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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, which is 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, 8, 6 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 increase the number of basic AAS preamble, we propose a circular index shift within 6 consecutive subcarrier block to define 192 (32 * 6) basic AAS preambles.

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

[Replace 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. In addition, add a text specifying a default back-off window sizes for ranging contention as a power of 2.]

Table 1. AAS-DLFP Structure, Diversity-Map Scan

Syntax	Size	Notes
AAS-DLFP() {		
AAS beam index	4 bits	This index is the index referred to by the AAS_Beam_Select message (see section 6.3.2.3.41).
Preamble select	1 bit	0 = Frequency shifted Preamble 1 = Time shifted Preamble
Uplink_Preamble_Config	2 bits	00 – 0 symbol 01 – 1 symbols 10 – 2 symbols 11 – 3 symbols
Downlink_Preamble_Config	2 bits	00 – 0 symbol 01 – 1 symbols 10 – 2 symbols 11 – 3 symbols
Initial_Ranging_Allocation_IE() {		
Uplink Permutation	2 bits	00 = PUSC 01 = Optional PUSC 10 = Band AMC (2 bin x 3 symbol) 11 = Reserved
OFDMA Symbol Offset	8 bits	
Ranging Subchannel Offset	~~6~~ 4 bits	
No of OFDMA Symbols	~~7~~ 5 bits	
No of Ranging Subchannels	~~6~~ 4 bits	
Ranging Method	2 bits	00 - Initial Ranging over two symbols 01 - Initial Ranging over four symbols 10 - BW Request/Periodic Ranging over one symbol 11 - BW Request/Periodic Ranging over three symbols
Code Set Partition Pattern	3 bits	Initial:BW Req.:Periodic:HandOff 000 – 1 : 1 : 1 : 1 001 – 2 : 2 : 2 : 2 010 – 4 : 4 : 4 : 4 011 – 8 : 8 : 8 : 8 1xx – Reserved
}		
AAS_Comp_DL_IE()	50 bits	
HCS	8 bits	
Reserved	1 bit	
Total	12 bytes	

The default values of initial and final back-off window size for initial, BW request, and hand-off ranging are 2^1 and 2^4, respectively.

[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 into "An AAS downlink preamble is formed by combining preamble sequences for 6 subcarrier sets defined in section 8.4.6.1.1. Specifically, AAS preamble sequences for 6 different sectors are formed by combining sequences for 6 subcarrier sets in cyclic order. For sector 0: 012345, sector 1:123450, sector 2: 234501, sector 3: 345102, sector 4: 450123, sector 5: 501234, respectively. Therefore, AAS preamble for sector 0 is equal to sum of non-AAS preambles of segment 0, segment 1, and segment 2 with the same ID_{cell}.

[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 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 1 – Exact shift
if (Time Index Shift Type == 0)		
Preamble Time Shift Index	4 bits	For PUSC, 0 – 0 sample cyclic shift 1 – floor(Nfft/4) sample cyclic shift …. 3 – floor(Nfft/4*3) sample cyclic shift 4-15 – reserved For optional PUSC, 0 – 0 sample cyclic shift 1 – floor(Nfft/3) sample cyclic shift 2 – floor(Nfft/3*2) sample cyclic shift 3-15 – reserved For AMC permutation, 0 – 0 sample cyclic shift 1 – floor(Nfft/9) sample cyclic shift …. 8 – floor(Nfft/9*8) sample cyclic shift 9-15 – reserved
} else {		
Preamble Time Shift Index	4 bits	For PUSC, 0 – 0 sample cyclic shift 1 – Nfft/4 sample cyclic shift …. 3 – Nfft/4*3 sample cyclic shift 4-15 – reserved For optional PUSC, 0 – 0 sample cyclic shift 1 – Nfft/3 sample cyclic shift 2 – Nfft/3*2 sample cyclic shift

		3-15 – reserved For AMC permutation, 0 – 0 sample cyclic shift 1 – Nfft/9 sample cyclic shift …. 8 – Nfft/9*8 sample cyclic shift 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.