3GPP TSG-GERAN#8 **TDoc TSGG#08(02)0153**
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Title: **Channel coding for O-TCH/WFS and O-TCH/WHS: Listening Test Plan**
Source: **Nokia**
Agenda Item: **7.1.5.8**

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1. Introduction

AMR narrowband speech codec in TCH/FS, TCH/HS and O-TCH/HS channels and AMR wideband speech codec in TCH/WFS channel have been already specified for GERAN Release 5. This document contains the set of test plans, which Nokia has been using when testing the subjective performance of the AMR-WB channel coding proposals O-TCH/WFS and O-TCH/WHS. The results of the testing can be found from Tdoc GP-020154.

This test plan assumes that the performance of the AMR-WB codec in 8-PSK channels is compared against the performance of the existing AMR-WB channel coding for GMSK FR-channel. All the 9 modes were tested in 8-PSK channels and for GMSK reference; an optimal mode for each C/I case is selected. The optimal mode for certain C/I in GMSK-channel has been selected by using informal expert listening. Tests have been designed in a manner, that in each of the experiments, the same speech material is used for all the tested conditions.

The test plan is split into 2 Experiments listed in the following table:

Exp. No.	Title
1	ACR-test, Clean speech with different C/Is for all the 9 modes in 8-PSK FR-channel
2	ACR-test, Clean speech with different C/Is for all the 9 modes in 8-PSK HR channel

2. Table of Contents

3. Information relevant to all Experiments

3.1. Format of the Speech Samples

Each source speech file contains one pair of sentences and lasts exactly 8 seconds, with a flexible time interval between the two sentences. An approximate 0.5 seconds period of silence precedes the first sentence in the file, and a similar period of silence follows the second sentence in the file. The speech files are organised as in the example shown in Figure 3.1. The sentences are simple meaningful sentences as described in Annex B1.4 of ITU-T Rec. P.800.

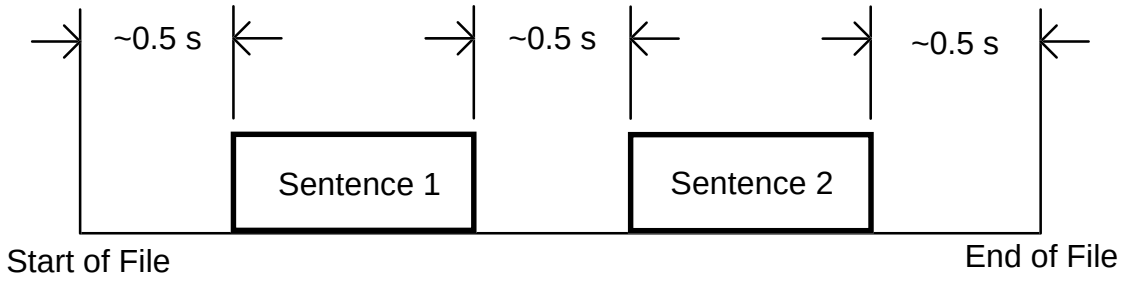

Figure 3.1 Example of Speech file structure for short speech samples

It must be noted that the trailing silence of 0.5s after the end of the second sentence in the file is of extreme importance, since there are (for some conditions) a series of FIR filters with large number of coefficients. If the prescribed trailing silence was not present, there is a considerable risk that speech would be clipped at the end of the file.

3.2. Processing of the Speech Files

All speech files need to be pre-processed prior to being processed through the experimental conditions. This pre-processing ensures that the speech is at the correct level and has the correct input characteristic. Speech levels are measured with the P.56 algorithm and level adjusted with the gain/loss algorithm to the level required for each test condition as defined in the test plans for the individual experiments. Where the nominal level is specified, this level should be set to 26dB (±1dB) below digital overload (-26dBovl). All material is at -26dBovl.

3.3. Listening Environment

For all experiments, subjects should be seated in a quiet environment; 30dBA Hoth Spectrum (as defined by ITU-T, Recommendation P.800 [1], Annex A, section A.1.1.2.2.1 Room Noise, with table A.1 and Figure A.1) measured at the head position of the subject.

The following points should be adhered to:

- Where the experiment design and the listening environment allows for multiple subjects in each listening session, the requirements stated above apply to each of the positions the subjects will occupy.
- Where there are multiple simultaneous subjects, they should not be able to see the responses made by other subjects.
- All test stimuli will be presented monaurally to the subjects over a high quality headphones
- Subjects should be told not to discuss the experiment with subjects who are yet to participate.
- Any test house performing multiple experiments must use different listening subjects for each experiment or sub-experiment.

3.4. Experimental Procedure

Initially the experimenter should present and explain the experiment instructions to the subjects. When the subject has understood the instructions, they will first listen and give score to the preliminary conditions. After the preliminaries have been completed, there should be sufficient time allowed for answering possible questions from the subjects. Any questions about the procedure or the meaning of the instructions should be answered, but any technical questions on matters such as the experimental methodology or details of the types of distortions they are listening to must not be answered until they have completed the experiment.

3.5. Preliminary Conditions

Preliminary conditions are included in the experiment to help acclimatise the subjects with the experimental procedure and to help reduce learning effects of the subjects, by ensuring that the subjects hear a full range of the potential qualities at the start of the experiment.

3.6. Reference Conditions

Two types of reference conditions are used in these experiments:

- MNRU references: These are included in all experiments as standard references of known and well-understood performance.
- AMR-WB codec in GMSK-channels: Used to establish a reference performance for the AMR-WB codec operating in the existing GMSK FR-channel.

3.7. Error Patterns

The 8-PSK error patterns used were the same that was used during the selection of O-TCH/HS channel coding. These patterns were generated by Nortel Networks to be used for channel coding work in GERAN.

In this test, static C/I conditions are used. Their value is quoted in terms of Carrier to Interference Ratio (C/I) in dB, and the average C/I over the duration of the test condition is set to a fixed value. In this test, a selection of static C/I values in the range from 1 dB to 22 dB are used along with error free condition.

4. Experiment 1: AMR-WB in 8-PSK FR-channel, ACR

4.1. Introduction

The purpose of this experiment is to evaluate the performances of the AMR-WB codec in 8-PSK FR-channel with different C/I-conditions.

The details provided in this section are those that are specific to this particular experiment. Generic information, relevant to this and other experiments can be found in chapter 3.

4.2. Test Conditions

The following Table 4.1 shows the conditions to be used in this experiment. A full list of conditions is given in annex A.

Main Codec Conditions		
Candidate	9	All 9 modes of the AMR-WB codec with four different C/I-ratios
Codec references		
Codec references	8	G.722 at 64 kbit/s, AMR-WB codec modes in GMSK-channel: 18.25 at C/I= 19dB, 15.85 at C/I= 16dB, 14.25 at C/I= 13dB, 12.65 at C/I= 10dB, 8.85 at C/I= 07dB, 6.60 at C/I= 04dB, 6.60 at C/I= 01dB
Other references		
Direct	1	Nominal input level, P.341
MNRU	5	Q=10,23,36 (all nominal input level, P.341)
Common Conditions		
Channels	4	Error-free, three different C/Is, unique for each nine modes
Number of talkers	4	2 male and 2 female
Number of speech samples	10	8+ 2 (preliminaries) sentence pairs per talker.
Listening Level	1	79dB SPL
Listeners	24	Naïve Listeners
Groups	8	8 groups of 3 listeners
Randomisation	24	Randomisation is unique for each listener
Rating Scale	1	ACR
Replications	1	
Languages	1	Finnish
Listening System	1	Monaural headphones (flat response in the audio bandwidth of interest: 50Hz-7kHz). The other ear is open.
Listening Environment		Room Noise: Hoth Spectrum at 30dBA (as defined by ITU-T, Recommendation P.800, Annex A, section A.1.1.2.2.1 Room Noise, with table A.1 and Figure A.1)

Table 4.1 Factors and conditions for Experiment 1

4.2.1. Preliminary Conditions

Condition	Codec and C/I or Q(dB)	Source Speech Sample
P1	MNRU, Q=23	F2 (S10)
P2	MNRU, Q=10	M2 (S09)
P3	MNRU, Q=49	F1 (S09)
P4	MNRU, Q=36	M1(S10)
P5	MNRU, Q=10	M2 (S09)
P6	MNRU, Q=49	F2 (S10)
P7	MNRU, Q=23	M1 (S09)
P8	MNRU, Q=36	F1 (S10)

Table 4.2 List of preliminary conditions

4.3. Speech Material

The speech material should be as defined in Section 3. Ten (10) speech samples (including preliminaries) are required for each talker for Experiment 1.

4.4. Processing

Annex A contains tables, which show how the input files and conditions need to be combined for each of the presentation orders (the preliminaries are given in Table 4.2).

4.5. Duration of the Experiment

The number of stimuli per subject is:

(48 conditions x 4 talkers) + 8 preliminaries = 200

Allowing 15 seconds in total for the presentation of the sample and score collection, this gives the following **per subject times for the experiment**:

200 stimuli x 15 seconds = 50 minutes

If **six simultaneous subjects** can be accommodated, the **total time to complete the experiment** is in the order of:

50 minutes x 4 = 3 hours 20 minutes

4.6. Votes Per Condition

Every condition will have 32 different speech samples passed through it (4 talkers x 8 groups). Each of these will be voted on by the 3 subjects in the group, giving:

(32 samples x 3 subjects/group) = 96 votes per condition

4.7. Opinion Scale

The question asked of the subject will be the ACR Listening Quality Scale. The subjects will listen to each sample and after it has completed they will be asked to give their opinion.

5. Experiment 2: AMR-WB in 8-PSK HR-channel, ACR

5.1. Introduction

The purpose of this experiment is to evaluate the performances of the AMR-WB codec in 8-PSK HR-channel with different C/I-conditions.

The details provided in this section are those that are specific to this particular experiment. Generic information, relevant to this and other experiments can be found in chapter 3.

5.2. Test Conditions

The following Table 5.1 shows the conditions to be used in this experiment. A full list of conditions is given in annex A.

Main Codec Conditions		
Candidate	9	All 9 modes of the AMR-WB codec with four different C/I-ratios
Codec references		
Codec references	8	G.722 at 64 kbit/s, AMR-WB codec modes in GMSK-channel: 18.25 at C/I= 19dB, 15.85 at C/I= 16dB, 14.25 at C/I= 13dB, 12.65 at C/I= 10dB, 8.85 at C/I= 07dB, 6.60 at C/I= 04dB, 6.60 at C/I= 01dB
Other references		
Direct	1	Nominal input level, P.341
MNRU	5	Q=10,23,36 (all nominal input level, P.341)
Common Conditions		
Channels	4	Error-free, three different C/Is, unique for each nine modes
Number of talkers	4	2 male and 2 female
Number of speech samples	10	8+ 2 (preliminaries) sentence pairs per talker.
Listening Level	1	79dB SPL
Listeners	24	Naïve Listeners
Groups	8	8 groups of 3 listeners
Randomisation	24	Randomisation is unique for each listener
Rating Scale	1	ACR
Replications	1	
Languages	1	Finnish
Listening System	1	Monaural headphones (flat response in the audio bandwidth of interest: 50Hz-7kHz). The other ear is open.
Listening Environment		Room Noise: Hoth Spectrum at 30dBA (as defined by ITU-T, Recommendation P.800, Annex A, section A.1.1.2.2.1 Room Noise, with table A.1 and Figure A.1)

Table 5.1 Factors and conditions for Experiment 2

5.2.1. Preliminary Conditions

Condition	Codec and C/I or Q(dB)	Source Speech Sample
P1	MNRU, Q=23	F2 (S10)
P2	MNRU, Q=10	M2 (S09)
P3	MNRU, Q=49	F1 (S09)
P4	MNRU, Q=36	M1(S10)
P5	MNRU, Q=10	M2 (S09)
P6	MNRU, Q=49	F2 (S10)
P7	MNRU, Q=23	M1 (S09)
P8	MNRU, Q=36	F1 (S10)

Table 5.2 List of preliminary conditions

5.3. Speech Material

The speech material should be as defined in Section 3. Ten (10) speech samples (including preliminaries) are required for each talker for Experiment 1.

5.4. Processing

Annex A contains tables, which show how the input files and conditions need to be combined for each of the presentation orders (the preliminaries are given in Table 5.2).

5.5. Duration of the Experiment

The number of stimuli per subject is:

(48 conditions x 4 talkers) + 8 preliminaries = 200

Allowing 15 seconds in total for the presentation of the sample and score collection, this gives the following **per subject times for the experiment**:

200 stimuli x 15 seconds = 50 minutes

If **six simultaneous subjects** can be accommodated, the **total time to complete the experiment** is in the order of:

50 minutes x 4 = 3 hours 20 minutes

5.6. Votes Per Condition

Every condition will have 32 different speech samples passed through it (4 talkers x 8 groups). Each of these will be voted on by the 3 subjects in the group, giving:

(32 samples x 3 subjects/group) = 96 votes per condition

5.7. Opinion Scale

The question asked of the subject will be the ACR Listening Quality Scale. The subjects will listen to each sample and after it has completed they will be asked to give their opinion.

References:

[1] GP-020152: Channel coding for O-TCH/WFS and O-TCH/WHS: High Level Description

[2] GP-020154 Channel coding for O-TCH/WFS and O-TCH/WHS: Listening Test Results

[3] GP-020155 Channel coding for O-TCH/WFS and O-TCH/WHS: Objective Measurements

[4] GP-020156 CR 45.003-016 Channel coding for O-TCH/WFS and O-TCH/WHS

Annex A: Processing Tables

The tables below show which speech files need to be processed through which conditions for each of the presentation orders. The sentences from each talker are named from S1 to S8. The group columns in the tables refer to the different presentation orders. There are 8 groups, which mean that all 8 samples are played once through every condition.

1.1. A.1 Processing Tables for Experiment 1, ACR-test

Cond.	Codec	C/I	**g1**	**g2**	**g3**	**g4**	**g5**	**g6**	**g7**	**g8**
1	AMR-WB 6.60 8-PSK FR	no errors	s1	s2	s3	s4	s5	s6	s7	s8
2	AMR-WB 6.60 8-PSK FR	C/I= 7 dB	s2	s3	s4	s5	s6	s7	s8	s1
3	AMR-WB 6.60 8-PSK FR	C/I= 4 dB	s3	s4	s5	s6	s7	s8	s1	s2
4	AMR-WB 6.60 8-PSK FR	C/I= 1 dB	s4	s5	s6	s7	s8	s1	s2	s3
5	AMR-WB 8.85 8-PSK FR	no errors	s5	s6	s7	s8	s1	s2	s3	s4
6	AMR-WB 8.85 8-PSK FR	C/I= 7 dB	s6	s7	s8	s1	s2	s3	s4	s5
7	AMR-WB 8.85 8-PSK FR	C/I= 4 dB	s7	s8	s1	s2	s3	s4	s5	s6
8	AMR-WB 8.85 8-PSK FR	C/I= 1 dB	s8	s1	s2	s3	s4	s5	s6	s7
9	AMR-WB 12.65 8-PSK FR	no errors	s1	s2	s3	s4	s5	s6	s7	s8
10	AMR-WB 12.65 8-PSK FR	C/I= 10 dB	s2	s3	s4	s5	s6	s7	s8	s1
11	AMR-WB 12.65 8-PSK FR	C/I= 7 dB	s3	s4	s5	s6	s7	s8	s1	s2
12	AMR-WB 12.65 8-PSK FR	C/I= 4 dB	s4	s5	s6	s7	s8	s1	s2	s3
13	AMR-WB 14.25 8-PSK FR	no errors	s5	s6	s7	s8	s1	s2	s3	s4
14	AMR-WB 14.25 8-PSK FR	C/I= 10 dB	s6	s7	s8	s1	s2	s3	s4	s5
15	AMR-WB 14.25 8-PSK FR	C/I= 7 dB	s7	s8	s1	s2	s3	s4	s5	s6
16	AMR-WB 14.25 8-PSK FR	C/I= 4 dB	s8	s1	s2	s3	s4	s5	s6	s7
17	AMR-WB 15.85 8-PSK FR	no errors	s1	s2	s3	s4	s5	s6	s7	s8
18	AMR-WB 15.85 8-PSK FR	C/I= 10 dB	s2	s3	s4	s5	s6	s7	s8	s1
19	AMR-WB 15.85 8-PSK FR	C/I= 7 dB	s3	s4	s5	s6	s7	s8	s1	s2
20	AMR-WB 15.85 8-PSK FR	C/I= 4 dB	s4	s5	s6	s7	s8	s1	s2	s3
21	AMR-WB 18.25 8-PSK FR	no errors	s5	s6	s7	s8	s1	s2	s3	s4
22	AMR-WB 18.25 8-PSK FR	C/I= 10 dB	s6	s7	s8	s1	s2	s3	s4	s5
23	AMR-WB 18.25 8-PSK FR	C/I= 7 dB	s7	s8	s1	s2	s3	s4	s5	s6
24	AMR-WB 18.25 8-PSK FR	C/I= 4 dB	s8	s1	s2	s3	s4	s5	s6	s7
25	AMR-WB 19.85 8-PSK FR	no errors	s1	s2	s3	s4	s5	s6	s7	s8
26	AMR-WB 19.85 8-PSK FR	C/I= 13 dB	s2	s3	s4	s5	s6	s7	s8	s1
27	AMR-WB 19.85 8-PSK FR	C/I= 10 dB	s3	s4	s5	s6	s7	s8	s1	s2
28	AMR-WB 19.85 8-PSK FR	C/I= 7 dB	s4	s5	s6	s7	s8	s1	s2	s3
29	AMR-WB 23.05 8-PSK FR	no errors	s5	s6	s7	s8	s1	s2	s3	s4
30	AMR-WB 23.05 8-PSK FR	C/I= 13 dB	s6	s7	s8	s1	s2	s3	s4	s5
31	AMR-WB 23.05 8-PSK FR	C/I= 10 dB	s7	s8	s1	s2	s3	s4	s5	s6
32	AMR-WB 23.05 8-PSK FR	C/I= 7 dB	s8	s1	s2	s3	s4	s5	s6	s7
33	AMR-WB 23.85 8-PSK FR	no errors	s1	s2	s3	s4	s5	s6	s7	s8
34	AMR-WB 23.85 8-PSK FR	C/I= 13 dB	s2	s3	s4	s5	s6	s7	s8	s1
35	AMR-WB 23.85 8-PSK FR	C/I= 10 dB	s3	s4	s5	s6	s7	s8	s1	s2
36	AMR-WB 23.85 8-PSK FR	C/I= 7 dB	s4	s5	s6	s7	s8	s1	s2	s3
37	AMR-WB 18.25 GMSK	C/I= 19 dB	s5	s6	s7	s8	s1	s2	s3	s4
38	AMR-WB 15.85 GMSK	C/I= 16 dB	s6	s7	s8	s1	s2	s3	s4	s5
39	AMR-WB 14.25 GMSK	C/I= 13 dB	s7	s8	s1	s2	s3	s4	s5	s6
40	AMR-WB 12.65 GMSK	C/I= 10 dB	s8	s1	s2	s3	s4	s5	s6	s7
41	AMR-WB 8.85 GMSK	C/I= 07 dB	s1	s2	s3	s4	s5	s6	s7	s8
42	AMR-WB 6.60 GMSK	C/I= 04 dB	s2	s3	s4	s5	s6	s7	s8	s1
43	AMR-WB 6.60 GMSK	C/I= 01 dB	s3	s4	s5	s6	s7	s8	s1	s2
44	MNRU 10	no errors	s4	s5	s6	s7	s8	s1	s2	s3
45	MNRU 23	no errors	s5	s6	s7	s8	s1	s2	s3	s4
46	MNRU 36	no errors	s6	s7	s8	s1	s2	s3	s4	s5
47	G.722 at 64 kbit/s	no errors	s7	s8	s1	s2	s3	s4	s5	s6
48	DIRECT	no errors	s8	s1	s2	s3	s4	s5	s6	s7

1.2. A.2 Processing Tables for Experiment 2, ACR-test

Cond.	Codec	C/I	**g1**	**g2**	**g3**	**g4**	**g5**	**g6**	**g7**	**g8**
1	AMR-WB 6.60 8-PSK HR	no errors	s1	s2	s3	s4	s5	s6	s7	s8
2	AMR-WB 6.60 8-PSK HR	C/I= 10 dB	s2	s3	s4	s5	s6	s7	s8	s1
3	AMR-WB 6.60 8-PSK HR	C/I= 7 dB	s3	s4	s5	s6	s7	s8	s1	s2
4	AMR-WB 6.60 8-PSK HR	C/I= 4 dB	s4	s5	s6	s7	s8	s1	s2	s3
5	AMR-WB 8.85 8-PSK HR	no errors	s5	s6	s7	s8	s1	s2	s3	s4
6	AMR-WB 8.85 8-PSK HR	C/I= 13 dB	s6	s7	s8	s1	s2	s3	s4	s5
7	AMR-WB 8.85 8-PSK HR	C/I= 10 dB	s7	s8	s1	s2	s3	s4	s5	s6
8	AMR-WB 8.85 8-PSK HR	C/I= 7 dB	s8	s1	s2	s3	s4	s5	s6	s7
9	AMR-WB 12.65 8-PSK HR	no errors	s1	s2	s3	s4	s5	s6	s7	s8
10	AMR-WB 12.65 8-PSK HR	C/I= 13 dB	s2	s3	s4	s5	s6	s7	s8	s1
11	AMR-WB 12.65 8-PSK HR	C/I= 10 dB	s3	s4	s5	s6	s7	s8	s1	s2
12	AMR-WB 12.65 8-PSK HR	C/I= 7 dB	s4	s5	s6	s7	s8	s1	s2	s3
13	AMR-WB 14.25 8-PSK HR	no errors	s5	s6	s7	s8	s1	s2	s3	s4
14	AMR-WB 14.25 8-PSK HR	C/I= 16 dB	s6	s7	s8	s1	s2	s3	s4	s5
15	AMR-WB 14.25 8-PSK HR	C/I= 13 dB	s7	s8	s1	s2	s3	s4	s5	s6
16	AMR-WB 14.25 8-PSK HR	C/I= 10 dB	s8	s1	s2	s3	s4	s5	s6	s7
17	AMR-WB 15.85 8-PSK HR	no errors	s1	s2	s3	s4	s5	s6	s7	s8
18	AMR-WB 15.85 8-PSK HR	C/I= 16 dB	s2	s3	s4	s5	s6	s7	s8	s1
19	AMR-WB 15.85 8-PSK HR	C/I= 13 dB	s3	s4	s5	s6	s7	s8	s1	s2
20	AMR-WB 15.85 8-PSK HR	C/I= 10 dB	s4	s5	s6	s7	s8	s1	s2	s3
21	AMR-WB 18.25 8-PSK HR	no errors	s5	s6	s7	s8	s1	s2	s3	s4
22	AMR-WB 18.25 8-PSK HR	C/I= 19 dB	s6	s7	s8	s1	s2	s3	s4	s5
23	AMR-WB 18.25 8-PSK HR	C/I= 16 dB	s7	s8	s1	s2	s3	s4	s5	s6
24	AMR-WB 18.25 8-PSK HR	C/I= 13 dB	s8	s1	s2	s3	s4	s5	s6	s7
25	AMR-WB 19.85 8-PSK HR	no errors	s1	s2	s3	s4	s5	s6	s7	s8
26	AMR-WB 19.85 8-PSK HR	C/I= 19 dB	s2	s3	s4	s5	s6	s7	s8	s1
27	AMR-WB 19.85 8-PSK HR	C/I= 16 dB	s3	s4	s5	s6	s7	s8	s1	s2
28	AMR-WB 19.85 8-PSK HR	C/I= 13 dB	s4	s5	s6	s7	s8	s1	s2	s3
29	AMR-WB 23.05 8-PSK HR	no errors	s5	s6	s7	s8	s1	s2	s3	s4
30	AMR-WB 23.05 8-PSK HR	C/I= 19 dB	s6	s7	s8	s1	s2	s3	s4	s5
31	AMR-WB 23.05 8-PSK HR	C/I= 16 dB	s7	s8	s1	s2	s3	s4	s5	s6
32	AMR-WB 23.05 8-PSK HR	C/I= 13 dB	s8	s1	s2	s3	s4	s5	s6	s7
33	AMR-WB 23.85 8-PSK HR	no errors	s1	s2	s3	s4	s5	s6	s7	s8
34	AMR-WB 23.85 8-PSK HR	C/I= 22 dB	s2	s3	s4	s5	s6	s7	s8	s1
35	AMR-WB 23.85 8-PSK HR	C/I= 19 dB	s3	s4	s5	s6	s7	s8	s1	s2
36	AMR-WB 23.85 8-PSK HR	C/I= 16 dB	s4	s5	s6	s7	s8	s1	s2	s3
37	AMR-WB 18.25 GMSK	C/I= 19 dB	s5	s6	s7	s8	s1	s2	s3	s4
38	AMR-WB 15.85 GMSK	C/I= 16 dB	s6	s7	s8	s1	s2	s3	s4	s5
39	AMR-WB 14.25 GMSK	C/I= 13 dB	s7	s8	s1	s2	s3	s4	s5	s6
40	AMR-WB 12.65 GMSK	C/I= 10 dB	s8	s1	s2	s3	s4	s5	s6	s7
41	AMR-WB 8.85 GMSK	C/I= 07 dB	s1	s2	s3	s4	s5	s6	s7	s8
42	AMR-WB 6.60 GMSK	C/I= 04 dB	s2	s3	s4	s5	s6	s7	s8	s1
43	AMR-WB 6.60 GMSK	C/I= 01 dB	s3	s4	s5	s6	s7	s8	s1	s2
44	MNRU 10	no errors	s4	s5	s6	s7	s8	s1	s2	s3
45	MNRU 23	no errors	s5	s6	s7	s8	s1	s2	s3	s4
46	MNRU 36	no errors	s6	s7	s8	s1	s2	s3	s4	s5
47	G.722 at 64 kbit/s	no errors	s7	s8	s1	s2	s3	s4	s5	s6
48	DIRECT	no errors	s8	s1	s2	s3	s4	s5	s6	s7

3GPP TSG-GERAN#8 **TDoc TSGG#08(02)0154**
February 4-8, Rome, Italy

Title: **Channel coding for O-TCH/WFS and O-TCH/WHS: Listening Test Results**

Source: **Nokia**

Agenda item: 7.1.5.8

---

1. INTRODUCTION

AMR narrow band speech codec in TCH/FS, TCH/HS and O-TCH/HS channels and AMR wideband speech codec in TCH/WFS channel have already been specified for GERAN Release 5. In this document, subjective test results are presented for AMR-WB channel coding for O-TCH/WFS and O-TCH/WHS in order to complete the channel coding work for AMR and AMR-WB codecs in Release 5.

2. LISTENING TEST ARRANGEMENT

The subjective testing was divided into two experiments: one for O-TCH/WFS and one for O-TCH/WHS. The detailed description of the tests is included in Tdoc GP-020153. The corresponding objective measurements from the tested conditions can be found in Tdoc GP-020155.

3. TEST RESULTS

Figures 1 and 2 contain the results from the O-TCH/WFS and O-TCH/WHS respectively. The full listing of individual MOS scores and corresponding confidence intervals are shown in Tables 1 and 2 in the Annex.

Figures 3 and 4 show the optimal performance curves from FR and HR channels respectively. In these Figures, the optimal link adaptation is assumed and the best mode in subjective quality for each of the measured C/I conditions is taken and plotted. This optimal performance curve is then compared to the corresponding curve in the existing AMR-WB GMSK channel.

4. CONCLUSION

This document presents subjective test results for the channel coding proposal for the O-TCH/WFS and O-TCH/WHS. The reasonable operating range for O-TCH/WFS seems to be above 7 dB and for O-TCH/WHS, the range is above 13 dB. In these scenarios, the very high quality of wideband speech can be maintained. O-TCH/WFS will bring clear performance advantage over the existing TCH/WFS. The performance of O-TCH/WHS seems to be about 3-6 dB below to the performance of TCH/WFS but O-TCH/WHS can bring substantial capacity improvement and enables the usage of all the AMR-WB codec modes.

The subjective results presented in this document are well aligned with the objective measurements [3] and show consistent and good performance of the O-TCH/WFS and O-TCH/WHS channel coding schemes. We propose these schemes to be included into 45.003 in order to finalise the channel coding work for 8-PSK speech services for Release 5.

5. REFERENCES:

[1] GP-020152: Channel coding for O-TCH / WFS and O-TCH / WHS: High Level Description
[2] GP-020153 Channel coding for O-TCH / WFS and O-TCH / WHS: Listening Test Plan
[3] GP-020155 Channel coding for O-TCH / WFS and O-TCH / WHS: Objective Measurements
[4] GP-020156 CR 45.003-016 Channel coding for O-TCH / WFS and O-TCH / WHS

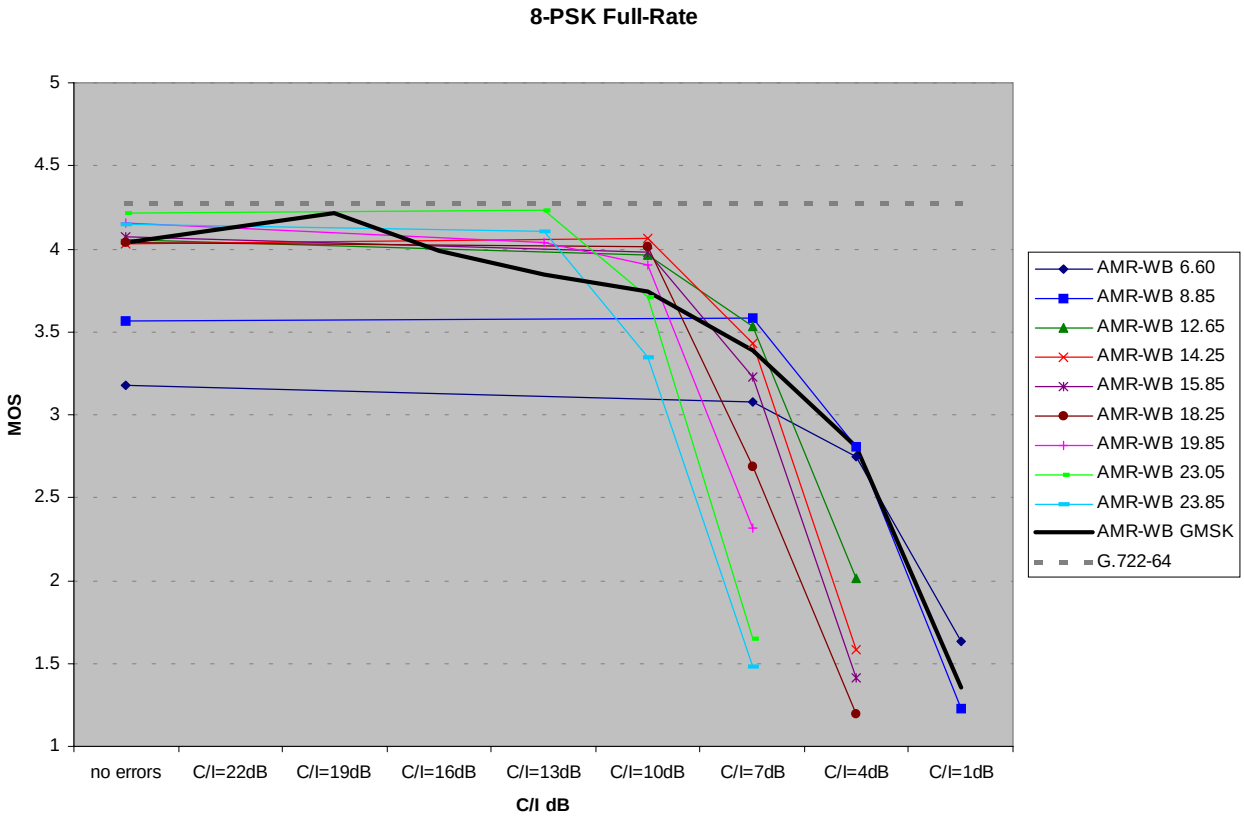

Figure 1: Subjective test results from experiment 1: 8-PSK FR-channel

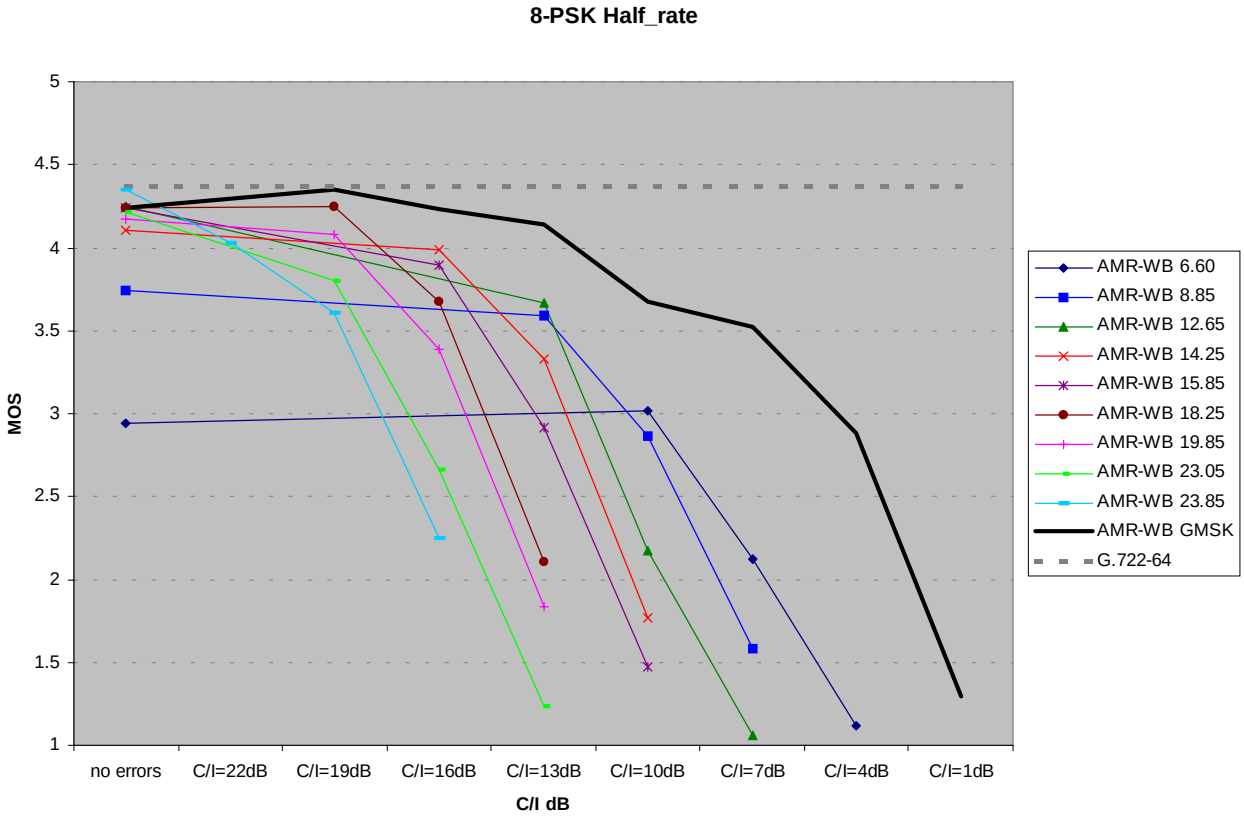

Figure 2:Subjective test results from experiment 2: 8-PSK HR-channel

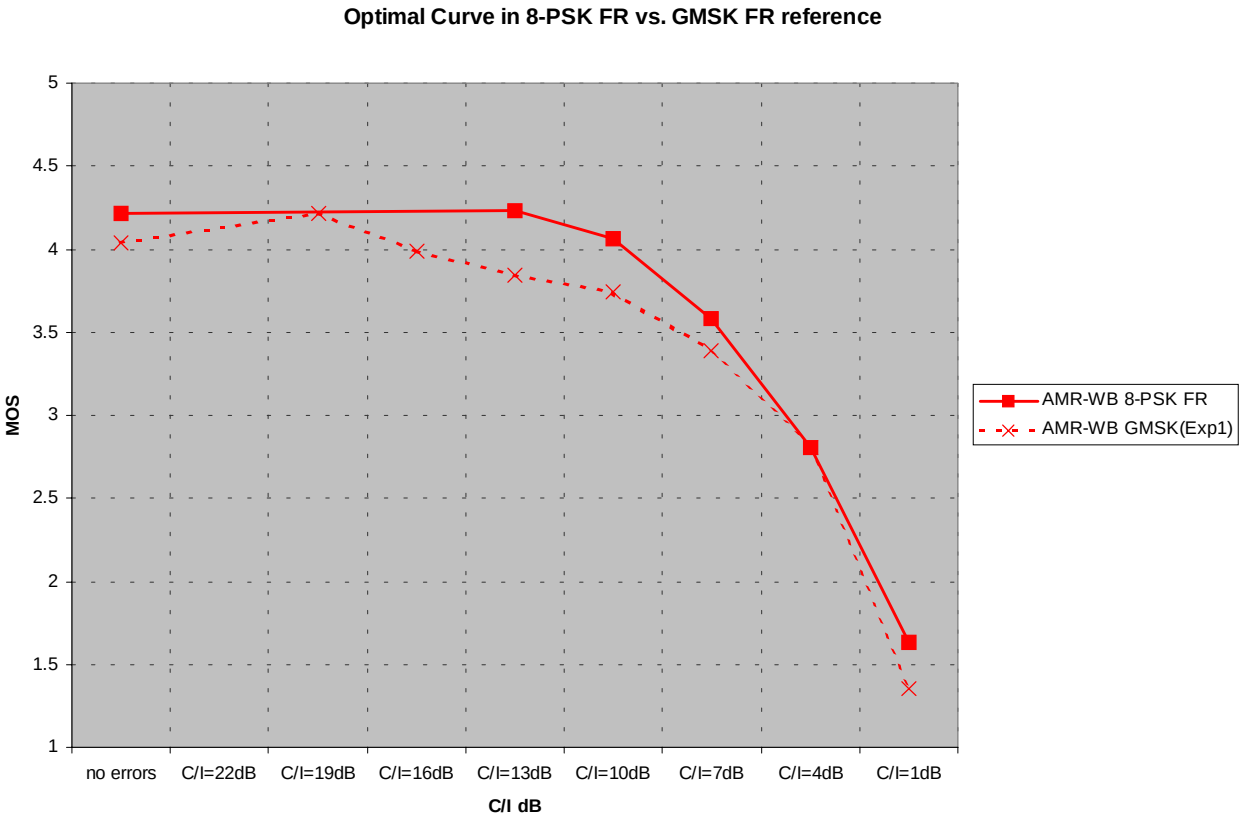

Figure 3: The optimal performance curve for 8-PSK FR-channel

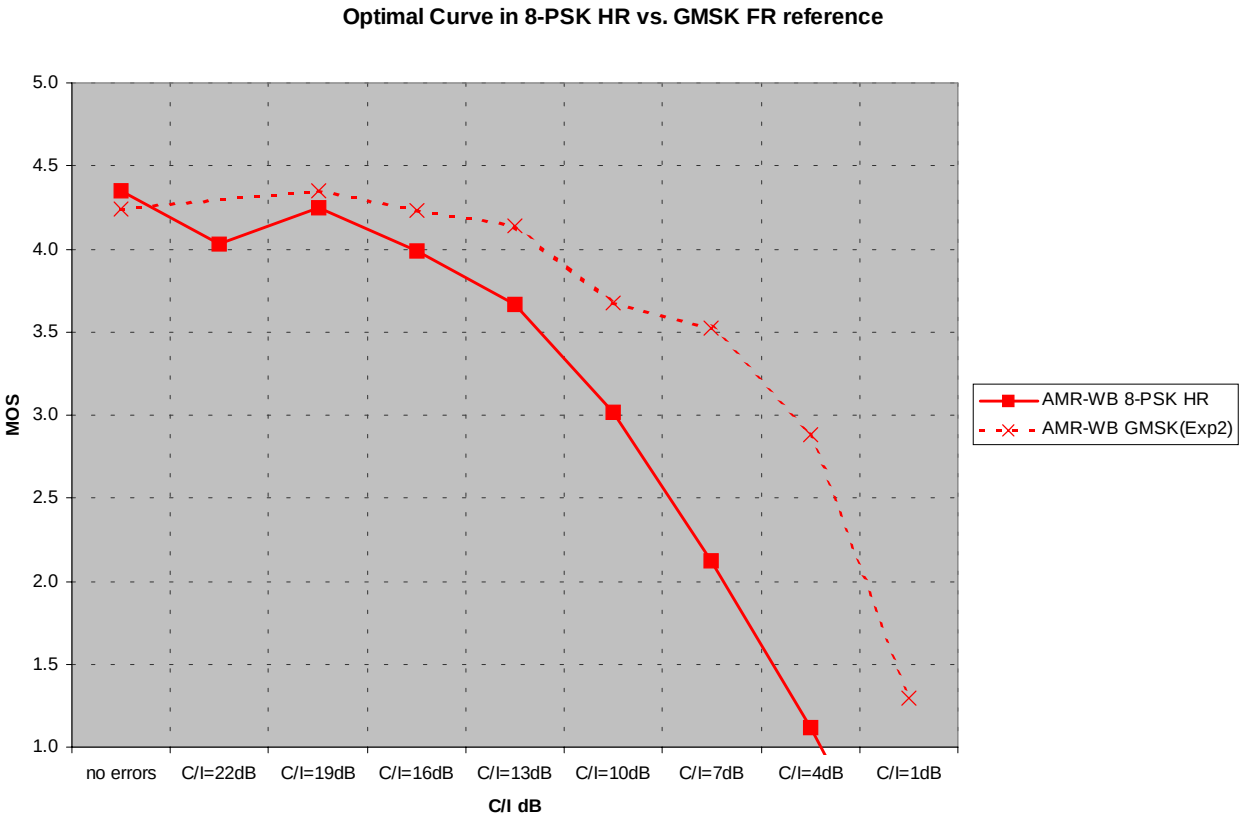

Figure 4: The optimal performance curve for 8-PSK HR-channel

ANNNEX

Table 1: Summary of test result for experiment 1: 8-PSK FR channel

Candidate	Condition	Votes	MOS	Stderr	CIU	CIL
1. AMR-WB 6.60 8-PSK FR	no errors	96	2.92	0.95	2.70	3.14
2. AMR-WB 6.60 8-PSK FR	C/I= 7 dB	96	2.83	0.93	2.62	3.05
3. AMR-WB 6.60 8-PSK FR	C/I= 4 dB	96	2.64	0.81	2.45	2.83
4. AMR-WB 6.60 8-PSK FR	C/I= 1 dB	96	1.54	0.69	1.38	1.70
5. AMR-WB 8.85 8-PSK FR	no errors	96	3.38	0.90	3.17	3.58
6. AMR-WB 8.85 8-PSK FR	C/I= 7 dB	96	3.50	0.84	3.31	3.69
7. AMR-WB 8.85 8-PSK FR	C/I= 4 dB	96	2.71	0.91	2.50	2.92
8. AMR-WB 8.85 8-PSK FR	C/I= 1 dB	96	1.28	0.48	1.17	1.39
9. AMR-WB 12.65 8-PSK FR	no errors	96	3.93	0.81	3.74	4.12
10. AMR-WB 12.65 8-PSK FR	C/I= 10 dB	96	3.86	0.86	3.66	4.06
11. AMR-WB 12.65 8-PSK FR	C/I= 7 dB	96	3.53	0.92	3.32	3.74
12. AMR-WB 12.65 8-PSK FR	C/I= 4 dB	96	1.83	0.77	1.66	2.01
13. AMR-WB 14.25 8-PSK FR	no errors	96	4.01	0.83	3.82	4.21
14. AMR-WB 14.25 8-PSK FR	C/I= 10 dB	96	4.00	0.82	3.81	4.19
15. AMR-WB 14.25 8-PSK FR	C/I= 7 dB	96	3.28	0.94	3.06	3.49
16. AMR-WB 14.25 8-PSK FR	C/I= 4 dB	96	1.50	0.65	1.35	1.65
17. AMR-WB 15.85 8-PSK FR	no errors	96	3.99	0.74	3.81	4.16
18. AMR-WB 15.85 8-PSK FR	C/I= 10 dB	96	3.90	0.86	3.70	4.10
19. AMR-WB 15.85 8-PSK FR	C/I= 7 dB	96	3.10	0.95	2.88	3.32
20. AMR-WB 15.85 8-PSK FR	C/I= 4 dB	96	1.39	0.59	1.25	1.53
21. AMR-WB 18.25 8-PSK FR	no errors	96	4.10	0.81	3.91	4.28
22. AMR-WB 18.25 8-PSK FR	C/I= 10 dB	96	3.86	0.83	3.67	4.05
23. AMR-WB 18.25 8-PSK FR	C/I= 7 dB	96	2.50	0.92	2.29	2.71
24. AMR-WB 18.25 8-PSK FR	C/I= 4 dB	96	1.15	0.36	1.07	1.24
25. AMR-WB 19.85 8-PSK FR	no errors	96	4.07	0.79	3.89	4.25
26. AMR-WB 19.85 8-PSK FR	C/I= 13 dB	96	4.03	0.89	3.82	4.23
27. AMR-WB 19.85 8-PSK FR	C/I= 10 dB	96	3.83	0.87	3.63	4.03
28. AMR-WB 19.85 8-PSK FR	C/I= 7 dB	96	2.15	0.85	1.96	2.35
29. AMR-WB 23.05 8-PSK FR	no errors	96	4.13	0.87	3.92	4.33
30. AMR-WB 23.05 8-PSK FR	C/I= 13 dB	96	4.21	0.73	4.04	4.38
31. AMR-WB 23.05 8-PSK FR	C/I= 10 dB	96	3.61	0.94	3.39	3.83
32. AMR-WB 23.05 8-PSK FR	C/I= 7 dB	96	1.58	0.67	1.43	1.74
33. AMR-WB 23.85 8-PSK FR	no errors	96	4.14	0.81	3.95	4.33
34. AMR-WB 23.85 8-PSK FR	C/I= 13 dB	96	4.11	0.90	3.90	4.32
35. AMR-WB 23.85 8-PSK FR	C/I= 10 dB	96	3.14	0.89	2.93	3.35
36. AMR-WB 23.85 8-PSK FR	C/I= 7 dB	96	1.39	0.59	1.25	1.53
37. AMR-WB 18.25 GMSK	C/I= 19 dB	96	3.99	0.91	3.78	4.20
38. AMR-WB 15.85 GMSK	C/I= 16 dB	96	3.92	0.80	3.73	4.10
39. AMR-WB 14.25 GMSK	C/I= 13 dB	96	3.63	0.88	3.42	3.83
40. AMR-WB 12.65 GMSK	C/I= 10 dB	96	3.56	0.89	3.35	3.76
41. AMR-WB 8.85 GMSK	C/I= 07 dB	96	3.28	0.88	3.08	3.48
42. AMR-WB 6.60 GMSK	C/I= 04 dB	96	2.63	0.80	2.44	2.81
43. AMR-WB 6.60 GMSK	C/I= 01 dB	96	1.35	0.59	1.21	1.48
44. MNRU 10	no errors	96	1.10	0.30	1.03	1.17
45. MNRU 23	no errors	96	2.00	0.69	1.84	2.16
46. MNRU 36	no errors	96	3.69	0.88	3.49	3.90
47. G.722 at 64 kbit/s	no errors	96	4.35	0.77	4.17	4.53
48. DIRECT	no errors	96	4.32	0.73	4.15	4.49

Notes: VOTES: Indicates Total of all votes on condition quality
MOS: Indicates ensemble Mean Opinion Score (across all Talkers, Sentence Pairs, and Listeners)
CIU: Indicates 95% confidence interval upper limit
CIL: Indicates 95% confidence interval lower limit
Stderr: Indicates Standard Error, Standard Deviation /Sqrt(# Votes)

Table 2: Summary of test result for experiment 2: 8-PSK HR channel

Candidate	Condition	Votes	MOS	Stderr	CIU	CIL
1. AMR-WB 6.60 8-PSK HR	no errors	96	2.92	0.80	2.77	3.07
2. AMR-WB 6.60 8-PSK HR	C/I= 10 dB	96	2.99	0.84	2.83	3.15
3. AMR-WB 6.60 8-PSK HR	C/I= 7 dB	96	1.98	0.82	1.83	2.14
4. AMR-WB 6.60 8-PSK HR	C/I= 4 dB	96	1.09	0.29	1.04	1.15
5. AMR-WB 8.85 8-PSK HR	no errors	96	3.63	0.78	3.48	3.78
6. AMR-WB 8.85 8-PSK HR	C/I= 13 dB	96	3.59	0.81	3.44	3.75
7. AMR-WB 8.85 8-PSK HR	C/I= 10 dB	96	2.82	0.89	2.66	2.99
8. AMR-WB 8.85 8-PSK HR	C/I= 7 dB	96	1.53	0.62	1.41	1.64
9. AMR-WB 12.65 8-PSK HR	no errors	96	4.17	0.79	4.02	4.32
10. AMR-WB 12.65 8-PSK HR	C/I= 13 dB	96	3.61	0.87	3.45	3.78
11. AMR-WB 12.65 8-PSK HR	C/I= 10 dB	96	2.16	0.76	2.01	2.30
12. AMR-WB 12.65 8-PSK HR	C/I= 7 dB	96	1.06	0.23	1.01	1.10
13. AMR-WB 14.25 8-PSK HR	no errors	96	4.01	0.79	3.86	4.16
14. AMR-WB 14.25 8-PSK HR	C/I= 16 dB	96	3.90	0.83	3.74	4.05
15. AMR-WB 14.25 8-PSK HR	C/I= 13 dB	96	3.25	0.89	3.08	3.42
16. AMR-WB 14.25 8-PSK HR	C/I= 10 dB	96	1.70	0.74	1.56	1.84
17. AMR-WB 15.85 8-PSK HR	no errors	96	4.20	0.73	4.07	4.34
18. AMR-WB 15.85 8-PSK HR	C/I= 16 dB	96	3.98	0.83	3.82	4.14
19. AMR-WB 15.85 8-PSK HR	C/I= 13 dB	96	2.85	0.95	2.67	3.03
20. AMR-WB 15.85 8-PSK HR	C/I= 10 dB	96	1.42	0.57	1.31	1.52
21. AMR-WB 18.25 8-PSK HR	no errors	96	4.26	0.72	4.12	4.39
22. AMR-WB 18.25 8-PSK HR	C/I= 19 dB	96	4.18	0.77	4.03	4.32
23. AMR-WB 18.25 8-PSK HR	C/I= 16 dB	96	3.56	0.91	3.39	3.74
24. AMR-WB 18.25 8-PSK HR	C/I= 13 dB	96	2.06	0.69	1.94	2.19
25. AMR-WB 19.85 8-PSK HR	no errors	96	4.19	0.78	4.05	4.34
26. AMR-WB 19.85 8-PSK HR	C/I= 19 dB	96	4.14	0.75	4.00	4.28
27. AMR-WB 19.85 8-PSK HR	C/I= 16 dB	96	3.22	0.95	3.04	3.40
28. AMR-WB 19.85 8-PSK HR	C/I= 13 dB	96	1.78	0.71	1.64	1.91
29. AMR-WB 23.05 8-PSK HR	no errors	96	4.19	0.75	4.05	4.34
30. AMR-WB 23.05 8-PSK HR	C/I= 19 dB	96	3.75	0.83	3.59	3.91
31. AMR-WB 23.05 8-PSK HR	C/I= 16 dB	96	2.53	0.88	2.36	2.69
32. AMR-WB 23.05 8-PSK HR	C/I= 13 dB	96	1.21	0.43	1.13	1.29
33. AMR-WB 23.85 8-PSK HR	no errors	96	4.19	0.74	4.05	4.32
34. AMR-WB 23.85 8-PSK HR	C/I= 22 dB	96	4.01	0.80	3.86	4.16
35. AMR-WB 23.85 8-PSK HR	C/I= 19 dB	96	3.53	0.95	3.35	3.71
36. AMR-WB 23.85 8-PSK HR	C/I= 16 dB	96	2.26	0.82	2.10	2.41
37. AMR-WB 18.25 GMSK	C/I= 19 dB	96	4.26	0.70	4.13	4.39
38. AMR-WB 15.85 GMSK	C/I= 16 dB	96	4.19	0.67	4.06	4.31
39. AMR-WB 14.25 GMSK	C/I= 13 dB	96	4.09	0.79	3.94	4.24
40. AMR-WB 12.65 GMSK	C/I= 10 dB	96	3.71	0.85	3.55	3.87
41. AMR-WB 8.85 GMSK	C/I= 07 dB	96	3.56	0.82	3.41	3.72
42. AMR-WB 6.60 GMSK	C/I= 04 dB	96	2.82	0.86	2.67	2.97
43. AMR-WB 6.60 GMSK	C/I= 01 dB	96	1.21	0.41	1.13	1.30
44. MNRU 10	no errors	96	1.09	0.29	1.04	1.15
45. MNRU 23	no errors	96	1.78	0.73	1.64	1.92
46. MNRU 36	no errors	96	3.76	0.98	3.57	3.94
47. G.722 at 64 kbit/s	no errors	96	4.41	0.64	4.29	4.53
48. DIRECT	no errors	96	4.32	0.73	4.19	4.46

Notes: VOTES: Indicates Total of all votes on condition quality
MOS: Indicates ensemble Mean Opinion Score (across all Talkers, Sentence Pairs, and Listeners)
CIU: Indicates 95% confidence interval upper limit
CIL: Indicates 95% confidence interval lower limit
Stderr: Indicates Standard Error, Standard Deviation /Sqrt(# Votes)

Technical Specification Group Services and System Aspects **TSGS#15(02)0004**
Meeting #15, Cheju Island, Korea, 11-14 March 2002

3GPP TSG GERAN **GP-(02)0505**
Meeting no 8 Agenda Item: 7.1.5.8
Rome, Italy
4 – 8 February 2002

Title:	LS on Speech Codecs references in GERAN specifications
Source:	TSG GERAN
To:	TSG SA WG4, TSG SA
Cc:	TSG SA WG1, TSG RAN WG1, TSG RAN WG2
Attachment:	GP-020153, GP-020154

Contact Person:
Name: Carole Esculier
E-mail Address: mailto:esculier@nortelnetworks.com
Tel. Number: +33 1 39 44 58 93

TSG GERAN would like to thank TSG SA WG4 for their Ls about "the introduction of AMR-WB and AMR-NB for 8 PSK GSM channels. (GP-020275)"

AMR-WB

The support of WB-AMR across GERAN-GMSK TCH/F, GERAN-8PSK TCH/F and TCH/H leads to 28 (8+10+10) different channel coding schemes. Supporting one or possibly several of these three configurations represents a non-negligible burden for terminals and BTS.

The current available performance evaluations (GP-020154 & 3GPP TR 26.976 v0.6.0) show no obvious advantage in supporting all the proposed Wide-Band speech modes for speech telephony service.

GERAN therefore ask SA4 to consider selecting a sub-set of the 9 WB-AMR modes that could be used for WB telephony service, ideally this sub-set should not include more than 4 different modes and should be common to the three above mentioned channel realizations. GERAN understands that the WB-AMR can be used for other applications than Wide-Band speech telephony such as MMS or PSM, for which more or different modes may be required. In consequence GERAN thinks that the WB-AMR speech codec as specified in 3GPP TS 26.190 can be kept identical but that only channel coding for a sub-set of the modes available in this speech codec would need to be specified for the WB speech telephony service.

GERAN understands that Wide-Band telephony service shall be also possible between UMTS and GSM networks and could be available on dual-mode terminals. GERAN asks SA for guidance on the application of the suggested restriction for the Wide-Band speech telephony service both for GERAN and UTRAN.

It is GERAN opinion that the easiness of implementation of WB Telephony will importantly contribute to the proliferation of WB-AMR in mobile terminals. This is a pre-requisite for operators before considering deploying this service in their networks.

Up-dating of the Codec list (3GPP TS 26.103) for R5

TSG GERAN reviewed, as requested by TSG SA WG4, the attached CR to the 26.103 and have the following comments:

- TSG GERAN confirms that, in addition to the current existing speech codecs, it is currently planned to introduce in R5 the following configurations:

  WB-AMR for GMSK Full Rate traffic channels,
  WB-AMR for 8-PSK Full Rate and Half Rate traffic channels,
  NB-AMR for 8-PSK Half Rate traffic channels.

- TSG GERAN would recommend to use the proposed wording along the CR:

- GERAN-GMSK and GERAN-8PSK to reference the Codec Types in Radio Access Technologies (e.g. in table 4.1 but also at other occurrences of the CR).
- In the abbreviations section, two corrections are needed
  - GERAN = GSM/EDGE Radio Access Network
  - UTRAN = UMTS Terrestrial Radio Access Network

Actions

3GPP TSG SA WG4: To investigate the feasibility of defining a sub-set of WB AMR modes to support for WB speech telephony service.

3GPP TSG SA: To provide guidance about the use of a common sub-set of WB AMR speech codec for WB telephony services in UTRAN and GERAN.

Next meetings

GERAN #9 15th-19th April 2002

GERAN #10 24th-28th June 2002