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SERIES I: INTEGRATED SERVICES DIGITAL NETWORK

Overall network aspects and functions – Performance objectives

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Relationships among ISDN performance Recommendations

ITU-T Recommendation I.351

(Previously CCITT Recommendation)

ITU-T I-SERIES RECOMMENDATIONS

INTEGRATED SERVICES DIGITAL NETWORK

GENERAL STRUCTURE	I.100–I.199
Terminology	I.110–I.119
Description of ISDNs	I.120–I.129
General modelling methods	I.130–I.139
Telecommunication network and service attributes	I.140–I.149
General description of asynchronous transfer mode	I.150–I.199
SERVICE CAPABILITIES	I.200–I.299
Scope	I.200–I.209
General aspects of services in ISDN	I.210–I.219
Common aspects of services in the ISDN	I.220–I.229
Bearer services supported by an ISDN	I.230–I.239
Teleservices supported by an ISDN	I.240–I.249
Supplementary services in ISDN	I.250–I.299
OVERALL NETWORK ASPECTS AND FUNCTIONS	I.300–I.399
Network functional principles	I.310–I.319
Reference models	I.320–I.329
Numbering, addressing and routing	I.330–I.339
Connection types	I.340–I.349
Performance objectives	**I.350–I.359**
Protocol layer requirements	I.360–I.369
General network requirements and functions	I.370–I.399
ISDN USER-NETWORK INTERFACES	I.400–I.499
Application of I-series Recommendations to ISDN user-network interfaces	I.420–I.429
Layer 1 Recommendations	I.430–I.439
Layer 2 Recommendations	I.440–I.449
Layer 3 Recommendations	I.450–I.459
Multiplexing, rate adaption and support of existing interfaces	I.460–I.469
Aspects of ISDN affecting terminal requirements	I.470–I.499
INTERNETWORK INTERFACES	I.500–I.599
MAINTENANCE PRINCIPLES	I.600–I.699
B-ISDN EQUIPMENT ASPECTS	I.700–I.799
ATM equipment	I.730–I.749
Management of ATM equipment	I.750–I.799

For further details, please refer to ITU-T List of Recommendations.

ITU-T RECOMMENDATION I.351

RELATIONSHIPS AMONG ISDN PERFORMANCE RECOMMENDATIONS

Summary

Recommendation I.351 defines a general structure for a set of existing and draft Recommendations that collectively provide the basis for the specification and apportionment of performance in narrowband and broadband Integrated Services Digital Networks (ISDNs), including network synchronization and timing performance. These Recommendations are intended to be used in describing performance between the measurement points that delimit and apportion international ISDNs.

Source

ITU-T Recommendation I.351 was revised by ITU-T Study Group 13 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 20th of June 1997.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. 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, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

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

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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As of the date of approval of this Recommendation, the ITU had/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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CONTENTS

		Page
1	Scope	1
2	Abbreviations	3
3	General scope and content of ISDN performance Recommendations	4
4	Index	8

Recommendation I.351

RELATIONSHIPS AMONG ISDN PERFORMANCE RECOMMENDATIONS

(revised in 1997)

1 Scope

Recommendation I.351 defines relationships among the following existing and draft ITU-T Recommendations: G.810, G.811, G.812, G.813, G.821, G.822, G.823, G.824, G.825, G.826, G.827, G.EPMRS, I.350, I.351, I.352, I.353, I.354, I.355, I.356, I.357, I.35bcp, and I.35D. Collectively, these Recommendations provide the basis for the specification and apportionment of performance in narrowband and broadband ISDNs, including network synchronization and timing performance. These Recommendations are intended to be used in describing performance between the measurement points that delimit and apportion international ISDNs.

The relevant Recommendations and their relationships are illustrated in Figure 1. The 3×3 performance description framework defined in Recommendation I.350 is used to illustrate the relationships among particular Recommendations. Three protocol-independent telecommunication functions are identified in the matrix: access, user information transfer, and disengagement. These general functions correspond to specified aspects of ISDN services conforming to ITU-T standardized protocols[1]. Each function is considered with respect to three general performance concerns (or "performance criteria"): speed, accuracy, and dependability. These express, respectively, the delay or rate, degree of correctness, and degree of certainty with which the function is performed. Recommendations shown within the matrix define sets of protocol-specific parameters ("primary parameters") that describe performance criteria relative to each function. An associated model provides a basis for describing overall service availability. A specified availability function compares the values for a subset of the primary parameters with corresponding outage thresholds to classify the services as "available" (no service outage) or "unavailable" (service outage) during scheduled service time. Figure 1 presents the Recommendations that specify availability functions and define availability parameters associated with ISDN services. Recommendations concerning timing and synchronization performance of digital networks including ISDNs are illustrated in Figure 1 by their relationships to the complementary aspects of network synchronization and timing equipment performance description.

The general scope and content of each Recommendation illustrated in Figure 1 is described in clause 3[2].

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[1] For B-ISDN, these general functions include multiparty and multipoint connection types.

[2] The most recent editions of draft and approved Recommendations should be consulted.

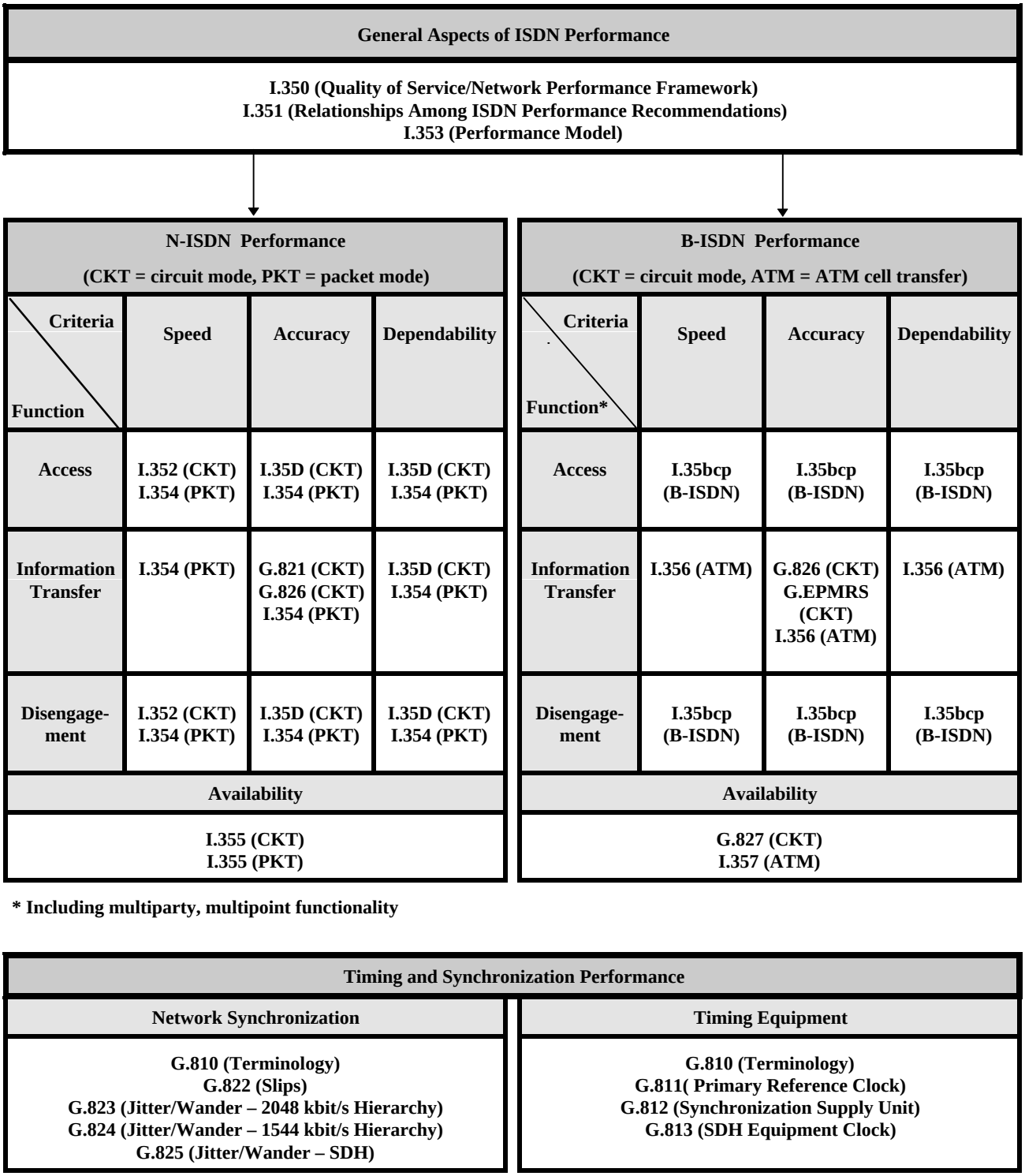

Figure 1/I.351 – Relationships among ISDN performance Recommendations

2 Abbreviations

This Recommendation uses the following abbreviations:

ADEV	Allan Deviation
ATM	Asynchronous Transfer Mode
B-ISDN	Broadband ISDN
CBR	Constant Bit Rate
CKT	Circuit Mode
FFM	Flicker Frequency Modulation
FPM	Flicker Phase Modulation
ISDN	Integrated Services Digital Network
kbit/s	kilobit/second
MDEV	Modified Allan Deviation
MRTIE	Maximum Relative Time Interval Error
MTIE	Maximum Time Interval Error
N-ISDN	Narrowband ISDN
NP	Network Performance
PDH	Plesiochronous Digital Hierarchy
PKT	Packet Mode
PRC	Primary Reference Clock
QOS	Quality of Service
RMS	Root Mean Square
RWFM	Random Walk Frequency Modulation
SDH	Synchronous Digital Hierarchy
SEC	SDH Equipment Clock
SSU	Synchronization Supply Unit
STM	Synchronous Transport Module
TDEV	Time Deviation
TIErms	Root Mean Square Time Interval Error
TVAR	Time Variance
UTC	Universal Co-ordinated Time
VC	Virtual Channel
WFM	White Frequency Modulation

3 General scope and content of ISDN performance Recommendations

The general scope and content of each of the ISDN performance Recommendations identified in Figure 1 is provided below. (For ease of reference, the Recommendations are listed alphanumerically.)

Recommendation G.810 – Definitions and terminology for synchronization networks (1996)

Recommendation G.810 provides definitions and terms for describing network synchronization performance. These definitions and terms are used in Recommendations G.811, G.812, G.813, G.822, G.823, G.824, and G.825.

Recommendation G.811 – Timing requirements at the outputs of primary reference clocks suitable for plesiochronous operation of international digital links (1988)

Recommendation G.811 (revised draft) defines parameters and objectives for describing Primary Reference Clock (PRC) performance. The parameter definitions utilize Recommendation G.810 terminology. Key parameters are MTIE, TDEV, total phase, and peak-to-peak jitter. The parameters and objectives apply to PRC jitter and wander performance. This Recommendation provides part of the basis for the slip performance objectives in Recommendation G.822 and the wander reference model in Recommendation G.823.

Recommendation G.812 – Timing requirements at the output of slave clocks suitable for plesiochronous operation of international digital links (1988)

Recommendation G.812 (revised draft) defines parameters and objectives for describing timing equipment synchronization supply unit performance. The parameter definitions utilize Recommendation G.810 terminology. Key parameters are MTIE, MRTIE, TDEV, total phase, and peak-to-peak jitter. The parameters and objectives apply to slave clock jitter, wander, transient, and holdover performance.

Recommendation G.813 – Timing characteristics of SDH equipment slave clocks (SEC) (1996)

Recommendation G.813 defines timing equipment parameters and objectives for describing SDH equipment clock performance. The parameter definitions utilize Recommendation G.810 terminology. Key parameters are MTIE, TDEV, total phase, and peak-to-peak jitter. The parameters and objectives apply to interfaces of "Option 1" and "Option 2" SDH equipment clocks. Option 1 applies to SDH networks optimized for the 2048 kbit/s hierarchy and Option 2 applies to SDH networks optimized for the particular 1544 kbit/s hierarchy that includes the rates 1544 kbit/s, 6312 kbit/s, and 44 736 kbit/s.

Recommendation G.821 – 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 (1996)

Recommendation G.821 defines accuracy parameters and objectives for describing N-ISDN circuit mode information transfer performance. Key parameters are errored second ratio and severely errored second ratio. The parameters and objectives apply to specified portions of an international end-to-end digital connection operating at a bit rate below the primary rate. This Recommendation provides a basis for N-ISDN circuit mode availability performance specified in Recommendation I.355.

Recommendation G.822 – Controlled slip rate objectives on an international digital connection (1988)

Recommendation G.822 defines parameters and objectives for describing network slip performance. The parameter definitions utilize Recommendation G.810 terminology. Key parameters are the mean slip rate and its associated proportion of time. The parameters and objectives apply to specified portions of an international digital connection. This Recommendation provides a basis for Option 1 and Option 2 network wander limits in Recommendation G.813.

Recommendation G.823 – The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy (1993)

Recommendation G.823 defines parameters and objectives for describing network jitter and wander performance based on the 2048 kbit/s hierarchy. The parameter definitions utilize Recommendation G.810 terminology. Key parameters are peak-to-peak jitter and wander, RMS jitter, and associated measurement filter bandwidths. The parameters and objectives apply to jitter and wander tolerance and network limits for PDH interfaces based on the 2048 kbit/s hierarchy and to jitter and wander transfer for equipment with PDH interfaces based on the 2048 kbit/s hierarchy.

Recommendation G.824 – The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy (1993)

Recommendation G.824 defines parameters and objectives for describing network jitter and wander performance based on the 1544 kbit/s hierarchy. The parameter definitions utilize Recommendation G.810 terminology. Key parameters are peak-to-peak jitter and wander, RMS jitter, and associated measurement filter bandwidths. The parameters and objectives apply to jitter and wander tolerance and network limits for PDH interfaces based on the 1544 kbit/s hierarchy and to jitter and wander transfer for equipment with PDH interfaces based on the 1544 kbit/s hierarchy. This Recommendation provides input to the Option 2 wander budget and network wander limits in Recommendation G.813.

Recommendation G.825 – The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (1993)

Recommendation G.825 defines parameters and objectives for describing network synchronization jitter and wander performance based on the SDH. The parameter definitions utilize Recommendation G.810 terminology. Key parameters are peak-to-peak jitter and wander, RMS jitter, and associated measurement filter bandwidths. The parameters and objectives apply to jitter and wander tolerance and network limits for SDH interfaces based on the SDH hierarchy. This Recommendation provides part of the basis for the Option 1 SEC bandwidth specification in Recommendation G.813.

Recommendation G.826 – Error performance parameters and objectives for international constant bit rate digital paths at or above the primary rate (1996)

Recommendation G.826 defines accuracy parameters and objectives for describing B-ISDN circuit mode information transfer performance. The key parameters are errored second ratio, severely errored second ratio, and background block-error ratio. The parameters and objectives apply to specified portions of an international end-to-end CBR digital path operating at or above the primary rate.

Recommendation G.827 – Availability performance and objectives for path elements of international constant bit rate digital paths at or above the primary rate (1996)

Recommendation G.827 defines parameters and (planned) objectives for describing B-ISDN circuit mode availability performance. The parameters are defined on the basis of G.826 parameter thresholds. Key parameters are availability ratio and mean time between digital path outages. The parameters and (planned) objectives apply to path elements of an end-to-end international CBR digital path at or above the primary rate.

Recommendation G.EPMRS – Error performance events for SDH multiplex and regenerator sections (planned)

Recommendation G.EPMRS (draft) defines error performance events and block structures applicable to error performance assessment on SDH multiplex sections. The Recommendation defines the events errored second, severely errored second, and background block errors. Block structures are given for bit rates less than STM-1, STM-1 to STM-16, and STM-64.

Recommendation I.350 – General aspects of quality of service and network performance in digital networks, including ISDNs (1993)

Recommendation I.350 defines Quality of Service (QOS) and Network Performance (NP) principles; illustrates how the QOS and NP concepts are applied in digital networks including ISDNs (providing both narrowband and broadband capabilities); describes the features of, and the relationships between, these concepts; indicates and classifies performance concerns for which parameters may be needed; and identifies generic performance parameters.

Recommendation I.351 – Relationships among ISDN performance Recommendations

Recommendation I.352 – Network performance objectives for connection processing delays in an ISDN (revision planned)

Recommendation I.352 defines speed parameters and objectives for describing N-ISDN circuit mode access and disengagement performance. The parameters are defined on the basis of I.353 reference events. Key parameters are call set-up delay and call clearing delay. The parameters and objectives apply to specified portions of an international end-to-end circuit mode connection. This Recommendation provides a basis for N-ISDN circuit mode availability performance specified in Recommendation I.355.

Recommendation I.353 – Reference events for defining ISDN performance parameters (revision planned)

Recommendation I.353 defines the measurement points and performance-significant reference events that are used in Recommendations I.352, I.354, I.355, I.356, I.357, I.35bcp, and I.35D to define performance parameters for international ISDN services.

Recommendation I.354 – Network performance objectives for packet mode communication in an ISDN (1993)

Recommendation I.354 defines speed, accuracy, and dependability parameters and objectives for describing N-ISDN packet mode access, information transfer, and disengagement performance. The parameters are defined on the basis of I.353 reference events. Key parameters are call set-up delay, call set-up denial probability, errored packet ratio, packet loss ratio, and call clearing delay. The parameters and objectives apply to specified portions of an international end-to-end packet mode connection. This Recommendation provides a basis for N-ISDN packet mode availability performance specified in Recommendation I.355.

Recommendation I.355 – ISDN 64 kbit/s connection type availability performance (1995)

Recommendation I.355 defines parameters and objectives for describing N-ISDN circuit mode and packet mode availability performance. The circuit mode and packet mode parameters are defined on the basis of G.821, I.352, and I.354 parameter thresholds. Key parameters are percent service availability and mean time between service outages. The parameters and objectives apply to specified portions of international end-to-end N-ISDN circuit mode and packet mode connections.

Recommendation I.356 – B-ISDN ATM layer cell transfer performance (1996)

Recommendation I.356 defines speed, accuracy, and dependability parameters and objectives for describing B-ISDN ATM information transfer performance. The parameters are defined on the basis of I.353 reference events. The key parameters include cell transfer delay, cell delay variation, cell error ratio, cell loss ratio, and severely errored cell block ratio. It includes adjusted parameter definitions that might be used when cells do not conform with the negotiated traffic contract. The parameters and objectives apply to specified portions of an end-to-end international B-ISDN ATM connection. Parameter values are grouped together into different QOS classes that users may request on a connection-by-connection basis. This Recommendation provides a basis for B-ISDN ATM availability performance specification in Recommendation I.357.

Recommendation I.357 – B-ISDN semi-permanent connection availability (planned)

Recommendation I.357 defines parameters and (planned) objectives for describing B-ISDN ATM availability performance. The parameters are defined on the basis of I.356 parameter thresholds and apply to semi-permanent connections. Key parameters are availability ratio and mean time between outages. The parameters and (planned) objectives apply to specified portions of an international end-to-end B-ISDN ATM semi-permanent connection.

Recommendation I.35bcp – Call processing performance for a B-ISDN (planned)

Recommendation I.35bcp (draft) defines speed, accuracy, and dependability parameters and objectives for describing B-ISDN access and disengagement performance, including call processing functions supporting multipoint connections and the adding and dropping of parties. The parameters are defined on the basis of I.353 reference events and apply to specified portions of an end-to-end international B-ISDN connection. The key parameters are connection establishment delay, party establishment delay, connection release delay, party release delay, disconnect delay, party disconnect delay, and connection failure probability. The parameters and objectives apply to specified portions of an international end-to-end B-ISDN connection.

Recommendation I.35D – Accuracy and dependability of ISDN 64 kbit/s circuit mode connection types (planned)

Recommendation I.35D (draft) defines accuracy and dependability parameters for describing N-ISDN circuit mode access, information transfer, and disengagement performance. The parameters are defined on the basis of I.353 reference events. Key parameters are connection denial probability, incorrect call set-up probability, and premature disconnect probability. The parameters apply to specified portions of an international end-to-end 64 kbit/s circuit mode connection.

4 Index

A

Allan Deviation (ADEV)
- Definition G.810
- Estimator and Properties G.810

ATM Adaptation Layer (AAL) Performance I.356

ATM Performance
- Availability I.357
- User Information Transfer I.356

ATM Performance Allocation
- Availability I.357
- User Information Transfer I.356

ATM Performance Assessment
- Availability I.357
- User Information Transfer I.356

ATM Performance Objectives
- Availability I.357
- User Information Transfer I.356

Availability Performance
- B-ISDN Semi-Permanent Connection I.357
- ISDN 64 kbit/s Connection Type I.355
- Path Elements of International CBR Paths at or above the Primary Rate G.827

Availability Performance Assessment
- B-ISDN Semi-Permanent Connection I.357
- ISDN 64 kbit/s Connection Type I.355
- Path Elements of International CBR Paths at or above the Primary Rate G.827

Availability Performance Objectives
- B-ISDN Semi-Permanent Connection I.357
- ISDN 64 kbit/s Connection Type I.355
- Path Elements of International CBR Paths at or above the Primary Rate G.827

Availability Performance Outage Criteria
- B-ISDN Semi-Permanent Connection I.357
- ISDN 64 kbit/s Connection Type I.355
- Path Elements of International CBR Paths at or above the Primary Rate G.827

Availability Performance Sampling Estimation
- B-ISDN Semi-Permanent Connection I.357
- ISDN 64 kbit/s Connection Type I.355
- Path Elements of International CBR Paths at or above the Primary Rate G.827

Availability Ratio I.357, G.827

Available Time
- B-ISDN Semi-Permanent Connection I.357
- Digital Connections G.821
- Digital Paths G.826
- ISDN 64 kbit/s Connection Type I.355

Path Elements of International CBR Paths at or above the Primary Rate G.827
SDH Multiplex Sections ..... G.EPMRS

B

Background Block Error
Digital Paths G.826
SDH Multiplex Sections ..... G.EPMRS

Background Block Error Ratio (Digital Paths) G.826

B-ISDN Performance
Availability I.357
Call Processing I.35bcp
User Information Transfer I.356

Bit Error Ratio (Digital Connections) G.821

Bit Errors I.353, G.821

C

Call Clearing Failure Probability I.35D

Call Set-Up Error Probability I.355

Call Set-Up Failure Probability I.355

Cell Block I.356

Cell Delay Variation (CDV) I.356

Cell Error Ratio (CER) I.356

Cell Loss Ratio (CLR) I.356

Cell Misinsertion Rate (CMR) I.356

Cell Transfer Delay (CTD) I.356

Cell Transfer Outcome I.356

Clock G.810

Clock Requirements
Primary Reference Clock (PRC) G.811
SDH Equipment Clock (SEC) G.813
Slave Clock G.812

Connection Portion Availability I.357, I.355

Connection Set-Up Error Probability I.355

Connection Set-Up Failure Probability I.355

Customer Equipment/Customer Network (CEQ) I.353

D

Defects resulting in Severely Errored Seconds
Digital Paths G.826
SDH Multiplex Sections ..... G.EPMRS

Derived Performance Parameters I.350

Disconnect Delay
Connection I.35bcp
Party I.35bcp

E

Entry Event I.353

Error Performance
Digital Connections G.821
Digital Paths G.826

Error Performance Allocation

Digital Connections
High Grade G.821
Local Grade G.821
Medium Grade G.821

Digital Paths
International Portion G.826
National Portion G.826

Error Performance Assessment
Based upon Bit Errors
Digital Connections G.821

Based upon Errored Blocks
Block Structure, Digital Paths G.826
Block Structure, SDH Multiplex Sections ..... G.EPMRS

In-Service Measurement ..... G.EPMRS, G.826

Error Performance Events
Digital Connections G.821
Digital Paths G.826
SDH Multiplex Sections ..... G.EPMRS

Error Performance Objectives
Digital Connections G.821
Digital Paths G.826

Errored Bit I.353, G.821

Errored Block ..... G.EPMRS, G.826

Errored Cell I.356

Errored Second
Digital Connections G.821
Digital Paths..... G.826
SDH Multiplex Sections..... G.EPMRS

Errored Second Ratio
Digital Connections G.821
Digital Path G.826

Exit Event I.353

F

Fractional Frequency Deviation G.810

Frequency Accuracy
- Definition G.810
- Requirement for Primary Reference Clock (PRC) G.811
- Requirement for SDH Equipment Clock (SEC) G.813
- Requirement for Slave Clock G.812

Frequency Drift G.810

Frequency Stability G.810

H

Hold-in Range
- Definition G.810
- Requirement for SDH Equipment Clock (SEC) G.813
- Requirement for Slave Clock G.812

Holdover
- Definition G.810
- Requirement for SDH Equipment Clock (SEC) G.813
- Requirement for Slave Clock G.812

Hypothetical Reference Connection (HRX)
- ATM Connection I.356
- Digital Connection G.821

Hypothetical Reference Path ..... G.EPMRS, G.821, G.826

I

ISDN Reference Event I.353

J

Jitter
- (Timing) Jitter G.810
- Alignment Jitter G.810

Jitter Generation Requirements
- Primary Reference Clock (PRC) G.811
- SDH Equipment Clock (SEC) G.813
- Slave Clock G.812

Jitter Measurement, 2048 kbit/s Hierarchy G.823

Jitter Network Limit
- Jitter Accumulation for SDH Network Synchronization G.813
- Output Jitter for 1544 kbit/s Hierarchy, Specification and Measurement G.824
- Output Jitter for 2048 kbit/s Hierarchy, Specification and Measurement G.823
- Output Jitter for SDH, Specification and Measurement G.825

Jitter Tolerance Requirements
- Digital Input Ports for Signals based on the 1544 kbit/s Hierarchy G.824
- Digital Input Ports for Signals based on the 2048 kbit/s Hierarchy G.823
- Digital Input Ports for Signals based on the SDH G.825

SDH Equipment Clock (SEC) G.813
Slave Clock G.812

Jitter Transfer Requirements
PDH Equipment based on the 1544 kbit/s Hierarchy G.824
PDH Equipment based on the 2048 kbit/s Hierarchy G.823
SDH Equipment Clock (SEC) G.813
Slave Clock G.812

L

Lost Cell I.356

M

Master Clock G.810

Maximum Time Interval Error (MTIE) – Definition, Estimator and Properties G.810

Mean Time Between Connection Portion Outages I.355

Mean Time Between Digital Path Outages G.827

Mean Time Between Outages I.357

Measurement Point (MP)
Measurement Point International (MPI) I.353
Measurement Point T (MPT) I.353

Minimal Test for Availability State Determination
ISDN 64 kbit/s Connection Type I.355

Misinserted Cell I.356

Modified Allan Deviation (MDEV) – Definition, Estimator and Properties G.810

N

Network Performance I.350

Node Clock G.810

Noise Generation
Primary Reference Clock (PRC) G.811
SDH Equipment Clock (SEC) G.813
Slave Clock G.812

Noise Tolerance
Digital Input Ports for Signals based on the 1544 kbit/s Hierarchy G.824
Digital Input Ports for Signals based on the 2048 kbit/s Hierarchy G.823
Digital Input Ports for Signals based on the SDH G.825
SDH Equipment Clock (SEC) G.813
Slave Clock G.812

Noise Transfer
PDH Equipment based on the 1544 kbit/s Hierarchy G.824
PDH Equipment based on the 2048 kbit/s Hierarchy G.823
SDH Equipment G.825
SDH Equipment Clock (SEC) G.813
Slave Clock G.812

Noise Types, Power Law
Flicker Frequency Modulation (FFM) G.810
Flicker Phase Modulation (FPM) G.810
Random Walk Frequency Modulation (RWFM) G.810
White Frequency Modulation (WFM) G.810
White Phase Modulation (WPM) G.810

O

Outage Intensity I.357, G.827

P

Party ADD/DROP I.35bcp

Path Elements and Categories G.827

Performance Significant Reference Event I.353

Phase Discontinuity
Requirement for Primary Reference Clock (PRC) G.811
Requirement for SDH Equipment Clock (SEC) G.813
Requirement for Slave Clock G.812

Phase Transient
Definition G.810
Short Term, Requirement for SDH Equipment Clock (SEC) G.813
Short Term, Requirement for Slave Clock G.812

Plesiochronous (Definition) G.810

Premature Disconnect Probability I.35D, I.355

Premature Disconnect Stimulation Probability I.35D

Primary Performance Parameters I.350

Primary Reference Clock (PRC) G.810

Pull-in Range
Definition G.810
Requirement for SDH Equipment Clock (SEC) G.813
Requirement for Slave Clock G.812

Pull-out Range
Definition G.810
Requirement for SDH Equipment Clock (SEC) G.813
Requirement for Slave Clock G.812

Q

Quality of Service I.350

Quality of Service Class (QOS Class) I.356

R

Reference Event (RE) I.353

Release Delay
- Connection I.35bcp
- Party I.35bcp

Reset Probability I.355

Reset Stimulus Probability I.355

Residual Error Ratio I.355

Root Mean Square Time Interval Error (TIErms) – Definition, Estimator and Properties G.810

S

Set-up Delay
- Connection I.35bcp, I.352
- Party I.35bcp

Set-up Error Probability
- Connection I.35bcp
- Party I.35bcp

Set-up Failure Probability
- Call I.35D
- Connection I.35bcp
- Party I.35bcp

Severely Errored Cell Block I.356

Severely Errored Cell Block Ratio (SECBR) I.356

Severely Errored Second
- ATM Layer Connections I.357
- Digital Connections G.821
- Digital Paths G.826
- SDH Multiplex Sections ..... G.EPMRS

Severely Errored Second Ratio
- Digital Connections G.821
- Digital Paths G.826

Slave Clock G.810

Slip
- Controlled Slip Rate Objectives G.822
- Controlled Slip, Definition G.810

Successfully Transferred Cell I.356

Switching/Signalling Node (SSN) I.353

Synchronization Network – Definition, Measurement Configurations and Structure G.810

Synchronization Supply Unit (SSU) G.810

T

Tagged Cell I.356
Throughput Capacity I.355
Time G.810
Time Deviation (TDEV) – Definition, Estimator and Properties G.810
Time Error Function G.810
Time Function G.810
Time Interval Error Function G.810
Time Scale G.810
Time Variance (TVAR) G.810
Timing Signal G.810

U

Unavailability Ratio I.357, G.827
Unavailability Time
B-ISDN Semi-Permanent Connection I.357
ISDN 64 kbit/s Connection Type I.355
Path Elements of International CBR Paths at or above the Primary Rate G.827
Unavailable Time
Digital Connections G.821
SDH Multiplex Sections ..... G.EPMRS
Unbounded Performance I.356
Universal Co-ordinated Time (UTC) G.810
Unspecified Performance I.356

W

Wander G.810
Wander Generation Requirements
Primary Reference Clock (PRC) G.811
SDH Equipment Clock (SEC) G.813
Slave Clock G.812
Wander Network Limit
Output Wander for 1544 kbit/s Hierarchy G.824
Wander Accumulation for SDH Network Synchronization G.813
Wander Reference Model
Networks Based on 2048 kbit/s Hierarchy G.823
VC-11 Island Model, SDH Networks Optimized for 1544 kbit/s Hierarchy G.813
Wander Tolerance Requirements
Digital Input Ports for Signals based on the 1544 kbit/s Hierarchy G.824
Digital Input Ports for Signals based on the 2048 kbit/s Hierarchy G.823
Digital Input Ports for Signals based on the SDH G.825

SDH Equipment Clock (SEC) G.813
Slave Clock G.812

Wander Transfer Requirements
PDH Equipment based on the 1544 kbit/s Hierarchy G.824
PDH Equipment based on the 2048 kbit/s Hierarchy G.823
SDH Equipment Clock (SEC) G.813
Slave Clock G.812

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Series A	Organization of the work of the ITU-T
Series B	Means of expression: definitions, symbols, classification
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Series D	General tariff principles
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