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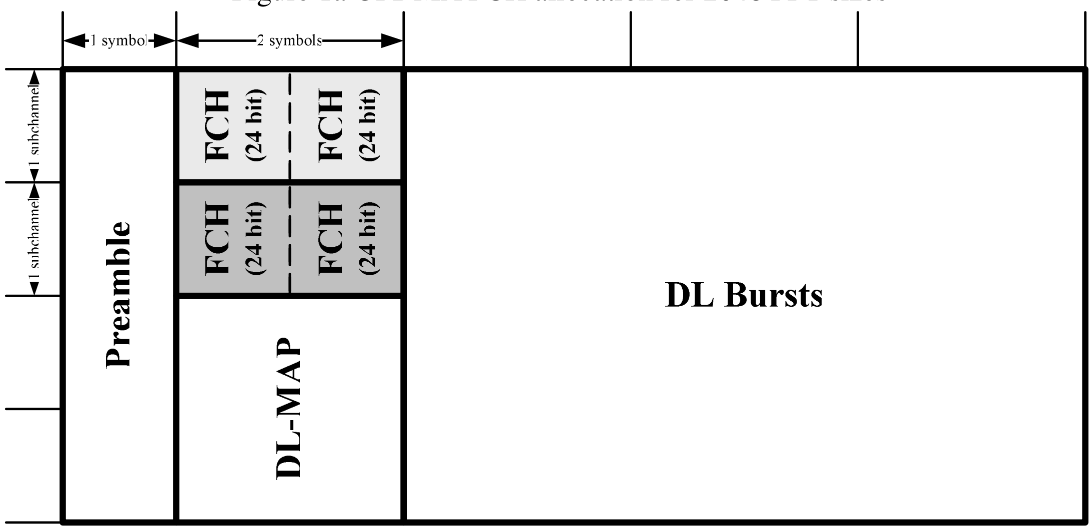
Source(s)	Kanchei (Ken) Loa, Yi-Hsueh Tsai, Yung-Ting Lee, Hua-Chiang Yin, Shiann-Tsong Sheu, Frank C.D. Tsai, Youn-Tai Lee, Chih-Chiang Hsieh, Heng-Iang Hsu Institute for Information Industry 8F., No. 218, Sec. 2, Dunhua S. Rd., Taipei City, Taiwan. [add co-authors here] Voice: +886-2-2739-9616 loa@iii.org.tw
Re:	IEEE 802.16j-07/013: “Call for Technical Comments Regarding IEEE Project 802.16j”
Abstract	This contribution provides R-FCH
Purpose	Text proposal for 802.16j Baseline Document
Notice	
Release	
Patent Policy and Procedures	

R-FCH for Relay Zone

Introduction

In IEEE 802.16-2004 page 500: The first two transmitted subchannels in the first data symbol of the downlink is called FCH. The FCH shall be transmitted using QPSK rate 1/2 with four repetitions using the mandatory coding scheme (e.g., the FCH information will be sent on four adjacent subchannels) in a PUSC zone.

Figure 1a OFDMA FCH allocation for 2048 FFT sizes

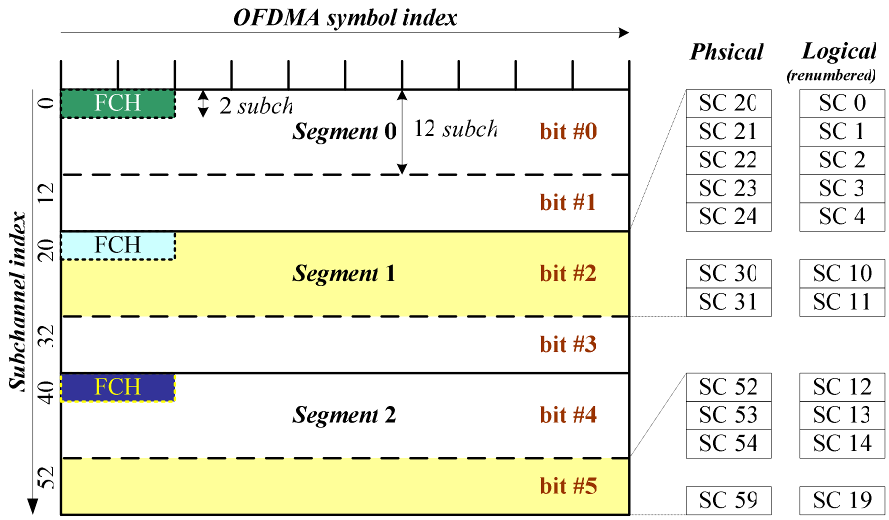


(Note: FCH use two subchannels in IEEE 802.16-2005 but four subchannels in IEEE 802.16e-2005)

In IEEE 802.16-2004 page 502: In PUSC, any segment used shall be allocated at least 12 subchannels. The first 4 slots in the downlink part of the segment contain the FCH as defined in 8.4.4.2. These slots contain 48 bits modulated by QPSK with coding rate 1/2 and repetition coding of 4. The basic allocated subchannel sets for Segments 0, 1, and 2 are Subchannels 0–11, 20–31, and 40–51, respectively. Figure 220 depicts this structure.

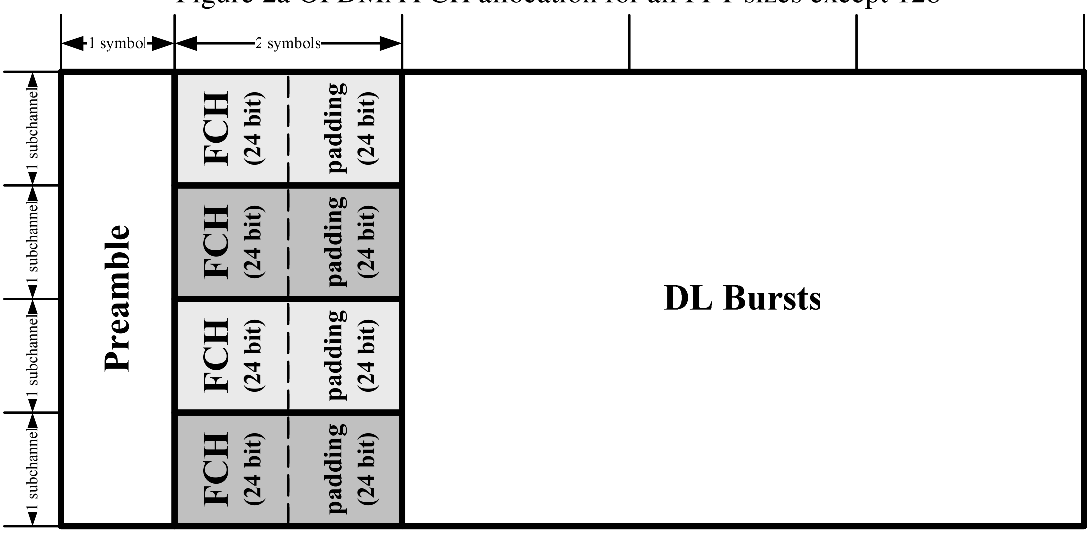
After decoding the DL_Frame_Prefix message within the FCH, the SS has the knowledge of how many and which subchannels are allocated to the PUSC segment. In order to observe the allocation of the subchannels in the downlink as a contiguous allocation block, the subchannels shall be renumbered. The renumbering shall start from the FCH subchannels (renumbered to values 0…11), then continue numbering the subchannels in a cyclic manner to the last allocated subchannel and from the first allocated subchannel to the FCH subchannels. Figure 221 gives an example of such renumbering for segment 1. For uplink, in order to observe the allocation of the subchannels as a contiguous allocation block, the subchannels shall be renumbered, the renumbering shall start from the lowest numbered allocated subchannel (renumbered to value 0), up to the highest numbered allocated subchannel, skipping non-allocated subchannels. Figure 222 gives an example of such renumbering for segment 1.

Figure 1b FCH subchannel allocation for all 3 segments



In IEEE 802.16e-2005 page 357: The FCH shall be transmitted using QPSK rate 1/2 with four repetitions using the mandatory coding scheme (i.e., the FCH information will be sent on four subchannels with successive logical subchannel numbers) in a PUSC zone. (see Table 268: OFDMA downlink Frame Prefix format for all FFT sizes except 128)

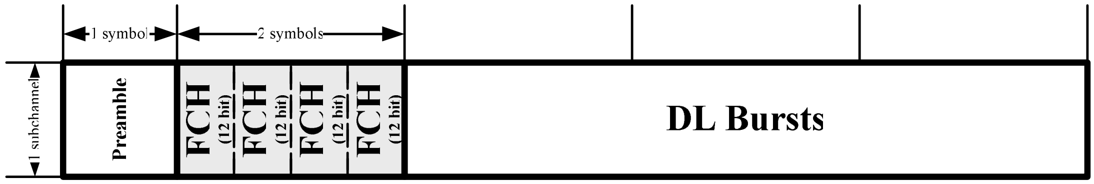
Figure 2a OFDMA FCH allocation for all FFT sizes except 128



(Note: FCH use two subchannels in IEEE 802.16-2005 but four subchannels in IEEE 802.16e-2005)

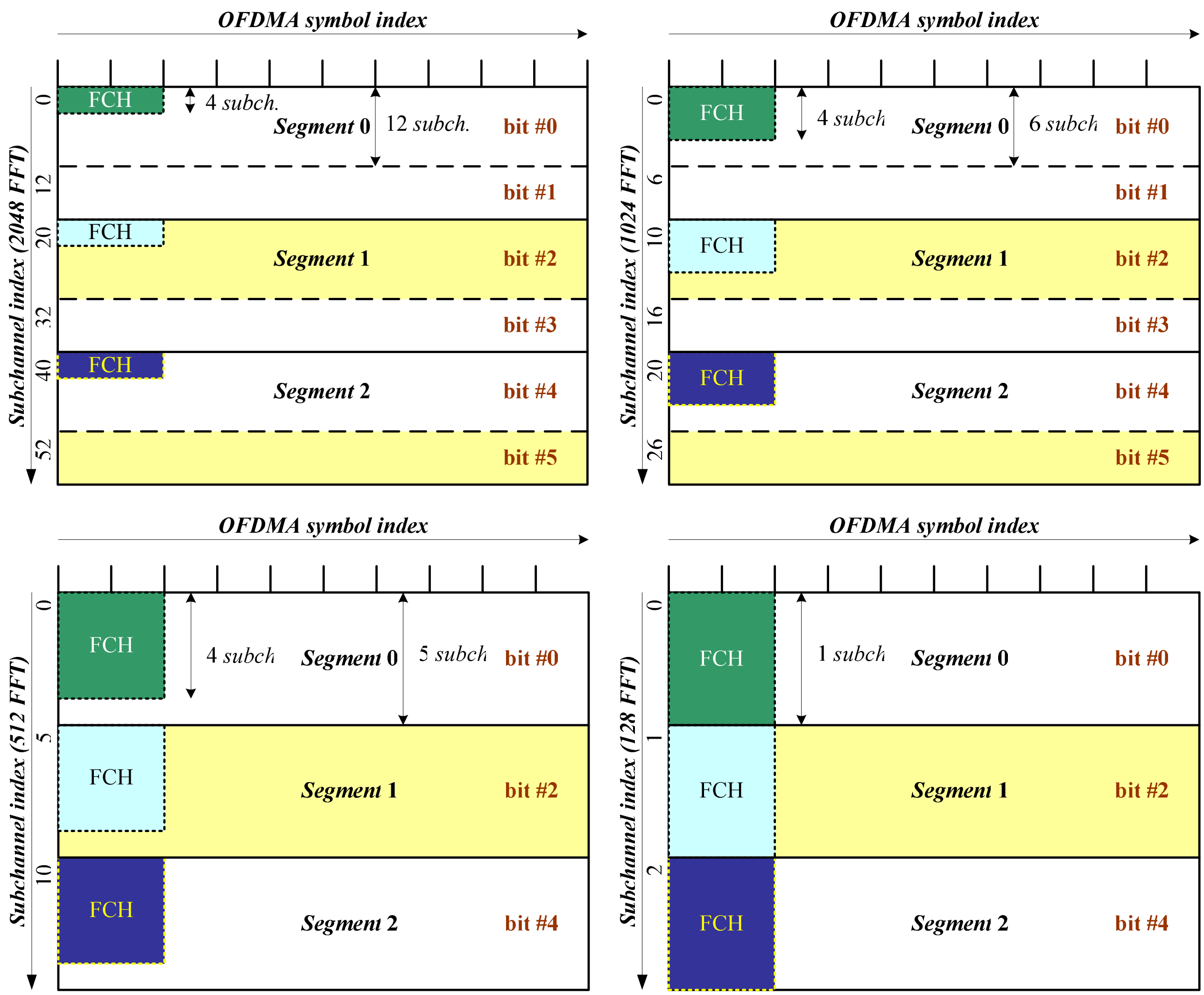
In IEEE 802.16e-2005 page 360: For the case of 128 FFT, the following compressed format shall be used for FCH. Before being mapped to the FCH, **the 12-bit DL Frame Prefix shall be repeated four times to form a 48-bit block,** which is the minimal FEC block size. (see Table 268b: OFDMA downlink frame prefix format for 128 FFT)

Figure 2b OFDMA FCH allocation for 128 FFT



In IEEE 802.16e-2005 page 361: In PUSC, any segment used shall be allocated at least the same number of subchannels as in subchannel group #0. For FFT sizes other than 128, the first 4 slots in the downlink part of the segment contain the FCH as defined in 8.4.4.2. **These slots contain 48 bits modulated by QPSK with coding rate 1/2 and repetition coding of 4.** For FFT-128, the first slot in the downlink part of the segment is dedicated to FCH and repetition is not applied. The basic allocated subchannel sets for Segments 0, 1, and 2 are Subchannel Group #0, #2, #4 respectively. Figure 220 depicts this structure.

Figure 1c FCH subchannel allocation for all 3 segments (for 2048, 1024, 512 and 128 FFT respectively)



In IEEE 802.16e-2005 page 634: Repetition coding can be used to further increase signal margin over the modulation and FEC mechanisms. In the case of repetition coding, R = 2, 4, or 6, the number of allocated slots (Ns) shall be a whole multiple of the repetition factor R for uplink. For the downlink, the number of the allocated slots (N_s) shall be in the range of $[R\times K, R\times K+(R-1)]$, where K is the number of the required slots before applying the repetition scheme. For example, when the required number of slots before the repetition is 10 (= K) and the repetition of R = 6 shall be applied for the burst transmission, then the number of the allocated slots (N_s) for the burst can be from 60 slots to 65 slots
The binary data that fits into a region that is repetition coded is reduced by a factor R compared to a nonrepeated region of the ($\lfloor (N_s/R)\times R\rfloor$) slots with the same size and FEC code type. After FEC and bit-interleaving, the data is segmented into slots, and each group of bits designated to fit in a slot will be repeated R times to form R contiguous slots following the normal slot ordering that is used for data mapping. The actual constellation data can be different because of the subcarrier randomization as defined by 8.4.9.4.1. **This repetition scheme applies only to QPSK modulation;** it can be applied in all coding schemes except HARQ with CTC defined in 8.4.9.2.3.5.

Remedy

The R-FCH shall be transmitted using QPSK rate 1/2 with four repetitions using the mandatory coding scheme (i.e., the R-FCH information will be sent on four subchannels with successive logical subchannel numbers). For the case of 128 FFT, the following compressed format shall be used for R-FCH. Before being mapped to the R-FCH, the 12-bit DL Frame Prefix shall be repeated four times to form a 48-bit block, which is the minimal FEC block size.

Figure 3a OFDMA FCH allocation for all FFT sizes except 128

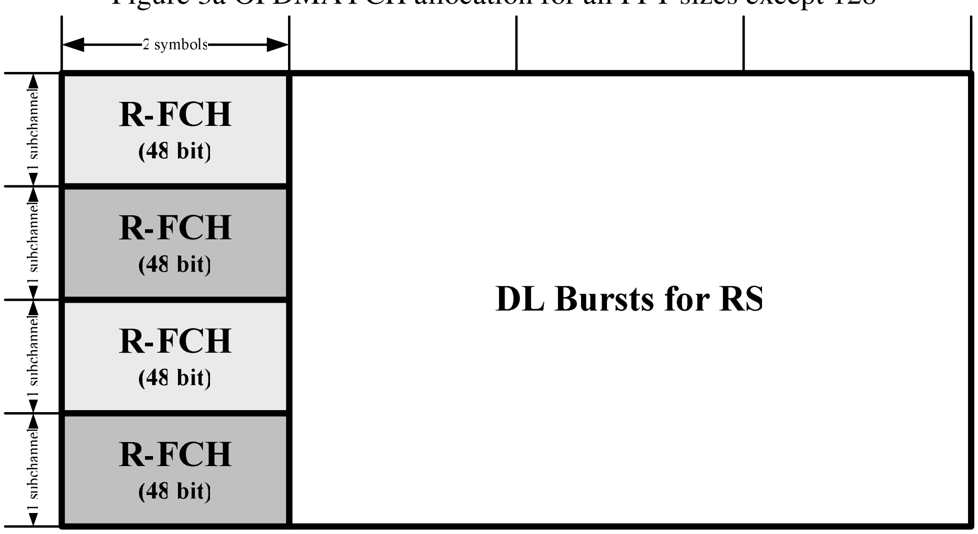
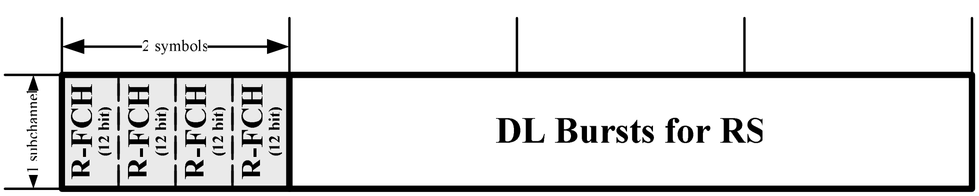


Figure 3b OFDMA FCH allocation for 128 FFT



Under the case of the first relay zone is PUSC zone, the R-FCH shall be allocated as follows. For FFT sizes other than 128, the first 4 slots in the downlink part of the segment contain the R-FCH. These slots contain 48 bits modulated by QPSK with coding rate 1/2 and repetition coding of 4. For FFT-128, the first slot in the downlink part of the segment is dedicated to R-FCH and repetition is not applied. The basic allocated subchannel sets for Segments 0, 1, and 2 are Subchannel Group #0, #2, #4 respectively. Figure 3c depicts this structure.

Under the case of the first relay zone is FUSC zone, the R-FCH shall be allocated as follows. For FFT sizes other than 128, the first 4 slots in the downlink part of subchannel contain the R-FCH. These slots contain 48 bits modulated by QPSK with coding rate 1/2 and repetition coding of 4. For FFT-128, the first slot in the downlink part of the subchannel is dedicated to R-FCH and repetition is not applied. Figure 3d depicts this structure.

Figure 3c R-FCH subchannel allocation for all 3 segments

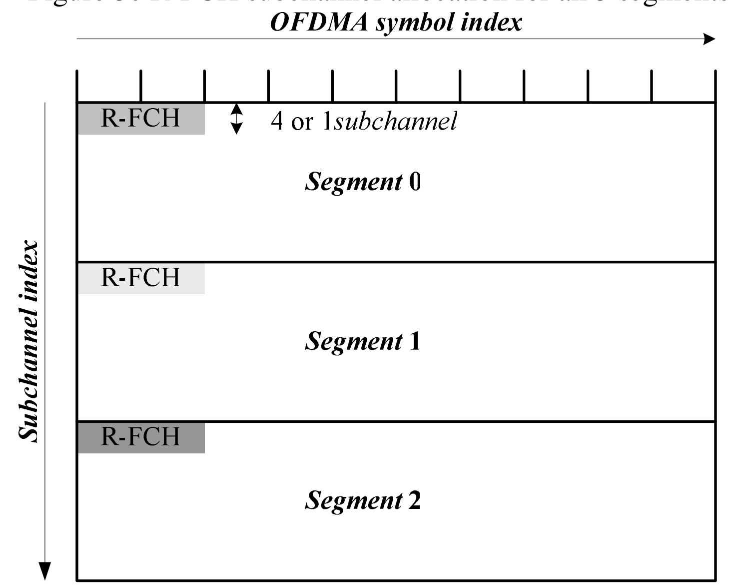
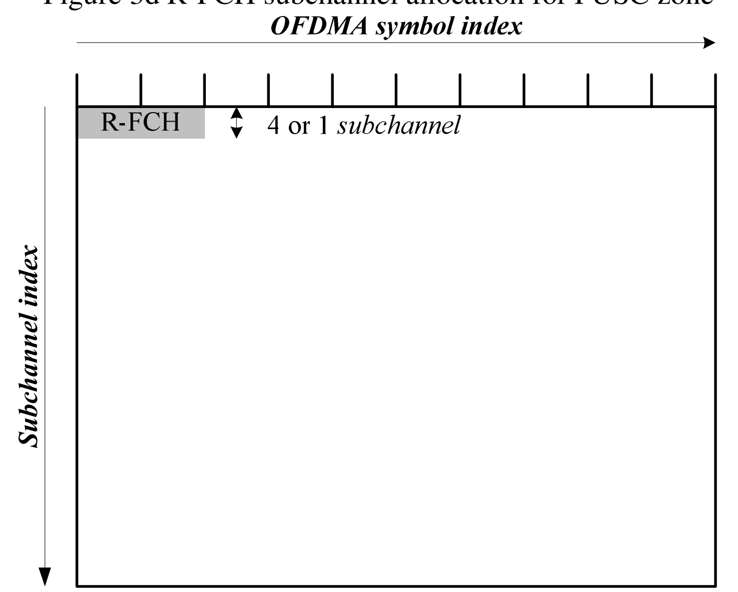


Figure 3d R-FCH subchannel allocation for FUSC zone



Text Proposal

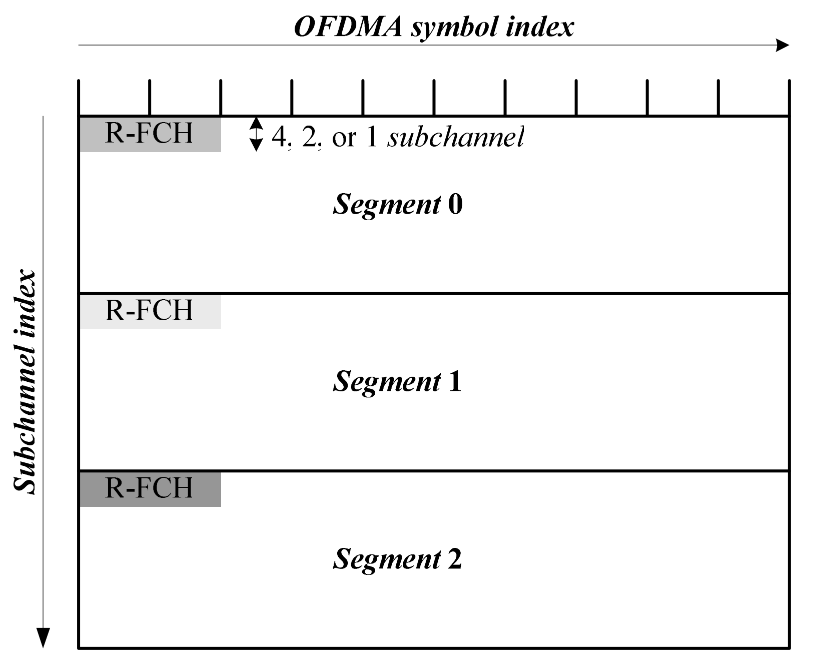
8.4.4.7.3 R-FCH channel

If a DL RS_Zone contains a R-FCH channel, the R-FCH channel shall be transmitted as FCH described in 8.4.4.2. The R-FCH contains the RS-Zone Prefix as described in 8.4.4.7.4.

The R-FCH shall be transmitted using QPSK rate 1/2 with TBD repetitions using the mandatory coding scheme For the case of 128 FFT, the following compressed format shall be used for R-FCH. Before being mapped to the R-FCH, the 12-bit DL Frame Prefix shall be repeated four times to form a 48-bit block, which is the minimal FEC block size.

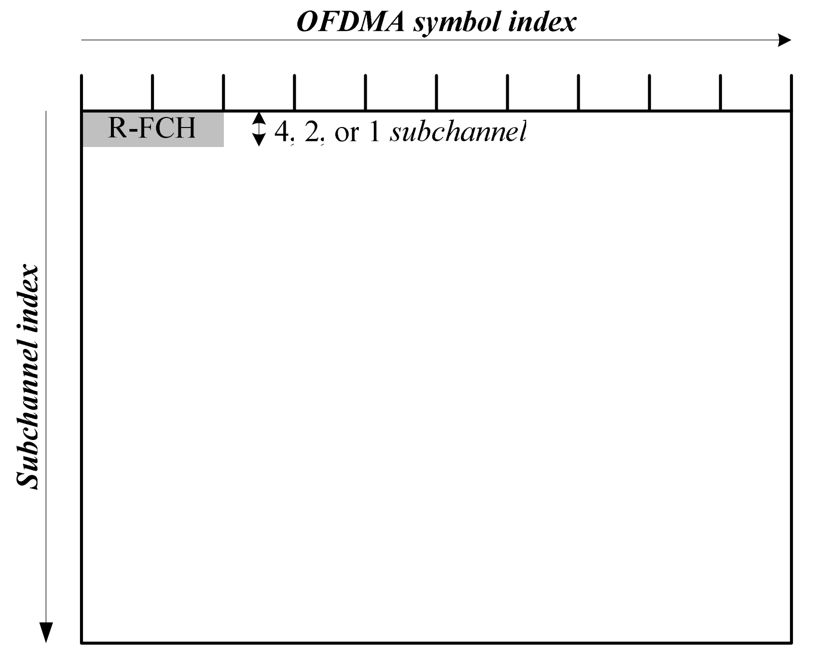
Under the case of the first relay zone is PUSC zone, the R-FCH shall be allocated as follows. For FFT sizes other than 128, the first TBD slots in the downlink part of the segment contain the R-FCH. These slots contain 48 bits modulated by QPSK with coding rate 1/2 and repetition coding of TBD. For FFT-128, the first slot in the downlink part of the segment is dedicated to R-FCH and repetition is not applied. The basic allocated subchannel sets for Segments 0, 1, and 2 are Subchannel Group #0, #2, #4 respectively. Figure xxx depicts this structure.

Figure xxx R-FCH subchannel allocation for all 3 segments



Under the case of the first relay zone is FUSC zone, the R-FCH shall be allocated as follows. For FFT sizes other than 128, the first TBD slots in the downlink part of subchannel contain the R-FCH. These slots contain 48 bits modulated by QPSK with coding rate 1/2 and repetition coding of TBD. For FFT-128, the first slot in the downlink part of the subchannel is dedicated to R-FCH and repetition is not applied. Figure yyy depicts this structure.

Figure yyy R-FCH subchannel allocation for FUSC zone



8.4.4.7.4 RS-Zone prefix

The RS-Zone prefix is a data structure transmitted on R-FCH of a DL RS_Zone. The RS-Zone prefix includes information regarding the location of the first RS_Zone in the next frame and the information required for decoding R-MAP. Table XXX defines the format of RS_Zone prefix.

Table xxx-a: RS-Zone prefix format for all FFT sizes except 128

Syntax	Size(bits)	Notes
RS_Zone_Prefix_format () {		
Next_Frame_First_Relay_Zone_Configuration {		
RS_Zone location	8~~7~~	The field indicates the OFDM symbol index reference to the beginning of next frame in unit of ~~2~~ OFDM symbol~~s~~
RS_Zone_Permutation	2	0b00 = PUSC 0b01 = FUSC 0b10 = Optional FUSC 0b11 = AMC 2x3 (2 bins by 3 symbols)
STC	2	0b00 = no STC 0b01 = STC using 2/3 antennas 0b10 = STC using 4 antennas 0b11 = FHDC using 2 antennas

Matrix indicator	2	STC matrix (see 8.4.8.1.4)
		If(STC==0b01 or STC==0b10)
		{
		0b00 = Matrix A
		0b01 = Matrix B
		0b10 = Matrix C
		0b11 = Reserved
		}
		else if(STC==ob11)

		{
		0b00 = Matrix A
		0b01 = Matrix B
		0b10-11 = Reserved
		}

DL_PermBase	5	-
AMC type	2	Indicates the AMC type in case permutation type=0b11, otherwise shall be set to 0. AMC type (NxM=N bits by M symbols) 0b00 - 1x6 0b01 - 2x3 0b10 - 3x2 0b11 - Reserved Note that only 2x3 Band AMC subchannel type (AMC Type=0b01) is supported by MS.
2/3 antennas select	1	0 = STC using 2 antennas 1 = STC using 3 antennas selects 2/3 antennas when STC=0b01
}		
Used_subchannel_bitmap	6	Bit #0: Subchannel group 0 Bit #1: Subchannel group 1 Bit #2: Subchannel group 2 Bit #3: Subchannel group 3 Bit #4: Subchannel group 4 Bit #5: Subchannel group 5
R-MAP length	8~~5~~	Length in unit of slot
FEC Code type and modulation type with repetition coding	6~~5~~	~~0b0000 = QPSK (CTC) 1/2~~ ~~0b0001 = QPSK (CTC) ¾~~ ~~0b0010 = 16-QAM (CTC) 1/2~~ ~~0b0011 = 16-QAM (CTC) 3/4~~ ~~0b0100 = 64-QAM (CTC) 1/2~~ ~~0b0101 = 64-QAM (CTC) 2/3~~ ~~0b0111 = 64-QAM (CTC) 3/4~~ ~~0b1000 = 64-QAM (CTC) 5/6~~ ~~0b1001-0b1111 reserved~~ FEC Code type and modulation type with repetition coding is defined in Table yyy.
~~Repetition_Coding_Indication~~	~~1~~	~~0: No repetition coding on R-MAP~~ ~~1: Repetition coding of 2 used on R-MAP~~
Reserved	6	Shall be zero
}		

RS_Zone location

An indicator regarding the location of RS_Zone in the next frame. The first OFDM symbol in each frame is indexed as 0. The RS_Zone location indicates the OFDM symbol index relative to the first OFDM symbol in next frame. The unit is ~~2~~ OFDM symbols.

RS_Zone location

An indicator regarding the permutation of RS_Zone in the next frame.

R-MAP length

The length in sub-channels of R-MAP message that immediately follows the RS_Zone prefix.

FEC Code type and modulation type with repetition coding

An indicator indicating the modulation and code rate with repetition coding used for R-MAP message.

Table xxx-b: RS-Zone prefix format for 128 FFT

Syntax	Size(bits)	Notes
RS_Zone_Prefix_format () {		
Used subchannel indicator	1	0: Subchannel 0 is used for segment 0, Subchannel 1 is used for segment 1, Subchannel 2 is used for segment 2, 1: Use all subchannels
R-MAP length	5	Length in unit of slot
FEC Code type and modulation type with repetition coding	6	FEC Code type and modulation type with repetition coding is defined in Table yyy.
}		

R-MAP length

The length in sub-channels of R-MAP message that immediately follows the RS_Zone prefix.

FEC Code type and modulation type with repetition coding

An indicator indicating the modulation and code rate with repetition coding used for R-MAP message.

Table yyy: FEC Code type and modulation type with repetition coding

0x00 = QPSK (CC) ½, repetition 6	0x20 = QPSK (CTC) ½, repetition 6
0x01 = QPSK (CC) ¾, repetition 6	0x21 = QPSK (CTC) ¾, repetition 6
0x02 = QPSK (CC) ½, repetition 4	0x22 = QPSK (CTC) ½, repetition 4
0x03 = QPSK (CC) ¾, repetition 4	0x23 = QPSK (CTC) ¾, repetition 4
0x04 = QPSK (CC) ½, repetition 2	0x24 = QPSK (CTC) ½, repetition 2
0x05 = QPSK (CC) ¾, repetition 2	0x25 = QPSK (CTC) ¾, repetition 2
0x06 = QPSK (CC) ½	0x26 = QPSK (CTC) ½
0x07 = QPSK (CC) ¾	0x27 = QPSK (CTC) ¾
0x08 = 16-QAM (CC) ½	0x28 = 16-QAM (CTC) ½
0x09 = 16-QAM (CC) ¾	0x29 = 16-QAM (CTC) ¾
0x0A = 64-QAM (CC) ½	0x2A = 64-QAM (CTC) ½
0x0B = 64-QAM (CC) ⅔	0x2B = 64-QAM (CTC) ⅔
0x0C = 64-QAM (CC) ¾	0x2C = 64-QAM (CTC) ¾
0x0D ~ 0x0F = Reserved	0x2D = 64-QAM (CTC) ⅚
0x10 = QPSK (BTC) ½, repetition 6	0x2E~ 0x2F reserved
0x11 = QPSK (BTC) ¾ or ⅔, repetition 6	0x30 = QPSK (ZT-CC) ½, repetition 6
0x12 = QPSK (BTC) ½, repetition 4	0x31 = QPSK (ZT-CC) ¾, repetition 6
0x13 = QPSK (BTC) ¾, repetition 4	0x32 = QPSK (ZT-CC) ½, repetition 4
0x14 = QPSK (BTC) ½, repetition 2	0x33 = QPSK (ZT-CC) ¾, repetition 4
0x15 = QPSK (BTC) ¾, repetition 2	0x34 = QPSK (ZT-CC) ½, repetition 2
0x16 = QPSK (BTC) ½	0x35 = QPSK (ZT-CC) ¾, repetition 2
0x17 = QPSK (BTC) ¾	0x36 = QPSK (ZT-CC) ½
0x18 = 16-QAM (BTC) ⅗	0x37 = QPSK (ZT-CC) ¾
0x19 = 16-QAM (BTC) ⅘	0x38 = 16-QAM (ZT-CC) ½
0x1A = 64-QAM (BTC) ⅔ or ⅝	0x39 = 16-QAM (ZT-CC) ¾
0x1B = 64-QAM (BTC) ⅚ or ⅘	0x3A = 64-QAM (ZT-CC) ½
0x1C ~ 0x1F = Reserved	0x3B = 64-QAM (ZT-CC) ⅔
	0x3C = 64-QAM (ZT-CC) ¾
	0x3D~ 0x3F reserved