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Title	**OFDMA subcarrier allocations**	
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Re:		
Abstract	Subchannelizations for OFDMA downlink and uplink channels are proposed.	
Purpose	Adoption of proposed subchannelization into 802.16-REVd	
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OFDMA subcarrier allocations

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Proposed Text Changes

We propose the following remedies in IEEE P802.16-REVd/D3

[Replace the section "8.4.6 OFDMA subcarrier allocations" with the following text]

8.4.5 OFDMA subcarrier allocations

Subtracting the DC subcarrier and the guard subcarrier from N_{FFT}, one obtains the set of "used" subcarriers N_{used} (assume N_{used} is even for the time being). For both uplink and downlink these used carriers are allocated to pilot carriers and data carriers. To constitute AMC subchannels both in downlink and uplink, nine contiguous subcarriers including one pilot carrier, all within a symbol are grouped into a bin. The structures of diversity subchannels are, however, different for downlink and uplink. In downlink, pilot carriers are allocated first and the remaining carriers are used exclusively for data transmission. For the uplink diversity subchannels, however, the set of adjacent subcarriers in time-frequency plane forms a tile and then a pilot carrier is allocated from within the tile.

In what follows, subcarriers are identified by a subcarrier index k and the corresponding frequency offset index is specified as

$$k_{foi} = \begin{cases} k - N_{used}/2, & k < N_{used}/2 \\ k - N_{used}/2 + 1, & k \geq N_{used}/2 \end{cases} \quad (1.)$$

where k_{foi} is frequency offset index, k is subcarrier index, and N_{used} is the number of used subcarriers. This relation with IFFT index is shown in Figure 1.

Each BS can reserve safety channels to provide a shelter to MS connected to other BS. For both uplink and downlink, AMC subchannels are defined with bins after excluding reserved ones for safety channels. The subcarriers in downlink diversity subchannels are punctured if their subcarrier indexes collide with the subcarriers allocated for safety channels. In uplink, however, there is no diversity subcarrier puncturing to support safety mode operation.

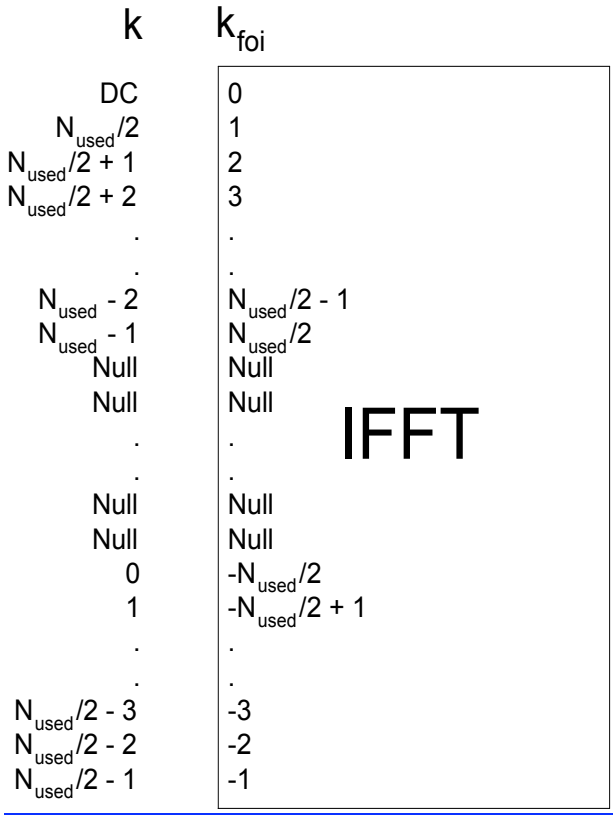

Figure 1 – Subcarrier index mapping

8.4.5.1 Downlink

8.4.5.1.1 Preamble

The first and second symbol of the downlink transmission are the preamble; there are 2 types of preamble carrier-sets, those are defined by allocation of even or odd subcarriers for each one of them; those subcarriers are modulated using a boosted BPSK modulation with a specific code.

The preamble carrier-sets are defined using the following formula:

$$P_{ID_{cell},s}[k] = \begin{cases} \sqrt{2}\left(1 - 2q_{ID_{cell},S}[m]\right) & k = 2m - \frac{N_{used}}{2}, m = 0,1,\cdots,\frac{N_{used}}{4} \\ \sqrt{2}\left(1 - 2q_{ID_{cell},S}[m-1]\right) & k = 2m - \frac{N_{used}}{2}, m = \frac{N_{used}}{4}+1, \frac{N_{used}}{4}+2,\cdots,\frac{N_{used}}{2} \\ 0, & otherwise \end{cases}$$

If [illegible] is IFFT-processed, it results in a pattern repeating itself once in the time-domain. In the previous equation, $\sqrt{2}$ is

multiplied so that the DL preamble has the same average power level as that of the data OFDMA symbols and $q_{ID_{cell},s}[m]$ is defined as follows.

Where,

All the sequences regarding to $T(m)$ should use the codes shown in Table 2 where, $H_{128}(i,j)$ is the (i,j)th element of the length 128 Walsh Hadamard matrix, $i,j = 0,1,\cdots 127$, and s denotes the sector ID. The elements of first row of H_{128} are all 1, so we should use the matrix except first row. means th permutation, represents largest integer not larger than . Those entire permutation indexes required for these preambles should use the indexes shown in Table 1.

Table 1 – Permutation

$\prod_0(l)$	1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 0
$\prod_1(l)$	25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 0
$\prod_2(l)$	71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 0

Table 2 –

ID cell	s	sequence	PAPR
0	0	11010000100010001100111000010010000100000100011001	5.66227
_	1	10111011000011111011011001100010100100010101010110	5.70745
_	2	00011010100111100100001111001011001000111011111101	5.40849
_	3	01011001100010110010000110101010010101011101001001	5.15736

_	4	010101011110011001000010010100101001011010111001	5.26919
_	5	111100001111110111001101100000010100111010011100	5.3337
_	6	011000010110010100000000100010000000111011011100	5.29553
_	7	101001001010000000000101010111001110000111000000	5.32531
1	0	101111100001100110101110000110101111011111110101	6.10532
_	1	110001000010101110011000001100101100110110111001	5.62257
_	2	100111000010011101110000101000000011111000111001	5.79533
_	3	110011110111101111100111110101110001101001011101	5.33121
_	4	110011100110001011000011000111010000101001100010	5.55509
_	5	110110011001010111001001111011100110100101101011	5.27733
_	6	111111010100101001100010111101101011111110000110	5.45897
_	7	110001100011110011111100110110101100001011110111	5.08909
2	0	110100010000001001001111011000010110000001111111	5.47031
_	1	110101001110010101110010001110100100011100000111	6.09491
_	2	010110001111010101001000110111010001001010101101	5.10417
_	3	010100000000001110011001110011011011101010111010	5.32371
_	4	100111010010111110010000011100010000111000101100	5.14353
_	5	010011101111000010111110010111000101100101111010	5.45375
_	6	111000110100010010101110000110111110000010100000	5.32171
_	7	000100111111110100000111100011011111110011011011	5.93181
3	0	111111111010001011000000111001110100001110101110	5.78104
_	1	011000111000010010100010000011000111000010011011	5.69795
_	2	001001010000110110100110101101110111110001001000	5.07135
_	3	010010000111100111111001011000101000100101110110	5.62232
_	4	101011000001101010000111000010001010101110110011	5.41997
_	5	000010010101100101010000011011111100110011110010	5.01052
_	6	010010011101010111110110101101101110000111100011	5.69835
_	7	010101111100001000101011110101100111011010100111	5.37886
4	0	111011001100010010010111100111011100011110101000	5.43829
_	1	011100001011000110110010111001011111011111101111	5.46168
_	2	000111110001010011011100100001111000001101100010	5.45045
_	3	011011100000101011001001001110100101111101001100	5.47401
_	4	011011101001010001010111100100110110110111100100	5.79718
_	5	001101111111010000001100001110100110010100000000	5.73225
_	6	000000111000101101110110110010101011100001001001	5.03968
_	7	000001110110000111001101010001100101010000010011	5.40678

5	0	000010101110011000010111011000000010110101100001	5.49265
_	1	001000101000110001011010100101111000111011100011	5.51033
_	2	010010011110001000000001010011100100100010010000	5.28067
_	3	010101100110011101100101001000000101111111000111	5.54078
_	4	000001111110111100011111111111010001100100010100	5.59233
_	5	010010001101000011000000101011111010101110100111	5.31327
_	6	101100111011011110101101110010101110010001110111	5.95788
_	7	010000000100000000111110110010101001011010110001	5.85279
6	0	101100110000000011001100111010011101000010011001	5.53586
_	1	011101100011000110101101100010110010001011100100	6.43591
_	2	101101001010111111111000011001010000110011001110	5.47739
_	3	010110010111110111101000101101000101011110001111	5.42959
_	4	111011001100100010011001001011111110101001001011	5.52623
_	5	000010010000101011011101010101110100100110001110	5.44813
_	6	001000111101110000011100011001110001111100101001	5.09877
_	7	001100001010101111001010010110110100000111111001	5.98801
7	0	011000110011111101010100111000100000001010011000	5.46205
_	1	001110001111001010001010100000111101000011101010	5.6163
_	2	010001010011100000001000000000111010101101100110	5.24158
_	3	100101100011001010100101001010001110100000010110	5.1687
_	4	110000100100000011100011000000110001001011000110	5.37153
_	5	010011011000111011000001011000110001101000011010	5.17321
_	6	101010111011110101010011111111001101100101111100	5.80558
_	7	110110111001000011110110010111101000111010110111	5.39675
8	0	110100000110000001000100000001100110010101110110	5.44115
_	1	110100011000000111101010011100000101011011110100	5.67817
_	2	010110011010100010001000001001010000111110111011	5.56102
_	3	011001001001001110111100000100010000101111100110	5.79203
_	4	001001110111111010100010000110011101001110001000	5.11439
_	5	001100101001000111100010000010000000011101010010	5.23452
_	6	000101010100110111101011001000000111000101011101	6.00725
_	7	000000100001001011001000010110001111010001101000	5.80379
9	0	101000111101101100011101110100011001001001010100	5.73676
_	1	011110010010111001101111101111100101110010000111	5.59874
_	2	111101001110011100111011110001100100000100001000	5.11814
_	3	110001110010001111111011001100111110001011110011	5.35878

_	4	100001101000101111001010001010001101001001011111	5.74794
_	5	011010110011011010001001001001011001000100100111	6.04283
_	6	100111100000000000001001100001000110111010010011	5.44761
_	7	011011011110111110000000111100001010001111101011	5.81628
10	0	110100001100100000111010100100111101100010100000	5.7145
_	1	110011110000011011110110001110100001100001010001	5.78021
_	2	001010101010100100000001110100010010001111010001	5.32233
_	3	000000101111000000000001001010001101010110011000	5.34119
_	4	101100000010110111110000111001101000010110010101	5.6172
_	5	110011100010001001010100011011110000001111010111	5.42501
_	6	101010010101110011010111010111111100110000001110	5.05427
_	7	111011001100110011001101100011111111000111010100	5.35262
11	0	111000110110101101111001011001000101110100011001	5.40748
_	1	100011111000011110111011110111001010101100111011	5.38702
_	2	110101100110101110100101111001101100011001011000	5.56969
_	3	111100110010010010100101101110000001010001010110 1	5.67081
_	4	001001000010001100000101011011000111010001001000	5.02695
_	5	101101000011110011101011110110010001101011010101	5.28885
_	6	100011010001001100010100101000101111011101000110	5.56452
_	7	111011101110111100100100011110010110111000000010	5.55677
12	0	010000101100100011000100101010100001011101011010	5.64993
_	1	010111001001001110110010001100010111001011010101	5.73807
_	2	101010110111001000101101010010100010010101000001	4.97464
_	3	100001010011110011111010010000011111100000110001	5.08541
_	4	001110110111010001110111110001001110111110110001	5.17833
_	5	100011110110100110100000111010011100110110110100	5.44252
_	6	011010100001111010011110110010000101010001000001	5.3158
_	7	010011101010001111000101100110111101100001111111	5.58027
13	0	010011000001111110100011001100010111011010010010	5.78842
_	1	011110011101001000011010111100000111101111000010	5.46939
_	2	100111111011000010011111011111000001110101001010	5.6087
_	3	110000001111101111111110000101001000100110111111	5.81079
_	4	001000001110001001100100110101001000010011100000	5.66395
_	5	001000100011110100101010101011111101100110110001	5.41695
_	6	000001110111011001000110101010010011001100111100	5.99419
_	7	001000110100100101000101101101100110001000101101	5.68873

14	0	011011101011010010011110011100111100010111010001	5.39798
_	1	101110011000110111100101101100110101110101110111	5.79618
_	2	101011110100010100100100110010110011111100100111	5.16981
_	3	101001111001100011110010100111001001111000000011	5.45632
_	4	001100011000010110100000011100000101110111010110	5.68124
_	5	111111010000001111100010101110101100001010101101	5.71208
_	6	010011100010001101000010011111111011100100111111	6.15659
_	7	011100010000011111100001100110101001100111001000	5.69043
15	0	010000111110011010101000111100100101110010101100	5.62828
_	1	001001011110000101010000001100001110010100110110	5.58581
_	2	110000111000010010010100110100010110011110110111	5.10237
_	3	100111101101000111010111110011000100111110001100	5.05382
_	4	110010000000110111000100000000101101101011101110	5.12906
_	5	010101010011011001101100010111100111101000001100	5.37247
_	6	100100110110000100101110001100101001100010000000	5.59404
_	7	101100001011100111101000011111110111101110111000	5.22303
16	0	110011011100101101110000110011000100000110000110	5.55543
_	1	010101011110011011110101100110000101111101011101	5.56685
_	2	010100001101000111010110000001111000101000011011	6.00847
_	3	101010000000000100100001101001000111001000111101	5.44112
_	4	101011011010010110000000101111001010010101100000	5.93448
_	5	110000011001100100100100101110111111110000101100	5.61612
_	6	001100001011001100111000111000001111100110101101	6.25398
_	7	101101011001101010111011011000000010111110100100	5.99946
17	0	110101010011001111011101010100001100111010010111	5.41124
_	1	111100101101011111101111101111010010110101111001	5.43992
_	2	000011111011111000110000010010000011110101001011	5.60097
_	3	010110110000001001001110101001010110100100011001	5.47693
_	4	100010111010001000010011101110000111100000001101	5.84543
_	5	011110101101001110001010110000100111100100011100	5.91958
_	6	101011011010111101000010011111111010110001110001	5.95431
_	7	011010110110101000101000000101110100100001110001	6.0074
18	0	100100010011101001010010000110111011001010010001	5.4584
_	1	011110101111100101010001110001011101011000000011	5.56105
_	2	001100100111100001100111001011110111010010111001	5.26762
_	3	101101110000100100010001111011100110100001101100	5.31641

_	4	111010010110100010011001100001010001101001000000	5.23496
_	5	100110110001100100100100001010000110111100000011	5.62023
_	6	000101010101011101010000111000010011111000001000	5.46795
_	7	001001001011100101100001011100010111101011010001	5.34549
19	0	110011001010111000111001110011000100000101011101	5.53714
_	1	001110101110010000000110100101111001011011101100	5.63025
_	2	100100010011001111011101101000110000011001111001	5.40207
_	3	100011010011010000001101011001101010101100110101	5.01684
_	4	100010111000001010011010111111001111011000100110	5.49291
_	5	000000001011000000111101101100111101101100011001	6.15248
_	6	011011110011110100011011010110000110000011001010	6.42099
_	7	110011001000011001101110010100100011011010010011	5.62151
20	0	111000010110110100000100111011111010100010010100	5.5247
_	1	011101001001100100001110111100000100110011100000	5.42905
_	2	110110101111001101101111001110101010111101100010	5.49398
_	3	110011000110010000011100010010100101000001010100	5.2273
_	4	000100011111100000010001100010111110011100010101	5.38088
_	5	100011001000011011011100101000100101101100110110	5.27308
_	6	100011001001100111001100111110001001000110010000	6.3006
_	7	100011001100010010100010101110110000010111010111	5.28889
21	0	100110011101000100101110001011011111111111111000	6.06748
_	1	110010110111011011110011011011001011101111100001	5.58275
_	2	000000000101100010011111100011011011010111011101	5.52333
_	3	010101001101010101011001001001001000001110011110	5.47386
_	4	001000001101101000011111100000000111101111010101	6.17795
_	5	110101101101000100000000001000001000001011000100	5.52037
_	6	000101011101001011100001001011111011110110001101	5.63197
_	7	001110010110001101110110110010111010110000101011	5.5878
22	0	000101000100001010111010001010101111100000010100	5.48042
_	1	001001000000011100011001000011101001010110101010	5.54003
_	2	001011011000101011111110101010010011010110001110	5.54329
_	3	001101011101011100000110000000100010010110010010	5.48972
_	4	101011110100111010101001001011110010000000000101	5.2639
_	5	100111011001111001111111111001111101001100111110	5.21962
_	6	111001110000100101011111001010100110011000111111	5.97209
_	7	001100110000011001101000110001001011000001100111	5.83849

23	0	11100010010000000111101001011110011101100011011	5.61823
_	1	10110011000010001110110011010001110000101110010 1	5.48566
_	2	01101011110100001110100111111100100101110001101 1	5.68987
_	3	00111001110011101110110010001011100000010001011 0	5.26213
_	4	11100111100101010000101000000101000010000000100 00	5.76646
_	5	11101010000000101000001101111010010010011110001 1	5.57245
_	6	10110000001110100011001101110000000000011111101 01	5.68117
_	7	11000111001110000110001011100011010001011011010 1	5.4414
24	0	10110000011101101101100110011011001111110010110 0	6.13606
_	1	11000110001101010101010111101000010010110001101 0	5.72737
_	2	00010100111001000001100010000100111111000101111 1	5.8725
_	3	01001101001101111100101000100011010000000100001 1	5.20035
_	4	11010110010111011101000100000111110111000011111 11	5.31939
_	5	11000011111000001101110100010111110111010101110 0	5.34265
_	6	01101100110111111001010100011111011000001100111 0	5.14113
_	7	10111000110010110100010000000000010011111000100 1	5.44336
25	0	00100011101001100101010101110110001001101000100 1	5.36221
_	1	11100010110111101111000100111110110010010011010 0	6.48709
_	2	10101011111010101100100000000001100000011010000 1	5.23712
_	3	10011010101001101011101010000101110111111100000 1	5.2158
_	4	11100000101000001100111100110001110011001011011 0	5.78448
_	5	10010000110111100011001010010011111001011110000 0	5.5573
_	6	10000010010101110001010001001011111101110110 0	5.18125
_	7	01011011110010100110101111100000000010111010101 1	5.67579
26	0	00100000100101001110010001011001011111100110000 1	5.59793
_	1	11010100110110011101111110111101000010100011000 1	5.72138
_	2	10011111101000110010100010011001000011011001111 0	5.07395
_	3	11001110011101110111010100111101110000100111111 1	5.14641
_	4	00001000101101100110010110111000010110011110010 1	5.63994
_	5	01011001100001100111110101100000101011101100111 0	5.21966
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_	4	00000100001101011100001000100110011110010010100	5.37031
_	5	00011100111000100101001010111001101111011101100	5.51583
_	6	10101010100010000100000100110011101011101110000	6.0271
_	7	11001110101110100001110010011010100011011101111	6.27385
105	0	10011011010111010000000011110100111010111010001	5.95961
_	1	11101110010000101001100101000111100101000000111	5.80221
_	2	01110011001001010110000010010000100111111110110	5.95307
_	3	10110011111000101101010001110010111010111001100	5.58917
_	4	10100101110010010011010001001101101011000010010	5.30994
_	5	11010011001101010100100101010111001010010110100	5.26182
_	6	11001010110100111101111111001010110110110101010	5.65862
_	7	10011110100101011000010100011110100000101111110	5.33454
106	0	10011100010001011100000101001110111000001001101	5.36112
_	1	11011000110001110110100110100011111101101011000	5.44223
_	2	10100110010111110010111010000011011011100111110	5.11182
_	3	11111000101011100110111111011101001101100100101	5.18747
_	4	01001100000010110111010000000101001100000011110	6.14129
_	5	10011000110011000110001011011011110101000100100	5.85689
_	6	10011001010101100100110011111001000111001011101	5.88461
_	7	10001111111000111111101111100001000010011100101	5.8839
107	0	01011010000000110001001000010101001110000001101	5.7582
_	1	00111101010100100101111101100101000110010010101	5.57077
_	2	01001111100011010110000000100011111010101110111	5.32448
_	3	10110011111001111100010111110011110101101110000	5.31757
_	4	11110111111001011000101011000110010000100110010	5.81411
_	5	00010010101010101110010010001111010100000100000	5.53765
_	6	10011110110110100100011110110001000111001101110	5.67179
_	7	01011011011111110011111111111000010011011001010	5.63564
108	0	00101100000100001010000000001000010000110101001	5.32447
_	1	00011101111101111111010101101000110001100010101	5.37368
_	2	10101110001100000010101111100101010011101111001	5.05079
_	3	01111011110010000110110101000010110010011011001	5.2514

_	4	011001000000011110111110101111010001010000011101 1	5.48326
_	5	001111100111001001100101011111010111110011100100	5.36805
_	6	101011010110110110010100111011010101001010100010	5.44207
_	7	111111010001011111011010000000010001011011111001	5.68318
109	0	011100101011011101010101001110111101101000000011	5.53802
_	1	011001111000010001001101100101000101100100010001	5.60374
_	2	010111101111101100110010010001011100001001001111	5.88288
_	3	100110101100111010111100001011000000010011110000	6.08189
_	4	101001001001101010001101100100011100101100001110	5.56045
_	5	110101110111100101011110101001000101110000000011	5.69892
_	6	010110001010010100110000111101000010110100001110	5.36536
_	7	010101010101010001100010101000100001001001101001	5.74282
110	0	010011001010110100011110100111001010100110000011	5.51666
_	1	111010100110111010001100010100010001010101010011	5.58194
_	2	000001110101111101101101100000100011100101100111	5.17366
_	3	000011010000101001000100001000010100001110110100	4.8908
_	4	110011000111010001101000100010111011000110000110	5.31483
_	5	100111011010000110011010010110011011010100101110	5.50261
_	6	000111111011010011101111000110011010111100110011	5.7512
_	7	110010000011010100000000010111000100011000111000	5.5706
111	0	111111001001111101010011101010100110010001010011	5.89292
_	1	100110111011010010000000010100100111101101100011	5.30863
_	2	010010000000001011101000010010100000001000100101	5.48346
_	3	000100111100010111111110011000111110101011111101	5.70374
_	4	111111000001101010011101000000010010001110101100	5.89737
_	5	001111111001111001001001001100101100010110111001	5.37376
_	6	100111110001110010010101110101100011111011111111	5.48055
_	7	110011000100011110101111101110011111001001010011	5.68568
112	0	110101111001100101001001001100000101000001101110 1	5.88024
_	1	010111000110101011111110110111011001111000011110	5.47095
_	2	101101101101001100001011101110111111011000011100	5.09554
_	3	101011010011011000000101111101101001100011001001	5.20864
_	4	101101101000001110011111101110000010011111001001	5.46282
_	5	011110100110111001001011000111101001000110110111	5.24083
_	6	100000110110000111110010010000110000101111001100	5.34804
_	7	011001010011000011111110010100010000111101100011	5.79381

113	0	0100101100101100111101110101010101110111111001110	5.70451
_	1	1100100000001011010001010000011001100011111000011	5.76646
_	2	0111011111101111001111101000111111010010100110 10	5.48922
_	3	1110011010101101001100100100011011010111100011 01	5.85459
_	4	0001001010100111000011110101001000100011011111100	5.34322
_	5	1100001101000100111000001010101100110101000110 11	5.38476
_	6	0001100100000100101010010010100010100000010110000	5.38847
_	7	0001011011011100000000101010101011101011000110001	5.62789
114	0	0011101101100100111010000100101101111110010100 11	5.38714
_	1	0111110100111111110011100011010011100110010001 01	5.96027
_	2	1101111110100100011011100100110110110101000000 01	5.23523
_	3	1100111011011111110001111100110100101000011011 10	5.02382
_	4	1100110011000100011000101101001010000010001010 11	5.44333
_	5	0111100010010110111011100110111011110001111001 00	5.48541
_	6	0011111111100010111010000010100110101000010111 10	5.36121
_	7	0111110001010111001100100010011111000001100111 011	5.65062
115	0	1101011011101001111111010101110101101001001011 00	5.46964
_	1	0011000110011111101000011100110111010100111110 100	5.6656
_	2	1100001010101000001100110011000011100101110000 00	5.12032
_	3	1001011010011010010001011010111001111111110000 11	5.11752
_	4	1110101011001010100100111110110100100101111011 111	5.72992
_	5	0001110110110010100011011111001101110101010010 10	5.38947
_	6	0111100101100010011100010101111111101010010001 10	5.76647
_	7	0000110100000011100110000110110111100011100000 101	5.46201
116	0	0100000001001101101100101111010001100111010110 00	5.61802
_	1	0001101001001111001110110101000001111110011011 01	5.60095
_	2	0101001110011101010010000110100110000100011001 01	5.78404
_	3	1000101001101110101101100011101110010001001000 10	5.83078
_	4	1001100110011010110100110010100111001100110111 011	6.73943
_	5	0110010011101100011001101001100000011111000000 100	5.78234
_	6	1000011110101111101111101111000000111101010110 11	5.62334
_	7	1010110011001111001011001011011110100001110000 10	5.54562
117	0	0011011001001010010011001000111101011000101000 11	5.18512
_	1	0110010000100100000110011001101001000000011100 11	5.53737
_	2	1010100110110000001001100111010011011001001111000	5.04084
_	3	0100111001100101011101100001110101100100101010 11	5.18877

_	4	001101010010100001010110001110000110110110000001	5.63776
_	5	001011011110101010111010011001101111010110111010	5.51185
_	6	001011011100001011100010101011011000011011000101	5.59396
_	7	001110011010111010011001001100000011111010011010	5.63623
118	0	100100000001100011001101100001011101011111110000	6.14053
_	1	011101010101111010100001101111010001001100011101	5.85618
_	2	011001001100110101110110111000110110011111110010	5.78596
_	3	111110011101010011010010010011110011001000110011	5.30879
_	4	110100100010111101100100001101011011100111101000	5.49243
_	5	011010011011111110110101001001100110010011101001	4.9792
_	6	110100000101100100101000101100111100000101111001	5.48403
_	7	110101010000101010101011101111010101011011001110	5.7467
119	0	111101010101110001011101000110000101111101111101	5.85524
_	1	000101011011000111001111110111111010111011111000	5.34138
_	2	010101011100101100101000110101001010110111000110	5.13632
_	3	101101101100011011101010010001100000100000100010	5.16527
_	4	011000011011000011000000110011111100110110000110	5.46585
_	5	010011011101110111011110110101010111100100011011	5.60961
_	6	111101010100101001001001000000011011111001101	5.64467
_	7	111011010001111101010100011001110111101000101001	5.61005
120	0	000000110000010011001010001100010101110110111010	5.47114
_	1	011001110001001110001110010100000001010101100100	5.5487
_	2	011010011110000101010001001011100100000010101110	5.64772
_	3	011111101110110010010001001100001111110010010101	5.32382
_	4	000101110101100001100011110101001001110000100000	5.58673
_	5	100100001010111010101001111010001001101011010010	5.56281
_	6	011011010100110010101000100010111011001101100010	5.82866
_	7	100000100001000000100110100100101011101110101010	5.72098
121	0	011000000000011001100010011100000100111110110110	5.55982
_	1	011001100101100101110011111100010110101011101011	5.95908
_	2	001000001010101100001001011100100001111000001100	5.80467
_	3	011001001001100111001111010100011011001000001110	5.78746
_	4	010100010010110101000001011111010110011000110101	5.43705
_	5	101010000110101000111101101110011100100011001010	5.62371
_	6	000100100000111000101011101100111101011111001111	5.21467
_	7	011011010100111000111100111011000110010100001011	5.44137

122	0	00111110100011001110110101110110010100000110000110	5.28322
_	1	11010110110111110101110111101100100110010001100 0	5.52593
_	2	00001011101000010011011010011100001101011001000 0	5.16118
_	3	10010000101110000111011001001001000110011111111 1	5.24138
_	4	00101000110110011111011011110101001011111111110 0	5.29281
_	5	11001101011110111111001100011000001101011110011	5.81859
_	6	10011010100100000001000110100011000100100010100 1	5.39217
_	7	00000111010101011010000011110011011010000010111	5.4718
123	0	01001001100001001111100100110001000000000110111 0	5.55493
_	1	01110000110001011111011110000000010101100100111 0	5.96005
_	2	01100110111101101110111010010010111101100110100 1	5.48706
_	3	01000101110101010001010101101110100101011100110 1	5.67064
_	4	11010001011010001110111010110010100010000000010 1	5.44018
_	5	01110110000110011010001101101100011011111001100 0	5.04313
_	6	11011100100000001101101000011100101011101110010 0	5.55619
_	7	10011100101000000110001000101001101000110111000 0	5.78161
124	0	01101101000000000110000111100110110110010101001 1	5.67486
_	1	00101100110010110110110100001010000000000101110 1	6.02822
_	2	11011000111011100110100100011011111010001001000 1	5.68113
_	3	01001011001110100110001010101100000100011100111 1	5.36005
_	4	10000000010111101100111010101010100000110100000 1	5.34754
_	5	01000101011010101101101100000000111011111101001 1	5.23916
_	6	01001110111001110111011110101000111110001011001 0	5.66904
_	7	01001000001100000111101111100110110011011100010 1	5.51148
125	0	01010010110010001011011000111001010000011100001 1	5.62586
_	1	01000101101100100100111101110000110101101001000 0	6.17023
_	2	10000010010111110000110101111000001011000101110 0	5.49749
_	3	01010001000000000100111111001110010000000100010 0	5.70179
_	4	00111000110111101101101101001001011101110101111 1	5.09412
_	5	00100001111000111100000100001101011101010011101 0	5.6387
_	6	00011010011101001011101110011110010011010000101 1	5.4194
_	7	00000101111110001111010101010000011000000011001 0	5.3626
126	0	00011011010111111000001101010101110100101100001 1	5.43152
_	1	10010001001010101110000100011110100001111001011 1	5.56319
_	2	00101110000000110010110011001001111101011010111 0	5.81927
_	3	00111111000111001111100100101110101000001000101 1	5.57609

_	4	000101111001100100001011101100110011111111101001	5.68232
_	5	010010011101100010010010001110101110100010011000	5.51824
_	6	111010000010110101001101010001101111101110010010	5.62734
	7	101101001011011001000000001101010011111110011101	5.41102

8.4.5.1.2 Symbol structure

The symbol structure is constructed using pilots, data and zero subcarriers. The symbol is first allocated with the appropriate pilots and with zero subcarriers, and then all the remaining subcarriers are used as data subcarriers (these will be divided into subchannels). In downlink, diversity symbol and AMC symbol have the same structure.

8.4.5.1.3 Safety channel constitution

Each BS reserves several bins for safety channels and transmits the information of safety channel locations via SICH. To construct safety channels, 96 frequency bins in a symbol are partitioned into 6 groups of 16 contiguous frequency bins. A safety channel consists of 6 bins each of which comes from each group.

The exact partitioning into channels is according to Equation (3), called safety channel permutation formula.

$$Bin(C,s,m) = \begin{cases} 16m' + \left\lfloor s' + P_{1,c_1}(m') \right\rfloor & 0 < c_1 < 16 \\ 16m' + s' & c_1 = 0 \end{cases} \quad (2.)$$

where

$Bin(C,s,m)$ = bin index of m-th bin in safety channel s.

m = bin-in-safety channel index. If safety channel size parameter N is 1, m = 0 ~ 5. If safety channel size parameter N is 2, m = 0 ~ 11

$m' = m \bmod 6$

s = index of a safety channel. If safety channel size parameter N is 1, s=0 ~ 15. If safety channel size parameter N is 2, s=0 ~ 7

$s' = s + 8 * \lfloor m/6 \rfloor$

$P_{1,c1}(j)$ = j-th element of the sequence obtained by rotating basic permutation sequence P_1 cyclically to the left c_1 times. P_1={1, 2, 4, 8, 3, 6, 12, 11, 5, 10, 7, 14, 15, 13, 9}

$c_1 = C \bmod 16$, C is channel partition id given by SICH.

In Equation (6), the operation in [ ] is over GF(16). In GF(16), addition is binary XOR operation. For example, 13 + 4 in GF(16) is $[(1101)_2$ **XOR** $(0100)_2]= (1001)_2 = 9$, where $(x)_2$ represents binary expansion of x.

A BS can allocate 0, 1 or 2 safety channels at a time. Safety channel information given by SICH is channel partition id C, number of safety channels N, and safety channel index s.

8.4.5.1.4 Downlink subchannels subcarrier allocation

Each subchannel is composed of 48 subcarriers. The AMC and safety subchannels consist of 6 bins while diversity subchannels consist of 48 scattered subcarriers. The carrier allocations for safety subchannel and AMC subchannel are described by band index b and bin index within band. Bin index for AMC subchannels starts zero at the first bin of the first AMC symbol and increases along symbol axis and goes back to the first symbol. It skips the bins allocated for safety operation. The subcarrier allocation for diversity subchannels is formulated using a permutation series, and is allocated out of the data subcarriers.

8.4.5.1.5 Partitioning of data subcarriers into subchannels in downlink

8.4.5.1.5.1 AMC subchannels

The s-th AMC subchannel in b-th band consists of 48 data subcarriers over 6 consecutive AMC bins. Figure 2 illustrates data subcarrier mapping among 6 bins of a AMC subchannel.

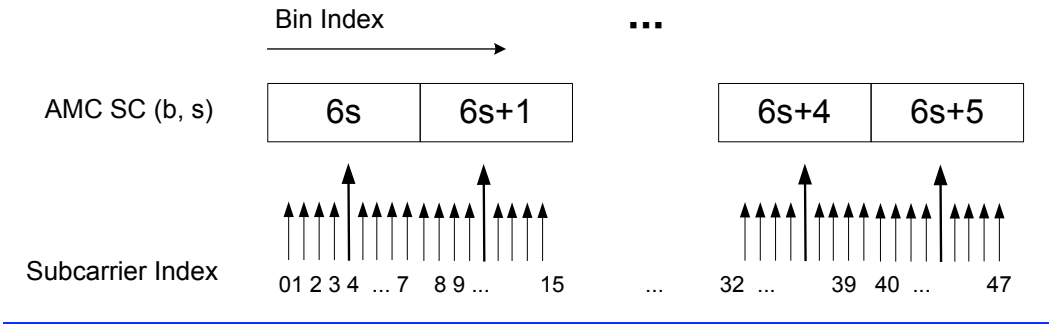

Figure 2 – Carrier mapping for AMC subchannels

8.4.5.1.5.2 Safety subchannels

The s-th safety subchannel in b-th band consists of 48 data subcarriers over 6 consecutive bins in a safety channel. The data subcarrier mapping among 6 bins of a safety subchannel is identical to that of AMC subchannels.

8.4.5.1.5.3 Diversity subchannels

To allocate the diversity subchannels, the whole data tones in a slot are partitioned into groups of contiguous data subcarriers. Each subchannel consists of one subcarrier from each of these groups. The number of groups is therefore equal to number of data subcarriers per subchannel, and its value is 48. The number of the subcarriers in a group is equal to the number of subchannels, say N_s. When a slot consists of T symbols and N_s is power of 2, the exact partitioning into subchannels is according to Equation (4), called DL permutation formula. The exact values of T are implicitly broadcasted via frame configuration number in SICH symbol.

$$Carrier(s,m;n) = \begin{cases} N_s \times k + \left[s + P_{1,c_1}(k') + P_{2,c_2}(k') \right]_{N_s} & 0 < c_1, c_2 < N_s \\ N_s \times k + \left[s + P_{1,c_1}(k') \right]_{N_s} & c_1 \neq 0, c_2 = 0 \\ N_s \times k + \left[s + P_{2,c_2}(k') \right]_{N_s} & c_1 = 0, c_2 \neq 0 \\ N_s \times k + s, & c_1 = 0, c_2 = 0 \end{cases} \quad (3.)$$

where

Carrier(*s*, *m*; *n*) = subcarrier index of *m*-th subcarrier in subchannel *s* at symbol *n*

$k = (m + s * \mathrm{PRM}(R)) \bmod \mathrm{R}$, R = 48 / T

$k' = k + n \times R$

n = data symbol index in slot, $n = \lfloor m/\mathrm{R} \rfloor$

m = subcarrier-in-subchannel index from the set [0 ~ 47]

s = index number of a subchannel from the set [0 ~ N_s-1]

PRM(*R*) is the largest prime number less than $\lfloor R/2 \rfloor$

$P_{1,c1}(j)$ = j-th element of the sequence obtained by rotating basic permutation sequence P_1 cyclically to the left c_1 times. See Table 3.

$P_{2,c2}(j)$ = j-th element of the sequence obtained by rotating basic permutation sequence P_2 cyclically to the left c_2 times. See Table 3.

$c_1 = ID_{cell} \bmod N_s$, $c_2 = \lfloor ID_{cell} / N_s \rfloor$, $0 \le c_1, c_2 < N_s$

In Equation (4), the operation in [ ] is done over GF(N_s). In GF(2^n), addition is binary XOR operation. For example, 13 + 4 in GF(2^n) is $[(1101)_2$ **XOR** $(0100)_2]= (1001)_2 = 9$, where $(x)_2$ represents binary expansion of x.

When $N_s = p^q - 1$ where p is a prime, the exact partitioning into subchannels is according to Equation (5)

$$Carrier(s,m;n) = N_s \times k + P_c(k',s) - 1, \quad 0 \le c < N_s \qquad (4.)$$

where

$$P_c(i,s) = \begin{cases} P_c(i) + s & \text{if } P_c(i) + s \neq 0 \\ P_c(i) & \text{if } P_c(i) + s = 0 \end{cases} \qquad (5.)$$

Carrier(s, m; n) = subcarrier index of m-th subcarrier in subchannel s at symbol n

$k = (m + s * \mathrm{PRM}(R)) \bmod \mathrm{R}$, R = 48 / T

$k' = k + n \times R$

n = data symbol index in slot, $n = \lfloor m/\mathrm{R} \rfloor$

m = subcarrier-in-subchannel index from the set [0 ~ 47]

s = index number of a subchannel from the set [1 ~ N_s]

PRM(R) is the largest prime number less than $\lfloor R/2 \rfloor$

$P_c(j)$= j-th element of the sequence obtained by rotating basic permutation sequence P_0 cyclically to the left c times.

c = cell number, $0 \le c < N_s$

In Equation (5), sequence P_0 is defined over GF(N_s+1)=GF(p^q). In the table below, each entry of the sequences defined over GF(p^q) is represented by p-ary q-tuple. The addition between two element in GF(p^q) is component-wise addition modulo p of two representation. For example, (56) + (34) in GF(7^2) = (13). In Equation (5) where P_0 is defined over GF(p^q), the subchannel index number s shell be represented by p-ary q-tuple and addition is over GF(p^q).

Table 3 – Permutation sequences for diversity subcarrier allocations

GF (8)	P_1	1, 2, 4, 3, 6, 7, 5
	P_2	1, 4, 6, 5, 2, 3, 7
GF (16)	P_1	1, 2, 4, 8, 3, 6, 12, 11, 5, 10, 7, 14, 15, 13, 9
	P_2	1, 4, 3, 12, 5, 7, 15, 9, 2, 8, 6, 11, 10, 14, 13
GF (32)	P_1	1, 2, 4, 8, 16, 5, 10, 20, 13, 26, 17, 7, 14, 28, 29, 31, 27, 19, 3, 6, 12, 24, 21, 15, 30, 25, 23, 11, 22, 9, 18
	P_2	1, 4, 16, 10, 13, 17, 14, 29, 27, 3, 12, 21, 30, 23, 22, 18, 2, 8, 5, 20, 26, 7, 28, 31, 19, 6, 24, 15, 25, 11, 9
GF (64)	P_1	1, 2, 4, 8, 16, 32, 3, 6, 12, 24, 48, 35, 5, 10, 20, 40, 19, 38, 15, 30, 60, 59, 53, 41, 17, 34, 7, 14, 28, 56, 51, 37, 9, 18, 36, 11, 22, 44, 27, 54, 47, 29, 58, 55, 45, 25, 50, 39, 13, 26, 52, 43, 21, 42, 23, 46, 31, 62, 63, 61, 57, 49, 33
	P_2	1, 4, 16, 3, 12, 48, 5, 20, 19, 15, 60, 53, 17, 7, 28, 51, 9, 36, 22, 27, 47, 58, 45, 50, 13, 52, 21, 23, 31, 63, 57, 33, 2, 8, 32, 6, 24, 35, 10, 40, 38, 30, 59, 41, 34, 14, 56, 37, 18, 11, 44, 54, 29, 55, 25, 39, 26, 43, 42, 46, 62, 61, 49

GF (97)	P_0	1, 5, 25, 28, 43, 21, 8, 40, 6, 30, 53, 71, 64, 29, 48, 46, 36, 83, 27, 38, 93, 77, 94, 82, 22, 13, 65, 34, 73, 74, 79, 7, 35, 78, 2, 10, 50, 56, 86, 42, 16, 80, 12, 60, 9, 45, 31, 58, 96, 92, 72, 69, 54, 76, 89, 57, 91, 67, 44, 26, 33, 68, 49, 51, 61, 14, 70, 59, 4, 20, 3, 15, 75, 84, 32, 63, 24, 23, 18, 90, 62, 19, 95, 87, 47, 41, 11, 55, 81, 17, 85, 37, 88, 52, 66, 39
GF (49)	P_0	01, 22, 46, 52, 42, 41, 26, 50, 05, 33, 62, 43, 63, 65, 32, 40, 04, 11, 23, 61, 21, 24, 13, 60, 06, 55, 31, 25, 35, 36, 51, 20, 02, 44, 15, 34, 14, 12, 45, 30, 03, 66, 54, 16, 56, 53, 64, 10
GF (25)	P_0	01, 22, 41, 21, 24, 30, 03, 11, 23, 13, 12, 40, 04, 33, 14, 34, 31, 20, 02, 44, 32, 42, 43, 10
GF (13)	P_0	1, 2, 4, 8, 3, 6, 12, 11, 9, 5, 10, 7

8.4.5.2 Uplink

8.4.5.2.1 Subchannelization for uplink control symbols

In order to mitigate inter-cell interference in multi-cell environment, uplink control symbols are partitioned into subchannels in different manner in different cells.

All 864 tones are partitioned into 4 groups of contiguous tones at first. Then, each group is partitioned again into 27 subgroups of 4 pairs of tones. A subchannel consists of 4 pairs of tones and each pair of tones comes from different group.

The exact partitioning of pairs of tones into subchannels is according to Equation (7), called UL control subchannel permutation formula.

$$Alloc(s,m) = \begin{cases} 108m + s'' + 4 \times \left\lfloor s' + P_{1,c}(m) \right\rfloor & 0 < c < 27 \\ 108m + s'' + 4 \cdot s' & c = 0 \end{cases} \quad (6.)$$

where

Alloc(*s*,*m*) = pair-of-tones index of *m*-th pair of tones in subchannel *s*.

m = pair-of-tones -in-control subchannel index, m = 0 ~ 3

s = index number of a control subchannel, s = 0 ~ 107

$s' = \lfloor s/4 \rfloor$, and s'' = s mod 4

$P_{1,c}(j)$ = *j*-th element of the sequence obtained by rotating basic permutation sequence P_1 cyclically to the left c_1 times. P_1={001, 212, 112, 102, 101, 222, 110, 011, 210, 021, 211, 200, 020, 002, 121, 221, 201, 202, 111, 220, 022, 120, 012, 122, 100, 010}

$c = ID_{cell} \bmod 27$ where ID_{cell} is the cell number

In Equation (7), sequence P_0 is defined over GF(27). In the table below, each entry of the sequences defined over GF(27) is represented by ternary 3-tuple. The addition between two element in GF(27) is component-wise addition modulo 3 of two representation. For example, (112) + (111) in GF(3^3) = (220). In Equation (7) where P_1 is defined over GF(27), the subchannel index number s shell be represented by ternary 3-tuple and addition is over GF(27).

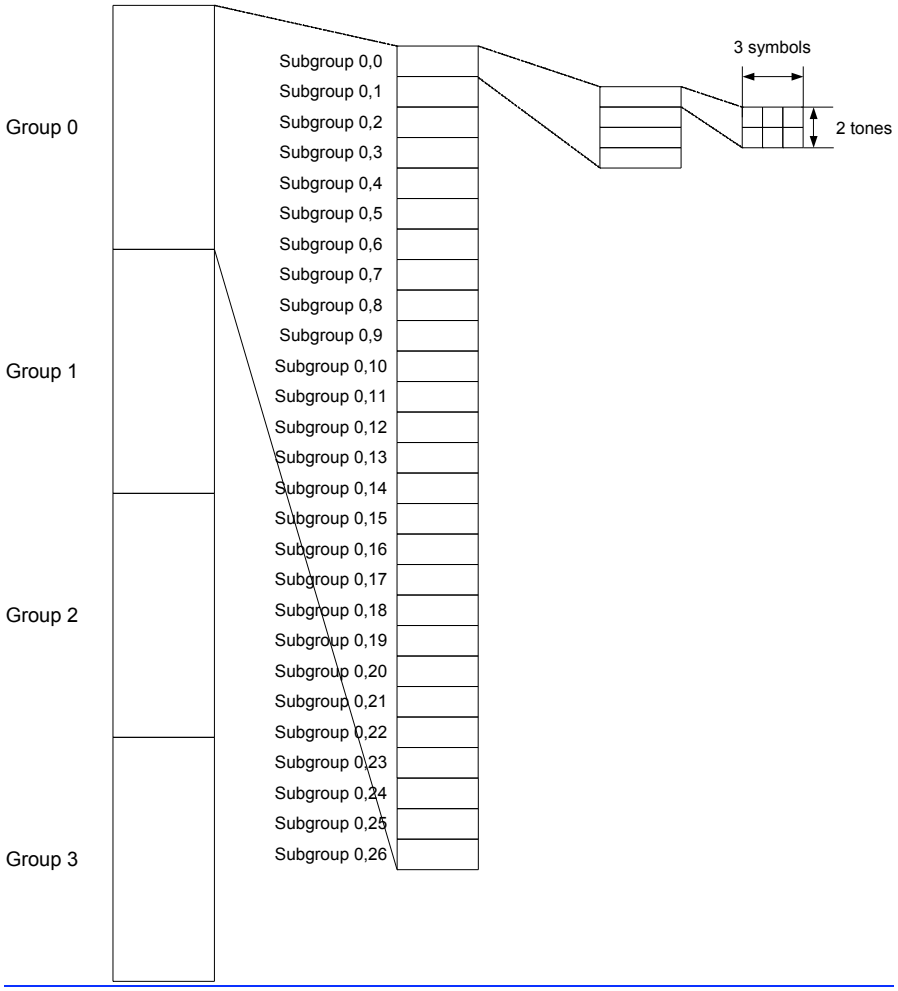

Figure 3 – Basic structure for control symbol subchannelization

8.4.5.2.2 AMC subchannel allocation

Uplink AMC subchannel allocation is basically the same as in the downlink. All the remaining data symbols after diversity subchannel symbols are assigned to AMC subchannels.

8.4.5.2.3 Diversity subchannel allocation

To allocate the subchannels, subcarriers in a slot are partitioned into tiles which is 3x6 frequency-time block containing 18 tones(2 pilot tones and 16 data tones, see **Error! Reference source not found.**). The whole frequency bands are partitioned into groups of contiguous tiles. Each subchannel consists of 3 tiles each of which is chosen from different groups. Number of tiles in a group is different according to FFT size.

For 1024-FFT, the number of tiles in a group is 32 and there are 9 groups in a symbol. Since a subchannel consists of 3 tiles, 3 groups at equal distance (3 groups away from each) are chosen and each tile is selected from each group.

The exact partitioning into subchannels is according to Equation (8), called UL permutation formula.

$$Tile(s,m) = \begin{cases} 96m + 32S + \left[s' + P_{1,c_1}(m) + P_{2,c_2}(m) \right]_{32} & 0 < c_1, c_2 < N_s \\ 96m + 32S + \left[s' + P_{1,c_1}(m) \right]_{32} & c_1 \neq 0, c_2 = 0 \\ 96m + 32S + \left[s' + P_{2,c_2}(m) \right]_{32} & c_1 = 0, c_2 \neq 0 \\ 96m + 32S + s' & c_1 = 0, c_2 = 0 \end{cases} \quad (7.)$$

where

Tile(*s*, *m*) = tile index of *m*-th tile in subchannel *s*.

S = $\lfloor s/32 \rfloor$, s' = s mod 32

m = tile-in-subchannel index from the set [0 ~ 2]

s = index number of a subchannel from the set [0 ~ 95]

$P_{1,c1}(j)$= *j*-th element of the sequence obtained by rotating basic permutation sequence P_1 cyclically to the left c_1 times. P_1={1, 2, 4, 8, 16, 5, 10, 20, 13, 26, 17, 7, 14, 28, 29, 31, 27, 19, 3, 6, 12, 24, 21, 15, 30, 25, 23, 11, 22, 9, 18}

$P_{2,c2}(j)$= *j*-th element of the sequence obtained by rotating basic permutation sequence P_2 cyclically to the left c_2 times. P_2={1, 4, 16, 10, 13, 17, 14, 29, 27, 3, 12, 21, 30, 23, 22, 18, 2, 8, 5, 20, 26, 7, 28, 31, 19, 6, 24, 15, 25, 11, 9}

$c_1 = ID_{cell}$ mod *32*, c_2 = = $\lfloor ID_{cell}/32 \rfloor$

In Equation (8), the operation in [ ] is over GF(32). In GF(2^n), addition is binary XOR operation. For example, 13 + 4 in GF(32) is $[(1101)_2$ **XOR** $(0100)_2]$= $(1001)_2$ = 9, where $(x)_2$ represents binary expansion of x.