Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
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Re:	IEEE 802.16e D3 Draft
Abstract	To improve the closed loop MIMO. This is the revision of the contribution, which is harmonized between three companies. The inserted texts are highlighted in blue. The deleted texts are stroked out.
Purpose	To incorporate the changes here proposed into the 802.16e D4 draft.
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Closed-loop MIMO enhancement

1 Background

The closed-loop MIMO was introduced for optional AMC channels in IEEE802.16eD3. In this contribution, we present a unified closed-loop MIMO frame work to enable more flexible schemes. ~~MIMO transmission format and singling is generalized to allow variety MIMO schemes to operate by using the same air-interface design, the basic transmission format are: (1) SM and (2) STTD, with vector or matrix weighted full MIMO or sub-MIMO transmission based on the 2 and 4 transmit antennas configurations.~~

Specific text changes

~~*[Add the following text into section 8.4.8.3.3 and 8.4.8.3.4]*~~

~~For two transmit antenna the matrix weighted spatial multiplexing transmission, the following matrix is defined:~~

$$D=\begin{bmatrix} w_1 s_1 + w_2 s_2 \\ w_3 s_1 + w_4 s_2 \end{bmatrix}$$

~~For four transmit antenna the matrix weighted spatial multiplexing transmission, the following matrix is defined:~~

$$E=\begin{bmatrix} w_1 s_1 + w_2 s_2 + w_3 s_3 + w_4 s_4 \\ w_5 s_1 + w_6 s_2 + w_7 s_3 + w_8 s_4 \\ w_9 s_1 + w_{10} s_2 + w_{11} s_3 + w_{12} s_4 \\ w_{13} s_1 + w_{14} s_2 + w_{15} s_3 + w_{16} s_4 \end{bmatrix}$$

~~---------Start text proposal-------~~

~~The matrix weight MxN SM transmission can be applied to single user case reception case where N>=M or to the multi-user concurrent transmission cases, such as 2x2x1, 4x4x1, 4x2x2, 4x3x2x1, where we denote: *number_of-tranmsit_antenna x number_of_users x number_of_recieve_antennas.*~~

~~*[Add the following text into section 8.4.9.4.3.2]*~~

---------Start text proposal-------

[Add the following text into section 8.4.8.3.7]

8.4.8.3.7 MIMO precoding

The space time coding output can be weighted by a matrix before mapping onto transmit antennas:

$$z = Wx,$$

where x is a $Mt \times 1$ vector with the output from the space-time coding (per-subcarrier), M_t is the number of antennas at the output of the space-time coding scheme. The matrix *W* is an $Nt \times Mt$ weighting matrix where the quantity N_t is the number of *actual transmit antennas.* The vector z contains the signals after weighting for the different actual antennas. The labeling of the elements in the weighting matrix W is performed in accordance with the example of W given below for the case of 4 actual antennas and 2 space-time coding output antennas:

$$W = \begin{bmatrix} w_{11} & w_{12} \\ w_{21} & w_{22} \\ w_{31} & w_{32} \\ w_{41} & w_{42} \end{bmatrix}$$

[Modify the following Table 298a in section 8.4.5.3.12.1]

~~8.4.5.4.12.1 CQICH Enhanced Allocation IE Format~~

Table 298a. CQICH Enhanced allocation IE format

Syntax	Size (bits)	Notes
CQICH_Enhanced_Alloc_IE() {		
Extended DIUC	4	0x09
Length	4	Length in bytes of following fields
CQICH_ID	variable	Index to uniquely identify the CQICH resource assigned to the MSS
Period (=p)	2	A CQI feedback is transmitted on the CQICH every 2^p frames
Frame offset	3	The MSS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the MSS should start reporting in 8 frames
Duration (=d)	3	A CQI feedback is transmitted on the CQI channels indexed by the CQICH_ID for 10 x 2^d frames. If d== 0, the CQICH is de-allocated. If d == 111, the MSS should report until the BS command for the MSS to stop.
Nt actual BS antennas	3	001 = Reserved 010 = 2 actual antennas 011 = 3 actual antennas 100 = 4 actual antennas 101 = 5 actual antennas 110 = 6 actual antennas

		111 = 7 actual antennas 000 = 8 actual antennas
Feedback_type	4	0000 = Fast DL measurement 0001 = Layer specific channel strengths ~~0010 = Antenna weight associated with specific antenna~~ 0010 =-Complex weight of specific element of *W* 0011 = MIMO mode and permutation zone feedback ~~0100 = 2x1 channel matrix~~ ~~0101 = 2x2 channel matrix~~ ~~0110 = 4x1 channel matrix~~ ~~0111 = 4x2 channel matrix~~ ~~1000 = 4x4 channel matrix~~ ~~1001 = 4x1x2 Sub-MIMO SM~~ ~~1010 = 4x1x1 Sub-MIMO S-STTD~~ ~~1011 = 4x1x2 Sub-MIMO D-STTD~~ ~~1100 = 4x1x2 Sub-MIMO SM/TxAA~~ ~~1101 ~ 1111 reserved~~ 0100 = Open loop precoding. Pilots in burst to be precoded with *W*. SS to rely only on pilots in burst for channel estimation. 0101 = Feedback of subset of antennas to use. 0110 ~ 1111 reserved
CQICH_Num	4	Number of CQICHs assigned to this CQICH_ID is (CQICH_Num +1)
for (i=0;i<CQICH_Num;i++) {		
Allocation index	6	Index to the fast feedback channel region marked by UIUC=0
}		
if (Feedback_type != 0011) { MIMO_permutation_feedback cycle }	2	00 = No MIMO and permutation mode feedback 01 = the MIMO and permutation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 4 frames. The first indication is sent on the 8th CQICH frame. 10 = the MIMO mode and permutation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 8 frames. The first indication is sent on the 8th CQICH frame. 11 = the MIMO mode and permutation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 16 frames. The first indication is sent on the 16th CQICH frame.
Padding	*variable*	The padding bits are used to ensure the IE size is integer number of bytes.

---------End text proposal-------