Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	Fast MAC Signaling	
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Re:	IEEE P802.16e/D2-2004	
Abstract	Fast MAC signaling to conserve power for Sleep, Idle and Awake modes	
Purpose	Adoption of proposed changes into P802.16e	
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1 Introduction

In 802.16-REVd/D5, DL-MAP message defines the access of DL resource and UL-MAP defines the access to UL resource. Each DL-MAP/UL-MAP message usually include multiple assignments with each assignment defined in DL-MAP_IE()/UL-MAP_IE(). For OFDMA based 802.16 systems in 802.16-REVd/D5, each DL-MAP_IE() includes a DIUC field of 4 bits, CID of 16 bits and resource allocation description field of 32 bits. Assuming that multiple MSS' traffic flows say more than 20 in a 2K-FFT system, are scheduled in one frame, the length of a DL-MAP message would be roughly 1000 bits. At each frame, a MSS has to demodulate and decode the whole DL/UL-MAP messages to check if there is any DL unicast or multicast traffic transmitted to it or if there is any UL resource assigned to it. In fact, to detect if there is any UL or DL assignment, the MSS first check if its CID(s) match those in the DL-MAP_IE() and UL-MAP_IE(). The information in DL-MAP_IE() and UL-MAP_IE() that does not correspond to the MSS' CID(s) is of no use to the MSS and constitutes an overhead to the MSS in terms of processing resource and battery consumption.

Saving MSS' battery consumption is of high importance to support mobile applications. In fact, if a Sleep Mode or Idle Mode MSS has to demodulate and decode the entire DL-MAP and UL-MAP messages every frame during listening interval, the battery saving benefit of Sleep Mode and Idle Mode will be reduced.

For the above reasons, in 802.16e, we propose to introduce the Alert_Awake_MSS_IE() which includes only CIDs of the connections to which DL and UL bursts are assigned. Two new MAPs, the Enhanced_DL-MAP and the Enhanced_UL-MAP which only define the resource allocation corresponding to the CIDs listed in the Alert_Awake_MSS_IE(), are defined. This concept is also applicable to alert a MSS in Sleep Mode or in Idle mode. This can be implemented by introducing Alert_Sleep_MSS_IE() and Alert_Idle_MSS_IE(). To enable the 802.16e MSSs to read the above new IEs, the DL_Alert_Prefix is defined. The DL_Alert_Prefix is transmitted immediately following the current DL-MAP message. The DL_Alert_Prefix include sufficient information to enable the MSS to demodulate and decode Alert_Awake_MSS_IE(), Alert_Sleep_MSS_IE() and Alert_Idle_MSS_IE(). The length, the modulation and the code rate of DL_Alert_Prefix are predefined.

Based on this proposal, at the begining of each frame, a MSS decodes DL_Frame_Prefix first and then decode DL_Alert_Prefix. From the DL_Alert_Prefix, a MSS can further locate the position of Alert_Awake_MSS_IE, Alert_Sleep_MSS_IE and Alert_Idle_MSS_IE. The Awake Mode MSS needs only to decode Alert_Awake_MSS_IE() to determine whether it shall continue to process the power efficient PE_DL-Map and the PE_UL-Map. Similarly, a Sleep/Idle MSS only needs to decode the Alert_Sleep_MSS_IE/Alert_Idle_MSS_IE during listening interval to know whether it shall return to Awake mode or perform some other actions as defined by action codes in the Alert_Sleep_MSS_IE()/Alert_Idle_MSS_IE(). If the ID of a MSS (CID of an Awake Mode MSS, SLPID of a Sleep Mode MSS and MAC address hash or Idle_ID of an Idle Mode MSS) appears in an Alert IE, the MSS shall continue to decode detailed resource allocation and associated information. Otherwise, the MSS shall stop any further process in this frame. This way, the battery consumption of MSS can be reduced. Here we suggest encapsulating the above-proposed control information in IE instead of MAC message in order to avoid MAC header of 6 bytes. Also, the required information which would appear in MAC header has been defined in DL_Alert_Prefix.

2 Proposed Text Changes

[*add a new section 8.4.4.9]*

8.4.4.4.2 DL_Alert_Prefix

The DL_Alert_Prefix is transmitted immediately following DL_MAP message and is used to indicate the length of the Alert_Awake_MSS_IE(), Alert_Sleep_MSS_IE() and Alert_Idle_MSS_IE(). The DL_Alert_Prefix also carries critical system information that is required by the MSS for synchronization, and proper decoding of DL information. Table xxx defines the structure of DL_Alert_Prefix format.

Table xxx – OFDMA DL_Alert_Prefix format.

Syntax	Size	Notes
DL_Alert_Prefix () {		
DCD count	8 bits	Match the count number in latest DCD
UCD count	8 bits	Match the count number in latest UCD
Length of Alert_Awake_MSS_IE()	8 bits	

Length of Alert_Sleep_MSS_IE()	6 bits	
Length of Alert_Idle_MSS_IE()	6 bits	
DCD_indicator	1 bit	1: DCD presents in this frame 0: no DCD presents in this frame
UCD_indicator	1 bit	1: UCD presents in this frame 0: no UCD presents in this frame
Broadcast message indicator	1 bit	1: At least one broadcast message (excluding UCD and DCD), presents in this frame 0: No broadcast message (excluding UCD and DCD) presents in this frame
CDMA_Allocation_indicator	1 bit	1: CDMA_Alloc_IE() present in this frame 0: no CDMA_Alloc_IE() present in this frame
PE_DL_Map_Length	8 bits	Defines the length in slots of the PE_DL_MAP message that follows immediately the DL_Alert_Prefix.
}		

The DL_Alert_Prefix shall be transmitted with QPSK modulation with coding rate 1/2 and repetition coding of 4.

[*Modify section 8.4.5: For each of the existing unicast/multicast IEs , a power efficient(PE) version shall be defined which shall be the same as the current one with one exception that the CID is omitted*]

[*Add the following sections to describe Alert_Awake_MSS_IE, Alert_Sleep_MSS_IE and Alert_Idle_MSS_IE format*].

8.4.5.3.8 Alert_Awake_MSS IE Format

Table XX Alert_Awake_MSS_IE format

Syntax	Size	Notes
Alert_Awake_MSS_IE() {		
Num_DL_PE_IE	8 bits	Number of DL power efficient IEs
For (I = 0;i< Num_DL_PE_IE; i++) {		
CID	16 bits	
}		
Num_UL_PE_IE	8 bits	Number of UL power efficient IEs
For (I = 0;i< Num_UL_PE_IE; i++) {		
CID	16 bits	
}		
Num_MIMO_DL_Basic_PE_IE	8 bits	Number of MIMO DL basic power efficient IEs
For (I = 0;i< Num_MIMO_DL_Basic_PE_IE; i++) {		
CID	16 bits	
}		
Num_MIMO_DL_Enhanced_PE_IE	8 bits	Number of MIMO DL enhanced power efficient IEs
For (I = 0;i< Num_MIMO_DL_Enhanced_PE_IE; i++) {		
CQICH_ID	Variable	Defined in DCD
}		
Num_MIMO_UL_Basic_PE_IE	8 bits	Number of MIMO UL basic

		power efficient IEs
For (i = 0;i< Num_MIMO_UL_Basic_PE_IE; i++) {		
CID	16 bits	
}		
PE_DL_Map_Length	8 bits	Defines the length in slots of the PE_DL_MAP message that follows immediately the Alert_Idle_MSS_IE().
}		

8.4.5.3.9 Alert_Sleep_MSS IE Format

Table XX. Alert_Sleep_MSS_IE format.

Syntax	Size	Notes
Alert_Sleep_MSS_IE_format () {		
FMT	1 bit	0=SLPID based format,1=CID based format
If (FMT == 0) {		
SLPID bit-map	Variable	
} else {		
Num-pos	7 bits	
For (i=0;i<Num_pos;i++) {		
CID	16 bits	
}		
}		

8.4.5.3.10 Alert_Idle_MSS IE Format

Table XX. Alert_Idle_MSS_IE format.

Syntax	Size	Notes
Alert_Idle_MSS_IE_format() {		
Num_Paging_Group IDs	8 bits	
For (i=0;i<Num_Paging_Group_IDs;i++) {		
Paging_Group_IDs	8 bits	
}		
Num_Alert_Idle_MSS_IE	4 bits	
For (i=0;i<Num_Alert_Idle_MSS_IE; i++) {		
Idle_ID	24 bits	
Action_Code	2 bits	
}		
}		

[*Add sub-sections in 6.3.2.3.45 to describe the PE_DL-MAP and PE_UL-MAP messages. The PE-DL-MAP/PE-UL-MAP messages are similar to the DL-MAP message and UL-MAP messages with one exception that PE_DL-MAP/PE_UL-MAP messages include a simplified or power efficient DL-MAP_IE() / UL-MAP_IE() which do not have CIDs*]