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Re:	IEEE 802.16e Sleep mode operation
Abstract	This document is to propose the response message and to resolve some ambiguities in terms of naming of the message. This document has been introduced as a one of proposals in the last meeting (IEEE802.16e-03-31).
Purpose	Present how the IEEE802.16a can be enhanced in order to support mobility.
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Some message changes in IEEE 802.16e Sleep Mode

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1 Problem Statement

The main motivation of the current sleeping mode operation is to save MSS power consumption based on the traffic pattern (4IPP model proposed in IEEE802.16e-03/15) during packet data transmission. Accordingly, traffic characteristics and its corresponding operation should be taken into account in terms of mobile environment. The current sleeping mode operation based on 4IPP traffic model is depicted in the figure 1.

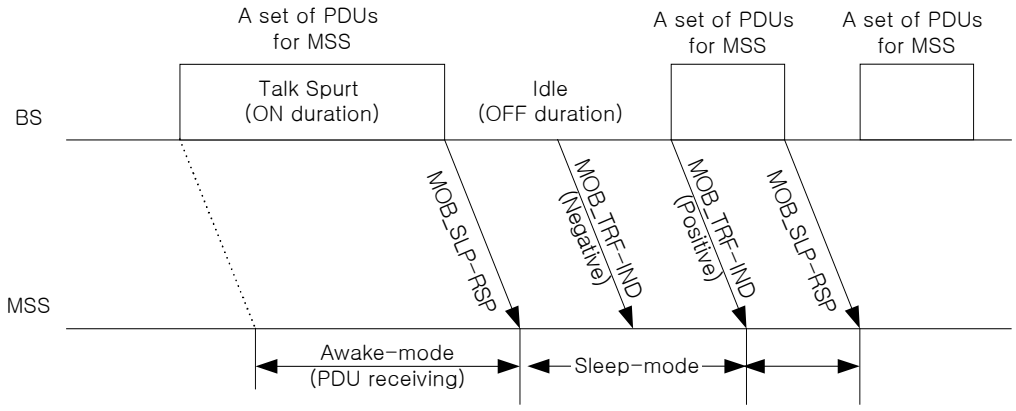

Figure 1. Call flow and PDU transmission in Sleep-mode and Awake-mode

Statement 1)

According to the current operation of sleeping mode, the state transition in case of the BS initiated awake-mode to sleep-mode, is achieved by the one-way direction (without response message from the MSS). Upon transmitting all of PDU and the MOB_SLP_RSP message to the MSS, the BS will be transited into sleep mode without notification from the MSS. Therefore, if the MOB_SLP_RSP message is corrupted or not delivered to the MSS appropriately due to mobile environment, the MSS shall be kept in awake-mode even though there is no PDU transmitted from the BS that has already been transited into sleep-mode. Figure 2 shows the problem caused by this unexpected operation. As shown in figure 2, if there is no definition of the response message corresponding to MOB_SLP_RSP message when the message is corrupted, a superfluous power of the MSS will be consumed. These operations must be violation of the basic purpose of sleep mode operation. Therefore, the response message shall be defined to avoid superfluous power consumption at the MSS side.

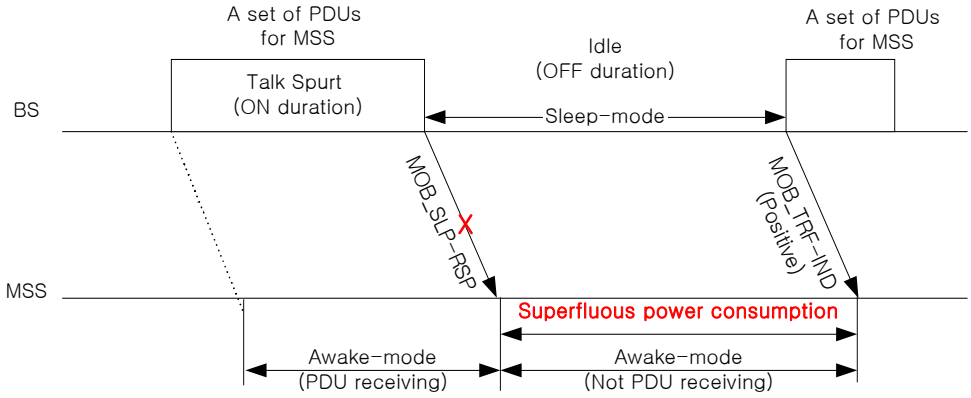

Figure 2. Superfluous power consumption

Statement 2)

There are two messages for mode changing from awake-mode to sleep-mode.

- MOB_SLP_REQ (from the MSS side)
- MOB_SLP_RSP (from the BS side) having two meanings
  - Unsolicited mode changes message
  - Response message to MOB_SLP_REQ message

According to current terminology, there may be ambiguity in terms of the naming of message. Especially, unsolicited mode change that the BS sends MOB_SLP_RSP message to indicate mode change from awake-mode to sleep mode needs to be clarified. Furthermore, considering with statement 1, the name of the message needs to be changed to identify the clear operation.

2 Proposed Remedy (Text changes)

The existing MOB_SLP_REQ message is no problem. The MOB_SLP_RSP message with two purposes is identified into two separated messages for response message to MOB_SLP_REQ message and mode changing indicate message, respectively. And the BS_SLP_RSP message is proposed to provide that the MSS sends a response message corresponding to BS_SLP_REQ message which is changed from the MOB_SLP_RSP message in case of unsolicited mode change. Table 1 shows the overall message changing.

Table 1. Overall message changing including statement 1 (proposal of the response message)

Original Message	Direction	Purpose	Changes to	Comments
MOB_SLP_REQ	MSS to BS	Request	N/A	No
MOB_SLP_RSP	BS to MSS	Response	N/A	No
		Unsolicited mode change	BS_SLP_REQ	Naming changed and proposed
N/A	MSS to BS	Response	BS_SLP_RSP	Proposed

6.2.2.3.49 Sleep Request message (BS_SLP-REQ)

BS supporting sleep-mode uses the BS_SLP-REQ message to indicate entering sleep-mode to the MSS. The BS_SLP-REQ message is sent from BS to the MSS on the MSS's basic CID.

Table 56xx: Sleep-Request (BS_SLP-REQ) message format

Syntax	Size	Notes
BS_SLP-REQ_Message_Format() {		
Management message type = XX	8 bit	
Start time	7bit	
min-sleeping window	6 bit	
max-sleeping window	10 bit	
listening interval	8 bit	
}		

Parameters shall be as follows:

Start-time

The number of MAC frames (not including the frame in which the message has been received) until the MSS shall enter the first sleep-interval.

Min window

Start value for the sleep interval (measured in MAC frames).

Max window

Stop value for the sleep interval (measured in MAC frames).

Listening interval

Value for the listening interval (measured in MAC frames)

6.2.2.3.50 Sleep Response message (BS_SLP-RSP)

The BS_SLP-RSP message shall be sent from MSS to a BS on the MSS's basic CID in response to the BS_SLP-REQ message. The MSS shall enter sleep-mode using the parameters indicated in the BS_SLP_REQ message.

Table 56XX: Sleep-Response (MOB_SLP-RSP) message format

Syntax	Size	Notes
MOB_SLP-RSP_Message_Format() {		
Management message type = XX	8 bit	
}		

References

[1] IEEE 802.16e-03/15, “IEEE802.16e Sleep Mode”

[2] IEEE Std 802.16-2001 “Part 16: Air Interface for Fixed Broadband Wireless Acce ss Systems”

[3] IEEE P802.16a/D7-2002 “Part 16: Air Interface for Fixed Broadband Wireless Acc ess Systems – Medium Access Control Modifications and Additional Physical Lay er Specifications for 2-11 GHz”

[4] IEEE 802.16.3c-01/30r1 “Traffic Model for 802.16 TG3 MAC/PHY Simulations”

[5] IEEE 802.16e-03/02, “Call for Proposals on IEEE Project 802.16e: Mobility Enhan cements to IEEE Standard 802.16/802.16a”

[6] IEEE802.16e-03/31, “IEEE802.16e Sleeping Mode Enhancement”

[7] IEEE 802.16e-03/07r2, “Part 16: Air interface for Broadband Wireless Access Systems-Amendment 4: Mobility Enhancement