International Telecommunication Union

ITU-T
TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Y.1540
Amendment 1
(01/2016)

SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT-GENERATION NETWORKS

Internet protocol aspects – Quality of service and network performance

Internet protocol data communication service – IP packet transfer and availability performance parameters

Amendment 1: New Appendix IX – Explanation of TCP-based measurement inadequacy to meet normative requirements

Recommendation ITU-T Y.1540 (2011) – Amendment 1

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Recommendation ITU-T Y.1540

Internet protocol data communication service – IP packet transfer and availability performance parameters

Amendment 1

New Appendix IX – Explanation of TCP-based measurement inadequacy to meet normative requirements

Summary

Amendment 1 to Recommendation ITU-T Y.1540 adds Appendix IX, which clarifies the Recommendation's status as a measurement method by comparing the TCP protocol to the requirements given in clause 6.12 of the Recommendation.

Readers of the Recommendation may find it useful to understand the implications of the normative requirements given in clause 6.12 when considering measurement methodologies, especially those based on available implementations of the TCP protocol. While TCP-based measurements are considered useful for informative surveys of user experience, they do not constitute the basis for standard metrics, methods of measurement or numerical objectives.

History

Edition	Recommendation	Approval	Study Group	Unique ID[*]
1.0	ITU-T I.380	1999-02-26	13	11.1002/1000/4573
1.0	ITU-T Y.1540	1999-02-26	13	11.1002/1000/5302
2.0	ITU-T Y.1540	2002-12-14	13	11.1002/1000/6189
2.1	ITU-T Y.1540 (2002) Amd. 1	2003-08-01	13	11.1002/1000/6975
3.0	ITU-T Y.1540	2007-11-13	12	11.1002/1000/9270
3.1	ITU-T Y.1540 (2007) Amd.1	2009-03-19	12	11.1002/1000/9727
4.0	ITU-T Y.1540	2011-03-01	12	11.1002/1000/11079
4.1	ITU-T Y.1540 (2011) Amd.1	2016-01-21	12	11.1002/1000/12761

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[*] To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

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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 received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

Recommendation ITU-T Y.1540

Internet protocol data communication service – IP packet transfer and availability performance parameters

Amendment 1

New Appendix IX - Explanation of TCP-based measurement inadequacy to meet normative requirements

(This appendix does not form an integral part of this Recommendation.)

IX.1   Introduction

Readers of this Recommendation may find it useful to understand the implications of the normative requirements in clause 6.12 of the Recommendation when considering measurement methodologies, especially those based on available implementations of the TCP protocol. While TCP-based measurements are considered useful for informative surveys of user experience, they do not constitute the basis for standard metrics, methods of measurement or numerical objectives. Comparison of TCP protocol with the requirements of clause 6.12 in this appendix clarifies its status as a measurement method.

IX.2   Comparison with normative requirements

The requirements in clause 6.12 are organized in two numbered lists. The first requirement list is for all parameters, and the second list is for parameters that assess the ability to sustain a given IP packet transfer rate.

For the first list of requirements (all parameters):

1) Regarding the required accounting for packet delivery into the network and successful transfer: Some versions of TCP may make available the count of re-transmitted segments during a connection (through a management interface), but retransmissions are based on the adaptive retransmission time out (RTO), not on whether the packets were actually lost, or are acknowledged after the time out expires, or whether an ACK was lost following successful delivery. TCP receivers do not distinguish whether the original or retransmitted (or both) packets arrive successfully. Furthermore, different TCP congestion control algorithms vary in their methods to achieve fairness to other flows and throughput, resulting in a larger number of lost packets when aggressive algorithms are used, or resulting in unnecessarily lower sending rates when packet losses are incorrectly interpreted as a signal of congestion (note the fixed mapping of packet loss interpreted as congestion in TCP flow control).

2) Regarding the required ability to measure partial paths: TCP's congestion control is highly sensitive to round-trip-time (RTT) in non-linear and sometimes unexpected ways. Thus, a TCP-based measurement on a partial path (EL or NS) will not typically predict the performance of a complete path, and TCP's dependence on RTT is one key reason.

For the list of requirements for assessment of sustained packet rate:

1) Regarding the required description of the traffic pattern offered to the network: TCP slow-start and congestion avoidance phases determine the sending pattern, and these patterns vary widely according to the conditions on the path, especially the presence of cross-traffic and characteristics of any bottlenecks encountered. Thus, the pattern is difficult or impossible to constrain or predict with TCP's flow control operating.

2)   Regarding the requirement to limit traffic rate to less than the capacity of connecting links: TCP's flow control continues to test for available capacity, assuming that conditions may change. It is not practical to limit a TCP sender to an exact capacity using the parameters available, partly due to the variation of RTT during the life of a TCP connection. In other words, TCP can always send traffic at a rate that exceeds connecting links.

Note that all difficulties caused by TCP flow control are further exacerbated by operating multiple simultaneous TCP connections, each independently evaluating their connection on the same path.

In conclusion, the transport protocol is determined and implemented in user hosts, and outside the purview of IP-based packet transfer service providers. Standard assessments of the service provider performance should avoid the contribution of layers that are chosen by others and must meet the normative requirements of clause 6.12 of this Recommendation.

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