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| Project | **IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>** |
| Title | **Additional AAS improvements for OFDMA PHY** |
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| Re: | Contribution supporting sponsor ballot recirculation |
| Abstract | This contribution proposes additional changes for OFDMA AAS improvement. |
| Purpose | Adopt into P802.16e/D3 |
| Notice |  |
| Release |  |
| Patent Policy and Procedures |  |

# Additional AAS improvements for OFDMA PHY

## Problem Definition

The comment #194 for AAS DL scan enhancement has been accepted by BRC members. The resolution is given in C802.16d-04/73r4 with editorial corrections in C802.16d-04/90. However, the suggested resolution still needs improvements and three issues are addressed in this contribution.

Firstly, we address an AAS ranging enhancement for lower latency and fast link establishment. Specifically, there is no mechanism for indicating permutation scheme~~. and code set partition pattern for uplink ranging subchannel allocation. In addition to ranging codes, the default value of initial and final back-off window size for ranging contention should be defined.~~

The second issue is about basic AAS preamble described in C802.16d-04/90. The suggested text for section 8.4.4.7.1 AAS Downlink Preamble reads "An AAS downlink preamble is formed by appropriately combining different preamble sequences defined in section 8.4.6.1.1" This definition leads to 32 different basic preambles since the length of preamble sequences should be equal to the number of used subcarriers, $N_{used}$. The 32 different preambles seem to be insufficient for sectorized system with frequency reuse 1.

Finally, the adopted UL AAS preambles are not consistent with the DL AAS preamble. Orthogonal AAS preambles are needed also in the UL to obtain the accurate UL channel response for multiple SS's transmitting simultaneously. The "exact time index shift" defined in PHY_MOD_DL_IE is missing in PHY_MOD_UL_IE.

## Proposed Enhancement

~~To resolve the ranging subchannel ambiguity, we are proposing the indicator bits for UL permutation and code set partition in AAS-DLFP of C802.16d-04/90. If we use 144 tones in OFDMA symbol for a ranging subchannel, 6, 8 and 8 data subchannels are required in PUSC, optional PUSC, and band AMC (2 bin x 3 symbol) permutation. Some of 256 ranging codes are serially designated for different purpose; initial, BW request, periodic, and hand-off ranging. An example for reflecting these two improvements is shown in Table 1.~~
To resolve the raging subchannel ambiguity, we will clarify the rule for determining the permutation for the UL ranging subchannel based on the DL permutation used for DLFP.

To increase the number of basic AAS preambles, we propose a circular index shift within 6 consecutive subcarrier block to define 192 (32 * ~~6~~ 3) basic AAS preambles. See the details in the suggested text changes below.

For orthogonal UL AAS preamble, we are proposing the same AAS preambles with DL shall be used for the UL AAS. The preambles shifted by rational number in time domain provides the perfect orthogonality and are actually implemented in the frequency domain.

## Proposed Text Changes

[Add the following text below Table 1 "AAS-DLFP Structure, Diversity-Map Scan" in Section 8.4.4.7 that will be added in IEEE802.16-REVd/D5 according to the adopted contributions IEEE C802.16d-04_90.]

The permutation for the ranging subchannel allocated in DLFP follows the permutation of the zone where the DLFP is carried. PUSC and FUSC zone in DL correspond to 4X3 tile PUSC zone in UL. The optional FUSC corresponds to the optional 3X3 tile PUSC zone. Lastly, AAS and AMC zone correspond to AAS and AMC zone.

[Modify the text 8.4.4.7.1 "AAS Downlink Preamble" that will be added in IEEE802.16-REVd/D5 according to the adopted contributions IEEE C802.16d-04_90.]

The text "~~An AAS downlink preamble is formed by appropriately combining different preamble sequences defined in section 8.4.6.1.1~~" is to be changed "An AAS downlink preamble for 3 different segments are formed by cyclically combining sequences for 3 subcarrier sets defined in section 8.4.6.1.1. Specifically, the basic preamble sequences P for sector s is given by

$$P(3n + m) = C_{mod(s+m,3)}(n) \text{ for } s = 0 \sim 3 \text{ and } 0 \le m < 2 \qquad \text{(aaa)}$$

,where $C_r(n)$ is the (n+1)-th element of PN sequences for r-th preamble carrier-set defined in section 8.4.6.1.1.

[Replace section 8.4.5.4.9 "UL-MAP physical Modifier IE" that will be added in IEEE802.16-REVd/D5 according to the adopted contributions IEEE C802.16d-04_90.]

8.4.5.4.9 UL-MAP Physical Modifier IE

The Physical Modifier Information Element indicates that the subsequent allocations shall utilize a preamble, which is either randomized or cyclically delayed in time by *k* samples (see Equation (1)). The PHYMOD_UL_IE can appear anywhere in the UL map, and it shall remain in effect until another PHYMOD_UL_IE is encountered, or until the end of the UL map.

**Table 4. Structure of PHYMOD_UL_IE ()**

| | | |
|---|---|---|
| PHY_MOD_UL_IE() { | | |
| Extended UIUC | 4 bits | |
| Length | 4 bits | |
| Preamble Modifier Type | 1 bit | 0 – Randomized preamble<br>1 – Cyclically shifted Preamble |
| if (Preamble Modifier Type == 0) { | | |
| Preamble Frequency Shift Index | 4 bits | Indicates the value of K in equation (aaa) |
| Reserved | 1 bit | |
| } else { | | |
| Time Index Shift Type | 1 bit | 0 – Rounded down shift<br>1 – Exact shift |
| if (Time Index Shift Type == 0) | | |
| Preamble Time Shift Index | 4 bits | For PUSC,<br>0 – 0 sample cyclic shift<br>1 – floor(Nfft/4) sample cyclic shift<br>….<br>3 – floor(Nfft/4*3) sample cyclic shift<br>4-15 – reserved<br>For optional PUSC,<br>0 – 0 sample cyclic shift<br>1 – floor(Nfft/3) sample cyclic shift<br>2 – floor(Nfft/3*2) sample cyclic shift<br>3-15 – reserved |

| | | |
|---|---|---|
| | | For AMC permutation,<br>0 – 0 sample cyclic shift<br>1 – floor(Nfft/9) sample cyclic shift<br>….<br>8 – floor(Nfft/9*8) sample cyclic shift<br>9-15 – reserved |
| } else { | | |
| Preamble Time Shift Index | 4 bits | For PUSC,<br>0 – 0 sample cyclic shift<br>1 – Nfft/4 sample cyclic shift<br>….<br>3 – Nfft/4*3 sample cyclic shift<br>4-15 – reserved<br>For optional PUSC,<br>0 – 0 sample cyclic shift<br>1 – Nfft/3 sample cyclic shift<br>2 – Nfft/3*2 sample cyclic shift<br>3-15 – reserved<br>For AMC permutation,<br>0 – 0 sample cyclic shift<br>1 – Nfft/9 sample cyclic shift<br>….<br>8 – Nfft/9*8 sample cyclic shift<br>9-15 – reserved |
| } | | |
| } | | |
| Reserved | ~~3~~ 2 bits | |
| } | | |

**Preamble Modifier Type**

This parameter defines whether the preamble will be ~~randomized or~~ cyclically shifted in time or in frequency.

**Preamble Frequency Shift Index**

This parameter effects the cyclic shift of the preamble in frequency axis, as defined by equation (aaa)

**Preamble Time Shift Index**

The parameter defines how many samples of cyclic shift shall be introduced into the preamble symbols. The unit of cyclic shift depends on the subchannel permutation to ensure the frequency-domain orthogonality between the different preambles in the same subchannel.

## [Replace Table 284 in section 8.4.5.3.11 in P802.16REVd/D5]

**Table 284.-OFDMA DL-MAP Physical Modifier IE format**

| | | |
|---|---|---|
| PHY_MOD_DL_IE() { | | |
| Extended DIUC | 4 bits | PHYMOD = 0x08 |
| Length | 4 bits | Length = 0x03 |
| Preamble Modifier Type | 1 bit | 0 – Randomized preamble<br>1 – Cyclically shifted Preamble |
| if (Preamble Modifier Type == 0) { | | |
| Preamble Frequency Shift Index | 4 bits | Indicates the value of K in equation (101) |
| Reserved | 1 bit | |
| } else { | | |
| Time Index Shift Type | 1 bit | 0 – Rounded down shift<br>1 – Exact shift |
| if (Time Index Shift Type == 0) | | |

| | | |
|---|---|---|
| Preamble Time Shift Index | 4 bits | For PUSC,<br>0 – 0 sample cyclic shift<br>1 – floor(Nfft/14) sample cyclic shift<br>….<br>13 – floor(Nfft/14*13) sample cyclic shift<br>14-15 – reserved<br><br>For AMC permutation,<br>0 – 0 sample cyclic shift<br>1 – floor(Nfft/9) sample cyclic shift<br>….<br>8 – floor(Nfft/9*8) sample cyclic shift<br>9-15 – reserved |
| } else { | | |
| Preamble Time Shift Index | 4 bits | For PUSC,<br>0 – 0 sample cyclic shift<br>1 – ~~floor(~~Nfft/14~~)~~ sample cyclic shift<br>….<br>13 ~~– floor(~~Nfft/14*13~~)~~ sample cyclic shift<br>14-15 – reserved<br><br>For AMC permutation,<br>0 – 0 sample cyclic shift<br>1 – ~~floor(~~Nfft/9~~)~~ sample cyclic shift<br>….<br>8 – ~~floor(~~Nfft/9*8~~)~~ sample cyclic shift<br>9-15 – reserved |
| } | | |
| } | | |
| Reserved | 2 bits | |
| } | | |