Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	**Revision of Scanning, Ranging, and Sleep Mechanism for Mobility Enhancement**	
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Re:	Response to IEEE 802.16e-03/58 (Call for Contributions on IEEE 802.16e/07r5)	
Abstract	Revision of Scanning, Ranging, and Sleep Mechanism for Mobility Enhancement	
Purpose	Stimulate discussion on a more completely defined, flexible model and mechanism for facilitating mobility functionality	
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Revision of Scanning, Ranging, and Sleep Mechanism for Mobility Enhancement

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Observations on Current IEEE 802.16e-03/07r5 Based on Criteria from Assumptions

1. **Scanning, Ranging, and Sleep**

Problem:

The fact that we have created a logical separation/use distinct between 'sleep' mode and 'scanning' mode seems unnecessary. When determining whether differentiating mechanically, I think it best to look at impact on the Serving BS and network when assessing the importance of maintaining a logical distinction. All the network cares is that the MSS is 'unavailable' during the described interval, for whatever reason, and that the Serving BS should not schedule any DL/UL slots addressed to the MSS. What the MSS does during that interval of absence is irrelevant to the Serving BS and network and does not affect the mechanics of the standard.

There is benefit to unifying the two concepts for performance reasons, as well as conceptually. We spent some time at the last meetings talking about re-synchronization on timing for MSS returning from 'sleep' mode. We did not make similar correction for MSS returning from 'scanning' mode. By combining the allocation mechanism for both under the 'sleep' mode rules we effectively eliminate that problem for 'scanning', and any other logical use, as well.

Remedy:

Delete the separate rules allocation for Scanning. Expand the definition and rules for ‘Sleep’ mode to be more flexible and generalized as an MSS ‘Unavailable’ period. Create an appropriate aging timer for Serving BS to consider connection to MSS in ‘Sleep’ mode lost.

Remedy Action 1:

*[Delete **1.4.1.2.1.2 MSS Scanning of neighbor BS** in its entirety.]*

Remedy Action 2:

*[Delete **6.4.2.3.46 Scanning Interval Allocation Request (MOB_SCN-REQ) message** in its entirety.]*

Remedy Action 3:

*[Delete **6.4.2.3.47 Scanning Interval Allocation Response (MOB_SCN-RSP) message** in its entirety.]*

Remedy Action 4:

*[In **6.4.17 Sleep-mode for mobility-supporting MSS**, **6.4.17.1 Introduction**, page 31, paragraphs 1 thru 10, replace current section with:]*

'Sleep-mode is a mode in which MSS's supporting mobility may power down, scan neighbor and foreign network BS, range neighbor and foreign network BS, conduct hand-over/network re-entry, or perform other activities for which the MSS will be unavailable to the Serving BS for DL or UL traffic. Sleep-mode is intended to enable mobility-supporting MSS to minimize their power usage and facilitate hand-over decision and operation while staying connected to the network; but sleep-mode use should not be narrowly interpreted. Implementation of sleep-mode is optional.

An MSS in sleep-mode shall engage in a sleep-interval, defined as a time duration, measured in whole frames, where the MSS is in sleep-mode. The sleep-interval is constructed of one or more variable-length, consecutive sleep-windows, with interleaved listening-windows, through one or more sleep-window-iterations. During a sleep-window, an MSS does not send or receive PDUs, has no obligation to listen to DL traffic and may power-down one or more physical operation components. During a listening-interval, an MSS shall synchronize with the Serving BS downlink and listen for an appropriate MOB_TRF-IND traffic indication message. The MSS shall decide whether to stay awake or go back to sleep based on a positive MOB_TRF-IND from the Serving BS. During consecutive sleep-windows and listening-windows, comprising a single sleep-interval, sleep-window shall be updated using an increasing algorithm as defined in 6.4.16.2 Sleep-window update algorithm.

Before entering sleep-mode the MSS shall inform the BS using MOB_SLP-REQ and obtain its approval. Serving BS shall respond with a MOB_SLP-RSP message. Serving BS may send an unsolicited MOB_SLP-RSP to MSS to initiate MSS sleep-mode. Upon Serving BS transmittal of an affirming MOB_SLP-RSP, Serving BS shall initiate aging timer (MSS Sleep-Aging-Timer, see Table 264a) to coincide with initiation of sleep-interval at start-frame. After receiving an MOB_SLP-RSP message from the BS, an MSS shall enter sleep-mode by beginning sleep-interval at the appropriate frame proscribed by start-frame.

An MSS shall awaken, enter into an interleaved listening-window, according to the sleep-interval and check whether there were PDUs addressed for it. The listening-window parameter defines the number of whole frames the MSS shall remain awake waiting for a MOB_TRF-IND message. Traffic indication message (MOB_TRF-IND) shall be sent by the BS on the broadcast CID during each appropriate MSS listening-window. If the number of positive indications is zero, the BS sends an empty indication message, that is, MOB_TRF-IND message with num-positive=0. The BS may buffer (or it may drop) incoming PDUs addressed to the sleeping MSS, and shall send notification to the MSS in its listening-window about whether data has been addressed for it during a preceding interval. If such PDUs exist, the MSS shall remain awake, terminating the sleep-interval and re-entering Normal Operation.

An MSS may terminate sleep-mode and return to Normal Operation anytime (i.e. there is no need to wait until the sleep-interval is over). If a Serving BS receives a PDU from an MSS that is supposed to be in sleep-mode, the BS shall assume that the MSS is no longer in sleep-mode. Any UL message from the MSS to the Serving BS shall interrupt the sleep-interval, shall signal the Serving BS that the MSS is still active and connected and has not dropped connection during its sleep-interval, and the Serving BS shall terminate the aging timer (MSS Sleep-Aging-Timer, see Table 264a).

Upon completion of sleep-interval, the MSS shall awaken and return to Normal Operation. .

If the intervening interval of MSS absence exceeds the aging timer, then the Serving BS shall assume loss of connection to the MSS and process as if it had received a backbone message announcing another BS becoming the Serving BS for the specified MSS (see section Backbone network HO procedures).'

*[In **10.1 Global Values**, **Table 264a—Parameters and Constants**, pages 43&44, append row to table:]*

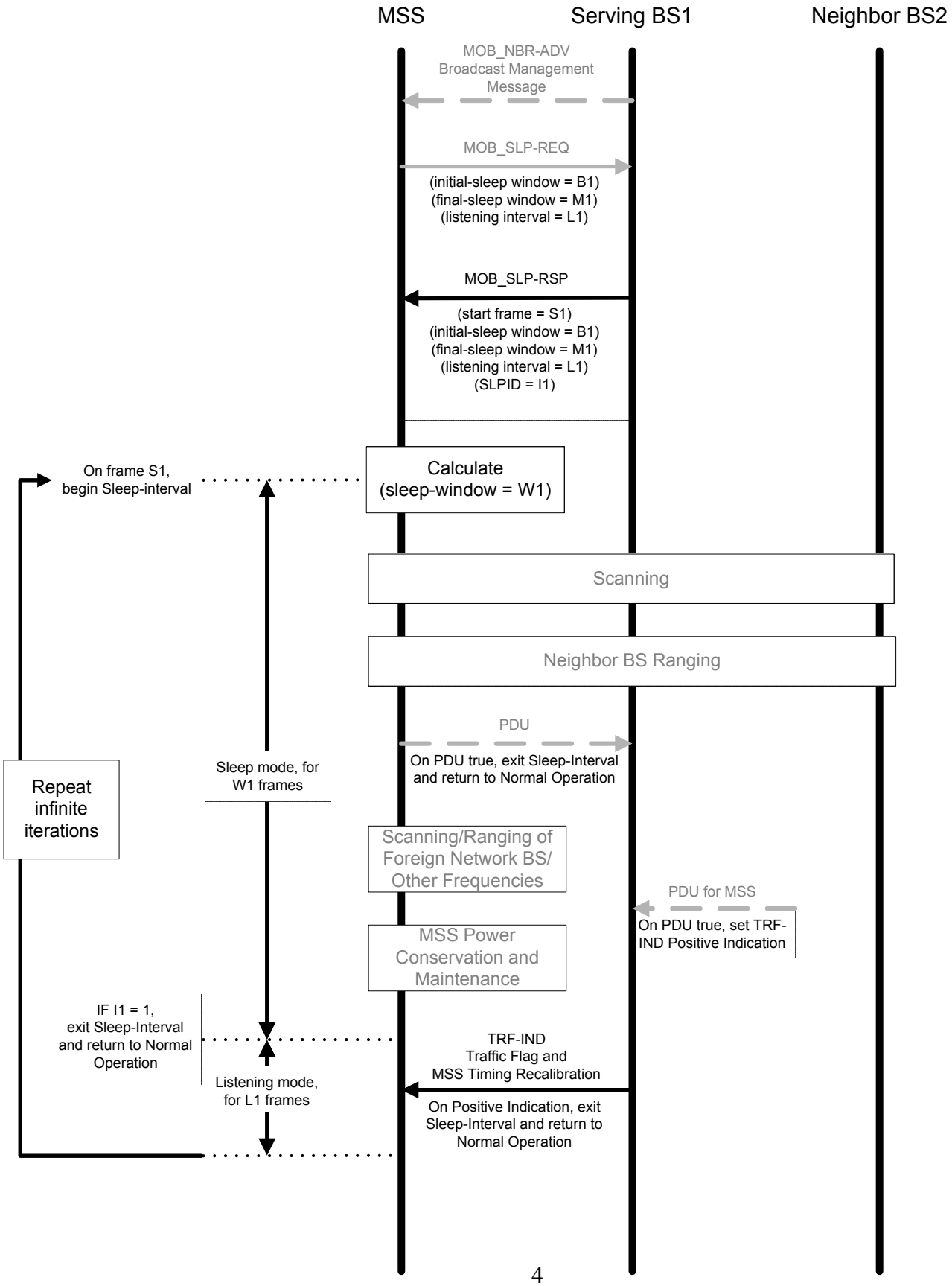
System	Name	Time Reference	Min. Value	Default Value	Max. Value
BS	MSS Sleep-Aging-Timer	Nominal time for aging of MSS Sleep disconnect.			10500s

*[In **6.4.17.3 Traffic indication signaling**, page 39, replace current paragraphs with:]*

'A BS shall notify each MSS in sleep-mode, during its listening-window, 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 into awake mode, Normal Operation. Similarly, if the MSS does not find the expected MOB_TRF-IND broadcast message, the MSS shall return to Normal Operation.

If the MSS does not find any positive indication with its CID in the MOB_TRF-IND message, or no CID in the MOB_TRF-IND message matches the MSS's basic CID, it shall consider this as a negative indication and shall continue in sleep-mode. For an example of sleep-mode operation, see Annex D.'

*[In **Annex D.2**, page 68, replace **Figure D.11** with:]*


MSS
Serving BS1
Neighbor BS2
MOB_NBR-ADV
Broadcast Management
Message
MOB_SLP-REQ
(initial-sleep window = B1)
(final-sleep window = M1)
(listening interval = L1)
MOB_SLP-RSP
(start frame = S1)
(initial-sleep window = B1)
(final-sleep window = M1)
(listening interval = L1)
(SLPID = I1)
On frame S1,
begin Sleep-interval
Calculate
(sleep-window = W1)
Scanning
Neighbor BS Ranging
PDU
On PDU true, exit Sleep-Interval
and return to Normal Operation
Repeat
infinite
iterations
Sleep mode, for
W1 frames
Scanning/Ranging of
Foreign Network BS/
Other Frequencies
PDU for MSS
On PDU true, set TRF-
IND Positive Indication
MSS Power
Conservation and
Maintenance
IF I1 = 1,
exit Sleep-Interval
and return to Normal
Operation
TRF-IND
Traffic Flag and
MSS Timing Recalibration
Listening mode,
for L1 frames
On Positive Indication, exit
Sleep-Interval and return to
Normal Operation

*[In **Annex D.2**, pages 69 & 70, delete **Figures D.12** and **D.13** entirely]*