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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
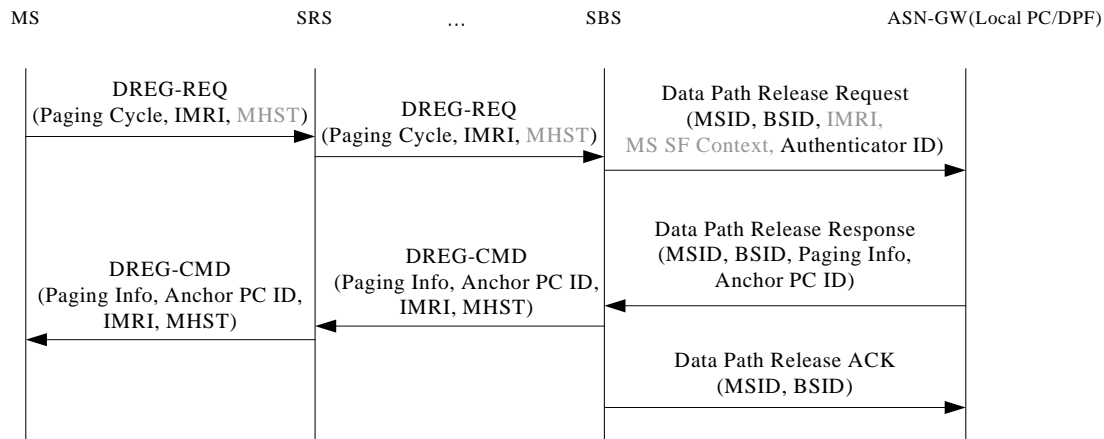**MHST:** MAC Hash Skip Threshold

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

MS   SRS   BS(PA)   Anchor PC

RNG-REQ
(Anchor PC ID)
          REL_RNG-REQ
          (Anchor PC ID)

LU Request
(MSID, BSID, Anchor PC ID, Auth
Ind, Paging Info, Power Down Ind)

LU Response
(MSID, BSID, AK Context, Anchor
PC ID, Anchor Auth ID, LU Status,
MS Data Structure, Paging Info,
Paging Info, Anchor PC ID)

RNG-RSP
(MSID, LU Status,
Paging Info,
Anchor PC ID, MHST)

REL_RNG-RSP
(MSID, LU Status,
Paging Info,
Anchor PC ID, MHST)

LU Confirm
(MSID, BSID, LU Status,
Security Context Update)

Exists only when anchor PC
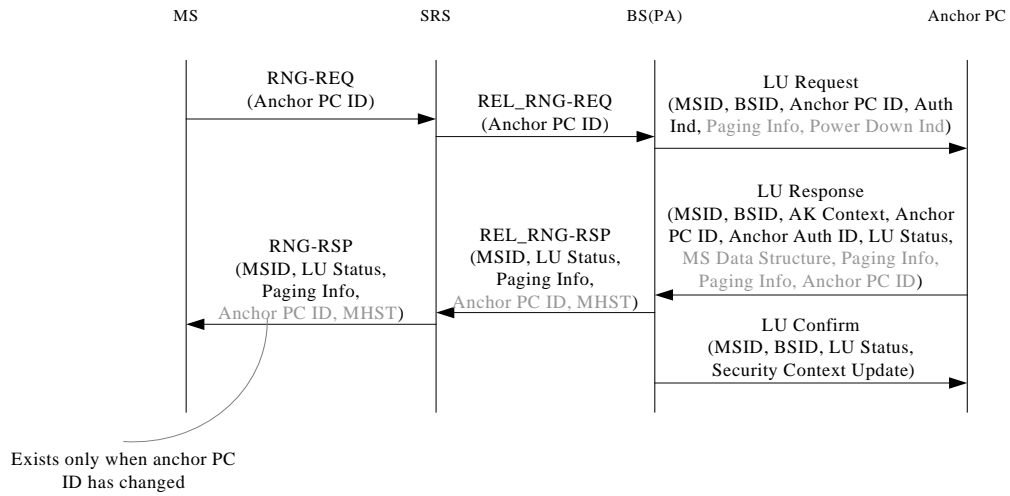ID has changed

Figure 2 MS Network Re-entry from Idle Mode

2.4 MS Location Update

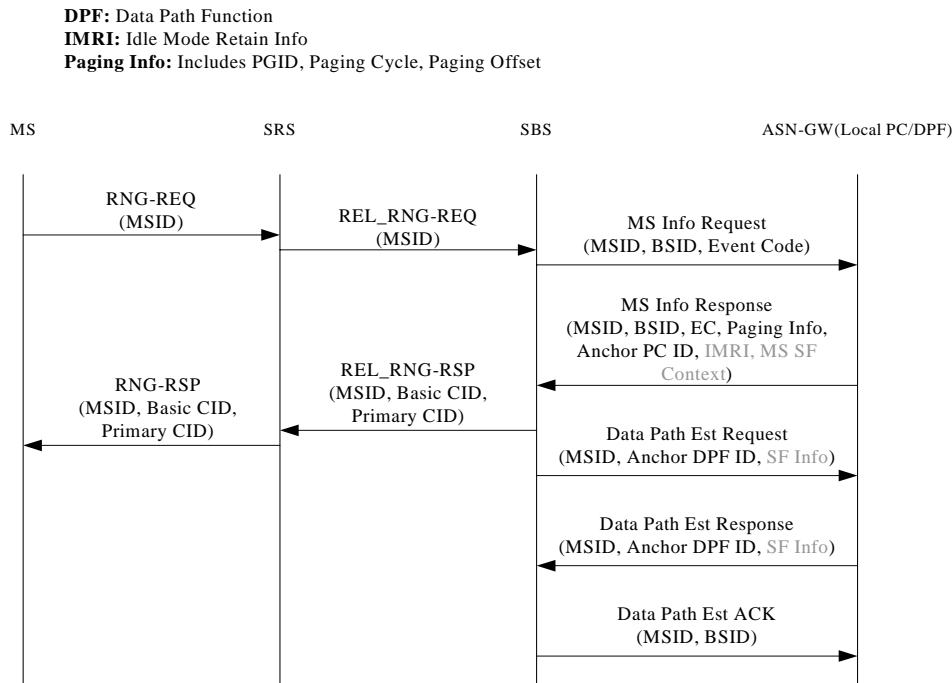The intermediate RS will relay the RNG-REQ/RSP message between the MR-BS and MS.

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

| MS | SRS | SBS | ASN-GW(Local PC/DPF) |

RNG-REQ
(MSID)

REL_RNG-REQ
(MSID)

MS Info Request
(MSID, BSID, Event Code)

MS Info Response
(MSID, BSID, EC, Paging Info,
Anchor PC ID, IMRI, MS SF
Context)

RNG-RSP
(MSID, Basic CID,
Primary CID)

REL_RNG-RSP
(MSID, Basic CID,
Primary CID)

Data Path Est Request
(MSID, Anchor DPF ID, SF Info)

Data Path Est Response
(MSID, Anchor DPF ID, SF Info)

Data Path Est ACK
(MSID, BSID)

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 removing 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.

In order to optimize the retransmission times and the MR-BS waiting time, a "PLI Count" indication bits may be included in the MOB_PAG-ADV message send to RS, which is described in 6.3.2.3.56. These bits can tell the RS how many times the MOB_PAG-ADV message has been transmitted/retransmitted by MR-BS at current message receiving point. The RS can determine its own paging retransmission times according to the "PLI Count" and the "Paging Retry Count" defined in Table 342 of 802.16e2005. So stations in MR-cell can stop the paging at the same time if no one received RNG-RSP message

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from MS.

When a RS relay the MOB_PAG-ADV message to its subordinate RSs, the "PLI Count" bits may be modified so as to synchronize with MR-BS.

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.

When a RS receives RNG-REQ from MS or relayed RNG-REQ from its subordinate RS, it may generate and send a MOB_PAG-ADV with paging stop command to its subordinate RSs except the one who relayed RNG-REQ message. When a RS received the MOB_PAG-ADV with paging stop command, it shall stop sending MOB_PAG-ADV message, and relay the paging stop command to its subordinate RSs. The paging stop command is fulfilled by setting the 'Stop Paging' bit in MOB_PAG-ADV described in 6.3.2.3.56.

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.
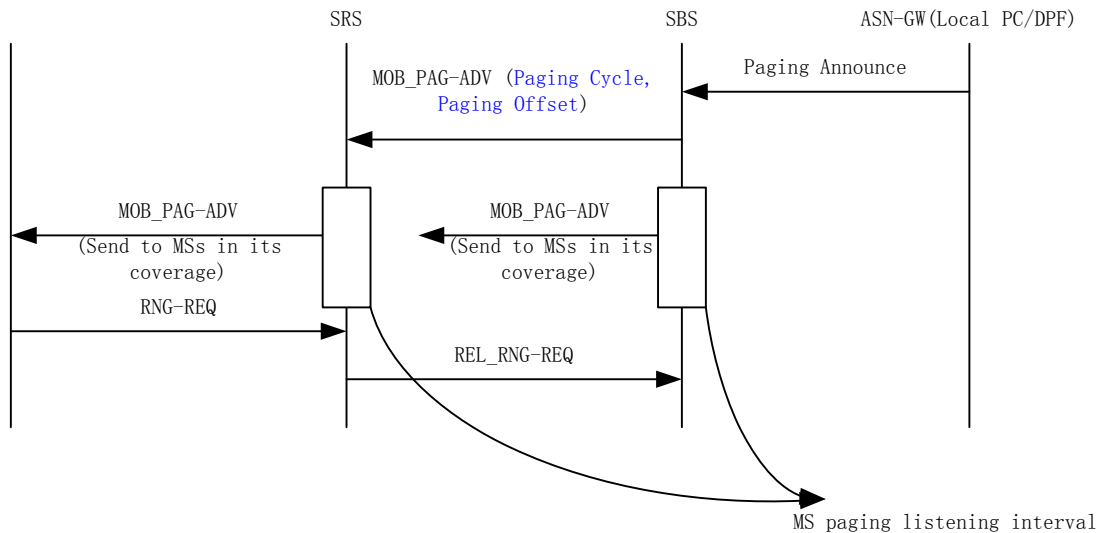

Figure 4 Paging

3 Text Proposal

6.3.24 MS Idle Mode

[Insert the following text after the last paragraph:]

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

6.3.24.1 MS Idle Mode Initiation

[Insert the following text after the last paragraph:]

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

6.3.24.6.1 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 removing the Paging Interval TLV and optionally 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.

In order to let each RS's paging retry count decrease to zero at the same time with MR-BS, a "PLI Count" indication field shall be included in the MOB_PAG-ADV message transmitted in the relay link, which is described in 6.3.2.3.56. This field is used for indicating the RS how many PLI has been elapsed since the first time MR-BS sending out the MOB_PAG-ADV message. That is equal to the value that the Paging Retry Count of MR-BS has been decreased. The RS will determine its own paging retry count according to the "PLI Count" and the "Paging Retry Count" of MR-BS defined in Table 342 of 802.16e2005.

When a RS relay the MOB_PAG-ADV message to its subordinate RSs, the "PLI Count" value shall be increased by one if the receiving RS will miss one more PLI.

When a RS receives the RNG-REQ for location updating or network reentry, it shall relay the RNG-REQ to the MR-BS, and stop sending Broadcast Paging message messages. At the same time, it shall generate and send paging stop command to its subordinate RSs who is still sending the broadcast paging message. The paging stop command is fulfilled by setting the 'Stop Paging' bit in MOB_PAG-ADV described in 6.3.2.3.56. When a RS receives the paging stop command, it shall stop sending Broadcast Paging message, and relay the paging stop command to its subordinate RSs who is still sending the Broadcast Paging message.

When intermediate RSs receive the relayed RNG-REQ message, they shall stop sending Broadcast Paging messages. At the same time, it shall generate and send a MOB_PAG-ADV with paging stop command to its subordinate RSs who is still sending the Broadcast Paging message.

When a MR-BS receives the RNG-REQ, it shall stop sending Broadcast Paging message messages. It shall generate and send paging stop command to its subordinate RSs who is still sending the broadcast paging message.

When a MR-BS receives paging stop announcement from paging controller, the MR-BS shall generate and send paging stop command to its subordinate RSs who is still sending the broadcast paging message.

If MR-BS has not received the RNG-REQ 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 seond 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.

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

[Change the subclause 6.3.2.3.56]

6.3.2.3.56 BS/RS Broadcast Paging (MOB_PAG-ADV) message

[Change the Tabel 109p]

Table 109p—BS/RS Broadcast Paging (MOB_PAG-ADV) message format

Syntax	Size	Notes
MOB_PAG-ADV_Message_format() {	—	—
Management Message Type=62	8 bits	—
Num_Paging_Group_IDs	16 bits	Number of Paging Group IDs in this message
For (i=0; i<Num_Paging_Group_IDs; i++) {	—	—

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Paging Group ID	16 bits	—
}	—	—
Num_MACs	8 bits	Number of MS MAC addresses
For (j=0; j<Num_MACs; j++) {	—	—
MS MAC Address hash	24 bits	The hash is obtained by computing a CRC24 on the MS 48-bit MAC address. The polynomial for the calculation is 0x1864CFB
Action Code	2 bits	Paging action instruction to MS 0b00=No Action Required 0b01=Perform Ranging to establish location and acknowledge message 0b10=Enter Network 0b11=Reserved
Stop Paging	1 bit	0b0= paging start command 0b1= paging stop command
PLI Count	3 bits	The number that PLI has been elapsed since the first time MR-BS sending out the MOB_PAG-ADV message
Reserved	2 bits	—
}	—	—
padding	variable	Padding bits to ensure octet aligned
TLV Encoded Information	variable	TLV specific
}	—	—

[Insert the following text at the end of the third paragraph:]

Stop Paging

When this bit is set to 1, the RS shall stop sending Broadcast Paging message.

Paged Count

This field indicates the number that PLI has been elapsed since the first time MR-BS sending out the MOB_PAG-ADV message. That is equal to the value that the Paging Retry Count of MR-BS has been decreased. The RS will determine its own paging retry count according to the "PLI Count" and the "Paging Retry Count" of MR-BS. When a RS relay the MOB_PAG-ADV message to its subordinate RSs, the "PLI Count" value shall be increased by one if the receiving RS will miss one more PLI.

[Insert the following text at the end of the last paragraph:]

Paging Interval (11.7.4)

This TLV informs RS the Paging Listening Interval for each paged MS, including paging cycle and paging offset.