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Re:	This is a response to Call for Technical Proposals issued by IEEE 802.16j.
Abstract	We suggest the procedure of tunnel establishment.
Purpose	The objective of this contribution is to propose the procedure of tunnel establishment in MMR system.
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Tunnel Establishment

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Introduction

Baseline document, IEEE 802.16j-06/026r3, includes the way to bind the path with CID. In this method, explicit DSA*-REQ is used to notify the information of connection to intermediate RSs and access RS, and contains the CIDs of connection, the path-id and optionally the SFID and the service flow parameter for the connection. So this method is suitable for the distributed scheduling.

But in the centralized scheduling, the bandwidth is unnecessarily wasted to process DSA*-REQ. So we propose more efficient method to bind CIDs to the path.

The procedures

If new tunnel is established as depicted in Figure 1, the MR-BS sends response message encapsulated with encapsulation subheader to the MS or RS. Then intermediate and access RS add CIDs in encapsulation subheader to its own routing table. Finally the access RS eliminates the encapsulation subheader and forwards it to the MR or RS.
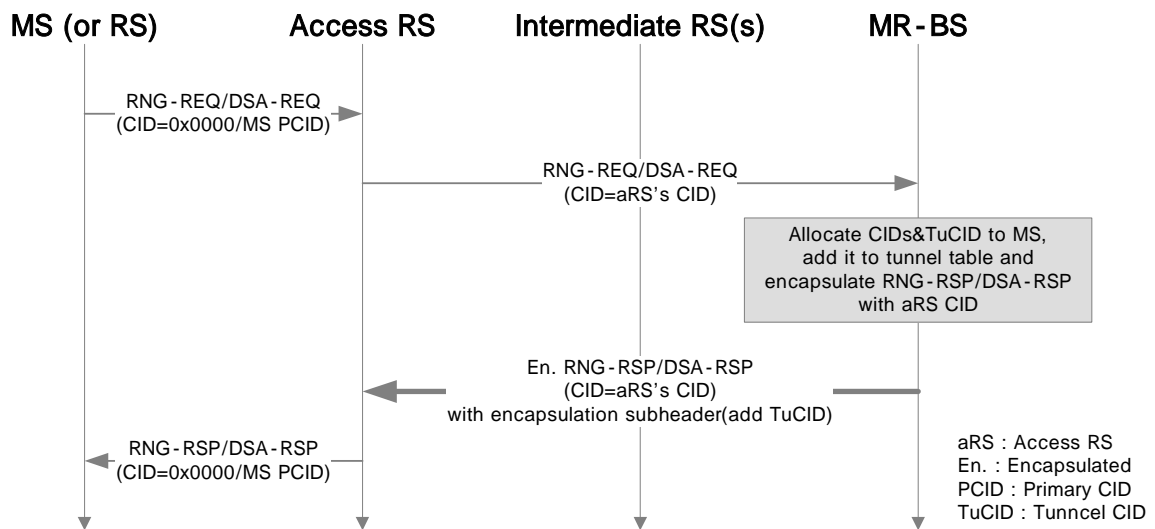

Figure 1—Addition of tunnel CID (initial ranging or service flow addition)

If any tunnel eliminated as depicted in Figure 2, the MR-BS sends response message encapsulated with encapsulation subheader to the MS or RS. Then intermediate and access RS remove CIDs in encapsulation subheader from its own routing table. Finally the access RS eliminates the encapsulation subheader and forwards it to the MR or RS.
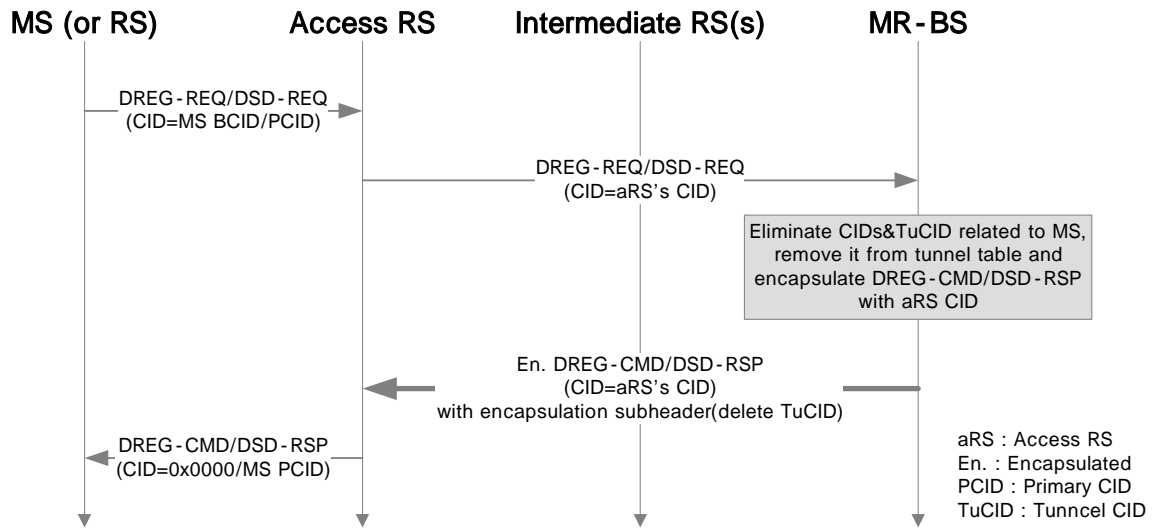
MS (or RS)   Access RS   Intermediate RS(s)   MR-BS

DREG-REQ/DSD-REQ
(CID=MS BCID/PCID)

DREG-REQ/DSD-REQ
(CID=aRS's CID)

Eliminate CIDs&TuCID related to MS,
remove it from tunnel table and
encapsulate DREG-CMD/DSD-RSP
with aRS CID

En. DREG-CMD/DSD-RSP
(CID=aRS's CID)
with encapsulation subheader(delete TuCID)

DREG-CMD/DSD-RSP
(CID=0x0000/MS PCID)

aRS : Access RS
En. : Encapsulated
PCID : Primary CID
TuCID : Tunncel CID

Figure 2—Deletion of tunnel CID (deregistration or service flow deletion)

The encapsulation

A MAC management messages from the MR-BR to the access RS is encapsulated with an encapsulation sub header depicted as Figure 3. The encapsulation subheader could be added to one MPDU or several MPDUs.

| GMH (CID=RS BCID) | Encapsulation subheader | GMH (CID=a) | Data | PAD | CRC |

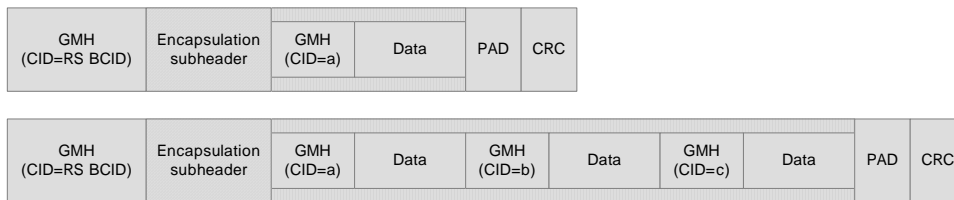| GMH (CID=RS BCID) | Encapsulation subheader | GMH (CID=a) | Data | GMH (CID=b) | Data | GMH (CID=c) | Data | PAD | CRC |

Figure 3—The example of encapsulation [2]

The encapsulation subheader includes CIDs related to the tunnel. Especially the tunnel CID is used for the access RS and intermediate RSs to manage the tunnel.

Proposed Text

6.3.2.1. MAC header formats

Insert the following at the end of 6.3.2.1:

The location of the EI(Encapsulation Indicator) field in the MAC header is to be determined.

6.3.2.2. MAC subheaders and special payloads

Insert new subclause 6.3.2.2.8 at the end of 6.3.2.2:

6.3.2.2.8 Encapsulation subheader

Encapsulation subheader is used to establish a tunnel and is added to MAC management message from/to multi-hop RS and MS. This subheader is solely used, so other subheader and extended subheader shall be not followed. The format of the encapsulation subheader is as described in Table 13m.

Table 13m—Encapsulation subheader

Syntax	Size	Notes
Encapsulation subheader_format() {		
TYPE	2 bits	0b00 : Addition of tunnel CID 0b01 : Deletion of tunnel CID 0b10 – 0b11 : reserved
N_CID	6 bits	Number of CIDs
For(i=0; i<N_CID; i++) {		
CID	16 bits	Basic, Primary, Tunnel CID
}		
}		

6.3.25 Relay path management and routing

Insert the following at the end of 6.3.25:

6.3.25.2.3 Tunnel establishment in centralized scheduling

In centralized scheduling, if new tunnel is established by the MR-BS, its CIDs are forwarded to intermediate RSs and the access RS by encapsulation subheader.

For example, in the last step of initial ranging of multi-hop RS or MS, the MR-BS allocates some new CIDs to it and forwards it RNG-RSP with encapsulation subheader to add new allocated CIDs to the routing table of the intermediate and access RS.

On the contrary, if any CID has to be eliminated, the MR-BS forwards intermediate and access RS MAC management message with encapsulation subheader to delete CID from the its routing table.

References

[1] C. K. Kim, et. Al, "Simple Path Management by Encapsulation in MMR System," IEEE C802.16j-07/168, I EEE 802.16 meeting #47, London, January 2007

[2] J. Z. Tao, et. Al, "Relay Tunnel Connection for 802.16j," IEEE X802.16j-07/115r3, IEEE 802.16 meeting #47, London, January 2007

[3] IEEE 802.16j-06/026r3