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

**International telephone connections and circuits –
Transmission plan aspects of special circuits and
connections using the international telephone connection
network**

**Transmission planning for voiceband services
over hybrid Internet/PSTN connections**

ITU-T Recommendation G.177

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION G.177**TRANSMISSION PLANNING FOR VOICEBAND SERVICES OVER HYBRID
INTERNET/PSTN CONNECTIONS****Summary**

This Recommendation provides transmission performance guidelines for voiceband services over networks that are an interconnection of an IP network (e.g. "the Internet") and the PSTN. As modern telecommunications systems continue to evolve, hybrid networks of various kinds will become more prevalent. This tendency, together with the reality that voiceband communications will be an important source of traffic on such networks, has led ITU-T to develop this Recommendation. The intent is to provide to a wide audience a set of principles on transmission performance aspects of hybrid Internet/PSTN connections.

Source

ITU-T Recommendation G.177 was prepared by ITU-T Study Group 12 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on 30 September 1999.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. The 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 Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 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 term *recognized operating agency (ROA)* includes any individual, company, corporation or governmental organization that operates a public correspondence service. The terms *Administration*, *ROA* and *public correspondence* are defined in the *Constitution of the ITU (Geneva, 1992)*.

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As of the date of approval of this Recommendation, the 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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Recommendation G.177**TRANSMISSION PLANNING FOR VOICEBAND SERVICES OVER HYBRID
INTERNET/PSTN CONNECTIONS***(Geneva, 1999)***1 Scope, purpose and application****1.1 Scope**

This Recommendation provides transmission planning guidelines for voiceband services over connections that include Internet and PSTN segments, i.e. hybrid Internet/PSTN connections. In particular, "voice over the Internet" or "Voice over Internet Protocol" (VoIP) connections are considered, where at least part of the connection is over an Internet Protocol (IP) network. PSTN-only connections (i.e. connections that begin, end, and are carried only on the PSTN) are considered as the reference against which the performance of other connections is compared.

This Recommendation provides end-to-end transmission performance guidance for hybrid Internet/PSTN connections carrying voiceband services. When one of the terminals is attached to an IP network, it is assumed that this terminal has functionality defined in Recommendation H.323. (The terminal need not be an H.323 terminal, but is assumed to have that functionality.) To support these end-to-end guidelines, guidance is given for interworking functions between Internet and PSTN. The functionality provided by Internet/PSTN gateways presents special performance issues that must be addressed to ensure high quality service. Protocol details of IP and higher level protocols (e.g. TCP, UDP, RTP, RSVP) are not considered in this Recommendation. Rather, the impact on performance of voiceband services of the packetized aspects of IP networks, such as delay associated with packet assembly, lost or discarded packets, is of primary interest here.

The importance of user expectations for voiceband services on hybrid Internet/PSTN networks is recognized. However, this Recommendation does not address this subject, nor does it offer detailed suggestions of how to assess the impact of user expectations on the acceptability of these services. Additional guidance on many of these issues is available in ITU-T P-series and G.100-series Recommendations.

This Recommendation also includes discussion of issues associated with the interworking functions provided by Internet/PSTN gateways.

1.2 Purpose

This Recommendation provides guidance on basic telephony issues involved in providing voiceband services over hybrid Internet/PSTN connections. This information will also be useful to equipment manufacturers, VoIP service providers, Internet Service Providers (ISPs), software developers, and PSTN providers where service goes over a gateway to IP networks. Traditional PSTN engineers will be familiar with the telephony aspects of this Recommendation, but will find useful the material on Internet-specific features of voiceband services over connections that incorporate an Internet segment.

1.3 Application

It is intended that the guidelines provided in this Recommendation be applied by equipment manufacturers, VoIP service providers, ISPs, software developers, and PSTN providers. Those who provide services where the PSTN interconnects with IP networks through a gateway should find this information useful as they design equipment, software and services for voiceband services over

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hybrid Internet/PSTN connections. Application of the guidelines herein by equipment manufacturers, VoIP service providers, Internet Service Providers, software developers, and PSTN providers should enhance the quality of voiceband services delivered over hybrid Internet/PSTN connections. Furthermore, if widespread customer acceptance of VoIP service is desired, the resulting voiceband service quality should approach that of the PSTN.

The guidance in this Recommendation applies to situations/connections where at least part of the connection is on an IP network. Special attention focussed on the "Gateway/Inter-Working Function" (which provides the essential interworking capabilities of these hybrid connections). A major application of this Recommendation will be Internet Telephony where the terminal (e.g. a PC) enjoys H.323 stack functionality. As noted above, this Recommendation will use PSTN-only connections as the reference against which the performance of other connections will be compared.

This Recommendation applies to connections where the data transfer phase occurs over hybrid Internet/PSTN connections. Issues of call set-up, number translation (between PSTN and IP numbering), etc., are not considered in this Recommendation.

This Recommendation applies to IP networks that provide voice telephony in accordance with any of the scenarios described in clause 5, Performance of hybrid Internet/PSTN connections. This Recommendation contains general information on end-to-end quality and the way in which quality is affected by various components in the VoIP system. A description of the relationship of the performance of terminals and of the network is also included.

2 Terminology

This Recommendation defines the following terms:

2.1 hybrid PSTN/Internet: A connection that includes at least one segment where traffic is carried on the PSTN and at least one segment where traffic is carried on a network that uses the Internet Protocol suite.

2.2 gateway/IWF: A connection element that interconnects different networks and performs the necessary translation between the protocols used on those networks.

2.3 interwork: The ability of two networks to be connected and transfer traffic from one to the other.

2.4 H.323-based terminal: A terminal that is either dedicated (e.g. a telephone set) or general purpose (e.g. a computer running an application that performs the terminal function) and that:

- is intended for connection to an IP network;
- provides the functionality defined in Recommendation H.323.

3 Acronyms and Abbreviations

This Recommendation uses the following abbreviations:

%GoB	Per cent Good-or-Better
%PoW	Per cent Poor-or-Worse
ACELP	Algebraic-Code-Excited Linear-Prediction
ACR	Absolute Category Rating
ADPCM	Adaptive Differential Pulse Code Modulation
ADSL	Asymmetric Digital Subscriber Line
ATM	Asynchronous Transfer Mode