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Re:	This is a response to a Call for Comments on IEEE P802.16e-D6
Abstract	Pilot carriers can be used as secondary CQICH in OFDMA
Purpose	This document is submitted for review by 802.16e Working Group members
Notice	
Release	
Patent Policy and Procedures	

Fast-feedback channel enhancement in OFDMA

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1. Introduction

1.1 Problem statement

The current Fast-feedback channel is not efficient in a point of view of MS power and uplink resource usage. The first issue arises in MS with two antenna and capability of STTD, and the second does in MS with single antenna and BS with non-coherent detection for Fast-feedback channel. When using the non-coherent detection, the four pilot sub-carriers per tile of PUSC mode are redundant for detection and result in power waste of MS. This contribution proposes the resource efficient structure using these pilot sub-carriers as secondary Fast-feedback channel.

1.2 Proposed solutions

To save the power of MS able STTD, this contribution introduces the Fast-feedback channel with STTD mode in UL PUSC as following figure 1,

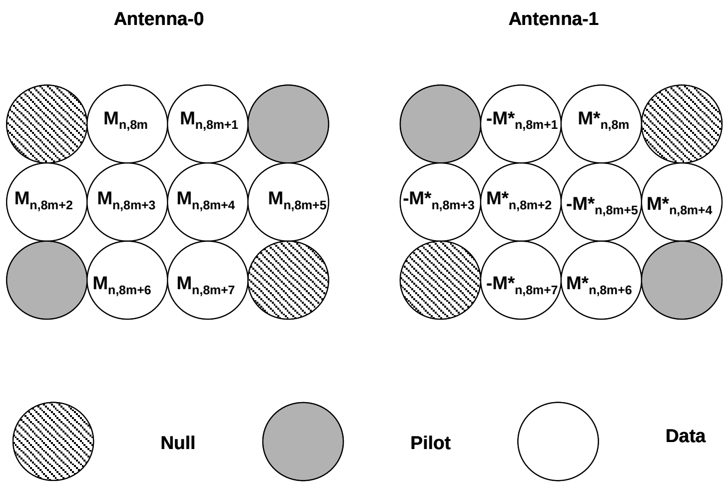
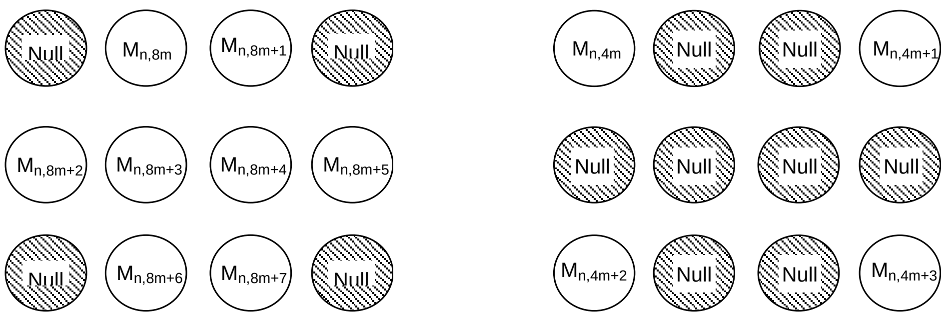


Figure 1. UL Fast-feedback channel structure using STTD in UL PUSC mode

This structure is identical with Figure 249 of P802.16-2004/Cor1/D1.

To save the uplink resources and MS transmit power, we introduce the two kinds of Fast-feedback channel such as primary and secondary channel as shown in the Figure 2.



(a) Primary Fast-feedback channel (b) Secondary Fast-feedback channel

Figure 2. Primary and Secondary Fast-feedback channel structures

Since the primary and secondary Fast-feedback channel nullifies or employs the four pilot carriers respectively, these are built in UL PUSC mode only.

2. Proposed text changes

[Insert the section 8.4.5.4.10.11 as follows]

8.4.5.4.10.11 Primary and secondary Fast-feedback channels

Primary Fast-feedback slot consists of 1 OFDMA slots mapped in a manner similar to the mapping of normal uplink data. A primary Fast-feedback slot uses QPSK modulation on the 48 data sub-carriers of UL PUSC tiles it contains, and can carry a data payload of 6 bits. The primary Fast-feedback slot has identical mapping between the payload bit sequences and the subcarriers modulation as the enhanced Fast-feedback slot of payload 6 bit except null pilot subcarriers within the slot.

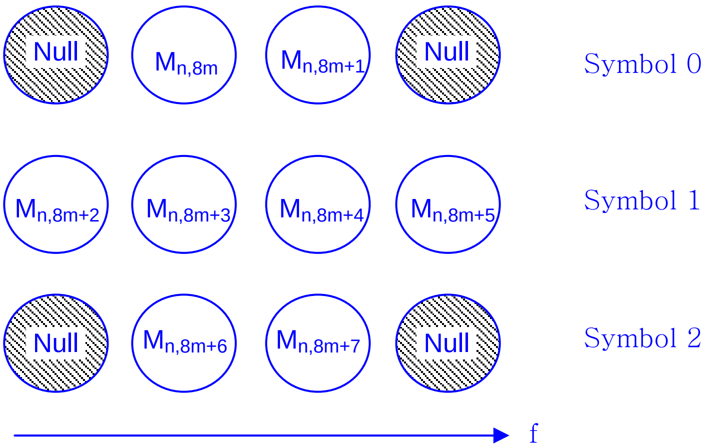


Figure 231f—Subcarrier mapping of primary Fast-feedback modulation symbol for PUSC

Secondary Fast-feedback slot consists of 1 OFDMA slots mapped in a manner similar to the mapping of normal uplink data. A secondary Fast-feedback slot uses QPSK modulation on the 24 pilot sub-carriers of UL PUSC tiles it contains, and can carry a data payload of 4 bits. Table xxx defines the mapping between the payload bit sequences and the subcarriers modulation.

Table xxx- Secondary Fast-feedback channel subcarrier modulation with 4 bit

4 bit payload	Vector indices per tile Tile(0), Tile(1),Tile(2), Tile(3),Tile(4), Tile(5)
0b0000	0,0,0,1,1,1
0b0001	1,1,1,0,0,0
0b0010	2,2,2,3,3,3
0b0011	3,3,3,2,2,2
0b0100	0,1,2,3,0,1
0b0101	1,2,3,0,1,3
0b0110	2,3,0,1,2,3
0b0111	3,0,1,2,3,0
0b1000	0,0,1,3,2,2
0b1001	1,3,2,2,3,1
0b1010	2,2,3,1,0,0
0b1011	3,3,1,0,1,1
0b1100	0,0,3,2,0,3

0b1101	1,2,0,2,2,0
0b1110	2,1,3,3,1,2
0b1111	3,2,2,1,1,2

The secondary Fast-feedback channel is orthogonally modulated with QPSK symbols. Let $M_{n,4m+k}$ $(0 \le k \le 3)$ be the modulation symbol index of the kth modulation symbol in the m-th uplink PUSC tile of the n-th secondary Fast-feedback channel. The possible modulation patterns composed of $M_{n,4m+k}$ in the mth tile of the nth secondary Fast-feedback channel are defined in Table yyy.

Table yyy- Orthogonal Modulation Index in Secondary Fast-feedback Channel

Vector index	$M_{n,4m}$, $M_{n,4m+1}$, $M_{n,4m+2}$, $M_{n,4m+3}$
0	P0, P0, P0, P0
1	P0, P2, P0, P2
2	P0, P1, P2, P3
3	P1, P0, P3, P2

where

$P_0 = \exp\left(j\frac{\pi}{4}\right)$, $P_1 = \exp\left(j\frac{3\pi}{4}\right)$,

$P_2 = \exp\left(-j\frac{3\pi}{4}\right)$, $P_3 = \exp\left(-j\frac{\pi}{4}\right)$.

$M_{n,4m+k}$ are mapped to secondary Fast-feedback channel tile as shown in Figure 231g for PUSC uplink subchannel. A secondary Fast-feedback channel is mapped to one subchannel composed of 6 tiles.

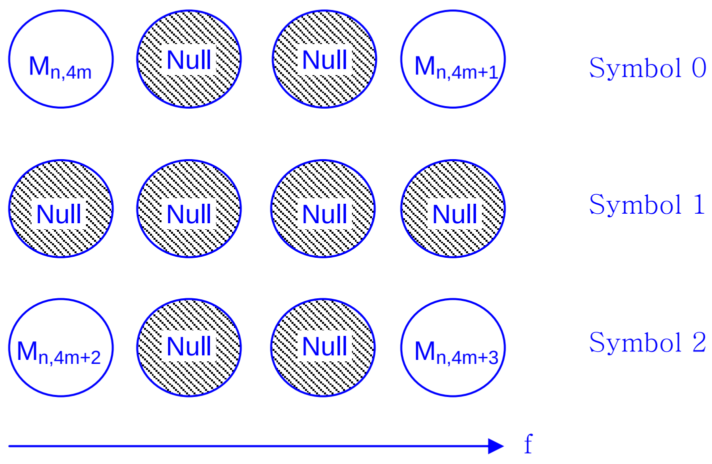


Figure 231g —Subcarrier mapping of secondary Fast-feedback modulation symbols for PUSC

[modify the table302a in page 335 of '8.4.5.4.15 CQICH Enhanced Allocation IE format']

Table 302a—CQICH Enhanced allocation IE format

Syntax	Size (bits)	Notes
CQICH_Enhanced_Alloc_IE(){		
…	…	...
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
CQICH type	~~2~~3	000 = 6 bit CQI 001 = DIUC CQI 010 = 3 bit CQI (even) 011 = 3 bit CQI (odd) 100 = 6 bit CQI (primary) 101 = 4 bit CQI (secondary) 110-111 = reserved
STTD indication	1	When CQICH type=000, 0 = reserved 1 = use STTD in PUSC only (see Figure 249)
}		
…	…	…

[Modify section '11.8.3.7.9 Uplink control channel support', page 497 lines 50-63 as follows]

Type	Length	Value	Scope
159	1	bit #0: Reserved; shall be set to zero. 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: A measurement report shall be performed on the last DL burst, as described in 8.4.5.4.10.1 bit #7: Primary/Secondary FAST_FEEDBACK~~Reserved; shall be set to zero~~	SBC-REQ (see 6.3.2.3.23) SBC-RSP (see 6.3.2.3.24)

3. Simulation results

In the simulation for the secondary Fast-feedback, performances of 4 bit payload Fast-feedback channel and 4 bit payload secondary Fast-feedback channel are compared in AWGN and Veh-A (60km/h). Because the secondary channel has half number of carriers, transmit power per carrier of the secondary channel was boosted by 3dB to make total transmit power of two Fast-feedback channels be equal. As shown in Figure 2, there was a performance loss about 1dB because the secondary channel has smaller Hamming distance. Therefore, the secondary Fast-feedback channel is appropriate for the mode selection feedback or for MS with good channel quality.

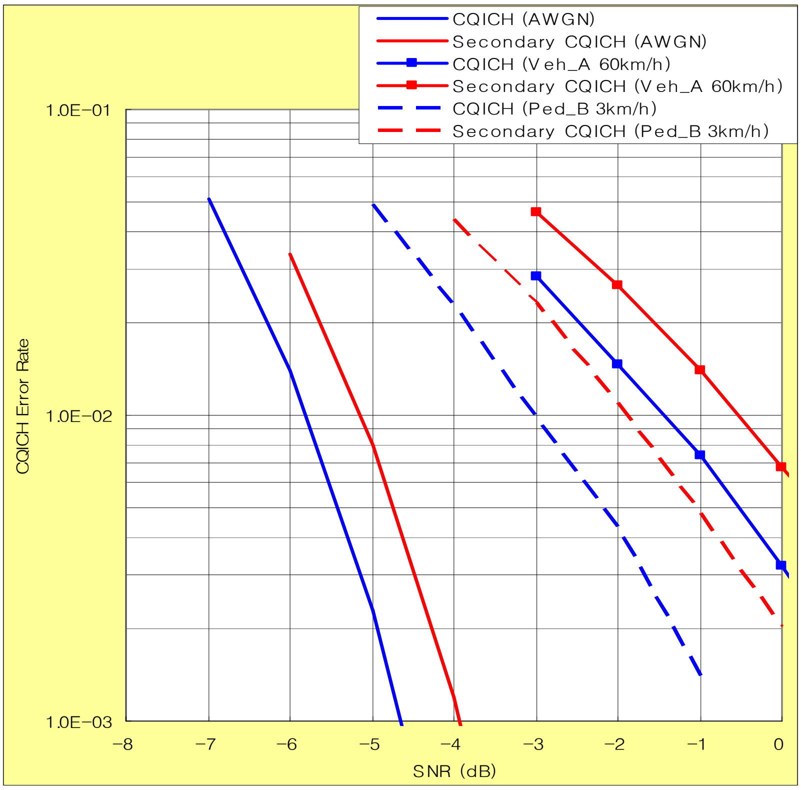


Figure 1. Fast-feedback and secondary Fast-feedback channel error rate for 4 bit payload