Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**Proposed Text of UL PHY Control Structure Section (15.9.2.1 Fast Feedback Channel) for the IEEE 802.16m Amendment**
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Re:	"802.16m amendment text": IEEE 802.16m-08/053r1, "Call for Contributions on Project 802.16m Draft Amendment Content". Target topic: "11.9 UL PHY control structure, especially mapping".
Abstract	The contribution proposes the text of UL PHY control structure section to be included in the 802.16m amendment.
Purpose	To be discussed and adopted by TGm for the 802.16m amendment.
Notice	
Release	
Patent Policy	

Proposed Text of UL PHY Control Structure Section (15.9.2.1 Fast Feedback Channel) for the IEEE 802.16m Amendment

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1. Introduction

The contribution proposes the text of UL PHY Control structure section 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/D8 [1], it is compliant to the 802.16m SRD [2] and the 802.16m SDD [3], and it follows the style and format guidelines in [4].

2. Modifications to the SDD text

The text proposed in this contribution is based on subclauses 11.9.2.1 in the IEEE 802.16m SDD [3]. Details beyond the SDD are summarized in contribution [5].

3. References

[1] IEEE P802.16 Rev2/D8, "Draft IEEE Standard for Local and Metropolitan Area Networks: Air Interface for Broadband Wireless Access," Oct. 2008.

[2] IEEE 802.16m-07/002r7, "802.16m System Requirements"

[3] IEEE 802.16m-08/003r6, "The Draft IEEE 802.16m System Description Document"

[4] IEEE 802.16m-08/043, "Style guide for writing the IEEE 802.16m amendment"

[5] IEEE 802.16m-09/066, "IEEE 802.16m Uplink Control Channel Design Details and Updates", Motorola

4. Text proposal for inclusion in the 802.16m amendment

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15. Advanced Air Interface

15.9.2 UL Control channel

15.9.2.1. UL Fast Feedback Channel

The UL fast feedback channel carries channel quality feedback and MIMO feedback. BW REQ indicators and rank indications can also be transmitted on this UL control channel.

There are two types of UL fast feedback control channels: primary and secondary fast feedback channels. The UL primary fast feedback control channel provides wideband feedback information including channel quality and MIMO feedback. It is used to support robust feedback reports. The UL secondary fast feedback control channel carries narrowband CQI and MIMO feedback information. The secondary fast feedback channel can be used to support CQI reporting at higher code rate and thus more CQI information bits.

The primary feedback information can be mapped to one of 72 values which correspond to 72 sequences that can be transmitted on the primary feedback channel (Table 1). 64 of the 72 sequences are used to transmit the wideband channel quality information, including mean of CINR, standard deviation of CINR across frequency, and standard deviation of CINR across time. The mean of CINR in dB is derived according to

$$(Averaged\ \mathrm{CINR}) \qquad \mu_{CINR,dB}[k]=\begin{cases}\hat{\mu}_{CINR,dB}[0] & k=0\\ \left(1-\alpha_{\mathrm{avg}}\right)^{n+1}\mu_{CINR,dB}[k-1]+\alpha_{\mathrm{avg}}{}^{n+1}\hat{\mu}_{CINR,dB}[k] & k>0\end{cases} \qquad (1)$$

$\hat{\mu}_{CINR,dB}[k]=10\log_{10}\left(\hat{\mu}_{CINR}[k]\right)$, $\hat{\mu}_{CINR}[k]=\frac{1}{N}\sum_{i=0}^{N-1}CINR[i,k]$, $CINR[i,k]=\frac{\left|s[i,k]\right|^2}{\left|r[i,k]-s[i,k]\right|^2}$ and $r[i,k]$ is the received sample i within message measured at time index k in frame units, $s[i,k]$ is the corresponding detected or pilot sample (with channel state weighting).

There are two standard deviations of CINR for an AMS to feedback to the BS. The first one is the standard deviation of CINR across frequency. The second one is the standard deviation of CINR across time. The normalized standard deviation of CINR across frequency is derived according to

$$(STD-f\ \mathrm{CQI}) \qquad \sigma^{f}_{CINR,dB}[k]=\begin{cases}\hat{\sigma}_{CINR,dB}[0] & k=0\\ \left(1-\alpha_{\mathrm{avg}}\right)^{n+1}\sigma^{f}_{CINR,dB}[k-1]+\alpha_{\mathrm{avg}}{}^{n+1}\hat{\sigma}_{CINR,dB}[k] & k>0\end{cases} \qquad (2)$$

and $\hat{\sigma}_{CINR,dB}[k]=10\log_{10}\left(\frac{\sqrt{\hat{\chi}_{CINR}[k]-\hat{\mu}^2_{CINR}[k]}}{\hat{\mu}_{CINR}[k]}\right)$, $\hat{\chi}_{CINR}[k]=\frac{1}{N}\sum_{i=0}^{N-1}CINR[i,k]^2$. The standard deviation of CINR across time is derived according to

$$(STD-t\ \mathrm{CQI}) \qquad \sigma^{t}_{CINR,dB}[k]=\sqrt{\chi_{CINR,dB}[k]-\mu^2_{CINR,dB}[k]} \qquad (3)$$

where $\chi_{CINR,dB}[k] = \begin{cases} \hat{\mu}^2_{CINR,dB}[0] & k=0 \\ \left(1-\alpha_{\text{avg}}\right)^{n+1} \chi_{CINR,dB}[k-1] + {\alpha_{\text{avg}}}^{n+1} \hat{\mu}^2_{CINR,dB}[k] & k>0 \end{cases}$.

The averaging parameter (α_{avg}) in equations (1-3) for CINR measurement may be sent as a DL broadcast message, and n is number of consecutive frames in which no measurement is made (n=0 if measurement is done in consecutive frames). The CINR information can be feedback to the serving BS with the following table. The CINR information includes 48 levels of mean of CINR, 8 levels of standard deviation of CINR in frequency, and 8 levels of standard deviation of CINR in time. The report of standard deviation of CINR in frequency and standard deviation of CINR in time can be interlaced with the report of mean of CINR with a lower frequency. The choice of reporting CINR (mean or standard deviation), rank indication, UL bandwidth request indication can be decided by an AMS or by a request from a BS.

Mapping	Mean CINR $\lfloor \mu_{CINR,dB} \rfloor$(dB)
1	< -9
2	-9
3	-8
4	-7
5	-6
6	-5
7	-4
8	-3
9	-2
10	-1
11	0
12	1
13	2
14	3
15	4
16	5
17	6
18	7
19	8
20	9
21	10
22	11
23	12
24	13
25	14
26	15
27	16
28	17
29	18
30	19
31	20
32	21
33	22
34	23
35	24
36	25
37	26
38	27
39	28
40	29
41	30
42	31
43	32
44	33
45	34
46	35
47	36
48	> 36

Mapping	STD-*f* CINR $\lfloor \sigma^{f}_{CINR,dB} \rfloor$(dB)
49	> 0
50	0
51	-1
52	-2
53	-4
54	-8
55	-10
56	< -10

Mapping	STD-*t* CINR $\lfloor \sigma^{t}_{CINR,dB} \rfloor$(dB)
57	< 2
58	2
59	4
60	6
61	8
62	10
63	12
64	> 12

Mapping	Function	Value
65	Rank indication	1
66		2
67		3
68		4
69	BW request indication	
70	reserved	
71	reserved	
72	reserved	

Table 1 Primary fast feedback channel mapping

The secondary fast feedback information contains 12-bit information. The information includes 6-bit CQI from (Table 1), 4-bit PMI (rotate for best-6 bands), and 2-bit rank indication (Table 1). The usage of 24-bit secondary fast feedback channel is FFS.

15.9.2.1.1. Multiplexing with other control channels and data channels

The UL fast feedback channel is FDM with other UL control and data channels.

The UL fast feedback channel starts at a pre-determined location, with the size defined in a DL broadcast control message. Fast feedback allocations to an MS can be periodic and the allocations are configurable. For periodic allocations, the specific type of feedback information carried on each fast feedback opportunity can be different. Wideband fast feedback information, narrow band fast feedback information, and rank indication for MIMO feedback can be feedback with different time period (Figure 1). Further, one feedback channel may contain wideband CQI information, narrow band CQI information, PMI, rank indication or a mixture of them.

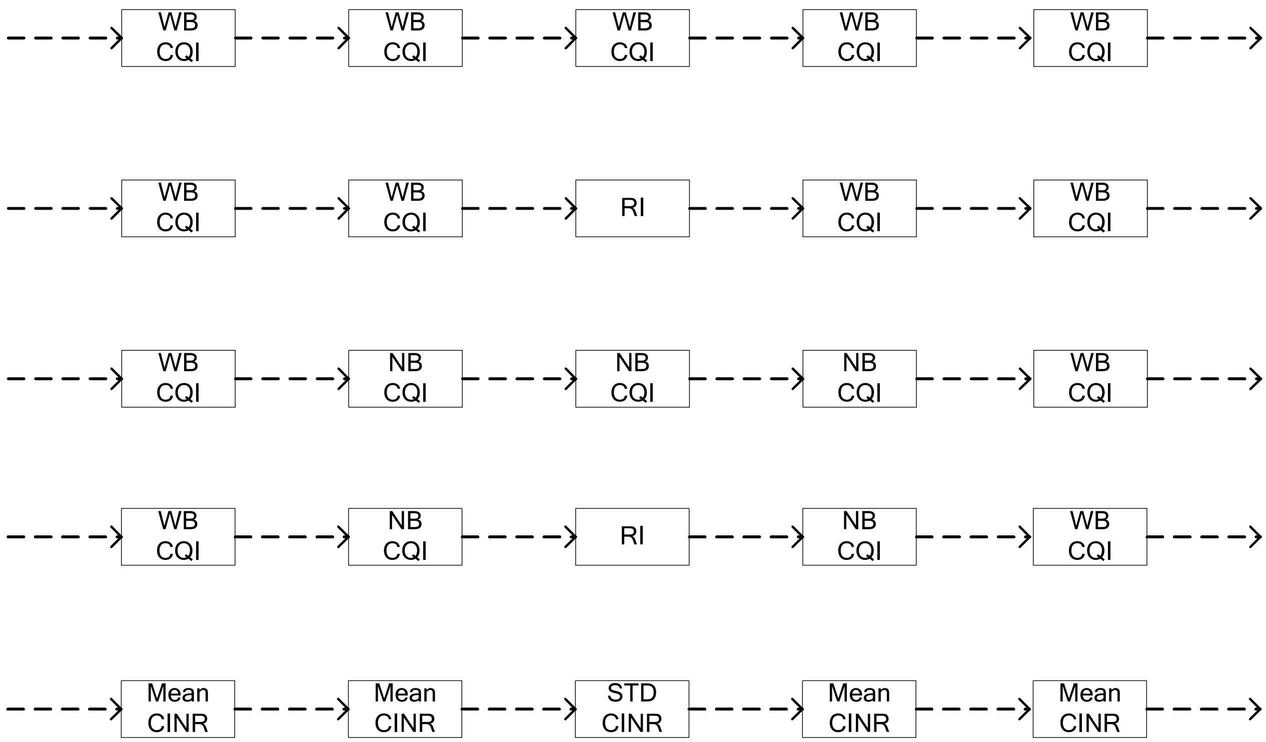

Figure 1. An Illustration of UL Fast Feedback Channel Timing Diagram

The secondary fast feedback channel can also be allocated in a non-periodic manner based on traffic, channel conditions etc, by a BS using DL-USCCH. For Event driven feedback information, they can be transmitted through UL inband control channel following the allocation message from the BS.

15.9.2.1.2. PHY structure

The minimum resource unit for UL fast feedback control channel is a UL feedback mini-tile (FMT) which contains 2 contiguous subcarriers by 6 OFDM symbols. Four UL fast feedback channels are multiplexed together using a mixture of FDM/TDM/CDM in three UL DRU tiles. For each group of four tones that are adjacent in time and frequency, pilot and data symbols from four fast feedback channels are CDMed together in order to take full advantage of the MS transmit power. Further, since these four tones are adjacent in time and frequency, orthogonal codes can be used to separate the four fast feedback channels. The PHY structure of a fast feedback channel for green field mode is shown in Figure 2, and for legacy mode in Figure 3.

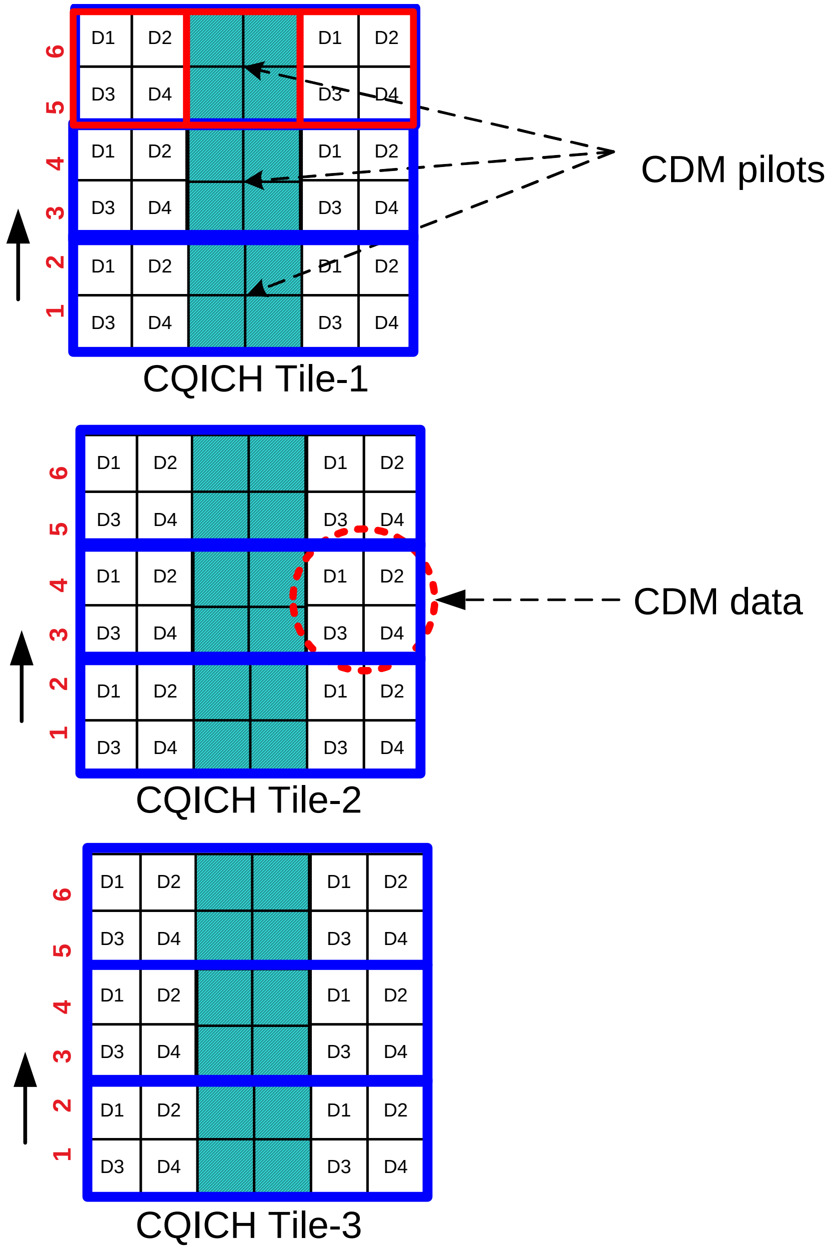

Figure 2. UL Fast Feedback Channel Pilot and Data Tone allocations (green field mode)

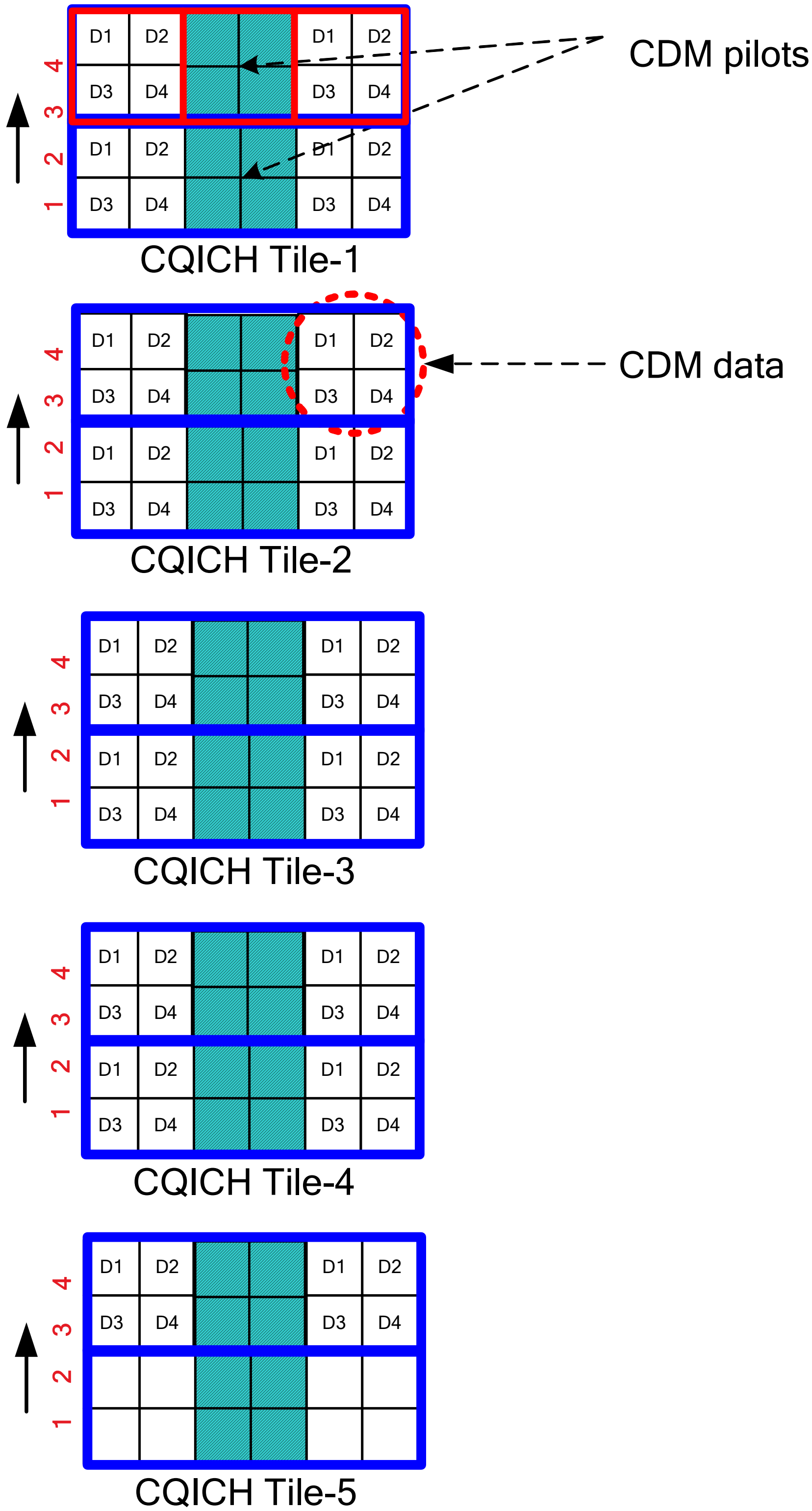

Figure 3. UL Fast Feedback Channel Pilot and Data Tone allocations (legacy mode)

For primary fast feedback channel, the 72 values of the fast feedback information is carried using the following (18, 72) QPSK sequences.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Q3	Q1	Q0	Q0	Q2	Q2	Q1	Q2	Q3	Q2	Q1	Q1	Q2	Q0	Q1	Q2	Q3	Q3
2	Q3	Q2	Q3	Q2	Q3	Q1	Q2	Q3	Q1	Q3	Q0	Q2	Q1	Q1	Q2	Q3	Q3	Q2
3	Q3	Q0	Q0	Q0	Q3	Q0	Q3	Q2	Q2	Q0	Q2	Q3	Q1	Q0	Q0	Q0	Q3	Q1
4	Q3	Q3	Q0	Q3	Q1	Q2	Q2	Q1	Q1	Q3	Q2	Q2	Q3	Q2	Q0	Q3	Q0	Q0
5	Q0	Q2	Q0	Q3	Q3	Q2	Q0	Q3	Q3	Q3	Q3	Q3	Q2	Q1	Q3	Q1	Q1	Q0
6	Q1	Q2	Q0	Q1	Q0	Q2	Q3	Q2	Q0	Q1	Q1	Q2	Q1	Q2	Q0	Q1	Q0	Q2
7	Q0	Q0	Q3	Q1	Q0	Q1	Q2	Q3	Q0	Q3	Q1	Q0	Q3	Q0	Q0	Q0	Q1	Q3
8	Q1	Q1	Q0	Q2	Q1	Q0	Q2	Q3	Q2	Q0	Q1	Q3	Q2	Q3	Q2	Q2	Q0	Q0
9	Q0	Q2	Q3	Q1	Q2	Q1	Q0	Q0	Q2	Q0	Q2	Q2	Q3	Q3	Q0	Q2	Q2	Q2
10	Q2	Q0	Q0	Q1	Q3	Q0	Q1	Q2	Q1	Q1	Q3	Q2	Q3	Q1	Q3	Q2	Q1	Q3
11	Q1	Q1	Q3	Q3	Q2	Q1	Q2	Q1	Q2	Q2	Q2	Q0	Q0	Q1	Q3	Q1	Q0	Q2
12	Q0	Q0	Q3	Q1	Q1	Q3	Q0	Q2	Q2	Q3	Q3	Q1	Q2	Q2	Q2	Q0	Q0	Q2
13	Q0	Q0	Q0	Q2	Q1	Q0	Q1	Q0	Q0	Q2	Q2	Q2	Q1	Q1	Q1	Q1	Q2	Q1
14	Q2	Q3	Q0	Q2	Q1	Q1	Q0	Q0	Q2	Q1	Q0	Q0	Q2	Q1	Q0	Q0	Q3	Q3
15	Q3	Q1	Q3	Q3	Q0	Q1	Q0	Q3	Q1	Q1	Q3	Q1	Q0	Q3	Q1	Q1	Q0	Q0
16	Q0	Q2	Q0	Q0	Q1	Q3	Q3	Q3	Q1	Q1	Q2	Q0	Q0	Q1	Q2	Q3	Q2	Q3
17	Q2	Q1	Q0	Q1	Q3	Q2	Q1	Q0	Q0	Q0	Q2	Q0	Q3	Q2	Q2	Q0	Q3	Q1
18	Q3	Q3	Q3	Q0	Q1	Q1	Q2	Q2	Q3	Q1	Q0	Q3	Q3	Q2	Q2	Q1	Q2	Q1
19	Q2	Q3	Q0	Q3	Q0	Q3	Q1	Q3	Q2	Q3	Q1	Q1	Q0	Q3	Q3	Q1	Q2	Q2
20	Q2	Q0	Q3	Q3	Q0	Q2	Q3	Q0	Q3	Q1	Q2	Q2	Q2	Q0	Q2	Q3	Q1	Q2
21	Q1	Q0	Q3	Q3	Q2	Q3	Q3	Q3	Q0	Q0	Q0	Q1	Q3	Q1	Q0	Q2	Q3	Q1
22	Q3	Q3	Q3	Q2	Q2	Q3	Q0	Q1	Q0	Q0	Q1	Q3	Q0	Q0	Q2	Q1	Q0	Q3
23	Q0	Q1	Q0	Q3	Q0	Q0	Q0	Q1	Q0	Q2	Q0	Q3	Q3	Q3	Q3	Q3	Q3	Q2
24	Q3	Q0	Q0	Q1	Q2	Q2	Q3	Q0	Q1	Q2	Q0	Q0	Q1	Q3	Q3	Q2	Q1	Q1
25	Q1	Q3	Q0	Q3	Q2	Q1	Q1	Q2	Q0	Q0	Q3	Q0	Q1	Q3	Q1	Q3	Q1	Q2
26	Q1	Q0	Q3	Q2	Q3	Q2	Q0	Q2	Q2	Q2	Q1	Q3	Q0	Q2	Q1	Q3	Q2	Q0
27	Q2	Q2	Q3	Q2	Q2	Q0	Q3	Q2	Q0	Q2	Q2	Q1	Q2	Q3	Q3	Q0	Q2	Q0
28	Q2	Q2	Q3	Q0	Q0	Q0	Q0	Q1	Q1	Q3	Q1	Q0	Q2	Q1	Q1	Q2	Q1	Q1
29	Q1	Q3	Q3	Q0	Q3	Q3	Q2	Q0	Q1	Q2	Q3	Q3	Q2	Q3	Q1	Q1	Q3	Q3
30	Q3	Q1	Q3	Q2	Q0	Q3	Q2	Q1	Q3	Q0	Q3	Q0	Q1	Q2	Q0	Q2	Q2	Q3
31	Q2	Q1	Q0	Q0	Q2	Q0	Q3	Q0	Q3	Q3	Q0	Q2	Q0	Q2	Q1	Q0	Q1	Q3
32	Q1	Q1	Q3	Q0	Q1	Q2	Q1	Q1	Q1	Q0	Q0	Q2	Q1	Q0	Q3	Q0	Q2	Q0
33	Q2	Q2	Q3	Q1	Q1	Q3	Q1	Q3	Q3	Q2	Q3	Q3	Q0	Q0	Q0	Q3	Q0	Q1
34	Q0	Q3	Q3	Q0	Q3	Q0	Q1	Q0	Q3	Q1	Q1	Q1	Q1	Q2	Q3	Q3	Q0	Q0
35	Q0	Q2	Q0	Q2	Q3	Q3	Q2	Q1	Q2	Q1	Q0	Q1	Q3	Q0	Q1	Q0	Q1	Q1
36	Q1	Q3	Q0	Q1	Q0	Q1	Q3	Q1	Q3	Q3	Q3	Q1	Q0	Q0	Q2	Q2	Q3	Q0

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
37	Q1	Q3	Q2	Q2	Q0	Q0	Q3	Q0	Q1	Q0	Q3	Q3	Q0	Q2	Q3	Q0	Q1	Q1
38	Q1	Q0	Q1	Q0	Q1	Q3	Q0	Q1	Q3	Q1	Q2	Q0	Q3	Q3	Q0	Q1	Q1	Q0
39	Q1	Q2	Q2	Q2	Q1	Q2	Q1	Q0	Q0	Q2	Q0	Q1	Q3	Q2	Q2	Q2	Q1	Q3
40	Q1	Q1	Q2	Q1	Q3	Q0	Q0	Q3	Q3	Q1	Q0	Q0	Q1	Q0	Q2	Q1	Q2	Q2
41	Q2	Q0	Q2	Q1	Q1	Q0	Q2	Q1	Q1	Q1	Q1	Q1	Q0	Q3	Q1	Q3	Q3	Q2
42	Q3	Q0	Q2	Q3	Q2	Q0	Q1	Q0	Q2	Q3	Q3	Q0	Q3	Q0	Q2	Q3	Q2	Q0
43	Q2	Q2	Q1	Q3	Q2	Q3	Q0	Q1	Q2	Q1	Q3	Q2	Q1	Q2	Q2	Q2	Q3	Q1
44	Q3	Q3	Q2	Q0	Q3	Q2	Q0	Q1	Q0	Q2	Q3	Q1	Q0	Q1	Q0	Q0	Q2	Q2
45	Q2	Q0	Q1	Q3	Q0	Q3	Q2	Q2	Q0	Q2	Q0	Q0	Q1	Q1	Q2	Q0	Q0	Q0
46	Q0	Q2	Q2	Q3	Q1	Q2	Q3	Q0	Q3	Q3	Q1	Q0	Q1	Q3	Q1	Q0	Q3	Q1
47	Q3	Q3	Q1	Q1	Q0	Q3	Q0	Q3	Q0	Q0	Q0	Q2	Q2	Q3	Q1	Q3	Q2	Q0
48	Q2	Q2	Q1	Q3	Q3	Q1	Q2	Q0	Q0	Q1	Q1	Q3	Q0	Q0	Q0	Q2	Q2	Q0
49	Q2	Q2	Q2	Q0	Q3	Q2	Q3	Q2	Q2	Q0	Q0	Q0	Q3	Q3	Q3	Q3	Q0	Q3
50	Q0	Q1	Q2	Q0	Q3	Q3	Q2	Q2	Q0	Q3	Q2	Q2	Q0	Q3	Q2	Q2	Q1	Q1
51	Q1	Q3	Q1	Q1	Q2	Q3	Q2	Q1	Q3	Q3	Q1	Q3	Q2	Q1	Q3	Q3	Q2	Q2
52	Q2	Q0	Q2	Q2	Q3	Q1	Q1	Q1	Q3	Q3	Q0	Q2	Q2	Q3	Q0	Q1	Q0	Q1
53	Q0	Q3	Q2	Q3	Q1	Q0	Q3	Q2	Q2	Q2	Q0	Q2	Q1	Q0	Q0	Q2	Q1	Q3
54	Q1	Q1	Q1	Q2	Q3	Q3	Q0	Q0	Q1	Q3	Q2	Q1	Q1	Q0	Q0	Q3	Q0	Q3
55	Q0	Q1	Q2	Q1	Q2	Q1	Q3	Q1	Q0	Q1	Q3	Q3	Q2	Q1	Q1	Q3	Q0	Q0
56	Q0	Q2	Q1	Q1	Q2	Q0	Q1	Q2	Q1	Q3	Q0	Q0	Q0	Q2	Q0	Q1	Q3	Q0
57	Q3	Q2	Q1	Q1	Q0	Q1	Q1	Q1	Q2	Q2	Q2	Q3	Q1	Q3	Q2	Q0	Q1	Q3
58	Q1	Q1	Q1	Q0	Q0	Q1	Q2	Q3	Q2	Q2	Q3	Q1	Q2	Q2	Q0	Q3	Q2	Q1
59	Q2	Q3	Q2	Q1	Q2	Q2	Q2	Q3	Q2	Q0	Q2	Q1	Q1	Q1	Q1	Q1	Q1	Q0
60	Q1	Q2	Q2	Q3	Q0	Q0	Q1	Q2	Q3	Q0	Q2	Q2	Q3	Q1	Q1	Q0	Q3	Q3
61	Q3	Q1	Q2	Q1	Q0	Q3	Q3	Q0	Q2	Q2	Q1	Q2	Q3	Q1	Q3	Q1	Q3	Q0
62	Q3	Q2	Q1	Q0	Q1	Q0	Q2	Q0	Q0	Q0	Q3	Q1	Q2	Q0	Q3	Q1	Q0	Q2
63	Q0	Q0	Q1	Q0	Q0	Q2	Q1	Q0	Q2	Q0	Q0	Q3	Q0	Q1	Q1	Q2	Q0	Q2
64	Q0	Q0	Q1	Q2	Q2	Q2	Q2	Q3	Q3	Q1	Q3	Q2	Q0	Q3	Q3	Q0	Q3	Q3
65	Q3	Q1	Q1	Q2	Q1	Q1	Q0	Q2	Q3	Q0	Q1	Q1	Q0	Q1	Q3	Q3	Q1	Q1
66	Q1	Q3	Q1	Q0	Q2	Q1	Q0	Q3	Q1	Q2	Q1	Q2	Q3	Q0	Q2	Q0	Q0	Q1
67	Q0	Q3	Q2	Q2	Q0	Q2	Q1	Q2	Q1	Q1	Q2	Q0	Q2	Q0	Q3	Q2	Q3	Q1
68	Q3	Q3	Q1	Q2	Q3	Q0	Q3	Q3	Q3	Q2	Q2	Q0	Q3	Q2	Q1	Q2	Q0	Q2
69	Q0	Q0	Q1	Q3	Q3	Q1	Q3	Q1	Q1	Q0	Q1	Q1	Q2	Q2	Q2	Q1	Q2	Q3
70	Q2	Q1	Q1	Q2	Q1	Q2	Q3	Q2	Q1	Q3	Q3	Q3	Q3	Q0	Q1	Q1	Q2	Q2
71	Q2	Q0	Q2	Q0	Q1	Q1	Q0	Q3	Q0	Q3	Q2	Q3	Q1	Q2	Q3	Q2	Q3	Q3
72	Q3	Q1	Q2	Q3	Q2	Q3	Q1	Q3	Q1	Q1	Q1	Q3	Q2	Q2	Q0	Q0	Q1	Q2

$$Q0=\exp\left(j\tfrac{\pi}{4}\right);\qquad Q1=\exp\left(j\tfrac{3\pi}{4}\right);\qquad Q2=\exp\left(-j\tfrac{3\pi}{4}\right);\qquad Q3=\exp\left(-j\tfrac{1\pi}{4}\right);$$

Table 2 (18, 72) QPSK sequences for primary fast feedback channel mapping

The four CDM codes for the four adjacent tones in a sector are chosen from the following sets of codes -

$$\mathbf{A}=\mathbf{U}\begin{bmatrix}1 & 1 & 1 & 1\\ 1 & 1 & -1 & -1\\ 1 & -1 & -1 & 1\\ 1 & -1 & 1 & -1\end{bmatrix},\mathbf{B}=\mathbf{U}\begin{bmatrix}1 & 1 & 1 & 1\\ -1 & -1 & 1 & 1\\ -i & i & i & -i\\ -i & i & -i & i\end{bmatrix},\mathbf{C}=\mathbf{U}\begin{bmatrix}1 & 1 & 1 & 1\\ -i & -i & i & i\\ -i & i & i & -i\\ -1 & 1 & -1 & 1\end{bmatrix},\mathbf{D}=\mathbf{U}\begin{bmatrix}1 & 1 & 1 & 1\\ i & i & -i & -i\\ 1 & -1 & -1 & 1\\ -i & i & -i & i\end{bmatrix},\mathbf{E}=\mathbf{U}\begin{bmatrix}1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\\ 0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\end{bmatrix}$$

where **U** is a unitary matrix (implementation specific).

For secondary fast feedback channel, the 12 information bits are carried using 1/3 tail-biting convolutional code (43 71 75) with QPSK modulation.

If there are multiple contiguous UL subframes within one frame, the UL fast feedback tiles are allocated in time dimension first in order to improve the coverage of fast feedback channel and to reduce the MS transmit power as shown in Figure 4. Further, subframe based frequency hopping of the tiles can be applied to improve the frequency diversity.

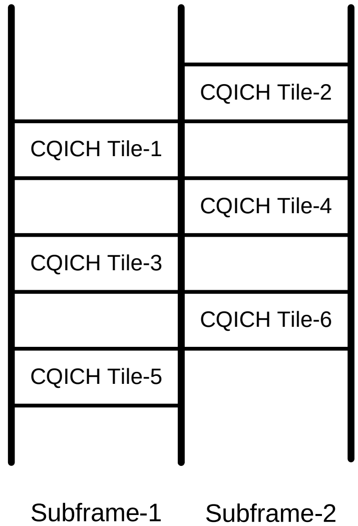

Figure 4. UL Fast Feedback Channel tile allocations

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