



INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

X.144

(10/2003)

SERIES X: DATA NETWORKS AND OPEN SYSTEM
COMMUNICATIONS

Public data networks – Network aspects

User information transfer performance parameters for public frame relay data networks

ITU-T Recommendation X.144

ITU-T X-SERIES RECOMMENDATIONS
DATA NETWORKS AND OPEN SYSTEM COMMUNICATIONS

PUBLIC DATA NETWORKS	
Services and facilities	X.1–X.19
Interfaces	X.20–X.49
Transmission, signalling and switching	X.50–X.89
Network aspects	X.90–X.149
Maintenance	X.150–X.179
Administrative arrangements	X.180–X.199
OPEN SYSTEMS INTERCONNECTION	
Model and notation	X.200–X.209
Service definitions	X.210–X.219
Connection-mode protocol specifications	X.220–X.229
Connectionless-mode protocol specifications	X.230–X.239
PICS proformas	X.240–X.259
Protocol Identification	X.260–X.269
Security Protocols	X.270–X.279
Layer Managed Objects	X.280–X.289
Conformance testing	X.290–X.299
INTERWORKING BETWEEN NETWORKS	
General	X.300–X.349
Satellite data transmission systems	X.350–X.369
IP-based networks	X.370–X.399
MESSAGE HANDLING SYSTEMS	X.400–X.499
DIRECTORY	X.500–X.599
OSI NETWORKING AND SYSTEM ASPECTS	
Networking	X.600–X.629
Efficiency	X.630–X.639
Quality of service	X.640–X.649
Naming, Addressing and Registration	X.650–X.679
Abstract Syntax Notation One (ASN.1)	X.680–X.699
OSI MANAGEMENT	
Systems Management framework and architecture	X.700–X.709
Management Communication Service and Protocol	X.710–X.719
Structure of Management Information	X.720–X.729
Management functions and ODMA functions	X.730–X.799
SECURITY	X.800–X.849
OSI APPLICATIONS	
Commitment, Concurrency and Recovery	X.850–X.859
Transaction processing	X.860–X.879
Remote operations	X.880–X.899
OPEN DISTRIBUTED PROCESSING	X.900–X.999

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

ITU-T Recommendation X.144

User information transfer performance parameters for public frame relay data networks

Summary

This Recommendation defines speed, accuracy and dependability performance parameters that may be used in specifying and assessing the user information transfer performance of public frame relay data networks. The defined performance parameters are applicable to both PVC and SVC services.

This revision was undertaken to take into account the development of ITU-T Rec. X.147 which specifies network availability objective values together with techniques for assessing frame relay network availability. Information previously pertaining to availability has been moved to ITU-T Rec. X.147. References have been updated to take into account the development of ITU-T Rec. X.146 which specifies performance objectives and classes of service, and of ITU-T Rec. X.148 which defines measurement techniques.

Source

ITU-T Recommendation X.144 was approved on 29 October 2003 by ITU-T Study Group 17 (2001-2004) under the ITU-T Recommendation A.8 procedure.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. 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 Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 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.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure e.g. interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, 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.

© ITU 2004

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

CONTENTS

Page

1	Scope	1
2	References.....	3
3	Abbreviations.....	4
4	Generic performance model	5
4.1	Components of an end-to-end connection.....	5
4.2	Frame transfer reference events.....	6
4.3	Frame transfer outcomes	7
5	Frame transfer performance parameters	8
5.1	User information frame transfer delay	11
5.2	User information frame delay jitter	11
5.3	User information frame loss ratio.....	12
5.4	Residual frame error ratio.....	13
5.5	Extra frame rate	13
5.6	Frame-based conformant traffic distortion ratio.....	13
5.7	Frame flow-related parameters.....	14
Annex A	– Conformance test for performance evaluation	15
A.1	Motivation	15
A.2	Limited standardized use.....	15
A.3	DDB definition	15
A.4	Using the DDB in evaluating FCTDR.....	16
Annex B	– Bit-based accuracy and dependability parameters.....	18
B.1	User information bit loss ratio.....	18
B.2	Residual bit error ratio.....	18
Annex C	– Some relations between frame-level and ATM-level performance parameters	20
C.1	Scope	20
C.2	Motivation for relating frame-level and ATM-level and performance parameters.....	20
C.3	Frame relay parameters considered.....	21
C.4	Relation between FR and ATM user information loss parameters	22
Appendix I	– Congestion notification.....	25
I.1	The effects of FECN, BECN and CLLM on performance.....	25
I.2	Controlling the effects on performance.....	25
Appendix II	– Performance effects of excessive demand for connection resources	26
II.1	Unanticipated simultaneous access line bursting	26
II.2	Full utilization of over-subscribed access lines.....	26
Appendix III	– A method for estimating the FLR: FLR extraction.....	26
III.1	FLR extraction methodology limitations.....	26
III.2	FLR extraction methodology.....	27

Document ID: 123456789

ITU-T Recommendation X.144

User information transfer performance parameters for public frame relay data networks

1 Scope

This Recommendation defines speed, accuracy and dependability performance parameters that may be used in specifying and assessing the user information transfer performance of public frame relay data networks. The defined parameters apply to end-to-end and point-to-point frame relay connections¹, and to specified portions of such connections when provided in accordance with ITU-T Recs X.36 and X.76.

The performance parameters defined in this Recommendation are intended to be used in the planning of international frame relay services. The intended users of this Recommendation include frame relay service providers, equipment manufacturers and end users. This Recommendation may be used:

- 1) by service providers in the planning, development and assessment of frame relay services to ensure that the achieved performance meet user's needs;
- 2) by equipment manufacturers as performance metrics that will affect equipment design; and
- 3) by users in evaluating performance.

The scope of this Recommendation is summarized in Figure 1. The frame relay performance parameters are defined on the basis of frame transfer reference events that may be observed at physical interfaces associated with specified boundaries. For comparability and completeness, frame relay performance is considered in the context of the 3×3 performance matrix defined in ITU-T Rec. X.140. Three protocol-independent data communication functions are identified in the matrix: connection set up, user information transfer and disengagement. Each function is considered with respect to three general performance concerns (or "performance criteria"):

- speed;
- accuracy; and
- dependability.

An associated two-state model provides a basis for describing service availability (see ITU-T Rec. X.147)

The performance parameters defined in this Recommendation define the speed, accuracy, and dependability of the user information transfer provided by frame relay networks. The user transfer performance parameters are applicable to both PVCs and SVCs.

ITU-T Rec. X.145 defines the speed, accuracy and dependability of the connection set-up and the disengagement phase of frame relay Switched Virtual Connections (SVC).

ITU-T Rec. X.146 specifies performance objectives and quality of service classes applicable to frame relay.

ITU-T Rec. X.147 specifies objectives and methods for assessing network availability of frame relay services.

¹ In the context of this Recommendation, a frame relay connection (denoted hereafter, unless noted otherwise, by the term "connection") refers to a virtual connection established between two specified end points.

ITU-T Rec. X.148 specifies procedures for measuring the performance of public frame relay data networks.

NOTE 1 – The parameters defined in this Recommendation may be augmented or modified based upon further study of the requirements for quantify the performance of frame relay networks.

NOTE 2 – The defined parameters are intended to characterize frame relay connections in the available state.

NOTE 3 – The parameters of this Recommendation are designed to measure the performance of network elements between pairs of section boundaries. However, users of this Recommendation should be aware that the behaviour of connection elements outside the pair of boundaries can adversely influence the measured performance of the elements between the boundaries. Examples are described in Appendix III.

This Recommendation is organized as follows:

- Clause 2 presents references.
- Clause 3 presents abbreviations.
- Clause 4 defines a performance model and a set of frame transfer reference events (FEs) that provide a basis for performance parameter definition.
- Clause 5 defines frame-based speed of service, accuracy and dependability parameters using the frame transfer reference events defined in clause 4.

Annex A presents a test for judging traffic conformance for performance assessment purposes. Annex B defines bit-based accuracy and dependability parameters associated with the transfer of user information in frame relay services. Annex C gives some relations between frame-level and ATM-level and performance parameters. Appendix I discusses the performance effects of network indications of congestion and makes general recommendations for controlling these effects. Appendix II discusses performance effects of excessive demand for connection resources. Appendix III gives a method of estimating the FLR from network statistics.

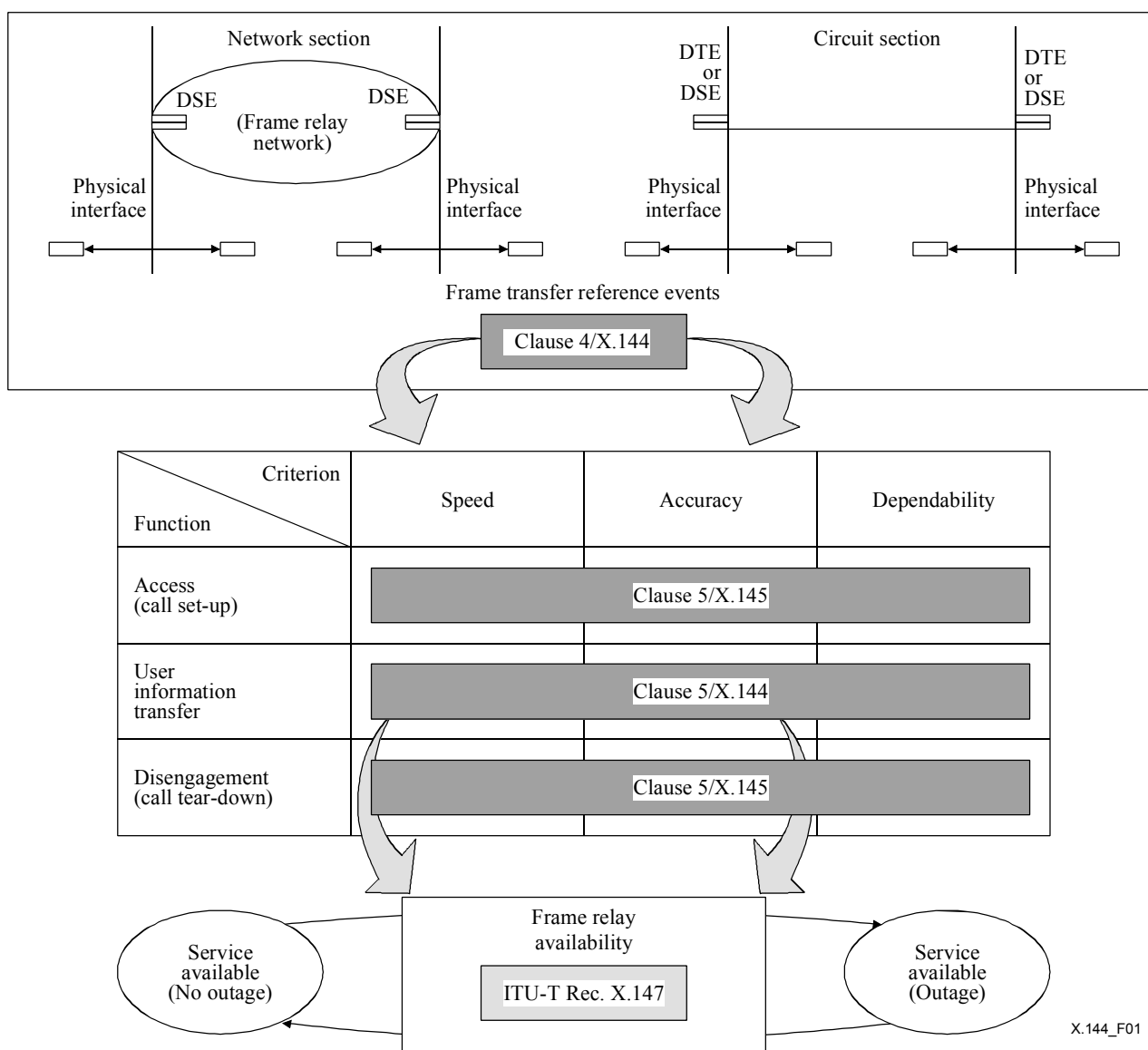


Figure 1/X.144 – Scope of ITU-T Rec. X.144

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; 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. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- ITU-T Recommendation I.356 (2000), *B-ISDN ATM layer cell transfer performance*.
- ITU-T Recommendation I.363 (1993), *B-ISDN ATM adaptation layer (AAL) specification*.
- ITU-T Recommendation I.365.1 (1993), *B-ISDN ATM adaptation layer sublayers: Frame relaying service specific convergence sublayer (FR-SSCS)*.
- ITU-T Recommendation I.370 (1991), *Congestion management for the ISDN frame relaying bearer service*.

- ITU-T Recommendation I.555 (1997), *Frame Relaying Bearer Service interworking*.
- ITU-T Recommendation X.36 (2003), *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for public data networks providing frame relay data transmission service by dedicated circuit*.
- ITU-T Recommendation X.76 (2003), *Network-to-network interface between public networks providing PVC and/or SVC frame relay data transmission service*.
- ITU-T Recommendation X.140 (1992), *General quality of service parameters for communication via public data networks*.
- ITU-T Recommendation X.145 (2003), *Connection establishment and disengagement performance parameters for public Frame Relay data networks providing SVC services*.
- ITU-T Recommendation X.146 (2000), *Performance objectives and quality of service classes applicable to frame relay*.
- ITU-T Recommendation X.147 (2003), *Frame Relay network availability*.
- ITU-T Recommendation X.148 (2003), *Procedures for the measurement of performance of public data networks providing the international frame relay service*.
- ITU-T Recommendation X.329 (2000), *General arrangements for interworking between networks providing frame relay data transmission services and B-ISDN*.

3 Abbreviations

This Recommendation uses the following abbreviations:

ACS	Access Circuit Section
ANS	Access Network Section
Bc	Committed Burst Size
BCTDR	Bit-based Conformant Traffic Distortion Ratio
Be	Excess Burst Size
BECN	Backward Explicit Congestion Notification
BLR	Bit Loss Ratio
CIR	Committed Information Rate
CLLM	Consolidated Link Layer Management
DE	Discard Eligible
DLCI	Data Link Connection Identifier
DSE	Data Switching Exchange
DTE	Data Terminal Equipment
EFR	Extra Frame Rate
EIR	Excess Information Rate
FCTDR	Frame-based Conformant Traffic Distortion Ratio
FDJ	Frame Delay Jitter
FE	Frame Layer Reference Event
FECN	Forward Explicit Congestion Notification

FLR	Frame Loss Ratio
FTD	Frame Transfer Delay
ICS	Internetwork Circuit Section
ISDN	Integrated Services Digital Network
MTBSO	Mean Time Between Service Outages
MTTSR	Mean Time To Service Restoral
NT	Network Termination
PVC	Permanent Virtual Circuit
RBER	Residual Bit Error Ratio
RFER	Residual Frame Error Ratio
SA	Service Availability
SVC	Switched Virtual Circuit
TE	Terminal Equipment
TNS	Transit Network Section

4 Generic performance model

This clause defines a generic frame relay service performance model composed of four basic connection sections:

- the access circuit section;
- the internetwork circuit section;
- the access network section; and
- the transit network section.

These four basic connection sections are defined in 4.1. They provide a set of building blocks with which any end-to-end connection can be represented. Each of the performance parameters defined in this Recommendation can be applied to the unidirectional transfer of user information on a connection section or a concatenated set of connection sections.

Clause 4 also specifies a set of frame transfer reference events that provide a basis for performance parameter definition. These reference events are derived from and are consistent with relevant ITU-T frame relay service and protocol Recommendations. The reference events are specified in 4.2.

This Recommendation provides parameters for quantifying performance at the top of the data link (i.e., frame) layer Service Access Point (SAP). Quantitative relationships between frame layer network performance and the performance of the physical layer and the performance of layers above the frame layer (e.g., applications) are for further study.

4.1 Components of an end-to-end connection

In the context of this Recommendation, an end-to-end connection is composed of sections as defined below. The defined terms are shown in Figure 2.

4.1.1 circuit section: Either an access circuit section or an internetwork circuit section.