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Kakovost prenosa govora in večpredstavnih vsebin (STQ) - Metrika kakovosti storitev (QoS) in zmogljivosti omrežja ter merilne metode - 3. del: Metode metrike in merjenja zmogljivosti omrežij v omrežjih IP

Speech and multimedia Transmission Quality (STQ) - QoS and network performance metrics and measurement methods - Part 3: Network performance metrics and measurement methods in IP networks

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ETSI Guide

**Speech and multimedia Transmission Quality (STQ);
QoS and network performance metrics and
measurement methods;
Part 3: Network performance metrics and
measurement methods in IP networks**

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Foreword

This ETSI Guide (EG) has been produced by ETSI Technical Committee Speech and multimedia Transmission Quality (STQ).

The present document is part 3 of a multi-part deliverable covering the QoS and network performance metrics and measurement methods, as identified below:

- Part 1: "General considerations";
- Part 2: "Transmission Quality Indicator combining Voice Quality Metrics";
- Part 3: "Network performance metrics and measurement methods in IP networks";**
- Part 4: "Indicators for supervision of Multiplay services";

Introduction

<https://standards.iteh.ai/catalog/standards/sist/d9c50aab-3141-4549-9370-d1bb659eef8b/sist-v-etsi-eg-202-765-3-v1-1-1-2016>

The need to define Internet performance metrics and measurement methodologies stems from the need to compare different measurements and to measure performance with a reproducible and unambiguous methodology, independent from transmission technology and implementation details. Both the ITU-T Study Group 12 and the IETF IPPM Working Group have produced such definitions (see table 1), although each with a different emphasis closely linked to the historical background of both organizations. The ITU has its origins in telephony, while the IETF has a data networking background. Whereas the ITU emphasizes the evaluation of a service and its quality, the IETF measures the network and wants to provide the IT-community with an accurate, common understanding and measurement of the performance and reliability the Internet [i.3].

In most cases this results in different terminology rather than in incompatibilities; most differences in approach and emphasis serve the different intended use of each metric, but have no operational significance. In some cases the terminology used by each organisations can be mapped to the other, while in some others there is only approximate equivalence (e.g. ITU network section versus an IPPM cloud; one focuses on corresponding events while the other measures the fate of a single packet). Other terms have no correspondence. For example, ITU-T Recommendation I.380 [i.38] has a notion of an IP packet transfer reference event while IPPM defines "wire time".

Other differences between IETF and ITU-T metrics result from their intended application. ITU-T metrics seek to provide a common language for providers to communicate about performance, so the ITU-T metrics do not concentrate on performance within a single network, while the IETF focuses on performance measurement protocols and implementation. ITU-T seeks to evaluate service and to exclude unfair use, while the IETF seeks to measure network quantities and avoid biased measurement results. Due to their respective backgrounds, the ITU generally produces statistical metrics geared towards a quantitative representation of the complete end-to-end user experience while the IETF IPPM working group mainly focuses more on statistical metrics which provide a detailed technical view of different aspects of transmission quality along the network path.

Table 1: Overview of Relevant Standards

	IETF RFCs	ITU-T Recommendations
Framework	RFC 2330 [i.3]	Y.1540 [i.1], sections 1 through 5
Loss	RFC 2680 [i.6]	Y.1540 [i.1], section 5.5.6 G.1020 [i.23]
Delay	RFC 2679 [i.5] (One-way) RFC 2681 [i.7] (Round Trip)	Y.1540 [i.1], section 6.2 G.1020 [i.23] G.114 [i.22] (One-way)
Delay Variation	RFC 3393 [i.10]	Y.1540 [i.1], section 6.2.2 G.1020 [i.23]
Connectivity / Availability	RFC 2678 [i.4]	Y.1540 [i.1], section 7
Loss Patterns	RFC 3357 [i.9]	G.1020 [i.23]
Packet Reordering Packet Duplication	RFC 4737 [i.15]	Y.1540 [i.1], sections 5.5.8.1 and 6.6 Y.1540 [i.1], sections 5.5.8.3, 5.5.8.4, 6.8, and 6.9
Link/Path Bandwidth Capacity, Link Utilization, Available Capacity	RFC 5136 [i.31]	
Bulk Transport Capacity	RFC 3148 [i.8], RFC 5136 [i.31]	

The goal of the present document is to define network performance metrics for applications sensitive to quality of service such as Voice over IP, referring to the existing work produced by both IETF and ITU-T. The present document highlights the differences between the two standards and provides guidelines on resolving these differences, when they are due to addressing different goals.

The scope of the present document is limited to IP performance metrics relevant for data transmission over IP-based networks for use in QoS sensitive applications. For each addressed metric, the document recommends one or more measurement methods. The document only focuses on intrinsic network QoS metrics; perceived QoS metrics applicable for voice transmission are out of scope of the present document.

The remainder of the present document is organised as follows: Clause 4 describes the definitions of the most important performance metrics as defined by the standard bodies and methods for measuring them, and discusses the applicability of the definitions and the differences between them. Clause 5 discusses other metrics applicable to QoS. Finally, clause 6 gives an overview of relevant QoS measurement standards, which can be used in end to end performance evaluation.

1 Scope

The present document provides an overview of the common metric definitions and measurement method specifications upon which the interoperability of network performance measurement (also called QoS measurement) is based. Two different standardisation bodies, the Internet Engineering Task Force (IETF) and the International Telecommunication Union - Telecommunication Standardization Sector (ITU - T), have addressed this issue. The present document addresses the following points:

- Survey the existing network performance related IETF standards and how these standards can be applied to end-to-end network performance measurements. The scope of this work is also to discuss the relationship of those standards to those of ITU-T and ETSI.
- Discuss and compare definitions of metrics used to specify and assess performance in IP networks. The metrics addressed in the present document are those defined by the IETF IPPM working group and ITU-T Study Group 12. Besides comparing the different definitions, the present document gives applicability guidelines on which metric is more appropriate for a particular application, configuration or scenario.
- Define measurement methods for selected performance metrics in IP networks, addressing both active and passive methods. Clarifying guidelines are given.

NOTE: All text sections in the remainder of the present document which are enclosed in quotation marks (") and *formatted in italic style* denote citations taken verbatim from referenced documents.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
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 - for informative references.

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NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

Not applicable.

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

- [i.1] ITU-T Recommendation Y.1540: "Internet protocol data communication service - IP packet transfer and availability performance parameters".
- [i.2] Void.
- [i.3] IETF RFC 2330: "Framework for IP Performance Metrics". V. Paxson, G. Almes, J. Mahdavi, M. Mathis. May 1998.
- [i.4] IETF RFC 2678: "IPPM Metrics for Measuring Connectivity". J. Mahdavi, V. Paxson. September 1999.
- [i.5] IETF RFC 2679: "A One-way Delay Metric for IPPM". G. Almes, S. Kalidindi, M. Zekauskas. September 1999.
- [i.6] IETF RFC 2680: "A One-way Packet Loss Metric for IPPM". G. Almes, S. Kalidindi, M. Zekauskas. September 1999.
- [i.7] IETF RFC 2681: "A Round-trip Delay Metric for IPPM". G. Almes, S. Kalidindi, M. Zekauskas. September 1999.
- [i.8] IETF RFC 3148: "A Framework for Defining Empirical Bulk Transfer Capacity Metrics". M. Mathis, M. Allman. July 2001.
- [i.9] IETF RFC 3357: "One-way Loss Pattern Sample Metrics". R. Koodli, R. Ravikanth. August 2002.
- [i.10] IETF RFC 3393: "IP Packet Delay Variation Metric for IP Performance Metrics (IPPM)". C. Demichelis, P. Chimento. November 2002.
- [i.11] Void <https://standards.iteh.ai/catalog/standards/sist/d9c50aab-3141-4549-9370-d1bb659eef8b/sist-v-etsi-eg-202-765-3-v1-1-1-2016>
- [i.12] Void.
- [i.13] Void.
- [i.14] IETF RFC 4656: "A One-way Active Measurement Protocol (OWAMP)". S. Shalunov, B. Teitelbaum, A. Karp, J. Boote, M. Zekauskas. September 2006.
- [i.15] IETF RFC 4737: "Packet Reordering Metrics". A. Morton, L. Ciavattone, G. Ramachandran, S. Shalunov, J. Perser. November 2006.
- [i.16] Void.
- [i.17] Void.
- [i.18] IETF RFC 5101: "Specification of the IPFIX Protocol for the Exchange of IP Traffic Flow Information". B. Claise, S. Bryant, S. Leinen, T. Deitz, B. Trammell. January 2008.
- [i.19] IPFIX Architecture. N. Brownlee et Al. Internet-Draft, work in progress.
- [i.20] IETF RFC 5102: "IPFIX Information Model". J. Quittek et Al. January 2008.
- [i.21] "IPFIX Applicability Statement". T. Zseby, E. Boschi, N. Brownlee, B. Claise. Internet-Draft, work in progress.
- [i.22] ITU-T Recommendation G.114 (05/03): "One-way transmission time".
- [i.23] ITU-T Recommendation G.1020 (07/06): "Performance parameter definitions for quality of speech and other voiceband applications utilizing IP networks".

- [i.24] IETF RFC 3917: "Requirements for IP Flow Information Export". J. Quittek, T. Zseby, B. Claise, S. Zander. October 2004.
- [i.25] Void.
- [i.26] Void.
- [i.27] Void.
- [i.28] Void.
- [i.29] "Reporting Metrics: Different Points of View", A. Morton, G. Ramachandran, G. Maguluri, work in progress, draft-morton-ippm-reporting-metrics-02.
- NOTE: <http://tools.ietf.org/html/draft-morton-ippm-reporting-metrics-02>, and the derived presentation "Reporting Metrics: Different Points of View" presented by Al Morton on IETF66 July 2006, <http://www3.ietf.org/proceedings/06jul/slides/ippm-2.pdf>.
- [i.30] IETF RFC 3611: "RTP Control Protocol Extended Reports (RTCP XR)", T. Friedman, R. Caceres, A. Clark. November 2003.
- [i.31] IETF RFC 5136: "Defining Network Capacity", P. Chimento, J. Ishac. February 2008.
- [i.32] IETF RFC 2581: "TCP Congestion Control", M. Allman, V. Paxson, W. Stevens. April 1999.
- [i.33] IETF RFC 5357: "A Two-Way Active Measurement Protocol (TWAMP)", K. Hedayat, R. Krzanowski, A. Morton, K. Yum, J. Babiarz. October 2008.
- [i.34] IETF RFC 1122: "Requirements for Internet Hosts - Communication Layers", R. Braden ed. October 1989.
- [i.35] IETF RFC 3550: "User Accounts for UCSB On-Line System".
- [i.36] IETF RFC 1633: "Integrated Services in the Internet Architecture: an Overview".
- [i.37] IETF RFC 2216: "Network Element Service Specification Template".
- [i.38] ITU-T Recommendation I.380: "Internet protocol data communication service - IP packet transfer and availability performance parameters".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in RFC 2330 [i.3], ITU-T Recommendation G.1020 [i.23] and RFC 2680 [i.6] apply.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

T, t	Time
T _{max}	Time threshold
dT	Time difference

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ASON	Automatically Switched Optical Network
ATM	Asynchronous Transfer Mode
BTC	Bulk transport Capacity
DNS	Domain Name System
ESD	End System Delay
FTP	File Transfer Protocol
HTTP	HyperText Transfer Protocol
ICMP	Internet Control Message Protocol
IETF	Internet Engineering Task Force
IPDV	IP Packet Dealy Variation
IPFIX	IP Flow Information eXport
IPLR	IP Packet Loss Ratio
IPPM	IP Performance Metrics
IPTD	IP Packet Transfer Delay
ITU-T	International Telecommunication Union - Telecommunication standardisation sector
MIB	Management Information Base
NSE	Network Section Ensemble
OP	Observation Point
OWAMP	One Way Active Measurement Protocol
OWD	One Way Delay
PDV	Packet Delay Variation
PIA	Percent IP service Availability
PON	Passive Optical Network
PSAMP	Packet SAMPling
QoS	Quality of Service
RFC	Request For Comments
RTCP	Real Time Control Protocol
RTD	Round Trip Delay
RTP	Real-Time Transport Protocol
RTT	Round Trip Time
SDH	Synchronous Digital Hierarchy
SLA	Service Level Agreement
TCP	Transmission Control Protocol
TWAMP	Two-Way Active Measurement Protocol
UTC	Coordinated Universal Time
VoIP	Voice over IP

4 Performance Metrics Definitions and Measurement Methods

This clause provides common definitions for network performance metrics. These definitions are based, whenever possible, on existing definitions proposed by other relevant standard bodies such as IETF or ITU-T. Note that the different definitions of similar metrics are in most cases compatible, that is, semantically equivalent or easily convertible into one another.