TSG-RAN Working Group 1 #9 **R1-99k36**

Dresden (Germany), 30th November – 3rd December 99

Agenda Item : AH 4

Source : Nortel Networks[1]

Title : Simulation results for FDD for two channel coding schemes for two AMR modes

Document for : Discussion

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1. Introduction

It is being discussed today in WG1 and S4, whether one or more TrCh should be defined per AMR class of bits. Since the coding scheme and static rate matching ratio are static parameters, defining only one TrCH par AMR class of bits prevents changing coding scheme for one class of bits between different AMR modes.

This document presents some results that show some gain with changing the channel coding between different AMR modes.

Thus we would recommend to have the possibility to have at least two TrChs defined per class of bits which would allow to have one "normal" coding and one fallback coding scheme. We think this is a reasonable compromise between having only one coding scheme for each class and defining up to one TrCh par class per mode as we suggested at the beginning.

2. Simulation conditions

- Uplink
- No power control
- No Antenna Diversity
- SF 256
- TFCI 2, TPC 2, Pilot 6
- Vehicular A, 120 km/h
- Real Channel Estimation
- Interleaving depth 20ms

We test two AMR modes : 7.4 kbps and 4.75kbps, and considered class A and B bits.

We try two configuration cases for the channel coding :

In the first configuration, only one TrCh is defined per class of bits, i.e. only one channel coding and static rate matching ratio for each class of bits.

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[1] Contact persons : Catherine Leretaille, Evelyne Le Strat

In the second configuration case, two TrCh are defined for each class of bits, i.e. two different channel coding are defined for each class of bits. This makes a total of four TrChs to transport two classes of bits. What we call channel coding 1 for class A and B are the same schemes as used in configuration 1. What we call channel coding 2 is a kind of adapted channel coding, to see if we can obtain some gains in some conditions by changing the channel coding scheme when we change AMR mode.

Channel coding characteristics :

CRC of 8bits on class A bits

Number of bits per class :

Mode 7.4 kbps : class A = 61bits, class B = 87bits, no class Cs

Mode 4.95kbps : class A=39bits, class B = 56bits, no class C

Channel coding 1: convolutional coding rate ½, about 23% puncturing as static rate matching for class B TrCh, and dynamic rate matching for the 4.75kbps to complete the uplink frame.

7.4 kbps channel coding 1	*Class A*	*Class B*
Net bits per 20 ms	61+8	87
MC ½		
Convolutional encoding (MC 1/2)	(61+8+8)*2 = 154 bits	(87+8) * 2 = 190 bits
Static Rate matching	(154+0) = 154 (+0%)	190-44= 146 (- 23 %)

4.75 kbps channel coding 1	*Class A*	*Class B*
Net bits per 20 ms	39+8	56
MC ½		
Convolutional encoding (MC 1/2)	(39+8+8)*2 = 110 bits	(56+8) * 2 = 128 bits
Static Rate matching	(110+0) = 110 (+0%)	128-30= 98 (- 23 %)
Dynamic Rate matching (+44%)	(110+50) = 160	98+42= 140

Channel coding 2: convolutional coding rate 1/3, about +3% static rate matching on class A and –27% on class B, no dynamic rate matching since the frame is filled.

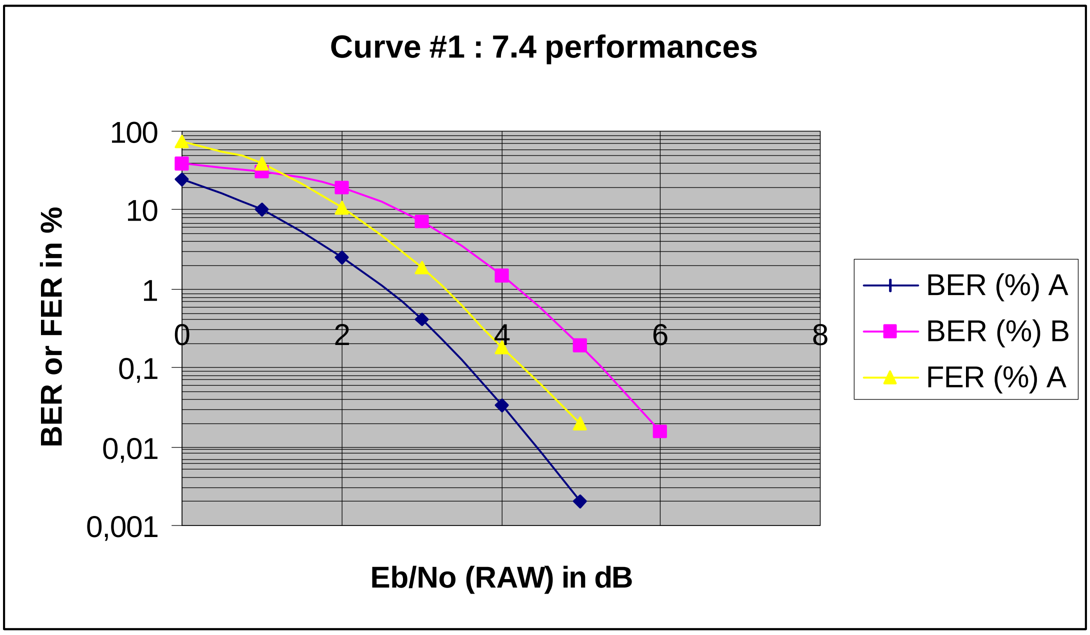
4.75 kbps channel coding 2	*Class A*	*Class B*
Net bits per 20 ms	39+8	56
MC ½		
Convolutional encoding (MC 1/3)	(39+8+8)*3 = 165 bits	(56+8) * 3 = 192 bits
Static Rate matching	(165-5) = 160 (-3%)	192-52= 140 (- 27 %)

Number of frames in error : a minimum of 1000 frames in errors on both class A and B or a maximum of 100000 frames processed.

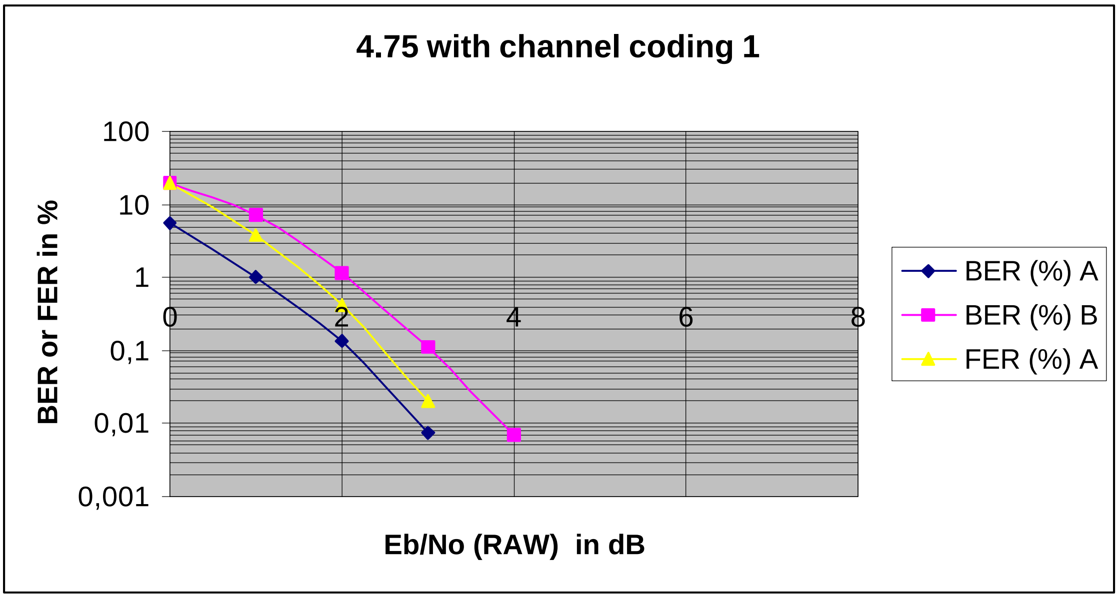
3. Simulation results

The channel coding was designed so that when the Class A FER is 0.1% the class B BER is around 1%.

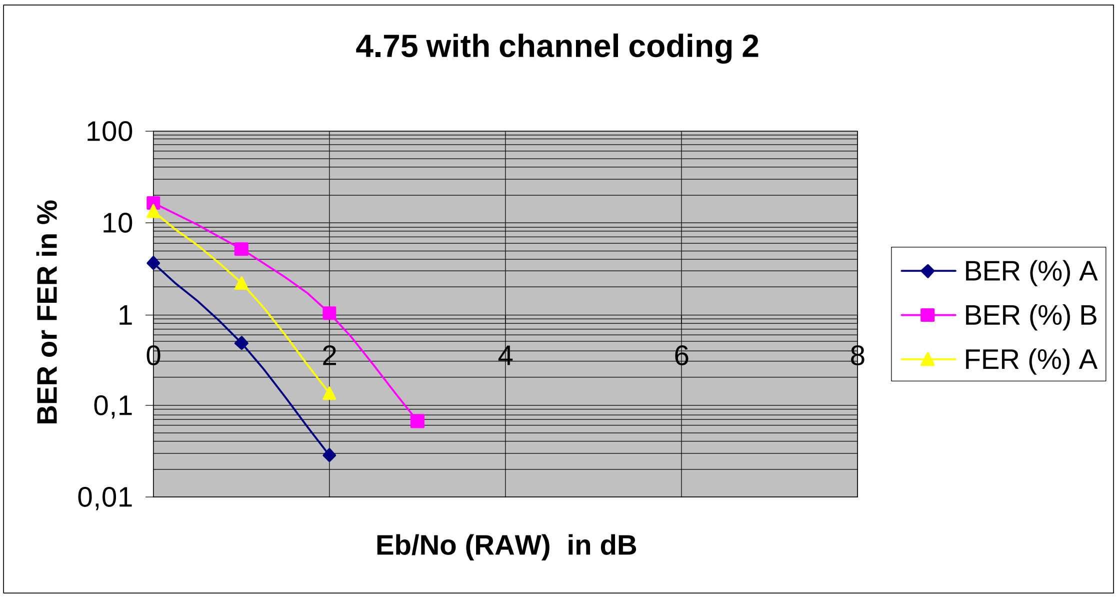
7.4 kbps AMR Mode with channel coding 1



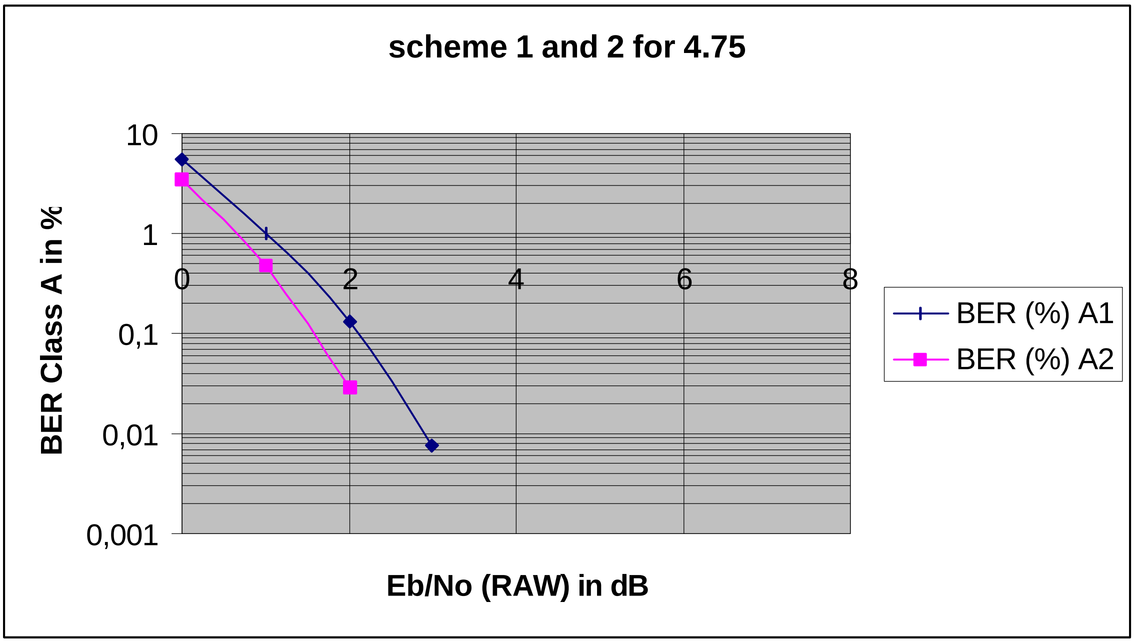
4.75 kbps AMR Mode with channel coding 1



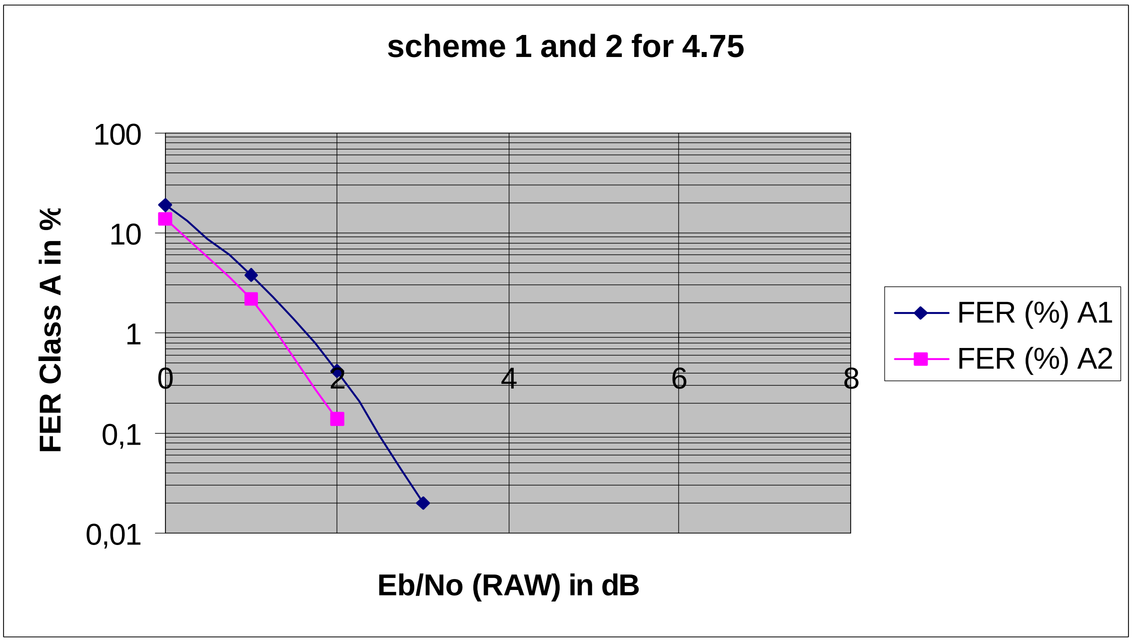
4.75 kbps AMR Mode with channel coding 2



Comparisons between 4.75 scheme 1 and 2 for Class A BER



Comparison of 4.75 with channel coding schemes 1 and 2 for class A FER



4. Analysis of the results

From the results, one can observe that the gain achieved between 7.4 and 4.75 for a BER Class A of 10-3 is 1.3dB when using the same static parameters (gain is brought by dynamic rate matching). When using another set of static parameters (Mother code Rate and Rate Matching), this gain increases to 1.8 dB.

The results show that going for a different channel coding for Mode 4.75kbps is beneficial compared to staying with the same channel coding scheme as the one used for 7.4kbps. At a Class A Target BER of 10-3, the gain is of about 0.5 dB.

Thus, in conditions where power control would be working, some energy can be saved by going for different channel coding when AMR mode is changed. In case where conditions are in limit of power control, going to a different channel coding when the mode is changed to a lower mode increases the chances not to lose the communication.

5. Conclusion

In this document, Nortel compared the performance of defining only one coding scheme for all modes of AMR, with defining two coding schemes, for each class of bits. Some gain is shown when it is possible to change of coding scheme when going from one mode to another one, i.e. from convolutional code ½ with repetition to convolutional 1/3.

Thus it is recommended to define more than one TrcH per AMR class of bits. Nortel think that defining two TrChs per class of bits allows to have a “normal” channel coding and a default channel coding scheme for fallback, and that this is a reasonable compromise between having only one channel coding scheme per class of bits, and having one channel coding scheme per mode for each class of bits, as we proposed first. Thus we recommend to set the minimum number of TrcHs defined to carry speech as being six for the speech bits (two per class of bits).