Project	***IEEE 802.16j Mobile Multihop Relay Task Group***
Title	***Enabling MAC tunneling over HARQ in 802.16j***
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Re:	*Response to the call for technical proposal regarding IEEE Project 802.16j (i.e., IEEE 802.16j-07/007r2, "Call for Technical Comments and Contributions regarding IEEE Project P802.16j").*
Abstract	*This contribution describes essential mechanisms that enable MAC tunneling over HARQ for 802.16j.*
Purpose	*To adopt the mechanisms proposed herein into IEEE 802.16j.*
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1. Introduction

This contribution proposes essential mechanisms to enable MAC tunneling over HARQ in 802.16j networks.

- For encapsulation mode in the tunneling, *SDU sequence number (SN) extended subheader* shall be inserted after the tunnel MAC header to address the potential out-of-order data delivery problem at HARQ, which arises when the tunnel PDU is processed by multiple parallel HARQ channels.
- The tunnel CID shall be used in the *reduced CID* (RCID) field for HARQ.

1.1 Problem Statement

A tunnel may be established between an MR-BS and an access RS to facilitate traffic handling. To run MAC tunnel over HARQ, two issues have to be clarified and addressed.

1. **Tunnel identification in HARQ :** One or multiple individual MAC connection can be contained in a MAC tunnel connection. Tunnel PDU can be constructed by encapsulating MPDUs that traverse a tunnel in a new type of header which carries the tunnel CID (T-CID) of the tunnel. Note that the MPDUs comprising the tunnel PDU may belong to different MAC connection and therefore have different individual CID.

However, when the tunnel PDU is handled by HARQ, there is only one *reduced CID* (RCID) field in each related DL/UL sub-burst IE. Thus, it is necessary to clarify what identifier should be used in the RCID field to unambiguously identify the tunnel PDU in the HARQ operation.

2. **Out-of-order data delivery:** When a tunnel PDU constructed by encapsulation is further handled by multiple HARQ channels, the out-of-order data delivery problem may arise. In fact, this problem has been well recognized and addressed in IEEE 802.16e by introducing a SDU sequence number (SN) extended Subheader.

1.2 Proposed Solution

To address the problem described in section 1.1, two simple solutions have been proposed as follows:

1. **Tunnel identification in HARQ:** When handled by HARQ, a MAC tunnel shall be perceived as one single connection. Thus, it is a natural solution to use the tunnel CID [1] in the RCID field.

2. **Out-of-order data delivery:** To address this problem, a PDU sequence number (SN) extended subheader shall be inserted immediately after the tunnel header, as shown in Figure 1.

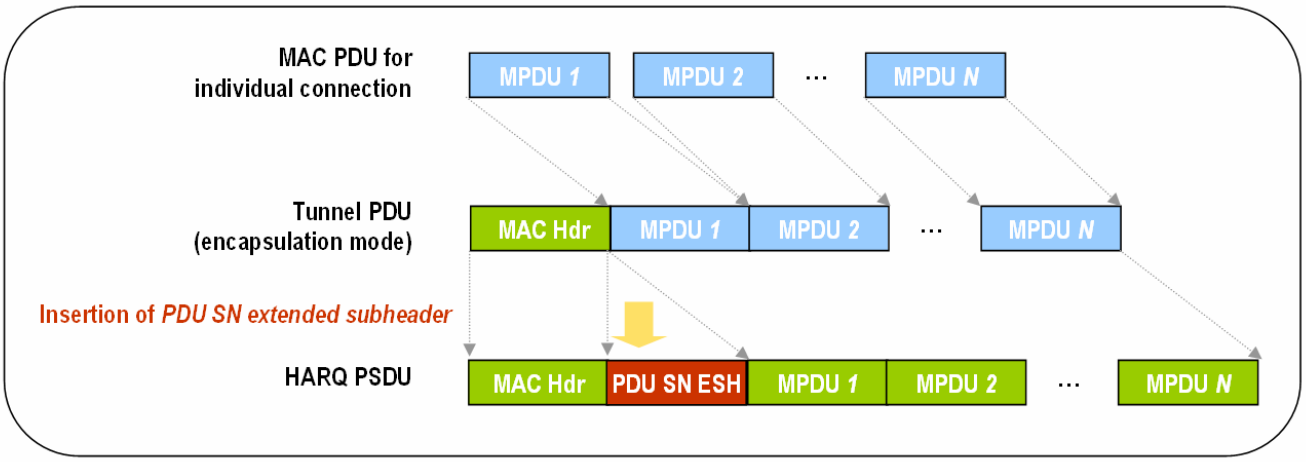

Figure 1: Insertion of PDU SN extended subheader.

2. Proposed Text Changes

6. MAC common part sublayer

[Add following text into new section 6.3.3.8]

6.3.3.8 MMR construction and transmission of Tunneling MAC PDUs

[Insert the following text]

If a tunnel PDU that is constructed by using encapsulation will be processed by parallel HARQ channels, the tunnel PDU then shall contain a PDU SN extended Subheader after the tunnel header.

8. PHY

8.4.5.3.21 HARQ DL MAP IE

[Change the description in this subclause as follows:]

Each HARQ Map IE and sub-burst IE shall be nibble-aligned. When there is an if-else clause, regardless of whether the 'if' clause or the 'else' clause is executed, the resulting Map IE shall be nibble-aligned. When there is a loop, nibble-alignment shall be required before the loop starts and inside the loop.

If MAC tunneling is used, tunnel CID should be used as RCID in the related DL HARQ sub-burst IE for the corresponding sub-burst.

8.4.5.4.24 HARQ UL MAP IE

[Change the description in this subclause as follows:]

The HARQ UL MAP IE defines one or more bursts. Each burst is separately encoded.

If MAC tunneling is used, tunnel CID should be used as RCID in the related UL HARQ sub-burst IE for the corresponding sub-burst.

11 TLV Encodings

11.13.36 PDU SN extended subheader for HARQ reordering

[Change the description in this subclause as follows:]

This TLV is valid only in HARQ enabled connection. It specifies whether PDU SN extended subheader should be applied by the transmitter on every PDU on this connection. *The PDU can be tunnel PDU that is constructed using encapsulation.* This SN may be used by the receiver to ensure PDU ordering.

3. References

[1] Jerry Sydir, et al. "Proposal on addresses, identifiers and types of connections for 802.16j", IEEE 802.16j contribution document C802.16j-06/274r2, November 16 2006.

[2] "IEEE Standard for Local and Metropolitan Area Networks − Part 16: Air Interface for Fixed Broadband Wireless Access Systems, Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands," IEEE Computer Society and the IEEE Microwave Theory and Techniques Society, February 2006.