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Abstract	This is revised version of Section 11.7.2.3.2 of IEEE 802.16m-08/003r4. This document provides further physical layer details.	
Purpose	Draft for further development of the IEEE 802.16m SDD	
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# Transmission format for Unicast Service Control Channel

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## 1. Introduction

This contribution is to introduce the resource allocation for unicast service control channel (USCCH). In case of the control channel, the USCCH should be transmitted with high reliability because HARQ scheme can be applied. To achieve the reliable transmission with small size of control message, the several requirements for the transmission of USCCH are illustrated as below;

- To achieve the sufficient frequency diversity gain for the small size of control message
- FDM manner for the multiplexing of the USCCH and data channel for maximizing the efficiency of power adaptation for USCCH
- No additional burdensome to transmit the USCCH

To meet these design requirements for USCCH, the subchannelization for DL distributed resource which is specified in 11.5.2.3 should be re-used as the resource allocation for USCCH. That is, the same resource allocation such as DL distributed resource is applied including the control and data channel. In addition, OL MIMO diversity scheme specified in data burst should be utilized for the USCCH.

## 2. Transmission format for Unicast Service Control Channel (USCCH)

### 2.1 Resource Allocation for USCCH

The Unicast Service Control Channel (USCCH) shall be transmitted in each subframe includes DL assignment channel, DL ACK channel, and DL Power Control channel. Such control channels, if present, shall be multiplexed and allocated to the tone-based DRUs (see 11.5.2.3) from the first LDRU (Logical DRU) in this region. The allocation shall proceed in the order of DL ACK channel, DL Power Control channel and DL assignment channel, as shown in Figure 1. The logically allocated channels shall be mapped to subcarriers by the permutation rule which is specified in 11.5.2.3 (FFS). The number of tones occupied by the total control channels in a subframe is given by

$$N_{\text{Tone,USCCH}} = N_{\text{Tone,DLACKCH}} + N_{\text{Tone,DLPCCH}} + N_{\text{Tone,DLACH}}$$

where  $N_{\text{Tone,DLACKCH}}$ ,  $N_{\text{Tone,DLPCCH}}$  are the number of data tones in DL ACK channel and DL Power Control channel, respectively.  $N_{\text{Tone,DLACH}}$  is the number of data tones in DL assignment channel, which is same as  $K \cdot n$  where  $K$  is the number of assignment messages and  $n$  is the number of tones per each assignment message. The value of  $n$  is determined according to MCS level and system bandwidth (FFS). If  $N_{\text{Tone,USCCH}}$  is not an integer multiple of  $N_{\text{Tone,LDRU}}$  where the number of data tones within each LDRU, no energy is transmitted on the

remaining tones, as shown in Figure 1. In addition to USCCH, the data is allocated into the following LDRUs.

With the allocated LDRUs, the tone-based DRU shall be applied to transmit either USCCH or data on physical resource units (PRU). The specific permutation rule for tone-based DRU is not determined yet. In this structure, the resource allocation for USCCH shall be same as one defined in DL PHY structure (see 11.5.2.3).

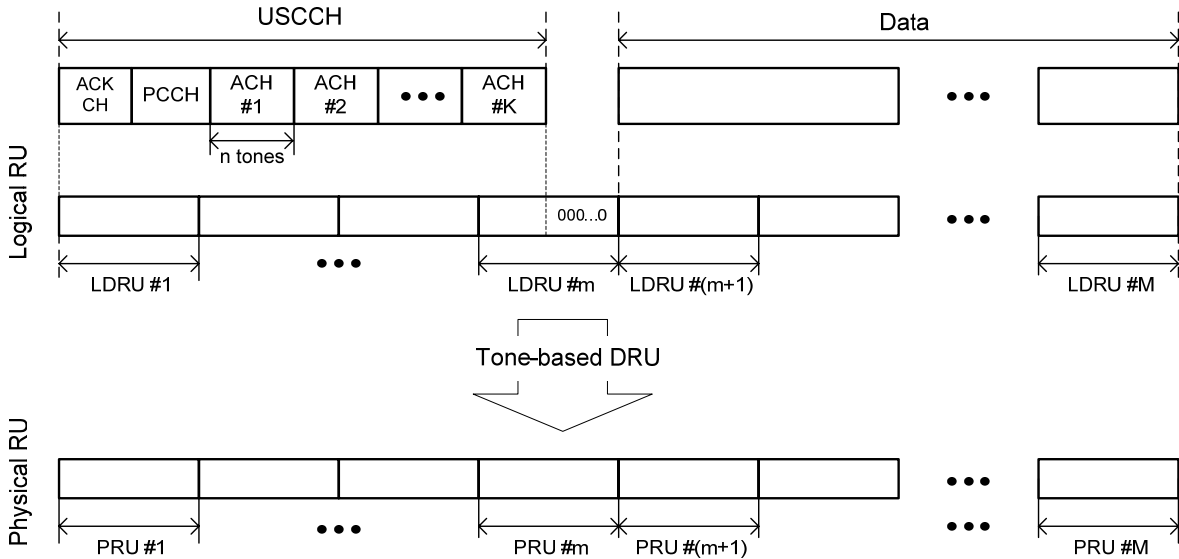


Figure 1 – Example resource allocation for unicast service control (e.g. physical to logical mapping)

## 2.2 MIMO scheme for USCCH

The MIMO scheme applied in USCCH is an OL MIMO diversity scheme such as SFBC, CDD and Precoder cycling and so on. A simple OL MIMO diversity scheme is enough for the reliable transmission of the USCCH.

## 3. Text Proposal for Modification in 802.16m SDD

*Change the text in Multiplexing scheme for data and unicast service control Sub-clause as follows:*

-----Start of the text-----

### 11.7.2.3.2 Multiplexing scheme for data and unicast service control

### 11.7.2.3.3 Location of control blocks

### 11.7.2.3.4 Resource allocation (physical to logical mapping, pilots, block size)

The logical resource for USCCH is mapped to subcarriers by the permutation rule which is defined in 11.5.2.3. The USCCH is inner-permuted together with DL data. The minimum number of PRUs for LDRU resource allocation is 4 PRUs to achieve frequency diversity gain. Open-loop diversity antenna scheme specified in DL data burst is used for USCCH transmission. The pilot patterns supported are

[identical to those defined in Section 11.5.](#)

~~<Editors' Notes: This section depends on SDD text included in the DL PHY Structure.>~~

~~**11.7.2.3.4.1 Pilot structure for unicast service control channels**~~

~~<Editors' Notes: This section depends on SDD text included in the DL PHY Structure.>~~

-----End of the text-----