TSG-RAN Working Group 1 meeting No. 5 TSGR1-556/99
June 1-4, Cheju, Korea

Agenda Item: **Adhoc 4 item 7 Channel Interleaving**

Source: **Siemens**

Title: **First Simulation results for Interleaver and Puncturing Evaluations**

Document for: **Information and Discussion**

Abstract

A drafting group in Adhoc 4 agreed to perform simulations to compare the performance of channel interleaving and puncturing schemes. The simulation assumptions have been defined in [1].

In this contribution we present first simulation results for some of the formats defined in [1]. We have chosen the modified FS-MIL interleaver and the associated interleaver patterns [2] and the puncturing scheme for optimised puncturing after inter frame interleaving according to [3]. We compared the results to the Algebraic interleaver and the associated patterns [4].

We present results for formats 1, 2, 11 and 12 for 3 and 30 kmh fading conditions and results for format 1 and 2 for AWGN. The AWGN results are intended to check the puncturing performance.

For the fading simulations we find that there are no statistically significant differences between the different interleaver schemes for the investigated channels, at least the differences become not visible at the length of the simulations we performed.

However, for the AWGN case we see an advantage of the optimised puncturing scheme. We therefore think that this scheme should be considered for implementation for the interleaving scheme.

Simulation conditions

a) AWGN Simulations:

- Raw bits distorted by AWGN (adding noise after transmitter interleaver output and connecting to receiver deinterleaver input),
- No channel estimation, no spreading.

This scenario obviously does not test interleaver properties but only puncturing properties. The latter can be studied better because AWGN channel shows less statistical variance than fading channel and because it is feasible to simulate a much higher number of samples.

b) Fading Simulations:

- Vehicular speeds : 30km/h and 3km/h
- No Power Control
- No Diversity
- Channel model : 2-path Raleigh fading (each path equal average power)
- Channel estimation : 2-slot averaging
- Max. Iterations : 10.000 frames

c) Labelling of curves depending on interleaver and puncturing scheme:

- Algebraic Nortel (labelled alg/alg_pnc/1 in simulation charts)
- Modified FS-MIL NTT DoCoMo / optimised Puncturing Siemens (labelled mil/siemens/mil in simulation charts)

d) investigated formats:

Interleaving span = 10 ms, DPDCH bit rate = 64 kbps, DPCCH bit rate = 16 kbps									
Format #	Input data	Tail for Conv.	Coded data	Puncturing		Punctured data		Dummy	DPDCH
	Bit/TrBlk	bit/TrBlk	bit/TrBlk	bit/frame	%	bit/frame	%	bit/frame	bit/frame
1	206	8	642	2	0,31	640	100,0	0	640
2	258	8	798	158	19,80	640	100,0	0	640
Note: - Format #1 - #8: Convolutional coding (R = 1/3, k = 9)									

Interleaving span = 80 ms, DPDCH bit rate = 256 kbps, DPCCH bit rate = 16 kbps									
Format #	Input data	Tail for Conv.	Coded data	Puncturing		Punctured data		Dummy	DPDCH
	Bit/TrBlk	bit/TrBlk	bit/TrBlk	bit/frame	%	bit/frame	%	bit/frame	bit/frame
11	6824	8	20496	2	0,08	2560	100,0	0	2560
12	8520	8	25584	638	19,95	2560	100,0	0	2560
Note: - Format #11 - #18: Convolutional coding (R = 1/3, k = 9)									

Conclusion

The AWGN simulations show an advantage for the optimised puncturing scheme compared to the algebraic puncturing scheme for format 2 which does contain puncturing. Of course there is no difference for format 1 which does not contain any significant puncturing. This case has been simulated as a reference only.

While AWGN simulations do not tell anything about the interleaving performances, they are a valid source to judge puncturing patterns. The same performance gain is expected to be maintained for fading channels as well, however, due to the statistical nature of those simulations no statistically significant difference can be observed there directly.

In order to maintain the advantages of the optimised puncturing scheme, we propose that this scheme should be considered for the channel interleaving/puncturing scheme.

References

[1] TSG-RAN Working Group 1, Ad Hoc 4 Drafting Group; Simulation Conditions for Channel Interleaver Evaluations; April 12, 1999

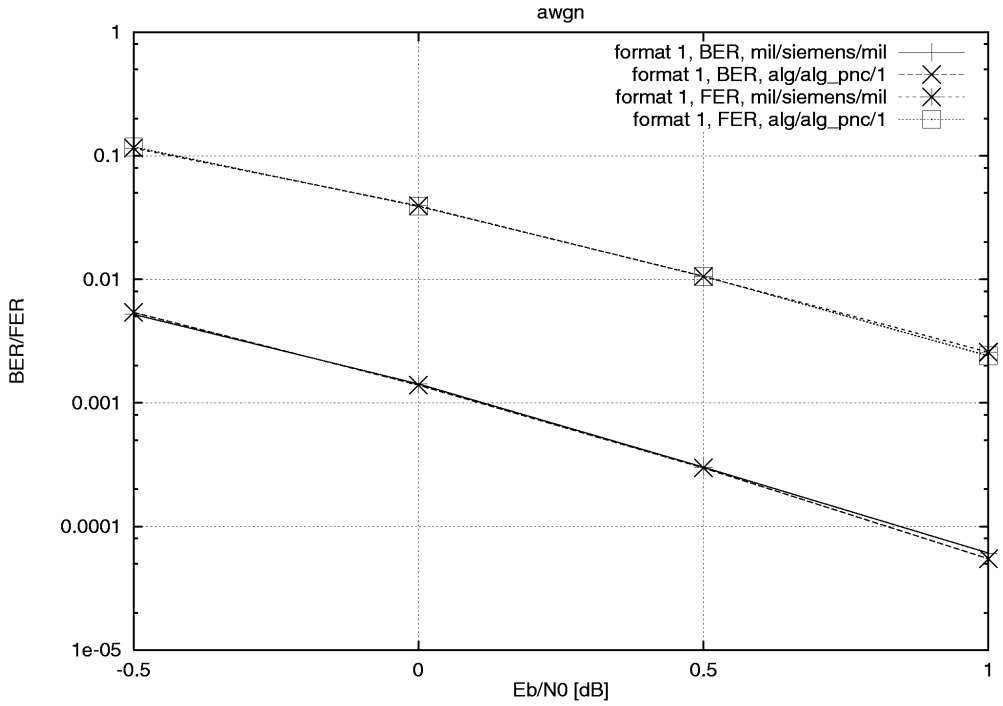
[2] NTT DoCoMo; Ad Hoc 4: Item 7 Channel interleaver patterns; May 10, 1999

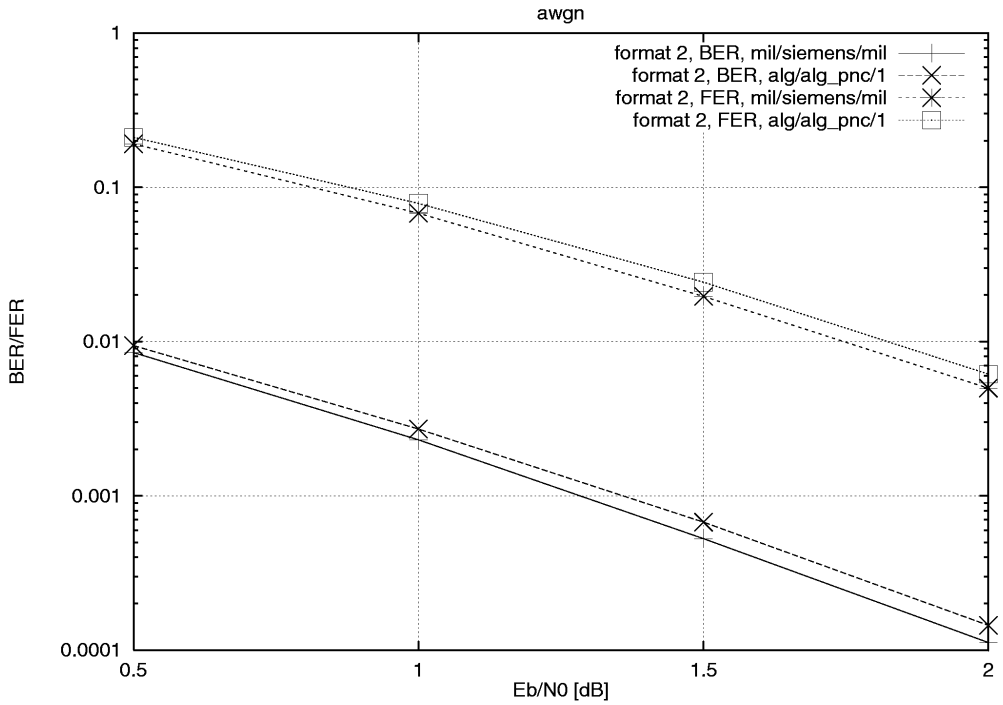
[3] Siemens; Optimised Rate Matching after interleaving rev2 of TSGR1#3(99) 203; April 13, 1999

[4] Nortel; Ad Hoc 4: Item 7 Nortel channel interleaver : Patterns for puncturing; April 16, 1999

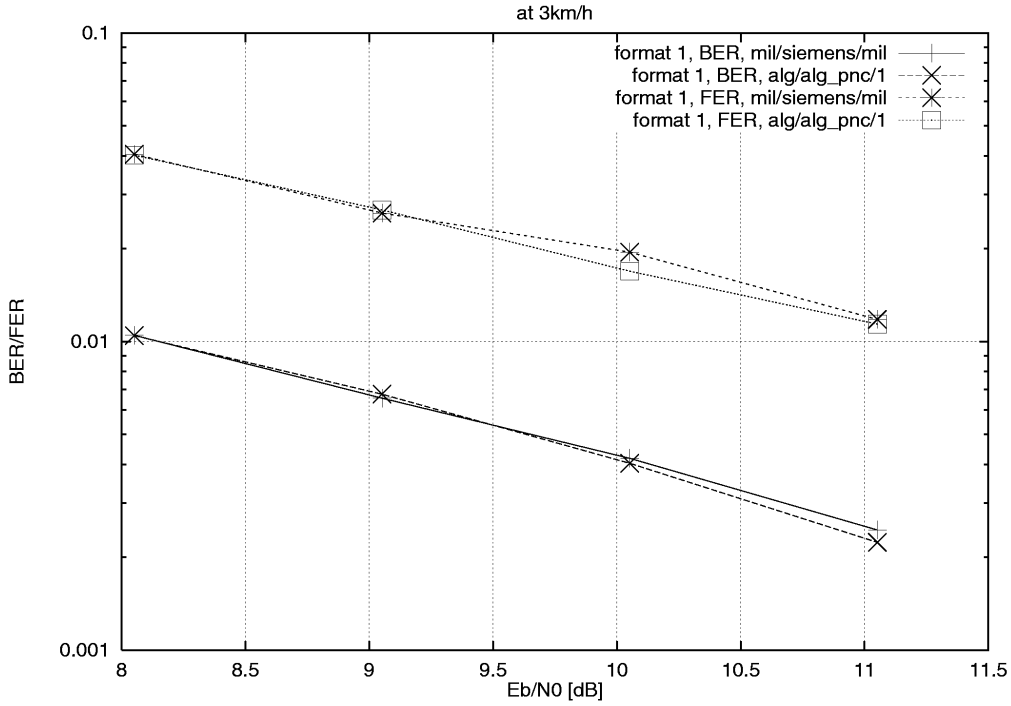
Detailed Results

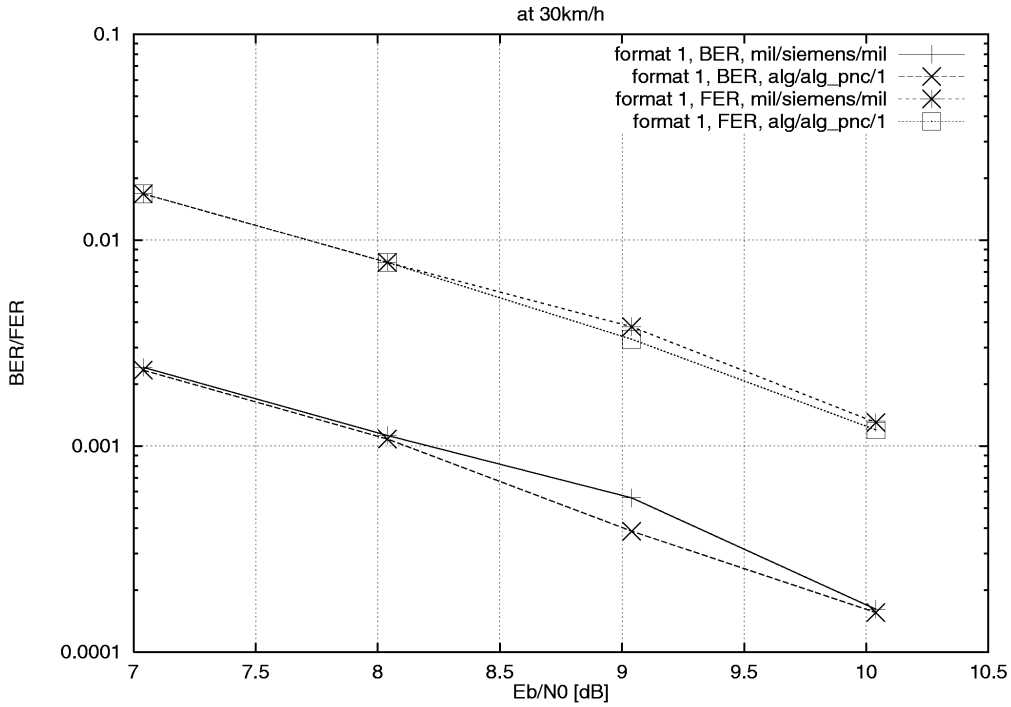
AWGN channel results for format 1 and 2



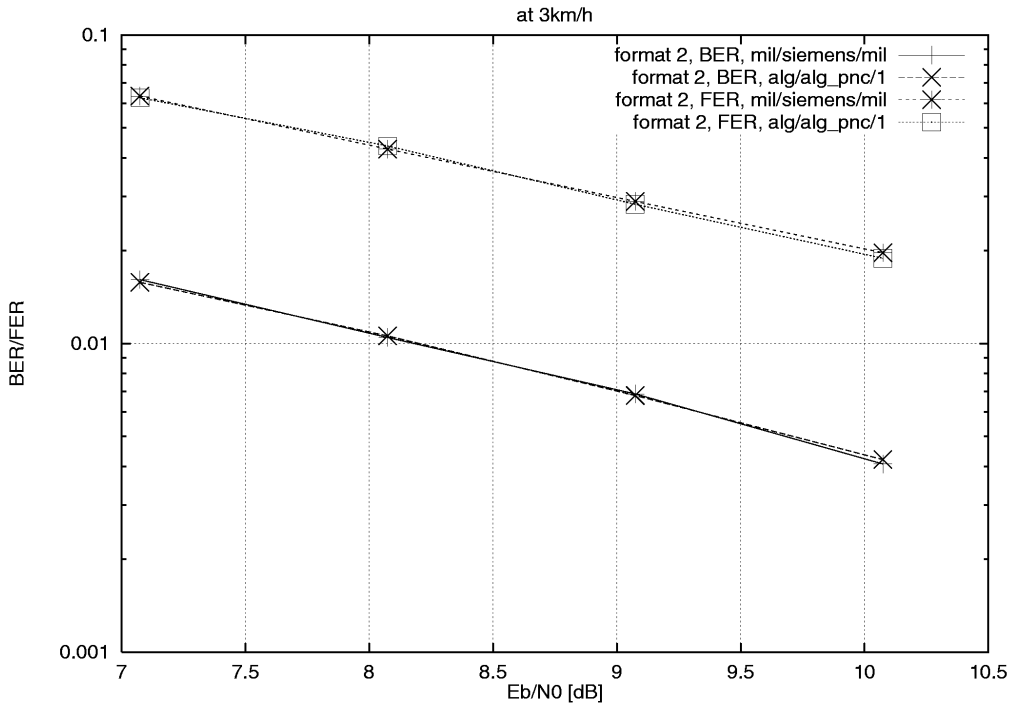


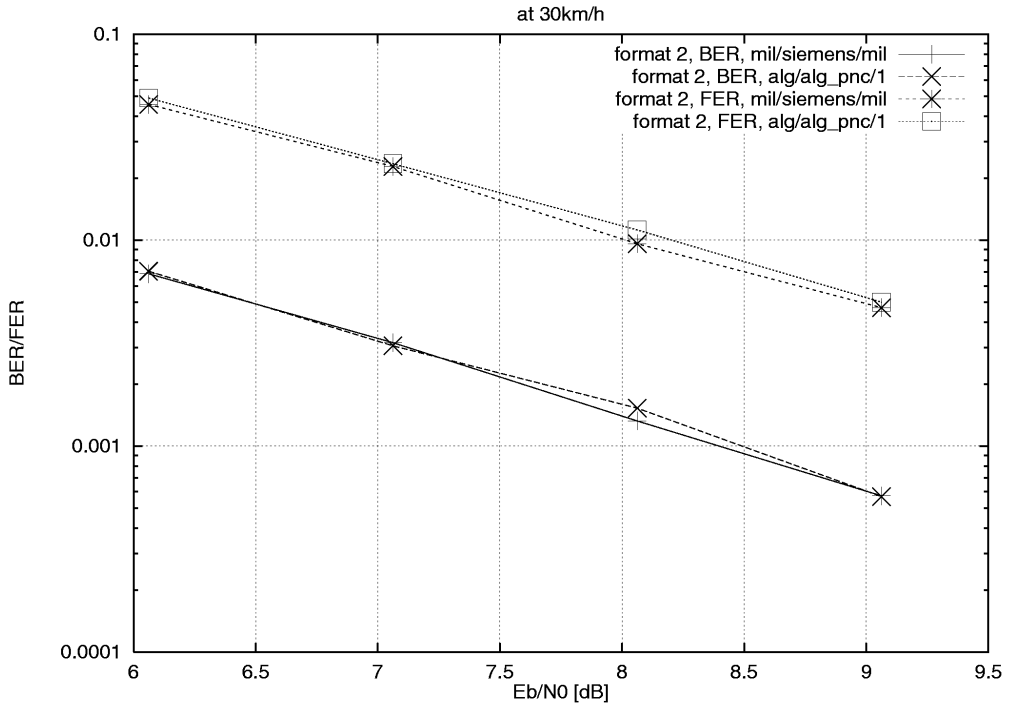
Fading channel results for format 1



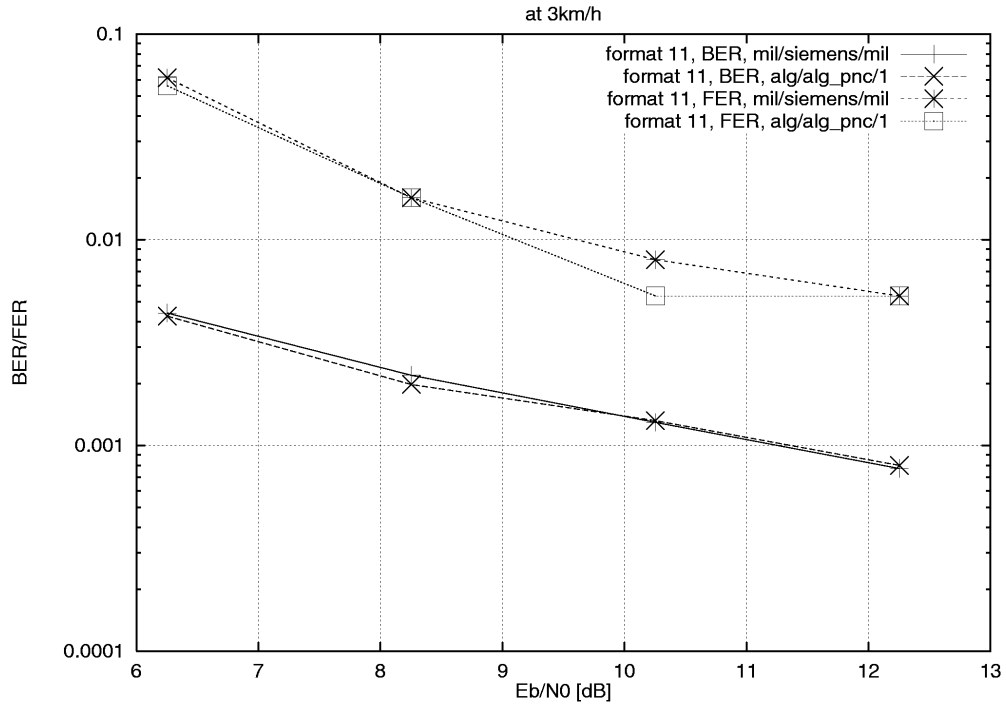


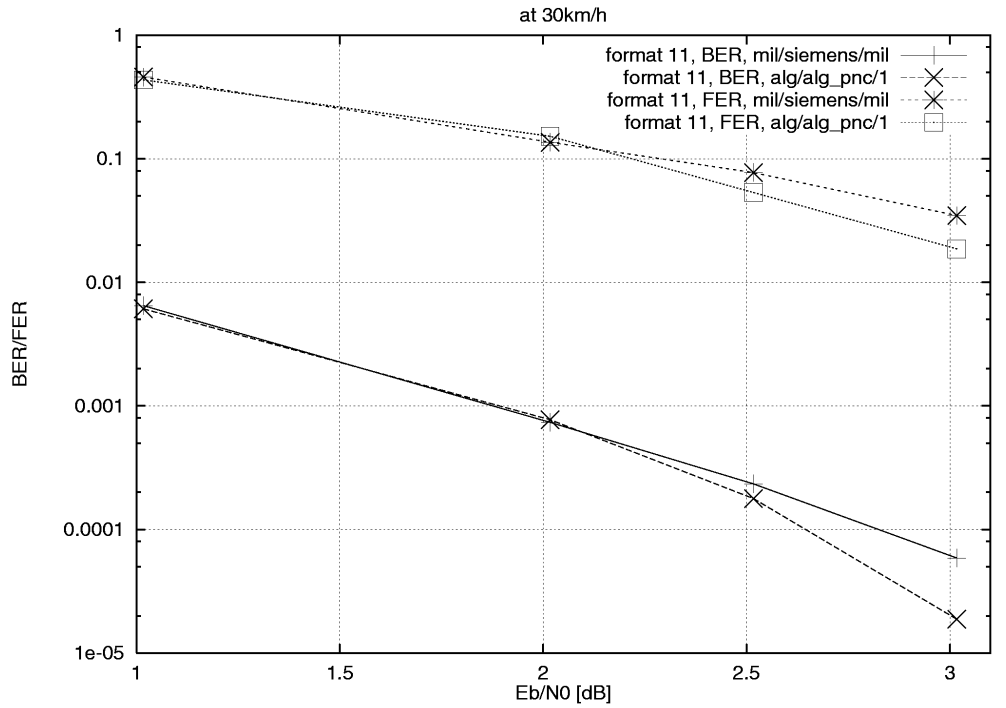
Fading channel results for format 2





Fading channel results for format 11





Fading channel results for format 12