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Title: **AMR Wideband Performance Requirements (WB-3) version 2.0**

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Introduction

This document contains the performance requirements for the AMR WB speech coder.

The performance requirements are defined for static and dynamic error conditions as well as speaker dependency, tandeming and input level dependency.

The requirements define the minimum acceptable performance of the candidate algorithm. Candidates are expected to pass all of the requirements. Objectives identify areas where particular emphasis should be placed by candidate developers who have met the requirements.

1. Definitions

The following systems/applications have been identified:

A GSM full-rate traffic channel (22.8 kbit/s gross bit-rate) with an additional constraint of 16 kbit/s A-ter sub-multiplexing

B GSM full-rate traffic channel (22.8 kbit/s gross bit-rate)

C EDGE phase II channels

D GSM multi-slot traffic channels (n*22.8 kbit/s)

E 3G UTRAN channels

Unless otherwise stated, the performance requirements and objectives shall be interpreted as “not worse than” the performance of the reference codec. The conditions “not worse than” and “better than” shall be determined statistically at the 95% confidence interval.

2. Requirements and Objectives for Applications A and B

2.1. Static conditions

Static conditions refer to channel cases where there is no shadowing. The speech quality of the codec modes applicable to the TCH-FS channel will be assessed over a range of C/I and background noise conditions to provide a ‘family’ of performance curves.

Requirements and objectives are specified for clean speech and background noise. The requirements and objectives for the TCH-FS traffic channels under static test conditions are specified in Table 1.

	Application A		Application B	
C/I	**Performance requirement**	**Performance objective**	**Performance requirement**	**Performance objective**
no errors	better than G.722-48k	G.722-56k	G.722-56k	G.722-64k
19 dB	better than G.722-48k		G.722-56k	
16 dB	G.722-48k		G.722-48k	
13 dB	G.722-48k		G.722-48k	
< 13dB	See Note 1		See Note 1	

Table 1a: Clean speech requirements under static test conditions for Applications A and B.

	Application A		Application B	
C/I	**Performance requirement** (see Note 2)	**Performance objective**	**Performance requirement** (see Note 2)	**Performance objective**
no errors	G.722-48k with 10% PoW	G.722-56k	G.722-56k with 10% PoW	G.722-64k
19 dB	G.722-48k with 10% PoW		G.722-48k with 10% PoW	
16 dB	G.722-48k with 10% PoW		G.722-48k with 10% PoW	
13 dB	G.722-48k with 10% PoW		G.722-48k with 10% PoW	
< 13dB	See Note 1		See Note 1	

Table 1b: Background noise requirements under static test conditions for Applications A and B.

Notes to Tables 1a and 1b:

Note 1: The AMR WB performance requirement for C/I values below 13dB is the following for Applications A and B: the degradation in subjective performance shall not be greater than the degradation in subjective performance demonstrated by EFR over the same C/I interval. The specific intervals of interest are 13dB to 10dB, 13dB to 7dB, and 13dB to 4dB.

Note 2: “with 10% PoW” shall be interpreted as no more than 10 additional percentage points of annoying degradation, in terms of annoying or very annoying (i.e. 1+2 votes), with respect to the reference codec. For example, consider a data set where we see that the reference codec has 12 of 344 votes in the annoying or very annoying categories. Thus, the observed proportion of annoying degradation is 0.03, leading to a criterion of a proportion of no more than 0.13 for the codec under test. Suitable statistical methods will be employed. Note that the average DMOS score is not part of this requirement.

2.2. Dynamic conditions

Dynamic conditions refer to channel cases where shadowing is present. Specifically derived channel profiles with varying C/I or C/N will be used.

The requirements for the TCH-FS 22.8 kbit/s traffic channels (applications A and B) under dynamic test conditions are specified in Table 2.

TCH-FS Full-Rate Channel	
Requirement for typical C/I conditions	Better than the EFR under the same conditions
Requirement for difficult C/I conditions ([typical conditions -6dB])	Same or better than the EFR under the same conditions

Table 2: Requirements under dynamic test conditions for Applications A and B

2.3. Additional speech codec performance requirements and objectives

The reference speech codecs for Applications A and B under tandeming, talker dependency, level dependency and language dependency conditions are specified in Table 3.

Tandeming performance and level dependency will be evaluated in the selection phase. It is anticipated that the other additional requirements will be evaluated in the characterisation phase.

	Application A		**Application B**	
Condition	**Performance requirement**	**Performance objective**	**Performance requirement**	**Performance objective**
Tandeming for clean speech signals (2 asynchronous encodings)	G.722-48k with 2 asynchronous encodings	G.722-56k with 2 asynchronous encodings	G.722-56k with 2 asynchronous encodings	G.722-64k with 2 asynchronous encodings
Low level input speech (-36dBov nominal input level)	better than G.722-48k with -36dBov nominal input level	G.722-56k with -36dBov nominal input level	G.722-56k with -36dBov nominal input level	G.722-64k with -36dBov nominal input level
High level input speech (-16dBov nominal input level)	better than G.722-48k with -26dBov nominal input level	G.722-56k with -26dBov nominal input level	G.722-56k with -26dBov nominal input level	G.722-64k with -26dBov nominal input level
Talker dependency	G.722-48k		G.722-56k	
Language dependency	G.722-48k		G.722-56k	

Table 3a: Additional performance requirements for clean speech signals for Applications A and B

	Application A		Application B	
Condition	**Performance requirement**	**Performance objective**	**Performance requirement**	**Performance objective**
Tandeming for speech signals with background noise (2 asynchronous encodings)	G.722-48k with 2 asynchronous encodings	G.722-56k with 2 asynchronous encodings	G.722-56k with 2 asynchronous encodings	G.722-64k with 2 asynchronous encodings

Table 3b: Additional performance requirements for speech signals with background noise for Applications A and B

	Application A		Application B	
Condition	**Performance requirement**	**Performance objective**	**Performance requirement**	**Performance objective**
Tandem with G.711	GSM EFR	Better than GSM EFR	GSM EFR	Better than GSM EFR
Tandem with GSM EFR	GSM EFR with 2 asynchronous encodings	Better than GSM EFR with 2 asynchronous encodings	GSM EFR with 2 asynchronous encodings	Better than GSM EFR with 2 asynchronous encodings

Table 3c: Additional performance requirements for tandeming with a narrowband system for Applications A and B

Notes to Table 3c:

Note 1: These conditions will be tested for both tandem configurations, i.e. the narrowband codec preceding the wideband codec and *vice versa*.

Note 2: An appropriate testing methodology for these conditions is to be determined. One option is to include them in a narrowband-only experiment in the selection tests, which may already be needed for testing reference coders for low C/I ratios. At the very least, codec proponents may be asked to include these conditions in demo material to be submitted as part of the stage 2 deliverables.

3. Requirements and Objectives for Applications C, D and E

3.1. Performance with channel errors

The performance requirements and objectives for Applications C and D with channel errors are specified in Table 4; the performance requirements and objectives for Application E with channel errors are specified in Table 5. The performance requirements for music are provided in Table 6.

	Application C		Application D	
C/I	**Performance requirement**	**Performance objective**	**Performance requirement**	**Performance objective**
no errors	G.722-64k		G.722-64k	
19 dB	G.722-64k		G.722-64k	
16 dB	G.722-56k	G.722-64k	G.722-56k	G.722-64k
13 dB	better than G.722-48k	G.722-56k	better than G.722-48k	G.722-56k
< 13dB	See note		See note	

Table 4a: Clean speech requirements under static test conditions for Applications C and D. Application D assumes n=2 (i.e. 45.6 kbps)

	Application C		Application D	
C/I	**Performance requirement**	**Performance objective**	**Performance requirement**	**Performance objective**
no errors	G.722-64k		G.722-64k	
19 dB	G.722-56k		G.722-56k	
16 dB	G.722-48k		G.722-48k	
13 dB	G.722-48k		G.722-48k	
< 13dB	See note		See note	

Table 4b: Background noise requirements under static test conditions for Applications C and D. Application D assumes n=2 (i.e. 45.6 kbps)

Notes to Tables 4a and 4b:

Note: The AMR WB performance requirement for C/I values below 13dB is the following for Applications C and D: the degradation in subjective performance shall not be greater than the degradation in subjective performance demonstrated by EFR over the same C/I interval. The specific intervals of interest are 13dB to 10dB, 13dB to 7dB, and 13dB to 4dB.

	Application E (see note 1)	
EC / [FER, RBER] (see note 2)	**Performance requirement**	**Performance objective**
No errors (see note 3)	G.722-64k	
{0.5%, -},	G.722-56k	
{1.0%, 0.1%}, note 4, UL	G.722-48k	
{1.0%, 0.1%}, note 4 , DL	G.722-48k	
{1.0%, 0.1%} note 5, UL		G.722-48k

Table 5a: Clean speech under channel errors for Application E.

	Application E (see note 1)	
EC / [FER, RBER] (see Note 2)	**Performance requirement**	**Performance objective**
No errors (see note 3)	G.722-64k	
{0.5%, -}	G.722-56k	
{1.0%, 0.1%} note 4, UL	G.722-48k	
{1.0%, 0.1%} note 4 , DL	G.722-48k	
{1.0%, 0.1%} note 5, UL		G.722-48k

Table 5b: Background noise requirements under channel errors for Application E.

Notes to table 5a and 5b:

Note 1: Application E includes all bit rates. The requirements are however only tested for the highest modes.

Note 2: The error performance for Application E is specified and evaluated using error protection schemes from the UTRAN toolbox. Each error condition (EC) is defined using two error profiles, one FER profile (single indicator per frame) and one residual BER profile (bit-level residual error channel).

Note 3: The requirement for the no error case applies to modes with higher bit rates, i.e. not tested in applications A and B

Note 4: The least significant bits shall be subjected to the residual error profile. The number of bits in this class shall be 25% of the total bits per frame.

Note 5: The least significant bits shall be subjected to the residual error profile. The number of bits in this class shall be 50% of the total bits per frame.

Condition	Requirement	Objective
Music	No annoying effects	G.722-56k

Table 6: Requirements and objectives with music for Applications C, D and E

3.2. Additional speech codec performance requirements and objectives

The reference speech codecs for Applications C, D and E under tandeming, talker dependency, level dependency and language dependency conditions are specified in Table 7.

	Applications C, D and E	
Condition	**Performance requirement**	**Performance objective**
Tandeming for clean speech signals (2 asynchronous encodings)	G.722-64k with 2 asynchronous encodings	
Low level input speech (-36dBov nominal input level)	G.722-64k with -36dBov nominal input level	
High level input speech (-16dBov nominal input level)	G.722-64k with -26dBov nominal input level	
Talker dependency	G.722-64k	
Language dependency	G.722-64k	

Table 7a: Additional performance requirements for clean speech in Applications C, D and E

	Applications C, D and E	
Condition	**Performance requirement**	**Performance objective**
Tandeming for speech signals with background noise (2 asynchronous encodings)	G.722-56k with 2 asynchronous encodings	

Table 7b: Additional performance requirements for speech with background noise in Applications C, D and E

4. Requirements and Objectives for All Applications

The performance requirements and objectives under bit-rate switching and DTX are specified in Table 8; the performance requirements and objectives for DTMF, information tones and idle noise are specified in Table 9.

Condition	Requirement	Objective
Switching between different AMR-WB bit-rates	No annoying artefacts	
Clean speech with DTX enabled	Performance with DTX disabled	
Speech and background noise with DTX enabled	Performance with DTX disabled	

Table 8: Additional performance requirements for speech signals (all applications)

Condition	Requirement	Objective
DTMF		Transparent transmission of DTMF.
Information tones	Recognisable as given information tone.	
Idle noise	-66dBm0 (unweighted)	

Table 9: Requirements and objectives for speech codec performance with non-speech inputs

5. Open Issues

This section lists open issues currently under discussion.

- Performance in tandem with other standards:
  - G.722 (selection and/or characterisation phase)
  - Other WB standards
- Performance under mode switching between NB and WB AMR
- Performance definition and testing for application E (and during which phases these are to be addressed)

Document History

Version	Date	Comment
0.1	October 1999	Initial version
0.2	October 1999	ETSI-SMG11#12/3GPP-SA4#7
0.3	December 1999	ETSI-SMG11#13/3GPP-SA4#8
1.0	December 1999	3GPP-SA
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