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Re:	This is a response to Call for Technical Proposals regarding IEEE Project P802.16j.
Abstract	This document proposes RS-initiated handover procedures and related messages for an RS which can support handover initiation, but cannot support handover process and decision in an IEEE 802.16j network.
Purpose	The document is submitted for review by 802.16 Working Group members.
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Patent Policy and Procedures	

RS-initiated Handover Procedure for Handover-unmanageable RS
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1 Introduction

This contribution covers the issues related to MAC layer handover procedures defined in Table of Contents of Task Group Working Document [1]. In this proposal, we describe the needs for RS-initiated handover. We also present RS-initiated handover procedures and related messages for an RS which can support handover initiation, but cannot support handover process and decision.

1.1 RS Types

In an MMR network, an RS has various features according to its target service and vendor requirements. Handover procedure and related messages depend on the capability of an RS. According to the type of broadcast frame structure to be supported, we divide an RS into two types as follows:

− **Synchronous RS**: The synchronous RS indicates the RS, which supports synchronous broadcast frame structure. When it receives a broadcast frame from MR-BS, it re-broadcasts the frame to MS's using the same preamble. The synchronous RS does not have the features of handover initiation and decision[2].

− **Asynchronous RS**: The asynchronous RS indicates the RS, which supports asynchronous broadcast frame structure. When it receives a broadcast frame from MR-BS, it re-broadcasts the frame to MS's using its own preamble.

According to the capability of handover initiation and decision, we also divide an RS into two types as follows:

− **Handover-unmanageable RS:** The handover-unmanageable RS indicates the RS, which can initate handover but cannot support handover process and decision. This type of RS just relays handover messages between MS and MR-BS.

− **Handover-manageable RS:** The handover-manageable RS indicates the RS, which can initiate, process, and decide handover. This type of RS can issue MOB_BSHO-REQ message to start handover and manage handover request from MS's.

In this proposal, we discuss RS-initiated handover procedure for handover-unmanageable RS.

1.2 Problem Statements

IEEE 802.16e defined that both MS and BS initiate handover. In an MMR network, it is required that an RS also be able to initiate handover because of several special cases. Service end event of RS is one of the cases. When service end event of an RS is occurred, all MS's connected to the RS should be handovered to another RS or MR-BS. So, the RS should trigger MS handover. Another situation is that an RS reassigns some of connected MS's to another RS or MR-BS due to the change of link quality

between the MR-BS and the RS, or the results of resource and QoS managements. In this situation, the RS should trigger handover of a specific MS subset.

In 802.16e legacy handover procedure, a BS triggers MS handover using MOB_BSHO-REQ message. But in the MMR network which consists of handover-unmanageable RS, an RS should request handover triggering to an MR-BS when MS handover is needed. To support this RS-initiated handover, handover messages and procedure (between MR-BS/RS and RS/MS) should be defined. The handover message and procedure should cover specific MS subset

1.3 Assumptions

In this proposal, we assume the followings:

1. We follow all the handover procedures in 802.16e for backward compatibility.
2. MR-BS maintains link quality information for RS's and MS's directly connected to it. The link quality information is used for intra-cell handover decision. To obtain the information, network topology acquisition scheme can be employed.
3. RS maintains address information for MS's directly connected to it. The address information contains MAC address, SFID, CID and so on.
4. MDHO/FBSS and RS-initiated handover for MBS are not covered in this proposal.

2 RS-initiated Handover Procedure

2.1 Handover-unmanageable/Synchronous RS

In an MMR network which consists of handover-unmanageable/synchronous RS, an MR-BS can change current access RS of an MS implicitly using ranging process between the MR-BS and the MS. Therefore, the RS shall request handover initiation to the MR-BS, when it wants to trigger MS handover. For this RS-initiated handover, we define two messages: MOB_RSHO-REQ and MOB_RSHO-RSP. MOB_RSHO-REQ contains information such as a list of MS triggered handover by the RS and a reason of triggering. MOB_RSHO-RSP contains information about acceptance/rejection of the handover request. Figure 1 shows an example of RS-initiated handover procedure for service end event of handover-unmanageable/synchronous RS. The general RS-initiated handover procedure for handover-unmanageable/synchronous RS is described as follows:

1. An RS shall transmit MOB_RSHO-REQ to an MR-BS so that it initiates handover of specific MS subsets. MOB_RSHO-REQ contains ID's of MS subset.
2. Upon receiving MOB_RSHO-REQ, the MR-BS shall transmit MOB_RSHO-RSP to the RS: accept or reject
3. Upon receiving MOB_RSHO-RSP, the RS acts differently according to the response. When its request is accepted, the RS performs service end process or deletes the information of the specific MS subset according to the purpose of handover initiation. When its request is rejected, the RS

modifies MOB_RSHO-REQ messages according to MOB_RSHO-RSP, and retransmits the modified MOB_RSHO-REQ to the MR-BS.

4. If the MR-BS accepts the handover request from RS, it selects new access station for the MS's of interest and transmits RNG-RSP to each MS of interest.

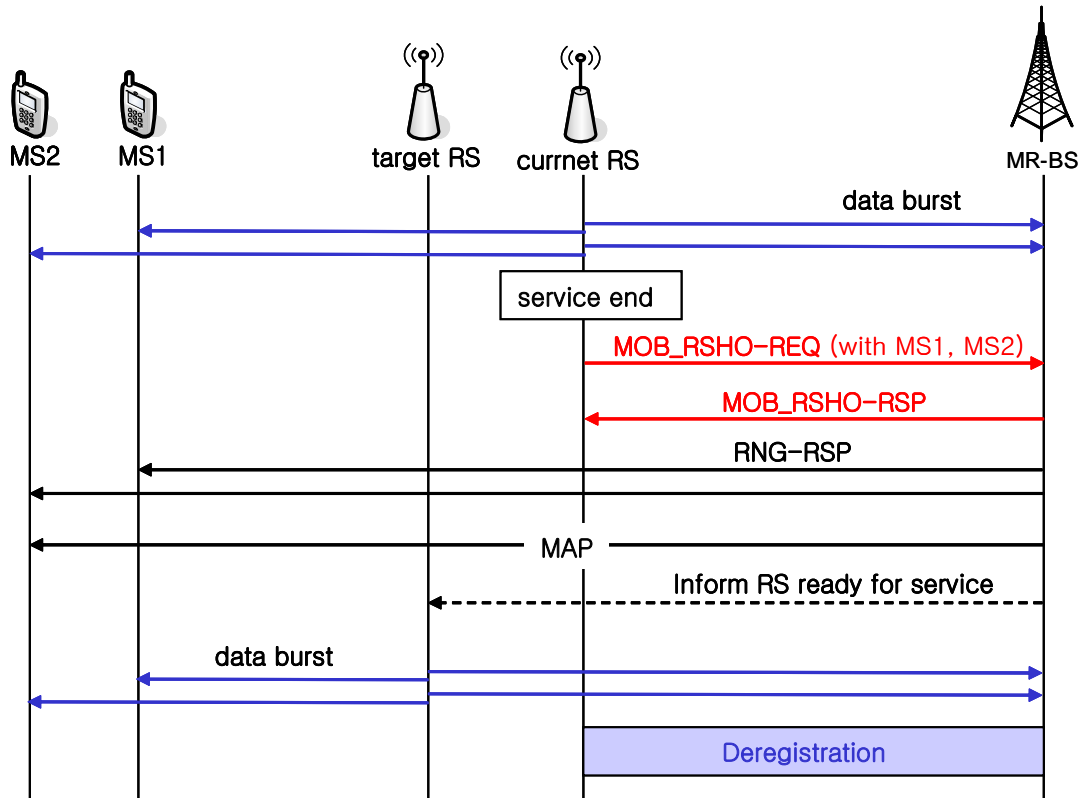5. Upon receiving RNG-RSP, MS's connect to the new access station.

Figure 1 Example of RS-initiated handover procedure with handover-unmanageable/synchronous RS

2.2 Handover-unmanageable/Asynchronous RS

In an MMR network composed of Handover-unmanageable/asynchronous RS, the intra-cell handover between MR-BS and MS is performed using 802.16e legacy handover procedure. Therefore, an RS shall request handover initiation to the MR-BS using MOB_RSHO-REQ and MOB_RSHO-RSP (which is defined in section 2.1), when it wants to initiate MS handover. Unlike the handover-unmanageable/synchronous RS, the handover-unmanageable/asynchronous RS should relay handover messages between MR-BS and MS. After MS handover is completed, the MR-BS transmits MOB_BSHO-IND. Figure 2 shows an example of RS-initiated handover procedure for handover-unmanageable/asynchronous RS. The general RS-initiated handover procedure for handover-unmanageable/asynchronous RS is described as follows:

1. An RS shall transmit MOB_RSHO-REQ to an MR-BS so that it initiates handover of specific MS subsets. MOB_RSHO-REQ contains ID's of MS subset.

2. Upon receiving MOB_RSHO-REQ, the MR-BS decides whether it accepts the request or not. If the request is accepted, MR-BS transmits MOB_RSHO-RSP and MOB_BSHO-REQ to the RS. MOB_BSHO-REQ is relayed to each MS of interest. And the MR-BS starts handover procedure with MS's of interest through the RS.

3. If MR-BS rejects the request, MR-BS transmits MOB_RSHO-RSP to the RS. Then, the RS modifies MOB_RSHO-REQ messages according to MOB_RSHO-RSP, and retransmits the modified MOB_RSHO-REQ to the MR-BS.

4. After handover procedure between the MR-BS and all MS's of interest is completed, MR-BS transmits MOB_BSHO-IND to the RS. Upon receiving MOB_BSHO-IND, the RS performs service end process or deletes the information of the specific MS subset according to the purpose of handover initiation.
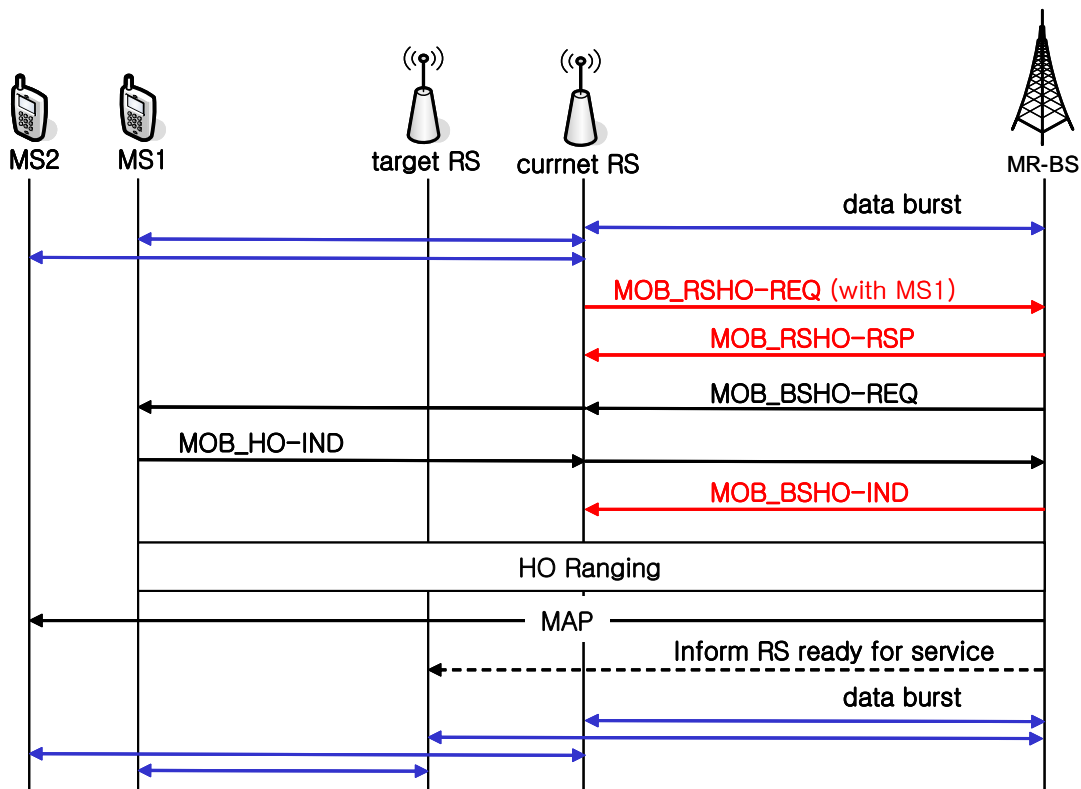

Figure 2 Example of RS-initiated handover procedure with handover-unmanageable/asynchronous RS

3. Text Proposals

[*Insert the following at the end of subclause 6.3.22.2.2*]

In an MMR network, RS can initiate MS handover for service end event, resource management, and QoS guarantee. This RS-initiated handover is performed by interactions between an MR-BS and an RS using

MOB_RSHO-REQ and MOB_RSHO-RSP messages. An RS requests handover by transmitting MOB_RSHO-REQ which includes handover mode, request reason and IDs of MS of interest. Upon receiving MOB_RSHO-REQ, the MR-BS responses using MOB_RSHO-RSP. The RS-initiated handover has different procedures according to the RS handover capabilities. If an RS can support handover initiation, but cannot support handover process and decision, the RS just requests handover initiation to an MR-BS and the MR-BS performs handover process and decision. After handover completion of all MS that are requested by the RS, the MR-BS transmits MOB_BSHO-IND.

[*Insert the following text after 6.3.2.3.XX*]

6.3.2.3.XX MOB_RSHO-REQ

An RS shall transmit MOB_RSHO-REQ message to MR-BS for initiating handover of specific MS subset. After receiving this message, the MR-BS determines whether to accept the request and responds to the RS with MOB_RSHO-RSP message. The message shall be transmitted on the basic CID.

Table XX−MOB_RSHO−REQ message format

Syntax	Size (bits)	Notes
MOB-RSHO-REQ_Message_Format() {		
Management Message Type=XX	XX	
REQ_Type	3	This parameter indicates that 00: RS ends service 01: MR-BS/RS link quality is low 02: Resource management is required 03: QoS of MS's will not be guaranteed 04~07: Reserved
RS_Mode	1	This parameter indicates that 0: RS can not support handover process and decision 1: RS can support handover process and decision
If(RS_Mode != 0x01){		
MS_Number	XX	Number of requested MS
For(i=0; i<MS_Number; i++) {		
Mobile Station ID	48	

}		
}		
TLV Encoding Information	**variable**	**optional**
}		

An RS shall generate MOB_RSHO-REQ messages in the format shown in Table XX. The following parameters shall be included in the MOB_RSHO-REQ message:

REQ_Type

Indicates the purpose of this handover request

00: RS ends service

01: MR-BS/RS link quality is low

02: Resource management is required

03: QoS of MS will not be guaranteed

04~07: Reserved

RS_Mode

Indicate the capability of RS

0: RS can not support handover process and decision

1: RS can support handover process and decision

For RS_Mode is not 01, the following parameters shall be included:

MS_Number

Indicate the number of MS that handover is requested

Mobile Station ID

Indicate the ID of mobile station

6.3.2.3.XX MOB_RSHO-RSP

The BS shall transmit an MOB_RSHO-RSP message upon reception of MOB_RSHO-REQ message. The message shall be transmitted on the basic CID.

Table XX-MOB_RSHO-RSP message format

Syntax	**Size (bits)**	**Notes**
MOB_RSHO-RSP_Message_Format() {		
Management Message Type=XX	**XX**	
RSP_Type	**2**	**This parameter indicates that 00: RS request is accepted**

		01: RS request is rejected partially **02: RS request is rejected generally** **03: Reserved**
If(RSP_Type == 01){		
MS_Number	**XX**	**Number of rejected MS**
For(i=0; i<MS_Number; i++) {		
Mobile Station ID	**48**	
}		
}		
TLV Encoding Information	**variable**	**optional**
}		

An MR-BS shall generate MOB_RSHO-RSP messages in the format shown in Table XX. The following parameters shall be included in the MOB_RSHO-RSP message:

RSP_Type

Indicates which type is for this response

00: RS request is accepted

01: RS request is rejected partially

02: RS request is rejected generally

03: Reserved

For RSP_Type is 01, the following parameters shall be included:

MS_Number

Indicate the number of rejected MS

Mobile Station ID

Indicate the ID of mobile station

6.3.2.3.XX MOB_BSHO-IND

An MR-BS shall transmit an MOB_BSHO-IND message, upon reception of MOB_HO-IND messages of all MS that are requested by RS. The message shall be transmitted on the basic CID.

Table XX−MOB_BSHO−IND message format

Syntax	**Size (bits)**	**Notes**

MOB_BSHO-IND_Message_Format() {		
Management Message Type=XX	XX	
MS_Number	XX	Number of indicating MS
For(i=0; i<MS_Number; i++) {		
Mobile Station ID	48	
HO_CPL_Indication	1	This parameter indicates that 0: HO failure 1: HO success
}		
}		
TLV Encoding Information	variable	optional
}		

An MR-BS shall generate MOB_BSHO-IND messages in the format shown in Table XX. The following parameters shall be included in the MOB_BSHO-IND message:

MS_Number
  Indicate the number of indicating MS
Mobile Station ID
  Indicate the ID of mobile station
HO_CPL_Indication
  Indicates whether MS handover is successful or not
    0: HO failure
    1: HO success

4. Reference

[1] IEEE 802.16j-06/017r2, "Table of Contents of Task Group Working Document"
[2] IEEE 802.16j-06/280, "MS Handover Support in Relay Mode"