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Agenda item: AH24 (HSDPA)

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Title: Impact of block length on turbo-code performance for HSDPA

Document for: Discussion

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1 Introduction

During WG1 #18, the potential benefits of a variable (dynamic) TTI for HSDPA were discussed. In [1], benefits of a variable TTI from a physical-layer point-of-vew were claimed, based on the argument that a short semi-static TTI would lead to reduced turbo-code performance due to too short code blocks. Already during WG1 #18 there were some comments on the simulation results presented in [1] and the conclusions drawn from these results.

Further studies have identified deviations between the results of [1] and the simulation results presented in e.g. [2]. More specifically:

- Comparing e.g. MCS5 with block length = 640 bits in [1] with QPSK and R=1/2 (block length = 400 bits) in [2] there is an E_b/N_0 difference in the order of 2-3 dB.
- In general, the performance curves of [1] seem to be less "steep" compared to the performance curves of [2].

In addition, the simulation results of [1] seem to indicate a performance gain that is approximately the constant for each factor-of-two increase in the length of the code block, independent of the block length. It is difficult to understand this behaviour.

2 Turbo-code performance

To clarify the HSDPA turbo-code performance as a function of the code block length, we have carried out simulations similar to those of [1]. The results are shown in Figure 1. As can be seen, the results differ noticeably from [1]:

- The performance is noticeably better compared to [1]
- The performance curves are noticeable more "steep" compared to [1]
- Although there is a gain with larger code blocks for higher SIR (lower BLER), there is no such gain for lower SIR (higher BLER). This behaviour can not be seen in [1]. Also, the gain for higher SIR is much smaller, compared to [1].

The results of Figure 1 have been compared to and found to agree well (within 0.5 dB) with the results of [2].

It should be noted that the simulations results of Figure 1 as well as those of [1] assume very "low" MCS, i.e. a very low coding rate (R=1/5). It can be expected that any gains with larger code blocks are even less noticeable for higher MCS. There have been claims that coding rates lower than R=1/2 may not needed for HSDPA, see e.g. WG1 HSDPA TR.

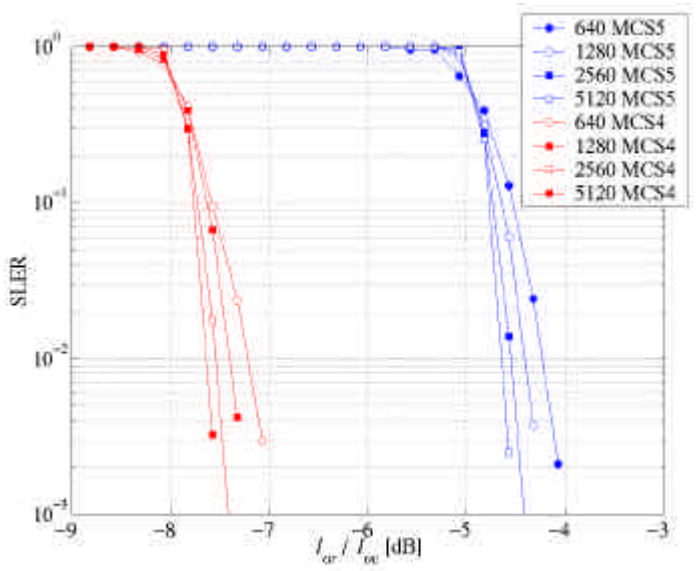

Figure 1 Turbo-code performance as a function of the turbo-code block length

3 Impact on HSDPA performance

As has been frequently pointed out in the HSDPA discussions, Hybrid ARQ will typically operate with a relatively high initial block-error rate, perhaps even as high as 50% or beyond. Thus, HSDPA performance will, to a large extent, depend on the Turbo-code performance at high BLER. Based on Figure 1 one can thus conclude that there are no significant gains with larger turbo-code blocks in the HSDPA context. This is further illustrated in Figure 2, which shows the throughput for different block-length.

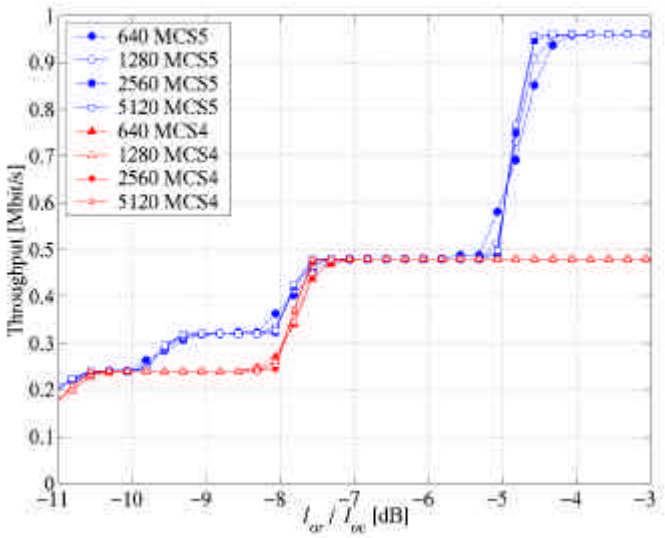

Figure 2 HSDPA performance as a function of the turbo-code block length

4 Conclusions

The impact of code-block length on the HSDPA performance has been studied. In contrast to [1], this study shows that there are no significant gains for larger code blocks. Hence, from this point-of-view, there are no reasons to introduce a dynamic (variable) TTI for HSDPA.

References

[1] “Variable TTI proposal for HSDPA ”, R1-010079, TSG-RAN1 #18

[2] “Forward Link Simulation Results for HSDPA”, R1-001241, TSG-RAN1 #16