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| Title | **Sleep Mode Operations for distributed scheduling in MR Network** |
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| Re: | IEEE 802.16j-07/007r2:"Call for Technical comments and contributions regarding IEEE Project P802.16j" |
| Abstract | This document presents sleep mode operations for IEEE 802.16j. The existing IEEE 802.16e messages are reused and new parameters are introduced in order to facilitate the sleep mode management in IEEE 802.16j. |
| Purpose | Propose the sleep mode operations for IEEE 802.16j |
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# Sleep Mode Operations in MR Network

## Introduction

As described in 16j Baseline 802.16j-06/026r2, in MR networks, the sleep mode shall be centrally controlled by the MR-BS in the presence of centralized or distributed scheduling.

Regardless of centralized scheduling or distributed scheduling, all MOB_SLP-REQ messages generated by MSs attached to an RS shall be relayed to the MR-BS, and the MR-BS shall be responsible for generating MOB_SLP-RSP messages, which will relayed by RS, either in response to a MOB_SLP-REQ or unsolicited.

With centralized scheduling, MR-BS totally controls all the radio resource scheduling and allocation. MR-BS approves the MS sleep mode and determines the related parameters of MS sleep mode such as the duration of sleep window and listening window. RS only relays the sleep mode messages, and it does not need to maintain any information of sleep mode MS.

With distributed scheduling, RS has the functionality of radio resource scheduling and MAC allocation. MR-BS approves the MS sleep mode and determines the related parameters of MS sleep mode such as the duration of sleep window and listening window. However, to support RS for distributed radio resource scheduling, RS has to know the MS sleep mode information, such as the sleep window, the listening window and so on. Based on this information, RS can perform the correct action to MS on time.

In order to facilitate the centralized management of sleep mode in distributed MR network, correct reception of MS sleep mode information by RS is required. With relatively simple modification to the BS, we propose to use the MAC header sent by RS to MR-BS to provide acknowledge the reception of MOB_SLP-RSP.

## Specific Text change

*[Modify section 6.3.2.1.2.2, Table 7g]*
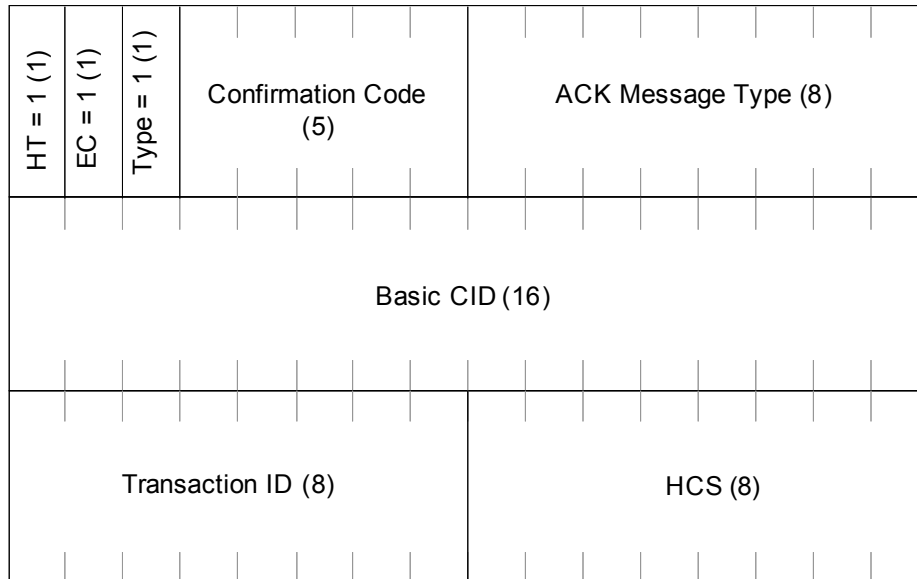
### 6.3.2.1.2.2 MAC signaling header type II

**Table 7g—Type field encodings for MAC signaling header type II**

| Type field | MAC header Type (with HT/EC=0b11) | Reference figure | Reference table |
|:---:|---|:---:|:---:|
| 0 | Feedback header, with another 4-bit type field, see Table 7i for its type encodings. | 20h, 20i | 7h |
| 1 | ~~Reserved~~ Acknowledgement Header used by the RS to acknowledge the reception of a MAC management message from the MR-BS or superordinate RS | 20l | 7k |

*[Insert the following new section 6.3.2.1.2.2.2]*

### 6.3.2.1.2.2.2 Acknowledgement Header

An Acknowledgement Header is sent by an RS as a response to a MAC management messages received from the MR-BS or its superordinate RS that requires acknowledgement. The RS sends this header to the MR-BS or its superordinate RS as an indication of the message reception. The Acknowledgement Header shall be sent on RS's basic CID. The Acknowledgement Header is illustrated in Figure 20l.

| HT = 1 (1) | EC = 1 (1) | Type = 1 (1) | Confirmation Code (5) | ACK Message Type (8) |
|---|---|---|---|---|
| Basic CID (16) | | | | |
| Transaction ID (8) | | | HCS (8) | |

**Figure 20l – Acknowledgement Header**

The Acknowledgement header shall have the following properties:

    a.   This is a MAC signaling header type II. The length of the header shall always be 6 bypes.

    b.   The Type field of this header shall be set to 1.

    c.   The content of the header is listed in table 7k.

The content of Acknowledgement header is defined in Table 7k.

Table 7k - Acknowledgement header fields

| Name | Size | Description |
|---|---|---|
| Confirmation Code | 5 bits | An indication that MAC message received by RS 0b00000: Received successfully 0b00001 – 0b11111 Reserved |
| ACK Message Type | 8 bits | The MAC message type of the message received by the RS from the MR-BS or its superordinate RS |
| Basic CID | 16 bits | The basic CID of the RS |
| Transaction ID | 8 bits | Transaction ID included in the MAC management message received from the BS |
| HCS | 8 bits | Header Check Sequence (same usage as HCS entry in Table 5). |

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*[Modify section 6.3.2.3.45 as following:]*

**6.3.2.3.45 Sleep Response message (MOB_SLP-RSP)**

*[Add "Transaction ID" TLV after HMAC/CMAC defintion:]*

Transaction ID TLV (see 11.16.3)
In MR networks, the "Transaction ID" TLV shall be included in the MOB_SLP-RSP message when supporting sleep mode operation for distributed scheduling.

*[Insert the following new section 6.3.21.7.2]*

**6.3.21.7.2 MS sleep mode support for distributed scheduling**

For an MS attached to the MR-BS through an RS with distributed scheduling, MS sleep mode operates as defined in section 6.3.21. All MOB_SLP-REQ messages generated by MSs attached to an RS shall be relayed to the MR-BS. The MR-BS shall be responsible for generating MOB_SLP-RSP messages, which will be relayed by RS, either in response to a MOB_SLP-REQ or unsolicited. Upon receiving MOB_SLP-RSP, the RS shall process and store the information contained in the message and send an Acknowledgement Header with ACK message Type set to 51 to MR-BS to indicate the reception of MOB_SLP-RSP. The RS shall also relay MOB_SLP-RSP to the MS(s). The MR-BS shall start timer T49 after transmitting a MOB_SLP-RSP to the RS. If T49 timer expires before an Acknowledgement header is received, the MR-BS may retransmit an MOB_SLP-RSP message to the RS. If duplicate MOB_SLP-RSP message is received at the RS, the RS shall send an Acknowledgement Header to MR-BS without further relaying the message.

For multihop relay, after receiving the MOB_SLP-RSP, the RS shall send an Acknowledgement Header to its superordinate RS to indicate the reception of message. The superordinate RS shall retransmit an MOB_SLP-RSP message if it does not receive an Acknowledgement Header before T49 Timer expires. If duplicate MOB_SLP-RSP message is received at the RS, the RS shall send an Acknowledgement Header to its superordinate RS without further relaying to the message

Figure xxx illustrates the procedure of MR-BS during MS sleep mode.

MR-BS        RS        MS

MR-BS → RS: MOB_SLP-RSP

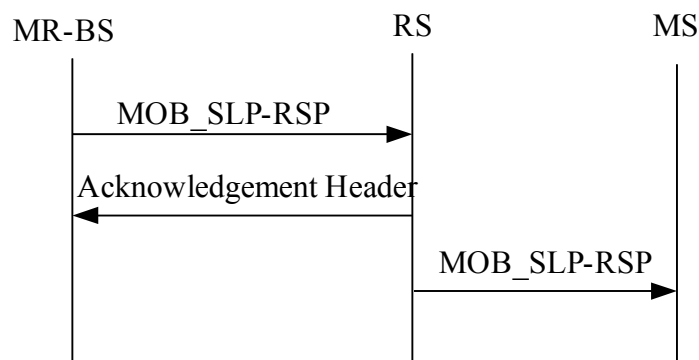RS → MR-BS: Acknowledgement Header

RS → MS: MOB_SLP-RSP

Figure xxx – The procedure of sleep mode

*[Insert the following row in Table 342 in section 10.1]*

**Table 342—Parameters and constants (continued)**

| System | Name | Time reference | Minimum value | Default value | Maximum value |
|---|---|---|---|---|---|
| MR-BS, RS | T49 | Time for MR-BS or RS waiting for Acknowledgement header after sending MOB_SLP-RSP | - | - | - |

*[Insert the following new section 11.16.3]*

11.16.3 Transaction ID

| Type | Length | Value | Scope |
|---|---|---|---|
| xx | 1 | Unique identifier for this transaction assigned by MR-BS | MOB_SLP-RSP |

# References

[1] IEEE802.16j-06/026r2 Baseline Document for Draft Standard for 16j
[2] IEEE C802.16j_07/010r2 Sleep Mode in MR network