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COMMUNICATIONS

Public data networks – Network aspects

Procedures for the measurement of the performance of public data networks providing the international frame relay service

ITU-T Recommendation X.148

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ITU-T Recommendation X.148

Procedures for the measurement of the performance of public data networks providing the international frame relay service

Summary

This Recommendation defines procedures for the measurement and assessment of the user information transfer performance parameters of Frame Relay virtual connections. Use is made of OAM Frames and methods for measuring Frame Transit Delay, Frame Delay Jitter and Frame Loss Ratio are specified. The techniques are applicable to both PVCs and SVCs. The techniques defined enable in-service real time performance estimation.

Source

ITU-T Recommendation X.148 (2003) was prepared by ITU-T Study Group 17 (2001-2004) and approved under the WTSA Resolution 1 procedure on 13 February 2003.

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.

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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.

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ITU-T Recommendation X.148

Procedures for the measurement of the performance of public data networks providing the international frame relay service

1 Scope

This Recommendation describes a methodology for measuring, in near real time, the performance parameters of virtual connections established over public frame relay data networks. The preferred measurement procedures are based on the use of FR-OAM Frames as defined by FRF.19.

Clause 5 provides a general overview of the measurement methodologies that may be used to measure the Quality of Service parameters. The use of test traffic, and the associated measurement architectures, is based on methods specified in ITU-T Rec. X.138. Clauses 6 through 10 present estimation procedures for frame transfer delay, frame delay jitter, frame loss ratio (derived from frame delivery ratio), and data delivery ratio based on the use of OAM Frames. Methods for estimating service availability are for further study.

Annex A provides information on the use of test traffic in conjunction with dedicated monitoring equipment. Note that other measurement devices and procedures that adhere to the performance parameter definitions in ITU-T Recs X.144, X.145 and X.146 are also acceptable for estimating the performance of frame relay public data networks.

1.1 General

The network performance of Frame Relay networks may need to be measured for the following reasons:

- network performance objectives may be included in service level agreements or other contractual arrangements;
- ongoing measurement/assessment of network performance as part of operational procedures;
- to assist network planning: collection of data for network dimensioning purposes;
- network operators may require ongoing knowledge of their network's capabilities as defined by the primary performance parameters;
- Quality of Service parameters may need to be measured for use in other Recommendations;
- National Regulatory Requirements

1.2 Parameters to be measured

ITU-T Recs X.144 and X.145 define performance parameters which specify the Quality of Service of a Frame Relay virtual connection. ITU-T Rec. X.146 defines various QoS classes. The QoS classes are characterized by distinct combinations of objective values for the following primary performance parameters:

- Frame Transfer Delay (FTD);
- Frame Delay Jitter (FDJ);
- Frame Loss Ratio (FLR) (derived from Frame Delivery Ratio).

These primary parameters, when taken together with the derived parameter of service or network availability, define the overall quality of the data transfer phase of a frame relay connection.

The measurement techniques defined in this Recommendation are applicable to both PVCs and SVCs since in both cases measurement of the performance parameters is related to the data transfer phase of a FR connection.

1.3 Accuracy requirements of measurements

1.3.1 Measurement objectives

In measuring network performance, there is always a cost versus sample size tradeoff which must be resolved when attempting to estimate a given performance parameter. As the cost of taking an observation can have a considerable effect on the final estimate achieved, this Recommendation does not recommend a minimum number of observations. However, a sufficient number of measurements must be made in order to obtain statistical significance. Additionally, in certain situations, estimating the parameter with a high level of precision may not be required. For example, estimating Frame Transfer Delay to within between 2 ms may be adequate for most planning and monitoring purposes.

Estimates of means, variances, percentile, modes, maxima and minima are all examples of statistical descriptors which may be used to quantify the performance achieved by a specific parameter. In reporting any such estimated parameters, it is always recommended that a measure of the precision of the estimate be included. The variance of the estimate, or a confidence interval about the estimate, are two common methods of expressing the estimate's precision.

1.3.2 Reference events

The time of occurrence of various reference events is the basis for the definitions of the speed of service parameters (i.e, FTD and FDJ) listed above. In this Recommendation, times are specified with respect to exit and entry events relative to the test equipment. Thus, the time of occurrence of an entry event into such a DTE is the time at which the last bit of the closing flag of the frame enters the DTE from a circuit section, and the time of occurrence of an exit event from such a DTE is the time at which the first bit of the address field of the frame enters the circuit section from the DTE.

The exact definition of a Frame Reference Event for the user information transfer parameters is given in ITU-T Rec. X.144.

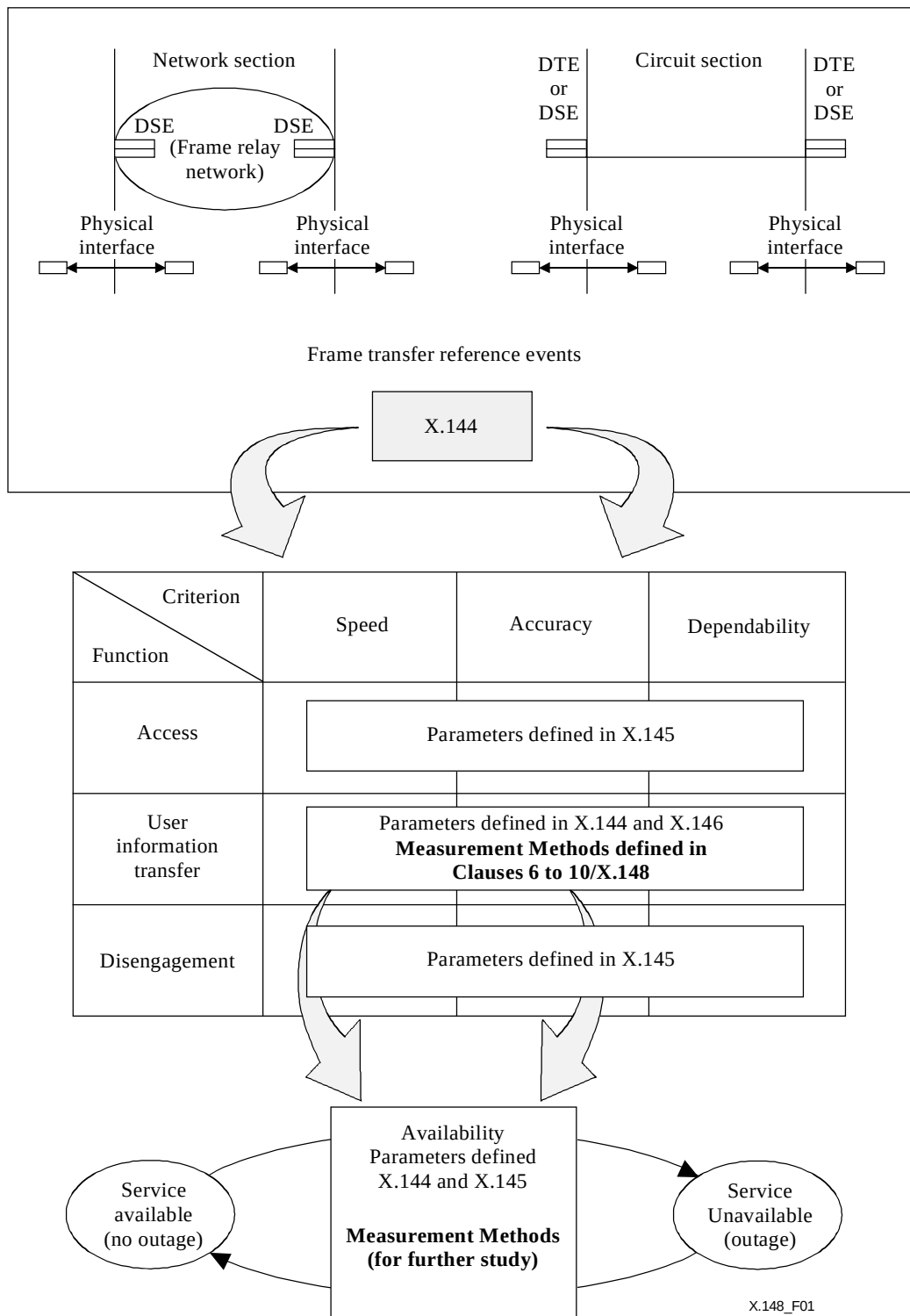


Figure 1/X.148 – Scope of ITU-T Rec. X.148

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 G.114 (2003), *One-way transmission time*.
- ITU-T Recommendation I.610 (1999), *B-ISDN operation and maintenance principles and functions*.
- ITU-T Recommendation I.620 (1996), *Frame relay operation and maintenance principles and functions*.
- 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.138 (1997), *Measurement of performance values for public data networks when providing international packet-switched services*.
- ITU-T Recommendation X.139 (1997), *Echo, drop, generator and test DTEs for measurement of performance values in public data networks when providing international packet-switched services*.
- ITU-T Recommendation X.140 (1992), *General quality of service parameters for communication via public data networks*.
- ITU-T Recommendation X.144 (2000), *User information transfer performance parameters for data networks providing international frame relay PVC service*.
- ITU-T Recommendation X.145 (1996), *Performance for data networks providing international frame relay SVC service*.
- ITU-T Recommendation X.146 (2000), *Performance objectives and quality of service classes applicable to frame relay*.
- Frame Relay Forum Implementation Agreement 19, FRF.19 (2001), *Frame Relay Operations, Administration, and Maintenance Implementation Agreement*.

3 Definitions

The terms and definitions used in this Recommendation are consistent with those defined in ITU-T Recs X.36, X.76, X.138, X.139, X.144, X.145, X.146, I.620, I.610 and Frame Relay Forum Implementation Agreement FRF.19.

4 Abbreviations

This Recommendation uses the following abbreviations:

CIR	Committed Information Rate
DCE	Data Circuit Terminating Equipment
DDR	Data Delivery Ratio

DE	Discard Eligibility
DLCI	Data Link Connection Identifier
DSE	Data Switching Exchange
DTE	Data Terminal Equipment
EFR	Extra Frame Rate
EIR	Excess Information Rate
FDJ	Frame Delay Jitter
FDR	Frame Delivered Ratio
FE	Frame Layer Reference Event
FLR	Frame Loss Ratio
FR	Frame Relay
FRF	Frame Relay Forum
FROMP	Frame Relay OAM Maintenance Point
FTD	Frame Transfer Delay
IF	Information Field
ISDN	Integrated Services Digital Network
MP	Maintenance Point
MTBSO	Mean Time Between Service Outages
MTTSR	Mean Time To Service Restoral
NLPID	Network Layer Protocol ID
OAM	Operations, Administration and Maintenance
PVC	Permanent Virtual Connection
RFER	Residual Frame-Error Ratio
RTD	Round Trip Delay
SA	Service Availability
SLA	Service Level Agreement
SVC	Switched Virtual Connection
TE	Terminal Equipment
TNS	Transit Network Section

5 Measurement Methodologies

This clause provides an overview of the measurement methodologies that may be used to measure the Quality of Service parameters for public Frame Relay data networks as specified in ITU-T Recs X.144, X.145 and X.146, together with general considerations for measuring the performance parameters. In general, two approaches may be used to estimate/monitor the network performance:

- a) use of test traffic;
- b) use of OAM frames.