Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	A proposal for timing compensation of idle mode in MR
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Re:	IEEE802.16j-06/034: "Call for Technical Proposals regarding IEEEP802.16j"
Abstract	This contribution proposes the method of timing compensation for idle mode.
Purpose	Text proposal for 802.16j Baseline Document
Notice	
Release	
Patent Policy and Procedures	

incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

A proposal for timing compensation of idle mode in MR

[*This contribution propose a harmonization text proposal on Idle Mode in MR*]

Introduction

This contribution proposes a method of timing compensation for timing-related control function, such idle mode. In 802.16e specification, several messages such as MOB_PAG-ADV are received at the pre-notified timing. However, in a non-transparent RS system[1], the message processing delay in RS makes it hard to fulfill that reception timing requirement. In order for MS to receive messages at the pre-notified timing, MR-BS compensates the timing when MS can receive messages with taking account of RS processing delay.

Details

In this proposed method, based on the following assumptions:

- The MR system is a non-transparent RS system[1].

- The RS can not relay message and data within the current frame. The message is delayed for fixed duration on account of relay processing in the RS.

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

Timing compensation for idle mode

As shown in Fig. 1, MS enters idle mode by receiving DREG-CMD message involving "PAGING_OFFSET" parameter from MR-BS. F_B, the beginning frame of Paging Listening Interval (PLI), is decided by condition defined in section 6.3.24.5.

According to the above assumption, the frame number in MR-BS and RS are same, both F_B decided by MR-BS and MS indicate same frame. So, timing of PLI managed in both MR-BS and MS are synchronized absolutely.

However, MOB_PAG-ADV message sent from MR-BS will delay of "D_R" in RS, it is received at MS D_R frame later. Therefore, it depends on the length of PLI and the timing of that MOB_PAG-ADV message is sent from MR-BS, MOB_PAG-ADV message does not reach within PLI of MS and MS fails to receive the message.
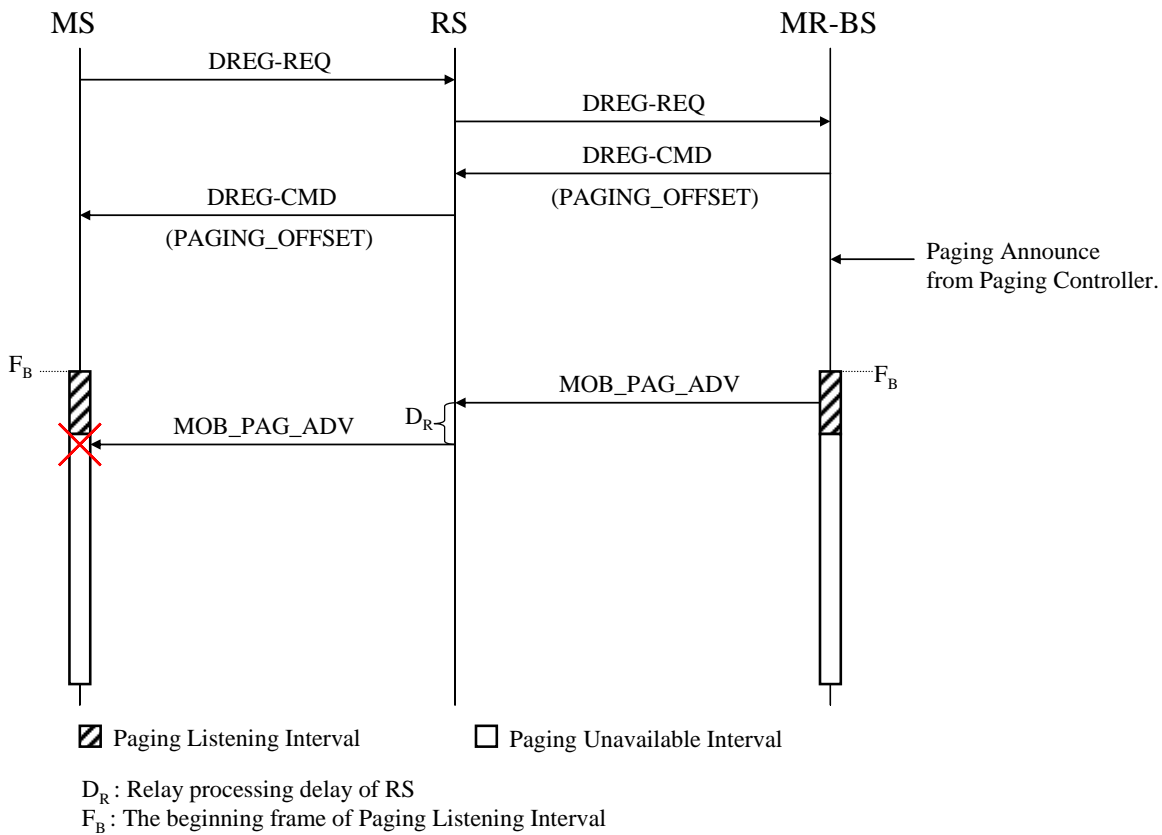
Fig. 1 PLI slipping problem of idle mode in MR

To avoid this problem, the timing of PLI managed in MR-BS and MS should be compensated. Proposed method is shown in Fig. 2.

When MR-BS receives DREG-REQ message and decides PAGING_OFFSET, MR-BS decides normal PAGING_OFFSET value using regular condition at first. MR-BS notifies MS of the beginning timing of PLI with this normal value. Then, MR-BS also decides modified PAGING_OFFSET value for itself. Modified value will be decided that the PLI managed internally in MR-BS is just shifted D_R earlier from the PLI of MS.

With this compensation method, MOB_PAG-ADV sent over the R-DL at any frame within PLI managed in MR-BS is received successfully within MS's PLI via RS relaying.

In order to decide the modified PAGING_OFFSET value in MR-BS, MR-BS needs to know D_R of RS. The value of D_R will be given to the MR-BS as a capability parameter of SBC-REQ message.
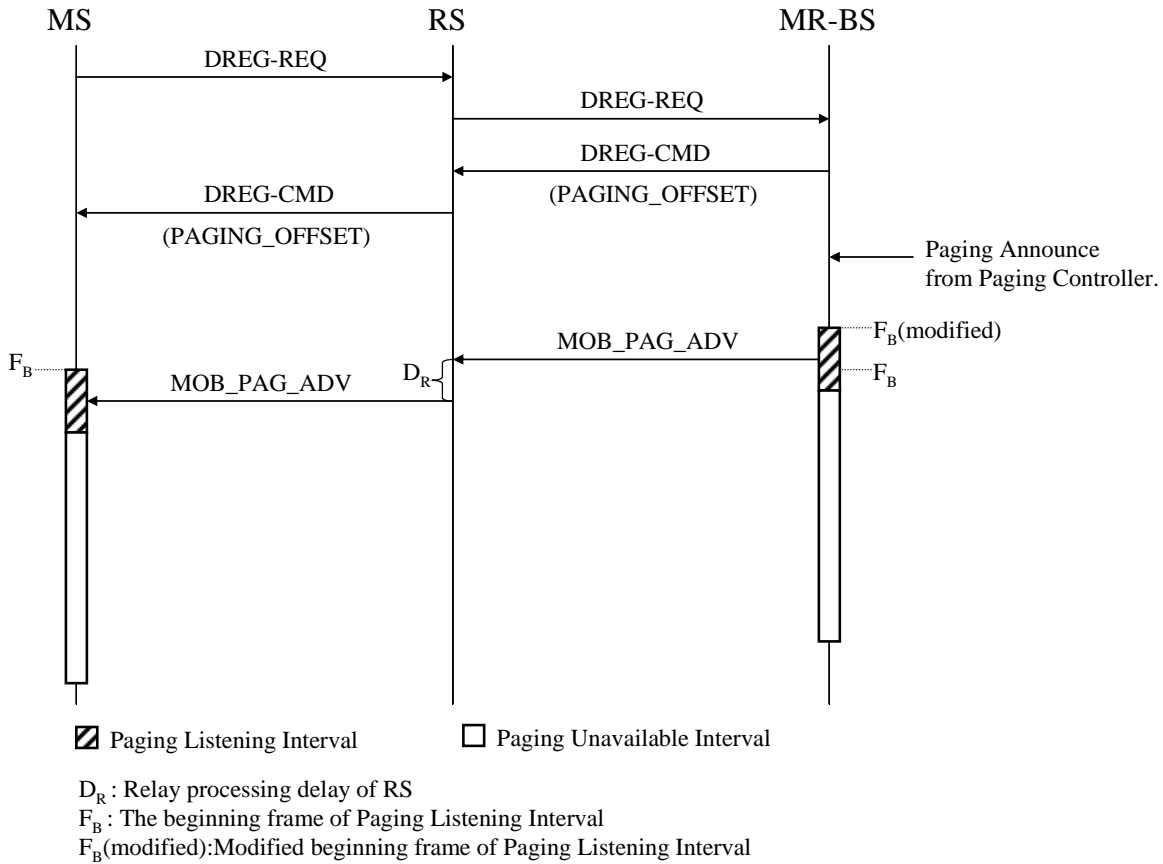
Fig. 2 Compensation for timing of PLI

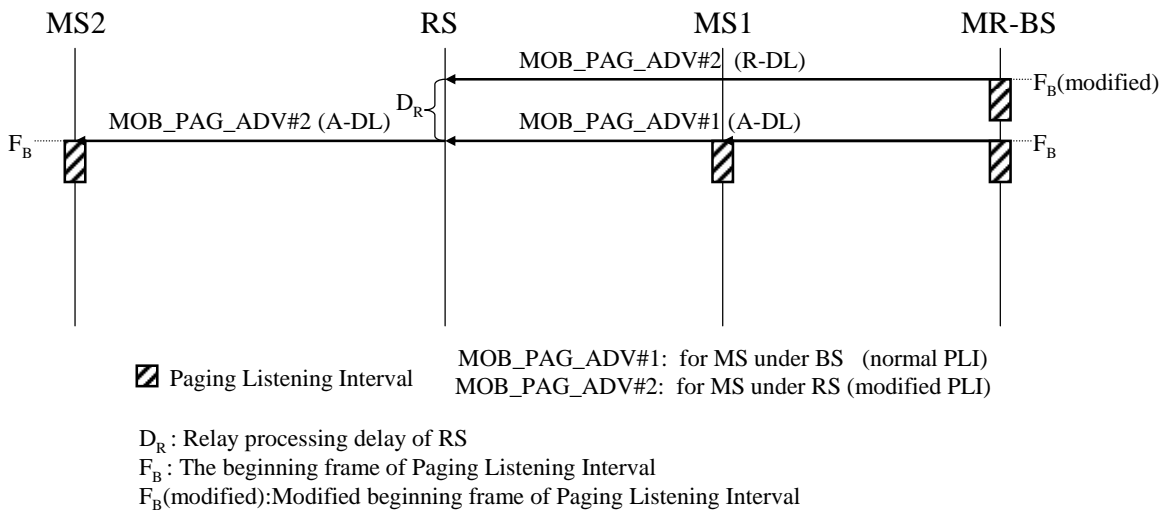Consider the case the MS moves across the areas of MR-BS and RS during the idle mode.

Fig. 3 MS under the MR-BS and RS

As shown in Fig. 3, MS1 entered idle mode under MR-BS and MS2 entered idle mode under RS. MR-BS can't recognize the location of each MS1 and MS2 because of idle mode. Both MS1 and MS2 are

managing normal PLI timing, and MR-BS are managing normal PLI timing for MS1 and modified PLI timing for MS2.

In order for both MSs to receive MOB_PAG-ADV, MR-BS shall send both MOB_PAG-ADV#1 for normal PLI over the access link and MOB_PAG-ADV#2 for modified PLI over the relay link.

Note that RS doesn't receive MOB_PAG-ADV#1 because it is sent over the access link. RS relays only MOB_PAG-ADV#2.

Consider the case that there are multiple RSs existing with different processing delay performance and hop counts between the MR-BS and MS, as shown in Fig. 4.

In this case, the MR-BS calculates the cumulative processing delay "D_C" of each path between the MR-BS and the MS, then finds the maximum of "D_C", which is "D_M". As shown in Fig. 4, the cumulative delay "D_C" is equal to $D_{R1}+D_{R2}$. And also the maximum "D_M" is $D_{R1}+D_{R2}$. The MR-BS decides modified beginning frame of PLI for itself with "D_M". Then MR-BS examine the waiting time "W" for each RS. In this case, RS1 needs to wait "W_1", which is $D_M - D_{R1}$ between finishing relay processing and sending MOB_PAG-ADV over access link. Such the waiting time will be notified in SBC-RSP message.

The MR-BS sends MOB_PAG-ADV over the R-DL as a pre-transmission D_M frame earlier than the normal MOB_PAG-ADV transmission over access link. The MR-BS shall waiting for D_M frames, and the RS which is notified waiting time by the MR-BS shall waiting for W frames, and then sends MOB-PAG-ADV data again over the access link.

If the MR-BS detects that the waiting time for some RS needs to be changed, MR-BS may send unsolicited SBC-RSP message and notifies RS which needs to change the waiting time of it.

D_R : Relay processing delay of RS
D_M : Maximum cumulative Relay processing delay
W_1 : Wait for access link transmission of RS1
F_B : The beginning frame of Paging Listening Interval
F_B(modified):Modified beginning frame of Paging Listening Interval

Fig. 4 Compensation for timing of PLI over multiple RSs

Conclusion

According to this compensation method, the MOB_PAG-ADV messages are surely delivered from MR-BS to MS through RS relaying.

Specific text changes

[Insert the following text at the end of 6.3.24.5:]

For MR, all the idle-mode MSs within same paging group shall receive the MOB_PAG-ADV at the same time. The RS delay, D_R, is given to MR-BS as a capability parameter of SBC-REQ message. MR-BS sends MOB_PAG-ADV over the R-DL as a pre-transmission D_R frame earlier than the normal MOB_PAG-ADV transmission time. MR-BS shall wait for D_R frames, and then sends MOB-PAG-ADV data again over the access link.

If multiple RSs with different delay performance existing, MR-BS shall firstly examine the cumulative processing delay "D_C" of each path between the MR-BS and the MS, then finds the maximum of "D_C", which is "D_M". The MR-BS decides modified beginning frame of PLI for itself with "D_M". Then MR-BS examine the waiting time "W" for each RS. Such the waiting time will be notified in SBC-RSP message. The MR-BS sends MOB_PAG-ADV over the R-DL as a pre-transmission D_M frame earlier than the normal MOB_PAG-ADV transmission over access link. The MR-BS shall wait for D_M frames, and the RS which is notified waiting time by the MR-BS shall wait for W frames, and then sends MOB-PAG-ADV again over the access link.

If the MR-BS detects that the waiting time for some RS needs to be changed, MR-BS may send unsolicited SBC-RSP message and notifies RS which needs to change the waiting time of it.
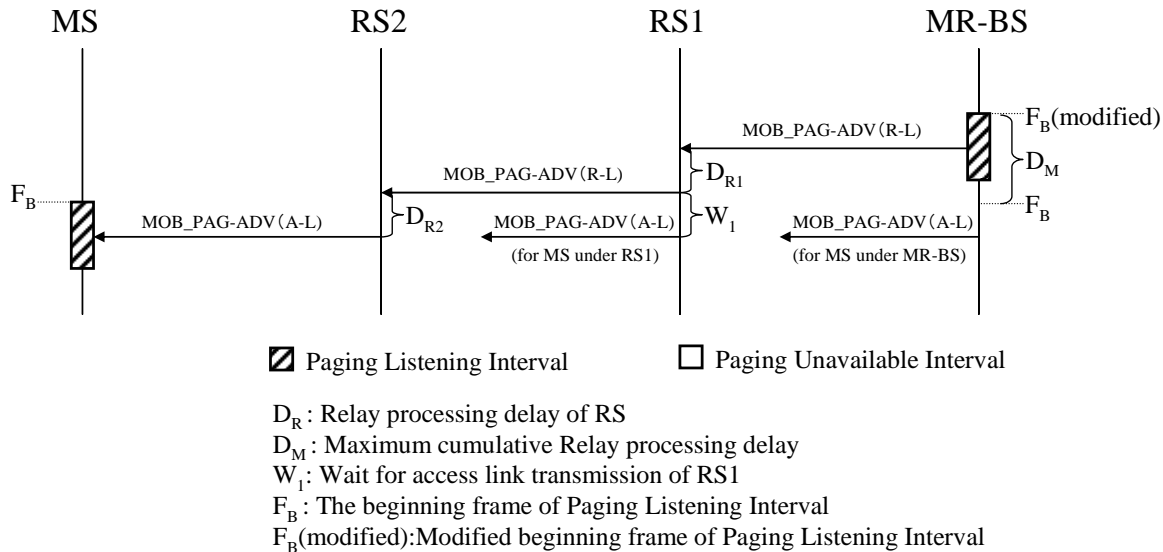
[Insert new subclause 11.8.3.7:]

11.8.3.7.X RS Downlink Processing Delay

Type	Length	Value	Scope
TBA	1	RS Downlink Processing Delay (unit: frame)	SBC-REQ

11.8.3.7.X RS waiting time for Paging

Type	Length	Value	Scope
TBA	1	RS waiting time for Paging (unit: frame)	SBC-RSP

References

[1] IEEE C802.16j-06/132, "Relaying methods proposal for 802.16j"