Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**DL-MAP and UL-MAP CID Table IEs with Multiple DL MAPs**
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Re:	Response to Sponsor Ballot on IEEE802.16e/D5a document

| Abstract | The proposed DL-MAP and UL-MAP CID table IEs can be used to not only improve DL subframe efficiency but also significantly reduce unnecessary power consumption. |

Purpose	To incorporate the text changes proposed in this contribution into the 802.16e/D6 draft.

DL-MAP and UL-MAP CID Table IEs

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1. Problem Statement

According to current standard draft IEEE P802.16e-D5a-2004, MAP messages are used to perform DL and UL allocation to the MSSs. The current MAP format for OFDMA mode presents the following two problems:

- **Excessive power consumption**: As defined in the current 802.16e standard, a MSS has to, at the minimum, finish listening to the whole DL-MAP and UL-MAP regardless there is DL traffic or UL traffic for the MSS in the current frame.
- **Extensive overhead on DL for MAP messages**: As defined in the current 802.16e standard, the DL data burst allocation can optionally include the list of CIDs designated. However, if the list of CIDs is not included in the DL MAP, it imposes a high requirement on MSS's processing power and drastically increase the MSS's battery consumption. To reduce MSS processing complexity and prolong battery life, the list of CIDs should always be included in the DL-MAP for the mobile network. However, when the CIDs are included, there can extensive overhead on DL caused by DL MAP transmission since the size of DL-MAP can be very large.

2. Proposed Solutions

To overcome the problems mentioned above, we would like to propose the following solution:

- Introduce an extended DL MAP message for OFDMA mode. This extended DL MAP message should follow the current DL MAP message. The definition of current DL MAP remains the same as defined in IEEE P802.16e-D5a-2004 section 6.3.2.3.2 and 8.4.5.3. The extended DL MAP message should only contain the IEs defined in IEEE P802.16e-D5a-2004 section 8.4.5.3.
- Introduce two new IEs, DL CID Table IE and UL CID Talbe IE. The CID table contains a list of CIDs for the MSSs with traffic allocated to in the current frame.
- The regular DL MAP is used to transmit CID Table IEs, H-ARQ MAP Pointer IE, Extended DL Map Pointer IE, broadcast burst allocation, and all IEs/ burst allocations related to 802.16d compliant SSs. The extended DL MAP contains all IEs and burst allocations related to 802.16e compliant MSSs. The UL MAP is transmitted following the extended DL MAP. The DL subframe structure is shown in Figure 1 with DL MAP and extended DL MAP.
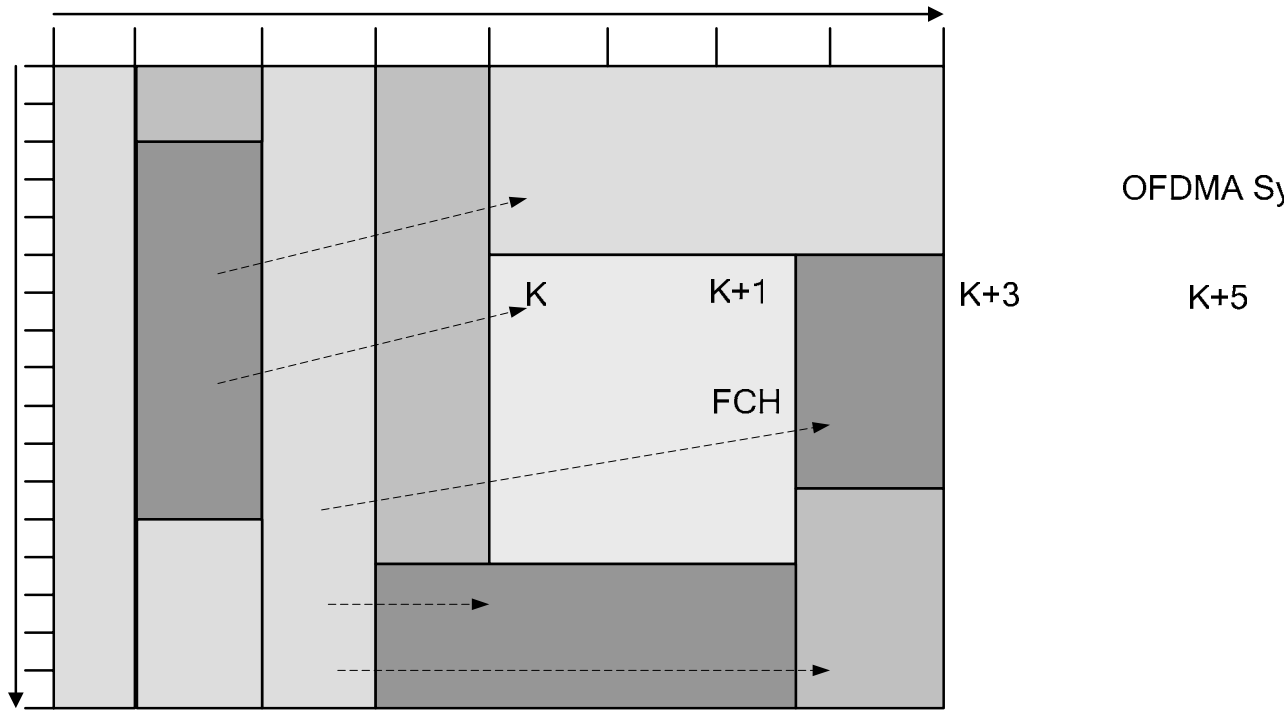
Figure 1. DL Subframe structure with DL_MAP and Extended DL MAP

- The DL CID table contains list of CIDs for the MSS with DL traffic allocation in the current frame. The DL CID table is composed of multiple CID records. There are two types of CID records.
    - Normal CID Record: Each normal CID record either contains a broadcast indication or a list of CID that is corresponding to an allocated data burst in DL_MAP.
    - Extended IE CID Record: Extended IE CID Record contains the all CIDs that can be included in extended IEs. There is only one Extended IE CID Record in a DL CID table.

- The association of CID records and DL_MAP allocations are shown in Figure 2.

Figure 2. Association for CID Records and DL MAP Data Burst Allocation

3. Specific Text Changes

[Modify the following section:]
6.3.2.3.2 Downlink map (DL-MAP) message

......

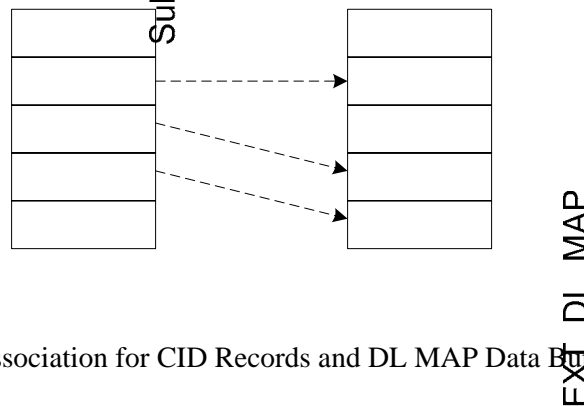The EXT-DL-MAP message (if such exists) shall always be transmitted on the burst described by the first DLMAP_IE of the DL-MAP. If there is no EXT-DL-MAP message, t~~T~~he UL-MAP (if such exists) message shall be always transmitted on the burst described by the first DLMAP_IE of the DL-MAP (or, in the case of the OFDM PHY mode, of the DLFP). Otherwise, the UL-MAP message shall be transmitted on the burst described by the second DLMAP_IE of the DL-MAP, immediately after EXT-DL-MAP message.

The DL-MAP_IEs in the DL-MAP shall be ordered in the increasing order of the transmission start time of the relevant PHY burst. The transmission start time is conveyed by the contents of the DL_MAP_IE in a manner which is PHY dependant.A

[Add the following section:]

6.3.2.3.59 Extended downlink map (EXT-DL-MAP) message

The EXT-DL-MAP message is a reduced form of DL-MAP. It shall be transmitted immediately after DL-MAP message before UL MAP transmission. The DL-MAP fields that are omitted from EXT-DL-MAP are retained from the most recent DL-MAP message. A BS shall generate EXT-DL-MAP messages in the format shown in Table 107f. The EXT-DL-MAP message shall only contain information addressed to MSS that is compliant to IEEE 802.16e standard. This message is only relevant to OFDMA PHY.

Syntax	Size	Notes
EXT-DL-MAP Message Format() {		
Management Message Type = 64	8 bits	
Begin PHY specific section {	See applicable PHY section	
for (i = 1; i <= n; i++) {		For each DL-MAP element 1 to n.
DL-MAP_IE()	Variable	See corresponding PHY specification
}		
}		
if !(byte boundary) {		
Padding Nibble	4 bits	Padding to reach byte boundary.
}		

The order of DL-MAP_IEs in the EXT-DL-MAP message shall conform to the order defined for the DL-MAP message in section 6.3.2.3.2.
The logical order in which MAC PDUs are mapped to the PHY layer bursts in the downlink is defined as the order of increasing start time of all PHY bursts in the frame regardless of the DL map message in which they are described. If two or more PHY bursts have the same start time, the logical order is determined according to the order of appearance in the concatenation of DL-MAP and EXT-DL-MAP message.

[Modify the following sections:]

8.4.5.3.20 DL-MAP CID table IE

Table 284k—DL-MAP CID Table IE

Syntax	Size	Notes
DL-MAP CID table IE () {		
Extended DIUC	4 bits	0x??
Length	4 bits	Length in bytes of following fields

CID Table Sequence	2 bits	00: First page 01: Middle page 10: Last page 11: Single Page
If ("CID Table Sequence" = "00")		
{		
CID Format	2 bits	00: 16 bits 01: 12 bits LSB 10: 8 bits LSB 11: 4 bits LSB
H-ARQ MAP INC	1 bits	0: H-ARQ MAP Pointer IE not included in DL_MAP 1: H-ARQ MAP Pointer IE included In DL_MAP
MBS MAP INC	1 bits	0: MBS Service MAP IE not included in DL_MAP 1: MBA Service MAP IE included in DL_MAP
}		
Begin CID records		Each CID record contains the list of CIDs. Two types of CID records: Normal CID Record: Each normal CID record contains a list of CID that is corresponding to a allocated data burst in DL_MAP Extended CID Record: Only one extended CID record, it contains the all CIDs that can be included in extended IE.
Ufor (i=0; i<n; i++)		0 to n records can be included in a DL_MAP_CID_Table_IE. n doesn't need to be defined, it can be deducted based on length field
{		
Broadcast Burst	1 bit	0: not a broadcast burst 1: broadcast burst
If (Broadcast Burst = 0)		Number of CIDs left from the last CID Table
{		
Record Type	1 bit	0: Normal CID Record 1: Extended IE CID Record
Continuation Flag	1 bit	0: This record will not be continued 1: This record will be continued in the first record of next IE
NUM CIDs	6 bits	Number of CIDs in this record
for (i=0; j < NUM CIDs; j++)		
{		
CID	N bits	N = 16 when "CID Format" = "00" N = 12 LSB when "CID Format" = "01" N = 8 when "CID Format" = "10" N = 6 when "CID Format" = "11"
} //end for-loop NUM CIDs		
} //if !broadcast burst		
}		
Padding bits	Variable	Set to zeros to align octet boundary

8.4.5.3.20 EXT-DL-MAP-LIST_IE format

In the DL-MAP, the BS may transmit DIUC=15 with EXT-DL-MAP-LIST_IE() to describe the allocation of EXT-DL-MAP message. The EXT-DL-MAP message shall be transmitted in a separate PHY burst and shall be the only message within the burst. These burst is allocated in frequency first slot mapping order. This IE is defined in table 284j..

Table 284j—EXT-DL-MAP-LIST extended IE format

Syntax	Size	Notes
EXT⌐DL-MAP-LIST_IE() {		
Extended DIUC	4 bits	0x??
Length	4 bits	Length = 2*n
For (i=0; i< n; i++)		
{		
DIUC	4 bits	
Number of slots	8 bits	
Repetition coding indication	2 bits	0b00 - No repetition coding 0b01 - Repetition coding of 2 used 0b10 - Repetition coding of 4 used 0b11 - Repetition coding of 6 used
Reserved	2 bits	Shall be set to zero
}		
}		

[Modify the following section:]

8.4.5.4.23 UL-MAP CID table IE

Table 284k—Field description of UL-MAP CID table IE

Syntax	Size	Notes
UL-MAP CID table IE () {		
Extended DIUC	4 bits	0x??
Length	4 bits	Length in bytes of following fields
CID Format	2 bits	00: 16 bits 01: 12 bits LSB 10: 8 bits LSB 11: 4 bits LSB
CID Table Sequence	2 bits	00: First page 01: Middle page 10: Last page 11: Reserved
NUM CIDs	8 bits	Number of CIDs in this IE
{		
CID	N bits	N = 16 when "CID Format" = "00" N = 12 LSB when "CID Format" = "01"

		N = 8 when "CID Format" = "10" N = 4 when "CID Format" = "11"
}		
Padding bits	Variable	Set to zeros to align octet boundary

4. References

[1]   IEEE 802.16- 2004 IEEE Standards for local and metropolitan area networks part 16: Air interface for fixed broadband wireless access systems
[2]   IEEE P802.16e-D5a-2004