IEEE Standards Interpretation for IEEE Std 802.16™-2004 IEEE Standard for Local and Metropolitan Area Networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems

This is an interpretation of IEEE Std 802.16-2004.

October 2008

Interpretation Request #1
In the subsection "8.3.3.3 Interleaving", there is a sentence in the first paragraph, "The second permutation insures that adjacent coded bits are mapped alternately onto less or more significant bits of the constellation, thus avoiding long runs of lowly reliable bits."

What is the meaning of "adjacent coded bits"? Does it mean the coded bits before the first permutation, or it does it mean the coded bits after the first permutation and before the second permutation?

Interpretation Response #1
[802.16 WG] "Adjacent coded bits" is in reference to the bits coming sequentially out of the FEC.

Interpretation Request #2
Another question is: what is the meaning of "less or more significant bits"? Take 16-QAM constellation (see Figure 203 in the subsection 8.3.3.4) for example -- does it mean that the bit "b3" is the more significant bit and "b0" is the less significant bit, or does it mean that the bits "b3" and "b1" are the more significant bits and "b2" and "b0" are the less significant bits?

Interpretation Response #2
[802.16 WG] The statement "less or more significant bits" refers to the less or more significant bits for I and Q individually in the QAM constellations. It means for 16-QAM as

specified in Figure 203 of IEEE Std 802.16-2004, b3 and b1 are the more significant bits and b2 and b0 are the less significant bits.

Interpretation Request #3
I am confused by the permutation, let k be the index of the coded bit before the first permutation; m_k be the index of that coded bit after the first and before the second permutation. Does it mean that after the permutation we send the bit streams in the order of m_0,m_1,m_2,...; or it does it mean that we send the bit streams in the order of 0,1,2,3,....,(in the order of the increasing m_k). Take Ncbps equal 24 (16-QAM) for example. From equation (71), we can get

m_k=0,2,4,6,8,10,12,14,16,18,20,22, 1, 3, 5, 7, 9,11,13,15,17,19,21,23 for
k=0,1,2,3,4, 5, 6, 7, 8, 9,10,11,12,13,14,15,16,17,18,19,20,21,22,23 .

Do we send the bits in the order of 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23 or in the order of 0, 12, 1, 13, 2, 14, 3, 15, 4, 16, 5, 17, 6, 18, 7, 19, 8, 20, 9, 21, 10, 22, 11, 23. For the later order, we have to compute k from m_k. For instance, we find that k=12 make m_k=m_12=1, so at the second sending bit we send the 12th bit.

Interpretation Response #3
[802.16 WG] The indexing due to the permutations is described in the second paragraph of section 8.3.3.3: "Within a block of Ncbps bits at transmission, let k be the index of the coded bit before the first permutation; mk be the index of that coded bit after the first and before the second permutation; and let jk be the index after the second permutation, just prior to modulation mapping."

Your second example, where the bits are sent in the order of 0, 12, 1, 13, 2, etc. matches this specification. (Please note, however, your value for Ncbps is incorrect for the example of 16-QAM. Please reference Table 223.)

We would like to draw your attention to section 8.3.3.5. That section provides a clear and explicit example of encoding and modulating a data burst for an uplink connection, including the interleaving steps. Following that example should also help answer your questions.