Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	DL Traffic Channel Definition and Enhanced DL Resource Allocation for OFDMA PHY
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Re:	IEEE P802.16e/D5a-2004
Abstract	This contribution proposes to define semi-static traffic channels (or region) on the DL. The objective is to reduce the overhead in DL resource allocation. This is a revised contribution. Changes are highlighted in change bar.
Purpose	Review and Adopt the suggested changes into P802.16e/D5a
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1 Introduction

In the current DL-MAP message, each DL access region is defined by the following fields: OFDMA symbol offset (8 bits), Subchannel offset (6 bits), number of OFDMA symbols (8 bits) and number of subchannels (6 bits), ie. a total of 28 bits. In this mechanism, the minimum or basic DL resource unit is 1 subchannel (or mini-subchannel) x 1 OFMDA symbol.

The above DL access region definition incurs a lot of overhead. If we assume 20 MSSes are assigned DL resource per frame, 560 bits in DL-MAP will be used for DL access region assignments. In most cases, the DL resource allocation to MSSes does not need to be as granular as a basic unit (i.e. one subchannel (or mini-subchannel) x one OFDMA symbol).

2 Proposed Solution

To reduce the overhead associated with DL resource allocation, we propose the following:

1) Semi-static traffic channel definition:

- Define DL access regions for a number of DL traffic channels in DCD. The **Channel Definition** (a new TLV for DCD) defines the following parameters for each traffic channel:
  - Access region in terms of OFDMA symbol offset (8 bits), Subchannel offset (6 bits), number of OFDMA symbols (8 bits) and number of subchannels (6 bits)
  - Channel ID (CHID)
  - ~~oChannel type (see next bullet)~~

  The channel definition can be updated slowly based on traffic statistics

~~• To allow sufficient flexibility for actual resource allocation through DL-MAP (see point #2 below), we propose to have two types of channel definition:~~

~~oType 1: A channel of type 1 includes a larger number basic resource units and an assigned channel ID (CHID)~~

~~ßThis type of channel is assigned to MSS who has a larger amount of DL traffic~~

~~ßOnly one of this type of channel can be assigned to a MSS in each burst allocation~~

~~oType 2: A channel of type 2 includes a small number of basic resource unit (could be as small as 1 OFDMA symbol x 1 subchannel or 1 OFDMA symbol x 1 mini-subchannel) and an assigned channel ID (CHID)~~

~~ßThis type of channel is assigned to MSS who has a small amount of DL traffic~~

~~ßOne or more of this type of channel can be assigned to a MSS in each burst allocation~~

2) Resource allocation description in DL-MAP (using Enhanced DL MAP IE) based on the above semi-static channel definition, where the DL burst region is identified by the CHID:

~~• For each CID that is assigned DL access, up to one Type 1 channel can be assigned, and multiple Type 2 channels can be assigned to that CID.~~

~~• Each Type 1 or Type 2 channel is identified by unique CHID~~

~~• For each Type 1 channel assignment, there is 1 bit to indicate channel type, and up to 6 bits for CHID. For each Type 2 channel assignment, there is 1 bit to indicate channel type, up to 6 bits for CHID, and 2 bits to indicate number of Type 2 channel assigned. Therefore, using this proposed scheme, we can reduce the number of bits required to allocate DL access region from 28 bits to 7 bits and 9 bits for Type 1 channel and Type 2 channel respectively.~~

Figure 1 shows an example of the above scheme.

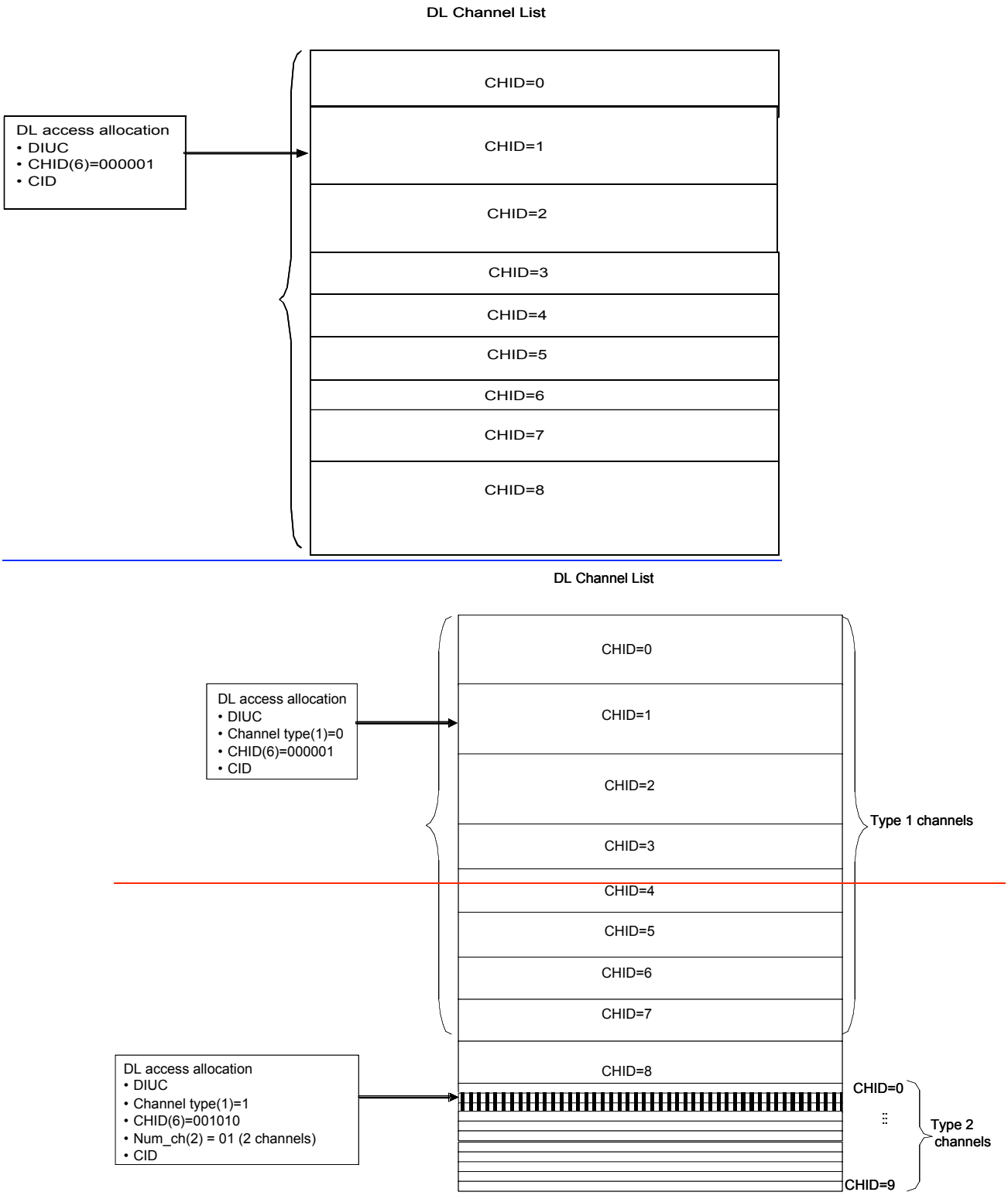
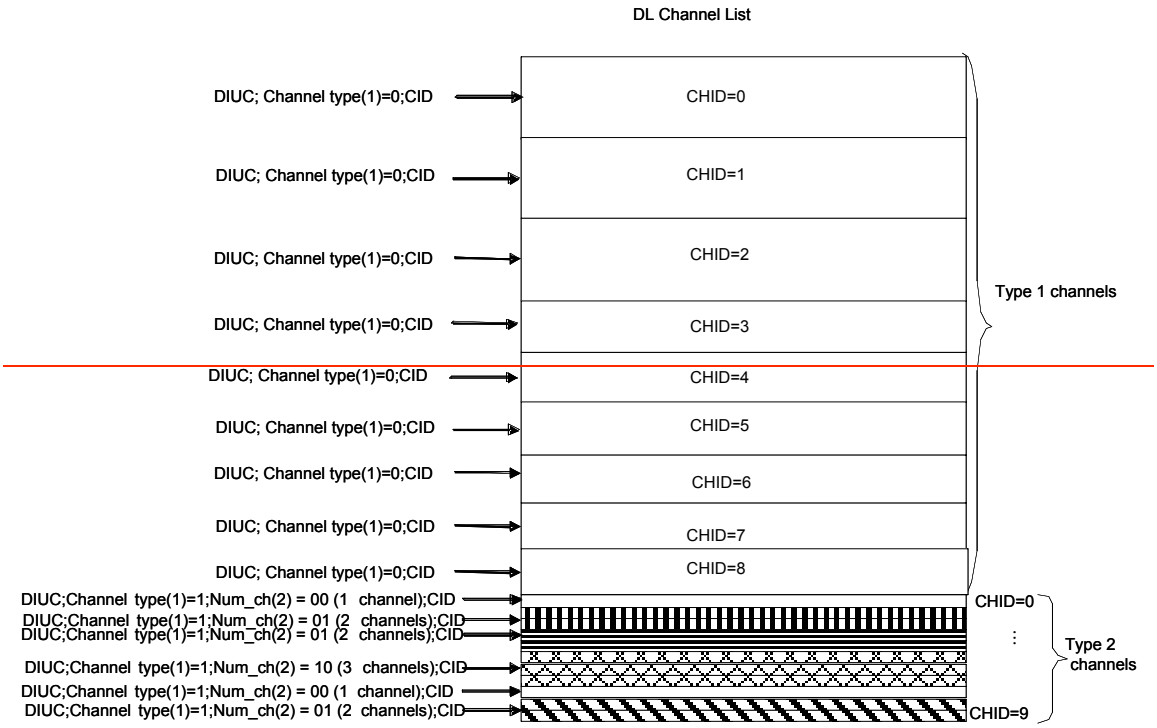


Figure 1.Example of semi-static channel definition and DL access allocation to reduce overhead (The channels layout shown above is logical).

Using the above scheme, the total overhead involved in defining DL access regions is reduced from 560 bits to 1240 bits (assume 20 ~~Type 1~~ channels) ~~or 180 bits (assume 20 Type 2 channels) if we assume 20 connections (CIDs) are scheduled in a frame~~.

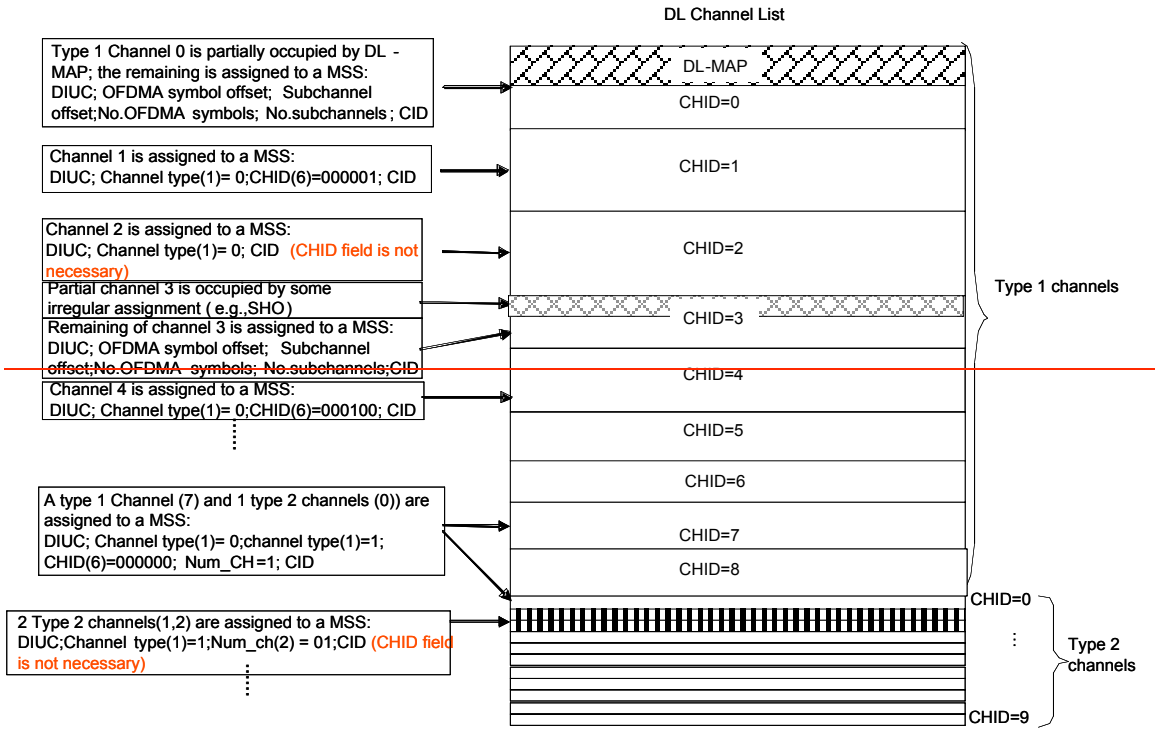
~~In fact, the overhead can be further reduced by omitting the CHID field in the DL access allocation. This is possible by setting the rule that each subsequent DL access allocation corresponds to the next increment of the CHID value of a particular channel type. This is illustrated in Figure 2. In this way, the overhead involved in defining DL access regions can be further reduced to 20 bits (assume 20 Type 1 channels) / 60 bits (assume 20 Type 2 channels), if we assume 20 connections (CIDs) are scheduled in a frame.~~



~~Figure 2. Example of semi-static channel definition and DL access allocation for the case where CHID is omitted (The channels layout shown above is logical)~~

The above semi-static channel definition and assignment does not preclude the normal DL region allocation (using OFDMA symbol offset, subchannel offset etc.) to be performed in the same frame. If a normal DL region allocation overlaps with a particular semi-static DL channel, that channel definition will be over-written.

~~The case shown in Figure 2 above (i.e. CHID omission) may not always be possible under certain situation where the access region defined for certain semi static channels is assigned to or overlapped with other 'irregular' region allocation, e.g. DL/UL MAP, SHO zone. Under such situation, the CHID needs to be included for the next semi static channel assignment following the 'irregular' region. For subsequent semi-static channel assignments, CHID can again be omitted. This is illustrated in Figure 3, which includes scenarios where DL MAP occupies partially the region defined for Type 1 channel #0 and SHO region occupies partially the region defined for Type 1 channel #3. For the above 2 scenarios, CHID is required for the next semi static channel assigned following the 'irregular' region.~~



~~Figure 3. Example of semi-static channel definition and DL access allocation for the case where there is irregular assignment that overlaps with region defined for the semi-static channel (The channels layout shown above is logical)~~

3 Proposed Text Changes

Remedy 1:
Define semi-static traffic channels in DCD. Introduce a new TLV called DL channel definition.

[Modify Table 356a – DCD channel encoding]

Name	Type	Length	Values
DL channel definition	19	variable	~~Size of CHID field (6 bits)~~ Num_~~Type 1~~_channels (6 bits) For (i = 0; i<Num_~~type1~~_channel;i++) ~~{~~ OFDMA symbol offset (8 bits) Subchannel offset (6 bits) No. OFDMA symbols (8 bits) No. subchannels (6 bits) ~~}~~ ~~Num_Type 2_channels (6 bits)~~ ~~For (i = 0; i<Num_type2_channel;i++)~~ ~~{~~ ~~OFDMA symbol offset (8 bits)~~ ~~Subchannel offset (6 bits)~~ ~~No. OFDMA symbols (8 bits)~~ ~~No. subchannels (6 bits)~~ ~~}~~ padding bits to align boundary of byte

Remedy 2:
Introduce a new IE called the Enhanced DL MAP IE to assign the semi-static channels to different MSS/CID.

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[Insert the following at the end of Section 8.4.5.3.19]

8.4.5.3.19 Enhanced DL MAP IE

This IE is used for BS to indicate the DL resource allocation by using ~~the two-step DL resource assignment method~~the channel definition specified ~~,~~in the DL channel definition TLV in the DCD.

Table 284j. Enhanced DL MAP IE

Syntax	Size	Notes
Enhanced_DL_MAP_IE() {		
Extended DIUC	4 bits	0x09
Length	4 bits	Length in bytes
Num_Assignment	4 bits	Number of assignments in this IE
For (i=0; i<Num_Assignment;i++)		
{		
if (INC_CID == 1) {		The DL-MAP starts with INC_CID =0. INC_CID is toggled between 0 and 1 by the CID-SWITCH_IE() (8.4.5.3.7)
N_CID		Number of CIDs assigned for this IE
For (n=0; n<N_CID; n++) {		
CID	16 bits	
}		
}		
DIUC	4 bits	
Boosting	3 bits	
~~-~~Repetition Coding Indication	2 bits	
~~Assignment_Code~~	~~3 bits~~	~~0b000: one type 1 channel assigned, with explicitly indicated CHID~~ ~~0b001: type 2 channel assigned, with explicitly indicated CHID of the first type 2 channel~~ ~~0b010: one type 1 channel + type 2 channel(s) assigned, with explicitly indicated CHIDs for the type 1 channel and the first type 2 channel~~ ~~0b011: Using normal region description~~ ~~0b100: one type 1 channel assigned, without explicitly indicated CHID~~ ~~0b101: type 2 channel(s) assigned, without explicitly indicated CHID~~ ~~0b110: one type 1 channel + type 2 channel(s) assigned, without explicitly indicated CHIDs for the type 1 channel and the first type 2 channel~~ ~~0b111: reserved~~
~~If (Assignment_Code == 000)~~		
~~CHID~~	~~Num_bits_CHID (as defined in DCD)~~6 bits	As defined in DCD
~~If (Assignment_Code == 001)~~		
~~{~~		
~~CHID~~	~~Num_bits_CHID (as defined~~	~~As defined in DCD~~

	~~in DCD)~~	
~~Num_Channel~~	~~2 bits~~	
~~}~~		
~~If (Assignment_Code == 010)~~		
~~{~~		
~~CHID~~	~~Num_bits_CHID (as defined in DCD)~~	~~As defined in DCD~~
~~CHID~~		
~~Num_channels~~	~~2 bits~~	
~~}~~		
~~If (Assignment_Code == 011)~~		
~~{~~		
~~OFDMA_symbol_offset~~	~~8 bits~~	
~~Subchannel_offset~~	~~6 bits~~	
~~No. OFDMA symbols~~	~~8 bits~~	
~~No. subchannels~~	~~6 bits~~	
~~}~~		
~~If (Assignment_Code = 101|110)~~		
~~Num_Channel~~	~~2 bits~~	~~Indicated in DCD~~
~~}~~		
~~}~~		

Num_Assignment

Number of assignments in this IE

~~Assignment_Code~~

~~0b000: one type 1 channel assigned, with explicitly indicated CHID~~

~~0b001: type 2 channel(s) assigned, with explicitly indicated the CHID of the first channel assigned~~

~~0b010: one type 1 channel + type 2 channel(s) assigned, with explicitly indicated CHIDs for the type 1 channel and the first type 2 channel~~

~~0b011: Using normal region description. When set, the resource allocation shall override the channel definition in DCD for the overlapping region.~~

~~0b100: one type 1 channel assigned, without explicitly indicated CHID (the type 1 channel assigned shall correspond to the next type 1 CHID, following the previous type 1 channel assignment)~~

~~0b101: type 2 channel(s) assigned, without explicitly indicated CHID (the first type 2 channel assigned shall correspond to the next type 2 CHID, following the previous type 2 channel assignment)~~

~~0b110: one type 1 channel + type 2 channel(s) assigned, without explicitly indicated CHIDs for the type 1 channel and the type 2 channel (the type 1 channel assigned shall correspond to the next type 1 CHID, following the previous type 1 channel assignment; the first type 2 channel assigned shall correspond to the next type 2 CHID, following the previous type 2 channel assignment)~~

~~0b111: reserved~~

CHID

Channel index defined in DCD message

~~Num_Channels~~

~~Number of type 2 channel(s) assigned~~

Remedy 3:

Introduce a capability TLV.

[Modify table in section 11.8.3.7.6]

Type	**Length**	**Value**	**Scope**
155	1	bit #0: H-ARQ MAP capability bit #1: DL channel definition support	SBC-REQ (see 6.3.2.3.23) SBC-RSP (see 6.3.2.3.24)

		bit #~~1~~2-7: reserved	