Project	***IEEE 802.16j Mobile Multihop Relay Task Group***	
Title	***Relay Tunnel Connection for 802.16j***	
Date	***2007-01-15***	
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Re:	*Response to the call for technical proposal regarding IEEE Project 802.16j (i.e., IEEE 802.16j-06/034, "Call for Technical Proposals regarding IEEE Project P802.16j", December 12, 2006).*	
Abstract	*This contribution describes a relay tunnel connection concept and mechanism for 802.16j networks*	
Purpose	*To adopt the relay tunnel connection concept and mechanism proposed herein into IEEE 802.16j.*	
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1. Introduction

This contribution proposes to establish a relay tunnel as an alternative to the end-to-end MAC tunnel on a relay link between MR BS and RS, between a pair of adjacent RSs, and/or between a RS and an access RS. The relay tunnel created on such a per link basis has the following advantages:

- Help handle the aggregate traffic on relay link.
- Support flexible traffic forwarding.
- Provide adaptive and quick response to route change.
- Accommodate fast handover of mobile relay stations (MRS).

Following sections provide more detailed discussion on relay tunneling, and its proper interaction with the HARQ.

1.1 Relay CID (R-CID)

A relay CID (R-CID) is used to uniquely identify the corresponding relay connection established on a relay link between a MR BS and a RS, between a pair of adjacent RSs, and/or between a RS and an access RS. Figure 1 provides an illustration of relay tunnel connection and the associated relay CID. The quality of service is managed on a per relay connection basis. The two end points of the relay tunnel have the full information with regard to the mapping between individual MAC connection (e.g., transport CID) and the relay tunnel connection (e.g., R-CID).

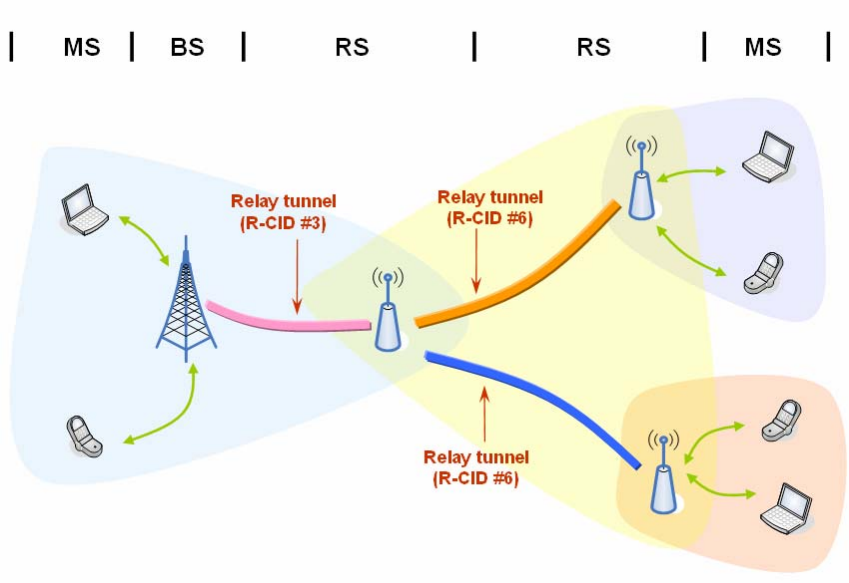

Figure 1: An illustration of relay tunneling in an MMR network.

Once a tunnel is established on a per link basis, the RS can route the traffic in a more flexible manner, thus potentially achieving better performance. This flexibility and adaptivity is particularly important for mobile relay network, wherein the mobility of relay stations may cause relatively frequent route change. Figure 2 illustrates the forwarding function at the relay station, when relay tunnel is created on each relay link.

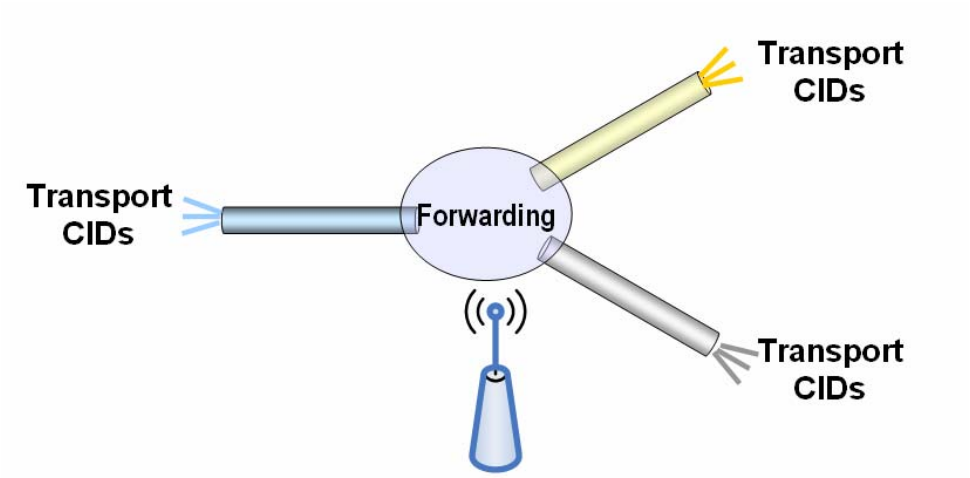

Figure 2: Traffic forwarding at RS.

1.2 Relay Tunnel Identification in HARQ

The MAC at MR-BS, RS and access RS aggregate multiple transport CIDs into a single relay tunnel connection, which is uniquely identified by a relay tunnel connection identifier (R-CID). When handled by HARQ, the relay tunnel shall be perceived as a single connection. Thus, it is a natural solution to use the proper form of R-CID in the reduced CID (RCID) field. The relay tunnels can be created during network entry/re-entry phase, and the R-CIDs for transport connections are assigned using the DSA messages. **Error! Reference source not found.** illustrates the connection mapping relation in the MMR network.

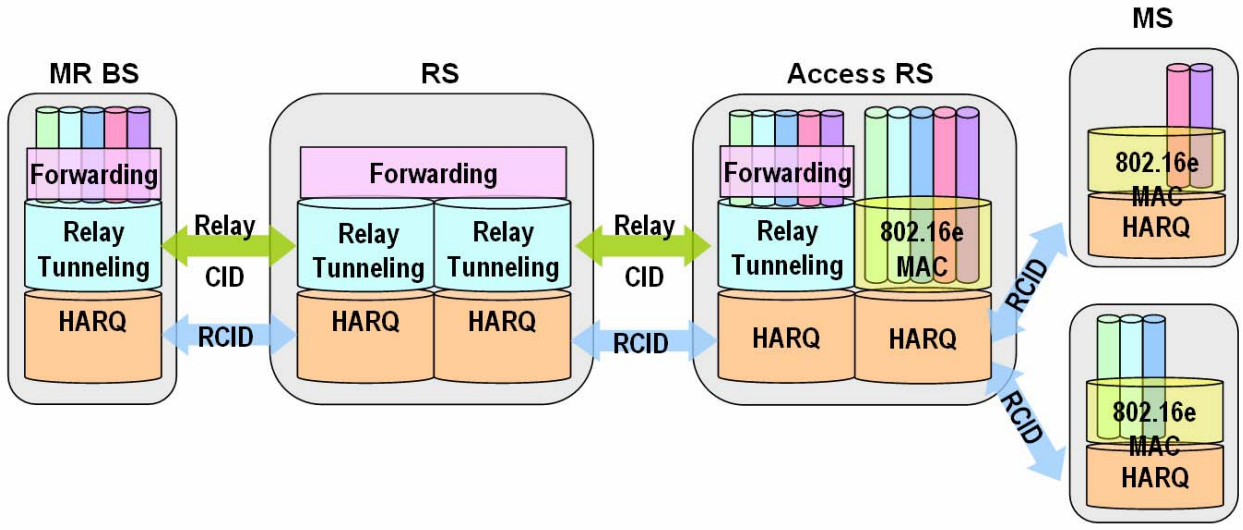

Figure 3: Connection mapping – a link-by-link approach.

1.3 Relay Tunnel Packet Ordering in HARQ

To construct a relay tunnel packet, MPDUs belonging to individual constituent MAC connection are encapsulated by appending a MAC header in the front. These MPDUs can also be concatenated before encapsulation. The resultant MPDU is called relay tunnel packet.

To address the potential out-of-order packet delivery problem, which arises when multiple HARQ channels are used to transport a relay tunnel packet, a PDU sequence number (SN) extended subheader shall be inserted between the MAC header and the concatenated MPDUs. This solution is shown in Figure 4. With the PDU SN extended subheader, HARQ receiver then can recover the data in the correct order before delivering them to the MAC layer.

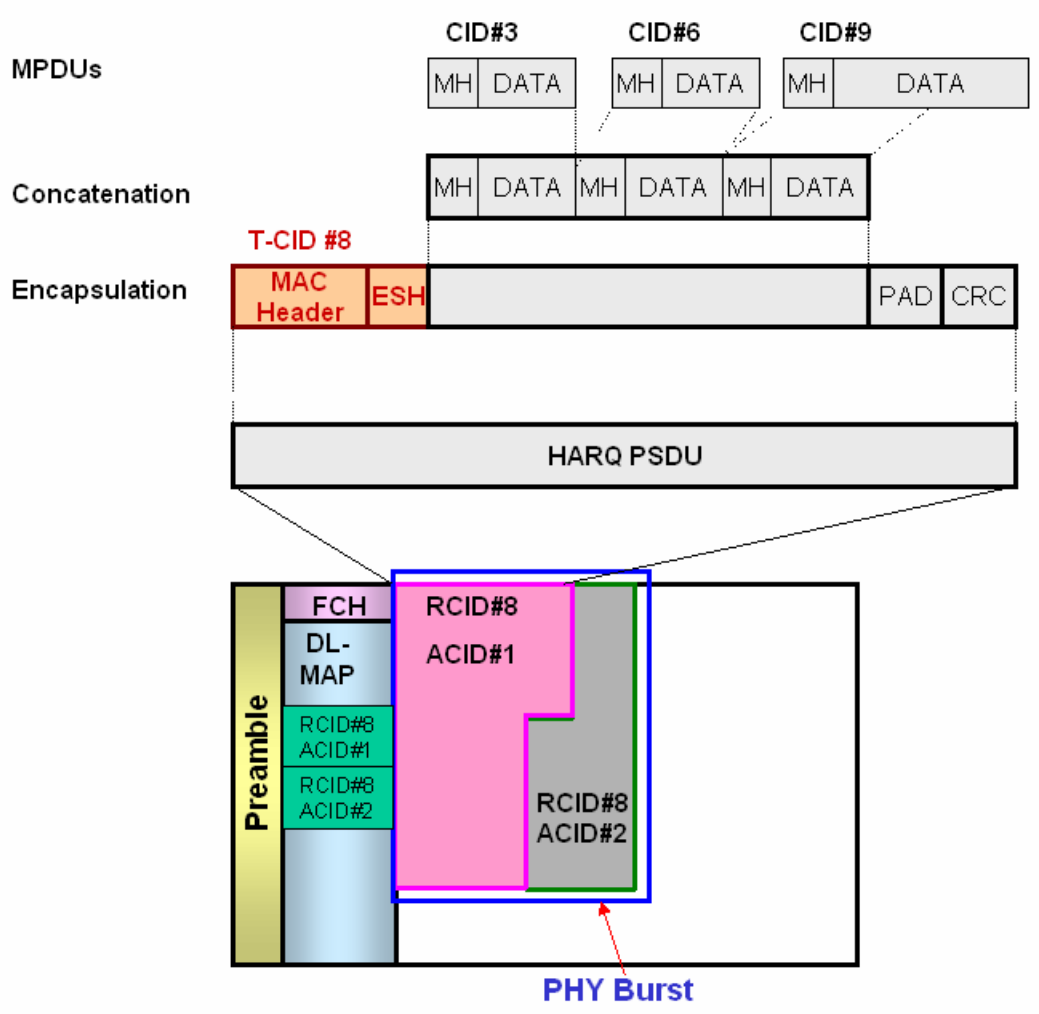

Figure 4: PDU SN extended subheader.

2. Proposed Text Changes

3. Definition

[Add following text into section 3]

3.90: R-CID (Relay tunnel CID): *A unique identifier taken from the connection identifier (CID) address space that uniquely identifies the relay tunnel connection between MR BS and RS, between a pair of adjacent RSs, or between a RS and an access RS.*

6. MAC common part sublayer

[Add following text into new section 6.3.3.9]

6.3.3.9 MMR construction and transmission of Relay Tunneling MAC PDUs

MPDUs from connections that traverse a relay tunnel connection form a relay tunnel PDU by encapsulation, whereby a MAC header is attached in the front. Multiple MPDUs from connections that traverse the relay tunnel connection can also be concatenated before encapsulation. MR BS or RS at the egress of the relay tunnel connection is responsible for removing the tunnel header and forwarding the recovered MPDU into the suitable relay tunnel connection on the next hop. The attached MAC header contains the relay tunnel CID (R-CID).

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 relay tunnel connection is used, a proper form of R-CID (Relay CID) should be used as RCID in the related DL HARQ sub-burst IE for the corresponding 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 relay tunnel connection is used, a proper form of R-CID (Relay CID) should be used as RCID in the related UL HARQ sub-burst IE for the corresponding burst.

10. Parameters and constants

10.4 Well-known addresses and identifiers

[Add following new CID into table 345-CIDs]

Table 345-CIDs

CID	Value	Description
…		
Relay CID	*n+1-k*	*Used by MMR-BS or RS for relay packets.*
Transport CIDs, Secondary Mgt CIDs	*k* +1-FE9F	For the secondary management connection, the same value is assigned to both the DL and UL connection.
…		

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 a relay tunnel PDU.* 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.