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Title	**CTC Bit grouping for IEEE 802.16m Amendment**	
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Re:	IEEE 802.16m-08/053r1 “Call for Comments and Contributions on Project 802.16m Amendment Working Document” Target Topic: “Channel coding and HARQ”	
Abstract	We propose new CTC Bit grouping schemes for IEEE 802.16m amendment.	
Purpose	Discussion and adoption for 802.16m amendment	
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CTC Bit grouping for IEEE 802.16m Amendment

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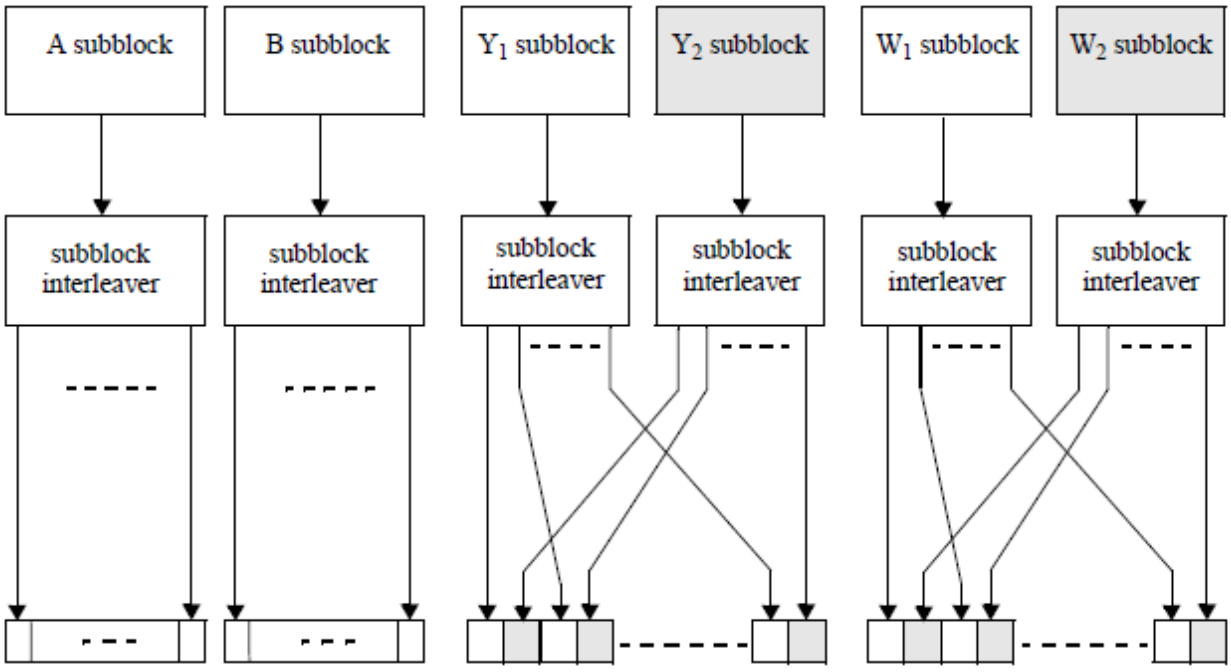
1. Introduction

In IEEE 802.16m SDD (IEEE 802.16m-08/003r6) [1], IEEE 802.16m uses the CTC (Convolutional Turbo Code) of code rate 1/3 defined in the IEEE 802.16e standard [2]. In IEEE 802.16e, CTC subpacket generation is used to generate a subpacket with various code rates for HARQ packet transmission. Procedures for CTC subpacket generation consist of bit separation, subblock interleaving, bit grouping and bit selection. The following figure shows bit grouping for CTC subpacket generation in IEEE 802.16e.



In bit grouping of the above figure, interleaved A and B subblock indicating information part are left untouched while interleaved Y1 and Y2 subblock and W1 and W2 subblock indicating parity part are multiplexed a bit by bit. Thus, bit grouping is performed in order to puncture parities from first encoding (C1 encoding, refer to 8.4.9.2.3.1 [2]) and those from second encoding (C2 encoding, refer to 8.4.9.2.3.1 [2]) evenly.

Using high order modulation such as 16QAM and 64QAM, bit grouping only considering puncturing evenly can cause performance degradation due to unbalance of bit reliability for high order modulation.

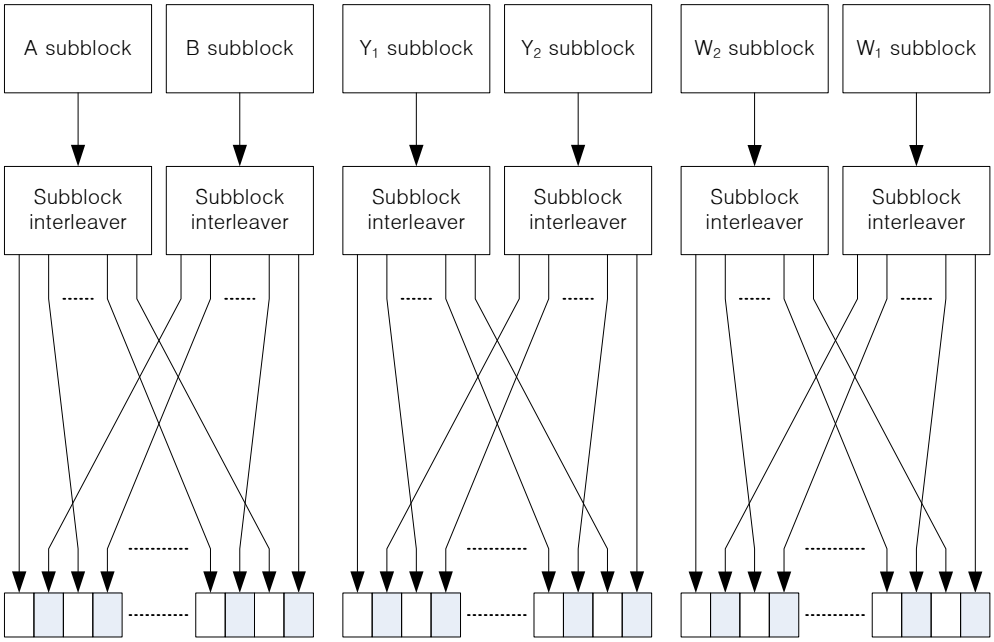
Let bits of subblock interleaved A subblock be A_i, bits of subblock interleaved B subblock be B_i, bits of subblock interleaved Y1 subblock be $Y1_i$ and bits of subblock interleaved W1 subblock be $W1_i$ where i is

running index. Bit A_i and bit B_i is one group input for the CTC encoder. Also, bit A_i, bit B_i, bit $Y1_i$ and bit $W1_i$ is one input for the CTC decoder.

For example, when 16QAM is used as modulation and the length of subblock, *N*, is even, if bit A_i is in low reliability, bit B_i, bit $Y1_i$ and bit $W1_i$ are also in low reliability. This may degrade a performance under high order modulation.

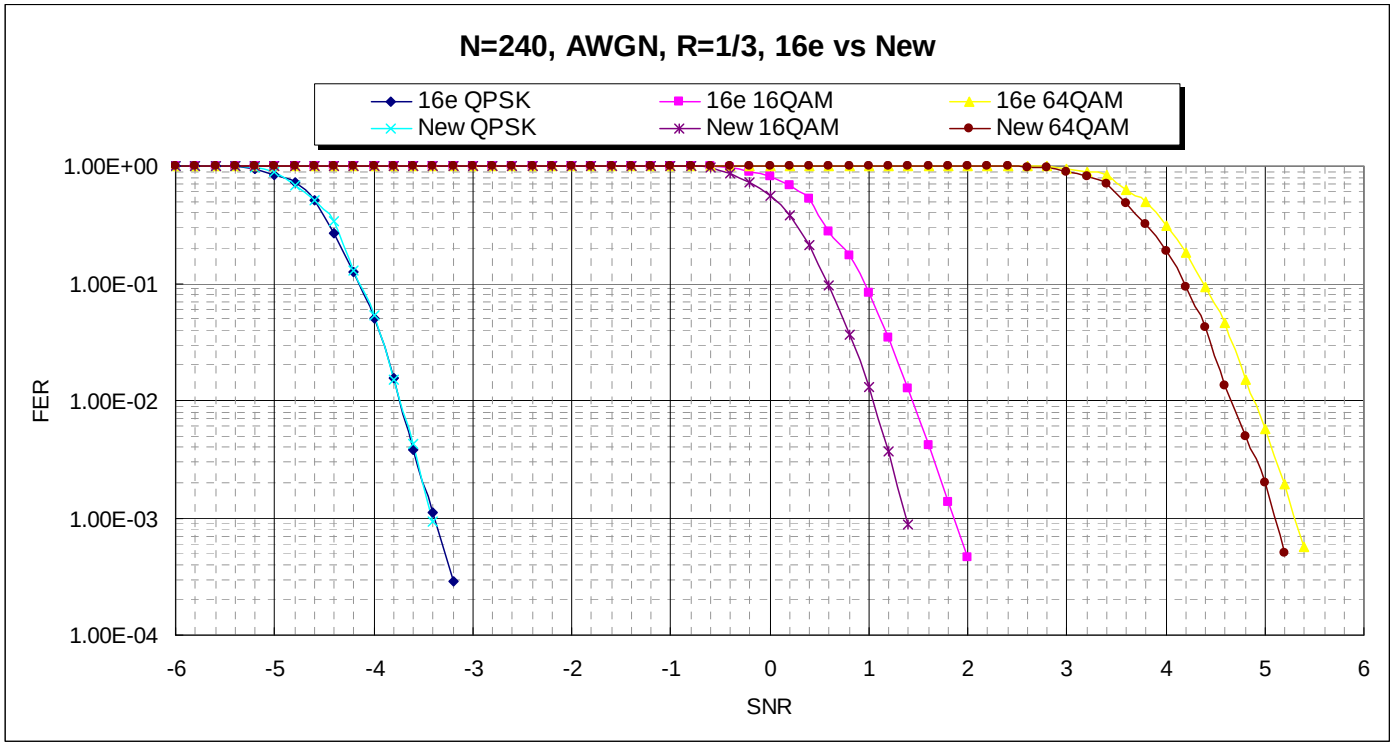
2. Proposed CTC bit grouping for IEEE 802.16m

Based on balances of bit reliability in terms of inputs for the CTC encoder and decoder, new CTC bit grouping is proposed as the following figure.



In new bit grouping for IEEE 802.16m, interleaved A and B subblock are multiplexed a bit by bit and interleaved Y1 and Y2 subblock are multiplexed a bit by bit while W2 and W1 subblock are multiplexed a bit by bit. In other words, The bit-by-bit multiplexed sequence of interleaved A and B subblock sequences shall consist of the first output bit from the A subblock interleaver, the first output bit from the B subblock interleaver, the second output bit from the A subblock interleaver, the second output bit from the B subblock interleaver, etc. The bit-by-bit multiplexed sequence of interleaved Y1 and Y2 subblock sequences shall consist of the first output bit from the Y1 subblock interleaver, the first output bit from the Y2 subblock interleaver, the second output bit from the Y1 subblock interleaver, the second output bit from the Y2 subblock interleaver, etc. The bit-by-bit multiplexed sequence of interleaved W2 and W1 subblock sequences shall consist of the first output bit from the W2 subblock interleaver, the first output bit from the W1 subblock interleaver, the second output bit from the W2 subblock interleaver, the second output bit from the W1 subblock interleaver, etc.

Comparing to results of bit grouping for IEEE 802.16e, those of new scheme have about 0.2~0.4dB gains at FER 10^{-2} in high order modulation. According to simulation results, we propose the new bit grouping for CTC in IEEE 802.16m.



3. Reference

[1] IEEE 802.16m-08/003r5, “The Draft IEEE 802.16m System Description Document”

[2] IEEE P802.16Rev2/D8, “Draft IEEE Standard for Local and Metropolitan Area Networks: Air interface for Broadband Wireless Access” Dec. 2008.

4. Text proposal for inclusion in the 802.16m amendment

---------- *Start of Proposed Text* ----------

Insert the following subsection at a new section 15:

15.x.1.6.1.6. Bit grouping

The channel interleaver output sequence shall consist a bit-by-bit multiplexed sequence of the interleaved A and B subblock sequence, followed by a bit-by-bit multiplexed sequence of the interleaved Y1 and Y2 subblock sequences, followed by a bit-by-bit multiplexed sequence of the interleaved W2 and W1 subblock sequences. The bit-by-bit multiplexed sequence of interleaved A and B subblock sequences shall consist of the first output bit from the A subblock interleaver, the first output bit from the B subblock interleaver, the second output bit from the A subblock interleaver, the second output bit from the B subblock interleaver, etc. The bit-by-bit multiplexed sequence of interleaved Y1 and Y2 subblock sequences shall consist of the first output bit from the Y1 subblock interleaver, the first output bit from the Y2 subblock interleaver, the second output bit from the Y1 subblock interleaver, the second output bit from the Y2 subblock interleaver, etc. The bit-by-bit multiplexed sequence of interleaved W2 and W1 subblock sequences shall consist of the first output bit from the W2 subblock interleaver, the first output bit from the W1 subblock interleaver, the second output bit from the W2 subblock interleaver, the second output bit from the W1 subblock interleaver, etc.

Figure aaa shows the interleaving scheme.

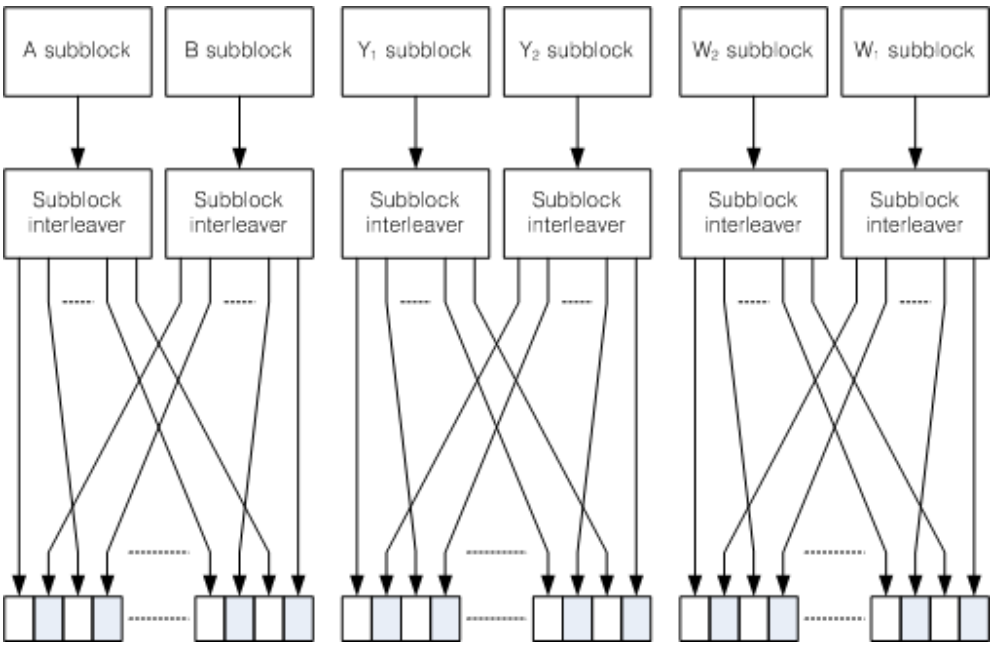


Figure aaa Block diagram of the interleaving scheme

---------- *End of Proposed Text* ----------