3GPP TSG RAN WG1 Meeting No 7 ***TSGR1#7 (99)c46***
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Agenda item: **Ad hoc 4**

Source: **Nortel Networks**

Title: **Comparison between UEP and EEP for AMR channel coding**

Document for: **Discussion**

1. Introduction

In this paper, we provide some simulation results to compare the use of unequal and equal error protection for AMR channel coding in the W-CDMA system. The simulations have been run for 2 different codec modes (12.2 and 7.95kbits/s) and the results show a gain when using UEP versus EEP. Thus Nortel Networks supports the idea of WG1 providing the tools to support UEP in UTRA for Release 99.

2. References

[1] TSGR1#6 99-887 Simulations results of UEP and EEP channel coding for AMR 12.2, Ericsson.
[2] TSGR1#7 99-951 Effect of EEP and EEP on AMR channel coding, Nokia.

3. Description of the proposed schemes

The following tables show how the 20ms speech frames containing respectively 244 and 159 bits are coded and arranged to map the AMR onto the physical channels of UTRA, using UEP or EEP.

	AMR 12.2	AMR 7.95
Bits per 20 ms	244	159
Application CRC	244+8 = 252	158+8 = 167
Tails bits and rate 1/3 coding	(252+8)*3 = 780	(167+8)*3 = 525
Rate matching	780 + 60 = 840	525 + 315 = 840
Effective code rate	840/252 = 3.33	840/167 = 5.03

Table 1 : bit allocation for EEP

	AMR 12.2		AMR 7.95	
Bits per 20ms	244		159	
Classes	Class A 81+103 = 184	Class B 60	Class A 75	Class B 84
Application CRC (class A)	184+8 = 192	60	75+8 = 83	84
Tails bits and convolutionnal coding	(192+8)*3 = 600	(60+8)*2 = 136	(83+8)*3 = 273	(84+8)*3 = 276
Rate Matching	600 + 84 = 684	136 + 20 = 156	273+191 = 464	276+100=376
Effective code rate	684/192 = 3.56	156/60 = 2.6	464/83 = 5.6	376/84 = 4.48
Total	840		840	

Table 2 : bit allocation for UEP

4. Simulations assumptions

They are the following:

- Downlink physical channel, no diversity.
- Spreading factor is 128.
- DPDCH and DPCCH have the same power.
- Real channel estimation.
- Vehicular A multipath, mobile speed 120km/h.
- No power control.
- 15 slots per 10ms frame.
- Chip rate 3.84MHz.
- DPCCH has 8 pilot bits, 2 TPC and 2 TFCI bits.
- Simulations so long as to observe at least 100 frame errors.

5. Simulation results

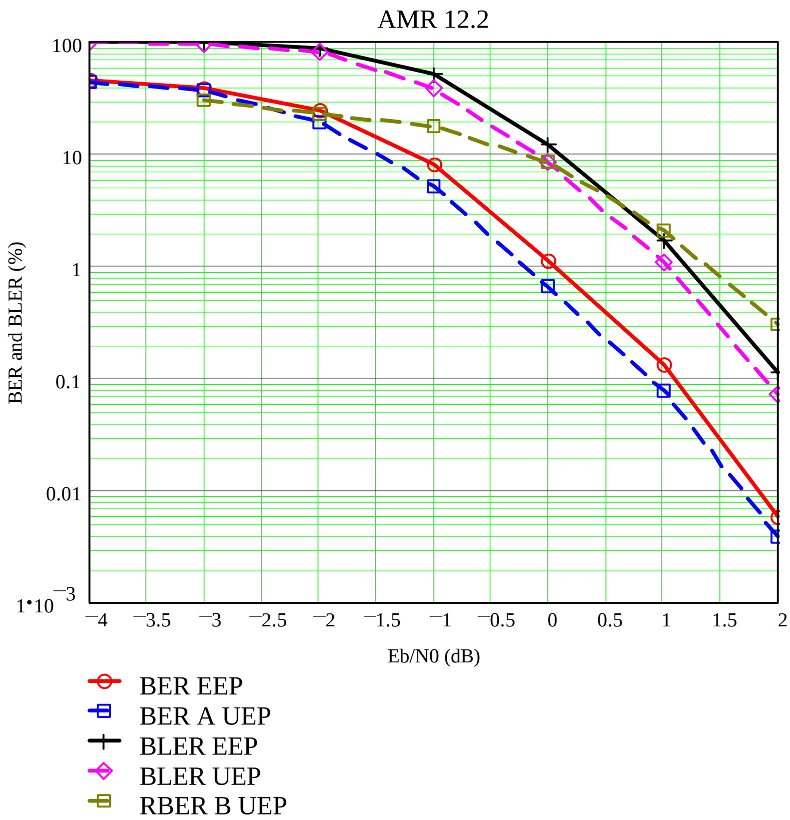
The following results are plotted :

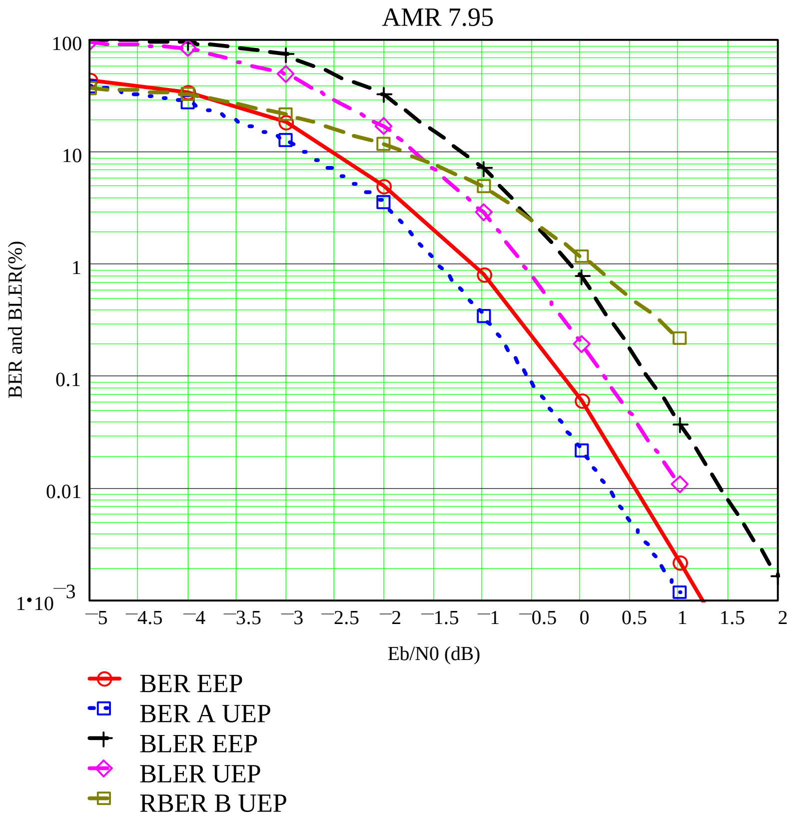
BLER : block error rate. The block errors are detected by application CRC which is computed on part of the frame, typically, class A.

BER : bit error rate. Computed for the whole frame in case of EEP and on each class of bits for UEP.

RBER : residual bit error rate. Computed on class B for the frames that have not been detected in error.

Eb/No : energy required to transmit a coded bit.





The design of the coding schemes for UEP was done to achieve the lowest BER on class A with the following constraint : when the BLER is around 1%, the residual BER on the less protected bits should not exceed 3-4% which was indicated to us as a reliable way of achieving fairly good speech quality.

With this method, for 12.2 coded, the effective code rates are almost the same for UEP (3.56 and 2.6) and EEP (3.33) which explains the gain of only 0.2-0.3dB at BER 10^{-3}. For the 7.95, it allows to differentiate more the effective code rates leading to 5.03 for EEP and 5.6/4.48 for UEP and to a gain of 0.5dB for UEP versus EEP at BER 10^{-3}, the same gain is achieved for BLER at BLER 1%.

6. Conclusion

As a conclusion, we would like to emphasize, the fact that UEP can both allow power savings and provide flexibility in the QoS of different transport channels. Nortel Networks therefore supports the idea of WG1 providing the tools to support UEP in UTRA for Release 99.