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<b>Re:</b>	This contribution supports a comment in Letter Ballot 14c 802.16e/D4. the document is a revision of IEEE 802.16e-04/354: added clarification of parameters for messages MOB-SLP-REQ/RSP	
<b>Abstract</b>	The document suggests language clarification for Sleep Mode section in 802.16e	
<b>Purpose</b>	The contribution is supposed to be considered together with the corresponding comment	
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## Clarification of Sleep Mode Language

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### 1. Document's Goal

The goal of the document is to clean up language of Sleep Mode section. The sections 6.3.19.1-2 were rewritten to follow certain logical sequence: 1) what is Sleep Mode 2) Entry into Sleep Mode 3) Sleep-window and listening-window intervals: their duration, what can be done and cannot be done during these intervals 4) Sleep Node termination 5) periodic ranging in Sleep Mode 6) duration of sleep-window. Most of sentences used in suggested text were used in the original text (though possibly in another order)

### 2. Specific Changes in 802.16e/D4

*[Replace sections 6.3.19.1, 6.3.19.2 starting from p. 59, line 14, with the following text]*

#### 6.3.19.1 Introduction

Sleep Mode is a state in which an MSS conducts pre-negotiated periods of absence from the Serving BS air interface. These pre-negotiated periods of absence are characterized by the unavailability of the MSS, as observed from the Serving BS, to DL or UL traffic. Sleep Mode is intended to enable MSS with decreased air interface DL or UL transmission requirements to minimize their power usage, and facilitate hand-over decision and operation while remaining connected to the network and decreasing usage of Serving BS air interface resources. Implementation of sleep-mode is optional for the MSS and mandatory for the BS.

Before entering Sleep Mode the MSS shall inform the BS using MOB-SLP-REQ and obtain its approval. The BS shall respond with an MOB-SLP\_RSP message. The Serving BS may send an unsolicited MOB-SLP-RSP to the MSS to initiate MSS Sleep Mode. After receiving an approving MOB-SLP-RSP message from the BS, an MSS shall enter Sleep Mode at the appropriate frame prescribed by the message.

Upon entering Sleep Mode, an MSS begins by entering a sleep-window. During a sleep-window, an MSS is not expected to send or receive any MAC PDUs to or from the Serving BS with few specific exceptions, and may power down one or more physical operation components, or may awaken for periodic ranging. Behavior of the MSS during sleep-windows is not restricted to powering down. The MSS may perform other activities during sleep-window such as scanning Available BS, ranging Available BS etc., which make the MSS unavailable to the Serving BS.

If more than one iteration of sleep-window is prescribed in the enabling message, then the MSS will follow the first sleep-window with a listening-window. During a listening-window, the MSS shall synchronize with the Serving BS downlink and listen for an appropriate MOB-TRF-IND message. The MSS shall examine the DCD and UCD change counts and the frame number of the DL-MAP PHY Synchronization Field to verify synchronization with the Serving BS. Upon detecting a changed DCD and/or UCD count in the DL MAP, the MSS shall continue the current listening-window until receiving the corresponding updated message. A traffic indication (MOB-TRF-IND) message shall be sent by the BS on the broadcast CID during each listening-window to alert MSS of Periodic Ranging opportunity within the next sleep-window or BS request for the MSS to end Sleep Mode. If there is no SLPID or Basic CID to be addressed, the BS shall send an empty indication message, that is, MOB-TRF-IND message without SLPID bit-map or Basic CID. During listening-window the MSS and Serving BS shall communicate as in Normal Operation, except as may be constrained by duration of the window. The MSS shall terminate Sleep Mode if the expected frame number of the DL-MAP PHY Synchronization Field is different from the discovered frame number, or the MSS fails to detect an appropriately formatted MOB-TRF-IND management message during the listening-window, or based on the presence of traffic indication for the MSS in a MOB-TRF-IND message. In all other cases the MSS shall continue the current Sleep Mode.

The cycle of sleep-window, listening-window may be repeated according to the iterations element of the MOB-SLP-RSP message. During consecutive sleep-windows and listening-windows sleep-window shall be updated using the algorithm as defined in 6.3.19.2.

The BS may buffer (or it may drop) MAC SDUs addressed to an MSS in Sleep Mode.

MSS in Sleep Mode may participate in the periodic ranging procedure if indicated by MOB-TRF-IND message. The procedure includes Serving BS allocation of UL transmission opportunity for periodic ranging in which the MSS shall transmit RNG-REQ message. After transmittal of the RNG-REQ, the MSS shall wait for the RNG-RSP message. Participation in the periodic ranging procedure does not terminate Sleep Mode.

An MSS may terminate Sleep Mode and return to Normal Operation anytime (i.e. there is no need to wait until the sleep-window is over). Any UL message except RNG-REQ or DBPC-REQ from the MSS to the BS during a sleep-window shall interrupt and end Sleep Mode and shall signal to the BS that the MSS is still active and connected and has not dropped connection during its Sleep Mode.

The Serving BS may verify MSS exit from Sleep Mode by making a UL allocation for MSS at any time subsequent to transmitting a MOB-TRF-IND message with indication for MSS to exit Sleep Mode, or after receiving UL MAC PDU other than RNG-REQ or DBPC-REQ from an MSS supposed to be in a sleep-window. When an MSS receives a UL allocation after receiving a positive MOB-TRF-IND message indication or after transmitting a previous UL MAC PDU to the Serving BS during a sleep-window, the MSS shall transmit at least BR message (if there is no data to transmit, BR field of the BR PDU shall be set to 0).

Upon completion of Sleep Mode, the MSS shall return to Normal Operation.

### 6.3.19.2 Sleep-window update algorithm

An MSS shall enter Sleep Mode after receiving an MOB-SLP-RSP message from the BS. Duration of the first sleep-window shall be equal to the initial-sleep-window. If the MSS re-enters sleep-window it shall double the duration of the preceding 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 duration of  $k^{\text{th}}$  sleep-window -  $I_k$ :

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

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 listening-window.

*[Delete section 6.3.19.3, p. 67, line 48]*

### ~~6.3.19.3 Traffic indication signaling~~

~~If the MSS receives a TRF-IND message with a negative indication, it may continue in sleep mode. For an example of sleep mode operation, see Annex E.~~

~~A BS shall notify each MSS in Sleep Mode, during its listening interval, if traffic has been addressed to the MSS during any sleep window iteration. The indication is sent on the MOB-TRF-IND broadcast message. The MSS shall examine the frame number from the PHY Synchronization Field during each listening window and shall verify synchronization with the BS. If the expected frame number is different than the discovered frame number, the MSS shall return to Normal Operation. Upon detecting a changed DCD count in the DL-MAP, the MSS shall remain awake until receiving the DCD message. Upon detecting the changed UCD count in UL-MAP, the MSS shall remain awake until it has received a UCD message.~~

*[Change in the Table 106a, page 31 line 31]*

Listening <del>interval</del> <u>window</u>	4 bits	
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*[Change in 6.3.2.3.44, page 31 line 48]*

### Listening ~~interval~~ window

Duration of MSS listening ~~interval~~ window (measured in frames) prior to begin next sleep window iteration.

*[Change in the Table 106b, page 32 line 40]*

Listening <del>interval</del> <u>window</u>	4 bits	
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*[Change in 6.3.2.3.45, page 33 line 5]*

Listening **interval window**  
~~Requested~~ Listening interval window (measured in frames) ~~to the MOB\_SLP\_REQ.~~