



INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.103

(12/98)

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

International telephone connections and circuits – General
definitions

Hypothetical reference connections

ITU-T Recommendation G.103

(Previously CCITT Recommendations)

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ITU-T RECOMMENDATION G.103

HYPOTHETICAL REFERENCE CONNECTIONS

Summary

This Recommendation was revised to introduce Integrated Services Digital Network and Integrated Digital Network Hypothetical Reference Connections, and also to allow for the introduction of ATM Technology into the PSTN. This Recommendation provides a number of Hypothetical Reference Connections that can be used to perform transmission impairment studies.

Source

ITU-T Recommendation G.103 was revised by ITU-T Study Group 12 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 3rd of December 1998.



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FOREWORD

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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.103**HYPOTHETICAL REFERENCE CONNECTIONS**

*(Mar del Plata, 1968; amended at Geneva, 1972, 1976 and 1980;
at Malaga-Torremolinos, 1984; revised in 1998)*

1 Scope

This Recommendation provides a number of Hypothetical Reference Connections. In particular, connections involving hybrid, i.e. analogue/digital networks, and wholly digital networks are addressed. The ongoing transitional problems associated with the conversion of hybrid networks to wholly digital networks are addressed in clause 6.

2 Purpose

A hypothetical reference connection for transmission impairment studies is a model in which the impairments contributed by circuits and exchanges are described.

Such a model may be used by an Administration:

- to examine the effect on transmission quality of possible changes of routing structure, noise allocations, signal processing impairments and transmission losses in national networks; and
- to test national planning rules for prima facie compliance with any statistical impairment criteria which may be recommended by the ITU-T for national systems.

For these purposes, several models are desirable. In each model, the international circuits and exchanges are assumed to be digital. The one wholly digital hypothetical reference connection and the five hybrid reference connections described below should encompass most of the studies required to be undertaken.

Hypothetical reference connections are *not* to be regarded as recommending particular values of loss or noise or other impairments, although the various values quoted are in many cases recommended values. Hypothetical reference connections are not intended to be used for the design of transmission systems.

3 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

- [1] *Transmission planning of switched telephone networks*, ITU, Geneva, 1976.
- [2] CCITT Recommendation E.171 (1988), *International telephone routing plan*.
- [3] ITU-T Recommendation G.101 (1996), *The transmission plan*.
- [4] ITU-T Recommendation G.111 (1993), *Loudness Ratings (LRs) in an international connection*.

- [5] ITU-T Recommendation G.113 (1996), *Transmission impairments*.
- [6] ITU-T Recommendation G.114 (1996), *One-way transmission time*.
- [7] ITU-T Recommendation G.120 (1998), *Transmission characteristics of national networks*.
- [8] ITU-T Recommendation G.121 (1993), *Loudness Ratings (LRs) of national systems*.
- [9] CCITT Recommendation G.726 (1990), 40, 32, 24, 16 kbit/s *Adaptive Differential Pulse Code Modulation (ADPCM)*.
- [10] ITU-T Recommendation M.60 (1993), *Maintenance terminology and definitions*.
- [11] ITU-T Recommendation P.310 (1996), *Transmission characteristics for telephone-band (300 – 3400 Hz) digital telephones*.

4 Composition of hypothetical reference connections

4.1 The composition of the various connections is defined in Figures 1, 2, 3, 4, 5 and 6.

Figure 1 – The longest wholly digital Integrated Services Digital Network (ISDN) international connection with the maximum number of international and national circuits expected to occur in practice.

Figure 2 – The longest Integrated Digital Network (IDN) international connection comprising the maximum number of international and national circuits expected to occur in practice.

Figure 3 – An integrated digital network international connection comprising the maximum number of international circuits and the least number of national circuits expected to occur in practice.

Figure 4 – An international connection comprising the maximum number of digital international circuits and the least number of analogue national circuits expected to occur in practice.

Figure 5 – An international connection of moderate length (i.e. not longer than 2000 km) comprising the most frequent number of international and analogue national circuits. In such a connection, the noise contribution of the national systems would be expected to predominate.

Figure 6 – The longest international connection with the maximum number of digital international and analogue national circuits expected to occur in practice. In such a connection, the noise contribution of the national systems would be expected to predominate. The attenuation distortion, group delay, and group-delay distortion would also be higher than for the IDN case. Such connections are expected to be extremely rare.

4.2 *General remarks applicable to Figures 1, 2, 3, 4, 5 and 6.*

4.2.1 The hypothetical reference connections show the international circuits connected together at 0 dBr and 0 dBr virtual switching points, as they are digital switching points interconnected by digital facilities, instead of –3.5 dBr and –4 dBr points, the values normally assigned to analogue ISC switches. This was felt to be more directly useful to those who might have to use the reference connections in their studies.

It might be felt that it is somewhat inconsistent that the hypothetical reference connections do not use "conventional" analogue ISC –3.5/–4 dBr virtual switching points. However, if the reference connections are drawn using that convention, the noise power figures appearing on the diagram can no longer be the familiar ones that appear elsewhere in other Recommendations. Annex A gives further explanations.

4.2.2 The nomenclature is based on the international routing plan recommended in Recommendation E.171, i.e. ISC = International Switching Centre.