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Quality of service, network management and traffic
engineering – Network management – Checking the
quality of the international telephone service

Performance parameters and measurement methods to assess N-ISDN 64 kbit/s circuit-switched bearer service UDI in operation

ITU-T Recommendation E.438

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ITU-T RECOMMENDATION E.438

PERFORMANCE PARAMETERS AND MEASUREMENT METHODS TO ASSESS N-ISDN 64 kbit/s CIRCUIT-SWITCHED BEARER SERVICE UDI IN OPERATION

Summary

This Recommendation presents an overview of performance parameters for the measurement and assessment of N-ISDN 64 kbit/s circuit switched UDI bearer services in operation. Guidelines and considerations for measurement methods are also provided. These parameters can be used for N-ISDN monitoring and improvement in operations. Their achieved values can be used both to establish guaranteed performance levels in Service Level Agreement with the customers and Service Quality Agreement with other administrations, and to verify, analyse and improve the performance level currently offered.

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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CONTENTS

Introduction

ISDN traffic is growing because it allows faster access to and use of advanced services (such as Internet access, videocommunication, etc.) than traditional PSTN networks. ISDN networks are completely defined by ITU-T in terms of architecture, features, access interfaces, transport and signalling protocols, interworking functionality and basic and supplementary services. Recommendation E.721 gives good guidance for planning and designing ISDN networks with adequate GOS levels. Recommendation M.3650 covers maintenance performance related aspects of ISDN. Operations related ISDN NP/QOS aspects, however, are spread among many specific ITU-T Recommendations, some of which only partially cover performance parameters, events and methods for their measurement. This Recommendation attempts to give a complete and organic overview of ISDN NP/QOS parameters and related measurement methods to be used in operations for monitoring and improvement purposes.

The measures, identified according to the methodological approach described in ITU-T Recommendations I.350 [6] and E.820 [4], are defined in clause 6. Additional definitions are given in clause 4. The ISDN NP/QOS parameters can be collected and measured by Administrations in accordance with the measurement methods described in clause 7.

Recommendation E.438

**PERFORMANCE PARAMETERS AND MEASUREMENT METHODS TO ASSESS
N-ISDN 64 kbit/s CIRCUIT-SWITCHED BEARER SERVICE UDI IN OPERATION**

(Geneva, 2000)

1 Introduction

ISDN traffic is growing because it allows faster access to and use of advanced services (such as Internet access, videocommunication, etc.) than traditional PSTN networks. ISDN networks are completely defined by ITU-T in terms of architecture, features, access interfaces, transport and signalling protocols, interworking functionality and basic and supplementary services. Recommendation E.721 gives good guidance for planning and designing ISDN networks with adequate GOS levels. Recommendation M.3650 covers maintenance performance related aspects of ISDN. Operations related ISDN NP/QOS aspects, however, are spread among many specific ITU Recommendations, some of which only partially cover performance parameters, events and methods for their measurement. This Recommendation attempts to give a complete and organic overview of ISDN NP/QOS parameters and related measurements methods to be used in operations for monitoring and improvement purposes.

The measures, identified according to the methodological approach described in ITU-T Recommendations I.350 [6] and E.820 [4], are defined in clause 6 of this Recommendation Additional definitions are given in clause 4. The ISDN NP/QOS parameters can be collected and measured by administrations in accordance with the measurement methods described in clause 7.

2 Scope

The main aim of this Recommendation is to give complete guidance for the characterization and assessment, in operation, of the performance of bearer CSCT 64 kbit/s UDI ISDN services by a set of operational NP/QOS measures, related to all the main functions/phases of an ISDN call (setup, information transfer, release). The values measured for these parameters are mainly used for Operation, but also for Administration and Maintenance (OAM) purposes, and for managing Service Level Agreements (SLAs) and Service Quality Agreements (SQAs) [21] with customers and other ROAs.

To pursue this aim, this Recommendation:

−   identifies the main ISDN NP/QOS parameters for assessing the serveability and integrity of 64 kbit/s based circuit switched ISDN connections and networks. References to E-, G-, I-, M-, O-, P- and Q-series Recommendations for NP/QOS parameters definition are provided. Measures are related both to single B-channel and multi B-channel applications using both BRA and PRA accesses.

−   relates these NP/QOS parameters to test call based, CDR-based and INMD-based measurement methods for assessing the connection setup, information transfer and disengagement phases of an ISDN call. Measurability considerations for these ISDN NP/QOS parameters, depending on the measurement method used, are given.

The most of the ISDN performance parameters identified are similar to those already made and used in operation for PSTN. This allows a set of homogeneous measures particularly useful in the case of mixed ISDN ↔ PSTN connections or for comparisons of services between ISDN and PSTN

connections in terms of performance values achieved. However, some performance parameters have been added or modified[1] to those related to PSTN because:

– ISDN connections, up to the network access point (and sometimes up to the service access point) are fully digital.

– Many services/applications can share the same connection(s).

– A single service/application communication[2] can involve more than one B-channel/connection.

– A communication request can be performed both by *en bloc* and by overlap sending.

– New communication control functions, in addition to those related to the basic telephone call, such as bearer control, compatibility checking, terminal selection, supplementary services control, notify, etc., may be present.

– Routing can depend on the kind of the bearer service chosen on a per call basis.

– Measurement can be made at standard user/network interfaces, using enhanced signalling protocols (e.g. DSS1, SS7 etc.).

The assessment of some NP/QOS parameters can also require measurement on B- (information transfer) channels in addition to those taken on D- (signalling) channel.

This Recommendation does not set performance planning objectives – these are mainly defined in [5] – but rather describes means by which actual NP can be assessed. The mapping of the measurement made with this Recommendation into parameters reflecting customer opinion is beyond the scope of this Recommendation and is left to the individual ROA.

3   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.112 (1993), *Vocabulary of terms for ISDNs*.

[2]   ITU-T Recommendation E.600 (1993), *Terms and definitions of traffic engineering*.

[3]   ITU-T Recommendation E.800 (1994), *Terms and definitions related to quality of service and network performance including dependability*.

[4]   ITU-T Recommendation E.820 (1992), *Call models for serveability and service integrity performance*.

[5]   ITU-T Recommendation E.721 (1999), *Network grade of service parameters and target values for circuit-switched services in the evolving ISDN*.

[6]   ITU-T Recommendation I.350 (1993), *General aspects of quality of service and network performance in digital networks, including ISDNs*.

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[1] Also some related objective values should be modified according to the media (voice, data, video) or the teleservice used in the call, even if they are not included in this Recommendation.

[2] With the term call, according to the ITU-T Recommendation E.600 [2], we intend a teleservice/application request that can involve in case of multi-channel call more than one bearer service/ network connection. For simplicity, we consider here multi-channel teleservices/applications using only 64 kbit/s UDI bearer service.

[7]   ITU-T Recommendation I.352 (1993), *Network performance objectives for connection processing delays in an ISDN.*

[8]   ITU-T Recommendation I.353 (1996), *Reference events for defining ISDN and B-ISDN performance parameters.*

[9]   ITU-T Recommendation I.355 (1995), *ISDN 64 kbit/s connection type availability performance.*

[10]   ITU-T Recommendation G.114 (1988), *Mean one-way propagation time.*

[11]   ITU-T Recommendation G.821 (1996), *Error performance of an international digital connection operating at a bit rate below the primary rate and forming part of an integrated services digital network.*

[12]   ITU-T Recommendation O.152 (1992), *Error performance measuring equipment for bit rates of 64 kbit/s and N × 64 kbit/s.*

[13]   ITU-T Recommendation E.846 (1993), *Accessibility for 64 kbit/s circuit-switched international end-to-end ISDN connection types.*

[14]   ITU-T Recommendation E.425 (1998), *Internal automatic observations.*

[15]   ITU-T Recommendation E.428 (1992), *Connection retention.*

[16]   ITU-T Recommendation E.850 (1992), *Connection retainability objective for the international telephone service.*

[17]   ITU-T Recommendation M.3650 (1997), *Network performance measurements of ISDN calls.*

[18]   ITU-T Recommendation I.430 (1995), *Basic user-network interface − Layer 1 specification.*

[19]   ITU-T Recommendation Q.921 (1997), *ISDN user-network interface − Data link layer specification.*

[20]   ITU-T Recommendation Q.931 (1998), *ISDN user-network interface layer 3 specification for basic call control.*

[21]   ITU-T Recommendation E.801 (1996), *Framework for Service Quality Agreement.*

[22]   ITU-T Recommendation P.561 (1996), *In-Service, non-intrusive measurement device − Voice service measurements.*

[23]   ITU-T Recommendation E.459 (1998), *Measurements and metrics for characterizing facsimile transmission performance using non-intrusive techniques.*

4   Terms and definitions

This Recommendations defines the following terms:

4.1   Differential One-Way Propagation Delay (DOWPD): It expresses the time difference between the one-way propagation delays (see [10]) measured for each couple of different channels involved in a call.

4.2   Call Success Ratio (CSR): Expresses the probability that a call has reached the correct number (i.e. is not misrouted) and starts the transfer of user data on the B-channel.

4.3   Call Disengagement Failure Ratio (CDFR): It is an estimate that a release attempt (made by the user or by the network) fails (namely does not release successfully) in disengaging all the resources previously engaged to set up an ISDN connection using a single channel.

NOTE – In case of multi-channel calls (N ≥ 2) for each measure expressed as a ratio (such as the above CSR, and CDFR parameters), a vector of N values should be obtained. It is also possible to measure the same kind of parameters referring to the multi-channel call, instead to the single channel. In this case, the success and acceptability criteria should be verified simultaneously for all the N-channels involved by the multi-channel call, while it is sufficient that a failure criteria affects at least one of the N-channels to consider the call failed.

5   Abbreviations and acronyms

This Recommendation uses the following abbreviations:

BRA   Basic Rate Access

CSCT   Circuit Switched Connection Type

DSS1   Digital Subscriber Signalling System No. 1

INMD   In-service, Non-intrusive Measurement Device

ISDN   Integrated Services Digital Network

NP   Network Performance

OAM   Operation Administration and Maintenance

PRA   Primary Rate Access

QOS   Quality of Service

TE   Terminal Equipment

UDI   Unrestricted Digital Information

6   ISDN CSCT NP/QOS parameters

The NP/QOS ISDN parameters are listed in Table 1. They are specified, according to the call phases, in terms of related performance criteria (speed, accuracy, dependability – see [6]) and classified as B (Basic) and O (Optional). The basic parameters, highlighted in bold in Table 1, are those easier to measure and of higher importance for NP/QOS monitoring and improvement in operations. They are normally used in SQA (see [21]) and SLA contracts. Their measurement methods are shown in Table 2. The optional parameters, related to performance aspects of minor importance, may be measured by some administrations for specific operational purposes and in specific contexts to assure a better service level to their customers.

**Table 1/E.438 – ISDN NP/QOS performance parameters and related ITU-T
Recommendation references including their definitions**

NP/QOS measures	Perf. Criterion	B/O	Recs. references for definition
Connection setup Phase			
ABR – Answer Bid Ratio	**D**	**B**	E.425 [14]
ASR – Answer Seizure Ratio	**D**	**B**	E.425 [14]
STA – Short Term Accessibility (Note 3)	D	O	E.846 [13]
NAR – Network Accessibility Ratio (Note 4)	D	O	E.800 [3]
NER – Network Effectiveness Ratio	**D**	**B**	E.425 [14]
CSR – Call Success Ratio	**D**	**B**	(Note 1)

Table 1/E.438 – ISDN NP/QOS performance parameters and related ITU-T Recommendation references including their definitions *(concluded)*

NP/QOS measures	Perf. Criterion	B/O	Recs. references for definition
MCED – Mean Call Establishment Delay	**S**	**B**	I.352 [7]
PRSD – PRe-Selection Delay	S	O	E.721 [5]
PSD – Post-Selection Delay (Note 5)	S	O	E.721 [5]
MR – Misrouting Ratio (Note 6)	D	O	E.800 [3]
Connection information transfer phase			
MOWPD – Mean One-Way Propagation Delay	**S**	**B**	G.114 [10]
MDOWPD – Mean differential OWPD (Note 7)	**S**	**B**	(Note 1)
MES – Mean Errored Seconds	**A**	**B**	G.821 [11]
MSES – Mean Severely Errored Seconds	**A**	**B**	G.821 [11]
PRR – Premature Release Ratio	**D**	**B**	E.428 [15], E.850 [16]
Connection disengagement phase			
CDFR – Call Disengagement Failure Ratio (Note 8)	**D**	**B**	(Note 1)
MCDD – Mean Call Disengagement Delay (Note 9)	**S**	**B**	I.352 [7]

A **Accuracy**

B **Basic**

D **Dependability**

O Optional

S **Speed**

NOTE 1 – The definition is contained in clause 4 .

NOTE 2 – All the delay measures are expressed as mean value, while calls performing effectively during the correspondent phases are expressed in terms of percentages.

NOTE 3 – This parameter is time statistical distribution based.

NOTE 4 – This parameter can be defined as the probability that a user attempting to establish a call receives an indication that the B-channel has been assigned to him. It simply estimates ratio between the seizures and the bids measured in a sample both of test calls and of real traffic calls.

NOTE 5 – Significant for overlap sending calls.

NOTE 6 – This parameter expresses the probability that a call is misrouted.

NOTE 7 – New measure relevant only for multichannel calls.

NOTE 8 – This parameter is important because it influences accessibility performance and revenue generated by traffic.

NOTE 9 – A similar measure, named release delay, is defined in [6].

7   Measurement methods for ISDN CSCT NP/QOS parameters

In this clause measurement methods for the ISDN CSCT NP/QOS basic parameters are defined.

7.1 Measurement methods applicable

Three different measurement methods are used for assessing ISDN CSCT NP/QOS parameters:

- Test call based measurements (made at the S/T interface).[3]
- CDR based measurements (made at the switches).
- INMD based measurements (made at the S/T interface or at the switches).

7.2 Comparison of three measurement methods in terms of measurable performance parameter

In Table 2 below the possible measurement methods used to assess each ISDN CSCT NP/QOS measure, both for single and multiple B-channel applications, are shown.

Table 2/E.438 – Basic ISDN NP/QOS operational parameters and related measurement methods

NP/QOS measures		Single B			Multiple B	
	Test Call	CDR (Note)	INMD	Test Call	CDR	INMD
Connection Setup Phase						
ABR – Answer Bid Ratio	–	O	*	–	*	*
ASR – Answer Seizure Ratio	–	O	*	–	*	*
NER – Network Effectiveness Ratio	O	O	*	O	*	*
CSR – Call Success Ratio	O	–	*	O		*
MCED – Mean Call Establishment Delay	O	O	*	O	•	*
Connection Information Transfer Phase						
MOWPD – Mean One-Way Propagation Delay	O	•	*	O	•	*
MDOWPD – Mean Differential OWPD	–	–	*	O	•	*
MES – Mean Errored Seconds	O	•	*	O	•	*
MSES – Mean Severely Errored Seconds	O	•	*	O	•	*
PRR – Premature Release Rate	O	•	*	O	•	*

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[3] In order to accurately represent network wide performance, large geographically disposed test devices may be required.

Table 2/E.438 – Basic ISDN NP/QOS operational parameters and related measurement methods *(concluded)*

NP/QOS measures		Single B			Multiple B	
	Test Call	CDR (Note)	INMD	Test Call	CDR	INMD
Connection Disengagement Phase						
CDFR – Call Disengagement Failure Ratio	O	O	*	O	•	*
MCDD – Mean Call Disengagement Delay	O	O	*	O	•	*
O Measurable						
• Not measurable						
– Not applicable						
* For further study						
NOTE – Since CDR/INMD measurement is made at the switching node, the results obtianed apply only to the portion of the network between the switch and at the end section.						

7.3 Characteristics of each measurement method

7.3.1 Test call based measurement

This method can measure almost all performance parameters. In order to obtain statistically valid NER, CSR, PRR, or CDFR, a sufficient number of test calls should be generated at the S/T interface. With test call measurements, one can also identify problems in any segment of the end-to-end connection by conducting appropriate analysis of the detailed DSS1/SS7 protocol messages.

7.3.2 CDR based measurement

CDR based measurement is suitable to measure ABR, ASR, NER and CDFR based on a large volume of live traffic. It also provides the possibility to measure connection setup delay and connection disengagement delay. However, off-line analysis is required to measure time interval by searching corresponding call detail data. This measurement method is not applicable for measuring performance parameters in information transfer phase and performances of multi-channel calls.

7.3.3 INMD based measurement

INMD measurements for ISDN can assess both transmission quality during the information transfer phase and performance parameters related to call establishment and call release phases. INMD based measurement over PSTN has already been recommended in P.561 [22] for speech, and E.459 [23] for G3 facsimile. In the similar way INMD based measurement for ISDN could be recommended for each Teleservice, e.g. G4 facsimile. This is for further study.

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