INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

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STANDARDIZATION SECTOR
OF ITU

Y.1541

Amendment 2

(02/2004)

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

Internet protocol aspects – Quality of service and network performance

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Network performance objectives for IP-based services

Amendment 2: New Appendix XI: Concatenating QoS values

ITU-T Recommendation Y.1541 (2002) – Amendment 2

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

ITU-T Recommendation Y.1541

Network performance objectives for IP-based services

Amendment 2

New Appendix XI: Concatenating QoS values

Source

Amendment 2 to ITU-T Recommendation Y.1541 (2002) was agreed on 12 February 2004 by ITU-T Study Group 13 (2001-2004).

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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New Appendix XI: Concatenating QoS values

XI.1 Introduction

This appendix addresses the derivation of the UNI-UNI performance of a path, knowing the performance of each section. The purpose is to provide information and aid the appreciation for this complex and important topic.

These rules produce reasonable estimates of the UNI-UNI performance. Errors in the estimation process are believed to be in balance with potential errors of the individual values themselves. When the values come from recent measurements or modelling activities, they can be subject to considerable error if conditions or assumptions are not stationary.

This information is intended to support flexible allocations facilitated by QoS signalling protocol(s). The rules must not be used to support fixed allocation of UNI-UNI values.

XI.2 Concatenating values

For the Mean Delay (IPTD) performance parameter, the UNI-UNI performance is the sum of the means contributed by Network Sections.

For the Loss Ratio (IPLR) performance parameter, the UNI-UNI performance is the sum of the values contributed by Network Sections. Note that this approximation is dependent on the low value of the IPLR objective at 10^{-3}, and that Network Sections will usually offer values $< 10^{-3}$ if they intend to meet the UNI-UNI objective. It also requires that the number of Network Sections should be <<1/IPLR, but this is not a limiting factor at these expected loss ratios. This method allows easy calculation at intermediate points along the UNI-UNI path. Error could be appreciable if the IPLR objective were 10^{-2} or higher.

A more accurate method of IPLR concatenation is to invert the probability of successful packet transfer across *n* Network Sections, as follows:

$$IPLR_{UNI\text{-}UNI} = 1 - \{ (1 - IPLR_{NS1}) \times (1 - IPLR_{NS2}) \times (1 - IPLR_{NS3}) \times ... \times (1 - IPLR_{NSn}) \}$$

For the Errored Packet Ratio (IPER) performance parameter, the UNI-UNI performance is the sum of the values contributed by Network Sections. Note that this approximation is dependent on the low value of the IPER objective at 10^{-4}, and that Network Sections will usually offer values $< 10^{-4}$ if they intend to meet the UNI-UNI objective. Here too, inverting the error-free packet transfer probability may yield a more accurate value.

The procedures for deriving the UNI-UNI Delay Variation (IPDV) performance from the Network Section values must recognize their sub-additive nature and cannot be calculated accurately without considerable information about the individual delay distributions. If, for example, characterizations of independent delay distributions are known or measured, they may be convolved to estimate the combined distribution. This detailed information will seldom be shared among operators, and may not be available in the form of a continuous distribution. As a result, the UNI-UNI IPDV estimation is the least accurate process of all.

The rule for assessing the UNI-UNI IPDV performance from the portion values is based on categorizing the Minimum minus the 99.9th percentile of 1-way delay for each Network Section into 10 ms bands (0 < IPDV ≤ 10 ms, 10 ms < IPDV ≤ 20 ms, etc., where each category is referred to by its upper limit). The number of sections allowed in each category depends on the largest one present in the UNI-UNI path. The values in the table below are <u>based on meeting the 50 ms IPDV objective</u>, and allow an assessment of whether the objective will be met (as opposed to estimating the concatenated IPDV). This method allows simplified reporting of IPDV performance, making practical implementation more likely.

Table XI.1/Y.1541 – Concatenating network sections to meet the 50 ms IPDV objective

Largest IPDV category present	**Number of network sections allowed in each IPDV category (given the largest IPDV category present in the path)**				
	≤ 50	**≤ 40**	**≤ 30**	**≤ 20**	**≤ 10**
≤ 50	1				
≤ 40		1		1	
		1			2
≤ 30			2		
			1	1	2
			1	2	1
			1		4
≤ 20				3	1
				2	4
				1	6
≤ 10					7

NOTE – The values of Table XI.1 are provisional and subject to change following further study and experience with network performance. The current values implement conservative limits, and the number of allowed network sections in the UNI-UNI path may be increased in the future. Grey cells are not possible.

When determining whether the concatenated IPDV of one or more networks in the UNI-UNI path will meet the 50 ms objective, use the following procedure:

1) Identify the largest IPDV category occupied by any network.
2) Find this category in the left-most column of Table XI.1/Y.1541.
3) The rows associated with this largest IPDV category contain the limits for networks in smaller categories.

Examples of this procedure follow:

If the network with largest IPDV is in the ≤ 50 ms category, then the end-end path can only have one such network and still meet the 50 ms objective (as shown in the first row).

If the network with largest IPDV is in the ≤ 40 ms category, then the end-end path can only have one such network in combination with one network in the ≤ 20 ms category and still meet the 50 ms objective (as shown in the second row). Alternatively, one ≤ 40 ms network in combination with two networks in the ≤ 10 ms category (as shown in the third row) are allowed.

We recognize the suggestion that IPDV values are additive on a RMS (root mean square) basis (i.e., variances are additive under some circumstances), but that method is not used here.

Other concatenation heuristics have been suggested. One requires knowledge of both the 99th and 99.9th percentiles of IPDV for each section. The UNI-UNI IPDV estimate is the 99.9th percentile of the section with the largest variation, summed with the 99th percentiles of all other sections.

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