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SERIES I: INTEGRATED SERVICES DIGITAL
NETWORK

Overall network aspects and functions – Performance
objectives

**Accuracy and dependability of ISDN 64 kbit/s
circuit mode connection types**

ITU-T Recommendation I.359

(Previously CCITT Recommendation)

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**ACCURACY AND DEPENDABILITY OF ISDN 64 kbit/s
CIRCUIT MODE CONNECTION TYPES**

Summary

This Recommendation defines parameters for assessing the accuracy and dependability performance of call processing in an Integrated Services Digital Network (ISDN) provided in accordance with Recommendations identified herein. The defined parameters apply to ISDN services using a single B-channel and associated D-channel; planned revisions to this Recommendation will address other ISDN bearer services (e.g. $n \times 64$ kbit/s and primary rate connection types).

Source

ITU-T Recommendation I.359 was prepared by ITU-T Study Group 13 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 15th of February 1999.

FOREWORD

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The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

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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.

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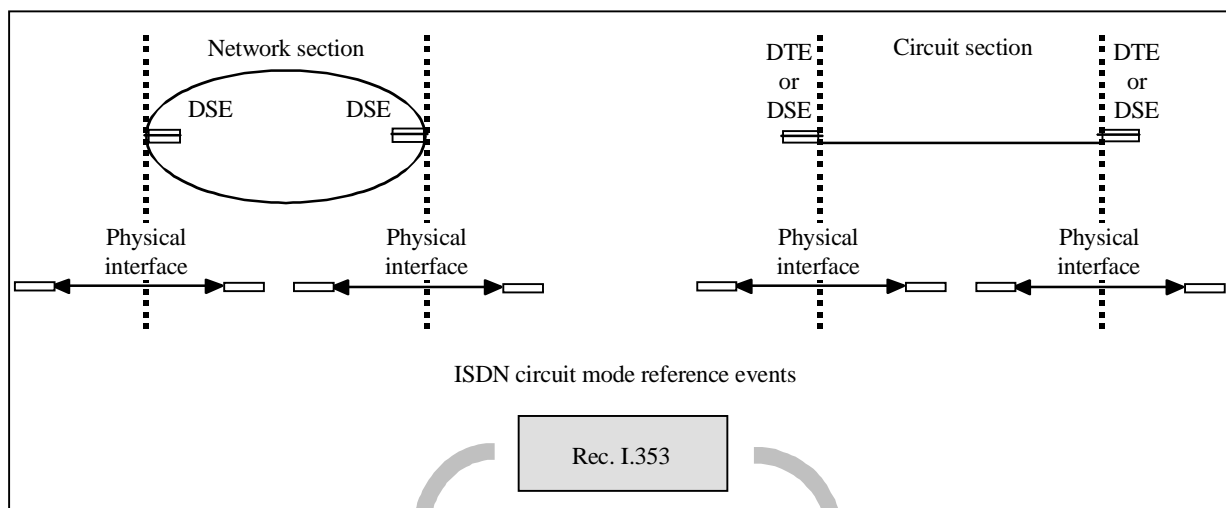
ACCURACY AND DEPENDABILITY OF ISDN 64 kbit/s CIRCUIT MODE CONNECTION TYPES

(Geneva, 1999)

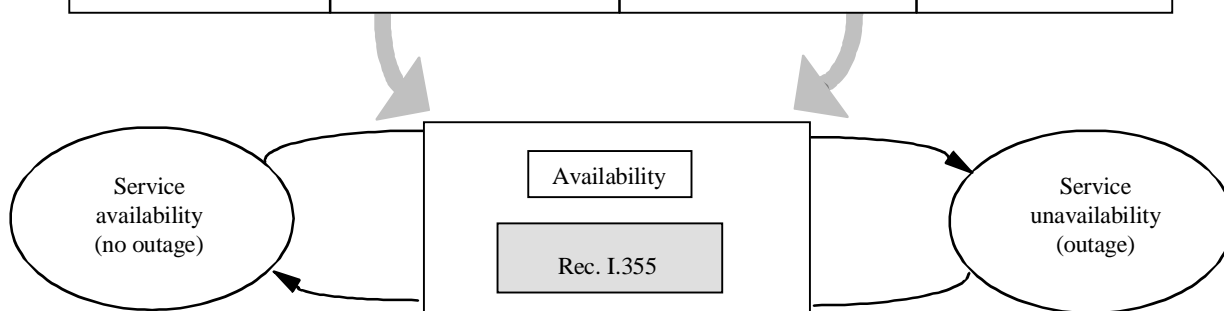
1 Scope

This Recommendation defines parameters for assessing the accuracy and dependability performance of call processing in an Integrated Services Digital Network (ISDN) provided in accordance with Recommendations identified herein. The defined parameters apply to ISDN services using a single B-channel and associated D-channel; planned revisions to this Recommendation will address other ISDN bearer services (e.g. $n \times 64$ kbit/s and primary rate connection types).

The scope of this Recommendation and its relationship with other Recommendations is illustrated in Figure 1. Recommendation I.353 defines measurement points and reference events at which ISDN circuit mode connection processing performance parameters may be defined. Recommendation I.353 also defines a 3×3 matrix that can be used in organizing and classifying performance parameters. Three protocol-independent data communication functions are identified in the matrix: access, user information transfer, and disengagement. Each function is considered with respect to three general performance concerns (or "performance criteria"): speed, accuracy, and dependability. Recommendation I.359 defines a set of primary parameters that describe accuracy and dependability performance relative to the access and disengagement functions. Specified values for these parameters may be compared with corresponding outage thresholds in determining 64 kbit/s availability performance. The availability function and availability parameters are defined in Recommendation I.355. Additional 64 kbit/s performance parameters applicable to ISDNs are defined in Recommendations I.352 and G.821.



| Function \ Criterion | Speed | Accuracy | Dependability |
|---------------------------|------------|----------------------------|---------------|
| Access | Rec. I.352 | CSEP Rec. I.359 CSFP | |
| User information transfer | | Rec. G.821 | |
| Disengagement | Rec. I.352 | PDP Rec. I.359 CCFP | |



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CSEP Connection Set-up Error Probability
 CSFP Connection Set-up Failure Probability
 PDP Premature Disconnect Probability
 CCFP Connection Clearing Failure Probability

Figure 1/I.359 – Scope of Recommendation I.359

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.

- [1] ITU-T Recommendation I.352 (1993), *Network performance objectives for connection processing delays in an ISDN*.
- [2] ITU-T Recommendation I.353 (1996), *Reference events for defining ISDN and B-ISDN performance parameters*.
- [3] ITU-T Recommendation I.355 (1995), *ISDN 64 kbit/s connection type availability performance*.
- [4] ITU-T Recommendation Q.921 (1997), *ISDN user-network interface – Data link layer specification*.
- [5] ITU-T Recommendation Q.931 (I.451) (1998), *ISDN user-network interface layer 3 specification for basic call control*.
- [6] ITU-T Recommendation Q.764 (1997), *Signalling System No. 7 – ISDN User Part signalling procedures*.

3 Abbreviations

This Recommendation uses the following abbreviations:

| | |
|-------|---|
| ANS | Answer |
| CCFP | Connection Clearing Failure Probability |
| CSEP | Connection Set-up Error Probability |
| CSFP | Connection Set-up Failure Probability |
| DSE | Data Service Equipment |
| DTE | Data Terminal Equipment |
| IAM | Initial Address Message |
| ISDN | Integrated Services Digital Network |
| ITU-T | International Telecommunications Union – Telecommunication Standardization Sector |
| MPI | Measurement Point International |
| MPT | Measurement Point Terminal |
| PDP | Premature Disconnect Probability |
| PDS | Premature Disconnect Stimulus |
| RE | Reference Event |
| SS7 | Signalling System 7 |
| TE | Terminal Equipment |

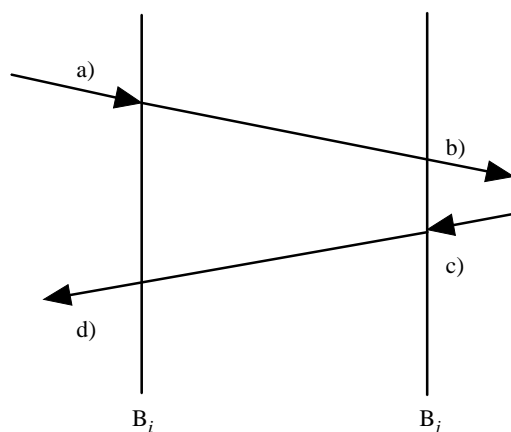
4 Accuracy and dependability parameters and objectives

This clause defines accuracy and dependability parameters for unrestricted digital connection types provided using ISDN circuit mode bearer services. These accuracy and dependability parameters can be measured or estimated at any pair of boundaries delimiting a portion or concatenation of portions.

4.1 Access parameters

Two circuit mode access parameters, connection set-up error probability and connection set-up failure probability, are defined in 4.1.1 and 4.1.2.

Connection set-up error and connection set-up failure are defined between pairs of portion boundaries (B_i , B_j). B_j is one of the set of boundaries to which the connection set-up attempt can properly be routed. Figure 2 identifies the sequence of four particular events that occur at these boundaries during a successful connection set-up. A connection set-up attempt over this portion is a sequential occurrence of corresponding events [a), b), c), d)] prior to expiration of timer T301 [5]. Connection set-up errors and connection set-up failures within this portion are defined below. Any other unsuccessful connection set-up attempt is caused by problems outside the portion and is excluded from the measurement.



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Figure 2/I.359 – Circuit mode reference events occurring during successful connection set-up

4.1.1 Connection set-up error probability (CSEP)

Connection set-up error probability is the ratio of total connection set-up attempts that result in connection set-up error to the total connection set-up attempts in a population of interest.

With reference to Figure 2, a connection set-up error is defined to occur on any connection set-up attempt in which event d) occurs, but event c) does not occur at an appropriate boundary prior to expiration of timer T301.

Connection set-up error is essentially the case of a network-caused "wrong number". It occurs when the network responds to a valid connection request by erroneously establishing a connection to a destination Terminal Equipment (TE) other than the one designated in the connection request, and does not correct the error prior to the user information transfer. It may be caused, for example, by network operator administrative or maintenance actions.

Connection set-up error is distinguished from successful connection set-up by the fact that the intended called user is not contacted and not committed to the session during the connection set-up attempt.

The specific Recommendation I.353 Reference Events (REs) used in measuring successful connection set-up at each portion boundary are those identified in Table 1 and Table 2.

Table 1/I.359 – REs at B_i occurring during successful ISDN circuit mode connect set-up

| Boundary B_i | Reference event | |
|--|------------------|---------------------|
| | a) | d) |
| MPT ₁ | P1a (SETUP exit) | P6b (CONNECT entry) |
| MPI ₁ | S1a (IAM exit) | S3b (ANS entry) |
| MPI ₂ | S1b (IAM entry) | S3a (ANS exit) |
| MPT ₂ | Not applicable | Not applicable |
| NOTE – <i>En bloc</i> and overlap sending options are defined at the MPT ₁ interface. | | |

Table 2/I.359 – REs at B_j occurring during successful ISDN circuit mode connect set-up

| Boundary B_j | Reference event | |
|--|-------------------|--------------------|
| | b) | c) |
| MPT ₁ | Not applicable | Not applicable |
| MPI ₁ | S1a (IAM exit) | S3b (ANS entry) |
| MPI ₂ | S1b (IAM entry) | S3a (ANS exit) |
| MPT ₂ | P1b (SETUP entry) | P6a (CONNECT exit) |
| NOTE – <i>En bloc</i> and overlap sending options are defined at the MPT ₁ interface. | | |

4.1.2 Connection set-up failure probability (CSFP)

Connection set-up failure probability is the ratio of total connection set-up attempts that result in connection set-up failure to the total connection set-up attempts in a population of interest.

With reference to Figure 2, connection set-up failure is defined to occur on any connection set-up attempt in which either one of the following outcomes is observed prior to expiration of timer T301.

- both events b) and d) do not occur;
- events b) and c) occur, but event d) does not.

The specific reference events are those defined in Tables 1 and 2. Connection set-up attempts that are cleared by the portion as a result of incorrect performance or non-performance on the part of an entity outside the portion are excluded.

A connection set-up attempt can fail as a result of user blocking. Such failures are excluded from network performance measurement. Examples of user blocking include the following:

- the called user issues a message to reject the call set-up attempt;
- the CONNect message (P6b) reference event fails to occur at the originating MPT boundary due to the lack of a CONNect message (P6a) reference event at the terminating MPT boundary;

- the called user delays excessively in generating the CONNect message (P6a) reference event during the connection period, with the result that a connection is not established before the time-out;
- all channels at the called TE are in use.

4.2 Disengagement parameters

This subclause defines two new disengagement parameters: premature disconnect probability and connection clearing failure probability. The definition of a third parameter, premature disconnect stimulus probability, is for further study.

4.2.1 Premature disconnect parameters

4.2.1.1 Premature disconnect probability (PDP)

The premature disconnect probability for a portion is the probability, in any given second, that a connection experiences a premature disconnect generated within that portion.

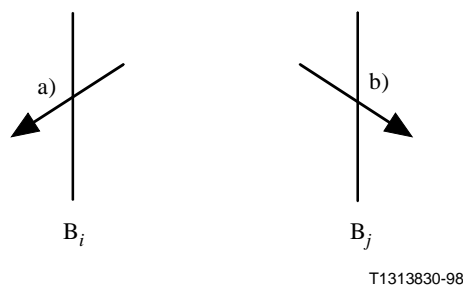


Figure 3/I.359 – Circuit mode Reference Events (REs) defining premature disconnect at B_i and B_j

Referring to Figure 3, a premature disconnect is defined to have been generated within a portion when, in the absence of an external disconnect event (e.g. a premature disconnect stimulus or a disconnect request), any of the Recommendation I.353 reference events a) or b) specified in Table 3 a) or Table 3 b) occur, or when a premature disconnect stimulus occurs within the portion and is transferred across a boundary of the portion.

Table 3 a)/I.359 – Category a) REs at B_i defining ISDN circuit mode premature disconnect probability

| Boundary B_i | Reference event |
|----------------|---|
| MPT | P8b DISCONNECT entry |
| MPI_1 | S4b RELEASE entry S6b CIRCUIT RESET entry S7b RESET entry |
| MPI_2 | S4a RELEASE exit S6a CIRCUIT RESET exit S7a RESET exit |

Table 3 b)/I.359 – Category b) REs at B_j defining ISDN circuit mode premature disconnect probability

| Boundary B_j | Reference event |
|----------------|---|
| MPT | P8b DISCONNECT entry |
| MPI_1 | S4a RELEASE exit S6a CIRCUIT RESET exit S7a RESET exit |
| MPI_2 | S4b RELEASE entry S6b CIRCUIT RESET entry S7b RESET entry |

NOTE – The reference events in Tables 3 a) and 3 b) are for further study (including, for example, Q.931 group disconnect).

4.2.1.2 Premature disconnect stimulus (PDS)

The complete definition of premature disconnect stimulus is for further study. However, ten consecutive severely errored seconds is an instance of a premature disconnect stimulus.

4.2.2 Connection clearing failure probability (CCFP)

Connection clearing failure probability is the ratio of total connection clearing failures to the total connection clearing attempts in a population of interest.

Connection clearing failure is defined with reference to events at the boundaries of a portion (B_i , B_j). A connection clearing attempt occurs when a DISConnect or RELease message enters the portion creating a reference event at B_i . A connection clearing failure occurs when no corresponding connection clearing reference event occurs at B_j within T_{ccf} seconds. The relevant reference events used in measuring connection clearing failure probability at each portion boundary are those identified in Table 4 and Table 5.

NOTE – The value of T_{ccf} is for further study.

Table 4/I.359 – REs at B_i used in defining ISDN circuit mode connection clearing failure probability

| Boundary B_i | Reference event |
|----------------------------------|------------------------|
| MPT ₁ | P8a (DISCONNECT exit) |
| MPI ₁ | S4a (RELEASE exit) |
| MPI ₂ | S4b (RELEASE entry) |
| MPT ₂ | Not applicable |

Table 5/I.359 – REs at B_j whose non-occurrence is used in defining ISDN circuit mode set-up connection clearing failure probability

| Boundary B_j | Reference event |
|----------------------------------|------------------------|
| MPT ₁ | Not applicable |
| MPI ₁ | S4a (RELEASE exit) |
| MPI ₂ | S4b (RELEASE entry) |
| MPT ₂ | P8b (DISCONNECT entry) |

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