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Title	**Proposed Text of UL Control Channel for IEEE 802.16m Amendment**
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Re	"802.16m amendment working document" IEEE 802.16m-08/053r1, "Call for Comments and Contributions on Project 802.16m Amendment Working Document". Target topic: "11.9 UL PHY control structure".
Abstract	The contribution proposes the text for UL Ctrl Structure
Purpose	To be discussed and adopted by TGm for the 802.16m amendment.
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Proposed Text of UL Control Channel for IEEE 802.16m Amendment

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1. Introduction

The contribution proposes the text of UL feedback channel structure to be included in the 802.16m amendment. The proposed text is developed so that it can be readily combined with IEEE P802.16 Rev2/D7 [1], it is compliant to the 802.16m SRD [2] and it follows the style and format guidelines in [3]. Performance evaluation of the proposed physical structures is provided in C802.16m-08/0190 [5].

2. Proposal in Section 15.3.8

The text proposed in this contribution is to detail the design of UL control channels including channel coding, pilot structure and sequence mapping. The key proposal for UL control channel is as follows:

- Details on the physical structure of primary fast feedback channel
- Design on the physical structure of secondary fast feedback channel
- Design on the physical structure of HARQ feedback channel

3. References

[1] IEEE P802.16 Rev2 / D7, “Draft IEEE Standard for Local and Metropolitan Area Networks: Air Interface for Broadband Wireless Access,” Oct. 2008.

[2] IEEE 802.16m-07/002r6, “802.16m System Requirements”

[3] IEEE C802.16m-08/043, “Style guide for writing the IEEE 802.16m amendment”

[4] IEEE 802.16m-08/003r6, “The Draft IEEE 802.16m System Description Document”

[5] IEEE C802.16m-08/0190r2, “Proposal for Physical Structure of UL Feedback Channel”

4. Text proposal for inclusion in the 802.16m amendment

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

Insert a new section 15:

15. Advanced Air Interface

15.3. Physical layer

15.3.8 UL control structure

15.3.8.1 Uplink Fast Feedback Channel

Fast-feedback channels (FFBCH) are individually allocated to AMS for transmission of PHY-related information that requires fast response from the AMS. The UL FFBCH carries channel quality feedback, MIMO feedback and BW REQ indicators. There are two types of UL fast feedback control channels: primary and secondary FFBCHs.

A UL FFBCH occupies 3 UL feedback mini-tiles (UL FMT), which are chosen from different tiles of a UL DRU for frequency diversity. Each UL FMT is defined as 2 contiguous subcarriers by 6 OFDM symbols.

15.3.8.1.1 Physical structure of Primary FFBCH

Table 1defines the mapping between the payload bits and subcarrier modulation for a primary FFBCH.

Table 1 Primary FFBCH subcarrier modulation sequence

6bit payload (binary)	Sequence S[0]~S[11], (binary)	6bit payload (binary)	Sequence S[0]~S[11], (binary)
000000	111111111111	100000	101011111001
000001	111100001111	100001	101000001001
000010	111111110000	100010	101011110110
000011	111100000000	100011	101000000110
000100	111111001001	100100	110011111010
000101	111100111001	100101	110000001010
000110	111111000110	100110	110011110101
000111	111100110110	100111	110000000101
001000	111110011010	101000	110010101001
001001	111101101010	101001	110001011001
001010	111110010101	101010	110010100110
001011	111101100101	101011	110001010110
001100	111110101100	101100	100111001010

001101	111101011100	101101	100100111010
001110	111110100011	101110	100111000101
001111	111101010011	101111	100100110101
010000	110010011111	110000	101010011100
010001	110001101111	110001	101001101100
010010	110010010000	110010	101010010011
010011	110001100000	110011	101001100011
010100	100110101111	110100	110011001100
010101	100101011111	110101	110000111100
010110	100110100000	110110	110011000011
010111	100101010000	110111	110000110011
011000	101011001111	111000	100110011001
011001	101000111111	111001	100101101001
011010	101011000000	111010	100110010110
011011	101000110000	111011	100101100110
011100	100111111100	111100	101010101010
011101	100100001100	111101	101001011010
011110	100111110011	111110	101010100101
011111	100100000011	111111	101001010101

The subcarrier modulation sequence of primary FFBCH is cyclic-shifted by 4 and mapped to 3 UL FMTs, as shown in Figure 1.

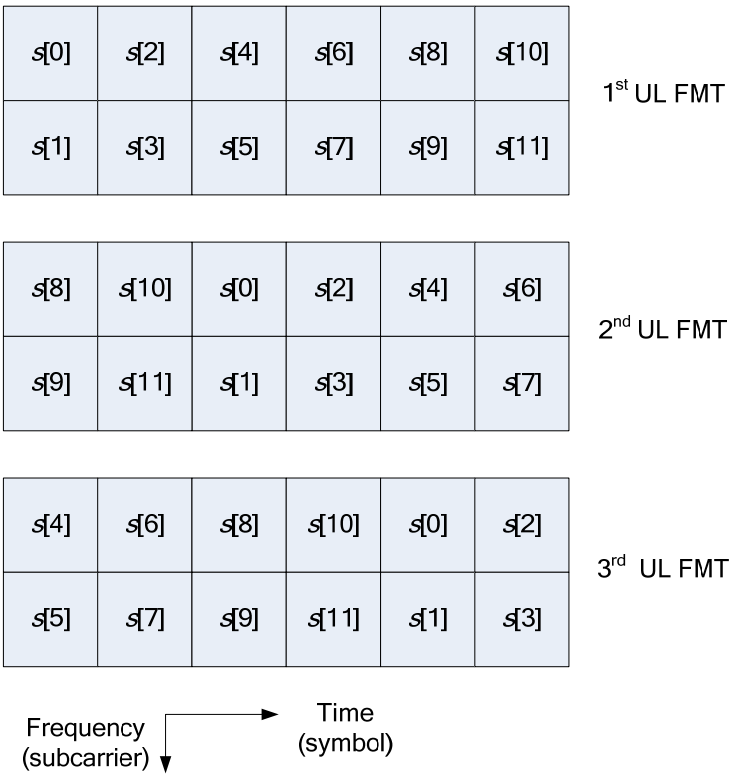

Figure 1 Subcarrier mapping of primary FFBCH sequence on UL FMT

15.3.8.1.2 Physical structure of Secondary FFBCH

The UL secondary FFBCH carries uplink control information which includes wideband and/or narrowband channel quality information, rank, and PMI. The UL secondary FFBCH occupies 3 UL FMTs and each FMT has 2 pilots in different position as shown in Figure 2. The UL secondary FFBCH uses QPSK modulation on 30 data subcarriers and can carry a data payload of 7~24 bits. The data payload size is determined by the feedback reporting format which is given in Table 2.

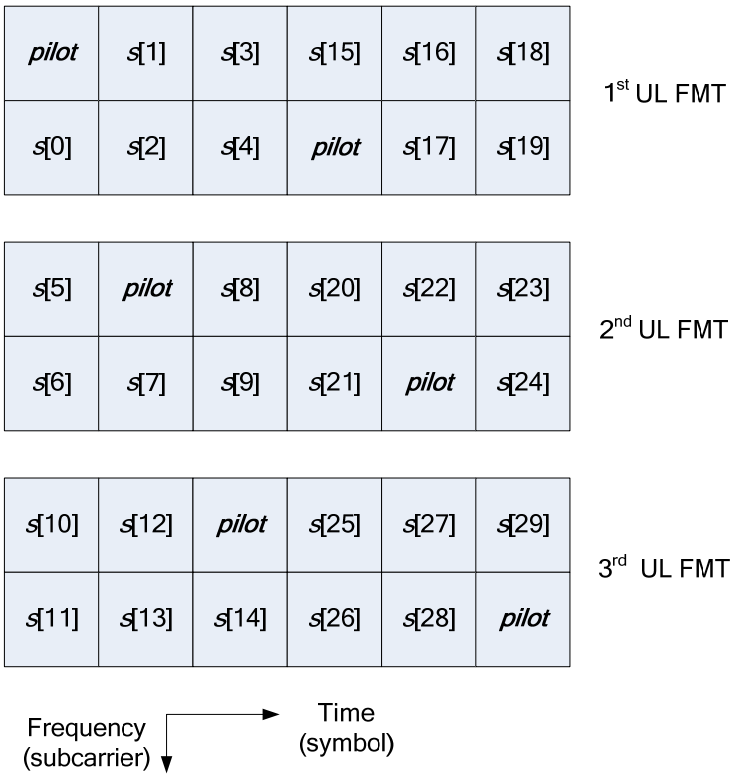

Figure 2 – Subcarrier mapping of secondary FFBCH sequence on UL FMT

The uplink feedback information bits are encoded to 60 bits using block code. The information bits to channel coder are denoted by $a_0, a_1, a_2, ..., a_{K-1}$ where $7 \le K \le 24$. For $K \le 12$, the information bits are encoded using $(60, D)$ code where $D = K$ and the encoded bits are a linear combination of the basis sequences denoted by $\mathbf{C_{i,d}}$ given in Table 2. The encoded bits are denoted by $b_0, b_1, b_2, ..., b_M$ where $M = 60$ and b_i is

$$b_i = \sum_{j=0}^{D-1} \left(a_j \cdot \mathbf{C_{i,j}} \right) \bmod 2 \quad \text{for} \quad i = 0, 1, ..., M-1.$$

Table 2 – Basis sequences for (60, D) code

i	$\mathbf{C_{i,0}}$	$\mathbf{C_{i,1}}$	$\mathbf{C_{i,2}}$	$\mathbf{C_{i,3}}$	$\mathbf{C_{i,4}}$	$\mathbf{C_{i,5}}$	$\mathbf{C_{i,6}}$	$\mathbf{C_{i,7}}$	$\mathbf{C_{i,8}}$	$\mathbf{C_{i,9}}$	$\mathbf{C_{i,10}}$	$\mathbf{C_{i,11}}$
0	1	0	1	1	0	0	1	1	1	0	0	1
1	0	0	1	0	1	0	1	1	0	1	1	1
2	0	1	1	0	1	0	0	1	1	1	0	0
3	0	0	0	0	0	1	0	0	0	0	0	0
4	1	0	1	0	1	0	1	0	1	1	0	0
5	0	0	0	0	0	0	0	0	1	0	0	0
6	0	0	1	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	1	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	1
9	0	0	0	0	1	0	0	0	0	0	0	0

10	1	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	1	0	0	0	0
12	0	0	0	0	0	0	0	0	0	1	0	0
13	0	0	0	1	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	1	0
15	0	1	0	0	0	0	0	0	0	0	0	0
16	1	0	1	1	0	1	1	0	0	1	0	0
17	0	0	0	0	1	0	1	0	0	1	1	0
18	0	1	1	0	0	0	1	1	1	0	0	0
19	0	0	1	0	0	1	1	1	1	0	0	0
20	0	0	1	1	1	0	1	1	0	0	0	0
21	1	0	0	0	0	0	1	0	0	1	1	1
22	1	1	1	0	1	0	1	0	1	0	0	0
23	1	0	1	0	0	1	1	0	1	1	0	0
24	1	0	0	1	1	0	0	1	1	1	0	1
25	1	0	1	1	1	0	0	1	0	1	1	0
26	1	1	0	1	0	0	1	1	0	1	1	0
27	0	1	0	1	0	1	0	0	1	0	1	0
28	1	1	0	0	1	1	1	1	0	0	1	1
29	0	1	1	0	0	1	1	0	0	1	0	0
30	1	0	1	1	1	1	0	1	0	0	0	0
31	0	0	1	0	1	0	0	1	1	0	1	0
32	0	1	0	1	0	0	0	1	1	1	0	1
33	0	0	1	1	1	1	0	1	1	0	1	1
34	1	1	1	1	0	0	1	1	0	0	1	1
35	1	1	1	1	1	1	0	1	0	0	1	1
36	1	1	0	1	0	1	1	1	1	1	1	0
37	1	1	0	1	1	1	1	0	0	1	1	0
38	1	1	0	0	1	1	0	1	1	0	1	1
39	1	1	1	1	0	1	0	1	1	1	0	0
40	1	0	0	1	1	1	0	0	0	1	1	1
41	1	1	0	0	0	0	0	0	0	1	1	1
42	0	1	0	1	1	1	0	0	1	1	0	1
43	0	0	0	1	0	1	1	1	0	0	1	1
44	1	1	1	0	0	0	1	0	1	0	1	1
45	1	1	0	1	1	1	0	1	0	1	0	1
46	1	0	0	0	0	1	0	1	1	1	1	0
47	0	1	1	0	1	0	0	0	0	0	0	1
48	1	0	0	0	1	1	1	1	1	1	0	1
49	1	0	1	0	0	0	0	0	0	0	0	0
50	1	0	1	1	0	0	0	0	1	0	0	1
51	1	0	0	1	1	0	0	0	1	0	1	1

52	1	1	1	0	1	0	0	1	0	0	1	0
53	1	1	0	0	0	1	1	0	1	0	0	1
54	1	0	0	0	0	1	1	0	0	0	0	0
55	0	0	0	1	1	0	0	0	0	1	0	0
56	1	0	0	1	0	0	0	0	0	0	1	0
57	0	1	0	0	0	0	0	1	0	0	1	0
58	0	1	0	0	0	1	0	1	1	0	0	1
59	1	0	0	0	0	1	1	1	0	1	0	1

For the case of $13 \le K \le 24$, the information bits are partitioned into two blocks which are less than 12 bits. Then, each block is separately encoded using $(30, D)$ code where the basis sequences are the same as $\mathbf{C}_{\mathbf{i,d}}$ of $(60, D)$ given in Table 2, except $M = 30$.

15.3.8.2 Uplink Acknowledgement Channel

The UL Acknowledgement channel (ACKCH) carriers the acknowledgement of downlink hybrid ARQ retransmission. The MS transmits ACK or NAK feedback for DL packet data.

A UL FMT for UL ACKCH is divided into three ACK mini-tiles, which consists of 2 subcarriers by 2 consecutive OFDM symbols. Each UL ACKCH occupies three ACK mini-tiles from different FMTs and different OFDM symbols as shown in Figure 3. Orthogonal sequences in Table 3 are used to multiplex 2 ACKCHs in ACK mini-tiles.

Table 3 Orthogonal sequences for UL ACKCH

Sequence index	Orthogonal sequence	Contents
0	[+1 +1 +1 +1]	2p-th user's ACK
1	[+1 +1 -1 -1]	2p-th user's NAK
2	[+1 -1 +1 -1]	(2p+1)-th user's ACK
3	[+1 -1 -1 +1]	(2p+1)-th user's NAK

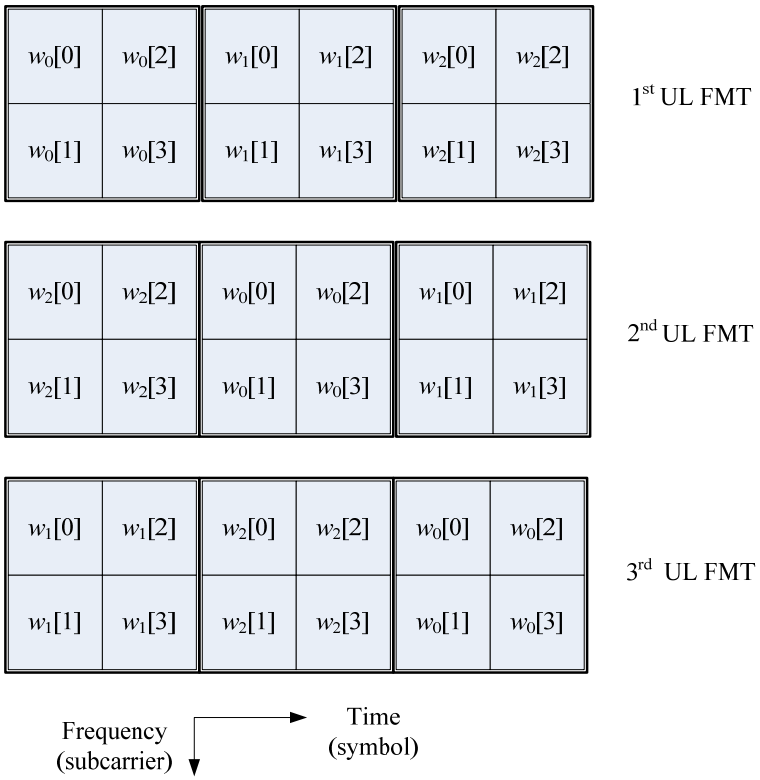

Figure 3 Subcarrier mapping of UL ACKCH on UL FMTs

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