INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Y.1541
Appendix X
(11/2002)

SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE AND INTERNET PROTOCOL ASPECTS

Internet protocol aspects – Quality of service and network performance

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Network performance objectives for IP-based services

Appendix X: Speech quality calculations for Y.1541 hypothetical reference paths

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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

Appendix X

Speech quality calculations for Y.1541 hypothetical reference paths

Source

Appendix X to ITU-T Recommendation Y.1541 was approved by ITU-T Study Group 13 (2001-2004) on 8 November 2002.

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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X.1 Introduction

One of the many applications of Y.1541 IP Network QoS Classes will be Voice over IP, or VoIP. It is possible to estimate the speech quality of IP Networks using the G.107 Transmission planning tool, also known as the E-model.

X.2 Reference connection

Appendix III gives assumptions and configuration details of calculations for Network (UNI-UNI) and endpoint delay. The example endpoint assumptions include codec (G.711), packet size, packet loss concealment, de-jitter buffer size, etc. Alternate speech codecs with lower bit rates, alternate packet sizes, and other variations are possible.

Figure X.1 gives the reference connection for this analysis.

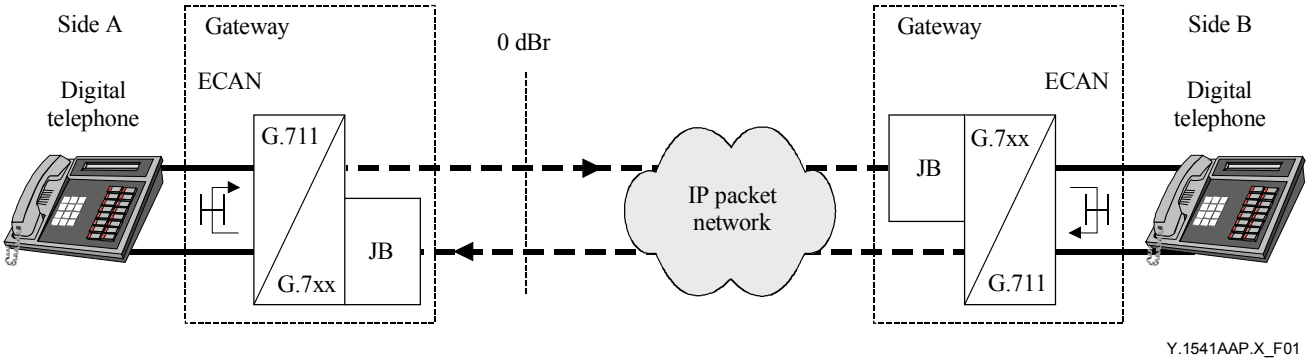

Figure X.1/Y.1541 – Reference Connection

Additional details on the reference end-systems may be found in Appendix III.

Table X.1/Y.1541 – E-model parameters

Parameters		Model input values		
Symbol	**Definition**	**G.107 default**	**Input values**	**Unit**
Nc	Electric Circuit Noise Referred to at the 0 dBr point	(–70)	–70.0	dBm0p
Pos	Room Noise (Send)	(35)	35.0	dB(A)
Por	Room Noise (Receive)	(35)	35.0	dB(A)
SLR	Send Loudness Rating	(8)	8.0	dB
RLR	Receive Loudness Rating	(2)	2.0	dB
Ds	D-factor (Send)	(3)	3.0	
LSTR	Listener's Sidetone Rating	(equ.)	18.0	dB
Nfor	Noise Floor	(–64)	–64.0	dBmp
STMR	Sidetone Masking Rating	(15)	15.0	dB
qdu	Quantizing Distortion Units	(1)	1.0	units
T	Mean One-Way Delay	(0)	**150.0**	ms
TELR	Talker Echo Loudness Rating	(65)	65.0	dB
WEPL	Weighted Echo Path Loss	(110)	110.0	dB
Ta	Absolute Delay from (S) to (R)	(0)	**150.0**	ms
Tr	Round-Trip Delay	(0)	**300.0**	ms
Ie	Equipment Impairment Factor	(0)	0.0	
A	Expectation Factor	(0)	0.0	
Dr	D-factor (Receive)	(3)	3.0	

We have assumed the default values for all parameters, except T, Ta, and Tr. The mean absolute 1-way delay was calculated using 100 ms for network delay (UNI-UNI, conforming to the QoS Class 0 objective) and 50 ms for the end-terminal, including G.711 packetization and de-jitter buffer (100 + 50 = 150 ms = T = Ta = Tr/2). Here, R = 89.5.

Packet loss also influences speech quality. We include a column below where approximately 0.1% loss results in Ie≈1.9 when packet loss concealment is Repeat 1, followed by silence, and Ie≈0.5 with Appendix I/G.711 PLC.

Appendix III also provides calculations showing longer mean network delays, and larger terminal delays. Table X.2 summarizes the findings.

Table X.2/Y.1541 – E-model results with Y.1541 hypothetical reference paths and end-terminals

Network, mean 1-way delay, ms	Terminal mean 1-way delay, ms	Total, mean 1-way delay, ms	Packet size, ms	Packet loss conceal.	R, no loss	R, with ~0.1% packet loss	Y.1541 QoS class
100	50	150	10	Rpt.1/Sil	89.5	87.6	0
100	80	180	20	G.711ApI	87.8	87.3	0
150	80	230	20	G.711ApI	81.9	81.4	1
233	80	313	20	G.711ApI	71.1	70.6	1

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