

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.113

Amendment 1

(03/2009)

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 due to speech
processing

**Amendment 1: Revised Appendix IV –
Provisional planning values for the wideband
equipment impairment factor and the wideband
packet loss robustness factor**

Recommendation ITU-T G.113 (2007) – Amendment 1

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Transmission impairments due to speech processing

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Revised Appendix IV – Provisional planning values for the wideband equipment impairment factor and the wideband packet loss robustness factor

Summary

Appendix IV to Recommendation ITU-T G.113 provides up-to-date information on available values of wideband equipment impairment factors, $I_{e,wb}$, and packet-loss robustness factors, $B_{pl,wb}$ for a number of codecs or codec families. These values are to be used on an extended transmission rating scale (R -scale), as defined in Recommendation ITU-T G.107.

Source

Amendment 1 to Recommendation ITU-T G.113 (2007) was agreed on 19 March 2009 by ITU-T Study Group 12 (2009-2012).

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). 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.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure e.g. interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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Recommendation ITU-T G.113

Transmission impairments due to speech processing

Amendment 1

Revised Appendix IV – Provisional planning values for the wideband equipment impairment factor and the wideband packet loss robustness factor

(This appendix does not form an integral part of this Recommendation)

1) Appendix IV

Revise Appendix IV as follows:

This appendix provides up-to-date information on available values of wideband equipment impairment factors, $I_{e,wb}$, and packet loss robustness factors, $B_{pl,wb}$, for a number of codecs or codec families. It is intended to be updated regularly. These values are to be used on an extended transmission rating scale (R -scale) as it is defined in Appendix II of [ITU-T G.107].

Table IV.1 – Provisional planning values for the wideband equipment impairment factor, $I_{e,wb}$, for wideband codecs in a monotic listening context

Codec type	Reference	Operating rate [kbit/s]	$I_{e,wb}$ value
ADPCM	[b-ITU-T G.722]	64	13
		56	20
		48	31
Modifieds lapped transform coding	[b-ITU-T G.722.1]	32	13
		24	19
CELP	[b-ITU-T G.722.2]	23.85	8
		23.05	1
		19.85	3
		18.25	5
		15.85	7
		14.25	10
		12.65	13
		8.85	26
		6.6	41
Embedded logPCM (A-law, μ -law)	[b-ITU-T G.711.1], mode R2b	80	1
	[b-ITU-T G.711.1], mode R3	96	0

The $I_{e,wb}$ values listed in Table IV.1 are mainly valid for a monotic listening context, i.e., when the users are assumed to be using handset-type telephones or monaural headsets. However, recent studies have shown that different values appear more appropriate in a diotic listening context, i.e., when users employ headsets or speakerphones. In this case, the values listed in Table IV.2 may lead to more realistic quality estimations.

Table IV.2 – Provisional planning values for the wideband equipment impairment factor, $I_{e,wb}$, for wideband codecs when a diotic sound presentation is assumed

Codec type	Reference	Operating rate [kbit/s]	$I_{e,wb}$ value (diotic)
ADPCM	[b-ITU-T G.722]	64	5
		56	10
		48	41
CELP	[b-ITU-T G.722.2]	23.85	10
		23.05	8
		15.85	17
		12.65	20
		8.85	41
		6.6	56
CELP with TDBWE and TDAC	[b-ITU-T G.729.1]	32	7
		24	16

Provisional planning values for the wideband equipment impairment factor, $I_{e,wb}$, for narrow-band codecs (downward-compatible to the narrow-band E-model) can be derived based on the extension of the R -scale by the following procedure.

$I_{e,wb}$ values for NB codecs correspond to the sum of the I_e value defined for the NB case (see Appendix I) and the difference between the WB and the NB "direct" channel, the latter having a position of 93.2 on the R -scale (standard G.711 coding and normal noise floor):

$$I_{e,wb} = \sum_{codecs} I_e + (129 - 93.2) = \sum_{codecs} I_e + 35.8$$

The application of $I_{e,wb}$ values and their potential additivity is for further study.

Based on new results, Appendix II of [ITU-T G.107] has been updated to also include the effect of packet loss on the quality of wideband coded speech. For diotic listening and uniform packet loss, Table IV.3 lists a first set of wideband packet loss robustness factors $B_{pl,wb}$ together with the corresponding $I_{e,wb}$ values to be employed with Equation II-2 of [ITU-T G.107] (2009) in this case. Note that no $B_{pl,wb}$ values are currently available for non-uniform loss or for packet loss and monotic sound presentation.

Table IV.3 – Provisional planning values for the wideband packet loss robustness factor, $B_{pl,wb}$, for wideband codecs when a diotic sound presentation is assumed

Codec type	Reference	Operating rate [kbit/s]	$I_{e,wb}$ value (diotic)	$B_{pl,wb}$ value (diotic)
ADPCM	[b-ITU-T G.722], high-quality PLC G.722, App. III (2006)	64	5	7.1
	[b-ITU-T G.722], low-complexity PLC G.722, App. IV (2006)	64	5	5.1
CELP	[b-ITU-T G.722.2]	23.85	10	4.9
		23.05	8	4.6
		12.65	20	4.3

Table IV.3 – Provisional planning values for the wideband packet loss robustness factor, $B_{pl,wb}$, for wideband codecs when a diotic sound presentation is assumed

Codec type	Reference	Operating rate [kbit/s]	$I_{e,wb}$ value (diotic)	$B_{pl,wb}$ value (diotic)
CELP with TDBWE and TDAC	[b-ITU-T G.729.1]	32	7	6.1
		24	16	7.3

NOTE – Table IV.4 provides additional descriptive information on various low bit-rate wideband codecs.

Table IV.4 – Brief description of the low bit-rate codecs

G.722	ITU-T Recommendation for 7 kHz audio coding within 64 kbit/s using sub-band adaptive differential pulse code modulation (SB-ADPCM) within a bit-rate of 64 kbit/s.
G.722.1	ITU-T Recommendation for low-complexity coding at 24 and 32 kbit/s for hands-free operation in systems with low frame loss.
G.722.2	ITU-T Recommendation for wideband coding of speech at around 16 kbit/s using adaptive multi-rate wideband (AMR-WB).
G.729.1	ITU-T Recommendation for embedded variable bit-rate scalable wideband coding at 8-32 kbit/s, bitstream interoperable with [b-ITU-T G.729].

2) Bibliography

Add the following Recommendations to the Bibliography:

- [b-ITU-T G.722] Recommendation ITU-T G.722 (1988), *7 kHz audio-coding within 64 kbit/s*.
- [b-ITU-T G.711.1] Recommendation ITU-T G.711.1 (2008), *Wideband embedded extension for G.711 pulse code modulation*.
- [b-ITU-T G.722.1] Recommendation ITU-T G.722.1 (2003), *Low-complexity coding at 24 and 32 kbit/s for hands-free operation in systems with low frame loss*.
- [b-ITU-T G.722.2] Recommendation ITU-T G.722.2 (2003), *Wideband coding of speech at around 16 kbit/s using Adaptive Multi-Rate Wideband (AMR-WB)*.
- [b-ITU-T G.729] Recommendation ITU-T G.729 (2007), *Coding of speech at 8 kbit/s using conjugate-structure algebraic-code-excited-linear prediction (CS-ACELP)*.
- [b-ITU-T G.729.1] Recommendation ITU-T G.729.1 (2006), *G.729-based embedded variable bit-rate coder: An 8-32 kbit/s scalable wideband coder bitstream interoperable with G.729*.

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