Project	***IEEE 802.16j Mobile Multihop Relay Task Group***	
Title	***Proposal for Relay MAC PDU Format***	
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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", February 19, 2007).*	
Abstract	*This contribution describes a general format for MAC PDU on relay links.*	
Purpose	*To adopt the relay MAC PDU format proposed herein into IEEE 802.16j.*	
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Proposal for Relay MAC PDU Format

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1. Motivation and Requirement

This contribution deals with the design of the *relay MAC PDU format*.

1.1 Motivation

A relay MAC PDU format must support following functions:

- Support encapsulation of one or multiple 802.16e MAC PDU of MS/RS
- Support a wide variety of data forwarding schemes, including various routing methods and QoS control

Unfortunately, it is ***not*** feasible to use the legacy 802.16e [1] MAC PDU header format as relay MAC PDU header, since the control functions implemented in MAC PDU header are different for RS from those of MS. More specifically,

1. Some fields in legacy 802.16e MAC header may not be needed any longer for RS operation:
   a. Not all the bits in *TYPE* field would be needed in 802.16j.

2. No sufficient bit space is left in legacy 802.16e MAC header to support RS control function (e.g., QoS control, source routing, high capacity RS BW request, flow control, etc.)
   a. ***Source routing:*** New subheaders that contain the route information would be included. The presence of such new subheaders needs to be indicated in the MAC header.
   b. ***QoS:*** The QoS level required by the tunnel may need to be indicated in the MAC header.
   c. High capacity RS ***Bandwidth request***

3. The legacy 802.16e MAC header is highly restrictive and rigid, and cannot be easily extended to accommodate any design needs that may arise in the future.

Due to above reasons, we suggest to define a new *relay MAC PDU header format* framework, instead of reusing the legacy 802.16e MAC generic header format, to support RS-related functions and open up opportunity for future extension.

1.2 Requirement

As suggested by the preceding discussion, the relay MAC PDU format design shall be based on the following principles:

1. The relay MAC PDU format and the legacy 802.16e format can be unambiguously distinguished on relay links.
    a. It is possible that MAC PDUs that follow legacy IEEE 802.16e format and relay MAC PDU format proposed hereafter may coexist on relay links.

2. It should be versatile enough to support a wide variety of new functions introduced in 802.16j on relay link.
    a. Support flexible routing control
    b. Support flexible QoS control
    c. Support high capacity RS BW request

3. It should be flexible enough for future extension

4. It should have low overhead and high protocol efficiency.

2. Summary of Proposal

2.1 Relay MAC PDU format

Relay MAC PDU shall be of the form illustrated below in Figure 1.

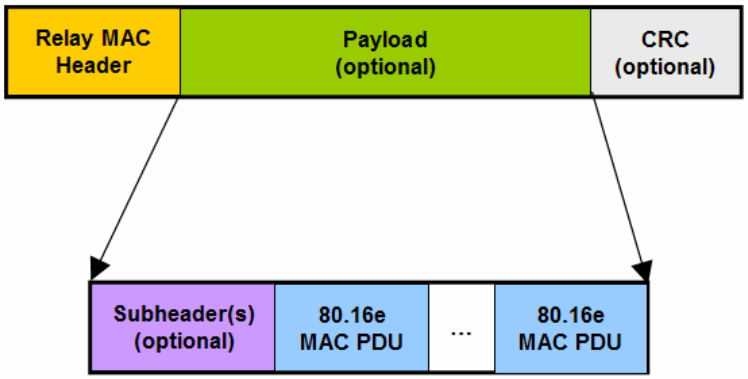

Figure 1: Proposed relay MAC PDU format.

The *relay MAC subheader* are optional, and are introduced to convey information needed by a wide variety of signaling and management function (e.g., QoS, security, routing).

The detailed format for *relay MAC subheader* is subject to further discussion.

2.2 Relay MAC PDU header format (DL)

The proposed relay MAC PDU header format for DL traffic is shown below in Figure 2: Proposed relay MAC PDU header format (DL).Figure 2.

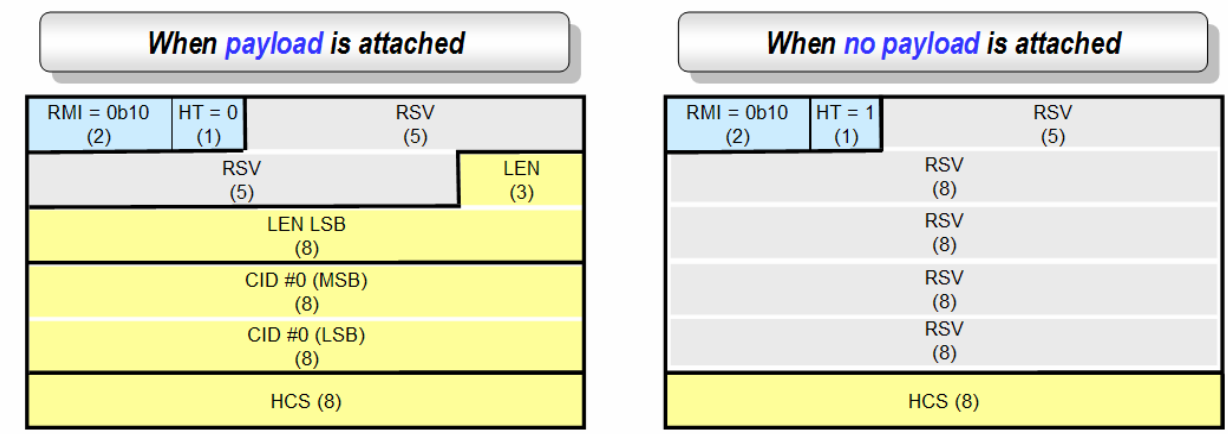

Figure 2: Proposed relay MAC PDU header format (DL).

In downlink, the first two bits of a legacy 802.16e MAC PDU can not be “0b10”. Thus, we can use the bit pattern “0b10” for the first two bits (i.e., Relay Mode Indicator) of the relay MAC PDU to distinguish it from legacy 802.16e MAC PDU.

In addition, one bit “HT” can be used to indicate whether the MAC PDU contains payload or not, similar to the “HT” bit in 802.16e MAC PDU header.

For those relay MAC PDus that contain some payload, they will be forwarded by RS to the final destination. To support various routing design, the relay MAC PDU header can contain a tunnel CID or basic CID of a RS.

Besides the new features described above, the rest of the relay MAC PDU header bears significant resemblance to the generic MAC header defined in 802.16e.

2.3 Relay MAC PDU header format (UL)

The proposed relay MAC PDU header format for UL traffic is shown below in Figure 3.

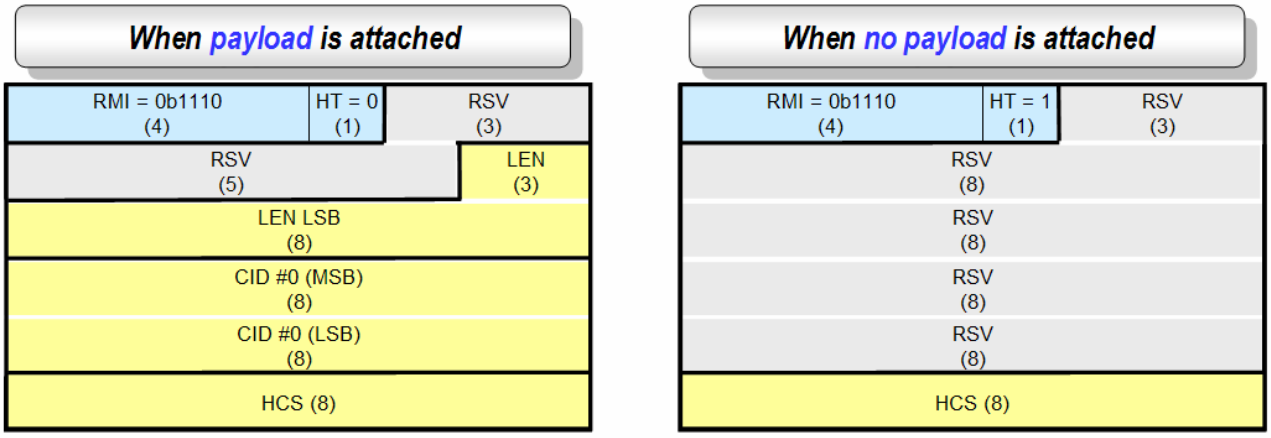

Figure 3: Proposed relay MAC PDU header format (UL).

In the UL case, the only pattern of the first 4 bits of the MAC PDU header that has not been used is "0b1110". Also, note that the first 4 bits can not assume value "0b1111", as it is explicitly prohibited by the 802.16e standard. As a result, we will use "0b1110" to distinguish the relay MAC PDU from legacy 802.16e MAC PDU in the UL direction.

The usage of "HT" bit is identical to that in the DL case. Moreover, the rest of the relay MAC PDU header is very similar to the generic MAC header specified in 802.16e.

3. Proposed Text Changes

6. MAC Common Part Sublayer

6.3.2 MAC PDU formats

[Insert the following paragraph at the end of this subclause]

For MAC PDUs sent on relay link, they can be of the form illustrated in Figure 18a. Each PDU can begin with a fixed length relay MAC PDU header. The relay MAC header may be followed by the Payload. If Payload is present after the relay MAC PDU header, the Payload shall consist of zero or more extended subheader, zero or more subheader, and zero or more IEEE 802.16e MAC PDUs. A relay MAC PDU may contain a CRC.

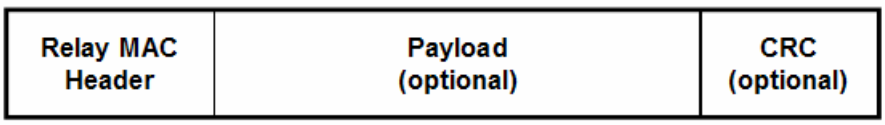

Figure 18a – Relay MAC PDU format

6.3.2.1 MAC header format

[Insert following subclause]

6.3.2.1.1.1 Relay MAC PDU header format (DL)

For DL MAC PDU with and without payload, different MAC header format shall be used, as defined in Table 6a and further illustrated in Figure 19b and 19c, respectively.

Syntax	Size	Notes
MAC Header() {		
RMI	2 bit	Relay mode indication: 10 = this MPDU uses 802.16j relay format others = this MPDU uses legacy 802.16e format
if (RMI == 0b10) {		If ***relay MAC PDU format*** will be used
HT	1 bit	0 = Relay MAC PDU with payload 1 = Relay MAC PDU without payload
if (HT == 0) {		If ***payload*** is attached
Reserved	10 bits	Actual usage and format are subject to further discussion
Length	11 bits	The length in bytes of the relay MAC PDU including the MAC header and the CRC if present
CID	16 bits	Tunnel CID or basic CID of the RS, depending on the range in which the CID value falls into.
HCS	8 bits	Header check sequence
}		
else if (HT == 1) {		If ***no payload*** is attached
Reserved	37 bits	Actual usage and format are subject to further discussion
HCS	8 bits	Header check sequence
}		
}		
elseif (RMI == others) {		If ***legacy 802.16/16e MAC PDU format*** will be used
Use legacy 802.16j format		
}		
}		

Table 6a — Relay MAC PDU header (DL)

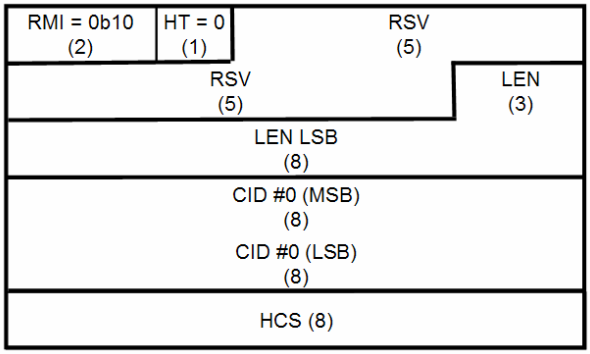

Figure 19b — Header format of relay MAC PDU with payload (DL)

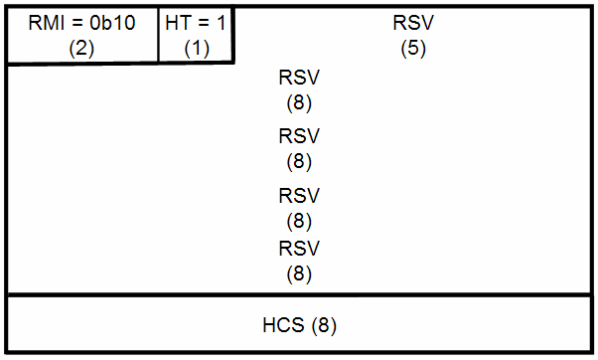

Figure 19c — Header format of relay MAC PDU without payload (DL)

[Insert following subclause]

6.3.2.1.1.2 Relay MAC header format (UL)

For UL MAC PDU with and without payload, different MAC header format shall be used, as defined in Table 6b and further illustrated in Figure 19d and 19e, respectively.

Syntax	Size	Notes
MAC Header() {		
RMI	4 bit	Relay mode indication: "0b1110" = this MPDU uses 802.16j relay format others = this MPDU uses legacy 802.16e format
if (RMI == 0b1110) {		If ***relay MAC PDU format*** will be used
HT	1 bit	0 = Relay MAC PDU with payload 1 = Relay MAC PDU without payload
if (HT == 0) {		
Reserved	8 bits	Actual usage and format are subject to further discussion
Length	11 bits	The length in bytes of the relay MAC PDU including the MAC header and the CRC if present

CID	16 bits	Tunnel CID or basic CID of the RS, depending on the range in which the CID value falls into.
HCS	8 bits	Header check sequence
}		
else if (HT == 1) {		
Reserved	35 bits	Actual usage and format are subject to further discussion
HCS	8 bits	Header check sequence
}		
}		
else if (RMI == others) {		If ***legacy 802.16/16e MAC PDU format*** will be used
Use legacy 802.16j format		
}		
}		

Table 6b — Relay MAC PDU header (UL)

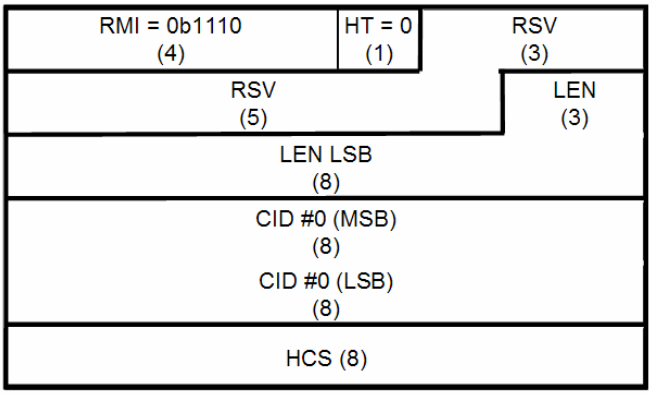

Figure 19d — Header format for relay MAC PDU without payload (UL)

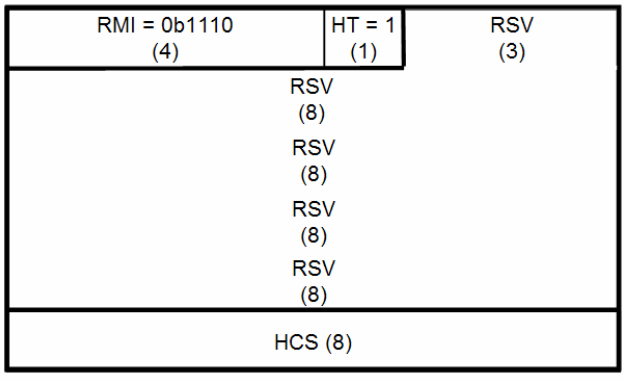

Figure 19e — Header format for relay MAC PDU without payload (UL)

4. References

[1] “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.