Technical Specification Group Services and System Aspects **_TSGS#13(01)0458_**
Meeting #13, Beijing, China, 24-27 September 2001

Source: TSG-SA WG4

Title: CRs to TR 26.975 Clarification of 3G simulator settings used for AMR characterization in 3G channels (R99 and Release 4)

Document for: Approval

Agenda Item: 7.4.3

The following CRs, agreed at the TSG-SA WG4 meeting #18, are presented to TSG SA #13 for approval.

Spec	CR	Rev	Phase	Subject	Cat	Vers	WG	Meeting	S4 doc
26.975	001		R99	Clarification of 3G simulator settings used for AMR characterisation in 3G channels	F	3.0.0	S4	TSG-SA WG4#18	S4-010469R
26.975	002		REL-4	Clarification of 3G simulator settings used for AMR characterisation in 3G channels	A	4.0.0	S4	TSG-SA WG4#18	S4-010470R

3GPP TSG-SA WG4 Meeting #18
03 – 07 Sep 2001, Erlangen, Germany

Tdoc S4 (01)0469R

CR-Form-v3

CHANGE REQUEST

⌘	**26.975**	**CR**	**001**	⌘	rev	**-**	⌘	Current version:	**3.0.0**	⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [X] Radio Access Network [X] Core Network [ ]

Title:	⌘	Clarification of 3G simulator settings used for AMR characterisation in 3G channels		
Source:	⌘	TSG SA WG4		
Work item code:	⌘	AMR	***Date:*** ⌘	24-09-2001
Category:	⌘	**F**	***Release:*** ⌘	R99
		Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change:	⌘	The performance shown for modes AMR12.2 and AMR10.2 on 3G channels is considerably worse than could be expected if the rate matching attributes of channel simulation had been optimised. In particular, the QoS attributes achieved for class C bits are much worse than recommended in 3GPP TS 26.102.
Summary of change:	⌘	A note is added that the performance shown for modes AMR12.2 and AMR10.2 is worse than could be expected with more suitable QoS attributes.
Consequences if not approved:	⌘	Wrong interpretation of the performance figures might lead to improper 3G system design compromising the achievable capacity.

Clauses affected:	⌘	Annex E		
Other specs affected:	⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘	
Other comments:	⌘	.		

Motivation of the proposed CR

The following two figures are taken from 3GPP TR 26.975 and show the speech quality degradation of the AMR codec with increasing FER. It is noticeable that mode AMR12.2 shows a significant degradation already at an FER of 0.5%. A similar tendency is visible throughout most of the results for modes AMR12.2 and AMR10.2 in Annex E of the TR.

This degradation is more than could be expected. The following tables 1 and 2 are taken from [2] and [3] and show results of analyses made on the 3G error patterns used for the 3G characterisation of the AMR codec. It can be seen that the residual BER figures for class C bits at a SDU error rate of 0.5 % are as high as up to 2.5 %. This is considerably higher than the recommended value of 0.5% at an SDU error rate of 0.7% [1]. The reason is that the rate matching attributes used, which were set according to the recommended median of the rate matching attributes defined in [4], do not provide sufficient protection for the class C bits.

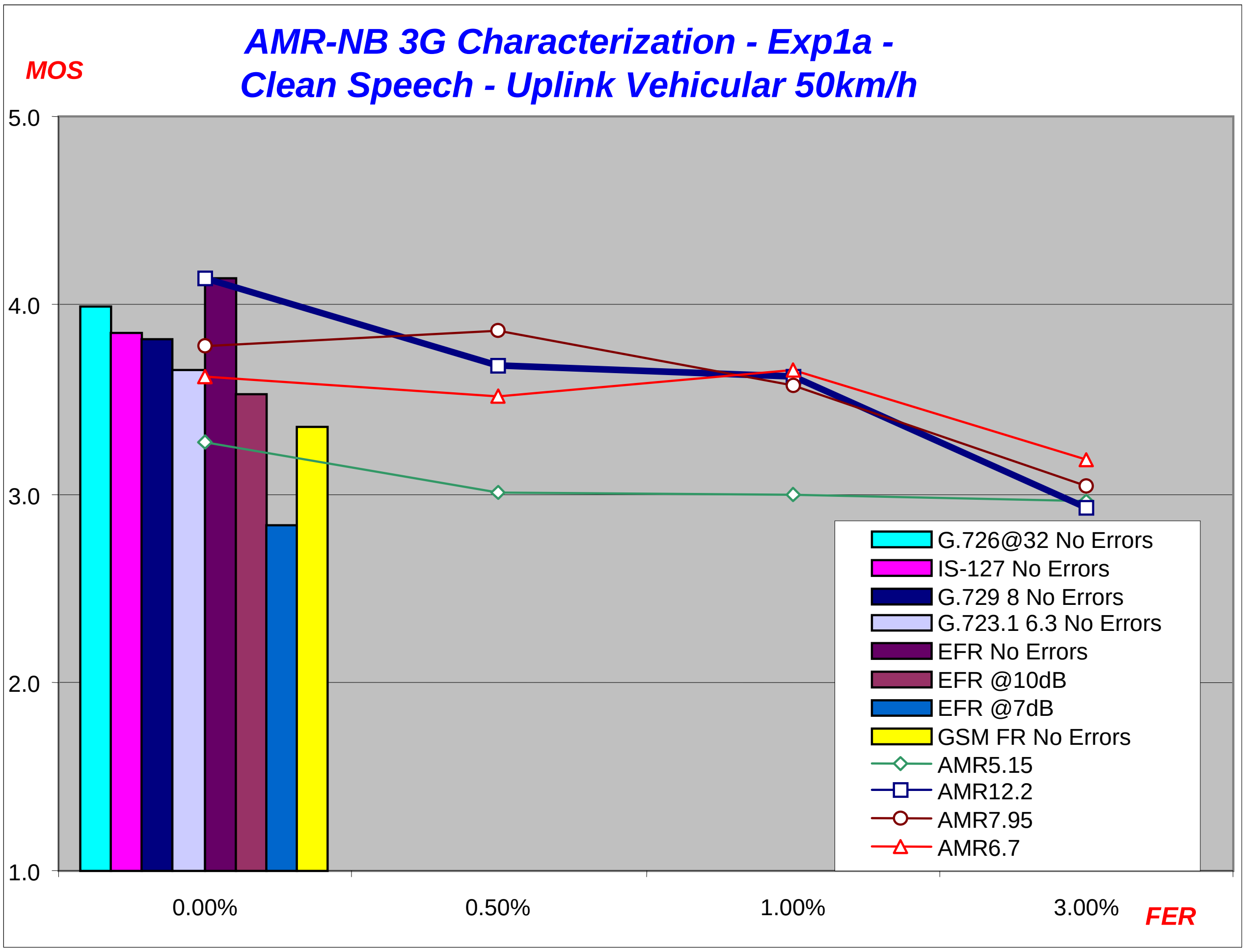

Figure 1: AMR-NB Characterisation – Experiment 1a

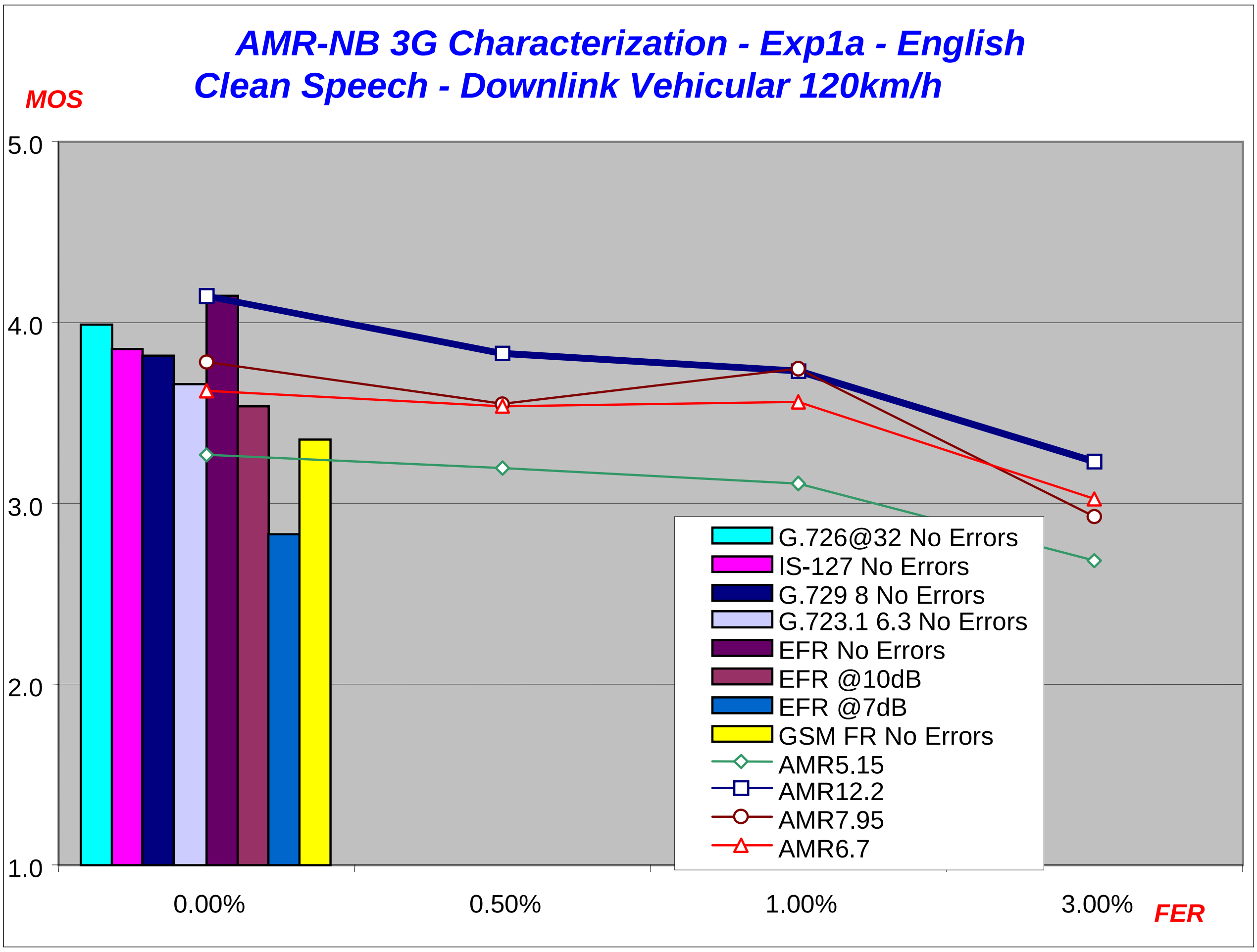

Figure 2: AMR-NB Characterisation – Experiment 1a

Table1: Statistics of 3G DL error patterns [2]

Experiment	AMR mode	File name	FER	RBER for Class B	RBER for Class C
1A	12.2	EC4A_122.ep	0.005	0.001159	0.025427
1A	12.2	EC5A_122.ep	0.01	0.001062	0.034844
1A	12.2	EC6A_122.ep	0.03	0.004873	0.070135
1B	12.2	EC1B_122.ep	0.005	0.000467	0.022969
1B	12.2	EC2B_122.ep	0.01	0.001657	0.037073
1B	12.2	EC3B_122.ep	0.03	0.004824	0.063896
1B	10.2	EC7B_102.ep	0.005	0.000758	0.017172
1B	10.2	EC8B_102.ep	0.01	0.001439	0.018547
1B	10.2	EC9B_102.ep	0.03	0.004463	0.043797
1C	12.2	EC4C_122.ep	0.005	0.000983	0.012188
1C	12.2	EC5C_122.ep	0.01	0.001311	0.024625
1C	12.2	EC6C_122.ep	0.03	0.00415	0.05299
2	10.2	EC1D_102.ep	0.005	0.000758	0.017172
2	10.2	EC2D_102.ep	0.01	0.001439	0.018547

Table2: Statistics of 3G UL error patterns [3]

Experiment	AMR mode	File name	FER	RBER for Class B	RBER for Class C
1A	12.2	EC1A_122	0,005	5,7*10e-4	8,5*10e-3
1A	12.2	EC2A_122	0,010	1,5*10e-3	1,3*10e-2
1A	12.2	EC3A_122	0,030	3,9*10e-3	3*10e-2
1C	12.2	EC1C_122	0,005	9*10e-4	2*10e-2
1C	12.2	EC2C_122	0,010	3,4*10e-3	3,2*10e-2
1C	12.2	EC3C_122	0,030	8,5*10e-3	6,6*10e-2
2	12.2	EC3D_122	0,005	1,4*10e-3	9,8*10e-3

2	12.2	EC4D_122	0,010	1,9*10e-3	1,6*10e-2
1A	10.2	EC7A_102	0,005	1*10e-3	6*10e-3
1A	10.2	EC8A_102	0,010	2,4*10e-3	7,3*10e-3
1A	10.2	EC9A_102	0,030	7,4*10e-3	2*10e-2
1B	10.2	EC4B_102	0,005	9,5*10e-4	3*10e-3
1B	10.2	EC5B_102	0,010	1,4*10e-3	6,3*10e-3
1B	10.2	EC6B_102	0,030	4,8*10e-3	1,4*10e-2
1C	10.2	EC7C_102	0,005	1,1*10e-3	4,5*10e-3
1C	10.2	EC8C_102	0,010	2*10e-3	7,8*10e-3
1C	10.2	EC9C_102	0,030	5,2*10e-3	1,8*10e-2
2	10.2	EC5D_102	0,005	1,3*10e-3	1,6*10e-2
2	10.2	EC6D_102	0,010	3,2*10e-3	2,2*10e-2

Conclusion

It is concluded that the shown performance drop for modes AMR12.2 and AMR10.2 is worse than could be expected with more appropriate setting of the rate matching attributes in the channel simulator.

References

[1] 3GPP TS 26.102: “AMR speech codec; Interface to Iu and Uu”, Version 3.3.0

[2] 3GPP TSG-SA4 Tdoc S4-010053: “Statistics of 3G error patterns provided by NTT DoCoMo”, January 2001, Munich, Germany

[3] 3GPP TSG-SA4 Tdoc S4-01xxxx: “Statistics of 3G error patterns provided by Nortel Networks”, September 2001, Erlangen, Germany

[4] 3GPP TSG-RAN Tdoc RP-000447: UTRAN Typical Radio Interface Parameter Sets, Version 1.3, August 2000, from the GSM-A

How the CR is implemented:

Annex E: AMR Characterization in 3G Channels

E1. Overview of the 3G Characterization Phase

Following the selection of AMR as the mandatory speech codec for the 3G system under the responsibility of 3GPP, it was decided to carry out a simplify 3G Characterization Phase to check the behavior of the speech codec in 3G radio channels. The corresponding tests, funded by the 3GPP PCG, were completed in 4Q00.

Because of the exhaustive tests already performed in the GSM environment, it was decided to restrict the scope of the 3G Characterization Phase to conditions directly impacted by the 3G Radio Interface. Consequently, most of the tests were performed in clean speech conditions, so that a maximum number of different propagation error conditions could be tested. The 3G Characterization Phase included 2 experiments and 3 sub-experiments, each performed by a different test laboratory. The scope of the different experiments is provided in the following table:

Experiment.	Test Laboratory	Language	Noise Condition
1a	*Dynastat*	English	Clean
1b	*Lookheed Martin GT*	Korean	Clean
1c	*NTT-AT*	Japanese	Clean
2	*Arcon*	English	Car Noise at 15dB SNR

Table E.1: Summary of the AMR 3G Characterization Test conditions

The other tasks were under the responsibility of:

Lookheed Martin GT: Preparation of the Test Plan and Processing Procedures Specification

Nortel Networks & NTT DoCoMo: Preparation of the Error Patterns

Arcon: Host Laboratory and Global Analysis

The experiments were dimensioned to evaluate the performances of a subset of the AMR codec modes for 3 Path Profiles at 3 different target FER. All conditions involved single encoding only (No Tandem) without DTX activated. The actual error conditions tested are summarized in the following table. All AMR modes were also tested in No Error conditions in all experiments, in addition to the following references: ADPCM G.726 at 32kbit/s (Not in Exp.2), G.723.1 at 6.3kbit/s, G.729 at 8kbit/s (all 3 in No errors), GSM EFR at 10 and 7 dB C/I, GSM FR and IS-127 (both in No Errors and in Exp.1 only).

Experiment.	Path Profile	Target FER	Modes Tested
1a	Uplink-Vehicular-B-50 km/h	0.5%, 1%, 3%	12.2, 7.95, 6.7, 5.15
	Downlink-Vehicular-B-120 km/h	0.5%, 1%, 3%	12.2, 7.95, 6.7, 5.15
	Uplink-Pedestrian-B-3 km/h	0.5%, 1%, 3%	10.2, 7.4, 5.90, 4.75
1b	Downlink-Vehicular-B-50 km/h	0.5%, 1%, 3%	12.2, 7.95, 6.7, 5.15
	Uplink-Indoor-A-3 km/h	0.5%, 1%, 3%	10.2, 7.4, 5.90, 4.75
	Downlink-Pedestrian-B-3 km/h	0.5%, 1%, 3%	10.2, 7.4, 5.90, 4.75
1c	Uplink-Vehicular-B-120 km/h	0.5%, 1%, 3%	12.2, 7.95, 6.7, 5.15
	Downlink- Indoor-A-3 km/h	0.5%, 1%, 3%	12.2, 7.95, 6.7, 5.15
	Uplink- Pedestrian-A-3 km/h	0.5%, 1%, 3%	10.2, 7.4, 5.90, 4.75
2	Downlink-Pedestrian-B-3 km/h	0.5%, 1%	10.2, 7.4, 5.90, 4.75
	Uplink-Vehicular-A-50 km/h	0.5%, 1%,	12.2, 7.95, 6.7, 5.15
	Uplink-Vehicular-B-120 km/h	0.5%, 1%,	10.2, 7.4, 5.90

Table E.2: Overview of the tested conditions

E2. Radio Simulator Parameters

The key parameters used for the simulation of the 3G Channels are summarized below. Note, however, that these parameters do not in any case ensure to meet appropriate QoS parameters for the different RAB subflows, for which a suitable example is to meet a residual BER for class B bits of 0.1% and a residual BER for class C bits of 0.5% at an SDU error ratio of 0.7% [E1].: Statistical analyses of the 3G error patterns used [E2], [E3] show that particularly for modes AMR12.2 and AMR10.2 the residual BER of class C bits partly is much higher than according to this example (up to 2.5% at a SDU error ratio of 0.5%). Moreover, the SDU error rate and residual BER figures obtained at a given radio simulator setting may exhibit considerable statistical variations, as, particularly for the case of 0.5% SDU error rate, the number of required frame erasures and residual bit errors is low compared to the length of the error pattern (1600 frames).

E2.1. General

Maximum source bit rate of 12.2 kbit/s

12 bits CRC size on Class A Bits

Normal Frames (not compressed)

Channel Coding: Based on Convolutional Codes defined in [7]

Rate Matching: Median values of Rate Matching attributes defined in [7]

Power Control: The Power Control is made of two loops, the so-called inner and outer loops. The inner loop is used to decide on the PC command based on the estimation of the SIR and its comparison to the SIR target, the outer loop is made to adjust the SIR target according to metrics that are used to evaluate the quality of the link. The outer loop has been disabled, e.g. the SIR target has been fixed in comparison with waited FER values of 0.5%, 1%, and 3%. The algorithms used for the measurements as well as the adjustment of the SIR target are proprietary.

The Power Control Algorithm referenced as option #1 has been used for the inner loop, with 1 dB steps.

The Power Control implies a certain loop delay, due to the SIR estimation, the transmission of the command on the reverse link, the decision on the Power Control command and its application. A delay of 1 time slot is used. The assumed BER on TPC bits is 4 %.

Diversity: There exist transmit and receive diversity. It is assumed that Rx diversity will be very common in the future UMTS networks. Therefore, in Uplink, receiver diversity is used. The Transmit diversity can be used in Downlink, but there will be many Node B which won't offer this feature. Therefore, no Tx diversity is assumed in DL.

Propagation profiles & mobile speeds : The Working Groups of the TSG RAN use six different profiles: Indoor A and B, Outdoor to Indoor A and B, and Outdoor A and B.

These profiles in conjunction with the mobile speed are used to simulate different scenarios, e.g. Outdoor-to-Indoor with a mobile speed of 3 km/h is assumed to correspond to a pedestrian in a urban environment, at 50 km/h it can correspond to car in a suburban environment.

Regarding the 3G AMR characterization, some typical scenarios have been defined and from these scenarios the profile and the mobile speed to use have been derived: speed of 3km/h for profiles indoor A, Pedestrian A and Pedestrian B; speed of 50 km/h for Vehicular A and Vehicular B; speed of 120 km/h for Vehicular B.

E2.2. Uplink

Spreading Factors: The spreading factor is 64 for the speech bitrates higher than 5.15 kbps, 128 otherwise.

Transport Format Combination Indicator: The TFCI informs the receiver about the instantaneous transport format combination of the transport channels mapped to the simultaneously transmitted uplink DPDCH radio frame. For this exercise, the TFCI is transmitted but not used because we suppose a perfect decoding (always the same transport format combination).

DCCH: A DCCH, of either 3.4 or 1.7 kbit/s depending on the spreading factor, shared the DPDCH with the TrCH carrying the voice.

Slot Format: The slot format for DPDCH and DPCCH is given in [8].

A spreading factor of 64 implies slot format #2 to be used for the DPDCH and a spreading factor of 128 implies slot format #1 to be used for the DPDCH. For DPCCH, non-compressed frame formats and no DL transmitter diversity imply to use slot format #0: the frame structure is 6 pilot bits + 2 TFCI + 2 TPC.

Gain Factors: The gain factor is the power offset between the DPCCH (which carries the control bits such as the Pilot bits, TFCI, TPC, etc.) and the DPDCH (which carries the user data and the UTRAN signalling). This difference of power comes from the difference between spreading factors.

The gain factor for DPCCH is 11 and the gain factor for DPDCH is 15.

Interferences**: There was no MAI in Uplink, however an AWGN channel was used.**

E2.3. Downlink

Spreading Factors: The spreading factor is 128 for the speech bitrates higher than 5.15 kbps, 256 otherwise.

Transport Format Combination Indicator: For DL, BTFD is assumed. Therefore no TFCI is used for format detection.

For this exercise, there is no BTFD error because we suppose a perfect decoding (always the same transport format combination) and ratio of BTFD error is relatively low compared with FER of speech information.

DCCH: A DCCH, of either 3.4 or 1.7 kbit/s depending on the spreading factor, shared the DPDCH with the TrCH carrying the voice.

Slot Format: A spreading factor of 128 and 256, which depends on source bit-rate, and non-compressed frame format imply slot format #12 to be used for DPCH including both DPDCH and DPCCH. The frame structure for DPCCH is 4 pilot bits + 2 TPC.

Gain Factors: Equal gain factors are used both DPDCH and DPCCH for DL. This means there is no power offset between them.

Interferences: Channel setting defined in Table C.3 of [9] is used for DL.

E3. AMR 3G Characterization Test Results in Clean Speech

The following diagrams present the raw test results of Experiments 1a, 1b and 1c, for the different path profiles and target FER tested in these experiments. The performances are presented as a function of the target FER. As in Annex D, the performances are usually showing no significant degradation of the speech quality down to 1% FER. It is to be noted that the shown performance degradation for modes AMR12.2 and AMR10.2 is worse than can be expected with more appropriate QoS attributes for class C bits.

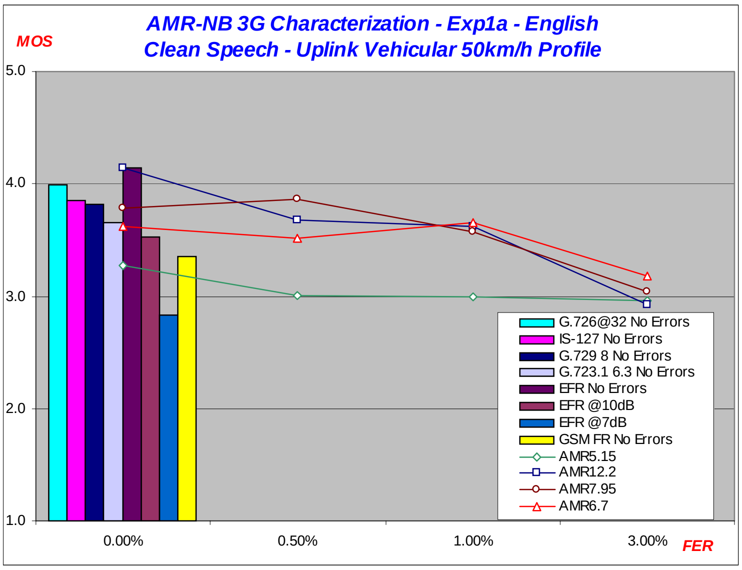

Figure E3-1: AMR 3G Characterization Exp. 1a Test Results – Clean Speech – Uplink Vehicular-B 50 km/h Profile

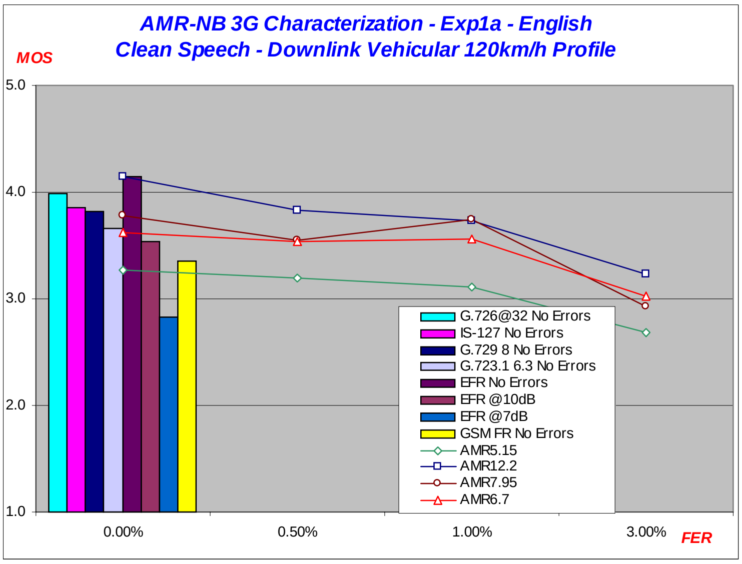

Figure E3-2: AMR 3G Characterization Exp. 1a Test Results – Clean Speech – Downlink Vehicular-B 120 km/h Profile

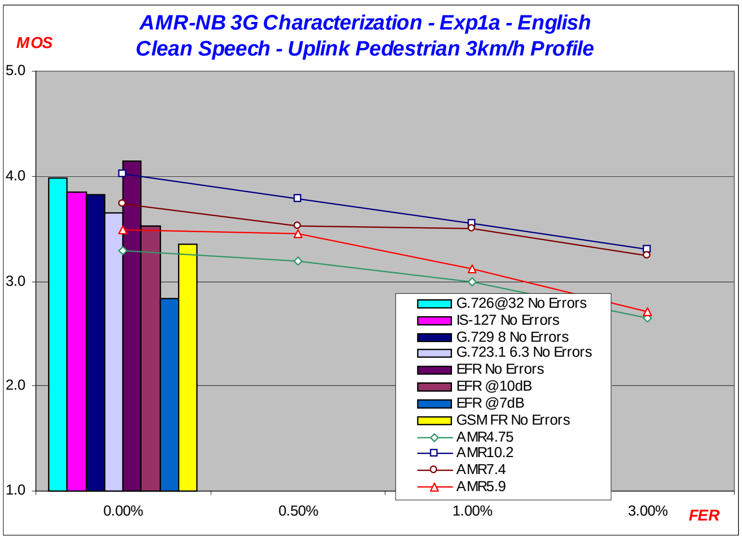

Figure E3-3: AMR 3G Characterization Exp. 1a Test Results – Clean Speech – Uplink Pedestrian-B 3 km/h Profile

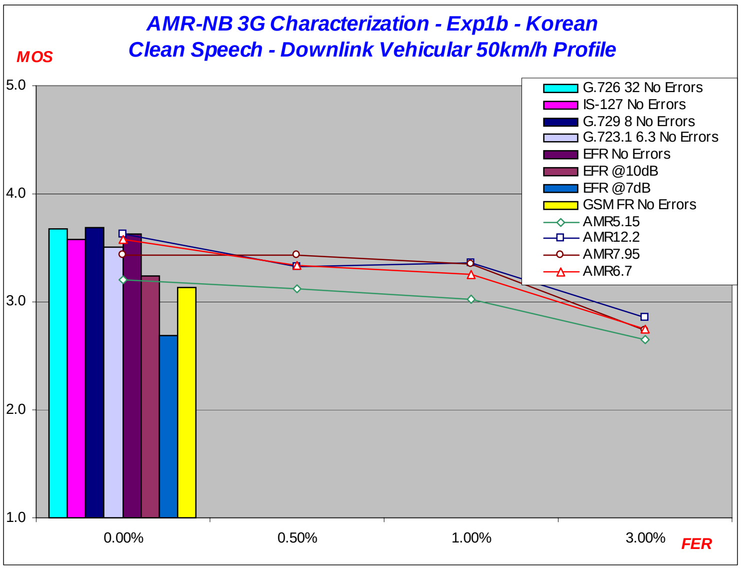

Figure E3-4: AMR 3G Characterization Exp. 1b Test Results – Clean Speech – Downlink Vehicular-B 50 km/h Profile

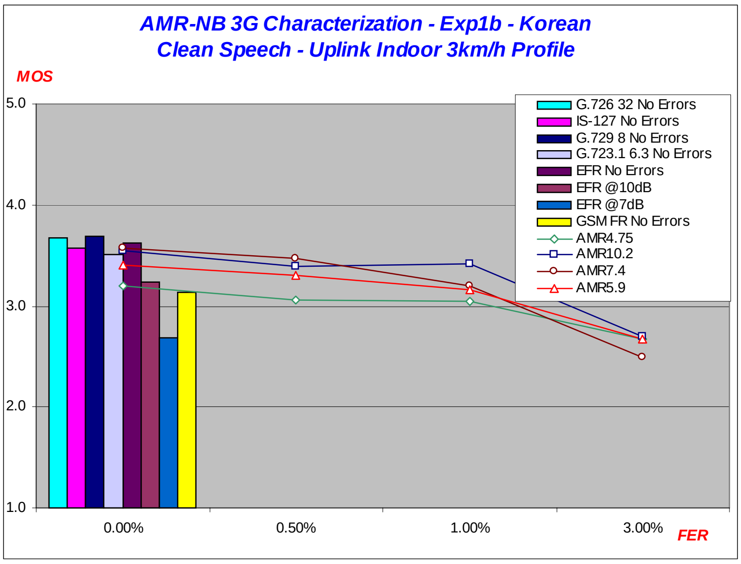

Figure E3-5: AMR 3G Characterization Exp. 1b Test Results – Clean Speech –Uplink Indoor-A 3 km/h Profile

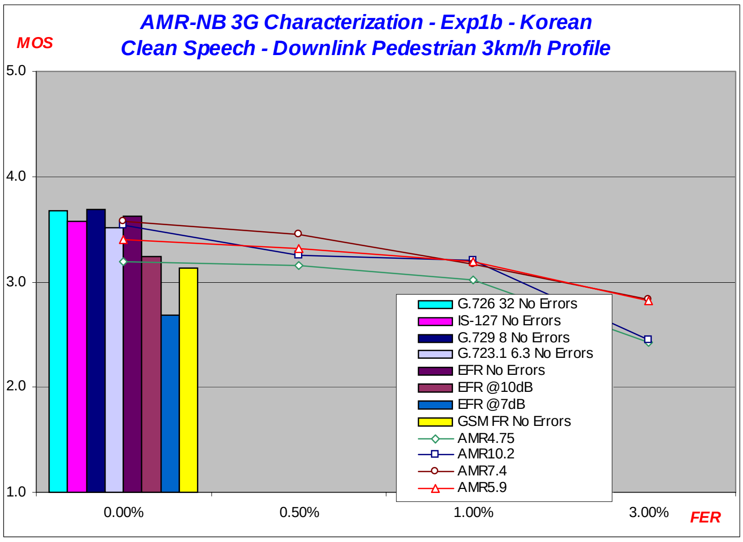

Figure E3-6: AMR 3G Characterization Exp. 1b Test Results – Clean Speech – Downlink Pedestrian-B 3 km/h Profile

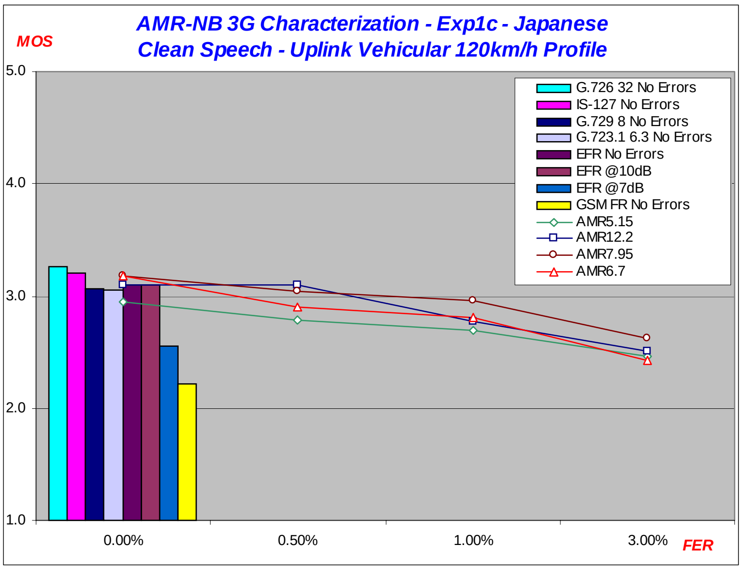

Figure E3-7: AMR 3G Characterization Exp. 1c Test Results – Clean Speech – Uplink Vehicular-B 120 km/h Profile

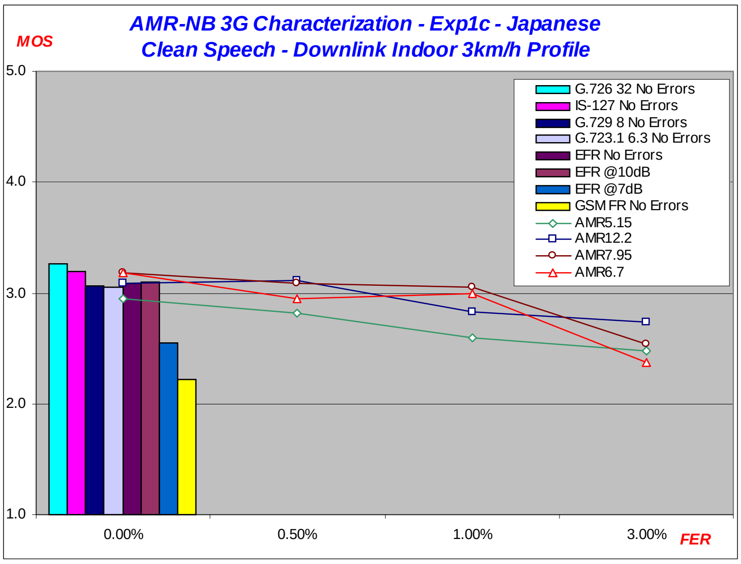

Figure E3-8: AMR 3G Characterization Exp. 1c Test Results – Clean Speech – Downlink Indoor-A 3 km/h Profile

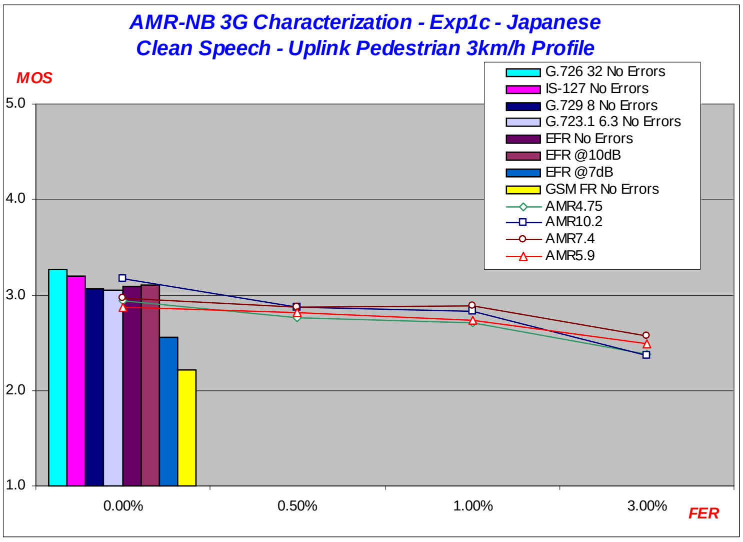

Figure E3-9: AMR 3G Characterization Exp. 1c Test Results – Clean Speech – Uplink Pedestrian-A 3 km/h Profile

E4. AMR 3G Characterization Test Results in Car Noise

The following diagrams present the raw test results of Experiment 2 for the different path profiles and target FER tested in this experiment. The performances are presented as a function of the target FER. Again, and as in Annex D, the performances are usually showing no significant degradation of the speech quality down to 1% FER. It is to be noted that the shown performance degradation for modes AMR12.2 and AMR10.2 is worse than can be expected with more appropriate QoS attributes for class C bits.

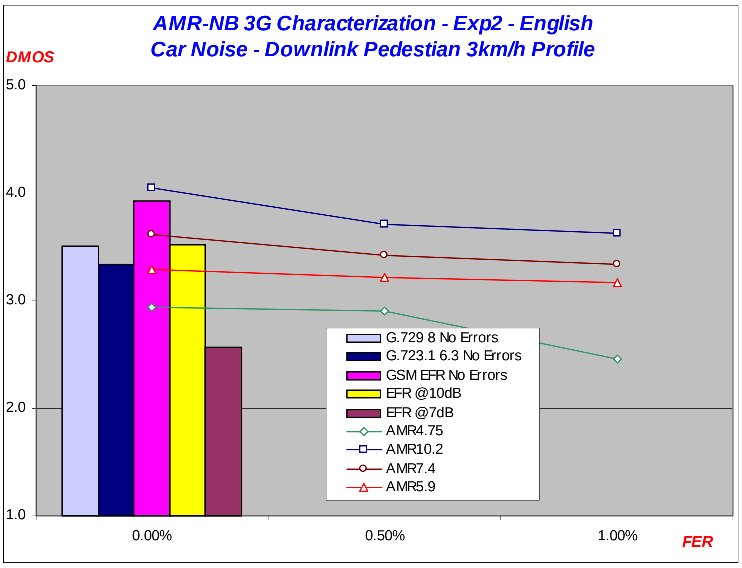

Figure E4-1: AMR 3G Characterization Exp. 2 Test Results – 15 dB SNR Car Noise – Downlink Pedestrian-B 3 km/h Profile

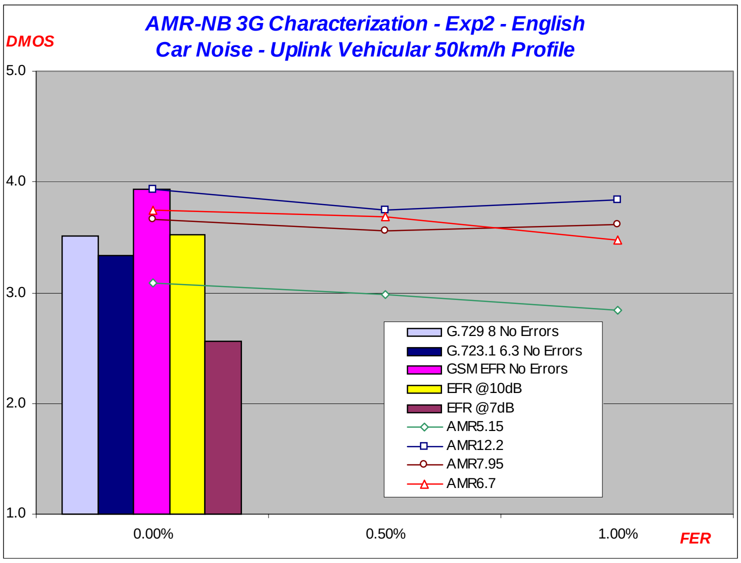

Figure E4-2: AMR 3G Characterization Exp. 2 Test Results – 15 dB SNR Car Noise – Uplink Vehicular-A 50 km/h Profile

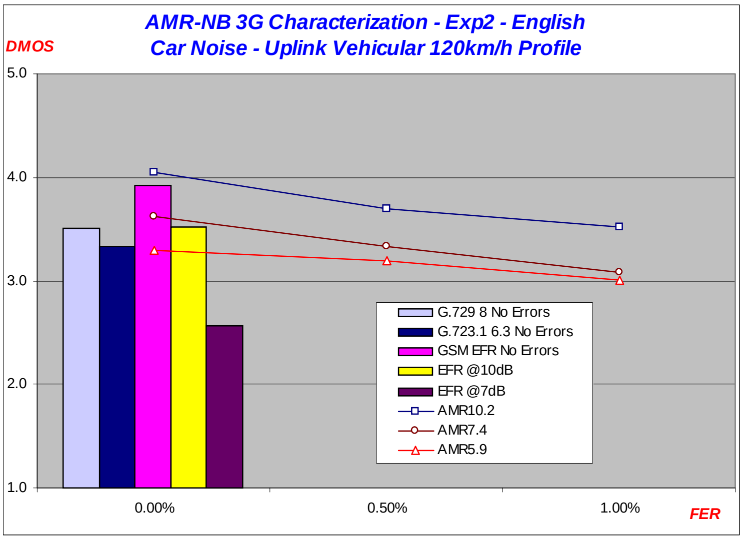

Figure E4-3: AMR 3G Characterization Exp. 2 Test Results – 15 dB SNR Car Noise – Uplink Vehicular-B 120 km/h Profile

References to Annex E:

[E1] 3GPP TS 26.102: "AMR speech codec; Interface to Iu and Uu", Version 3.3.0

[E2] 3GPP TSG-SA4 Tdoc S4-010053: "Statistics of 3G error patterns provided by NTT DoCoMo", January 2001, Munich, Germany

[E3] 3GPP TSG-SA4 Tdoc S4-010490: "Statistics of 3G error patterns provided by Nortel Networks", September 2001, Erlangen, Germany

3GPP TSG-SA WG4 Meeting #18
03 – 07 Sep 2001, Erlangen, Germany

Tdoc S4 (01)0470R

CR-Form-v3

CHANGE REQUEST

⌘	**26.975**	**CR**	**002**	⌘ rev	**-**	⌘ Current version:	**4.0.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [X] Radio Access Network [X] Core Network [ ]

Title:	⌘	Clarification of 3G simulator settings used for AMR characterisation in 3G channels		
Source:	⌘	TSG SA WG4		
Work item code:	⌘	AMR	***Date:*** ⌘	24-09-2001
Category:	⌘	**A**	***Release:*** ⌘	Rel-4
		Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change:	⌘	The performance shown for modes AMR12.2 and AMR10.2 on 3G channels is considerably worse than could be expected if the rate matching attributes of channel simulation had been optimised. In particular, the QoS attributes achieved for class C bits are much worse than recommended in 3GPP TS 26.102.
Summary of change:	⌘	A note is added that the performance shown for modes AMR12.2 and AMR10.2 is worse than could be expected with more suitable QoS attributes.
Consequences if not approved:	⌘	Wrong interpretation of the performance figures might lead to improper 3G system design compromising the achievable capacity.

Clauses affected:	⌘	Annex E	
Other specs affected:	⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘
Other comments:	⌘	.	

Motivation of the proposed CR

The following two figures are taken from 3GPP TR 26.975 and show the speech quality degradation of the AMR codec with increasing FER. It is noticeable that mode AMR12.2 shows a significant degradation already at an FER of 0.5%. A similar tendency is visible throughout most of the results for modes AMR12.2 and AMR10.2 in Annex E of the TR.

This degradation is more than could be expected. The following tables 1 and 2 are taken from [2] and [3] and show results of analyses made on the 3G error patterns used for the 3G characterisation of the AMR codec. It can be seen that the residual BER figures for class C bits at a SDU error rate of 0.5 % are as high as up to 2.5 %. This is considerably higher than the recommended value of 0.5% at an SDU error rate of 0.7% [1]. The reason is that the rate matching attributes used, which were set according to the recommended median of the rate matching attributes defined in [4], do not provide sufficient protection for the class C bits.

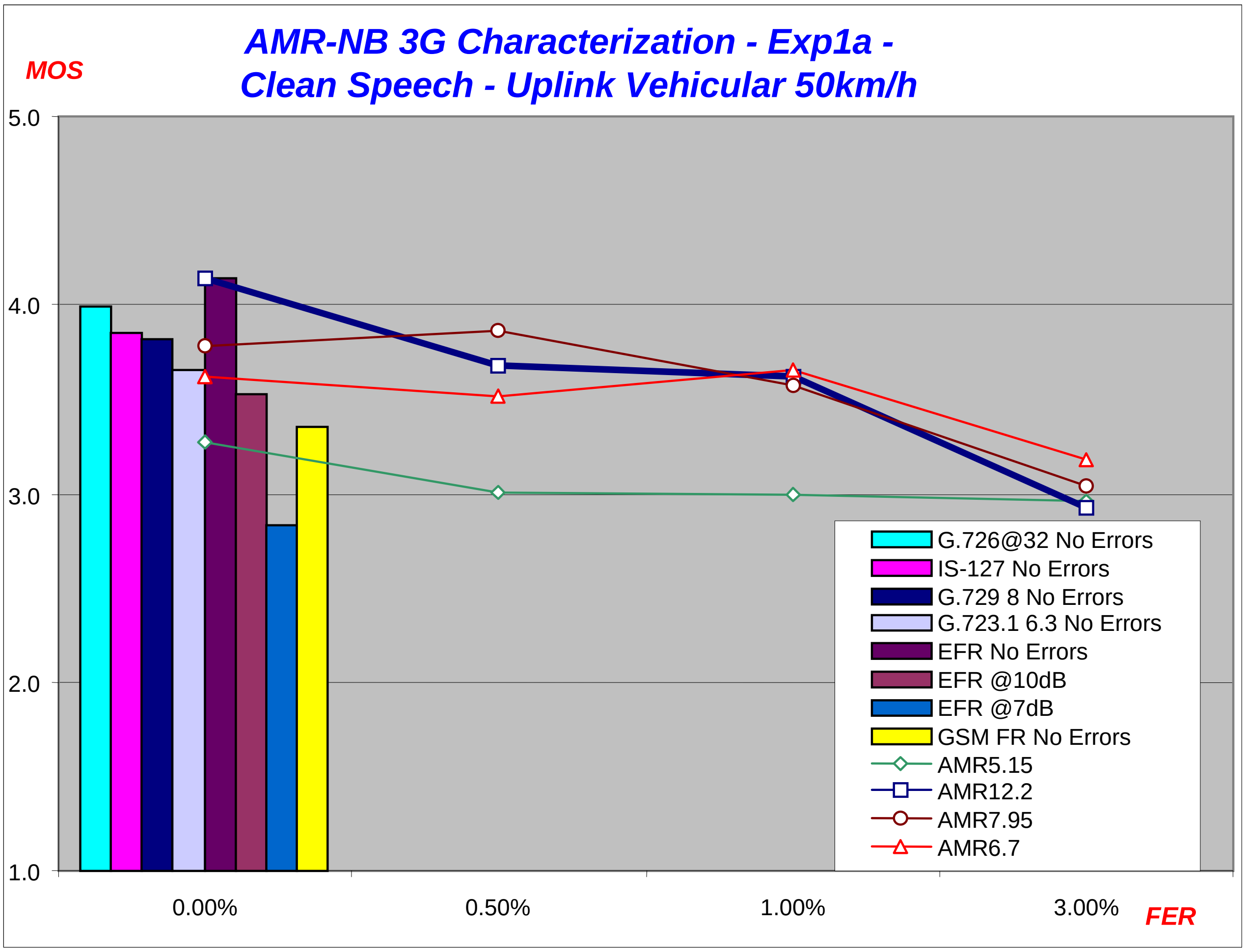

Figure 1: AMR-NB Characterisation – Experiment 1a

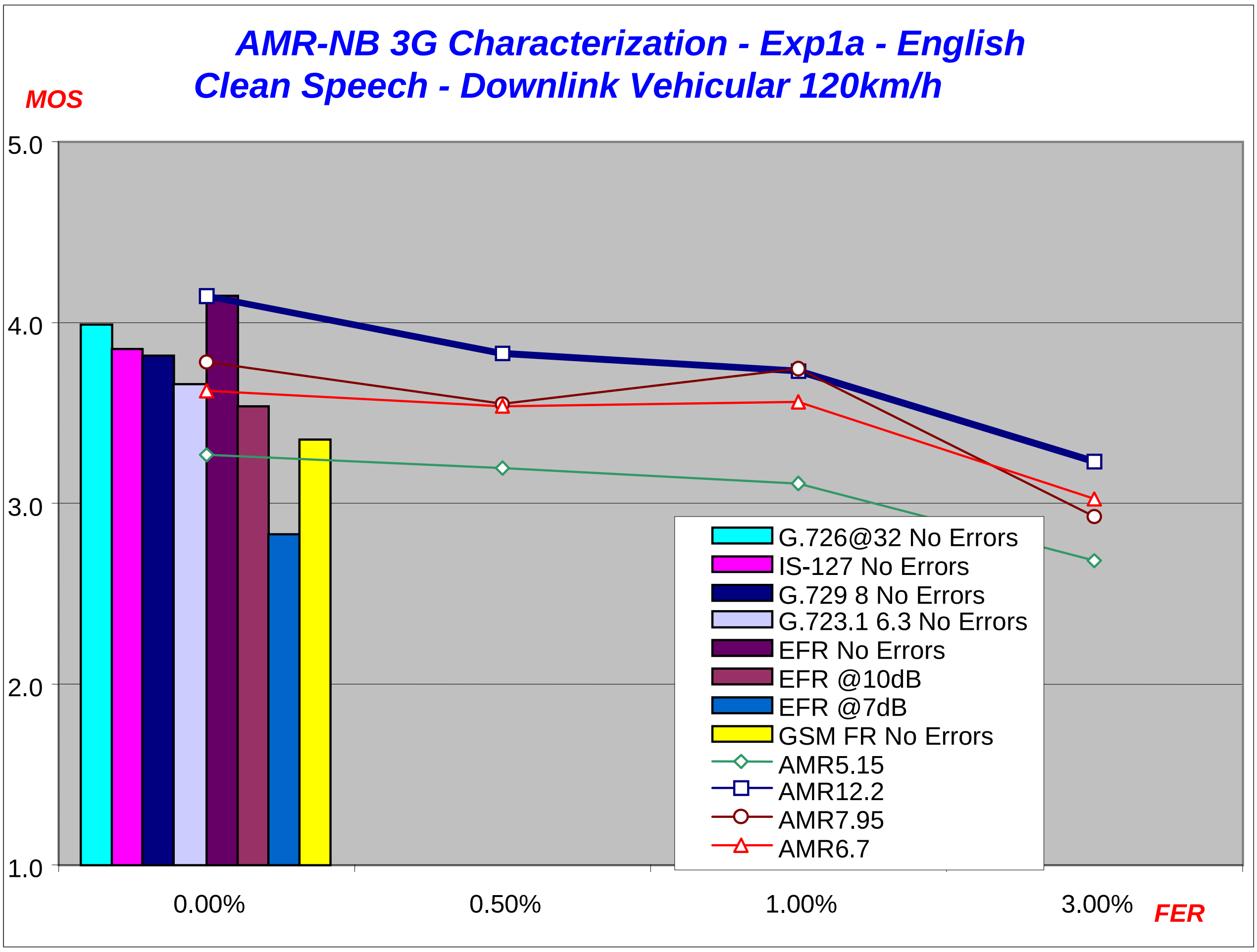

Figure 2: AMR-NB Characterisation – Experiment 1a

Table1: Statistics of 3G DL error patterns [2]

Experiment	AMR mode	File name	FER	RBER for Class B	RBER for Class C
1A	12.2	EC4A_122.ep	0.005	0.001159	0.025427
1A	12.2	EC5A_122.ep	0.01	0.001062	0.034844
1A	12.2	EC6A_122.ep	0.03	0.004873	0.070135
1B	12.2	EC1B_122.ep	0.005	0.000467	0.022969
1B	12.2	EC2B_122.ep	0.01	0.001657	0.037073
1B	12.2	EC3B_122.ep	0.03	0.004824	0.063896
1B	10.2	EC7B_102.ep	0.005	0.000758	0.017172
1B	10.2	EC8B_102.ep	0.01	0.001439	0.018547
1B	10.2	EC9B_102.ep	0.03	0.004463	0.043797
1C	12.2	EC4C_122.ep	0.005	0.000983	0.012188
1C	12.2	EC5C_122.ep	0.01	0.001311	0.024625
1C	12.2	EC6C_122.ep	0.03	0.00415	0.05299
2	10.2	EC1D_102.ep	0.005	0.000758	0.017172
2	10.2	EC2D_102.ep	0.01	0.001439	0.018547

Table2: Statistics of 3G UL error patterns [3]

Experiment	AMR mode	File name	FER	RBER for Class B	RBER for Class C
1A	12.2	EC1A_122	0,005	5,7*10e-4	8,5*10e-3
1A	12.2	EC2A_122	0,010	1,5*10e-3	1,3*10e-2
1A	12.2	EC3A_122	0,030	3,9*10e-3	3*10e-2
1C	12.2	EC1C_122	0,005	9*10e-4	2*10e-2
1C	12.2	EC2C_122	0,010	3,4*10e-3	3,2*10e-2
1C	12.2	EC3C_122	0,030	8,5*10e-3	6,6*10e-2
2	12.2	EC3D_122	0,005	1,4*10e-3	9,8*10e-3

2	12.2	EC4D_122	0,010	1,9*10e-3	1,6*10e-2
1A	10.2	EC7A_102	0,005	1*10e-3	6*10e-3
1A	10.2	EC8A_102	0,010	2,4*10e-3	7,3*10e-3
1A	10.2	EC9A_102	0,030	7,4*10e-3	2*10e-2
1B	10.2	EC4B_102	0,005	9,5*10e-4	3*10e-3
1B	10.2	EC5B_102	0,010	1,4*10e-3	6,3*10e-3
1B	10.2	EC6B_102	0,030	4,8*10e-3	1,4*10e-2
1C	10.2	EC7C_102	0,005	1,1*10e-3	4,5*10e-3
1C	10.2	EC8C_102	0,010	2*10e-3	7,8*10e-3
1C	10.2	EC9C_102	0,030	5,2*10e-3	1,8*10e-2
2	10.2	EC5D_102	0,005	1,3*10e-3	1,6*10e-2
2	10.2	EC6D_102	0,010	3,2*10e-3	2,2*10e-2

Conclusion

It is concluded that the shown performance drop for modes AMR12.2 and AMR10.2 is worse than could be expected with more appropriate setting of the rate matching attributes in the channel simulator.

References

[1] 3GPP TS 26.102: “AMR speech codec; Interface to Iu and Uu”, Version 3.3.0

[2] 3GPP TSG-SA4 Tdoc S4-010053: “Statistics of 3G error patterns provided by NTT DoCoMo”, January 2001, Munich, Germany

[3] 3GPP TSG-SA4 Tdoc S4-01xxxx: “Statistics of 3G error patterns provided by Nortel Networks”, September 2001, Erlangen, Germany

[4] 3GPP TSG-RAN Tdoc RP-000447: UTRAN Typical Radio Interface Parameter Sets, Version 1.3, August 2000, from the GSM-A

How the CR is implemented:

Annex E: AMR Characterization in 3G Channels

E1. Overview of the 3G Characterization Phase

Following the selection of AMR as the mandatory speech codec for the 3G system under the responsibility of 3GPP, it was decided to carry out a simplify 3G Characterization Phase to check the behavior of the speech codec in 3G radio channels. The corresponding tests, funded by the 3GPP PCG, were completed in 4Q00.

Because of the exhaustive tests already performed in the GSM environment, it was decided to restrict the scope of the 3G Characterization Phase to conditions directly impacted by the 3G Radio Interface. Consequently, most of the tests were performed in clean speech conditions, so that a maximum number of different propagation error conditions could be tested. The 3G Characterization Phase included 2 experiments and 3 sub-experiments, each performed by a different test laboratory. The scope of the different experiments is provided in the following table:

Experiment.	**Test Laboratory**	**Language**	**Noise Condition**
1a	*Dynastat*	English	Clean
1b	*Lookheed Martin GT*	Korean	Clean
1c	*NTT-AT*	Japanese	Clean
2	*Arcon*	English	Car Noise at 15dB SNR

Table E.1: Summary of the AMR 3G Characterization Test conditions

The other tasks were under the responsibility of:

Lookheed Martin GT: Preparation of the Test Plan and Processing Procedures Specification

Nortel Networks & NTT DoCoMo: Preparation of the Error Patterns

Arcon: Host Laboratory and Global Analysis

The experiments were dimensioned to evaluate the performances of a subset of the AMR codec modes for 3 Path Profiles at 3 different target FER. All conditions involved single encoding only (No Tandem) without DTX activated. The actual error conditions tested are summarized in the following table. All AMR modes were also tested in No Error conditions in all experiments, in addition to the following references: ADPCM G.726 at 32kbit/s (Not in Exp.2), G.723.1 at 6.3kbit/s, G.729 at 8kbit/s (all 3 in No errors), GSM EFR at 10 and 7 dB C/I, GSM FR and IS-127 (both in No Errors and in Exp.1 only).

Experiment.	**Path Profile**	**Target FER**	**Modes Tested**
1a	Uplink-Vehicular-B-50 km/h	0.5%, 1%, 3%	12.2, 7.95, 6.7, 5.15
	Downlink-Vehicular-B-120 km/h	0.5%, 1%, 3%	12.2, 7.95, 6.7, 5.15
	Uplink-Pedestrian-B-3 km/h	0.5%, 1%, 3%	10.2, 7.4, 5.90, 4.75
1b	Downlink-Vehicular-B-50 km/h	0.5%, 1%, 3%	12.2, 7.95, 6.7, 5.15
	Uplink-Indoor-A-3 km/h	0.5%, 1%, 3%	10.2, 7.4, 5.90, 4.75
	Downlink-Pedestrian-B-3 km/h	0.5%, 1%, 3%	10.2, 7.4, 5.90, 4.75
1c	Uplink-Vehicular-B-120 km/h	0.5%, 1%, 3%	12.2, 7.95, 6.7, 5.15
	Downlink- Indoor-A-3 km/h	0.5%, 1%, 3%	12.2, 7.95, 6.7, 5.15
	Uplink- Pedestrian-A-3 km/h	0.5%, 1%, 3%	10.2, 7.4, 5.90, 4.75
2	Downlink-Pedestrian-B-3 km/h	0.5%, 1%	10.2, 7.4, 5.90, 4.75
	Uplink-Vehicular-A-50 km/h	0.5%, 1%,	12.2, 7.95, 6.7, 5.15
	Uplink-Vehicular-B-120 km/h	0.5%, 1%,	10.2, 7.4, 5.90

Table E.2: Overview of the tested conditions

E2. Radio Simulator Parameters

The key parameters used for the simulation of the 3G Channels are summarized below. Note, however, that these parameters do not in any case ensure to meet appropriate QoS parameters for the different RAB subflows, for which a suitable example is to meet a residual BER for class B bits of 0.1% and a residual BER for class C bits of 0.5% at an SDU error ratio of 0.7% [E1].: Statistical analyses of the 3G error patterns used [E2], [E3] show that particularly for modes AMR12.2 and AMR10.2 the residual BER of class C bits partly is much higher than according to this example (up to 2.5% at a SDU error ratio of 0.5%). Moreover, the SDU error rate and residual BER figures obtained at a given radio simulator setting may exhibit considerable statistical variations, as, particularly for the case of 0.5% SDU error rate, the number of required frame erasures and residual bit errors is low compared to the length of the error pattern (1600 frames).

E2.1. General

Maximum source bit rate of 12.2 kbit/s

12 bits CRC size on Class A Bits

Normal Frames (not compressed)

Channel Coding: Based on Convolutional Codes defined in [7]

Rate Matching: Median values of Rate Matching attributes defined in [7]

Power Control: The Power Control is made of two loops, the so-called inner and outer loops. The inner loop is used to decide on the PC command based on the estimation of the SIR and its comparison to the SIR target, the outer loop is made to adjust the SIR target according to metrics that are used to evaluate the quality of the link. The outer loop has been disabled, e.g. the SIR target has been fixed in comparison with waited FER values of 0.5%, 1%, and 3%. The algorithms used for the measurements as well as the adjustment of the SIR target are proprietary.

The Power Control Algorithm referenced as option #1 has been used for the inner loop, with 1 dB steps.

The Power Control implies a certain loop delay, due to the SIR estimation, the transmission of the command on the reverse link, the decision on the Power Control command and its application. A delay of 1 time slot is used. The assumed BER on TPC bits is 4 %.

Diversity: There exist transmit and receive diversity. It is assumed that Rx diversity will be very common in the future UMTS networks. Therefore, in Uplink, receiver diversity is used. The Transmit diversity can be used in Downlink, but there will be many Node B which won't offer this feature. Therefore, no Tx diversity is assumed in DL.

Propagation profiles & mobile speeds : The Working Groups of the TSG RAN use six different profiles: Indoor A and B, Outdoor to Indoor A and B, and Outdoor A and B.

These profiles in conjunction with the mobile speed are used to simulate different scenarios, e.g. Outdoor-to-Indoor with a mobile speed of 3 km/h is assumed to correspond to a pedestrian in a urban environment, at 50 km/h it can correspond to car in a suburban environment.

Regarding the 3G AMR characterization, some typical scenarios have been defined and from these scenarios the profile and the mobile speed to use have been derived: speed of 3km/h for profiles indoor A, Pedestrian A and Pedestrian B; speed of 50 km/h for Vehicular A and Vehicular B; speed of 120 km/h for Vehicular B.

E2.2. Uplink

Spreading Factors: The spreading factor is 64 for the speech bitrates higher than 5.15 kbps, 128 otherwise.

Transport Format Combination Indicator: The TFCI informs the receiver about the instantaneous transport format combination of the transport channels mapped to the simultaneously transmitted uplink DPDCH radio frame. For this exercise, the TFCI is transmitted but not used because we suppose a perfect decoding (always the same transport format combination).

DCCH: A DCCH, of either 3.4 or 1.7 kbit/s depending on the spreading factor, shared the DPDCH with the TrCH carrying the voice.

Slot Format: The slot format for DPDCH and DPCCH is given in [8].

A spreading factor of 64 implies slot format #2 to be used for the DPDCH and a spreading factor of 128 implies slot format #1 to be used for the DPDCH. For DPCCH, non-compressed frame formats and no DL transmitter diversity imply to use slot format #0: the frame structure is 6 pilot bits + 2 TFCI + 2 TPC.

Gain Factors: The gain factor is the power offset between the DPCCH (which carries the control bits such as the Pilot bits, TFCI, TPC, etc.) and the DPDCH (which carries the user data and the UTRAN signalling). This difference of power comes from the difference between spreading factors.

The gain factor for DPCCH is 11 and the gain factor for DPDCH is 15.

Interferences**: There was no MAI in Uplink, however an AWGN channel was used.**

E2.3. Downlink

Spreading Factors: The spreading factor is 128 for the speech bitrates higher than 5.15 kbps, 256 otherwise.

Transport Format Combination Indicator: For DL, BTFD is assumed. Therefore no TFCI is used for format detection.

For this exercise, there is no BTFD error because we suppose a perfect decoding (always the same transport format combination) and ratio of BTFD error is relatively low compared with FER of speech information.

DCCH: A DCCH, of either 3.4 or 1.7 kbit/s depending on the spreading factor, shared the DPDCH with the TrCH carrying the voice.

Slot Format: A spreading factor of 128 and 256, which depends on source bit-rate, and non-compressed frame format imply slot format #12 to be used for DPCH including both DPDCH and DPCCH. The frame structure for DPCCH is 4 pilot bits + 2 TPC.

Gain Factors: Equal gain factors are used both DPDCH and DPCCH for DL. This means there is no power offset between them.

Interferences: Channel setting defined in Table C.3 of [9] is used for DL.

E3. AMR 3G Characterization Test Results in Clean Speech

The following diagrams present the raw test results of Experiments 1a, 1b and 1c, for the different path profiles and target FER tested in these experiments. The performances are presented as a function of the target FER. As in Annex D, the performances are usually showing no significant degradation of the speech quality down to 1% FER. It is to be noted that the shown performance degradation for modes AMR12.2 and AMR10.2 is worse than can be expected with more appropriate QoS attributes for class C bits.

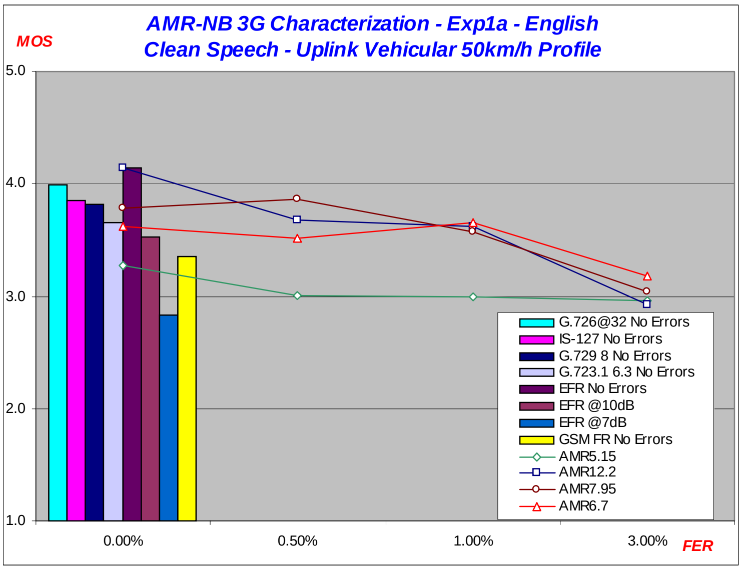

Figure E3-1: AMR 3G Characterization Exp. 1a Test Results – Clean Speech – Uplink Vehicular-B 50 km/h Profile

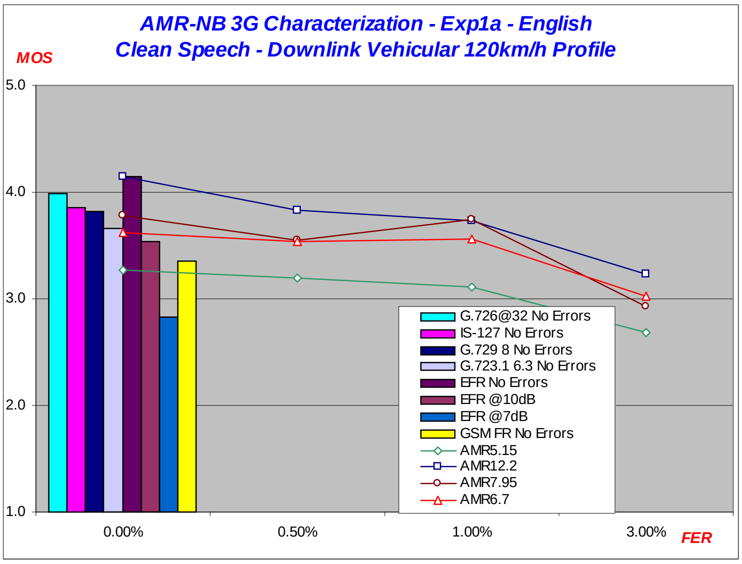

Figure E3-2: AMR 3G Characterization Exp. 1a Test Results – Clean Speech – Downlink Vehicular-B 120 km/h Profile

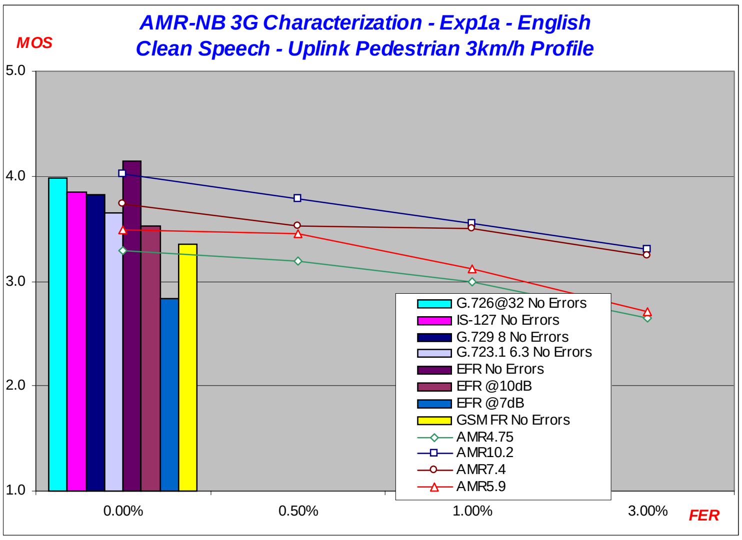

Figure E3-3: AMR 3G Characterization Exp. 1a Test Results – Clean Speech – Uplink Pedestrian-B 3 km/h Profile

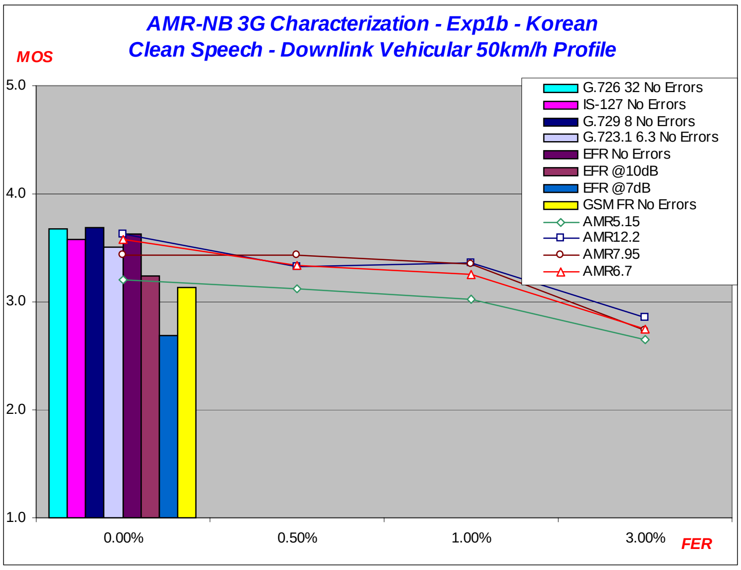

Figure E3-4: AMR 3G Characterization Exp. 1b Test Results – Clean Speech – Downlink Vehicular-B 50 km/h Profile

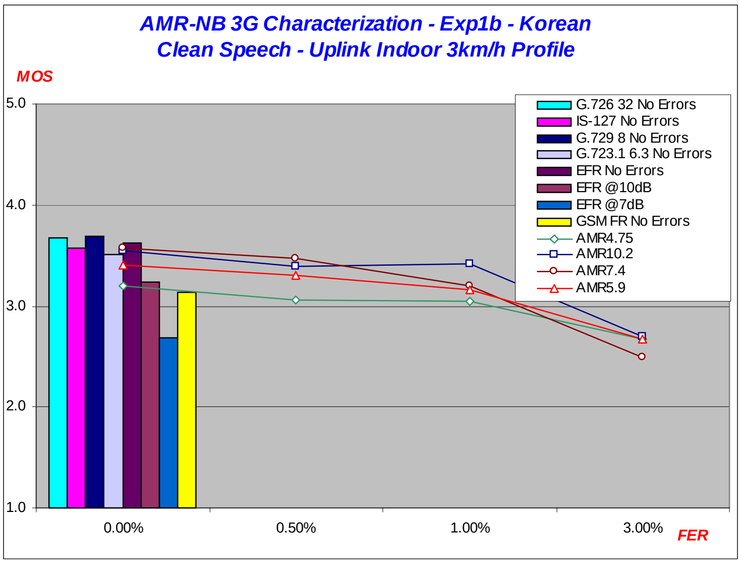

Figure E3-5: AMR 3G Characterization Exp. 1b Test Results – Clean Speech –Uplink Indoor-A 3 km/h Profile

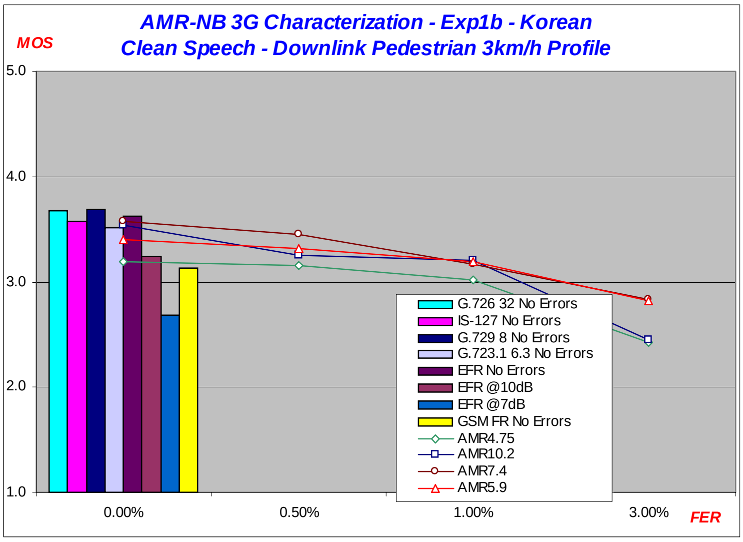

Figure E3-6: AMR 3G Characterization Exp. 1b Test Results – Clean Speech – Downlink Pedestrian-B 3 km/h Profile

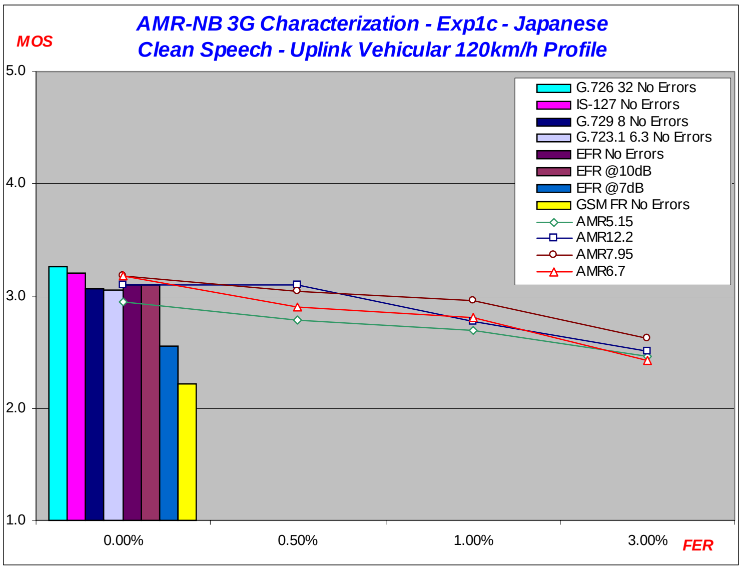

Figure E3-7: AMR 3G Characterization Exp. 1c Test Results – Clean Speech – Uplink Vehicular-B 120 km/h Profile

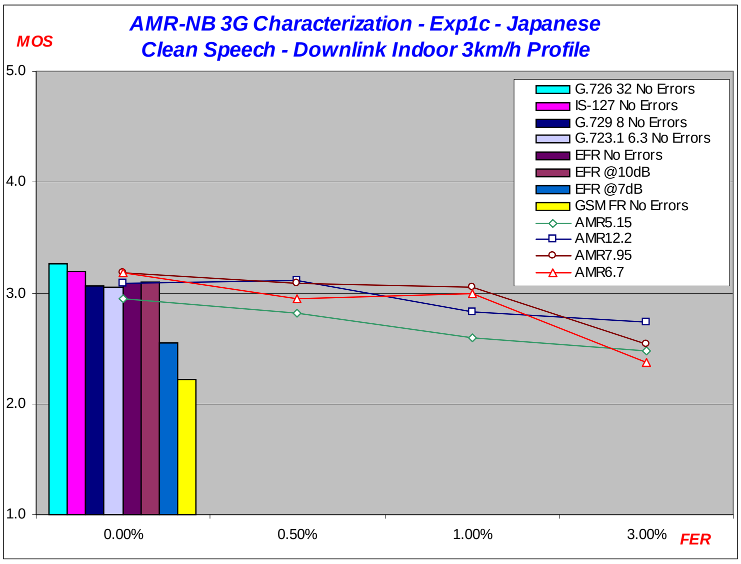

Figure E3-8: AMR 3G Characterization Exp. 1c Test Results – Clean Speech – Downlink Indoor-A 3 km/h Profile

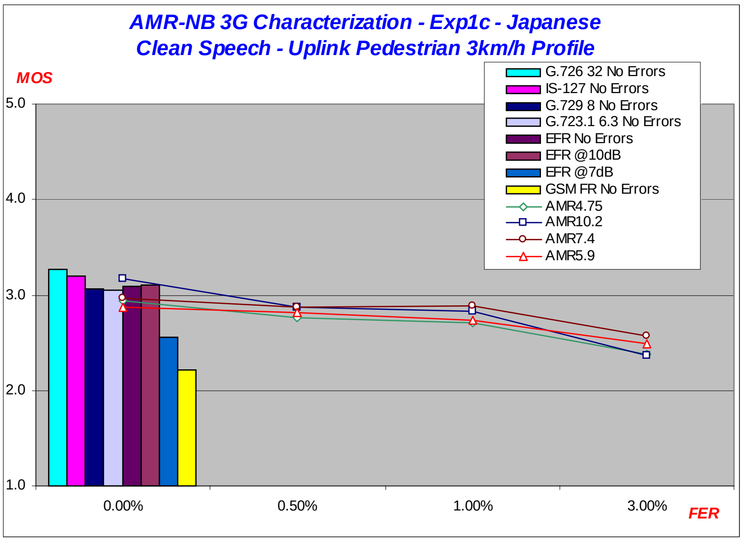

Figure E3-9: AMR 3G Characterization Exp. 1c Test Results – Clean Speech – Uplink Pedestrian-A 3 km/h Profile

E4. AMR 3G Characterization Test Results in Car Noise

The following diagrams present the raw test results of Experiment 2 for the different path profiles and target FER tested in this experiment. The performances are presented as a function of the target FER. Again, and as in Annex D, the performances are usually showing no significant degradation of the speech quality down to 1% FER. It is to be noted that the shown performance degradation for modes AMR12.2 and AMR10.2 is worse than can be expected with more appropriate QoS attributes for class C bits.

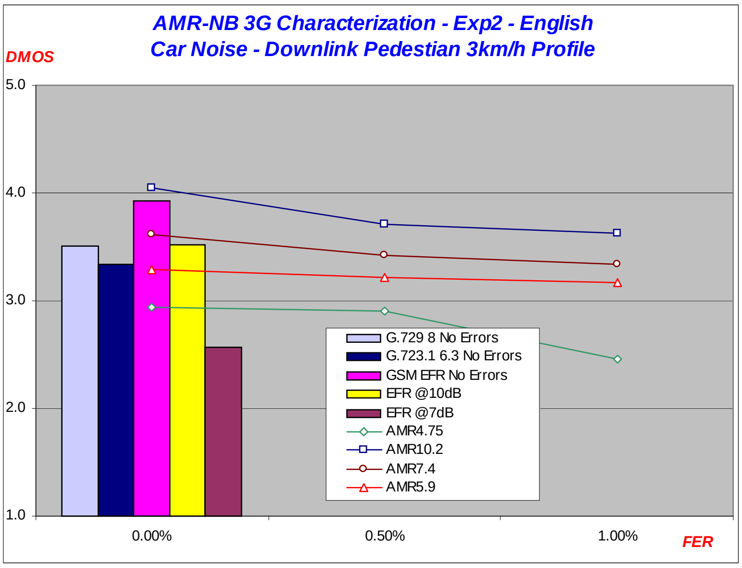

Figure E4-1: AMR 3G Characterization Exp. 2 Test Results – 15 dB SNR Car Noise – Downlink Pedestrian-B 3 km/h Profile

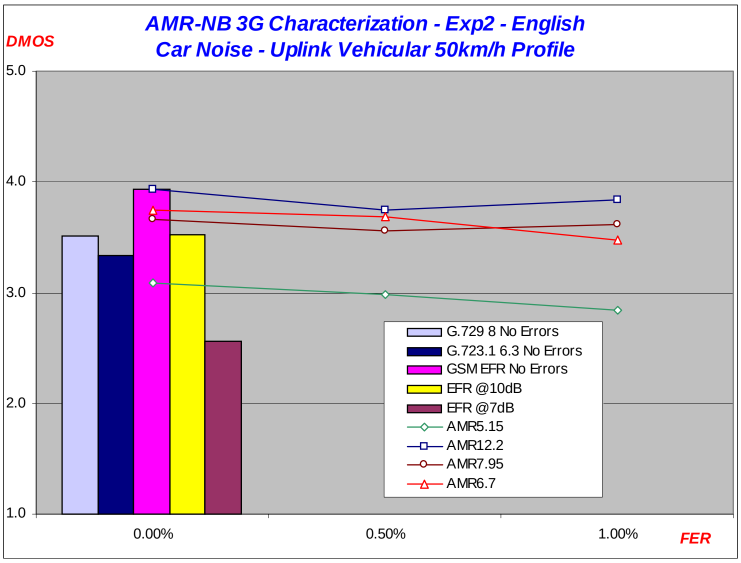

Figure E4-2: AMR 3G Characterization Exp. 2 Test Results – 15 dB SNR Car Noise – Uplink Vehicular-A 50 km/h Profile

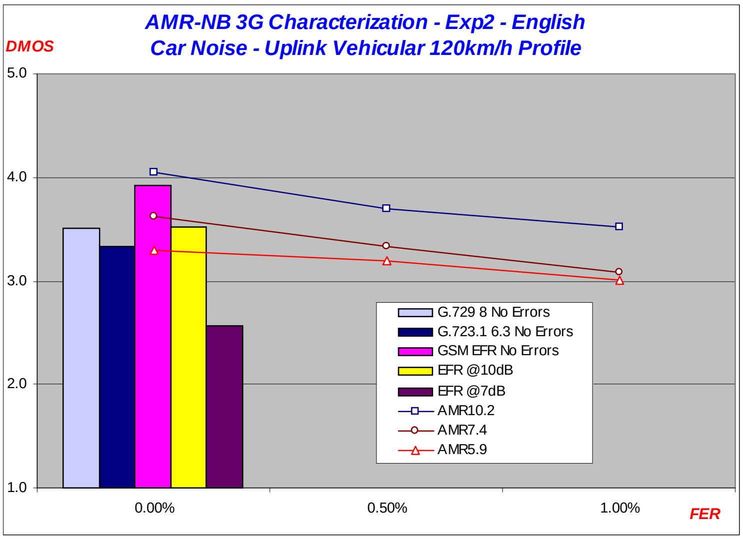

Figure E4-3: AMR 3G Characterization Exp. 2 Test Results – 15 dB SNR Car Noise – Uplink Vehicular-B 120 km/h Profile

References to Annex E:

[E1] 3GPP TS 26.102: "AMR speech codec; Interface to Iu and Uu", Version 3.3.0

[E2] 3GPP TSG-SA4 Tdoc S4-010053: "Statistics of 3G error patterns provided by NTT DoCoMo", January 2001, Munich, Germany

[E3] 3GPP TSG-SA4 Tdoc S4-010490: "Statistics of 3G error patterns provided by Nortel Networks", September 2001, Erlangen, Germany