

[Sleep mode operation for IEEE802.16m]

Document Number: C802.16m-08/721r1

Date Submitted: 2008-07-07

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Re : Call for contributions on project IEEE 802.16m: Upper MAC concepts and methods (Power Management)

[Reply to IEEE802.16m-08/024]

Base Contribution: N/A

Purpose: Discuss and include the proposed text changes into SDD document

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Design Principles

- Lower Signaling Overhead
 - Without explicit management signaling message exchanging when going back to sleep mode
- Higher Power Saving
 - MS keeps its sleep mode as long as possible especially even in light bursty traffic coming
- Utilize flexible DL/UL data transmission in normal data connection
 - Support H-ARQ data connection
 - Transmission of Residual packet data in the buffer
- Utilize the scheduling and adopt the traffic pattern coming through the network
 - Variable and flexible Sleep Interval (Begin at initial interval or doubling sleep interval)
- Reuse the fundamental design concept of 802.16e

Proposed Enhanced Sleep Mode

Item	16e	16m (Proposal)
Sleep mode initiation	MOB_SLP-REQ/RSP	
Possible states from sleep mode	Normal Operation and Sleep Mode	
Indication bit in MOB_TRF-IND	1bit	
Negative MOB_TRF-IND (0)	Keep in Sleep mode with doubling Sleep Interval	Keep in Sleep mode with doubling Sleep Interval
Positive MOB_TRF-IND (1)	Transit to awake mode	Keep in Sleep mode with Initial Sleep Interval
Sleep mode termination	Explicit signaling	Explicit signaling
Sleep Window (SW) and <i>Listening Window</i> (LW)	Doubling SW when negative indication Fixed Sleep Window Fixed Listening Window	Doubling SW when negative indication Minimum SW when positive indication Fixed Sleep Window Extendable Listening Window

New Definitions and Modifications (1/2)

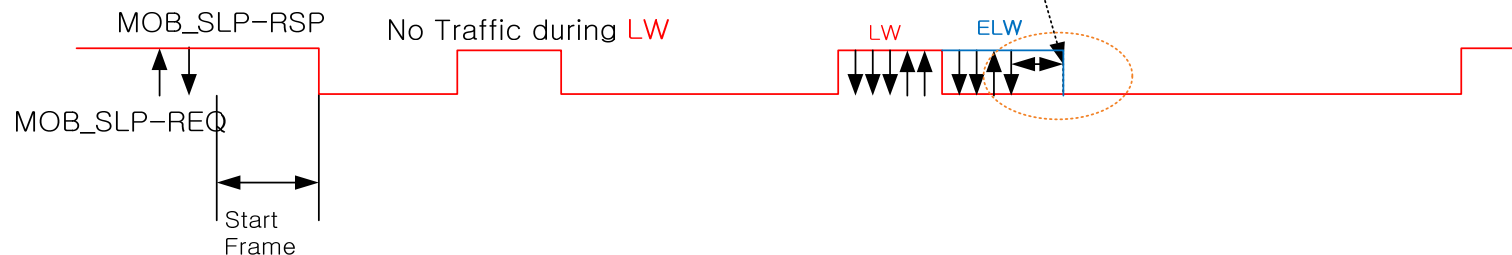
- Negotiation via MOB_SLP-REQ/RSP message
 - ELW_required field (1bit)
 - Extendable Listening Window or Fixed listening window
 - TRF-IND_required field (1bit) for MOB_TRF-IND() use
 - MOB_TRF-IND(0) : Negative, doubling sleep window
 - MOB_TRF-IND(1) : Positive, reset to initial sleep window
 - ELW is always enabled
- Sleep mode on the basis of Super Frame
 - Listening window starts at the beginning of Super Frame
 - Sleep cycle is equal to multiples of a Super frame
 - Initial sleep cycle begins at the first frame of Super Frame
- Negotiable 3 Types of Sleep Mode Operations
 - Fixed Sleep Cycle and Fixed Listening Window
 - Fixed Sleep Cycle and Extendable Listening Window
 - Variable Sleep Cycle and Extendable Listening Window

New Definitions and Modifications (2/2)

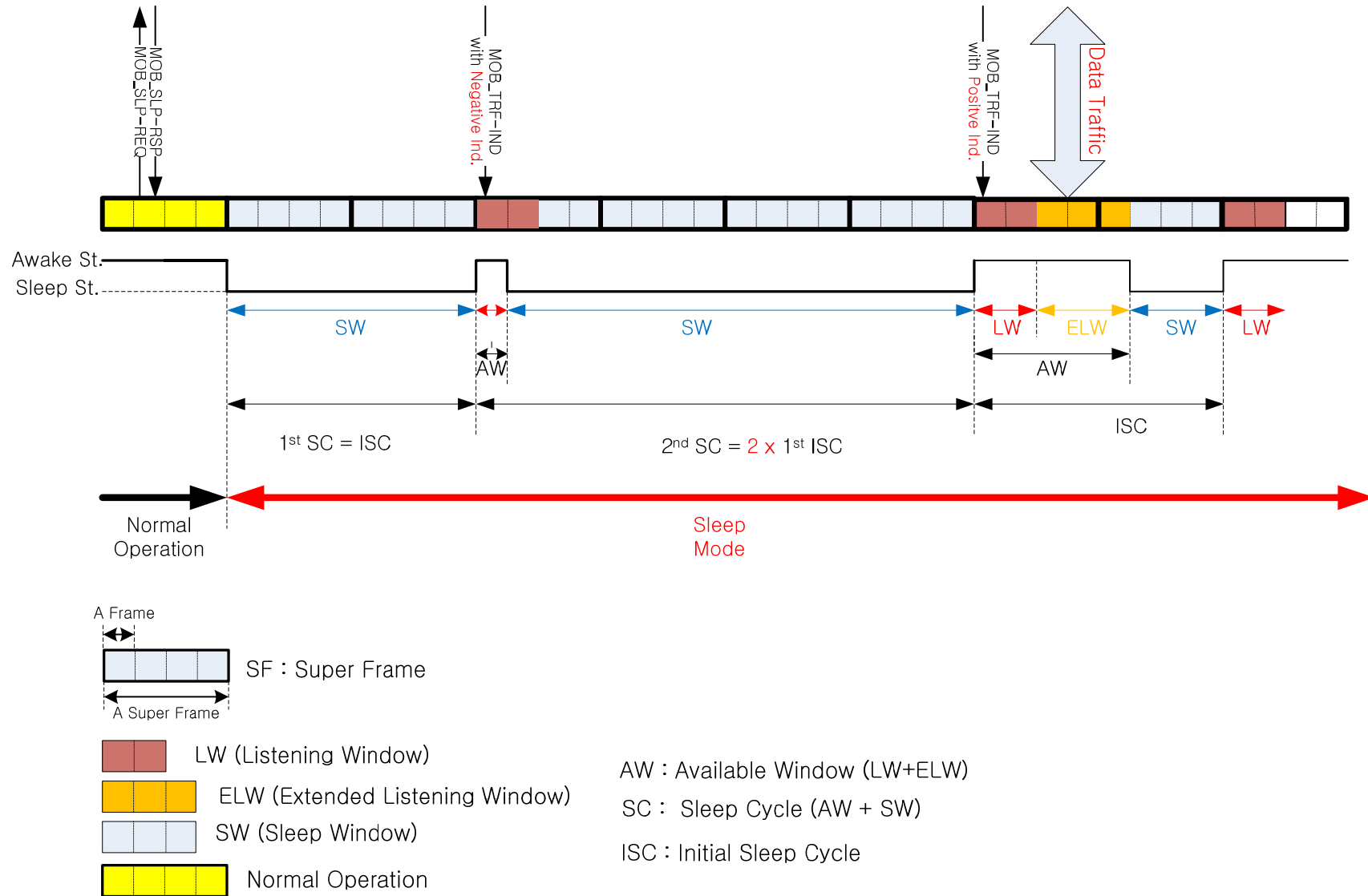
- Extended Listening Window

- The MS and BS exchange the traffic during listening interval
- Listening Window can be extended as long as there is DL/UL data traffic including H-ARQ ACK/NACK
- Once entering listening window, the timer starts and reset if any traffic reception/transmission performed
- If the timer is expired due to no more traffic exchanging the MS may enter sleep mode until next scheduled Listening Window

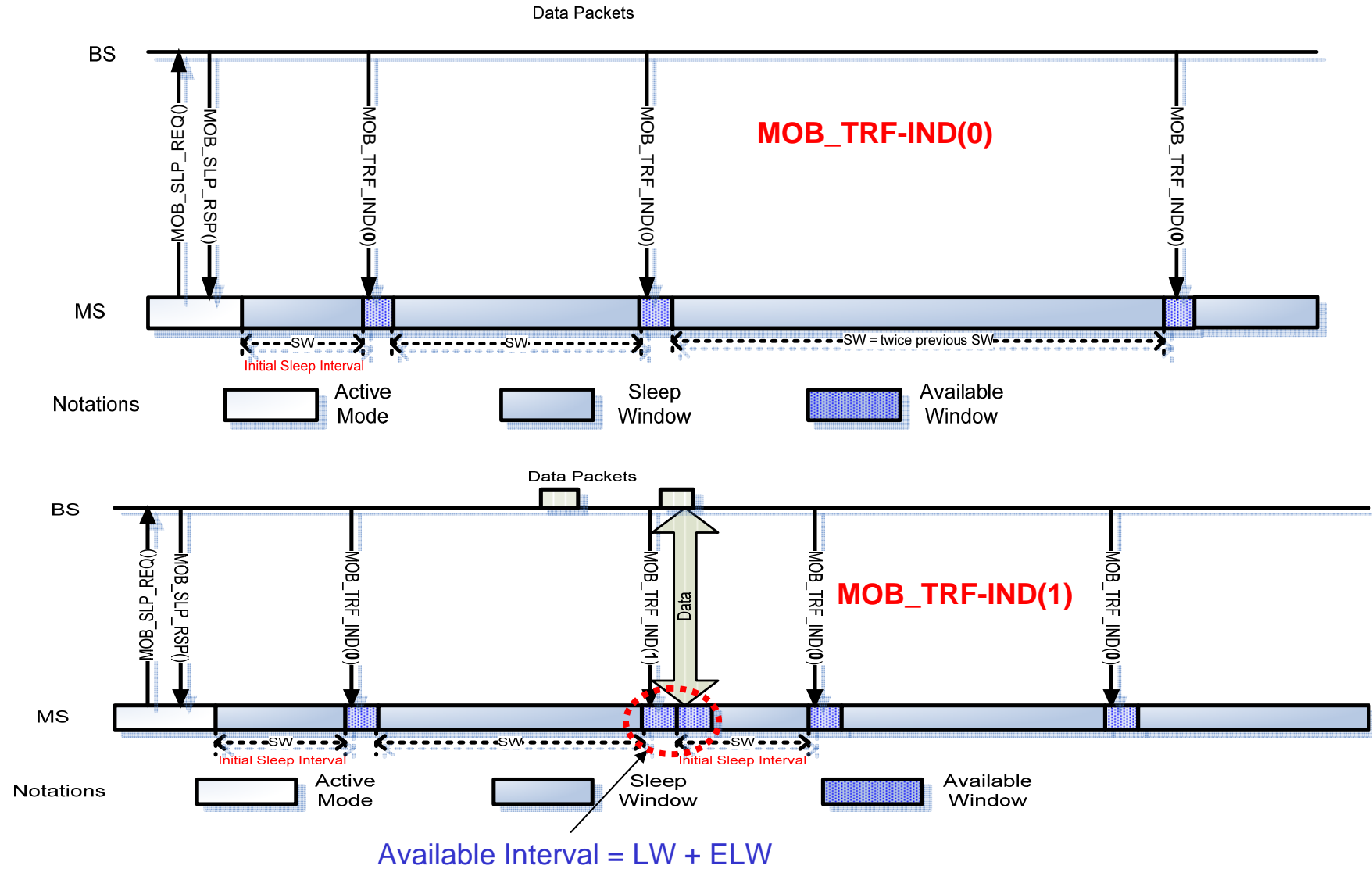
- Timer expires due to No DL data traffic nor Acknowledgement for UL
- Retries of UL H-ARQ retransmission are exhausted
- MS enters sleep state until next scheduled Listening Window



Basic Structure

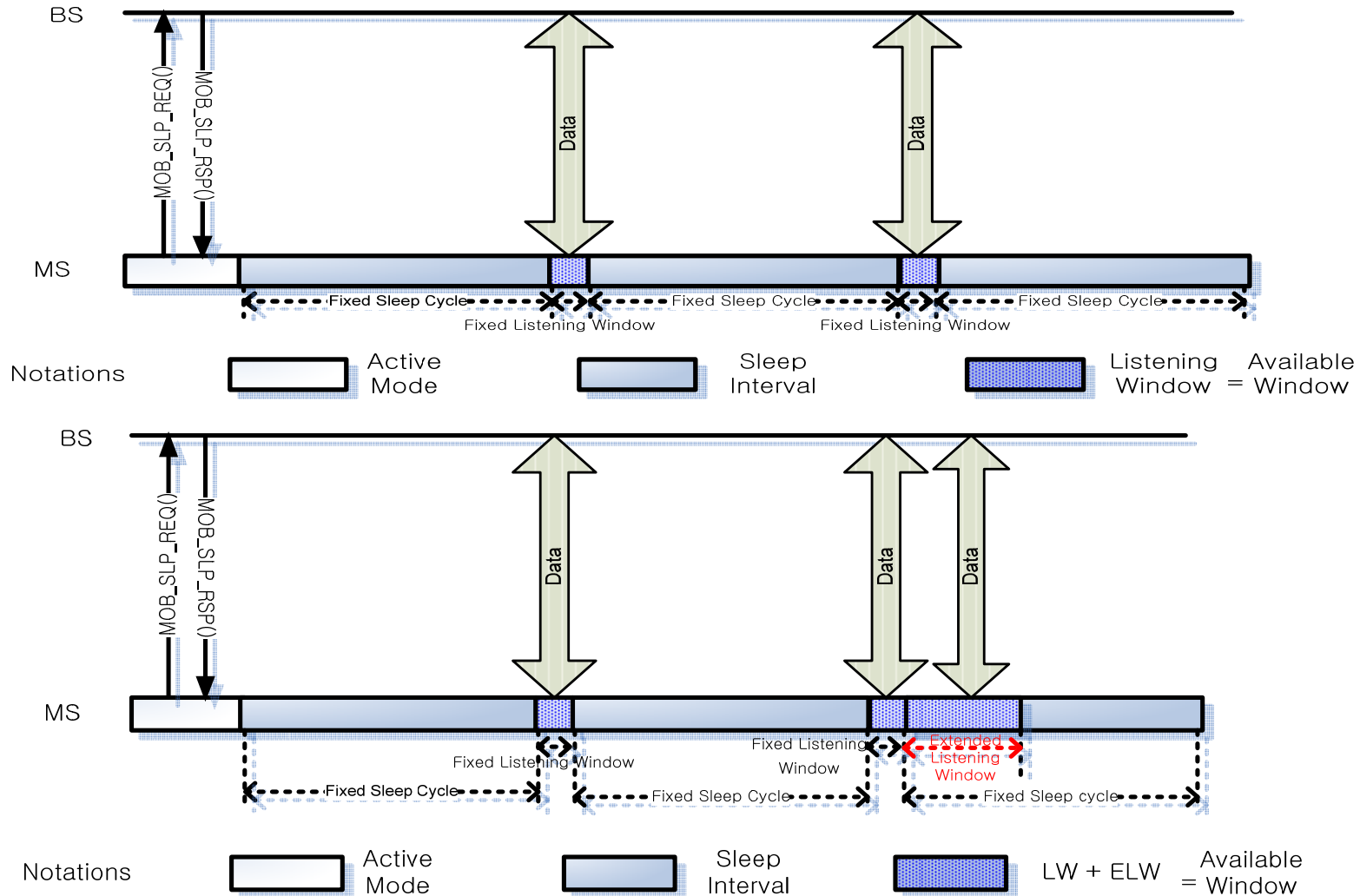


Basic operation with MOB_TRF-IND



Basic operation without MOB_TRF-IND

- TRF-IND-Required = 0 in MOB_SLP-REQ/RSP (Fixed Sleep Cycle)



Conclusions

- Lower Signaling Overhead
 - Reducing signaling overhead by allowing returning to sleep interval without explicit exchange of management messages
- Higher Power Saving
 - Keeping MS in the sleep mode as much as possible even in light bursty traffic coming
- Utilize flexible DL/UL data transmission in normal data connection using Extended Listening Interval
 - Supporting H-ARQ and transmitting Residual packet data in the buffer
- Utilize the scheduling and traffic pattern coming through the network
 - Adapting the available interval within a sleep cycle based on data delivery results
 - Variable and flexible Sleep Interval (Begin at initial interval or doubling sleep interval)
- Reuse the fundamental design concept of 802.16e

Proposed Text

- **Following Text should be included into SDD document**

----- **Start Text** -----

10.X Sleep mode operation

To efficiently save power consumption of the MS, the MS goes back to sleep mode without explicit management message after exchanging of traffic with BS. In addition, the MS exchanges the traffic during sleep window with extension of the listening interval if there is traffic. The MS and BS set the type of sleep mode operation based on the application traffic. And also sleep cycle is variable to flexibly adopt the traffic pattern
