TSG-RAN Working Group1 meeting #7 **TSGR1#7(99)b02**
Hannover, Germany, Aug. 30-Sept. 3, 1999

Agenda Item:
Source: SAMSUNG Electronics Co.
Title: Additional simulation results of rate matching algorithm
Document for: Discussion

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1. Introduction

This document supplements Tdoc [1] and [2] proposed by Samsung and LGIC with some additional simulation results for downlink over AWGN channel. Also, this document compares performance of rate matching algorithms for rate 1/2 turbo code among three puncturing schemes such as the current Berrou puncturing, Samsung and LGIC puncturing, and Nortel Networks puncturing[3], respectively. According to the Ad Hoc 5 report, the proposal by Nortel Networks to replace the current Berrou puncturing scheme to produce rate 1/2 turbo code by a new scheme with the turbo interleaving based puncturing should be taken into account in WG1#7 to be verified[4]. So, in this document, we present additional simulation results about this issue.

2. Simulation conditions

For turbo codes, the simulation conditions are as follows

- Block sizes: 320, 324, 640, 1280 for downlink
- Puncturing rates: P=33% (to produce rate 1/2 turbo code)
- Decoding algorithm: Log MAP decoder
- Turbo interleaver: PIL
- Number of iterations: 12
- Number of frame errors: greater than 100
- Channel model: AWGN
- Algorithms: Berrou puncturing, SEC & LGIC puncturing, Nortel Networks puncturing (Turbo interleaving based puncturing)

In the following figures, HALF, SEC_LGIC and NORTEL mean the following parameter settings for rate matching block 2 (RMB2) and rate matching block 3 (RMB3), respectively[1],[2].

	RMB1	RMB2	RMB3
HALF (Berrou puncturing)	Not used	Even puncturing	Even puncturing
SEC_LGIC (Samsung & LGIC)	Not used	(a,b)=(2,1)	(a,b)=(3,1)
NORTEL (Nortel Networks)	Not used	Even puncturing	Turbo Interleaving based puncturing

3. Results and conclusion

In Figure 1, with interleaver size of 320 the difference of performance in dB at BER=10^{-6} is at least 0.25dB. In terms of FER, the difference is even more. The current Berrou puncturing scheme showed similar performance compared with Samsung and LGIC scheme. In fact, Samsung and LGIC puncturing scheme showed slightly better performance than the current Berrou puncturing scheme. However, the turbo interleaver based puncturing scheme proposed by Nortel Networks showed performance degradation in terms of both BER and FER. In Figure 2, we compared the performance of three puncturing schemes with interleaver size of 324. The difference of performance in dB at BER=10^{-6} is at least 0.13dB. In terms of FER, the difference is even more. Performance of three puncturing schemes showed consistency compared with performance in Figure 1. In Figure 3 and 4, we compared the performance of three puncturing schemes with interleaver size of 640 and 1280, respectively. The difference of performance in dB at BER=10^{-5} is at least 0.1dB.

According to simulation results, it was shown that the turbo interleaving based puncturing scheme proposed by Nortel Networks could not promise performance improvement of rate 1/2 turbo code. Therefore the current Berrou puncturing scheme would be better for rate matching algorithm for rate 1/2 turbo code. In addition, we propose that Samsung and LGIC puncturing scheme should be taken into account if concern is raised for a new scheme to improve performance of rate 1/2 turbo code. We also propose that rate matching puncturing should be used in the same way in order to generate rate 1/2 turbo code.

4. References

[1] "Unified rate matching scheme for Turbo/convolutional codes and up/down links", Samsung Electronics Co., TSGR1#6(99)919

[2] "Unified rate matching scheme for turbo codes in both uplink and downlink", Samsung Electronics Co. and LGIC, TSGR1#6(99)a30

[3] "Rate matching puncturing for 8-PCCC and convolutional code", Nortel Networks, TSGR1#6(99)950

[4] "Report on Ad Hoc 5 meeting of 15-16 July 1999", Ad Hoc 5 chair, TSGR1#6(99)a13

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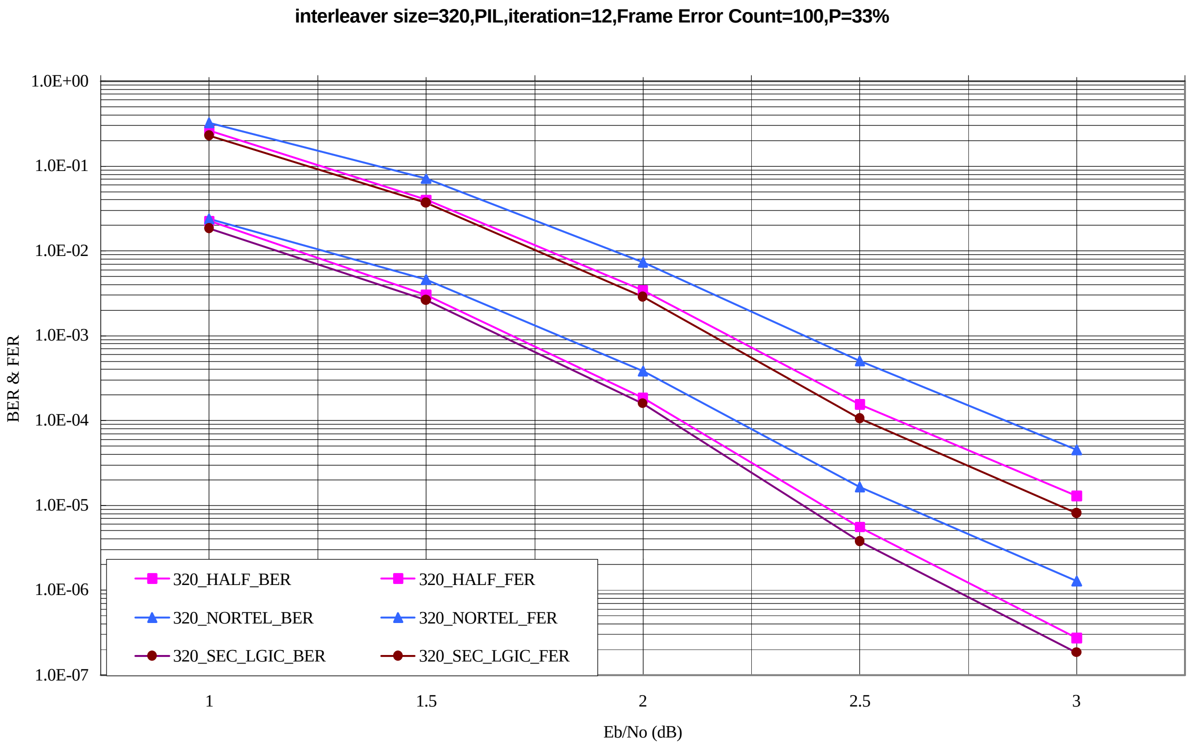

Fig. 1. BER and FER performance of three puncturing schemes (N=320, P=33%, downlink).

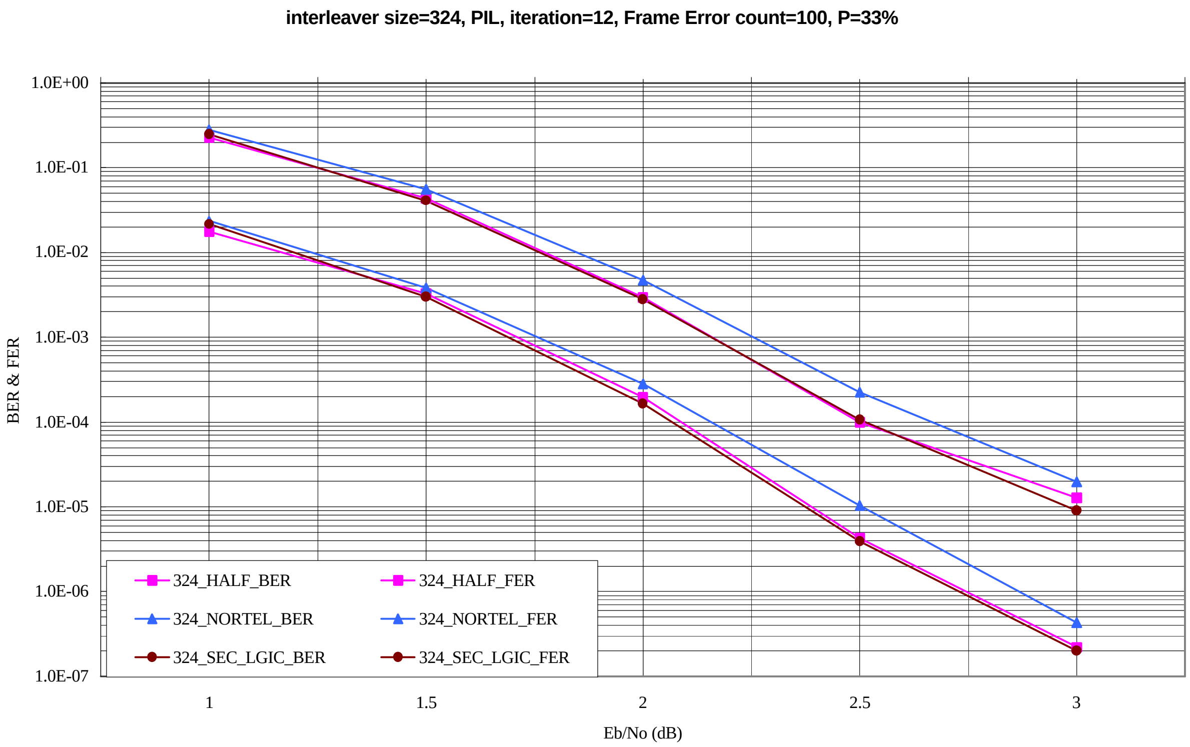

Fig. 2. BER and FER performance of three puncturing schemes (N=324, P=33%, down link).

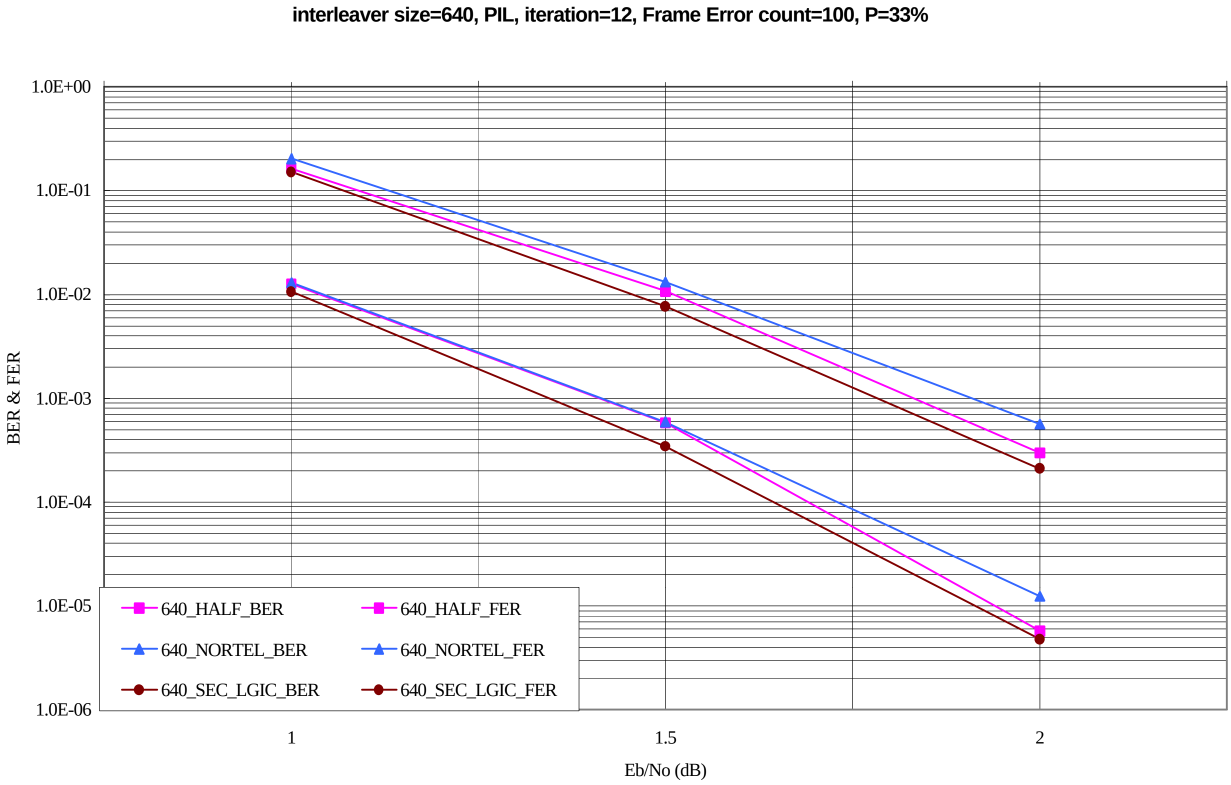

Fig. 3. BER and FER performance of three puncturing schemes (N=640, P=33%, down link).

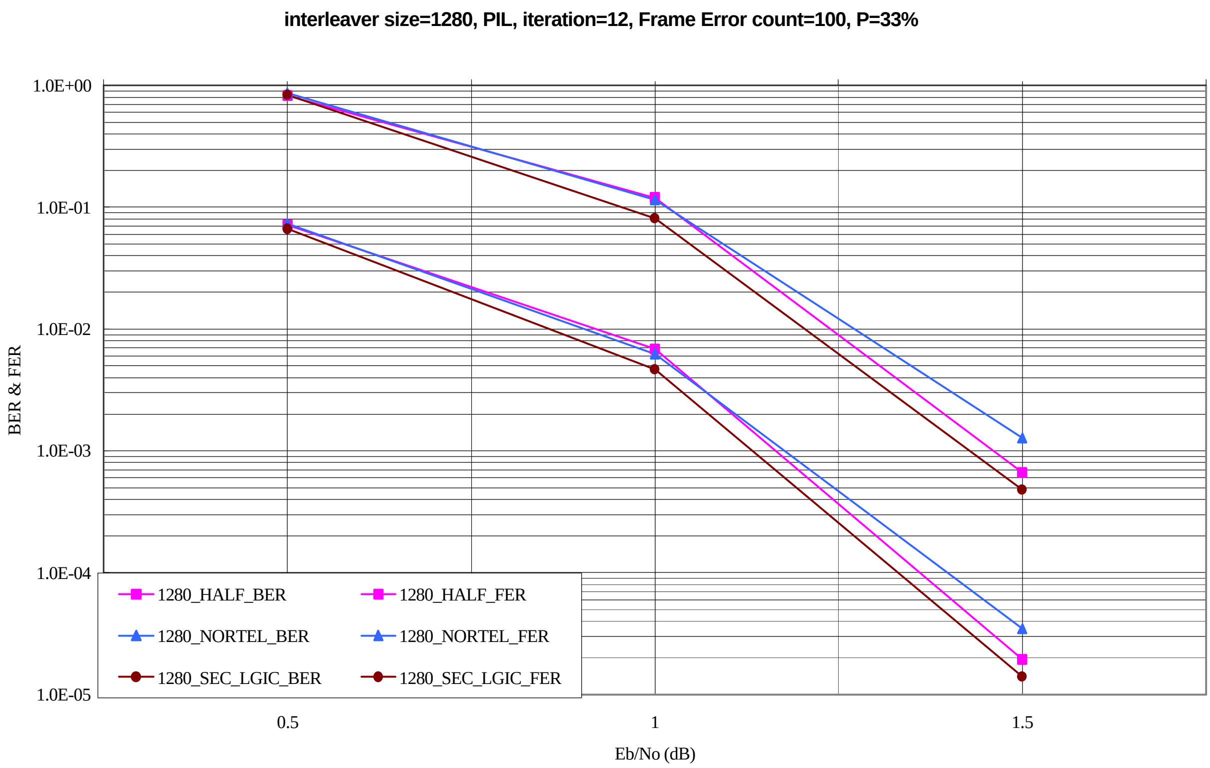

Fig. 4. BER and FER performance of three puncturing schemes (N=1280, P=33%, down link).