INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.113

Appendix I

(10/2001)

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Transmission impairments due to speech processing

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Transmission impairments due to speech processing

Appendix I

Provisional planning values for the equipment impairment factor *Ie*

Source

Appendix I to ITU-T Recommendation G.113 was prepared and approved by ITU-T Study Group 12 (2001-2004) on 26 October 2001.

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.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. 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, 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.

ITU-T Recommendation G.113

Transmission impairments due to speech processing

Appendix I

Provisional planning values for the equipment impairment factor *Ie*

This appendix provides up-to-date information on available values of the Equipment Impairment Factor, *Ie*. It is intended to be updated regularly.

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
	G.729E	11.8	4
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 (Note 2)	**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 1 – Number of frames per packet:

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

NOTE 2 – Here, packet loss is defined as the effective packet loss as valid for the packet sequence at the entrance of the speech decoder. It describes the packet loss as accumulated due to network packet loss as well as packet loss introduced by jitter buffers.

Table I.3/G.113 – Provisional planning values for the equipment impairment factor *Ie* under conditions of packet loss, codecs G.711 with Packet Loss Concealment (PLC)

Packet loss % (Note 3)	**G.711 w/ PLC** (Note 1)	
	Random packet loss	**Bursty packet loss** (Note 2)
0	0	0
1	5	5
2	7	7
3	10	10
5	15	30
7	20	35
10	25	40
15	35	45
20	45	50

NOTE 1 – Speech packet length: 10 ms.

NOTE 2 – Results are only to be understood as margin values and different burst production models can lead to different impairment values at identical overall packet loss rates.

NOTE 3 – Here, packet loss is defined as the effective packet loss as valid for the packet sequence at the entrance of the speech decoder. It describes the packet loss as accumulated due to network packet loss as well as packet loss introduced by jitter buffers.

NOTE 4 – The values for G.711 without PLC have been withdrawn because they were considered to be too pessimistic. An update of these values is envisaged shortly.

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**).

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