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Title	Enhanced Idle Mode Operation	
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Re:	IEEE P802.16e/D2-2004	
Abstract	Enhanced Idle Mode operation to reduce MAC signaling overhead and enable fast transition	
Purpose	Adoption of proposed changes into P802.16e	
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1 Introduction

In 802.16e/D2, the Idle Mode is an optional mode as described in Section 6.3.21. The BS pages the MSS using MOB_PAG_ADV message which includes the MSS's MAC address hash. After receiving this message, with action code set to '01', the MSS shall perform initial ranging to establish location and acknowledge paging. If the action code is set '10', the MSS shall perform initial ranging and enter the network. The initial ranging includes sending initial ranging code in OFDMA ranging channel, waiting for reply (RNG_RSP or CDMA_Alloc_IE) and retrying if no expected reply is received. The above procedure may introduce long delay due to possible collision and back-off.

The currently defined initial ranging is performed on a randomly chosen Ranging Code within the initial ranging code domain. The access operation is therefore contention based. This is not efficient for the case of paging (MOB_PAG_ADV) with action code of either '01' or '10'. This is because when the BS pages a MSS, the event of response from the MSS is a deterministic event and is fully under the control of the BS. As such, the access operation of initial ranging can be made contention free. Here, we propose to modify the current paging-and-response procedure by assigning a dedicated ranging channel (code) to a MSS at the same time when BS pages a MSS in Idle Mode. In this way, the possible collision and back-off can be completely avoided.

A MSS in Idle mode shall update its location to the network when the MSS enters a new paging-group or the MSS is requested to update its location by the BS through MOB_PAG_ADV message. The paging groups of Idle Mode are designed to trade-off between paging overhead and location update signaling overhead. If the paging group size is small, the paging overhead will be small. However, there will be frequent location update which increases the associated signaling overhead. On the other hand, if the paging group size is large, the paging overhead will be large. However, the signaling overhead associated with location update will be reduced. In the current standard, the location update procedure is similar to that of an initial ranging. In fact, the purpose of location update is to inform the network of a MSS' location, instead of a network entry. Therefore the current location update procedure can be simplified to eliminate unnecessary overhead and delay. We propose a modified location update method in this contribution. Key modification here is to introduce location update MAC header to replace the RNG_REQ message during the location update procedure.

2 Enhanced Idle Mode Operation

The following defines the procedure to support the enhanced paging and location update operation for Idle Mode, as introduced in Section 1.

At the Idle Mode initiation, either initiated by the MSS or the BS, the DREQ_CMD message sent from the BS shall include an Idle_ID (24 bits), which is assigned to a MSS entering Idle Mode. The Idle_ID shall be unique to each MSS in Idle_Mode. When the BS pages a MSS in Idle Mode, the BS sends a MOB_PAG_ADV message which includes the MSS' Idle_ID, and the assigned ranging sub-channel index and CDMA code index.

At the MSS side, after the MSS receives the MOB_PAG_ADV with action code set to either '01' or '10', the MS shall perform initial ranging using the assigned ranging sub-channel and code. At the BS side, the BS monitors the assigned ranging sub-channel and code. For the case of action code equals to '10', the BS and the MSS shall continue the ranging procedure and the network re-entry procedure as defined in 802.16e/D2. For the case of action code equals to '01', once the MSS receives a RNG_RSP with 'State = Success', instead of sending the RNG_REQ, the MSS shall send the Location Update (LU) MAC Header to the BS on the assigned UL resource. Once the BS detects the LU MAC Header, the BS shall send a LU_RSP_IE() to the MSS to acknowledge the reception of LU MAC Header. In both cases of action code equals to '01' and '10', the ranging process, thus the page-and-response process is speed up since there is no collision and backoff.

For the case of MSS performing unsolicited location update when the MSS detects that it enters a new paging group, we introduce a reserved ranging code set for location update. This is in addition to the currently defined code sets for initial ranging, periodic ranging, and bandwidth request.

3 Proposed Text Changes

[Modify Table 92k – BS Broadcast Paging (MOB_PAG_ADV) message format by adding the assigned ranging channel index and code index.]

Table 92k – BS Broadcast Paging (MOB_PAG-ADV) message format

Syntax	Size	Notes
MOB_PAG_ADV_Message_Format() {		
Management Message Type	8 bits	
Num_Paging_Group_IDs	8 bits	
For (i=0;i< Num_Paging_Group_IDs;i++) {		
Paging_Group_ID	8 bits	
}		
Num_MACs	8 bits	
For (j=0;j< Num_MACs;j++) {		
~~MSS MAC Address hash~~ Idle_ID	24 bits	~~The hash is obtained by computing a CRC24 on the MSS 48 bit MAC address. The polynomial for the calculation is 0x864CFB~~ ID uniquely identify a MSS in Idle Mode
Action Code	2	
If (Action Code == 01 || Action Code == 10) {		
Ranging_Sub-channel_Index	6	Index to the ranging sub-channel
Ranging Code_Index	6	Index to the ranging code
}		
reserved	*variable*	Padding bits to ensure octet aligned
}		
}		

Idle_ID

This is an ID assigned to a MSS entering the Idle Mode. It uniquely identify a MSS in Idle Mode

Ranging sub-channel index

Index to the ranging sub-channel assigned to the MSS to perform network entry or location update

Ranging Code index

Index to the ranging code assigned to the MSS to perform network entry or location update

[Modify the following text in section 6.3.21.8.1 to describe enhanced paging procedure]

An MSS shall terminate Idle Mode and re-enter the network if it decodes a BS Broadcast Paging message that contains the MSS own MSS ~~MAC Address hash~~ Idle_ID and an Action Code of 10, enter network. The MSS shall perform initial ranging using the assigned ranging sub-channel and code in MOB_PAG_ADV. In the event that an MSS decodes a BS Broadcast Paging message that contains the MSS own MSS ~~MAC Address hash~~ Idle_ID and an Action Code of 01, Perform Ranging, the MSS shall conduct and complete Initial Ranging to establish location to the network and acknowledge message decoding. The MSS shall perform initial ranging using the assigned ranging sub-channel and code in MOB_PAG_ADV. Once the MSS receives a RNG_RSP with 'State = Success', the MSS shall send the Location Update (LU) MAC Header to the BS on the assigned UL resource. Similarly, the MSS shall conduct and complete Initial Ranging to establish location to the network and acknowledge message decoding in the event that it fails to find the MSS own Paging Group ID in the Broadcast Paging message. In this case, the MSS shall randomly select a location update ranging code within the location update code domain defined in UCD. Once the MSS receives a RNG_RSP with 'State = Success', the MSS shall send the Location Update (LU) MAC Header to the BS on the assigned UL resource. In either instance of required Initial Ranging, upon completion of the Ranging procedure the MSS shall assume the Paging Group ID of the Preferred BS.

[Add the following paragraph to section 6.3.21.8.2 to describe enhanced paging procedure]

After the BS sends a MOB_PAG_ADV to the MSS with action code set to either '01' or '10', the BS shall monitor the ranging sub-channel and code assigned to the MSS for initial ranging signal. Once the ranging is successful, and the BS detects the LU MAC Header from the MSS, the BS shall send a LU_RSP_IE() to the MSS to acknowledge the reception of LU MAC Header.

[*Add Section 6.3.2.1. 4 to describe the location update (LU) MAC header format*]

6.3.2.1.4. Location Update Header

The location update PDU shall consist of location update (LU) header alone and shall not contain a payload. The location update header is illustrated in Figure XX.

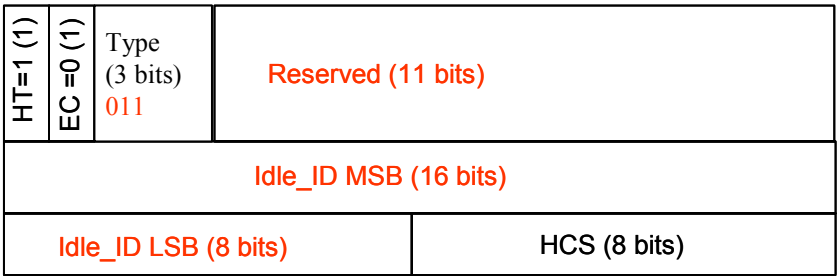

Figure XX. Location Update header format.

The TYPE field shall be set as '011' to indicate that this is a location update header and no payload attached. Idle_ID field (24 bits) is the Idle_ID assigned to a MSS when the MSS enters Idle Mode.

An MSS receiving a Location Update Header on the downlink shall discard the PDU.

[*Add Section 8.4.5.3.8 to describe the location update response IE.]*

8.4.5.3.8 Location Update Response IE (UL_RSP_IE) format

In the DL_MAP, BS shall transmit DIUC = 15 with the LU_RSP_IE() to acknowledge the decoding of UL location update header.

Table XX. Location update response IE (UL_Rsp_IE).

Syntax	Size	Notes
LU_Res_IE() {		
Extended DIUC	4	
Length	4	
Num_RSP	4	
For (i = 0; i<Num_Rsp; i++) {		
Idle_ID }}	24 bits	Used in LU MAC header