INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.114
Appendix II
(09/2003)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

International telephone connections and circuits – General Recommendations on the transmission quality for an entire international telephone connection

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Appendix II:
Guidance on one-way delay for Voice over IP

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/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.

APPENDIX II

(to ITU-T Recommendation G.114)

Guidance on One-way Delay for Voice over IP

II.1 Introduction

This appendix gives additional guidance on the application of Recommendation G.114. The main purpose is to provide practical information for end-to-end VoIP network planning. Also, this appendix provides a linkage to the IP Network delay objectives in Recommendation Y.1541.

II.2 Achieving Satisfactory Delay

For many *intra-regional* (e.g., within Africa, Europe, North America) routes in the range of 5000 km or less, users of VoIP connections are likely to experience mouth-to-ear delays < 150 ms. Appendix III/Y.1541 illustrates this calculation using reference terminals with a total of 50 ms mean delay (10 ms packets). The calculation shows that the 100 ms objective of Y.1541's Class 0 can be met with a well-engineered access network (with a T1 or E1 rate or larger as Y.1541 requires) and with as many as 12 network routers. Appendix X/Y.1541 shows that similar speech quality can be maintained with reference terminals contributing a total delay of a less stringent 80 ms (using 20 ms packets and robust packet loss concealment).

For *inter-regional* routes covered terrestrially, even those traversing the 27,500 km of the ITU's traditional worst-case Hypothetical Reference Connection, a VoIP mouth-to-ear path is likely to see a delay of just over 300 ms. This assumes terminals contributing a total of 80 ms delay (20 ms packets), a well-engineered access network and supporting IP network paths encountering 20 or fewer network routers (as per Appendix III/Y.1541). Of course, it is extremely unlikely that the worst case of 27,500 km will be encountered by many calls. For the much more frequent inter-regional calls of, for example, 10, 000 km or less, the corresponding delays would be approximately 225 ms – certainly not as low (or as desirable) as 150 ms, but still quite satisfactory for the vast majority of users.

Whilst delays in the mid-200 ms range may not be a serious problem for long inter-regional calls, where users expect calls to be somewhat different from regional calls, it is critical that network planners do not allow local and regional calls to encounter such delays because user expectations are that such calls be completely delay-transparent.

Whilst it is recognised that using VoIP technologies will increase the delays well above that of non-packetized TDM transmission, this analysis demonstrates that the widespread use of end-end VoIP need not cause problematic delays if appropriate care and planning is exercised.