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Project	IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>
Title	**MS MAC Handover Procedure in an MR Network-Termination**
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Re:	Submitted in response to Call for technical proposals issued by IEEE 802.16j on 2006-12-12
Abstract	This document proposes termination and other miscellaneous procedures related to MSs in IEEE 802.16j networks where both MR-BS and its subordinate RSs in an MR-cell transmit their own broadcast control message such as preamble, FCH, DCD, UCD, DL-MAP and UL-MAP.
Purpose	This contribution is provided as input for the IEEE 802.16j amendment.
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	notify the Chair <mailto:chair@wirelessman.org> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be 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>.

1. Introduction

The proposed MAC handover scheme will enable an 802.16e compliant MS to handover seamlessly in an MR network following the MAC handover procedure defined in subclause 6.3.22 of IEEE 802.16e-2005. This contribution proposes additions/modifications to handover termination and other miscellaneous processes defined in subclauses 6.3.22.2.3, 6.3.22.2.5, and 6.3.22.2.6 of IEEE 802.16e-2005.

Figure 1 depicts the seven handover cases that are covered in this contribution.
Please refer to Sections 1.1 of [1] for terminologies used in this contribution.

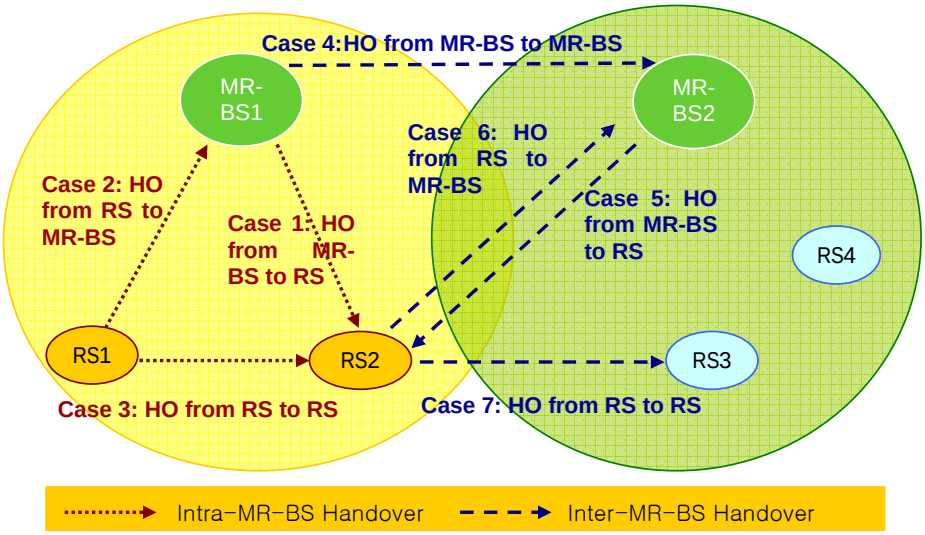


Figure 1. Seven Handover Cases in an MR network

In this handover termination process, it is assumed that RSs as well as MR-BSs transmit their own broadcast control messages such as preamble, FCH, DCD, UCD, DL-MAP and UL-MAP. In a distributed MR network, an RS may have a capability of authentication on management messages from/to an MS.

2. Termination and other miscellaneous procedures related to MS handover

2.1 Handover Termination

During the handover process, the MS sends its current access station a MOB_HO-IND (HO_IND_type = 0b00) to release it. This message contains a *Target BS_ID* field which indicates the target access station.

The detailed termination processes are described in Table 1 (a) and (b). In IEEE 802.16e-2005, the successful MS network attachment at the target BS is informed to the old serving BS over the backbone. Similarly, we propose a new MAC management message *HO_CPL*. This message is used to inform the successful MS network attachment at a target access station over the relay links. If the access station is an RS in a centralized network and it does not maintain any MS context information, the MR-BS and the access RS may not need to exchange a HO_CPL message.

Figure 2 shows an example of signaling in relation to MOB_HO-IND and HO_CPL for six cases of Figure 1 (expect Case 4) assuming that the access RS maintains the MS context information. Case 4 is not included because it exactly follows the 802.16e procedure.

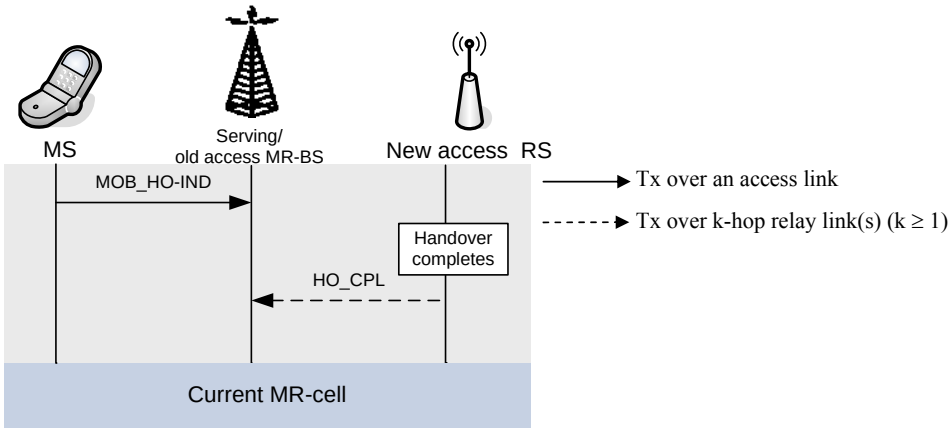
Table 1. Termination
(a) after Intra MR-BS handover

New Access / Old Access	MR-BS in the same MR cell	RS in the same MR cell
MR-BS	N/A	(1) When receiving a MOB_HO-IND message, the MR-BS shall keep the MS context information as the serving MR-BS. (2) As the handover completes at the new access RS, it transmits a *HO_CPL* message to the old access MR-BS to inform the handover completion.
RS	(1) A MOB_HO-IND message is relayed to the serving MR-BS. (2) The old access RS may start its Resource_Retain_Time timer. (3) As the handover completes at the new access station, i.e., the serving MR-BS, it issues the *HO_CPL* message to the old access RS over the relay links. (4) Upon expiration of Resource_Retain_Time timer or receiving a *HO_CPL* message, the old access RS shall remove all the MS context information. (5) Resource release along the old path may be initiated either by the MR-BS or by the old access RS.	(1) A MOB_HO-IND message is relayed to the serving MR-BS. (2) The old access RS may start its Resource_Retain_Time timer. (3) At the handover completion, the new access RS informs the serving MR-BS and/or the old access RS of the handover completion by transmitting a *HO_CPL* message. If a 1-hop relay link exists between the old access RS and the new access RS, a *HO_CPL* message may be transmitted directly from the new to the old access station. Otherwise, the serving MR-BS transmits to the old access RS the *HO_CPL* message received from the new access RS. (4) Upon expiration of Resource_Retain_Time timer or receiving a *HO_CPL* message, the old access RS shall remove all the MS context information. (5) Resource release along the old path may be initiated either by the MR-BS or by the old access RS.

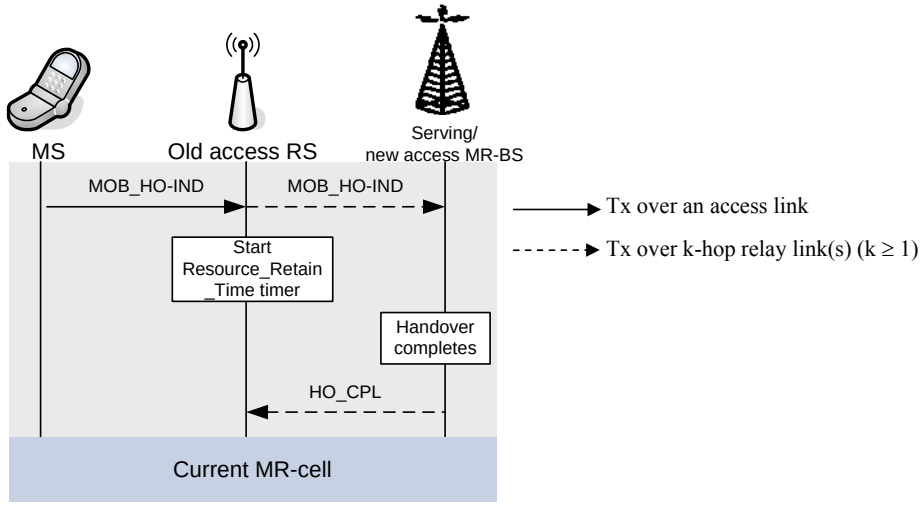
(b) after Inter MR-BS handover

New Access / Old Access	MR-BS in a different MR cell	RS in a different MR cell
MR-BS	Follows the procedure as defined	(1) Upon receiving a MOB-HO_IND

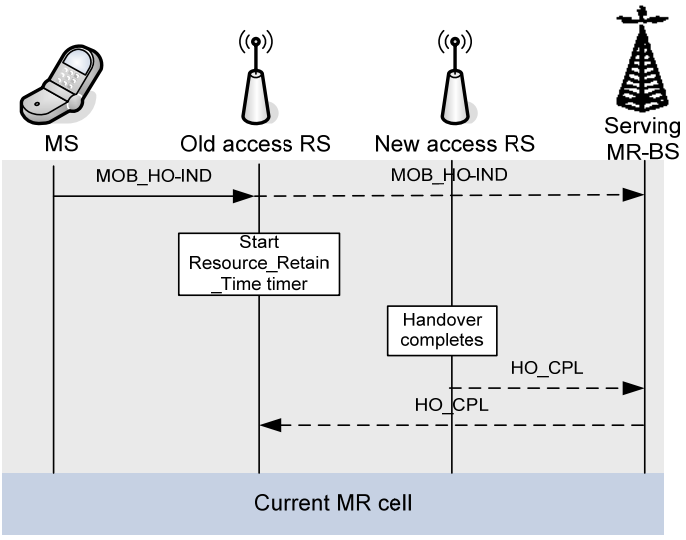
	in IEEE 802.16e-2005	message, the old access MR-BS starts Resource_Retain_Time timer. (2) At the handover completion, the new access RS transmits a *HO_CPL* message to the new serving MR-BS to inform the handover completion. (3) The new serving MR-BS sends a backbone message to the old serving MR-BS indicating successful MS network attachment at the target access station. (4) Upon expiration of Resource_Retain_Time timer or receiving the backbone message, the old access MR-BS shall remove all the MS context information and release the resource assigned to the MS.
RS	(1) A MOB_HO-IND message is relayed to the old serving MR-BS. (2) The old serving MR-BS shall start Resource_Retain_Time timer upon receiving the MOB_HO-IND message. The old access RS may start Resource_Retain_Time timer upon receiving the MOB_HO-IND message. (3) At the HO completion, the new access MR-BS sends a backbone message to the old serving MR-BS indicating successful MS network attachment at the target access station. (4) Upon receiving the backbone message, the old MR-BS issues a *HO_CPL* message to the old access RS to inform the handover completion. (5) Upon expiration of Resource_Retain_Time timer or receiving a *HO_CPL* message, the old access RS and old serving MR-BS shall remove MS context information and release resource. (6) Resource release along the old path may be initiated either by the MR-BS or by the old access RS.	(1) A MOB_HO-IND message is relayed to the old serving MR-BS. (2) The old serving MR-BS shall start Resource_Retain_Time timer upon receiving a MOB_HO-IND message. The old access RS may start Resource_Retain_Time timer upon receiving a MOB_HO-IND message. (3) At the handover completion, the new access RS transmits a *HO_CPL* message to the new serving MR-BS indicating successful MS network attachment at the target access station. (4) Then, the new serving MR-BS sends a backbone message to the old serving MR-BS indicating successful MS network attachment at the target access station. Upon receiving the backbone message, the old serving MR-BS issues a *HO_CPL* message to the old access RS. (5) Upon expiration of Resource_Retain_Time timer or receiving a *HO_CPL* message, the old access RS and old serving MR-BS shall remove MS context information and release resource. (6) Resource release along the old path may be initiated either by the MR-BS or by the old access RS.



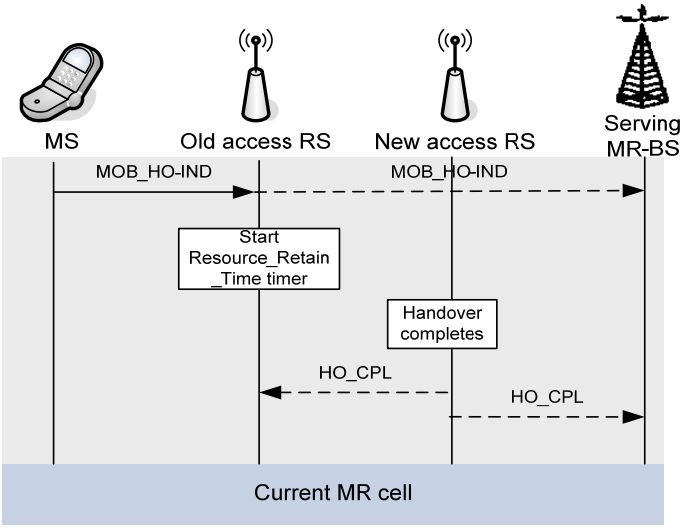
(a) Case 1: The old access station is an MR-BS and the new access station is an RS in the same MR cell



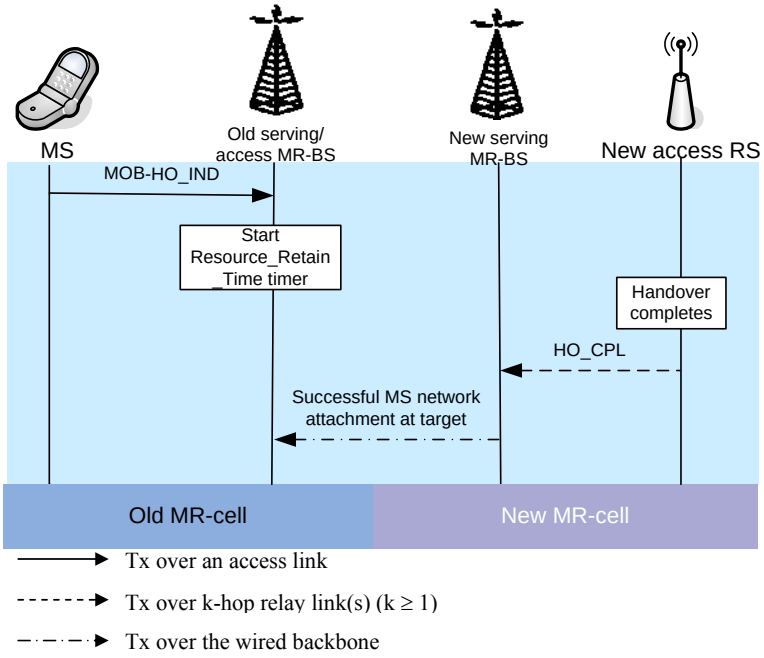
(b) Case 2: The old access station is an RS and the new access station is a serving MR-BS



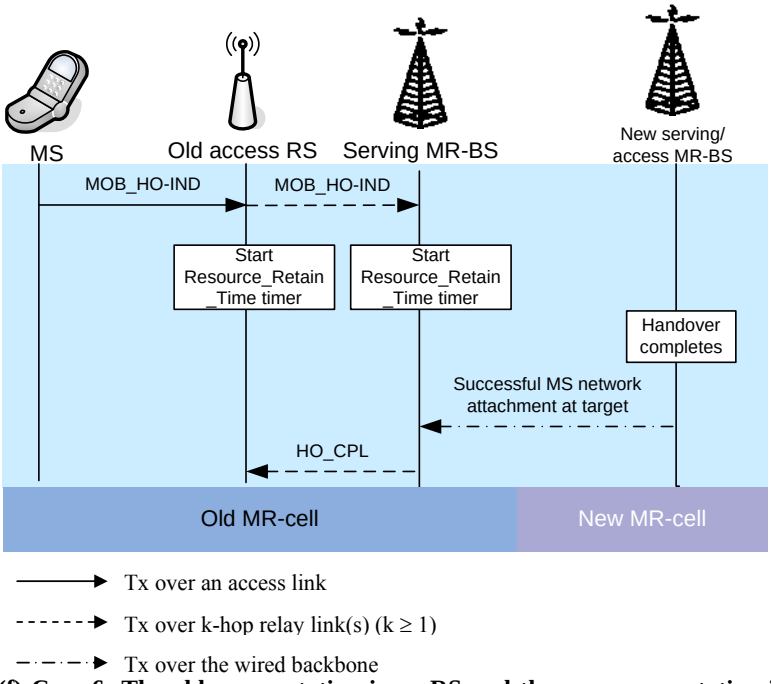
(c) Case3: The old access station is an RS and the new access station is another RS in the same MR cell. This flow is an example when a direct 1-hop relay link doesn't exist between the current and the target access RSs.



(d) Case3: The old access station is an RS and the new access station is another RS in the same MR cell. This flow is an example when a direct 1-hop relay link exists between the current and the target access RSs.



(e) Case 5: The old access station is an MR-BS and the new access station is an RS in a different MR cell



(f) Case 6: The old access station is an RS and the new access station is an MR-BS in a different MR cell

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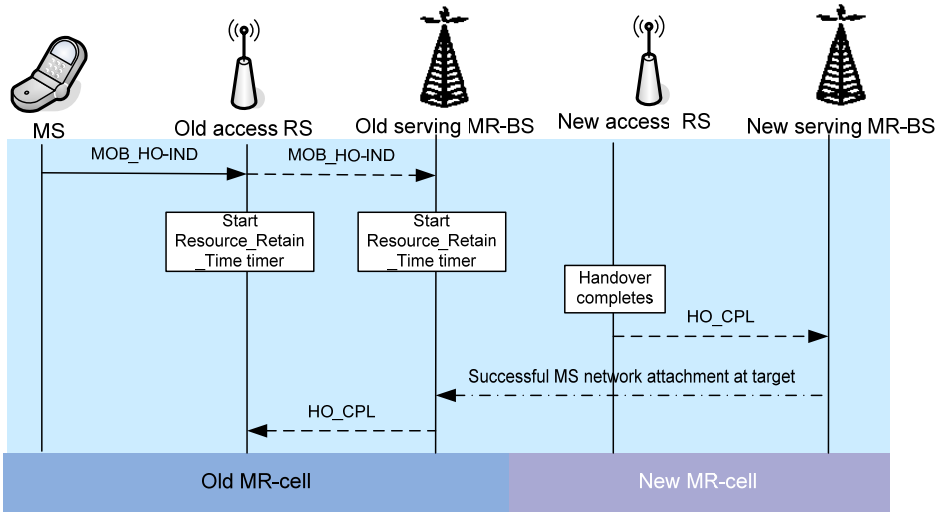

Tx over an access link

Tx over k-hop relay link(s) (k ≥ 1)

Tx over the wired backbone

(g) Case 7: The old access station is an RS and the new access station is another RS in a different MR cell.

Figure 2. An example of signaling message exchanges for termination. (Other flows are possible for each case)

2.2 Drop

When a drop is detected by an MS, the MS follows the procedure defined in 6.3.22.2.6 of IEEE 802.16e-2005.

If the access station is an RS and it detects a drop, the access station reacts as if it receives MOB_HO-IND with BS release (HO_IND_type = 0b00).

3. Proposed text

[Insert the following at the end of subclause 6.3.22.2.5]

Upon receiving a MOB_HO-IND message with HO_IND_type = 0b00 from an MS, the old access RS shall relay it to the old serving MR-BS and may start its Resource_Retain_Time timer. The old access RS with the authorization capability may read the MOB_HO-IND message received from the MS.

The successful MS network attachment at a target access station is informed to the old access station and/or old serving station and/or target serving station by transmitting HO_CPL message over the relay links.

Upon expiration of Resource_Retain_Time timer or receiving a HO_CPL message, the old

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access RS shall remove all the MS context information. An old serving MR-BS can receive a MOB_HO-IND message directly from an MS or a relayed one from its subordinate RS. When an MR-BS receives a MOB_HO-IND message, the MR-BS shall start Resource_Retain_Time timer in the case that a target access station in the MOB_HO-IND message is not managed by the MR-BS.

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[Insert the following at the end of subclause 6.3.22.2.6]

If the access station is an RS and it detects a drop, the access station reacts as if it receives MOB_HO-IND with BS release (HO_IND_type = 0b00).

[Insert the following as a new subclause 6.3.2.3.xx]

6.3.2.3.XX HO-CPL

This message is to inform MS's network attachment at a target access station.

Syntax	Size (bits)	Notes
HO_CPL_Message_format() {		
Management Message Type = TBD	TBD	
MS ID	48	
}		

Annex I

(informative)

MAC management message flow related to handover in MR networks

I.XX HO_CPL message flow related to handover completion

As the handover completes at a new access station, a HO_CPL message is delivered following the procedure below:

- Intra MR-BS handover
  - If the old access station is an MR-BS and the new access station is an RS (or vice versa), the new access station transmits *HO_CPL* to the old access station to inform the handover completion.
  - If both old and new access stations are RSs, the new access RS transmits *HO_CPL* to the serving MR-BS to inform the handover completion. If a 1-hop relay link exists between the old access RS and the new access RS, *HO_CPL* may be transmitted directly from the new to the old access station. Otherwise, the serving MR-BS transmits to the old access RS the *HO_CPL* message received from the new access RS.
- Inter MR-BS handover
  - If the new access station is an RS, it transmits a *HO_CPL* message to the new serving MR-BS.
  - Upon receiving the new *HO_CPL* message from a new access RS or if the MR-BS is a new access station, the MR-BS sends a backbone message to the old serving MR-BS indicating successful MS network attachment at the target access station.
  - If an MR-BS receives a backbone message indicating successful MS network attachment at the target access station and the old access station is its subordinate RS, it transmits a *HO_CPL* message to the old access RS.

References

[1] IEEE C802.16j-07/082, “Overview of the proposal for MS MAC handover procedure in an MR Network,” Jan. 2007