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Title	**Location Management for supporting IDLE mode in IEEE P802.16e**
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Re:	Call for inputs for the Handoff Ad-hoc group
Abstract	This contribution describes Location Management for supporting IDLE mode in IEEE P802.16e/D2-2004.
Purpose	Handoff Ad Hoc draft proposal for the IEEE802.16e group.
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Location Management for supporting IDLE mode in IEEE P802.16e

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1. Statement of the problem

According to the current IEEE P802.16e/D2-2004, the BSs are divided into logical groups called paging groups, of which the purpose is to offer a contiguous coverage region in which the MSS in IDLE mode does not need to transmit in the UL. The size of paging group has the trade-off between the paging overhead of system and power saving of MSS: if the size is large, the paging overhead is heavy and the power consumption is low; if the size is small, the paging overhead is light and the power consumption is high. This contribution focuses on reducing the paging overhead of system while maximizing the power saving of MSS in IDLE mode. In order to reduce the paging overhead, the size of paging group should be set to small as much as possible, which causes the MSS to frequently cross a paging group boundary and resultantly makes the meager power saving due to the frequent network re-entry.

In this contribution, we propose the light and secure location update procedures in IDLE mode. While a MSS in IDLE mode crosses the boundary of a paging group, the MSS shall perform location update operation instead of doing network re-entry. This location update procedure should be designed in order to protect the fake location update from the malicious user.

2. Summary of solution

2.1 IDLE authentication information

A IDLE authentication information is an authentication key used by a MSS in IDLE mode in order to support secure location update. Upon transition into IDLE mode, each MSS is implicitly allocated a IDLE authentication key which is an active AK from current Serving BS. If the MSS has two active AKs, a IDLE authentication key is newer AK. The DREG-REQ message from a MSS triggers the Serving BS to create the MSS's IDLE authentication information, and then the Serving BS replies the DREG-CMD with paging and location management (PLM) server ID which identifies who controls the paging and location management for IDLE mode. The PLM server may be co-located in the current Serving BS, or if the centralized network topology is preferred, ASA server or new network element. If the PLM server ID is unequal to the current Serving BS ID, the Serving BS will relay the IDLE authentication information to the PLM server which can thereafter authenticate the MSS in IDLE mode.

2.2 Location update procedure in IDLE mode

The MSS in IDLE mode shall perform location update operation if the update condition is met. We propose two location update conditions as following:

- Zone-based update

  The MSS performs location update when the paging group is changed. The MSS can detect the change of paging group by monitoring the paging group identifier, PG_ID which is transmitted on the **MOB_PAG-ADV** message.
- Timer-based update

The MSS periodically performs location update whenever a predefined timer expires. This scheme enables the PLM server to ascertain a MSS in IDLE mode to keep alive. If the PLM server ascertains a MSS in IDLE mode to be died, the PLM server may delete all information for the MSS.

If the MSS in IDLE mode needs to update its location, the MSS sends to a BS MOB_LU-REQ message with PLM server ID and HMAC-Digest calculated from a IDLE authentication key. The BS which receives MOB_LU-REQ from a MSS in IDLE mode delivers the MSS's location update information to the PLM server, and the PLM server will update the MSS's location information provided that the HMAC-Digest is correctly verified.

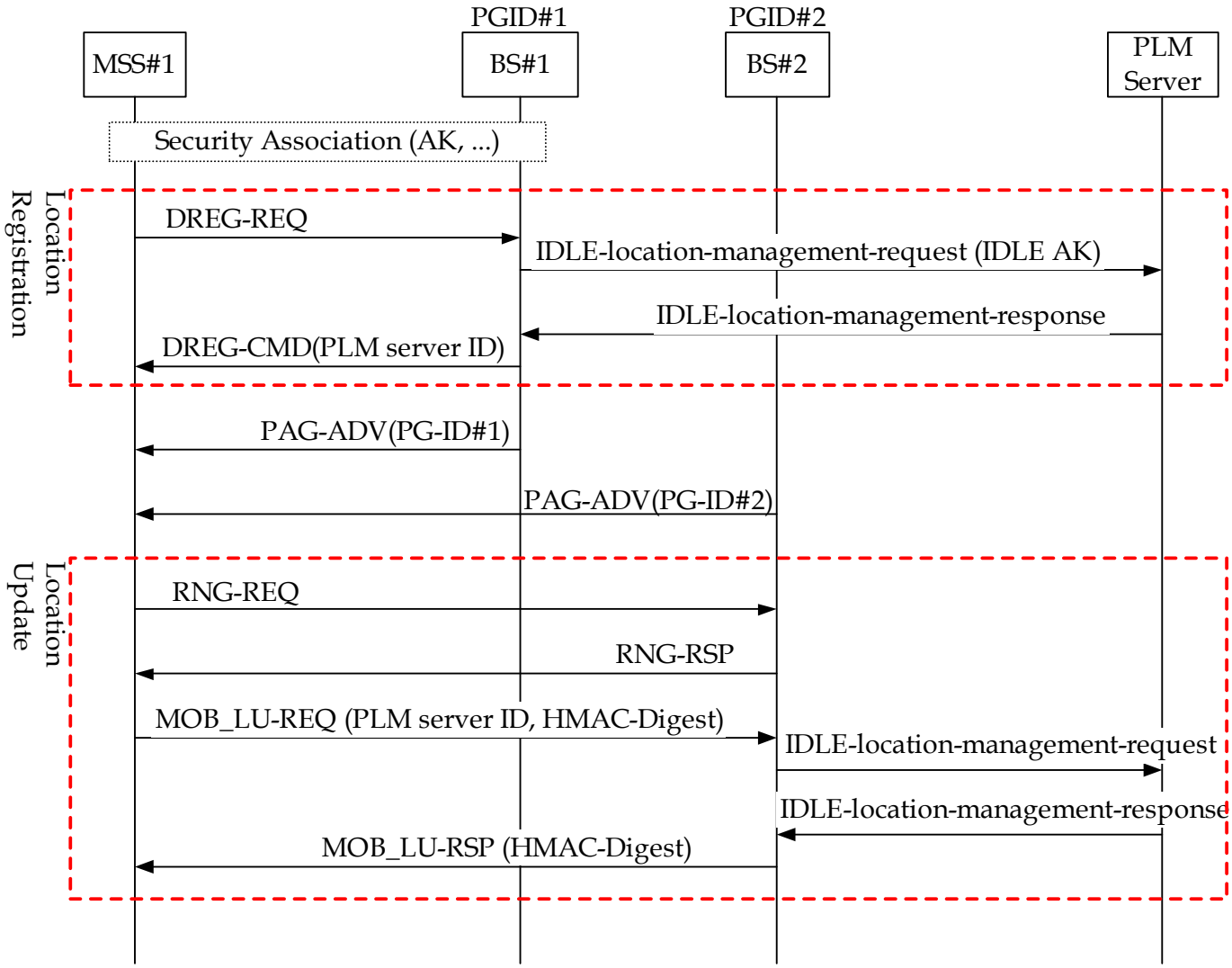

Figure xx. Location management for IDLE mode

3. Specific text changes

[Modify 6.4.2.3.26 De/Re-register Command (DREG-CMD) message]

Table 55m— DREG-CMD Message Format

Syntax	Size	Notes
DREG-CMD_Message_Format() {		
Message Type	8 bits	29
Action Code	8 bits	
TLV_Paging Information	48 bits	
TLV_REQ-duration	24 bits	
TLV_PLM Server ID	48 bits	An identifer of network element which takes charge of the PLM server of the MSS in IDLE mode.
TLV_HMAC Tuple	176 bits	
}		

The DREG-CMD may include the following parameters encoded as TLV tuples:

PLM Server ID

An identifer of network element which takes charge of the PLM server of the MSS in IDLE mode. The network element may be the current serving BS, ASA server, or new network element.

[Add new section 6.3.21.9 with the following sentences after section 6.3.21.8.2]

6.3.21.9.Location Update

The MSS in IDLE mode shall perform location update operation if the location update condition is met. The location update procedures are the followings:

- Zone-based update

  The MSS performs location update when the paging group is changed. The MSS can detect the change of paging group by monitoring the paging group identifier, PG_ID which is transmitted on the **MOB_PAG-ADV** message.
- Timer-based update

  The MSS periodically performs location update whenever a predefined timer expires. This scheme enables the PLM server to ascertain a MSS in IDLE mode to keep alive. If the PLM server ascertains a MSS in IDLE mode to be died, the PLM server may delete all information for the MSS.

If the MSS in IDLE mode needs to update its location, the MSS sends to a BS MOB_LU-REQ message with PLM server ID and HMAC-Digest calculated from an IDLE authentication key. The BS which receives MOB_LU-REQ from a MSS in IDLE mode delivers the MSS's location update information to the PLM server, and the PLM server will update the MSS's location information provided that the HMAC-Digest is correctly verified.

[Add MAC Management messages to 6.4.2.3 MAC Management messages; editor will make appropriate allocation of numbering for subsection and Management Message Type, set appropriate Table number nn, and adjust referenced Table 14a to include new Management Message Type reference]:

6.4.2.3.?? Location Update Request (MOB_LU-REQ) message

The MSS in IDLE mode shall send the MOB_LU-REQ message in order to update its location. The MOB_LU-REQ message shall be sent on the primary CID.

Table xxx— MOB_LU-REQ Message Format

Syntax	Size	Notes
MOB_LU-REQ_Message_Format() {		
Message Type = ??	8 bits	
Reserved	6 bits	
Action Code	2 bits	00 – Location update by new Paging Group ID 01 – Location update by Timer expiry 10 ~ 11 – reserved
TLV_Paging Cycle Request	40 bits	
TLV_Previous Subnet Zone ID	8 bits	
TLV_PLM Server ID	~~64~~48 bits	
TLV_HMAC-Digest	176 bits	Calculated with IDLE authentication key
}		

A MSS shall generate MOB_LU-REQ messages in the format shown in Table xxx. The following parameters shall be included in the MOB_LU-REQ message,

Action Code

Action code identifying the type of location update request:

0x00 = Location update by detection of new Paging Group ID

0x01 = Location update by Timer expiry

0x11 = reserved

The MOB_LU-REQ shall include the following parameters encoded as TLV tuples:

PLM Server ID

An identifer of network element which takes charge of the PLM server of the MSS in IDLE mode. The network element may be the current serving BS, ASA server, or new network element.

The MOB_LU-REQ may include the following parameters encoded as TLV tuples:

Paging Cycle Request

PAGING_CYCLE requested by MSS

Subnet Zone ID

Subnet Zone ID which the MSS belonged to previously.

HMAC-Digest

The HMAC-Digest attribute contains a keyed Message digest (to authenticate the sender). The HMAC-Digest is calculated with IDLE authentication key.

6.4.2.3.?? Location Update Response (MOB_LU-RSP) message

The MOB_LU-RSP message shall be sent from BS to a MSS on the MSS's primary CID in response to an MOB_LU-REQ message. After successful Location update, the MSS shall re-enter IDLE mode using the parameters in the message.

Table xxx— MOB_LU-RSP Message Format

Syntax	Size	Notes
MOB_LU-RSP_Message_Format() {		
Message Type	8 bits	??
Action Code	8 bits	0x00=MOB_LU-RSP corresponding to successful MOB_LU-REQ from the MSS in Idle mode 0x01=MOB_LU-RSP corresponding to failed MOB_LU-REQ from the MSS in Idle mode. The MSS should perform network re-entry. 0x02=The MSS shall not retransmit the LU-REQ message and shall wait the LU-RSP message 0x03-0xFF: reserved
TLV_Paging Information	48 bits	Bits 15: 0 - PAGING_CYCLE Bits 23:16 - PAGING_OFFSET Bits 31:24 - Paging Group ID,
TLV_HMAC-Digest	176 bits	Calculated with IDLE authentication key
}		

A BS shall generate MOB_LU-RSP messages in the format shown in Table xxx. The following parameters shall be included in the MOB_LU-RSP message,

Action Code

Action code identifying the type of location update request:

0x00= MOB_LU-RSP corresponding to successful MOB_LU-REQ from the MSS in Idle mode

0x01= MOB_LU-RSP corresponding to failed MOB_LU-REQ from the MSS in Idle mode. The MSS should perform network re-entry.

0x02= The MSS shall not retransmit the LU-REQ message and shall wait the LU-RSP message

0x03-0xFF: reserved

The MOB_LU-REQ shall include the following parameters encoded as TLV tupels:

HMAC- Digest

The HMAC-Digest shall be the last attribute in the message

When the MOB_LU-RSP message is sent with Action Code = 00, the following TLV shall be included:

Paging Information

The Paging Information TLV defines the Paging Group ID and the PAGING_CYCLE and PAGING_OFFSET parameters to be used by the MSS in IDLE mode.

[Add new sections D.2.11 and D.2.12. The sections will include the following text]:

D.2.11 IDLE-location-management-request message

This message may be sent from one BS to another (or to the ASA server, or to the PLM server) to request registration or update of MSS location information. The message contains the following information,

Table Cxxx— IDLE-location-management-request Message Format

Field	Size	Notes
IDLE-location-management-request_Message_Format() {		
Global Header	152 bits	Message Type=??
For (i=0; i<Num_Records; i++) {		
MSS ID	48 bits	
Action Code	8 bits	0x00 : Location Registration 0x01 : Location Update 0x02-FF: reserved
TLV_IDLE AUTH Information	variable	Only valid if Action code = 0x00. An IDLE authentication key which is an active AK from current Serving BS. If the MSS has two active AKs, a IDLE authentication key is newer AK.
TLV-Paging Cycle Request	16 bits	
TLV_Previous PG-ID	24 bits	
TLV_HMAC-Digest	176 bits	Only valid if Action code = 0x01. This value is equal to the HMAC-Digest in MOB_LU-REQ message.
}		
Security field	TBD	
}		

D.2.12 IDLE-location-management-response message

This message may be sent from one BS to another BS (or to the ASA server, or to the PLM server), typically in response to a IDLE-location-management-request message. This message serves to provide the BS that sent the IDLE-location-mamagement-request message with information about the result of location registration or update. The message contains the following information.

Table Cxxx— IDLE-location-management-response Message Format

Field	Size	Notes
IDLE-location-management-response_Message_Format() {		
Global Header	152 bits	Message Type=??
For (i=0; i<Num_Records; i++) {		
MSS ID	48 bits	
Action Code	8 bits	0x00 : Location Registration 0x01 : Successful Location Update 0x02 : Failed Location Update 0x03-FF: reserved
TLV-Paging Information	16 bits	
TLV_HMAC-Digest	176 bits	The HMAC-Digest is calculated with IDLE authentication key
}		
Security field	TBD	
}		