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Re:	The contribution contains material for comment submitted to 802.16 WG ballot on IEEE 802.16e/D3
Abstract	The documents suggests changes in 802.16e/D3 to support SSs with limited amount on-chip memory
Purpose	The contribution contains material for comment submitted to 802.16 WG ballot on IEEE 802.16e/D3
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New SS capability - Receive buffer limit

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1. Motive for receive buffer limitation

The goal is to provide support for SSs with limited capabilities in terms of storage available for concurrent DL bursts, which the SS has to receive. For example, if there are two concurrent in time DL bursts with no CID information in DL-MAP, the SS has no choice but receive / process one of them while another must be buffered e.g. in the format of input for FEC decoder [metrics in the case of CC]. This may result in significant amount of data storage required on the chip.

2. Improvement in DL-MAP format

[Change in 8.4.5.3, Table 273—OFDMA DL-MAP_IE format]

Syntax	Size	Notes
DL-MAP_IE() {		
DIUC	4 bits	
if (DIUC == 15) {		
Extended DIUC dependent IE	variable	See clauses following 8.4.5.3.1
} else {		
if (INC_CID == 1) {		The DL-MAP starts with INC_CID =0. INC_CID is switched between 0 , 1and 2 by the CID-SWITCH_IE() (8.4.5.3.7)
N_CID	8 bits	Number of CIDs assigned for this IE
for (n=0; n< N_CID; n++) {		
CID	16 bits	
} else {		
if (INC_CID == 2) {		
N_CID	8 bits	Number of CID pairs
for (n=0; n< N_CID; n++) {		
CID_min	16 bits	Minimum Basic CID / multicast CID value of those to which the data is addressed
CID_max	16 bits	Maximum Basic CID / multicast CID value of those to which the data is addressed
}		
}		
OFDMA Symbol offset	8 bits	
Subchannel offset	6 bits	

Boosting	3 bits	000: normal (not boosted); 001: +6dB; 010: -6dB; 011: +9dB; 100: +3dB; 101: -3dB; 110: -9dB; 111: -12dB;
No. OFDMA Symbols	7 bits	
No. Subchannels	6 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
}		
}		

[Change in 8.4.5.3.7]
In the DL-MAP, a BS may transmit DIUC=15 with the CID-Switch_IE() to switch between different modes of inclusion of the CID parameter in DL-MAP allocations. The DL-MAP shall begin in the mode where CIDs are not included (INC_CID = 0). Each next appearance of the CID-Switch_IE() increments INC_CID value modulo 3.

3. <u>New SS capability: Receive buffer limit</u>

[Add after 11.8.3.7.5]
OFDMA Receive buffer limit

Type	Length	Value	Scope
155	2	Receive buffer limit; value 0 means no limitations	SBC-REQ SBC-RSP

BS has to take into account the following restriction. Suppose in certain frame N data regions potentially contain data addressed to the given SS i.e. all data regions with modulation/coding option agreed during DBPC-REQ/RSP dialog except the following:
- Data regions pointed by DL-MAP IEs under INC_CID = 1 with CIDs not belonging to the SS (including case of multicast CIDs and broadcast CID)
- Data regions pointed by DL-MAP IEs under INC_CID = 2 where CIDs range does not cover CIDs related to the SS

Let's exclude from this set the region that contains the largest amount of data (if there are several, the one that appears first in DL-MAP). Then the total amount of data (bytes), in the remaining N-1 data regions shall not exceed the indicated value.

4. <u>Scheduling tips</u>

The following is a scheme suggested for DL scheduling, just to show that the introduced Receive buffer limitation does not increase dramatically the complexity of scheduler. The following actions are anyway required:

- Decide on amount of data (set of MAC SDUs) to transmit from each SS selected to Tx at the current frame, according to QoS requirements
- Divide the selected SSs (and sets of MAC SDUs) into groups by channel rate (modulation/coding type)
- Calculate number of slots needed for each group
- For each group, decide on dimensions and allocation of data regions carrying data for this group; create DL-MAP IEs, in format corresponding INC_CID = 2
- For each group select MAC SDUs for transmission, according to channel rate agreed during DBPC-REQ/RSP dialog

From this point there is a difference: the scheduler additionally takes care of order of CIDs in the group (which previously was not important)

The following procedure is applied to each group separately:
- Sort selected for transmission MAC SDUs, by CIDs: Basic CID for unicasts, multicast CID for multicasts
- Start stuffing MAC SDUs, in the ascending order of Basic CIDs/multicast CIDs, into data region(s), from the largest data region to the smallest. During this process for each SS Receive buffer limit status must be monitored. In the case limit reached, stop allocation of data for the SS

The picture below shows channel rate by color; there are two regions in "green" group, one in "yellow" group etc. So "green" SS #1 has to receive one region (burst), SS #3 – two regions etc. If volume of one green strip exceeds limit for SS#3, then BS may choose either to remove two packets from upper strip or merge two upper strips in a single one.