Mueller Exhibit 32

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Agenda Item: 4
Source: Samsung Electronics Co.
Title: Enhanced Symbol Mapping method for the modulation of Turbo-coded bits based on bit priority
Document for: Discussion and approval

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1. Introduction

This contribution proposes enhanced symbol mapping method for the modulation of Turbo-coded bits based on bit priority in HSDPA channel structure. The output of Turbo encoder consists of systematic (S) bits and parity (P) bits and it is well known that S bits have higher priority than P bits for the decoder performance. In HSDPA, high order modulations, e.g., 16QAM, 64QAM, are used, whose symbol consists of bits with different reliability. Then it is expected that the overall system performance would be improved if higher priority bits have higher reliability. Based on this idea, this contribution suggests an enhanced symbol mapping method, where S bits are mapped to high reliability bits and P bits to low reliability bits for modulation. The performance gain of the proposed method is evaluated by simulations for 16QAM and 64 QAM.

2. Current HSDPA channel structure

Figure 1 shows the current HSDPA channel structure [1].

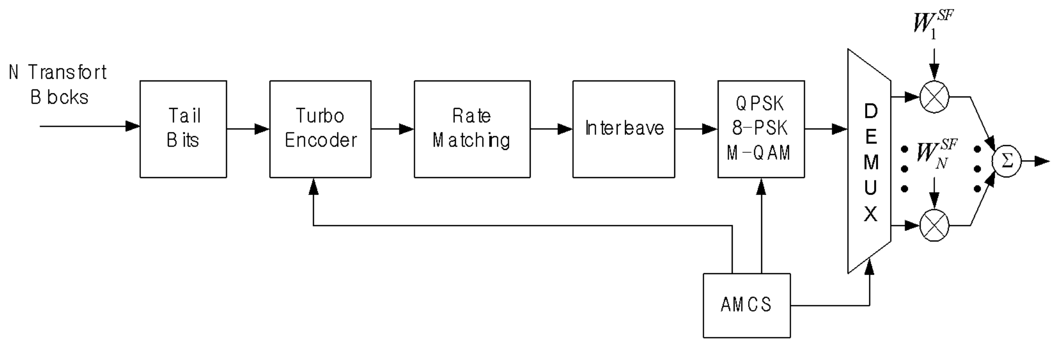

Figure 1 Current HSDPA channel structure

The interleaver mixes the output S bits and P bits of turbo encoder randomly before the symbol mapping for modulation. Thus, S bits and/or P bits are assigned to symbols without considering their priorities.

3. Proposed structure

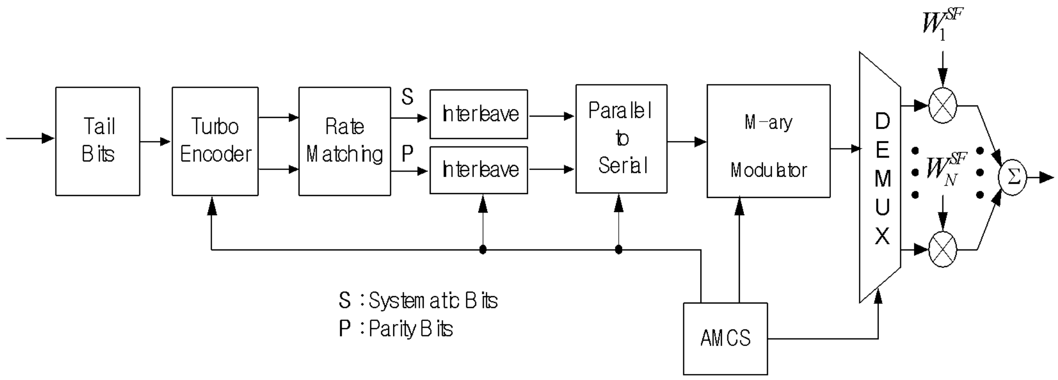

Figure 2 proposed HSDPA channel structure

Figure 2 shows the proposed structure where the original interleaver is replaced by two independent interleavers under the control of AMCS. The idea of separating S bits from P bits was proposed in [2] for HARQ combining but, in [2], no symbol includes S and P bits simultaneously, while a symbol for the proposed method includes S and P bits simultaneously according to the mapping rule.

P/S (Parallel to Serial) block maps the output of the interleavers to high (H) and low (L) priority parts as shown in figure 3 for 3.33ms TTI, where S and P bits are placed on H and L part respectively.

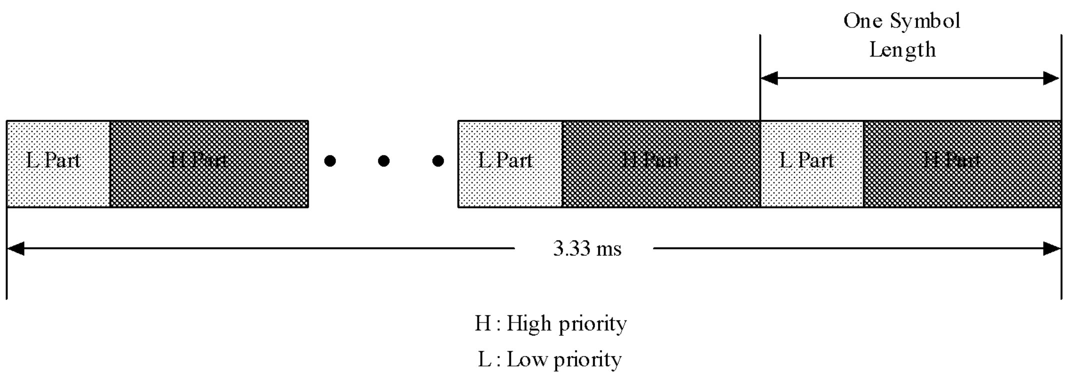

Figure 3 Parallel-to-Serial output

Every symbol includes S part and P part and the size of two parts could be different according to the coding rate. Figure 4 shows how to map the P/S output to a symbol.

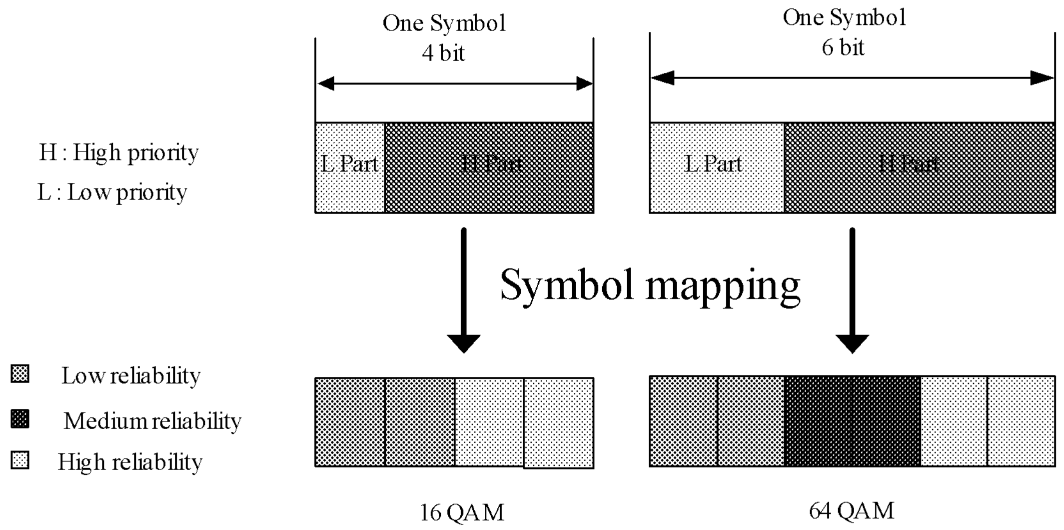

Figure 4 Symbol mapping of P/S output

4. Simulation results

The proposed method is compared with the conventional method under the following simulation parameters.

- Code block size: 2304bits/3.33ms
- Coding rate: 0.5 (S and P parts are symmetric)
- Modulation: 16QAM and 64QAM
- Carrier Frequency: 2GHz
- Channel: AWGN and single path fading with speed 60km
- HARQ: off

For AWGN channel, referring to figure 5-6, about 0.3dB-0.7dB gain is achieved and the gain of 64QAM is better than that of 16QAM. Since the gain difference between high and low reliability bits is bigger for 64QAM than 16QAM, proposed method is more efficient for 64QAM. Also, in figure 7-8, the gain 1dB-2.5dB for fading is bigger than AWGN since separated interleaver gain may be added, i.e., independently interleaved bits are diffused to inherent place in symbols and it may has an effect as extra interleaving.

5. Conclusion

An enhanced symbol mapping method is proposed for the modulation of Turbo coded bits based on bit priority. Simulation results show that the BER performance improves considerably by employing the proposed method. Therefore, it is suggested that the proposed method be considered for HSDPA and included in RAN WG1 technical report.

6. Reference

[1] R1-01-0430, 3G TR25.848 v0.6.0 "Physical Layer Aspects of UTRA High Speed Downlink Packet Access".

[2] R1-01-0206, "Text proposal for HARQ complexity evaluation section of TR25.848" , Panasonic.

Annex A. Simulation results

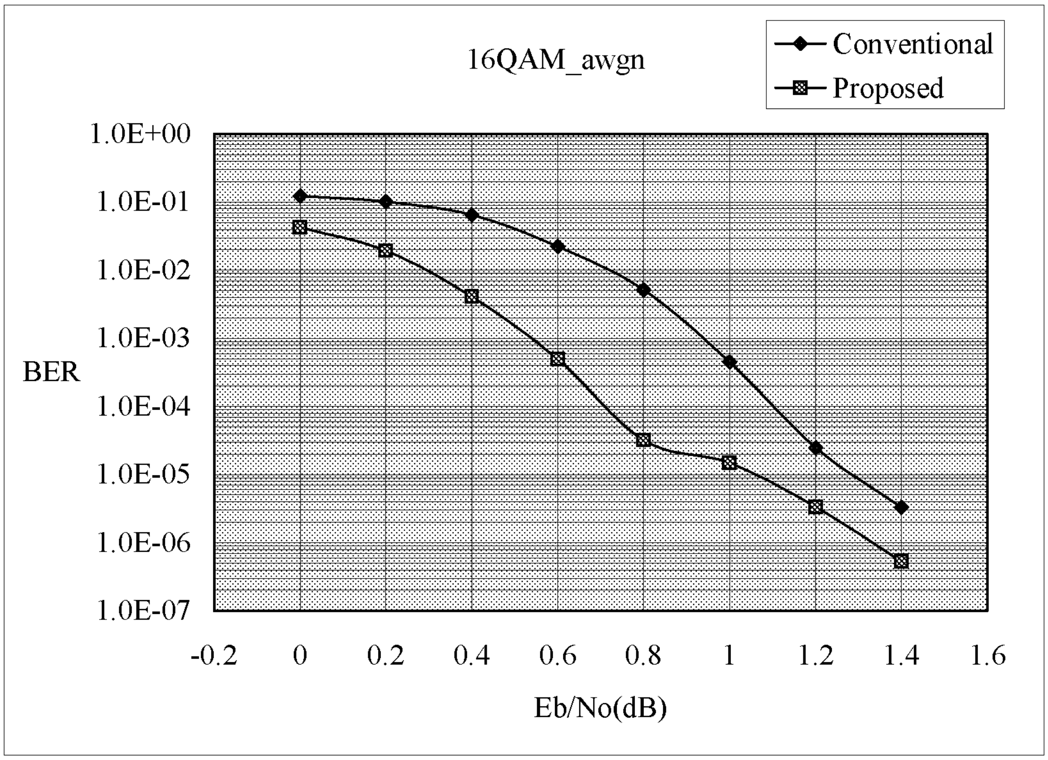

Figure 5 Bit error rate for 16QAM under AWGN

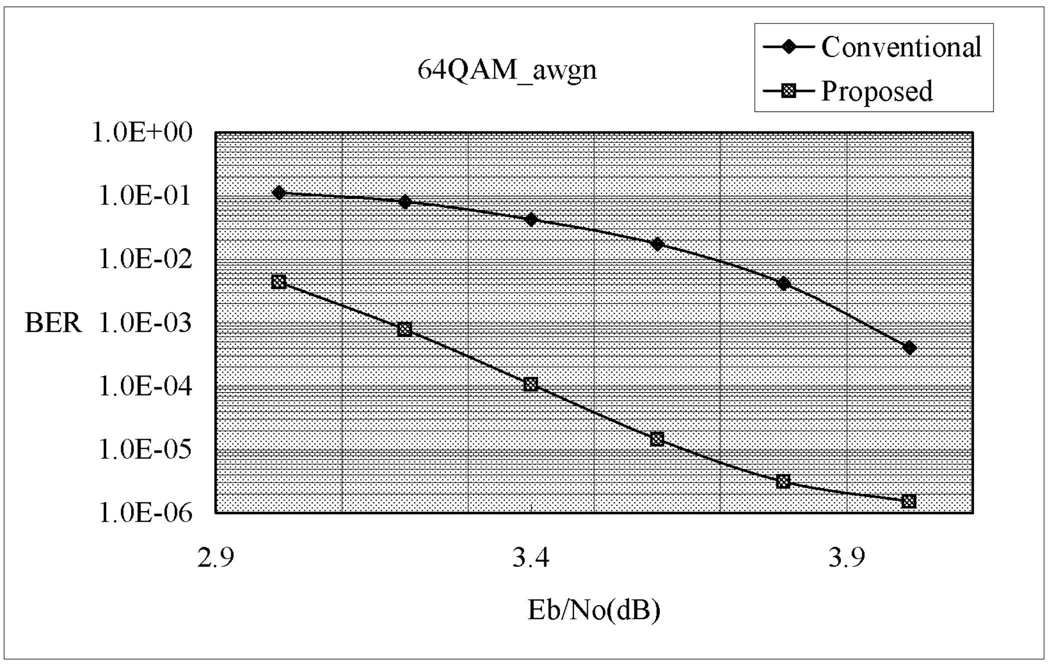

Figure 6 Bit error rate for 64QAM under AWGN

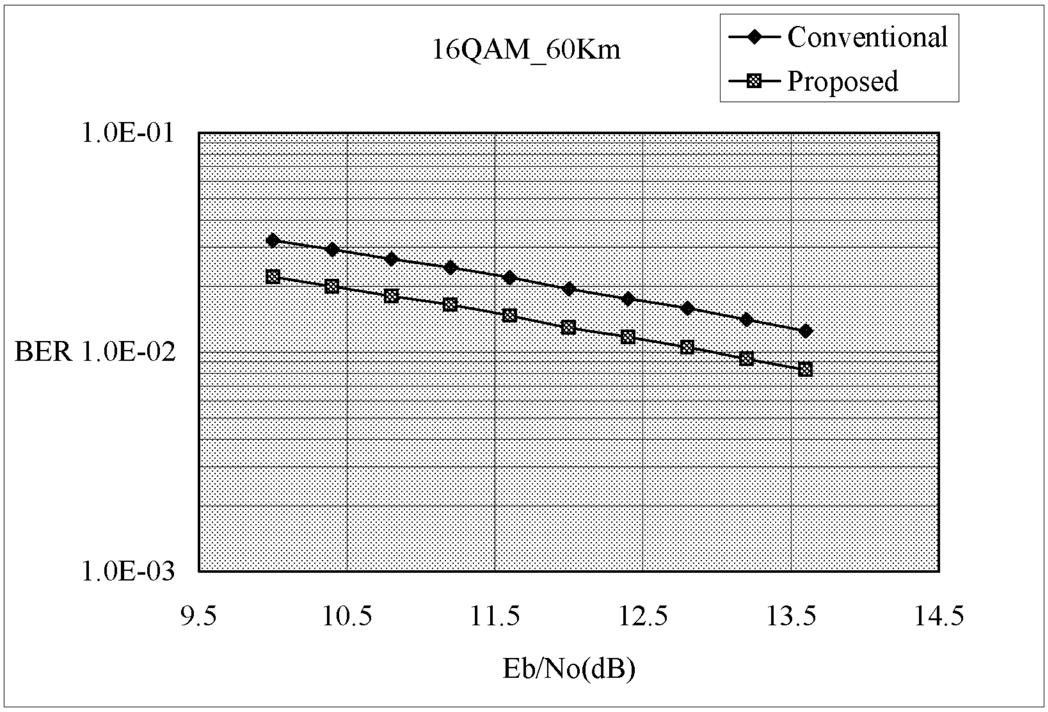

Figure 7 Bit error rate for 16QAM under fading (60km)

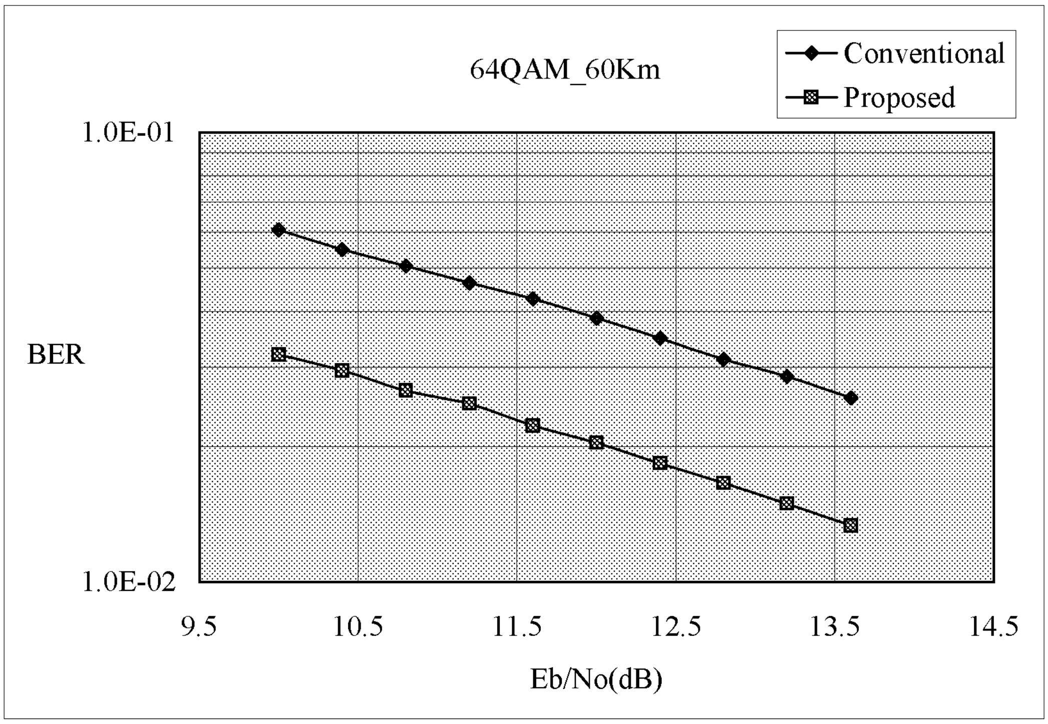

Figure 8 Bit error rate for 64QAM under fading (60km)