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Re:	Call for inputs for commentary of p802.16e/D1	
Abstract	This contribution describes paging procedure in idle mode for IEEE P802.16e/D1-2004.	
Purpose	Discuss and Adopt enhanced feature of p802.16e/D1	
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Paging Procedure in Idle mode for IEEE802.16e

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1. Problem Statements

– Absence of paging procedures

By adopting idle mode in the 802.16e standard, we need to define the paging procedures for the BSS to send a message to the MSS while it stays in idle mode. If a BS has messages or events to send to an MSS in idle mode, the BS shall send MAC messages on the broadcast CID. If a MSS is in idle mode, the MSS shall monitor the down link only at a specific time for power conservation and then go back to idle mode for the left predetermined interval. It means that the BS should know the exact time when the MSS will wake up in order to monitor the downlink and also should know the exact location of the MSS. A BS is able to know the exact time information when a MSS listen to the downlink channel by the idle mode negotiation procedure when a MSS transit to idle mode but not able to be sure whether the MSS is still located in the same cell or move to other cells. In this document, we introduce efficient monitoring and paging procedures to achieve those requirements. This proposal also provides a paging frame determination algorithm.

2. Overview of Proposed Solutions

Upon entering idle mode from awake mode, a MSS and a BS shall negotiate the paging parameters. This enables the BS and MSS to determine the exact time of monitoring and paging a message on the downlink.

The BS shall send the paging message in one of a monitoring frame set of the MSS while it stays in idle mode. The BS can send the paging message with each different purpose and for each case, different paging procedure is applied. We can classify the different paging purposes of the BS as following :

1. Triggering the MSS to perform the network re-entry and initialization
2. Transmitting a paging message to an upper layer or application without the acknowledgment(no **MOB_PAG-RSP** message)
3. Transmitting a paging message to an upper layer or application and Requesting the acknowledgement(**MOB_PAG-RSP** message)
4. Changing the rest interval and the timer-based registration interval
5. Requesting the zone-based registration.

The MSS shall only monitor downlink message with broadcast CID during the monitoring frame. During the frames of the rest interval, in which the MSS is not being monitored, the MSS can suspend or stop its processing for power conservation.

When the MSS receives a paging message, it determines whether there is any paging information destined to itself or not by matching its MSS address. Otherwise, the MSS shall perform the update procedure if a received message is one of configuration messages.

If there is no paging message in a monitoring frame, the MSS shall ignore and then be back into idle mode for left interval if needed

3. Proposed Text Change

Accept following section 6.4.18,xx paging procedure in idle mode as whole.

6.4.18.4 Paging procedure in idle mode

When the network requests to the BS for transmitting the paging messages, it has to inform the BS of the MSS's location.

The **MOB_PAG-REQ** shall be used to send a paging message that contains paging messages designated to MSS(s) in one paging frame. The BS may request the MSS to respond with the **MOB_PAG-RSP** message or may force the MSS to start re-entry procedure, using **PAG_PURPOSE** field of the **MOB_PAG-REQ** message.

When an MSS monitors a frame in idle mode, it will check the frame number to ensure that it does not lose frame synchronization with the BS, if it finds neither the **MOB_PAG-REQ** message nor its own MAC address in the **MOB_PAG-REQ** message, it ignores the frame and then it may perform idle procedures of idle mode.

6.4.18.4.1 Negotiation for Paging

Upon entering idle mode from Awake mode, the MSS and the BS shall negotiate the paging parameters

REST_INTERVAL_INDEX. This enables the BS and MSS to determine the exact time of monitoring and paging a message on the downlink. The MSS can specify its preferred value using **REST_INTERVAL_INDEX** field of **MOB_IDL-REQ** message and the BS can specify the value using **REST_INTERVAL_INDEX** field of **MOB_IDL-RSP** message.

6.4.18.4.2 Frame determination

To determine the MSS's monitoring frame with the **REST_INTERVAL_INDEX** and the MSS MAC Address, the BS shall use the algorithm described below.

The MSS obtains the frame offset, **FRAME_OFFSET** by performing the hash function with the input and the MSS MAC Address.

The frames monitored by the MSS are decided as the following :

F_0 : the frame offset mod Y .

F_n : frame number for nth monitoring element.

Monitoring frame set : $F_{n+1} = (F_n + D) \bmod Y$

_____ , where n is an integer, D is the rest interval and Y is the maximum number of frame index, 2^{24} , in one paging cycle.

D, rest interval, is given by $D = (2^i * \delta) < Y$, where $\delta = 2^j$ ($j = 0, \text{recommended}$)

and i is the **REST_INTERVAL_INDEX**.

The BS shall transmit the paging message for the MSS on the monitoring frame F_n , where n is an integer.

6.4.18.4.3 Paging Procedure

When there are MAC PDUs for the MSS, the BS may transmit MOB_PAG-REQ message to wake up the MSS or transmit short user data to the MSS on a monitoring frame. For the other purpose such as request for location updating or parameters updating for Idle mode, the BS may transmit MOB_PAG-REQ. The BS can discriminate each different case of triggering MOB_PAG-REQ message with PAG_PURPOSE. And the BS may transmit MOB_PAG-REQ only to trigger re-initialization of the MSS.

When the MSS receive MOB_PAG-REQ message, according to PAG_PURPOSE, the MSS may be forced to re-initialize, transmit MOB_PAG-RSP or update parameters relating with Idle mode. If the MSS is forced to re-initialize, transmit MOB_PAG-RSP or update registered location, the MSS shall transit to Awake mode. The other case, the MSS may remains in the Idle mode.

If the MSS is forced to transmit MOB_PAG-REQ or update registered location, after transition to Awake mode, the MSS should operate Initial Ranging Process. After the MSS received Basic CID and Primary CID from the BS, using CID, the MSS transmit MOB_PAG-REQ or MOB_LU-REQ message.

Accept following MAC Management Message

6.4.2.3 MAC Management Messages

Table 14b. MAC Management Messages

<u>Type</u>	<u>Message Name</u>	<u>Message Description</u>	<u>Connection</u>
<u>??</u>	<u>MOB_PAG-REQ</u>	<u>Paging request message</u>	<u>broadcast</u>
<u>??</u>	<u>MOB_PAG-RSP</u>	<u>Paging response message</u>	<u>primary</u>
<u>38, 57-255</u>		<u>Reserved</u>	

6.4.2.3.55 Paging Request (MOB_PAG-REQ) Message

This message is sent from BS to MSS on the broadcast CID. The message indicates whether there has been traffic addressed to each MSS that is in idle-mode. An MSS that is in idle-mode at its monitoring frame shall decode this message to seek paging messages those are designated to itself by the MAC Address matching..

Table MOB_PAG-REQ Message Format

<u>Syntax</u>	<u>Size</u>	<u>Notes</u>
<u>MOB_PAG-REQ_Message_Format() {</u>		
<u>Management message type = ??</u>	<u>8 bits</u>	
<u>Number of paged terminals</u>	<u>8 bits</u>	
<u>For (j=0; j<Number of paged terminals; j++) {</u>		
<u>MAC_ADDRESS</u>	<u>48 bits</u>	<u>48bit MSS unique MAC address</u>
<u>PAG_PURPOSE</u>	<u>8bits</u>	
<u>LENGTH</u>	<u>8 bits</u>	<u>The length of the payload, units of bytes</u>
<u>PAYLOAD</u>	<u>Variable</u>	<u>Paging information.</u>
<u>}</u>		
<u>}</u>		

Parameters shall be as follows:

Number of paged terminals

The number of paging messages inside this message

MAC_ADDRESS

MAC address of the designated MSS that is supposed to receive this paging message.

PAG_PURPOSE

This field represents the purpose of paging.

Table PAG_PURPOSE

<u>value</u>	<u>Description</u>
<u>00000000</u>	<u>Reserved</u>
<u>00000001</u>	<u>Performing the network re-entry and initialization.</u>
<u>00000010</u>	<u>No ACK required. (no MOB_PAG-RSP).</u>
<u>00000011</u>	<u>MOB_PAG_RSP is required</u>
<u>00000100</u>	<u>Change rest interval</u>
<u>00000101</u>	<u>Requesting the location update_LU</u>
<u>00000110 ~ 0xff</u>	<u>Reserved</u>

LENGTH

The length of the payload..

PAYLOAD

This has a different message structure according to the **PAG_PURPOSE**.

- A Request of entering awake mode : this payload is used when **PAG_PURPOSE = 0x01**

<u>Syntax</u>	<u>Size</u>	<u>Notes</u>
<u>Reason</u>	<u>8 bits</u>	<u>Value</u> <u>0 : DL User data buffered</u> <u>1~0xff : reserved</u>

- A Request of changing rest interval : this payload is used when **PAG_PURPOSE = 0x04**

<u>Syntax</u>	<u>Size</u>	<u>Notes</u>
<u>Rest interval index</u>	<u>4 bits</u>	
<u>Reserved</u>	<u>4 bits</u>	

When **PAG_PURPOSE =0x02 or 0x03**, **PAYLOAD** may be the user data for the MSS.

6.4.2.3.56 Paging Response (MOB_PAG-RSP) Message

The **MOB_PAG-RSP** message shall be sent from an MSS to the BS on the MSS's primary CID in response to an **MOB_PAG-REQ** message which requires the acknowledgement message of the **MOB_PAG-REQ**.

Table MOB_PAG-RSP Message Format

<u>Syntax</u>	<u>Size</u>	<u>Notes</u>
<u>MOB_PAG-RSP Message Format() {</u>		
<u>Management message type = ??</u>	<u>8 bits</u>	
<u>Cause</u>	<u>2 bits</u>	<u>00 & 11: reserved</u> <u>01 : MOB_PAG-REQ accepted</u> <u>10 : MOB_PAG-REQ rejected</u>
<u>Reserved</u>	<u>6 bits</u>	
<u>}</u>		