Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Additional optional Symbol Structure**
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Re:	Sponsor re-circulation Ballot
Abstract	Additional optional Symbol Structure
Purpose	Adoption of proposed changes into P802.16-REVd/D4-2004
Notice	
Release	
Patent Policy and Procedures	

Add the following new paragraph:

8.4.6.1.4 Additional optional Symbol Structure for FUSC

The additional optional subchannel structure in the downlink supports 32 subchannels where each transmission uses 48 data carriers symbols as their minimal block of processing. In the downlink, all the pilot carriers are allocated first, and then the remaining carriers are used exclusively for data transmission. N_{used} subcarriers are divided into 9 contiguous subcarriers in which one pilot carrier is allocated. The position of the pilot carrier in 9 contiguous subcarriers varies according to the index of OFDM symbol which contains the subcarriers. If the 9 contiguous subcarriers indexed as 0 ~ 8, the index of the pilot carrier shell be $3l + 1$ where $l = m \bmod 3$(m is the symbol index).

Table 1 Downlink subcarrier allocation

parameters	Value	comments
Number of DC Subcarriers	1	
Number of Guard Subcarriers, Left	159	
Number of Guard Subcarriers, Right	160	
Number of Used Subcarriers(N_{used})	1728	
Number of Pilot Subcarriers	192	
Pilot subcarrier index	$9k$+$3m$+1, for k=0,…, 191 and m=[symbol index]mod3	Symbol index 0 is the first symbol from which the diversity subchannelization is applied.
Number of Data Subcarriers	1536	

8.4.6.1.4.1 Downlink subchannels subcarrier allocation

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, 32. The exact partitioning into subchannels is according to Equation (1), called DL permutation formula.

$$Carrier(s,m) = \begin{cases} 32 \times k + \lfloor s + P_{1,c_1}(k) + P_{2,c_2}(k) \rfloor, & 0 < c_1, c_2 < N_s \\ 32 \times k + \lfloor s + P_{1,c_1}(k) \rfloor, & c_1 \neq 0, c_2 = 0 \\ 32 \times k + \lfloor s + P_{2,c_2}(k) \rfloor, & c_1 = 0, c_2 \neq 0 \\ 32 \times k + s, & c_1 = 0, c_2 = 0 \end{cases} \quad (1.)$$

where

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

$k = (m + s * 23) \bmod 48$

n = data symbol index in slot, $n = \lfloor m/48 \rfloor$

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

s = index number of a subchannel from the set [0 ~ 31]

$P_{1,c1}(j)$ = 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}

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

In Equation (1), the operation in [ ] is done over GF(N_s). In GF(2^5), addition is binary XOR operation. For example, 29 + 12 in GF(2^n) is [$(11101)_2$ **XOR** $(01100)_2$]= $(10001)_2$ = 17, where $(x)_2$ represents binary expansion of x.