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Title	<b>MAP and Data Association in RS for Centralized Scheduling</b>		
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Re:	80216-07_043: IEEE 802.16 Working Group Letter Ballot #28: Announcement		
Abstract	This contribution proposes methods to provide mapping between bandwidth allocation from MAP messages to MAC PDUs at RS when centralized scheduling is used.		
Purpose	Discuss and adopt proposed text in TG16j		
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# MAP and Data Association in RS for Centralized Scheduling

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## Introduction

As defined in current draft 16j/D1, when centralized bandwidth allocation is used, the MR-BS shall determine the bandwidth allocations for all links (access and relay) in its MR-cell. For non-transparent RS, the MR-BS performs bandwidth allocations for all DL and UL links and sends scheduling result in MAP message to each RS via RS' basic connection. Data packets are relayed through the network using the bandwidth allocation over transport connections or tunnel connection. Hence, MAP messages and data packets using the bandwidth allocations are received by the RS through difference connections asynchronously. A mapping (reference) is needed between bandwidth allocation and MAC PDUs to allow the RS transmitting the intended MAC PDUs using a specific allocation.

This contribution proposes methods to provide the mapping between bandwidth allocation and MAC PDUs to be used by RS to determine the intended MAC PDUs for each allocation.

## Problem Statement

As defined in the current baseline document, MAP messages and data packets using the bandwidth allocations are received by the RS through difference connections asynchronously. Except when tunnel burst mode is used, MAC PDUs are relayed through the relay links instead of data burst. In addition, each data burst allocation can contain multiple MAC PDUs of different connections. To further explain the operation of MAC PDU relaying, an example is provided based on Tunnel Packet Mode. Figure 1 shows an example of 3-hops relay with three tunnels, T1, T2 and T3, each tunnels carries one or two connections from MR-BS to RSs.

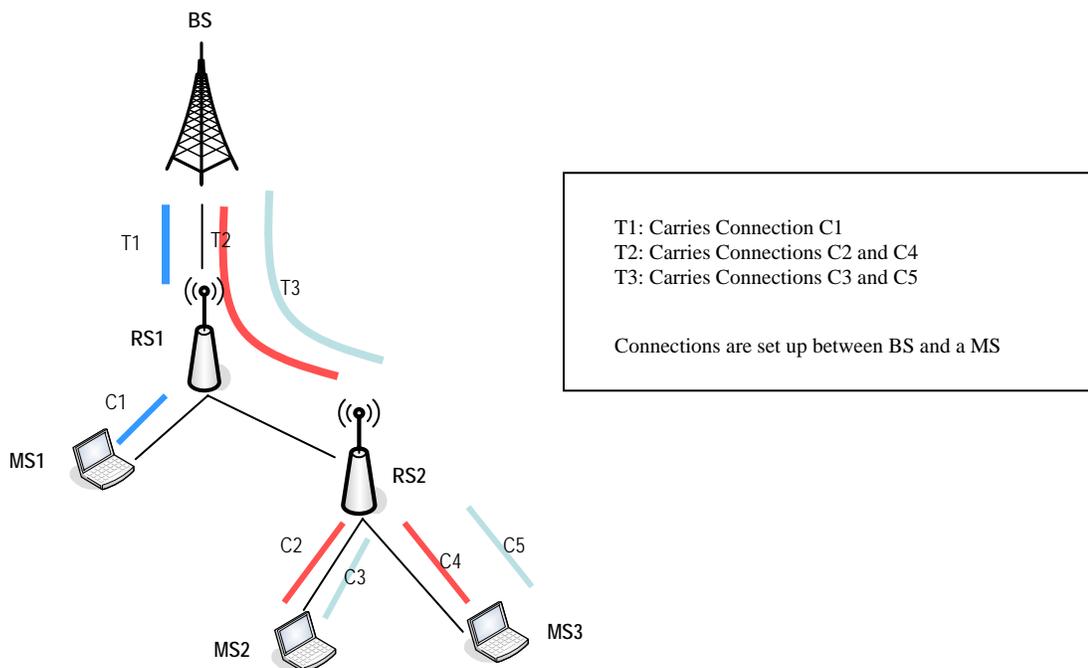


Figure 1 Example of 3 hops Relay

Figure 2 shows an example of MAC PDU relaying through the relay network illustrated in Figure 1. The color

boxes represent the tunnel MAC PDUs transmitted over the tunnel with respective color. The grey box represents a data burst allocation. In this example, it is shown that MAC PDUs concatenated within one data burst over one relay link can be re-bundled with other MAC PDUs when transmitting over another relay link or access link. Figure 2 also shows that if a MAC PDU is lost over a relay link, i.e. MAC PDU T1 at frame 1, the RS may incorrectly transmit MAC PDUs received later, as indicated in Frame 4.

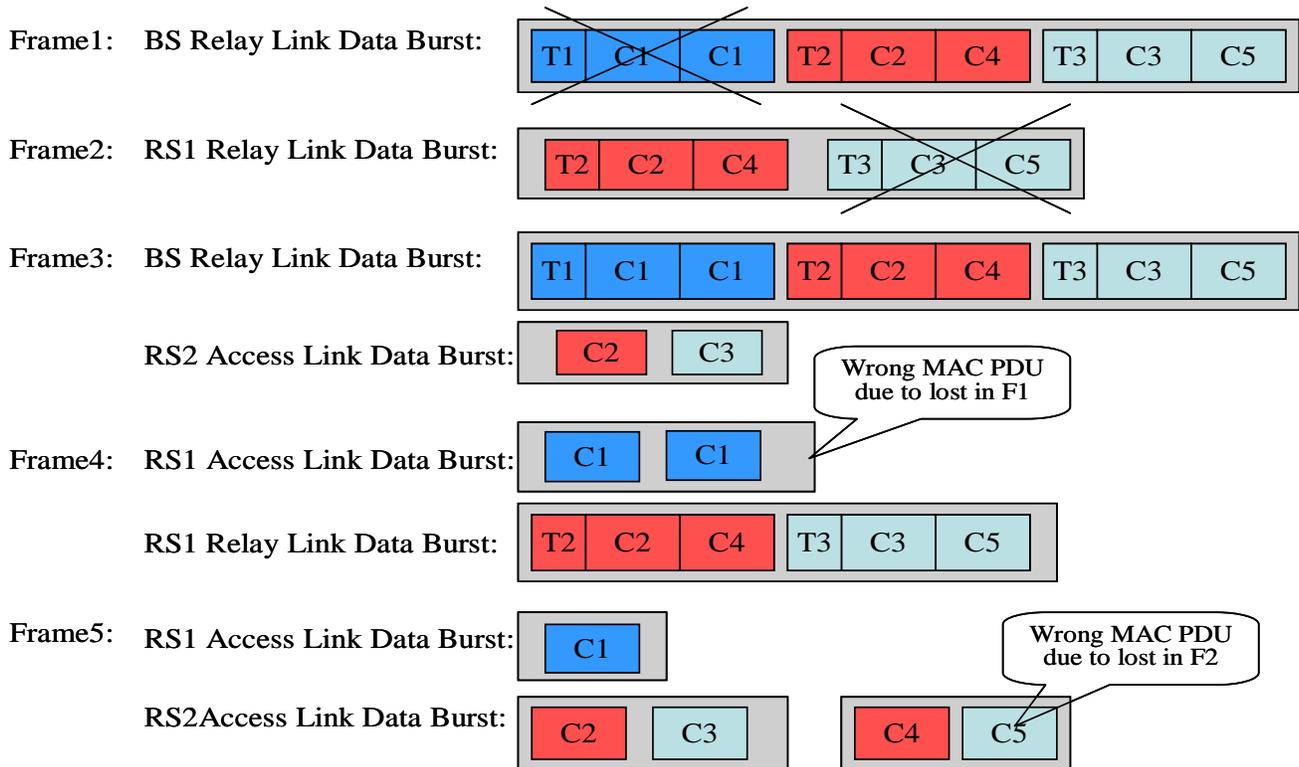


Figure 2. Example of MAC PDU relay

As described in the example above, the following issues need to be resolved to allow RS determine the intended MAC PDU for each allocation:

1. When relaying is not done per data burst, RS needs to identify which MAC PDUs are intended for the allocation
2. RS needs to be able to detect lost packet (MAC PDU or data burst) and ignore an allocation if the intended data packets are lost over relay link. Without lost detection, the RS could potentially send “future” MAC PDUs (PDUs arrived at a later time) to the MS which could impact the QoS performance of the connections (such as impact on jitter control).

## Proposed Solutions

There are multiple transmission options included in the baseline document, namely, tunnel packet mode, tunnel burst mode and station CID. There exists an allocation subheader used for transmission using tunnel packet mode. In this contribution, we propose the solution to address the transmission using tunnel burst mode and station CID. The methods will be used to provide MAP and data referencing.

### **Tunnel Burst Mode and Station CID**

This method is defined for transmission without relay MAC header. The method is defined as following:

- DL Allocation Reference IE is defined in the format of DL-MAP extended-2 IE
  - DL Allocation Reference IE is used to include a reference to MAC PDUs for each allocation and should follow its associated DL-MAP-IE immediately. The associated DL-MAP-IE includes data burst allocation for which DL Allocation Reference IE is providing a reference to the MAC PDUs concatenated in the data burst.
  - DL Allocation Reference IE contains the following parameters per connections included in data burst:
    - a. *CID*: Identity the connection that is transmitting. For Tunnel Burst mode, CID should be tunnel CID when sending over relay zone or RS management CID.
    - b. *Total Data Allocated*: Total data allocated for this connection, in unit of bytes.
    - c. *Received Frame*: Frame number where the MAC PDUs should be received by the RS
  - RS should store the received frame number for each MAC PDU and use the stored frame number to match what's included in DL Allocation Reference IE.
  - If RS cannot find any MAC PDU that matches the DL Allocation Reference IE, it should ignore the DL allocation.
  - DL Allocation Reference IE should be included in both R-MAP and DL-MAP used by RS
  - RS removes DL Allocation Reference IEs from MAP message before broadcasting in access zone or relay zone.
- UL Allocation Reference IE is defined in the format of UL-MAP extended-2 IE
  - UL Allocation Reference IE is used to include a reference to MAC PDUs for each allocation and should follow its associated UL-MAP-IE immediately. The associated UL-MAP-IE includes data burst allocation for which UL Allocation Reference IE is providing a reference to the preferred MAC PDUs to be relayed in uplink data burst
  - UL Allocation Reference IE contains the following parameters:
    - a. *CID*: Identity of a preferred connection to use the relay burst allocation. For Tunnel Burst mode, CID should be tunnel CID when sending over relay zone or RS management CID.
  - RS should use UL Allocation Reference IE as a reference to determine the MAC PDUs to be preferentially relayed in the burst allocation. However, if MAC PDUs that match the UL Allocation Reference IE specification are not sufficient to fill the burst allocation, the RS may fill the remainder of the burst with other MAC PDUs.
  - UL Allocation IE should only be included in R-MAP used by RS

## Proposed Text

[To modify section 6.3.3.8.1 on Page 77 and section 6.3.3.8.2 on Page 78.]

### 6.3.3.8.1 Transmission using tunnels

[To insert the following sentences at the end of the second paragraph]

When tunnel burst mode is used with centralized scheduling, DL Allocation Reference IE shall be included in DL MAP and R-MAP messages sent to RS via RS basic CID, and UL Allocation Reference IE may be included in R-MAP message sent to RS via broadcast connection and basic connection .. RS shall use DL Allocation Reference IE and UL Allocation Reference IE to match the MAC PDUs with corresponding allocation in the MAP message for downlink and uplink transmission .

### 6.3.3.8.2 Transmission using station CID

[To insert the following sentences at the end of this section ]

With centralized scheduling, forwarding of MPDU by each RS is performed based on burst described in MAP IEs, namely burst-based forwarding. DL Allocation Reference IE and UL Allocation Reference IE shall be used for burst-based forwarding scheme with centralized scheduling. RS shall use DL Allocation Reference IE and UL Allocation Reference IE to match the burst with corresponding allocation in the MAP message for downlink and uplink transmission.

[Modify section 8.4.5.3.2.2, table 385 on Page 153]

Extended-2 DIUC (hexadecimal)	Usage
...	...
0E	AAS_SDMA_DL_IE
0F	<del>Reserve</del> DL Allocation Reference IE

[Insert section 8.4.5.3.30, table 421c on Page 181]

#### 8.4.5.3.30 DL Allocation Reference IE format

MR-BS may transmit DL Allocation Reference IE when sending DL-MAP and R-MAP messages to RS to inform RS the bandwidth allocation of RS' access zone and relay zone. Each DL Allocation Reference IE is associated with a DL MAP IE with DIUC 0-12. When included, the DL Allocation Reference IE shall follow the associated DL-MAP-IE immediately. The associated DL-MAP IE includes data burst allocation for which DL Allocation Reference IE is providing a reference to.

DL Allocation Reference IE shall be removed from the MAP messages by RS before broadcasting.

**Table 421c – DL Allocation Reference IE format**

Syntax	Size	Notes
<a href="#">DL Allocation Reference IE()</a> {	-	-
<a href="#">Extended-2 DIUC</a>	4 bits	<a href="#">DL Allocation Reference IE=0xF</a>
<a href="#">Length</a>	8 bits	-
<a href="#">Num Connections</a>	4 bits	<a href="#">Number of connections included in the associated allocation</a>
<a href="#">for( i=0;i&lt;Num Connections;i++) {</a>	-	-
<a href="#">    CID</a>	16bits	<a href="#">CID of connection</a>
<a href="#">    Total Data Allocated</a>	12bits	<a href="#">Total data allocated for this connection, in unit of bytes.</a>
<a href="#">    Received Frame</a>	4 bits	<a href="#">LSB of frame number where the MAC PDUs are received by the RS.</a>
<a href="#">}</a>	-	-
<a href="#">}</a>	-	-

[Modify table 290c, insert after table 433 on Page 183 in Section 8.4.5.4.4.2]

<b>Extended-2 DIUC (hexadecimal)</b>	<b>Usage</b>
00	CQICH_Enhanced Allocation_IE
01	HO_Anchor_Active_UL-MAP_IE
02	HO_Active Anchor UL MAP
03	Anchor_BS_switch_IE
04	UL_sounding_command_IE
05	Reserved
06	MIMO UL Enhanced IE
07	07 HARQ UL MAP IE
08	HARQ ACKCH Region Allocation IE
09	HARQ ACKCH Region for Relay Data IE

0A	MR UL-MAP Monitor IE
0B	MIMO UL Extended IE
<a href="#">0C</a>	<a href="#">UL Allocation reference IE</a>
0D	Reserved
0E	AAS_SDMA_UL_IE
0F	Feedback_polling_IE

[Insert section 8.4.5.4.32]

#### **8.4.5.4.32 UL Allocation Reference IE format**

MR-BS may transmit UL Allocation Reference IE when sending R-MAP messages to RS. Each UL Allocation Reference IE is associated with a UL-MAP-IE with UIUC 0-10. When included, the UL Allocation Reference IE shall follow the associated UL-MAP-IE immediately. The associated UL-MAP IE specifies data burst allocation for which UL Allocation Reference IE provides additional information as to which MAC PDUs should be given preferential use of the allocation.

**Table 486e – UL Allocation reference IE format**

<u>Syntax</u>	<u>Size</u>	<u>Notes</u>
<u>UL_Allocation_Reference_IE(){</u>	<u>-</u>	<u>-</u>
<u>Extended-2 UIUC</u>	<u>4 bits</u>	<u>UL Allocation Reference IE=0xC</u>
<u>Length</u>	<u>8 bits</u>	<u>-</u>
<u>Num_Connections</u>	<u>4 bits</u>	<u>Number of connections included in the associated allocation</u>
<u>for( i=0;i&lt;Num_Connections;i++) {</u>	<u>-</u>	<u>-</u>
<u>    <u>CID</u></u>	<u>16bits</u>	<u>CID of connection</u>
<u>    <u>Total Data Allocated</u></u>	<u>12bits</u>	<u>Total data allocated for this connection, in unit of bytes.</u>
<u>    <u>Received Frame</u></u>	<u>4 bits</u>	<u>LSB of frame number where the MAC PDUs are received by the RS.</u>
<u>  <u>}</u></u>	<u>-</u>	<u>-</u>
<u>}</u>	<u>-</u>	<u>-</u>

## Reference

- [1] “Air Interface for Fixed and Mobile Broadband Wireless Access Systems - Multihop Relay Specification”,  
IEEE 802.16j-06/026r4, June 2007