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Re:	This is a response to a Call for Comments IEEE802.16e-04/xx on IEEE P802.16e-D2
Abstract	In this contribution, it is suggested that sleep window size of an MSS be maintained before and after handover.
Purpose	This document is submitted for review by 802.16e Working Group members
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Management of sleep window size during Handover

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1. Introduction

In the IEEE P802.16e/D2, the sleep mode is defined to save the battery power when an MSS has no data to send or receive. To support the sleep mode, section 6.3.2.3.47 and 6.3.2.3.48 specified 4 fields (initial-sleep window, final-sleep window base, listening interval, and final-sleep window exponent) in MOB-SLP-REQ and MOB-SLP-RSP messages.

When an MSS in sleep mode moves to a target BS with LONG sleep interval, the MSS should perform re-entry after waking up and send MOB-SLP-REQ to sleep again. In this case, if the field of initial-sleep window is set to much smaller value than the sleep interval which was used in the previous BS, it will take long time for the MSS to have the same sleep interval with the previous one, resulting in wasting of battery power. Thus, it seems reasonable that an MSS, which moves within the sleep interval, may request the initial sleep window with the size of sleeping interval which was used in the previous cell just before the handover to make the MSS have sound sleep fast. The MSS in sleep mode, however, cannot maintain the size of sleep window with those fields in the MOB-SLP-REQ/RSP messages only.

In an extreme case, for example the sleep interval is $1023*6^7$ ($> 2^{28}$), the initial sleep window cannot express the size which is larger than 2^6-1 frames. To express the large initial sleep window, the MOB-SLP-REQ/RSP messages need to extend the size of 'initial sleep window' from 6 bits to 29 bits (i.e. additional 3 Bytes needed) to express the all possible initial sleep window, but, it seems too heavy message.

In this contribution, we propose a mechanism that enlarges the size of initial sleep window to maintain the sleep interval during the handover with minimum modification.

2. Problem

The field of initial sleep window in the messages of MOB-SLP-REQ/RSP can not express the size which is larger than 2^6-1 frames, so that the MSS can not start to sleep after the handover with the sleep window size which was used just before the handover.

3. Proposed Changes

remedy 1

[Add text to sections 6.3.19.2 in pages 40 as follows]

6.3.19.2 Sleep-window update algorithm

An MSS shall enter sleep-mode after receiving an MOB-SLP-RSP message from the BS. In the first time it enters sleep-mode, it shall use the initial-sleep window value for the sleep interval. If during the following listening interval the BS has not signaled that traffic has been addressed for the MSS, the MSS shall re-enter sleep-mode and double the duration of the sleep-window. This procedure shall be repeated as long as the resulting sleep-window does not exceed the final-sleep window value. The following formula defines the calculation of the duration of k^{th} sleep-window - I_k:

$$\begin{cases} I_0 &= initial - sleep\ window \\ I_k &= \min\{2 \cdot I_{k-1},\ final - sleep\ window\} \qquad k > 0 \end{cases} \quad (1)$$

When the MSS has reached the final-sleep window size, it shall continue in sleep mode without further increasing the sleep-window. The next sleep window shall start from the end of the previous one.

When the MSS has moved to a target BS within a sleep-mode, the MSS will perform re-entry procedure after waking up in a target BS and then may send MOB-SLP-REQ message to a new serving BS with the sleep interval which was used in the serving BS just before the handover.

Remedy 2 :

[Modify sections 6.3.2.3.47 and 6.3.2.3.48 in pages 16-18 as follows]

6.3.2.3.47 Sleep Request message (MOB-SLP-REQ)

MSS supporting sleep-mode uses the MOB-SLP-REQ message to request permission from the BS to enter sleep-mode. The MOB-SLP-REQ message is sent from the MSS to the BS on the MSS's basic CID.

Table 92-a Sleep Request (MOB-SLP-REQ) message format

Syntax	Size	Notes
MOB-SLP-REQ_Message_Format() {		
Management message type = 46	8 bits	
Initial-sleep window base	6 bits	
final-sleep window base	10 bits	
listening interval	4 bits	
final-sleep window exponent	3 bits	
previous sleep count	5 bits	If the MSS was not in sleep mode just before handover, this field is set to '00000'
Reserved	~~1 bits~~4 bits	
}		

Parameters shall be as follows:

Initial-sleep window base

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

The factor which is used to calculate the initial-sleep window which means start value for the sleep interval

Final-sleep window base

~~Final value for the sleep interval (measured in frames).~~

The factor which is used to calculate the final-sleep window which means final value for the sleep interval

Listening interval

Requested listening interval (measured in frames) to the MOB-SLP-REQ.

Final-sleep window exponent

Defines the factor by which the final-sleep window base is multiplied in order to calculate the final-sleep window. The following formula is used:

final-sleep window(measrured in frames) = final-sleep window base * $6^{(\text{final-sleep window exponent})}$

Previous sleep count

Defines that how many times the MSS has increased the sleep window consecutively in the previous cell just before the MSS performed handover.

The initial sleep window is determined with the following formula.

Initial-sleep window(measured in frames) = initial-sleep window base*$2^{(\text{previous sleep count})}$

6.3.2.3.48 Sleep Response message (MOB-SLP-RSP)

The MOB-SLP-RSP message shall be sent from BS to a MSS on the MSS's basic CID in response to an MOB-SLP-REQ message, or may be sent unsolicited. The MSS shall enter sleep-mode using the parameters and Sleep ID (SLPID) indicated in the message. In the case where sleep is denied (After-REQ-action=1), it is recommended that the BS provide unsolicited MOB-SLP-RSP message.

Table 92b- Sleep-Response (MOB-SLP-RSP) message format

Syntax	Size	Notes
MOB-SLP-RSP_Message_Format() {		
Management message type = 47	8 bits	
Sleep-approved	1 bit	0 : Sleep-mode request denied 1 : Sleep-mode request approved
If(Slep-approved == 0) {		
After-REQ-action	1 bit	0: The MSS may retransmit the MOB-SLP-REQ message after the time duration(REQ-duration) given by the BS in this message 1: The MSS shall not retransmit the MOB-SLP-REQ message and shall await the MOB-SLP-RSP message from the BS
REQ-duration	4 bits	Time duration for case where After-REQ-action value is 0.
Reserved	2 bits	
}		
else {		
Start frame	6 bits	
Initial-sleep window base	6 bits	
final-sleep window base	10 bits	

listening interval	4 bits	
final-sleep window exponent	3 bits	
previous sleep count	5 bits	If the MSS was not in sleep mode just before handover, this field is set to '00000'
SLPID	10 bits	
Reserved	3 bits	
}		
}		

Parameters shall be as follows:

Sleep approved

The activation indication of the MSS when the MSS receives this message from the BS.

After-REQ-action

On MSS request to enter sleep mode rejected by the BS, indicate recourse action.

REQ-duration

Waiting value for the MOB-SLP-REQ message re-transmission (measured in MAC frames)

Start-frame

Lower 7 bits of the frame number in which the MSS shall enter into sleep mode.

Initial-sleep window base

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

The factor which is used to calculate the initial-sleep window which means start value for the sleep interval

Final-sleep window base

~~Final value for the sleep interval (measured in frames).~~

The factor which is used to calculate the final-sleep window which means final value for the sleep interval

Listening interval

Requested listening interval (measured in frames) to the MOB-SLP-REQ.

Final-sleep window exponent

Defines the factor by which the final-sleep window base is multiplied in order to calculate the final-sleep window. The following formula is used:

final-sleep window(measrured in frames) = final-sleep window base * $6^{(\text{final-sleep window exponent})}$

Previous sleep count

Defines that how many times the MSS has increased the sleep window consecutively in the previous cell just before the MSS performed handover.

The initial sleep window is determined with the following formula.

Initial-sleep window(measured in frames) = initial-sleep window base*$2^{(\text{previous sleep count})}$

SLPID

This is a number assigned by the BS whenever an MSS is instructed to enter sleep-mode. This number shall be unique in the sense that it is assigned to a single MSS that is instructed to enter sleep-mode. No other MSS shall be assigned the same number while the first MSS is still in sleep-mode.