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Re:	IEEE 802.16j-07/007r2: " Call for Technical Comments and Contributions regarding IEEE Project 802.16j"
Abstract	This contribution describes the MS's Idle mode in non-transparent relay system.
Purpose	This contribution is submitted for discussion and adoption in 802.16j.
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# MS Idle Mode in Relay System

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## 1 Introduction

In response to the IEEE 802.16j TG Call for Technical Contributions, this document proposes a MAC procedure in order to support MS Idle Mode in non-transparent relay systems.

## 2 Proposed Procedure

### 2.1 Assumptions

RSs and their serving MR-BS belong to the same paging group.

Each frame sent by MR-BS and RS are synchronized.

### 2.2 MS Idle Mode Initiation

The intermediate RS will relay the DREG-REQ/CMD message between the MR-BS and MS.

**DPF:** Data Path Function  
**IMRI:** Idle Mode Retain Info  
**Paging Info:** Includes PGID, Paging Cycle, Paging Offset  
**MHST:** MAC Hash Skip Threshold

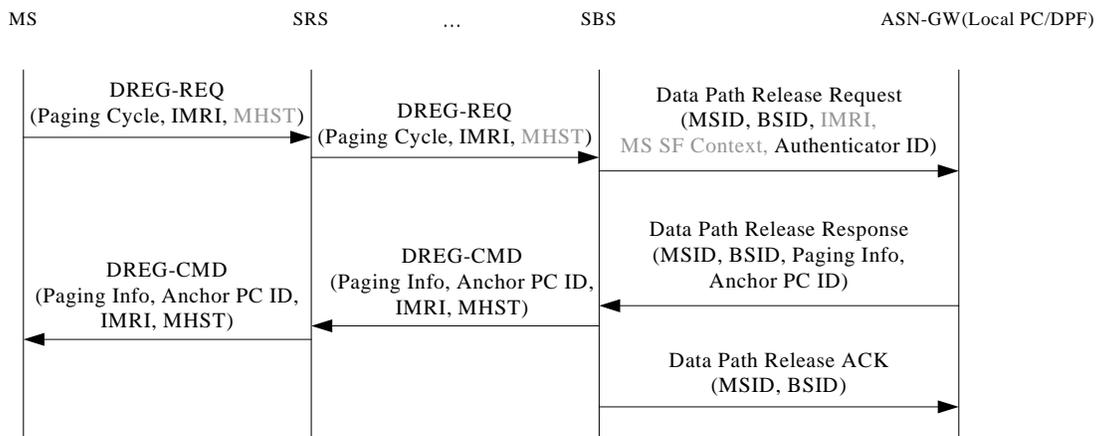


Figure 1 MS Idle Mode Initiation

### 2.3 MS Network Re-entry from Idle Mode

The intermediate RS will relay the RNG-REQ/RSP message between the MR-BS and MS.

**PA:** Paging Agent  
**LU:** Location Update  
**Auth Ind:** Authentication Indication [ ] Indicates whether or not the BS has security information for verifying authenticated RNG-REQ  
**Power Down Ind:** Power Down Indication

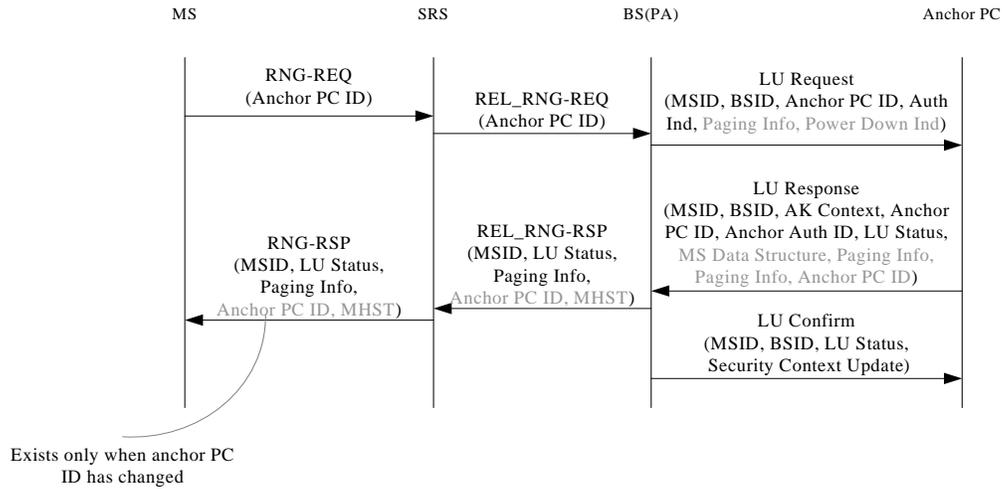


Figure 2 MS Network Re-entry from Idle Mode

## 2.4 MS Location Update

The intermediate RS will relay the RNG-REQ/RSP message between the MR-BS and MS.

**DPF:** Data Path Function  
**IMRI:** Idle Mode Retain Info  
**Paging Info:** Includes PGID, Paging Cycle, Paging Offset

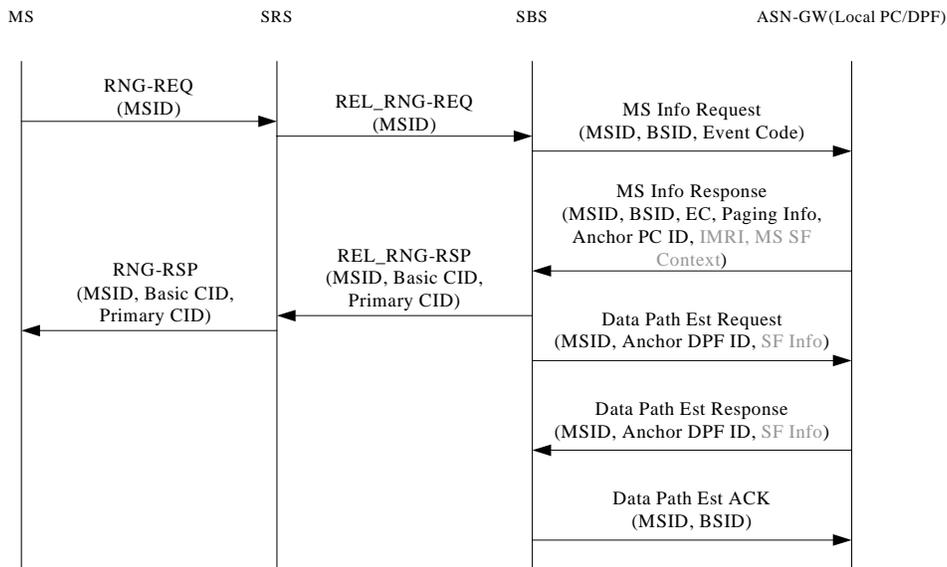


Figure 3 MS Location update

## 2.5 Paging

When a paging is need to some MS's in a Paging Group, RSs belonging to the Paging Group shall be involved to transmit MOB\_PAG-ADV to the MSs. The MOB\_PAG-ADV message shall be transmitted by MR-BS to RSs in a relay link. When MR-BS need to transmit MOB\_PAG-ADV message to RSs, MR-BS shall include Paging Interval information and RS frame offset, etc. So RSs can transmit the MOB\_PAG-ADV in MS Paging Listening Interval on its own scheduling.

When a RS receives MOB\_PAG-ADV message from MR-BS or its upstream RS in the relay link, the RS shall forward the message to its subordinate RSs in the relay link.

A RS may broadcast one or more Broadcast Paging messages during the MS Paging Listening Interval in the access link. In order to enable this function, a Paging Interval TLV defined in 11.17.4 shall be included in the MOB\_PAG-ADV message transmitted in the relay link. This TLV informs RS the Paging Listening Interval for each paged MS.

When a RS received MOB\_PAG-ADV message including the Paging Interval TLV in the relay link, the RS shall reconstruct the MOB\_PAG-ADV message by extracting the Paging Interval TLV and optional include the TLVs defined in 11.17.1 and 11.17.2 of 802.16e2005, and transmit the reconstructed message in MS Paging Listening Interval in the access link.

After transmitting the Broadcast Paging message with Action Code 'Perform Ranging' or 'Enter Network', if the RS does not receive RNG-REQ from the MS paged until the next MS Paging Listening Interval, the RS shall retransmit the Broadcast Paging message. Every time the RS retransmits the Broadcast Paging message, it decreases the predefined "Paging Retry Count" by one.

When a RS receives the RNG-REQ for location updating or network reentry, it shall stop sending MOB\_PAG-ADV messages and shall relay the RNG-REQ to the MR-BS. When intermediate RSs receive the relayed RNG-REQ message they shall cease sending MOB\_PAG-ADV messages. If the MR-BS has not received the RNG-REQ from its subordinate MS or relayed RNG-REQ from its subordinate RS after the paging retry count decrease to zero, the MR-BS shall startup a new waiting timer, which is based on the transmission delay from the last hop RS to the MR-BS. If the RNG-REQ is not received after the expiration of the timer, the MR-BS regards the MS to be unavailable.

When the MR-BS receives the paging announce from PC, the MR-BS shall send the MS's paging information (including paging cycle, paging offset) to both subordinate transparent and non-transparent RSs using a new TLV in the MOB\_PAG-ADV message. In the MOB\_PAG-ADV message sent to a transparent RS, the MR-BS should include the TLVs defined in 11.17 of 802.16e2005. Intermediate RSs shall forward the MOB\_PAG-ADV messages.

Both transparent and non-transparent RSs shall send the MOB\_PAG-ADV message in the MS paging listening interval according to the information received in the MOB\_PAG-ADV message. The non-transparent RS should generate and include the TLVs defined in 11.17.

When a RS receives the RNG-REQ for location updating or network reentry, it shall stop sending MOB\_PAG-ADV messages and shall relay the RNG-REQ to the MR-BS. When intermediate RSs receive the relayed RNG-REQ message they shall cease sending MOB\_PAG-ADV messages. If the MR-BS has not received the RNG-REQ from its subordinate MS or relayed RNG-REQ from its subordinate RS after the paging retry count decrease to zero, the MR-BS shall startup a new waiting timer, which is based on the transmission delay from the last hop RS to the MR-BS. If the RNG-REQ is not received after the expiration of the timer, the MR-BS regards the MS to be unavailable.

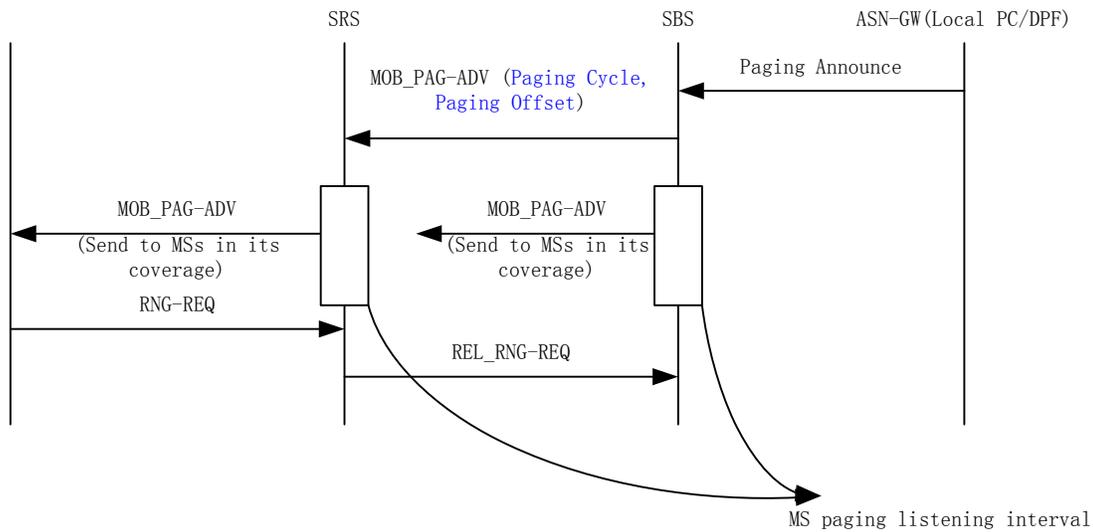


Figure 4 Paging

### 3 Text Proposal

~~[Insert new subclause 6.3.24.12]~~

#### 6.3.24.12\_ MS Idle Mode ~~in Relay system~~

~~[Insert the following text after the last paragraph:]~~

~~In the MMR-cell, Each each~~ frame sent by MR-BS and RSs are synchronized.

#### 6.3.24.12\_1 MS Idle Mode Initiation

~~[Insert the following text after the last paragraph:]~~

~~In the MMR-cell,~~

~~MS follow the procedure defined in 6.3.24.1 to enter the idle mode. The the~~ intermediate RS will relay the DREG-REQ/CMD message between the MR-BS and MS.

#### 6.3.24.12.2 MS Network Re-entry from Idle Mode

~~MS follow the procedure defined in 6.3.24.9 to exit the idle mode. The intermediate RS will relay the RNG-REQ/RSP message between the MR-BS and MS.~~

#### 6.3.24.12.3 MS Location Update

~~MS follow the procedure defined in 6.3.24.8 to perform the location update. The intermediate RS will relay the RNG-REQ/RSP message between the MR-BS and MS.~~

### 6.3.24.4-1 RS Broadcast Paging message

*[Insert the following text after the first paragraph:]*

When a RS receives MOB\_PAG-ADV message from MR-BS or its upstream RS in the relay link, the RS shall forward the message to its subordinate RSs in the relay link. As described in 6.3.24.5, the transmission time shall be compensated based on the processing delay in each RSs.

A RS may broadcast one or more Broadcast Paging messages during the MS Paging Listening Interval in the access link. In order to enable this function, a Paging Interval TLV defined in 11.17.4 shall be included in the MOB\_PAG-ADV message transmitted in the relay link. This TLV informs RS the Paging Listening Interval for each paged MS.

When a RS received MOB\_PAG-ADV message including the Paging Interval TLV in the relay link, the RS shall reconstruct the MOB\_PAG-ADV message by extracting the Paging Interval TLV and optional include the TLVs defined in 11.17.1 and 11.17.2 of 802.16e2005, and transmit the reconstructed message in MS Paging Listening Interval in the access link.

After transmitting the Broadcast Paging message with Action Code 'Perform Ranging' or 'Enter Network', if the RS does not receive RNG-REQ from the MS paged until the next MS Paging Listening Interval, the RS shall retransmit the Broadcast Paging message. Every time the RS retransmits the Broadcast Paging message, it decreases the predefined "Paging Retry Count" by one.

When a RS receives the RNG-REQ for location updating or network reentry, it shall stop sending MOB\_PAG-ADV messages and shall relay the RNG-REQ to the MR-BS. When intermediate RSs receive the relayed RNG-REQ message they shall cease sending MOB\_PAG-ADV messages. If the MR-BS has not received the RNG-REQ from its subordinate MS or relayed RNG-REQ from its subordinate RS after the paging retry count decrease to zero, the MR-BS shall startup a new waiting timer, which is based on the transmission delay from the last hop RS to the MR-BS. If the RNG-REQ is not received after the expiration of the timer, the MR-BS regards the MS to be unavailable.

When the MR-BS receives the paging announce from PG, the MR-BS shall send the MS's paging information (including paging cycle, paging offset) to both subordinate transparent and non-transparent RSs using a new TLV in the MOB\_PAG-ADV message. In the MOB\_PAG-ADV message sent to a transparent RS, the MR-BS should include the TLVs defined in 11.17 of 802.16e2005. Intermediate RSs shall forward the MOB\_PAG-ADV messages. As described in 6.3.24.5, the transmission time shall be compensated based on the processing delay in intermediate RSs to make sure all the idle-mode MSs which have same PLI within same paging group shall receive the MOB\_PAG-ADV at the same time.

Both transparent and non-transparent RSs shall send the MOB\_PAG-ADV message in the MS paging listening interval according to the information received in the MOB\_PAG-ADV message. The non-transparent RS should generate and include the TLVs defined in 11.17.

When a RS receives the RNG-REQ for location updating or network reentry, it shall stop sending MOB\_PAG-ADV messages and shall relay the RNG-REQ to the MR-BS. When intermediate RSs receive the relayed RNG-REQ message they shall cease sending MOB\_PAG-ADV messages. If the MR-BS has not received the RNG-REQ from its subordinate MS or relayed RNG-REQ from its subordinate RS after the paging retry count decrease to zero, the MR-BS shall startup a new waiting timer, which is based on the transmission delay from the last hop RS to the MR-BS. If the RNG-REQ is not received after the expiration of the timer, the MR-BS regards the MS to be unavailable.

### 6.3.24.8.2 Location Update Process

*[Insert the following text after the second paragraph:]*

In the MMR-cell, the intermediate RS will relay the RNG-REQ/RSP message between the MR-BS and MS.

#### 6.3.24.9 Network Re-entry from Idle Mode

*[Insert the following text after the last paragraph:]*

In the MMR-cell, the intermediate RS will relay the RNG-REQ/RSP message between the MR-BS and MS.

*[Insert new subclause 11.17.4]*

#### 11.7.4 Paging Interval

The 'Paging Interval' field indicates the assigned paging listening interval for each MS who is paged.

<u>Type</u>	<u>Length (bits)</u>	<u>Value</u>	<u>Scope</u>
<u>XXX</u>	<u>Variable;</u> <u>Num_MACs * 24</u>	<u>Subsequent (Num_MACs * 24) bits:</u> <u>For (i = 0, i &lt; Num_MACs, i++) {</u> <u>    <u>16 bits - PAGING_CYCLE for the paged MS.</u></u> <u>    <u>8 bits - PAGING OFFSET for the paged MS.</u></u> <u>}</u>	<u>MOB_PAG-ADV</u> <u>In Relay link</u>