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Source(s)	Yeongmoon Son Changhoi Koo Jungje Son Samsung Electronic, Suwon P.O.Box 105, 416, Maetan-3dong, Paldal-gu, Suwon-si,Gyeonggi-do, Korea 442-742 Voice : +82-31-279-5091 Fax : +82-31-279-5130 ym1004.son@samsung.com chkoo@samsung.com junje.son@samsung.com
Re:	This contribution is for call for contribution about IEEE802.16e-D1
Abstract	This contribution is to propose the MOB_TRF IND message in order to perform the periodic ranging within sleep interval.
Purpose	Handoff Ad Hoc draft proposal for the IEEE802.16e group.
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Periodic Ranging in Sleep mode

Yeongmoon Son, Changhoi Koo, Jungje Son

SAMSUNG Electronic

1. Problem Statement

In IEEE P802.16e/D1-2004, MSS joined to BS shall perform the periodic ranging procedure in order to adjust transmission parameters so that the MSS can maintain uplink communications with the BS.

For backward compatibility with the periodic ranging in IEEE P802.16-REVd/D3-2004, MSS supporting mobility in IEEE 802.16e/D1-2004 shall support the periodic ranging without changing its procedure or scheme.

For each MSS, the BS shall maintain a T27 timer as defined in IEEE P802.16-REVd/D3-2004. At each expiration of the timer, the BS shall issues ranging opportunity (or uplink burst) to the MSS using UL-MAP message for an uplink transmission. The timer is restarted each time a unicast grant is made to the MSS. Each MSS shall maintain a T4 timer as defined in IEEE P802.16-REVd/D3-2004. The expiration of this timer indicates to the MSS that it has not been given the opportunity to transmit to the BS for an extended period of time. Operating on the assumption that its uplink transmission parameters are no longer useable, the MSS initiates a restart of its MAC operations

If MSS supports sleep mode, There is big problem in performing periodic ranging. BS has a T27 timer for each MSS irrespective of Support of sleep mode. During a sleep-window, an MSS does not send or receive PDUs, has no obligation to listen to DL traffic and may powerdown one or more physical operation components. Thus, BS may allocate the uplink burst for periodic ranging to MSS in sleep window at expiration of the timer. Since MSS does not know whether BS grants bandwidth to it or not during sleep window, moving MSS may not perform periodic ranging with BS in several times. As a result, MSS has difficulty in communication with the BS in uplink. In the worst case, MSS may accept any grant of bandwidth before expiration of its T4 timer , and initiate a restart of its MAC operations.

2. Proposed Remedy

For the purpose to resolve the above problems, we propose the modified MOB_TRF-IND message consideringboth sleep mode and periodic ranging.

Currently, the MOB_TRF-IND message consists of some parameters including SLPID bit map. Each bit of SLPID bit map is allocated to an MSS in order, according to the sleep id which is assigned to MSS entering sleep mode by BS. Therefore, the MSS shall decode the MOB_TRF-IND message during listening interval in order to check whether the Positive indication for itself exists or not. It means that MSS checks its own single bit mapped to its sleep id.

For supporting both periodic ranging and power saving in sleep mode, we propose the MOB_TRF-IND message to have the extended 2 bits mapped to a SLPID and the additional frame offset(10bits) which means frame for MSS to awake within sleep window for periodic ranging operation.

- The extended two bits assigned to an MSS has additional information about not only Traffic Indication but also Periodic Ranging Operation
  - Each bit of 2bits means the following, respectively
    - OPR : Occurrence of Periodic Ranging in next sleep mode, 1st msb bit of 2 bits
    - TRF_or_MGMI : Indication of Tranffic Indication, or Indication of Management message Indication after Periodic Ranging. 2nd lsb bit of 2bits

- Thus, 2bits consists of (OPR:TRF_or_MGMI). Table 1 shows the bit allocation policy and commands for the MSS action

Table 1. Bit Allocation and MSS action

Bit Allocation (OPR:TRF_or_MGMI)	Meaning	MSS Action
0:0	During Sleep window, Periodic Ranging Operation doesn't Occur DL Traffic Indication for an MSS is negative	May return to Sleep mode
0:1	During Sleep window, Periodic Ranging Operation doesn't Occur DL Traffic Indication for an MSS is Positive	Shall transit to Awake mode in order to receive DL Traffic
1:0	During Sleep window, Periodic Ranging Operation Occurs Additional MAC Management message doesn't exist After Completion of Periodic Ranging	May return to sleep mode until the start of periodic Ranging Operation (using Frame Offset to awake during sleep window) And then Awaken for Periodic ranging Operation After Completion of Periodic ranging Operation, MSS may return to sleep mode
1:1	During Sleep window, Periodic Ranging Operation Occurs Additional MAC Management message exists After Completion of Periodic Ranging	May return to sleep mode until the start of periodic Ranging Operation (using Frame Offset to awake during sleep window) And then Awaken for Periodic ranging Operation After Completion of Periodic ranging Operation, MSS shall wait MAC Management message maintaining awake mode

- The additional frame offset(FR_OFFSET-Frame offset to awake within sleep window for periodic ranging) means
  - If the periodic ranging Operation dose occurs, that is, if BS allocates the uplink burst for periodic ranging in UL-MAP message to MSS in sleep mode, MSS shall enter awake mode within sleep window in order to get the UL burst for periodic ranging. Therefore, MSS has to know when to awake during the sleep window. For this reason, MSS whose OPR is '1', that is, MSS with periodic ranging operation during sleep window shall refer to its own FR_OFFSET that its unit is frame.
  - MSS whose OPR bit is '1' shall check the ranking among All the MSSs whose OPR bit is '1' and then read its own FR_OFFSET in the order of SLPID. And then, For power saving, MSS may return to sleep mode until the start of periodic ranging operation apart from end of the listening interval as FR_OFFSET.

Figure 1 shows the example of the proposed operation of periodic ranging and sleep mode

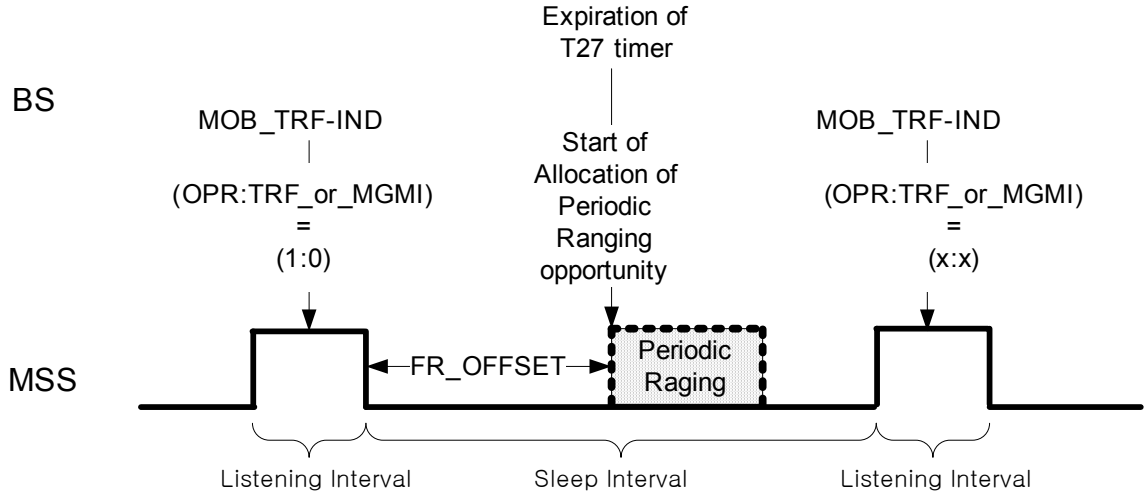

Figure 1. The proposed operation of sleep mode and periodic ranging

3. Proposed Text Changes

[Modify the paragraph of 6.4.2.3.4.44 in Page 23, Line 52 as follows]

6.4.2.3.44 Traffic Indication message (MOB_TRF-IND)

This message is sent from BS to MSS on the broadcast CID. The message is intended for MSS's that are in sleep-mode, and is sent during those MSS's listening-intervals. The message indicates whether there has been traffic addressed to each MSS ~~that is~~ in sleep-mode and whether Periodic Ranging Operation for each MSS occurs or not within its own sleep window. An MSS that is in sleep-mode during its listeninginterval shall decode this message to seek an 2bit indication addressed to itself.

When an MSS awakens, it will check the frame number to ensure that it did not lose frame synchronization with the BS, ~~if it does not find its own SLPID in the MOB_TRF-IND message, it will consider this as a negative indication and shall return to sleep mode~~.

If the MSS finds two bits set to "00" on the allocated bit position, MSS considers it as that there is no periodic ranging operation within sleep window and no DL Traffic to be sent to it from BS. Thus, it may return to th sleep-mode.

If the MSS finds its own two bits set to "01", MSS consider it as that there is no periodic ranging operation within sleep window but DL Traffic to receive. Thus, it shall maintain awake mode and wait to receive the DL traffic from BS

If the MSS finds its own two bits set to "10", MSS consider it as that there is periodic ranging operation within sleep window but no MAC management message to receive after completion of periodic ranging operation. Therefore, it checks the ranking of MSSs whose two bits are "10" or "11" and read its own Frame Offset to Awake for Periodic Ranging in the order of SLPID from MOB_TRF-IND message. And then, it shall return to sleep mode until the start of periodic ranging operation apart from end of the negotiated listening interval as its own Frame Offset to Awake for Periodic Ranging. At expiration of Frame Offset, it shall awaken to decode the UL-MAP for periodic ranging opportunity. Upon completion of Periodic ranging operation, it may return to sleep mode because of no existence of MAC Management message to receive.

If the MSS finds its own two bits set to "11", MSS consider it as that there is periodic ranging operation within sleep window and MAC management message to receive after completion of periodic ranging operation. Therefore, it read its own Frame Offset using the identical scheme like two bits "10". And then, it shall do the same operation as two bits "10" except for maintaining awake mode to receive the addition MAC Management message after completion of periodic ranging operation.

During Periodic raniging, MSS reaching its listening interval shall monitor and decode MOB_TRF-IND message.

[Modify Table 85c in Page 24, Line 1 – Traffic-Indication(MOB_TRF-IND) message format as follows]

Table 85c --- Traffic-Indication(MOB_TRF-IND) Message format

Syntax	Size	Notes
MOB_TRF-IND_Message_Format() {		
Management message type = 48~~7~~		
Byte of SLPID bit-map	8 bit	
SLPID bit-map	Variable	Two bits are allocated to one MSS 00 : No Periodic Ranging Operation in Sleep Window and No DL Traffic 01 : No Periodic Ranging Operation in Sleep Window and DL Traffic 10 : Periodic Ranging Operation in Sleep Window and Return to Sleep mode after Perodic Ranging 11 : Periodic Ranging Operation in Sleep Window and Maintain Awake mode after Perodic Ranging
NUM_of_MSS_Periodic_Ranging	8 bit	
For(i=0; i<NUM_of_Periodic_Ranging; i++) {		
Frame Offset to Awake for Periodic Ranging	10 bit	Frame Offset to Awake within sleep window Where Two bit of MSS in SLPID bit-map are 10 or 11
}		
Padding	Variable	
}		

Parameters shall be as follows:

Byte of SLPID bit-map

The Size of SLPID bit-map field in bytes

SLPID bit-map

The SLPID bit-map field is a variable length field and may be padded for byte alignment (that is it's length is determined by the number of SLPID currently assigned by the BS). The least-significant 2 bits of the first byte in this field relate~~s~~ to SLPID=0, and subsequent 2 bits relate to SLPID=1, etc.

The MSS that has been assigned SLPID=n by the SLP-RSP message shall interpret the consecutive nth 2 bit~~s n~~ ($b_{n+1}b_n$~~b_n~~) in the SLPID bit map in the following manner:

~~b_n = 0 means negative indication, MSS may return to sleep mode b_n = 1 means positive indication, MSS shall awake~~ b_n means whether the periodic ranging operation exist or not within next sleep window

b_n = 0 that the periodic ranging operation does not exist within next sleep window.

b_n = 1 means that the periodic ranging operation exists within next sleep window.

b_{n+1} has a several meanings according to the value of b_n

In case of $b_n = 0$

$b_{n+1} = 0$ means negative indication of DL Traffic

$b_{n+1} = 1$ means positive indication of DL Traffic

In case of $b_n = 1$

$b_{n+1} = 0$ means that MSS shall return to sleep mode after completion of periodic ranging operation

$b_{n+1} = 1$ means that MSS shall maintain mode after completion of periodic ranging operation

Num_of_MSS_Periodic_Ranging

The number of MSS whose b_n is 1, That is, The number of Frame Offset to awake within sleep window for periodic Ranging

Frame Offset to Awake for Periodic Ranging

The SLPID bit-map field is a variable length field and may be padded for byte alignment (that is it's length is determined by the number of SLPID currently assigned by the BS). The least-significant 2 bits of the first byte in this

Padding

Padded dummy bits for byte alignment of MOB_TRF-IND message

[Modify the paragraph of 6.4.17.1 in Page 35, Line 22 as follows]

6.4.17.1 Introduction

Sleep-mode is a mode in which MSSs supporting mobility may power down, scan neighbor BSs, range neighbor BSs, 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 MSSs to minimize their power usage and to facilitate hand-over decision and operation while staying connected to the network. 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 powerdown one or more physical operation components, or may awaken for periodic ranging,. During a listening-interval, an MSS shall synchronize with the Serving BS downlink and listen for an ppropriate MOB_TRF-IND traffic indication message. The MSS shall decide whether to stay awake or go back to sleep based on ~~a~~ the value of its own 2 bits of SLPID bitmap in ~~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 the algorithm as defined in 6.4.17.2 Sleep-window update algorithm.

An MSS shall awaken, enter into an interleaved listening-window according to the sleep-interval, and check whether there were PDUs addressed for it and Periodic Ranging Operation within the next sleep window. The listening-window parameter defines the maximum number of whole frames the MSS shall remain awake waiting for an 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~~there is MSS to awaken due to no existence of both its DL traffic and Periodic Ranging within next sleep window, the BS sends an empty indication messaage, that is, MOB_TRF-IND message with Byte of SLPID bit map~~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 there are or not DL traffic~~data~~ and periodic ranging procedure~~has~~

~~been~~ addressed for it during an preceding interval. If DL traffic exists ~~If such PDUs exist~~, or if the listening interval has passed but the MSS didn't receive any TRF-IND message, the MSS shall remain awake, terminating the sleep-interval and re-entering Normal Operation.

If MSS find that there is DL traffic addressed to it, MSS aIf MSS find that there is Periodic Ranging operation within next sleep window from dccoding MOB_TRF-IND message, it shall check the ranking of MSSs which have its respective periodic ranging procdure within next sleep window and, shall read its own Frame Offset to Awake for Periodic Ranging in the order of SLPID from MOB_TRF-IND message. , it shall return to sleep mode until the start of periodic ranging operation apart from end of the negotiated listening interval as its own Frame Offset to Awake for Periodic Ranging. At expiration of Frame Offset, it shall awaken to decode the UL-MAP for periodic ranging opportunity. Upon completion of Periodic ranging operation, it may return to sleep mode or not according to its own two bits.

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 sleepmode, 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.