Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	Clarifications for MIMO data mapping in PUSC
Date Submitted	**2006–05–04**
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Re:	IEEE P802.16e-2005
Abstract	Clarifies ambiguities in the data mapping for MIMO in PUSC for 2 TX antennas (matrix A,B)
Purpose	Adopt changes
Notice	
Release	
Patent Policy and Procedures	

Clarifications for MIMO data mapping

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1. Motivation

The mapping of data to subcarriers in MIMO modes is not clear in the standard, especially for PUSC and FUSC. Two main things are not clear:

1. The meaning of the matrices (what s_0,s_1 appearing in the matrix format mean, or where in the encoded data stream they come from)
2. How data subcarriers are mapped to physical slots

We focus on the PUSC permutation, 2 transmit antennas and matrix A,B, and propose a solution based on the concepts of 802.16d.

2. Text changes

8.4.3 OFDMA basic terms definition

[Add a new subsections at the end of the section 8.4.8.1.2.1]

8.4.8.1.2.1.3 ~~3.5~~ STC data mapping

In the STC zone, for spatial multiplexing, the mapping of modulated data after channel encoding to MIMO streams depends on the type of encoding (horizontal or vertical encoding).

For vertical encoding (num_layer=1), the number of data slots used by the FEC encoder equals R times the number of physical slots allocated in the map, where R is the ~~STC~~ space time coding ~~code~~ rate and equals the number of streams in case of spatial multiplexing ~~(matrix B)~~. Denote the number of allocated physical slots by D (duration). The D·R data slots shall be encoded, including splitting the data into FEC blocks according to the concatenation rule, randomization, encoding, interleaving, and repetition, as specified in 8.4.9, and shall be mapped to QAM symbols. Then, the resulting QAM symbols shall be mapped in stream-first order into R streams as described in 8.4.8.

For example, if the rate is R=2, and no precoding is used, then the 48 QAM symbols of the first data slot are mapped to the first 24 subcarriers of the first physical slot (in antenna first order, so that the even QAM symbols are mapped to antenna 0 and the odd QAM symbols to antenna 1), the next 48 ~~subcarriers~~ symbols are mapped to subcarriers 25..47 of the first physical slot. The mapping continues to the second physical slot, and so on.

For horizontal encoding with rate ~~R~~T, (num_layer=~~R~~T), the number of data slots used by the FEC encoder equals the number of physical slots allocated in the map, and ~~R~~ T different bursts are encoded. Each burst is allocated to a stream.

8.4.4.2 PMP frame structure

[Add the following text at the end of the section]

The number of symbols in an STC zone (not including the midamble) shall divide by the number of ~~columns~~ symbols in ~~of~~ any MIMO matrix used in the zone. In addition, the STC zone shall include at least one full period of the pilot pattern defined for the relevant permutation and the number of antennas.

8.4.8.1 STC using two antennas

[~~add~~ at the end of section~~the following subsection~~8.4.8.1.2.1.1]

~~8.4.8.1.6 STC data mapping example for DL PUSC~~

The following tables shows an STC data mapping example for the DL PUSC using vertical encoding as the result of mapping of QAM symbols (see 8.4.3.5) followed by MIMO encoding. Each row is subcarrier-in-subchannel, and each column is a symbol. s0..s47 denote first slot out of the FEC, s48..s95 denote second slot. The figure is in logical subcarriers (subcarrier in subchannel) over symbols (before DL PUSC permutation).

	STTD (Matrix A), 2 antennas				**SM (Matrix B), 2 antennas**			
	Antenna 0		**Antenna 1**		**Antenna 0**		**Antenna 1**	
	Even symbol	Odd symbol	Even symbol	Odd symbol	Even symbol	Odd symbol	Even symbol	Odd symbol
Sub carrier 0	s0	-s24*	s24	s0*	s0	s48	s1	s49
Sub carrier 1	s1	-s25*	s25	s1*	s2	s50	s3	s51
.	s2	-s26*	s26	s2*	s4	s52	s5	s53
.	s3	-s27*	s27	s3*	s6	s54	s7	s55
.	s4	-s28*	s28	s4*	s8	s56	s9	s57
.	s5	-s29*	s29	s5*	s10	s58	s11	s59
	s6	-s30*	s30	s6*	s12	s60	s13	s61
	s7	-s31*	s31	s7*	s14	s62	s15	s63
	s8	-s32*	s32	s8*	s16	s64	s17	s65
	s9	-s33*	s33	s9*	s18	s66	s19	s67
	s10	-s34*	s34	s10*	s20	s68	s21	s69
	s11	-s35*	s35	s11*	s22	s70	s23	s71
	s12	-s36*	s36	s12*	s24	s72	s25	s73
	s13	-s37*	s37	s13*	s26	s74	s27	s75
	s14	-s38*	s38	s14*	s28	s76	s29	s77
	s15	-s39*	s39	s15*	s30	s78	s31	s79
	s16	-s40*	s40	s16*	s32	s80	s33	s81
	s17	-s41*	s41	s17*	s34	s82	s35	s83
.	s18	-s42*	s42	s18*	s36	s84	s37	s85
.	s19	-s43*	s43	s19*	s38	s86	s39	s87
.	s20	-s44*	s44	s20*	s40	s88	s41	s89
.	s21	-s45*	s45	s21*	s42	s90	s43	s91
Subcarrier 22	s22	-s46*	s46	s22*	s44	s92	s45	s93
Subcarrier 23	s23	-s47*	s47	s23*	s46	s94	s47	s95