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Re:	This contribution is response to call for contribution about IEEE802.16e-D2	
Abstract	In this contribution, it is suggested that sleep window size of a 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 6.3.2.3.32 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 cell 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 cell, 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.

In this contribution, we propose 4 options that an MSS can maintain the sleep interval during the handover.

2. Proposed Changes

Option 1 :

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	6 bits	If the MSS was in the sleep mode with sleep window size which is larger than 63, the MSS may set this field to '111111'.
final-sleep window base	10 bits	
listening interval	4 bits	
final-sleep window exponent	3 bits	
Reserved	1 bit	
}		

Option 2

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	~~6 bits~~ 29 bits	
final-sleep window base	10 bits	
listening interval	4 bits	
final-sleep window exponent	3 bits	
Reserved	~~1 bits~~2 bits	
}		

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	~~6 bits~~ 29 bits	
final-sleep window base	10 bits	

listening interval	4 bits	
final-sleep window exponent	3 bits	
SLPID	10 bit	
Reserved	1 bit	
}		
}		

Option 3

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

Requested start value for the sleep interval (measured in frames).

Final-sleep window base

Requested final value for the sleep interval (measured in frames).

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 = 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. The initial sleep window is determined with the following formula.

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

initial-sleep window shall not exceed 2^{28}.

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).

Final-sleep window base

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

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 = final-sleep window base * 6(final-sleep window exponent)

Previous sleep count

Defines that how many times the MSS has increased the sleep window consecutively in the previous cell. The initial sleep window is determined with the following formula.

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

initial-sleep window shall not exceed 2^{28}.

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.

Option 4

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~~	
maximum sleep count	5 bits	
previous sleep count	5 bits	

Reserved	~~1 bits~~4 bits	
}		

Parameters shall be as follows:

Initial-sleep window base

Requested start value for the sleep interval (measured in frames).

~~**Final-sleep window base**~~

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

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 = final-sleep window base * 6^(final-sleep window exponent)~~

Maximum sleep count

Defines that how many times the MSS can increase the sleep window consecutively in a cell. The final sleep window is determined with the following formula.

Final-sleep window = initial-sleep window base*$2^{(\text{Maximum sleep count})}$

final-sleep window shall not exceed 2^{28}.

Previous sleep count

Defines that how many times the MSS has increased the sleep window consecutively in the previous cell. The initial sleep window is determined with the following formula.

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

final-sleep window shall not exceed 2^{28}.

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~~ 29 bits	
~~**final-sleep window base**~~	~~10 bits~~	
listening interval	4 bits	
~~**final-sleep window exponent**~~	~~3 bits~~	
maximum sleep count	5 bits	
previous sleep count	5 bits	
SLPID	10 bits	
Reserved	1 bit	
}		
}		

3. Discussion and Conclusion

Assumptions :

- An MSS was in sleep mode with the sleep window size which is longer than 63.
- The MSS performed handover and tried to be in sleep mode again.
- The size of the sleep window size is maintained before and after the handover.

Option 1 (the size of MOB-SLP-REQ = 4 Bytes)

- merit : The current specification can be used without modification.
- drawback : The MSS can not have sleep window size which is longer than 63 after handover. So, it takes long time to make the MSS have sound sleep as in the previous cell.

Option 2 (the size of MOB-SLP-REQ = 8 Bytes)

- merit : The MSS can have the same sleep window size as in the previous cell with simple modification of current specification.
- drawback : Additional 4 Bytes are needed to support large initial-sleep window.

Option 3 (the size of MOB-SLP-REQ = 5 Bytes)

- merit : The MSS can have the same sleep window size as in the previous cell.

- drawback : Additional 1 Byte and 1 field in the messages are needed. The method of calculating initial sleep window size should be changed.

Option 4 (the size of MOB-SLP-REQ = 4 Bytes)

- merit : The MSS can have the same sleep window size as in the previous cell without change in the size of the MOB-SLP-REQ/RSP messages.
- drawback : The method of calculating initial sleep window size and final sleep window size should be changed.

As a conclusion, we propose the OPTION 4 as a change for the specification to support sleep mode efficiently during handover.