Agenda item:	HSDPA
Source:	Nokia
Title:	HSDPA uplink signaling coding simulation results
Document for:	Discussion

Summary:

In this contribution a performance comparison of ½ rate convolutional code and 1st order Reed-Muller code in case of up to 5 HSDPA uplink signaling bits is presented. According to the results they both have very similar performance when 5 HSDPA signaling bits are transmitted. For smaller number of HSDPA signaling bits convolutional code seem to outperform the 1st order Reed-Muller code. One possible explanation of this behavior is the fact that when there are less than 5 information bits the resulting set of code words of 1st order Reed-Muller code (as defined in TS 25.212) is orthogonal having worse distance properties than a set of bi-orthogonal codes words. Thus, if we limit ourselves to the already specified channel codes, convolutional coding is a very potential solution for the encoding method of HSDPA uplink signaling.

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1. INTRODUCTION

In the joint TSG-RAN WG1 and WG2 meeting on HSDPA possible solutions for uplink signaling to support HSDPA were presented [1]. It was pointed out that already specified encoding methods should be used if possible. In the following chapters some simulation results comparing the performance of 1st order Reed-Muller code and convolutional code are presented.

2. SIMULATION RESULTS FOR UL SIGNALING CODING

The performance of 1st order Reed-Muller code was compared to ½ rate convolutional code both as defined in [2]. They were selected for simulations as we can map the encoded bits quite easily to 20 channel bits either by repetitions or puncturing. The number of available channel bits per HSDPA TTI was set to 20 (i.e. encoded signaling bits are mapped to two slots) following the one possible structure of a TTI as presented in [1]. Otherwise the simulation parameters were as shown in the Table 1.

Table 1. Simulation parameters.

Parameter	**Value**
Channel model	Pedestrian A
Mobile velocity	3 km/h
SF	128
Fast power control	on
HSDPA TTI Length	3 slots
Mapping of signaling bits in UL	Over 2 slots
# of information bits	2 or 5
# of coded bits	20
Encoding scheme	1/2-rate convolutional code with 8 tail bits and puncturing
	bi-orthogonal (16,5) code and repetition
CRC	No

Figures 1 and 2 show the BLER and BER results as a function of E_b/N_t for the case of 5 information (HSDPA uplink signaling) bits per HSDPA TTI. Figures 3 and 4 show the corresponding results for the case of 2 HSDPA uplink signaling bits per HSDPA TTI.

Based on the results the half rate convolutional code seem to provide same performance as the (16, 5) Reed-Muller code as specified in [2] when the number of signaling bits is 5. If we go for 2 signaling bits per HSDPA TTI convolutional code seem to give about 1 dB better performance over the (16, 5) block code. A likely reason for this is the way the code words are constructed for (16, 5) code. If we have 1-4 information bits the encoded code words form an orthogonal set whose distance properties are worse than that of bi-orthogonal set. Only if there are 5 information bits the resulting set of code words is bi-orthogonal.

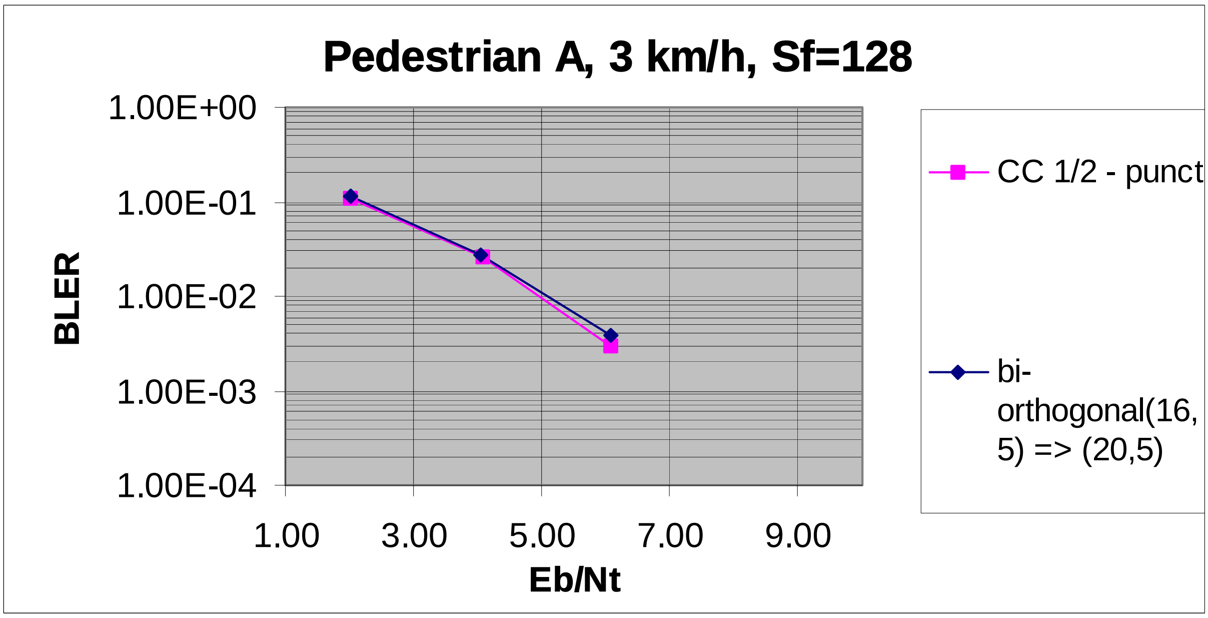

Figure 1. Block error rate of HSDPA signaling in uplink as a function of E_b/N_t. Five information bits have been assumed.

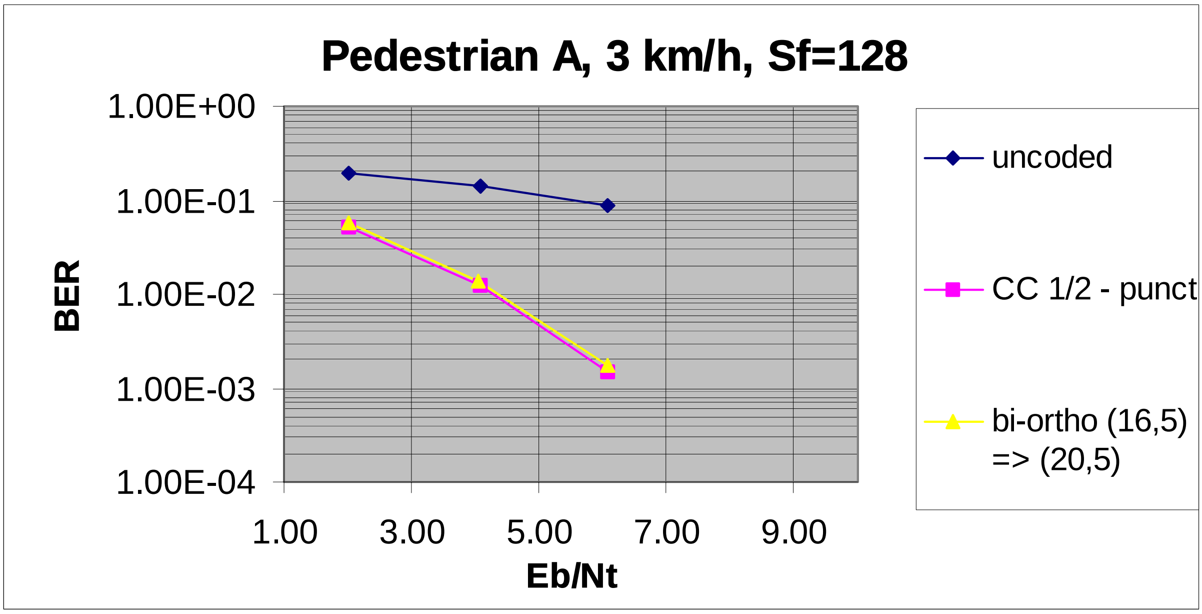

Figure 2. Bit error rate of HSDPA signaling in uplink as a function of E_b/N_t. Five information bits have been assumed.

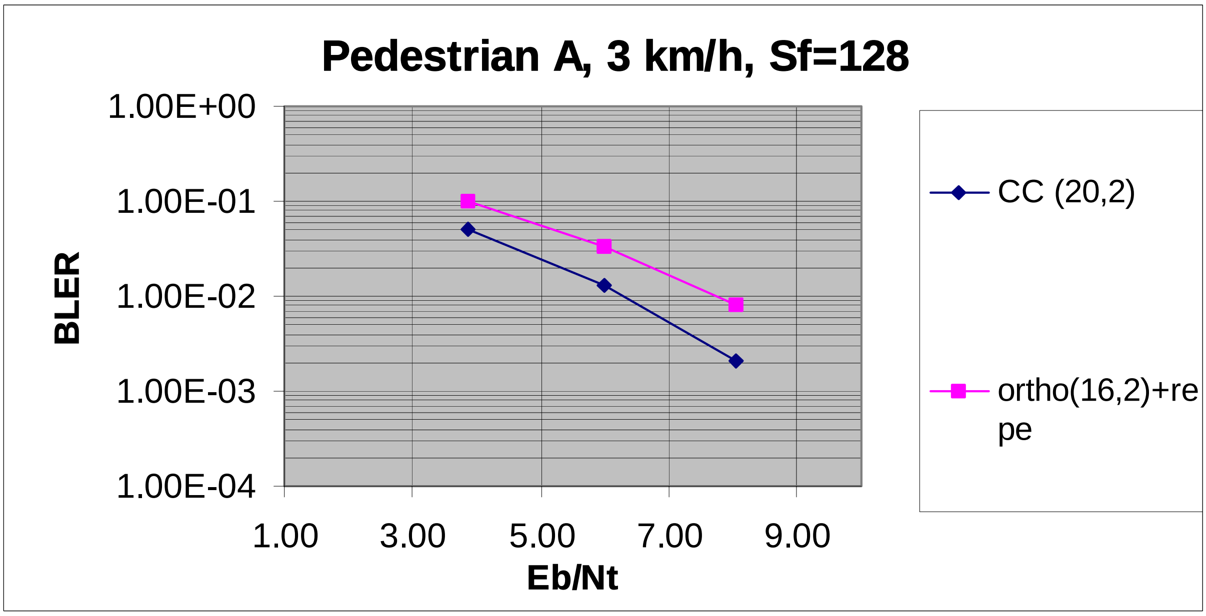

Figure 3. Block error rate of HSDPA signaling in uplink as a function of E_b/N_t. Two information bits have been assumed.

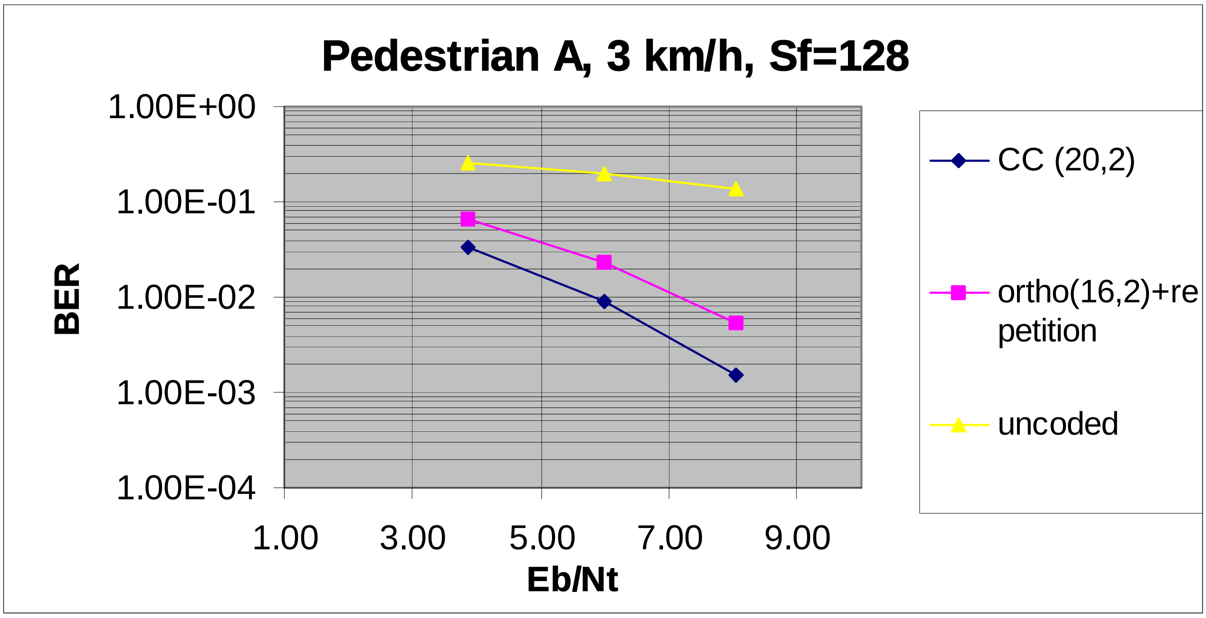

Figure 4. Bit error rate of HSDPA signaling in uplink as a function of E_b/N_t. Two information bits have been assumed.

The performance difference between orthogonal and bi-orthogonal signaling increases as the number of information bits decreases. That is the probable reason, why the specified (16, 5) code is performing worse than the ½ rate convolutional code when there is only 2 HSDPA uplink signaling bits. As the output of the convolutional code can easily be rate matched to varying number of available channel bits it seems to be the preferred choice for the channel encoding solution of HSDPA uplink signaling.

3. CONCLUSIONS

According to the presented simulation results the half rate convolutional code seem to perform as well or even better than the specified (16, 5) Reed-Muller code. Thus it is a very potential solution for the encoding method of HSDPA uplink signaling.

REFERENCES

[1] Nokia. HSDPA uplink signaling. 3GPP TSG-RAN WG1 and WG2 joint meeting on HSDPA, Technical Document 12A010008, 5-6th, April, 2001, Sophia Antipolis, France, 10 p.

[2] 3GPP TSG RAN. Multiplexing and channel coding (FDD). TSG-R1 Technical Specification, TS 25.212 v4.0.0, 62 p.