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Title	**Overlapped two-dimensional resource allocation scheme in OFDMA DL-MAP**	
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Re:	This contribution is response to call for contribution about IEEE 802.16e-D4	
Abstract	Enhancement of a two-dimensional allocation scheme in OFDMA DL-MAP	
Purpose	Adoption of proposed changes into P802.16e-D4-2004	
Notice		
Release		
Patent Policy and Procedures		

Overlapped two-dimensional resource allocation scheme in OFDMA DL-MAP

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1. Introduction

In the downlink of OFDMA, a data region can be regarded as a two-dimensional allocation group of contiguous subchannels. This allocation can be visualized as a rectangle shown in Figure 1.

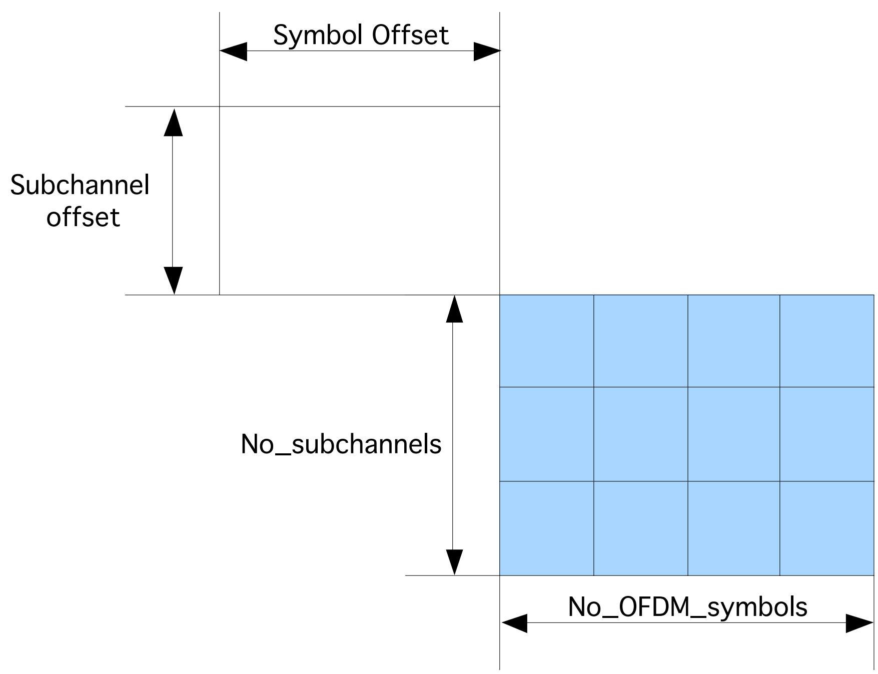

Figure 1 an example of the data region which defines the OFDMA allocation

The procedure of downlink OFDMA data mapping is as follows:

1) Segment the data into blocks sized to fit into one OFDMA slot.
2) Each slot shall span one or more subchannels in the subchannel axis and two OFDMA symbols in the time axis. Map the slots such that the lowest numbered slot occupies the lowest numbered subchannel in the lowest numbered OFDMA symbol.
3) Continue the mapping such that the OFDMA symbol index is increased. When the edge of the data region is reached, continue the mapping from the lowest numbered OFDMA symbol in the next subchannel.

Figure 2 show an example of the two-dimensional radio resources allocation, as a result of continuing the data region (burst) allocation and downlink OFDMA data mapping.

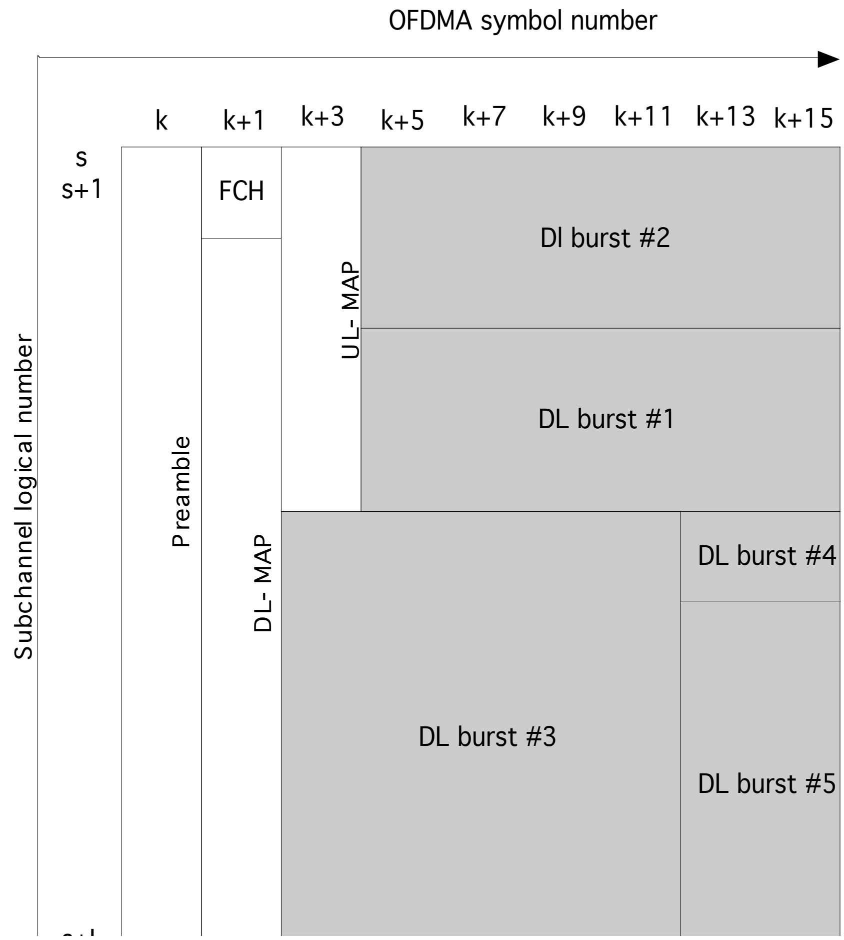

Figure 2 an example of the two-dimensional radio resources allocation

However, the two-dimensional resource allocation reduces the flexibility and efficiency of resource allocations. If we define one slot as (one subchannel) × (one OFDMA symbol), then we cannot allocate specific size such as 29, 31, etc. slots by using the two-dimensional resource allocation scheme. Also, after assigning some DL bursts, it is difficult to allocate the required slots with the remaining resources because of the constraint of making a data region as rectangle.

2. Proposed Remedy

In order to increase the flexibility and efficiency of resource allocation, we use various kinds of resource shape which is made by rectangles. In the proposed scheme, we also use a rectangle to describe a data region in a DL burst, which is defined using the subchannel offset, symbol offset, the number of subchannels, and the number of symbols. However, in the proposed scheme the rectangle can be overlapped by other rectangles.

The DL-MAP message format is as follows:

Syntax	Size	Notes
DL-MAP_Message_Format() {		
Management Message Type = 2	8 bits	
PHY Synchronization Field	Variable	See appropriate PHY specification.
DCD Count	8 bits	
Base Station ID	48 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$_i$()	*variable*	
}		
}		
if !(byte boundary) {		
Padding Nibble	4 bits	Padding to reach byte boundary.
}		
}		

We denote the set of slots defined by a rectangle for DL-MAP IE$_i$ as S_i. In this case, the data region for the DL-MAP IE$_2$ is given by S_2-S_1. Also, the data region for the DL-MAP IE$_3$ is determined by $S_3 - S_2 - S_1$**.** That is, a predefined DL-MAP IE preoccupies the slots defined by the rectangle for the DL-MAP IE.

Figure 3 shows an example of the proposed subchannel allocation. In the conventional method, we cannot allocate the resource such as DL burst #5. However, we can allocate the resource such as DL burst #5 using the proposed method and fully use resources.

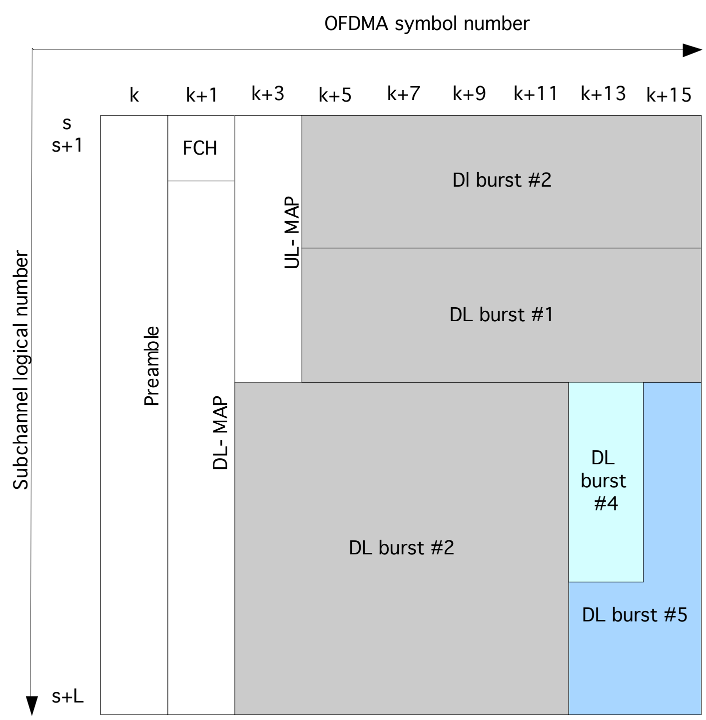

Figure 3 an example of the proposed subchannel allocation

Now, we assume that the remaining resources are 3 symbols by 3 subchannels and one slot is one symbols by one subchannel. If we want to allocate 2 slots for DL-MAP IE$_n$, 2 slots for DL-MAP IE$_{n+1}$, and 5 slots for DL-MAP IE$_{n+2}$

respectively, the conventional scheme cannot allocate the required resources, but our scheme can solve this problem such as the method shown in Figure 4.

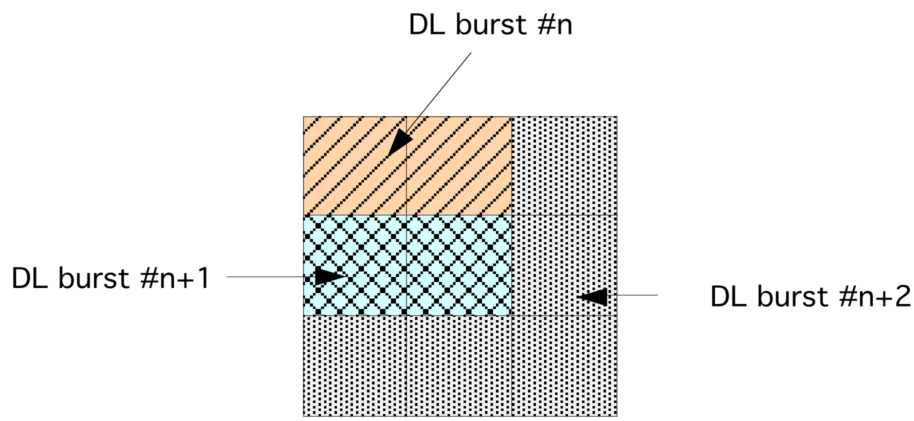

Figure 4 an example of 3 DL-bursts allocation

If we use multiple regions for one MSS, the amount of map IEs will increase. Also, some MAC SDUs should be divided into several PDUs. In our proposed scheme, multiple regions can be served as one PHY burst. Therefore, the amount of map IEs will not increase and the flexibility of determining the MAC PDU size will be increase. The complexity of SS in compute the data region of other CIDs will not be high because there are a few PHY bursts in a MAC Downlink frame.

Thus, by using the proposed **'overlapped two-dimensional resource allocation in OFDMA DL-MAP'**, we can enhance the flexibility of the resource allocation and reduce the complexity of the BS scheduler.

3. Proposed Text Change

[Add the following text after the Figure “Example of the data region which defines the OFDMA allocation” in section 8.4.3.1]

Data Regions are sequentially allocated in the DL-MAP.
If an SS supports the overlapped DL-MAP which is defined by TLV in 11.7.8.9, a data region represented by a DL-MAP IE may overlap with the pre-allocated data regions. In this case only non-overlapped region is actually allocated by the IE.

[Add the following text to the 11.7.8.9 SS capability encodings]

11.7.8.9 Overlapped DL-MAP support
This field indicates whether or not the SS supports overlapped DL-MAP

Type	Length	Value	Scope
18 (TBD)	1	0 : No overlapped DL-MAP support 1 : overlapped DL-MAP support 2~255 : reserved	REG-REQ REG-RSP