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Title	**MIMO transmission for UL FAST_FEEDBACK and Fast MIMO Feedback Channels**
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Re:	IEEE 802.16-REVe/D5a, BRC recirc
Abstract	Enhance the UL feedback channels by space time coding The update is in green font
Purpose	To incorporate the changes here proposed into the 802.16e D5a draft.
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MIMO Transmission for UL FAST_FEEDBACK and Fast MIMO Feedback Channels

1 Introduction

The uplink feedback channels such as FAST_FEEDBACK and fast MIMO feedback channel are fundamental to the network operation, the high reliability of such channel is critical for the network and user performance. In this contribution, we propose to use existing UL MIMO transmit mechanics such STTD and collaborative SM for the two key feedback channel transmission: (1) FAST_FEEDBACK channel (2) fast MIMO feedback channel.
The advantages for the space time coded feedback channel transmission are:

(1) STTD to increased the CIR margin for feedback channel or reduce the MSS transmission power
(2) Multi-user collaborative SM to reduce the overall UL feedback channel overhead

2 Performance Simulation Results

The performance simulation is conducted to evaluate the benefit of the MIMO transmission of CQICH. Figure 1 shows the comparison of 1x2 and 2x2 transmission of CQICH, as we can see, the 2x2 STTD transmission can provide the about 1dB gain over the 1x2 transmission, this implies that for a MMS equipped with 2 transmit antennas, it is preferable to use two transmit to send CQICH to BS rather than to use single antenna while turn of the other antenna, this gives 28% power saving, in Figure 1 we also show that for the improved power saving by 58% if the enhance the code can be used for CQICH (see C80216e-04_562r1)

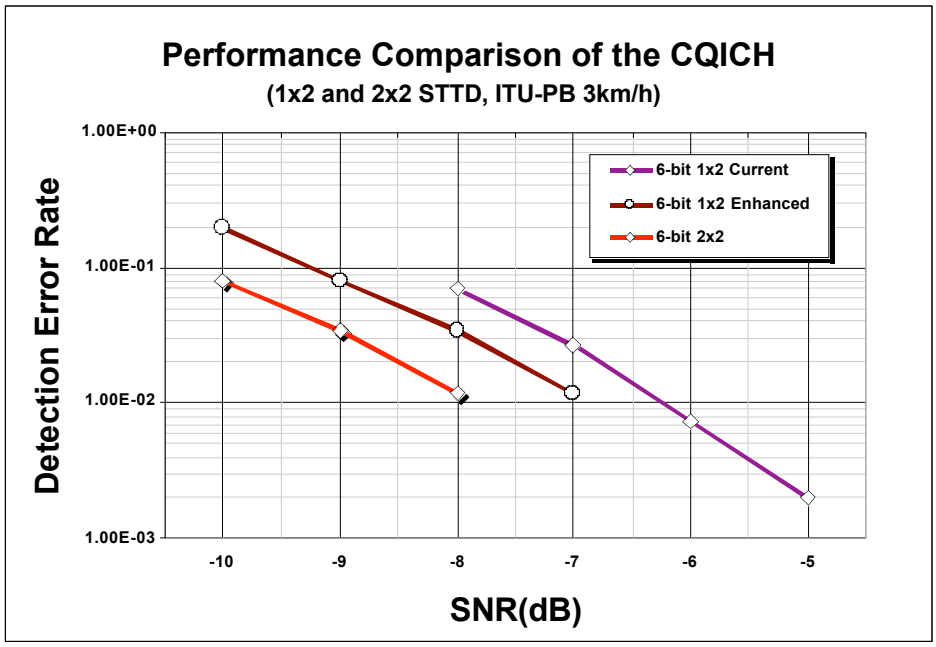

Figure 1 Comparison of the 1x2 and 2x2 STTD transmission of CQICH

Figure 2 show the comparison of the 1x2 transmission and SM joint transmission by two MSSs with single antenna. As we can see the CQICH capacity can be doubled with negligible performance penalty

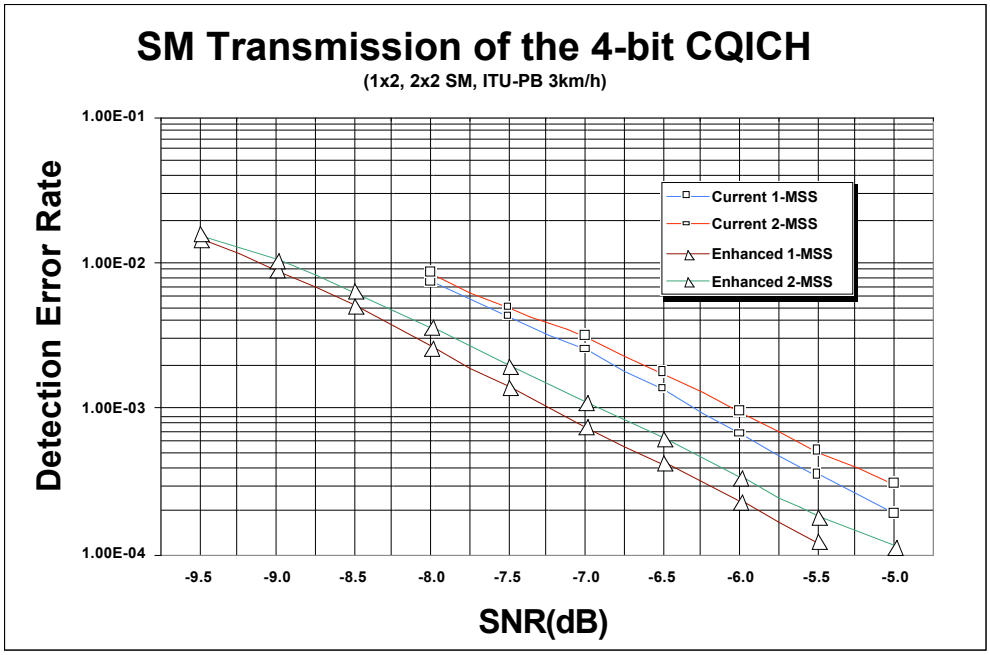

Figure 2 Comparison of the 1x2 and SM transmission of CQICH

3 Proposed Text

Add a new section ***8.4.5.4.10.10***

----------Start Text ----------

8.4.5.4.10.10 Enhanced MIMO Fast Feedback channel

The same modulation and coding scheme as defined in 8.4.5.10 for non-MIMO operation shall be applied. The table 296b shall be used for the mapping between the payload bit sequences and subcarrier modulation for 6 bit fast feedback. The feedback channel allocation shall use CQICH_Alloc_IE(), CQICH_Enhanced_Alloc_IE().

8.4.5.4.10.10.1 Enhanced transmit diversity Fast Feedback channel for PUSC

~~For UL MIMO enabled MSSs (MSSs with two transmit antennas), STC may be applied in the transmissions of uplink feedback channels to improve the coverage. 2xM STTD is implemented (M is the number of receive antennas at BS).~~ With the UL tile allocation shown in figure 249a for PUSC zone, the transmission from antenna-0 is the same as in non-MIMO operation, however, the different sub-carrier mapping method is applied to antenna-1 (see figure WWW).

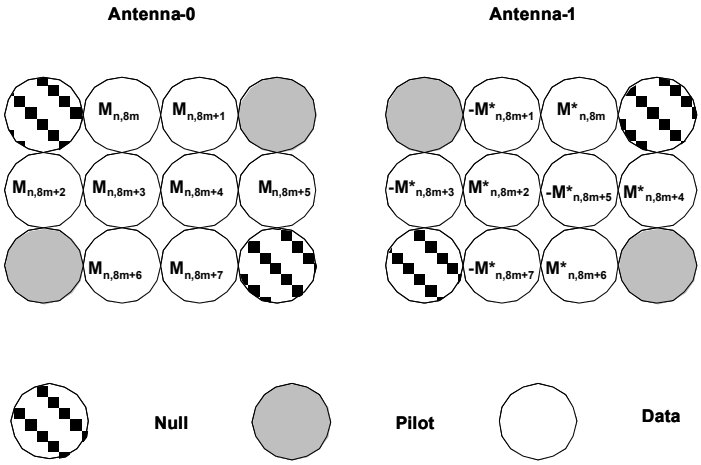

Figure WWW

8.4.5.4.10.10.2 Enhanced transmit diversity Fast Feedback channel for optional PUSC

With the UL tile allocation shown in figure 252a for optional PUSC zone, two data sub-carriers should be punctured in each MIMO tile in order to obtain two extra pilot sub-carriers (same requirement for UL MIMO traffic channel), ~~To reduce the impact from the puncturing,~~ the first QPSK symbol (P0) in each orthogonal modulation index is removed (Table 295 and 296c) (see figure XXX). The mini subchannelization scheme described in section 8.4.6.2.4 shall be used with M=2, type = 01. CQICH channel shall be allocated simultaneously for two MSS, each uses one of the mini subcahnnel as specified in CQICH_Enhanced_Alloc_IE().

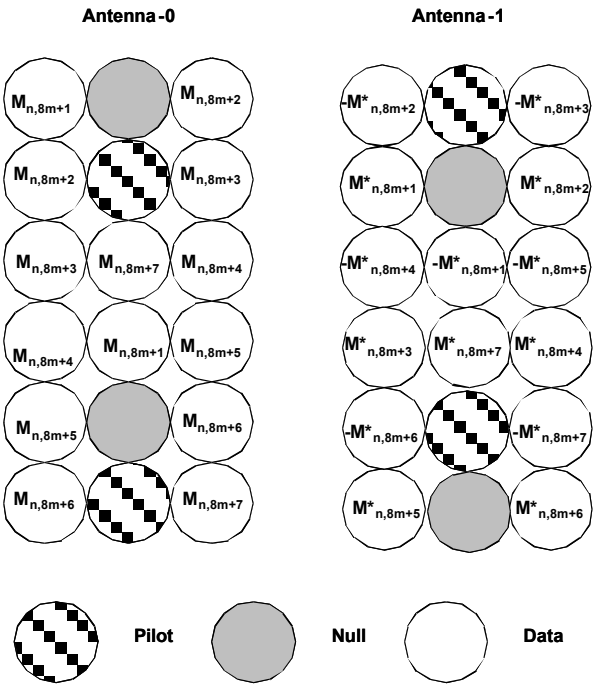

Figure XXX

8.4.5.4.10.10.3 Enhanced collaborative spatial multiplexing Fast Feedback channel for PUSC

~~Multi-user collaborative spatial multiplexing can also be applied to uplink feedback channel to reduce the overhead introduced by the uplink feedback channels.~~ In this case, BS assigns the same feedback channel resource to two single antenna MSSs. Each MSS selects the tile patter (pattern A or pattern B) according to the instruction from BS, and transmits the data burst independently with the same modulation and coding scheme for non-MIMO operation. Figure YYY and figure ZZZ show the mapping of the orthogonal modulation index for MSS-1 and MSS-2, where M is the orthogonal modulation index for MSS1 and N is the orthogonal modulation index for MSS2

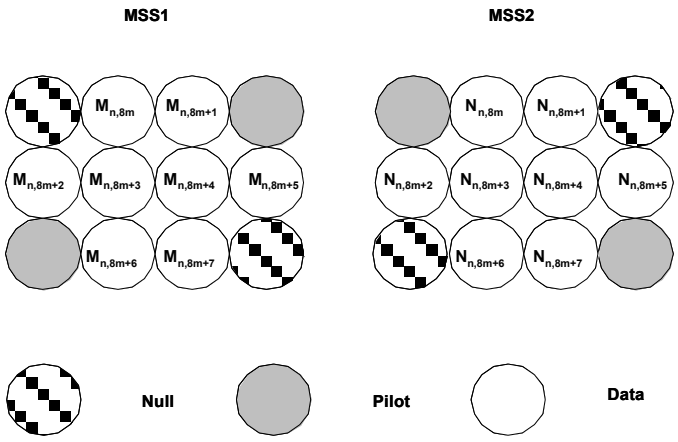

Figure YYY

8.4.5.4.10.10.3 Collaborative spatial multiplexing Fast Feedback channel for Optional PUSC

CQICH channel shall be allocated simulatanously for two MSSs, each uses one of the mini subcahnnel as specified in CQICH_Enhanced_Alloc_IE(). The same physical CQICH channel resource can be allocated to another two MSSs through spatial multiplexing. The MSS shall use the pilot pattern as specified in CQICH_Enhanced_Alloc_IE().

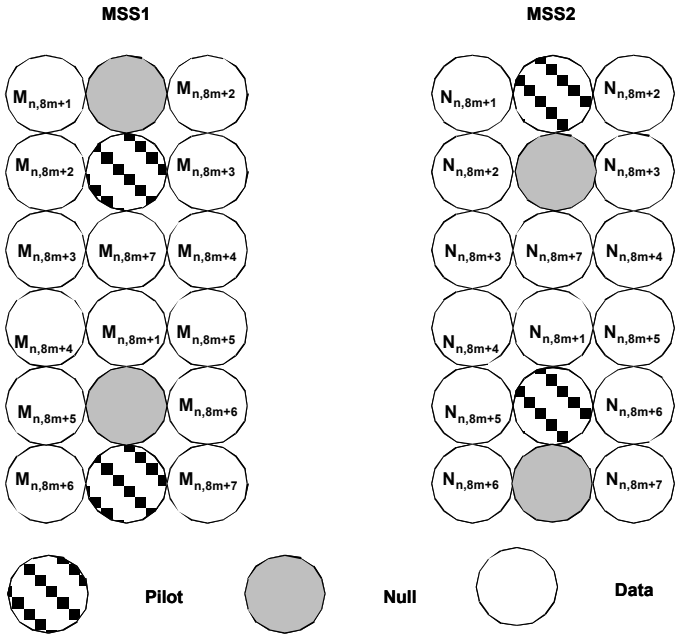

Figure ZZZ

---------- end ----------

Insert one row in the Table 298a in section 8.4.5.4.12.1 to enable the collaborative SM fast feedback channel

---------- Begin Text----------

Table 298a. CQICH Enhanced allocation IE format

Syntax	Size (bits)	Notes
CQICH_Enhanced_Alloc_IE() {		

if ((Feedback_type != 011) & (! 6-bit CQICH)) {
 	
MIMO_permutation_feedback cycle
}
	2	This field exists only for 4-bit and 5-bit CQI payload.
		
		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.

Pilot pattern	1	This field is used only for collaborative SM feedback channel

		0: Pilot Pattern A 1: Pilot Pattern B
Mini Suchannel Index	1	This field is used for Enahced MIMO fast feedback channel for optional PUSC mode
Padding	*variable*	The padding bits are used to ensure the IE size is integer number of bytes.
}		

----------End Text ----------

Modify the table in section 11.8.3.7.7 Uplink control channel support

---------- *Begin text*----------

Type	Length	Value	Scope
	1	bit #0: FAST_FEEDBACK bit #1: Enhanced FAST_FEEDBACK bit #2: UL ACK bit #3: Enhanced UL ACK bit #4: Optional FAST_FEEDBACK for the 4-bit payload bit #5: Optional FAST_FEEDBACK for the 5-bit payload bit #6: Enhanced transmit diversity FAST_FEEDBACK bits ~~#6,~~7: ~~reserved; shall be set to~~ zeroEnhaced collaborative spatial multiplexing FAST_FEEDBACK	SBC-REQ (see 6.3.2.3.23) SBC-RSP (see 6.3.2.3.24)

---------- End text----------