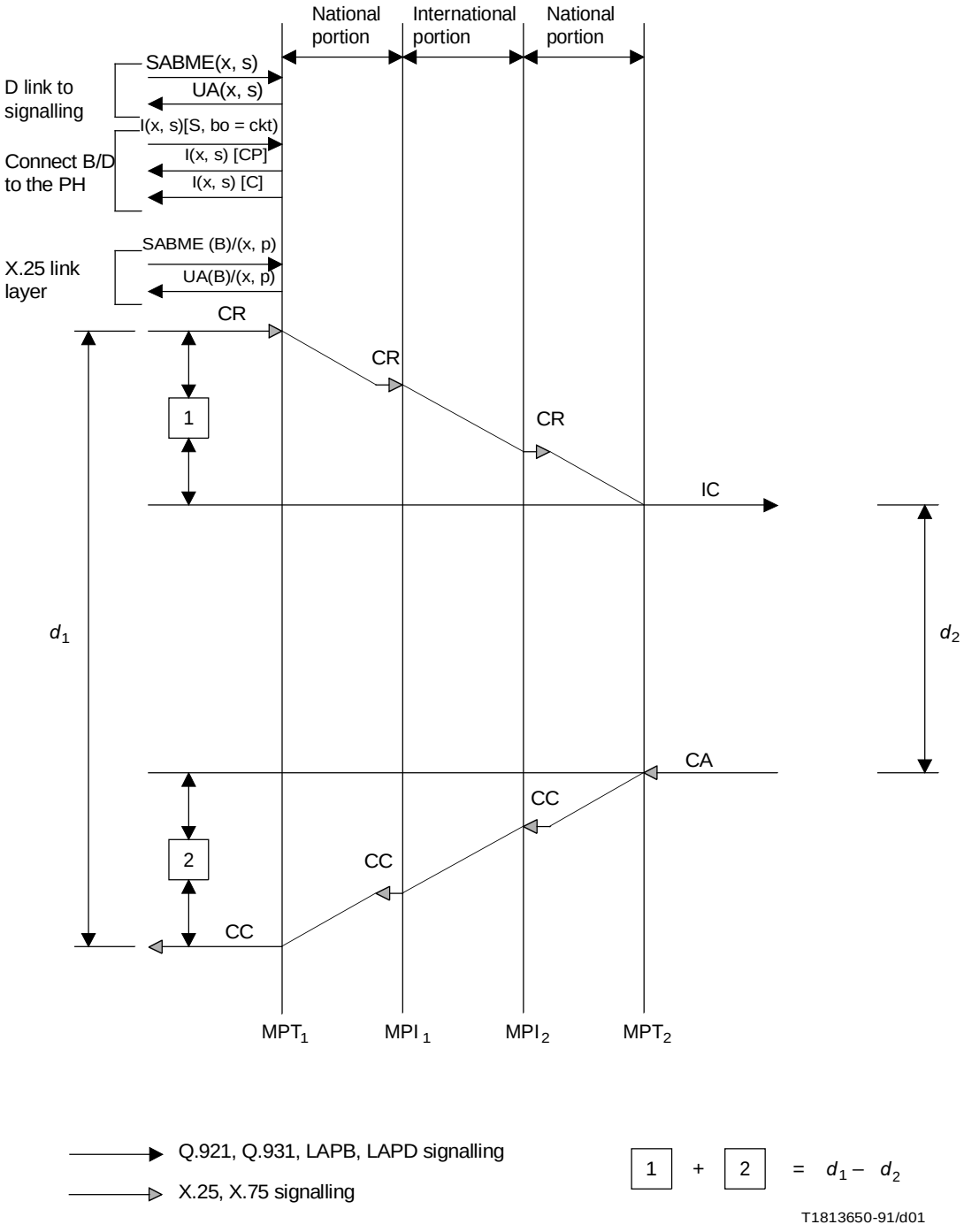

FIGURE A.1/I.354

End-to-end call set-up delay/usual case

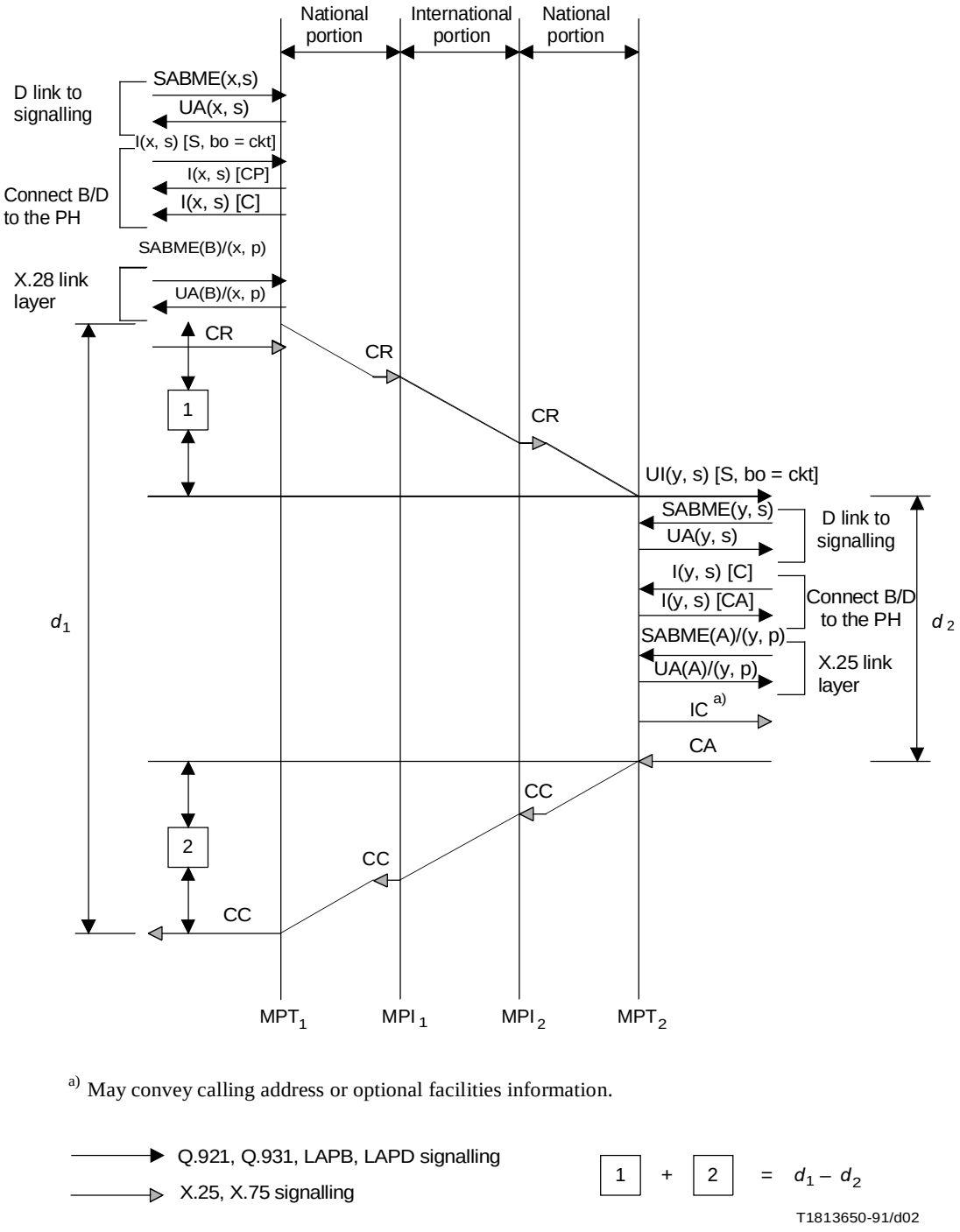

FIGURE A.2/I.354

End-to-end call set-up delay/exceptional case

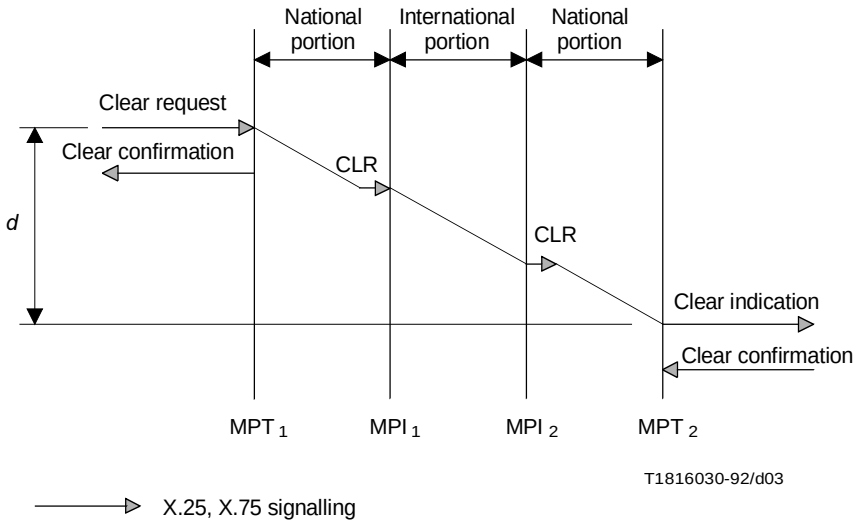

FIGURE A.3/I.354

End-to-end clear indication delay

Appendix I

(to Recommendation I.354)

Method used to calculate worst-case ISDN performance values

(This appendix does not form an integral part of this Recommendation)

This Recommendation's specification of worst-case values for ISDN packet-mode bearer services is based on differences between a packet connection over an X.25 packet network and over an ISDN (see Figure I.1). A methodology is utilized which converts the values specified in Recommendation X.135 to the values in this Recommendation.

The differences between a packet connection over an ISDN and the packet connections detailed in Recommendation X.135 are the presence of a packet handler (PH) functionality in the ISDN end office (acting like an additional packet switch) and the presence of an X.75 (or Network internal protocol) link from the PH to the local PSPDN as illustrated in Figure I.1.

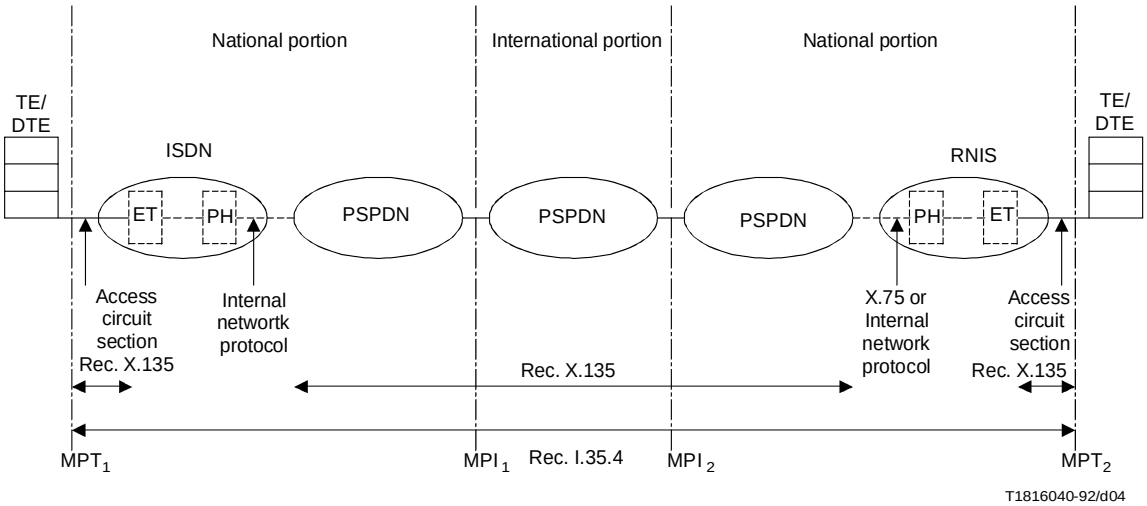

FIGURE I.1/I.354

Performance model comparison of X.135 and I.354 [3)]

1

An ISDN correction factor[4)] based on the new elements in the performance model is added to the mean delay values in Recommendation X.135. This correction factor is calculated on the basis of one PH and X.75 link at each end of the connection. The 95th percentiles of the national portions in Recommendation I.354 are calculated as the ratio of the 95th percentiles to the mean in Recommendation X.135 times the new mean of this Recommendation.

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3) The model is used only to derive the performance values. The actual implementation of ISDNs carrying packet mode connection types (case B of Recommendation X.31) may be different.

4) The correction factors used in this Recommendation are not specifications of equipment performance.