INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.113
Appendix I
(09/99)

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

---

Transmission impairments

Appendix I: Provisional planning values for the equipment impairment factor *Ie*

ITU-T Recommendation G.113 – Appendix I

(Previously CCITT Recommendation)

ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
General definitions	G.100–G.109
General Recommendations on the transmission quality for an entire international telephone connection	**G.110–G.119**
General characteristics of national systems forming part of international connections	G.120–G.129
General characteristics of the 4-wire chain formed by the international circuits and national extension circuits	G.130–G.139
General characteristics of the 4-wire chain of international circuits; international transit	G.140–G.149
General characteristics of international telephone circuits and national extension circuits	G.150–G.159
Apparatus associated with long-distance telephone circuits	G.160–G.169
Transmission plan aspects of special circuits and connections using the international telephone connection network	G.170–G.179
Protection and restoration of transmission systems	G.180–G.189
Software tools for transmission systems	G.190–G.199
INTERNATIONAL ANALOGUE CARRIER SYSTEM	
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TESTING EQUIPMENTS	
TRANSMISSION MEDIA CHARACTERISTICS	G.600–G.699
DIGITAL TRANSMISSION SYSTEMS	
TERMINAL EQUIPMENTS	G.700–G.799
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999

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

ITU-T RECOMMENDATION G.113

TRANSMISSION IMPAIRMENTS

APPENDIX I

Provisional planning values for the equipment impairment factor *Ie*

Source

Appendix I to ITU-T Recommendation G.113 was revised 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)*.

INTELLECTUAL PROPERTY RIGHTS

The ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. The ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

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.

CONTENTS

Page

Recommendation G.113

TRANSMISSION IMPAIRMENTS

APPENDIX I

Provisional planning values for the equipment impairment factor *Ie*

(revised in 1999)

Table I.1 of Ie values refers to non-error conditions. For propagation errors and frame-erasures or packet loss, no definite values are available which would be valid for more than one codec or codec family. In order to help the transmission planner, examples of *Ie* values under conditions of packet loss are given in Tables I.2 and I.3, and for propagation error patterns EP1 and EP2 in Table I.4. These values are provisional only as they were determined in single experiments. In Table I.5, a brief description of the codecs is provided for information.

Table I.1/G.113 – Provisional planning values for the equipment impairment factor *Ie*

Codec type	Reference	Operating rate kbit/s	*Ie* value
ADPCM	G.726, G.727	40	2
	G.721 (1988), G.726, G.727	32	7
	G.726, G.727	24	25
	G.726, G.727	16	50
LD-CELP	G.728	16	7
		12.8	20
CS-ACELP	G.729	8	10
	G.729-A + VAD	8	11
VSELP	IS-54	8	20
ACELP	IS-641	7.4	10
QCELP	IS-96a	8	21
RCELP	IS-127	8	6
VSELP	Japanese PDC	6.7	24
RPE-LTP	GSM 06.10, Full-rate	13	20
VSELP	GSM 06.20, Half-rate	5.6	23
ACELP	GSM 06.60, Enhanced Full Rate	12.2	5
ACELP	G.723.1	5.3	19
MP-MLQ	G.723.1	6.3	15

Table I.2/G.113 – Provisional planning values for the equipment impairment factor *Ie* under conditions of random packet loss, codecs G.729-A + VAD and G.723.1-A + VAD and GSM EFR

% Packet loss	G.729-A + VAD	G.723.1-A + VAD 6.3 kbit/s	GSM EFR
0	11	15	5
0.5	13	17	–
1	15	19	16
1.5	17	22	–
2	19	24	21
3	23	27	26
4	26	32	–
5	–	–	33
8	36	41	–
16	49	55	–

NOTE – Number of frames per packet:

- G.729-A + VAD: 2;
- G.723.1-A + VAD: 1;
- GSM EFR: 1.

Table I.3/G.113 – Provisional planning values for the equipment impairment factor *Ie* under conditions of packet loss, codecs G.711 without and with Packet Loss Concealment (PLC)

Packet loss %	G.711 w/o PLC	G.711 w/ PLC	
		Random packet loss	Bursty packet loss
0	0	0	0
1	25	5	5
2	35	7	7
3	45	10	10
5	55	15	30
7	–	20	35
10	–	25	40
15	–	35	45
20	–	45	50

NOTE – Speech packet length: 10 ms

Table I.4/G.113 – Provisional planning values for the equipment impairment factor *Ie* under propagation error conditions, GSM codecs

Codec type	Error pattern	*Ie* Range
GSM-HR	EP1	25...32
	EP2	31...42
GSM-FR	EP1	32...39
	EP2	40...45
GSM-EFR	EP1	15...22
	EP2	26...35
NOTE 1 – The range given results from the difficulties in deriving exact impairment factor values for these conditions. NOTE 2 – EP1 is equivalent to 10 dB C/I, EP2 is equivalent to 7 dB C/I. C/I is the carrier-to-interference ratio.		

Table I.5/G.113 – Brief description of the low bit-rate codecs

IS-54	First generation digital TDMA cellular system in North America utilizing Vector Sum Excited Linear Prediction (**VSELP**) coding at a net bit rate of 7.95 kbit/s (plus 5.05 kbit/s FEC).
IS-96a	First generation digital CDMA cellular system in North America utilizing Qualcomm Code-Excited Linear Prediction (**QCELP**) coding at a variable net bit rate of 8, 4, and 2 kbit/s.
IS-127	Second generation digital CDMA cellular system in North America utilizing Residual Code-Excited Linear Prediction (**RCELP**) coding at a variable net bit rate of 8, 4, and 2 kbit/s.
IS-641	Second generation digital TDMA cellular system in North America utilizing Algebraic Code-Excited Linear Prediction (**ACELP**) coding at a net bit rate of 7.4 kbit/s (plus 5.6 kbit/s FEC).
GSM-FR	First generation digital European Global System for Mobile communications (**GSM**) cellular system utilizing Regular Pulse Excitation Long Term Prediction (**RPE-LTP**) coding at a net bit rate of 13 kbit/s (plus 9.8 kbit/s FEC). Defined in ETSI standard GSM 06.10.
GSM-HR	Half-rate version of the voice codec for the GSM system utilizing Vector Sum Excited Linear Prediction (**VSELP**) coding at a net bit rate of 5.6 kbit/s. Defined in ETSI Standard GSM.06.20.
GSM-EFR	Second generation speech codec of the digital European Global System for Mobile communications (GSM) cellular system utilizing Algebraic Code-Excited Linear Prediction (**ACELP**) coding at a net bit rate of 12.2 kbit/s (plus 10.6 kbit/s FEC). Defined in ETSI standard GSM 06.60.
PDC	First generation digital Japanese Personal Digital Communication (PDC) system utilizing a Japanese version of Vector Sum Excited Linear Prediction (**JVSELP**) coding at a net bit rate of 6.7 kbit/s (plus 4.5 kbit/s FEC).
G.723.1	ITU-T Recommendation for speech coding in PSTN videophones utilizing Algebraic Code-Excited Linear Prediction (**ACELP**) coding at 5.3 kbit/s and Multipulse Maximum Likelihood Quantization (**MP-MLQ**) at 6.3 kbit/s.
G.726	ITU-T Recommendation for speech coding at 40, 32, 24, and 16 kbit/s utilizing Adaptive Differential Pulse Code Modulation (**ADPCM**).
G.728	ITU-T Recommendation for speech coding at 16 kbit/s utilizing Low-Delay Code-Excited Linear Prediction Coding (**LD-CELP**). This algorithm also has 12.8 and 9.6 kbit/s bit-rate extensions.
G.729	ITU-T Recommendation for speech coding at 8 kbit/s utilizing Conjugate Structure Algebraic Code-Excited Linear Prediction Coding (**CS-ACELP**).

ITU-T RECOMMENDATIONS SERIES

Series A	Organization of the work of the ITU-T
Series B	Means of expression: definitions, symbols, classification
Series C	General telecommunication statistics
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	**Transmission systems and media, digital systems and networks**
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks and open system communications
Series Y	Global information infrastructure and Internet protocol aspects
Series Z	Languages and general software aspects for telecommunication systems