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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 2006-10-15	
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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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 and 1.3 of [1] for terminologies and assumptions used in this contribution.

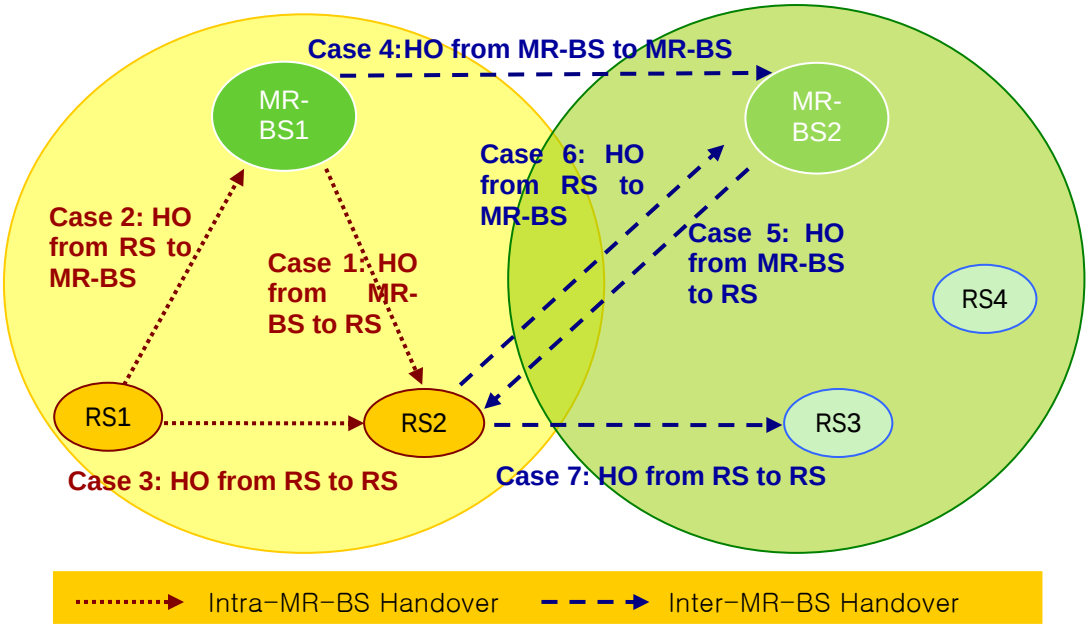


Figure 1. Seven Handover Cases in an MR network

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. Upon receipt of this message, if the old access station has not already done so, it shall inform the target access and/or target serving station(s) of the MS information by transmitting an unsolicited *MS_INFO-RSP*. The procedure to transmit an unsolicited *MS_INFO-RSP* follows the one described in Table 1 (a) and (b) of the contribution [2] ignoring the procedure related to transmit a *MS_INFO-REQ* message.

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 old access/serving station(s) and a target serving station of the successful MS network attachment at a target access station. We note that ane old access station can determine whether the handover is intra or inter MR-BS handover by reading the Target_BS_ID parameter of the MOB_HO-IND 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). Case 4 is not included because it exactly follows the 802.16e procedure.

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

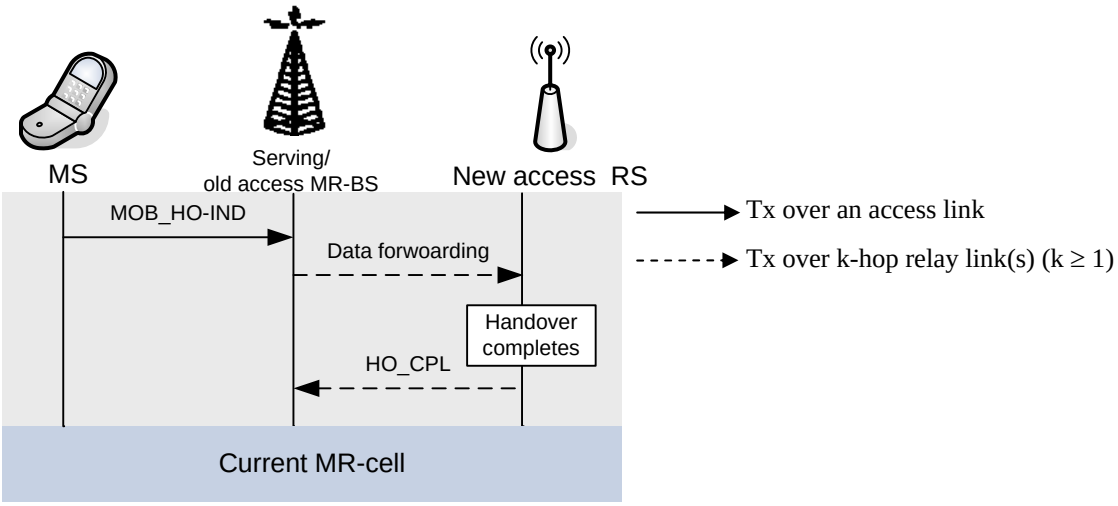
New Access / Old Access	MR-BS in the same MR cell	RS in the same MR cell
MR-BS	N/A	(1) When receiving the MOB_HO-IND message, the MR-BS doesn't have to start Retain_Resource_Time timer because the MR-BS keeps the MS information as the serving MR-BS. (2) The old access MR-BS stops data transmission via access link to the MS and starts data forwarding to the new access RS. (3) As the handover completes at the new access RS, it transmits *HO_CPL* to the old access MR-BS to inform the handover completion. The MS information remains at the MR-BS since it is the serving station.
RS	(1) The MOB_HO-IND message is relayed to the serving MR-BS so that it stops forwarding data to the old access RS. (2) The old access RS starts its Retain_Resource_Time timer. (3) As the handover completes at the new access station, i.e., the serving MR-BS, it issues the *HO_CPL* along the multi-hop path destined to the old access RS. (4) Upon expiration of Retain_Resource_Time timer or receiving the *HO_CPL*, the old access RS removes all the MS information. (5) Resource release along the old path can be initiated either at the MR-BS or at the old access RS following the path management and routing procedure in TBD section.	(1) The MOB_HO-IND message is relayed to the serving MR-BS so that it stops forwarding data to the old access RS and starts data forwarding to the new access RS. (2) The old access RS starts its Retain_Resource_Time timer. (3) At the handover completion, the new access RS, it transmits a *HO_CPL* message to both the serving MR-BS and the old access RS to inform them of the handover complettion. If a 1-hop relay link exists between the old access RS and the new access RS, *HO_CPL* is transmitted directly from the new to the old access station. If not, the serving MR-BS transmits a *HO_CPL* message to the old access RS as it receives the message from the new access RS. (4) Upon expiration of Retain_Resource_Time timer or receiving the *HO_CPL*, the old access RS removes all the MS information. (5) Resource release along the old path can be initiated either at the MR-BS or

		at the old access RS following the path management and routing procedure in TBD section.

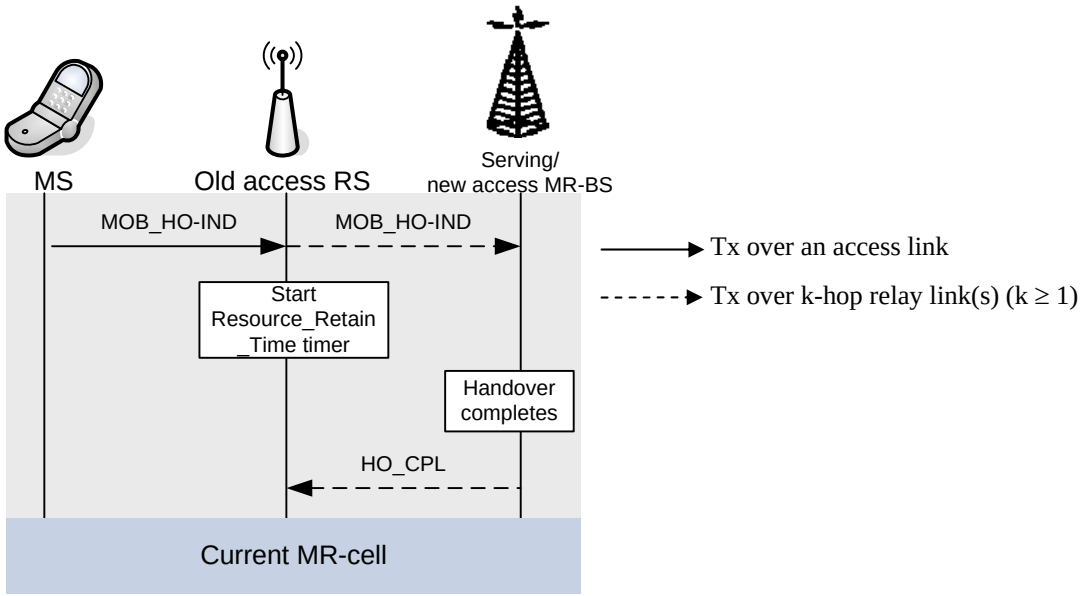
(b) after Inter MR-BS handover

New Access / Old Access	MR-BS in a different MR cell	RS in a different MR cell
MR-BS	Follows the procedure as defined in IEEE 802.16e-2005	(1) Upon receiving MOB-HO_IND, the old access MR-BS starts Resource_Retain_Time timer (2) The old access MR-BS stops data transmission via access link to the MS and starts data forwarding to the new serving MR-BS over the backbone. (3) At the handover completion, the new access RS transmits a *HO_CPL* message to the new serving MR-BS to inform the handover completion. (4) The new serving MR-BS sends a backbone message to the old serving MR-BS (i.e., old access MR-BS at the same time) indicating successful MS network attachment at the target. (5) Upon expiration of Resource_Retain_Time timer or receiving the backbone message, the old access MR-BS removes all the MS information and releases the resource assigned to the MS.
RS	(1) The MOB_HO-IND message is relayed to the old serving MR-BS so that it stops forwarding data to the old access RS and starts data forwarding to the new access MR-BS over the backbone. (2) Both the old access RS and old serving MR-BS start Resource_Retain_Time timer upon receiving MOB_HO-IND. (3) As the HO completes, the new access MR-BS sends a backbone message to the old serving MR-BS indicating successful MS network attachment at the target. (4) Upon receiving the backbone message, the old MR-BS issues a *HO_CPL* to the old access RS to inform the handover completion. (5) Upon expiration of	(1) The MOB_HO-IND message is relayed to the old serving MR-BS so that it stops forwarding data to the old access RS and starts data forwarding to the new serving MR-BS over the backbone. (2) Both the old access RS and old serving MR-BS start Resource_Retain_Time timer upon receiving MOB_HO-IND (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. (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. Upon receiving the backbone message, the old

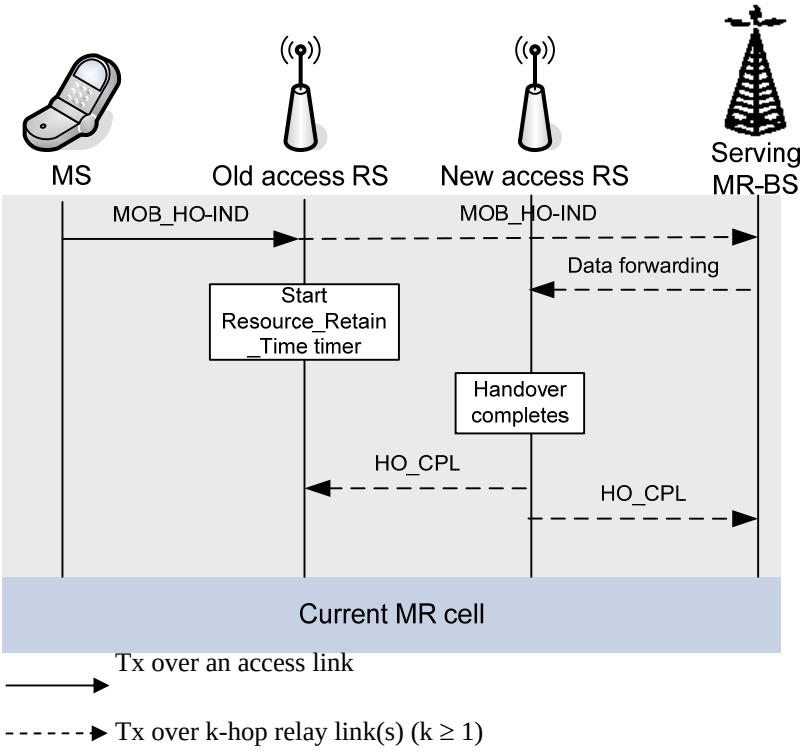
	Resource_Retain_Time timer or receiving *HO_CPL*, the old access RS and old serving MR-BS remove MS information and release resource. (6) Resource release along the old path can be initiated either by the MR-BS or by the old access RS following the path management and routing procedure of TBD section.	serving MR-BS issues the *HO_CPL* message to the old access RS. (5) Upon expiration of Resource_Retain_Time timer or receiving *HO_CPL*, the old access RS and old serving MR-BS remove MS information and release resource. (6) Resource release along the old path can be initiated either by the MR-BS or by the old access RS following the path management and routing procedure of TBD section.



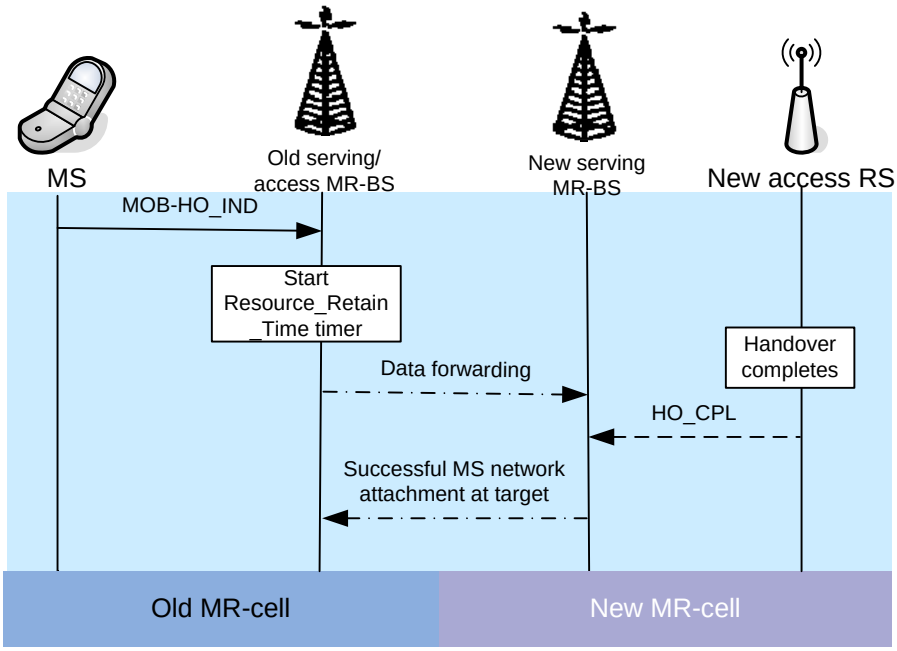
(a) Case 1: Old access station is an MR-BS and new access station is an RS in the same MR cell



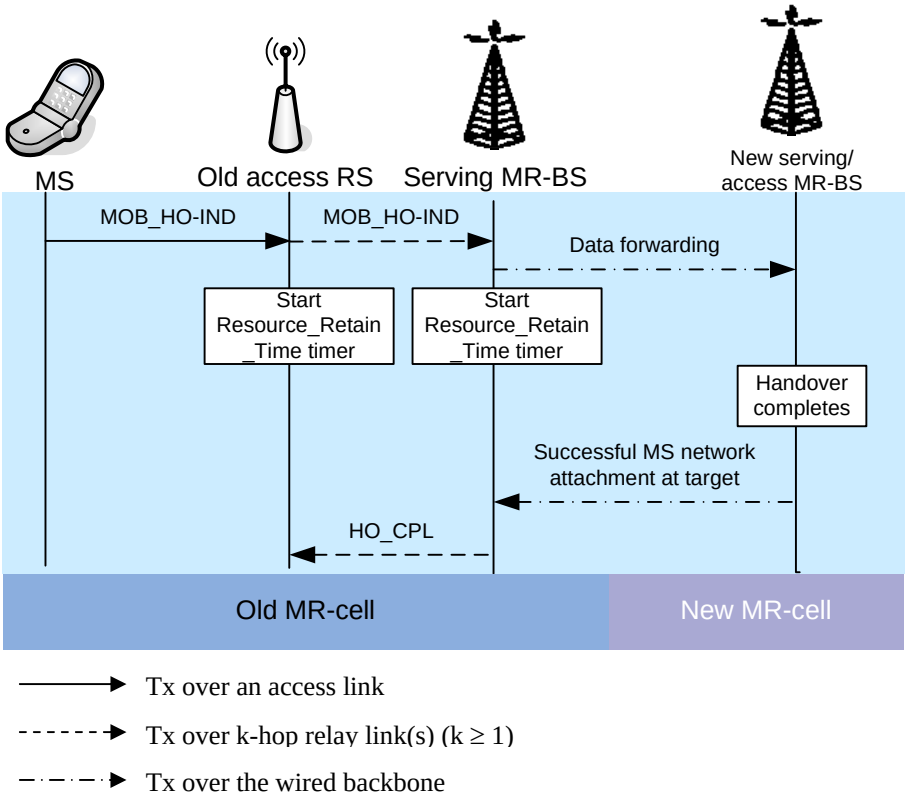
(b) Case 2: Old access station is an RS and new access station is a serving MR-BS



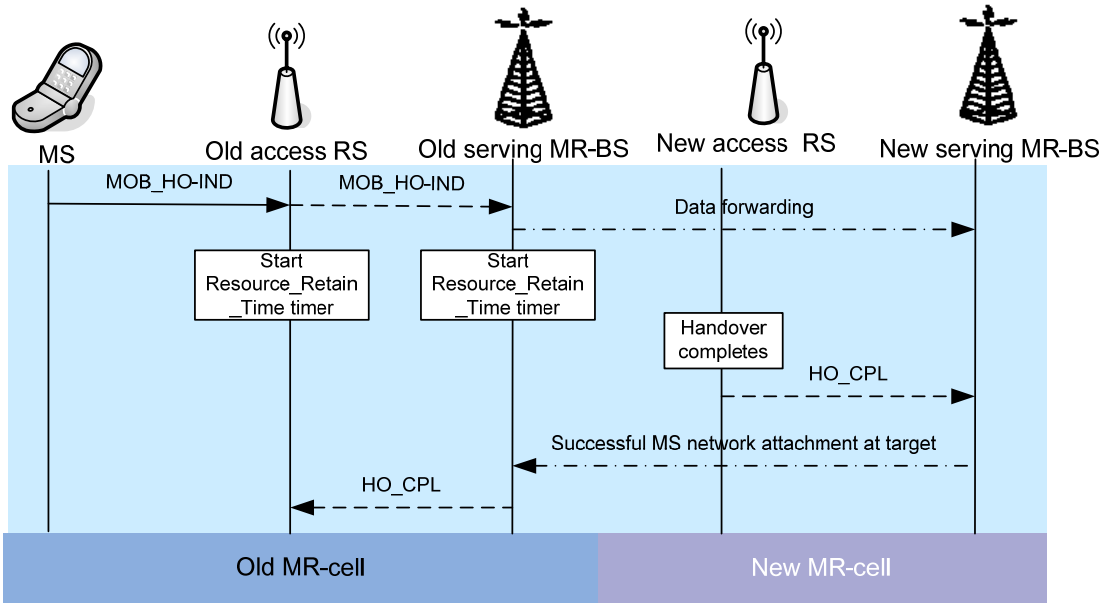
(c) Case3: Old access station is an RS and new access station is another RS in the same MR cell. This flow is an example when a direct 1-hop relay link exists between the current and the target access RSs.



(d) Case 5: Old access station is an MR-BS and new access station is an RS in a different MR cell



(e) Case 6: Old access station is an RS and new access station is an MR-BS in a different MR cell



Tx over an access link

Tx over k-hop relay link(s) (k ≥ 1)

Tx over the wired backbone

(f) Case 7: Old access station is an RS and 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 Handover cancellation

After an MS or an access station has initiated a handover, the MS may cancel the handover at any time prior to the expiration of the Resource_Retain_Time timer interval by transmitting a MOB_HO-IND message with HO_IND_type = 0b01. Handover cancellation from the perspective of an MS is processed according to Section 6.3.22.2.3 of IEEE 802.16e-2005.

If the current access station is an RS, a *MOB_HO-IND* message with HO_IND_type = 0b01 (indicating the handover cancellation) is forwarded to the current serving MR-BS and thus the normal operation communication can be resumed.

2.3 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

[Editor's note: Figure and Table numbers are subject to change when the text is inserted into the amendment. The figures and tables appeared in the above sections will not be repeated in

this section]

[Insert the following at the end of subclause 6.3.22.2.5]

For an MR network, upon receipt of a MOB_HO-IND (HO_IND_type = 0b00) message, if the old access station has not already done so, it shall inform the target access station of the MS information by transmitting an unsolicited *MS_INFO-RSP*. The procedure to transmit an unsolicited *MS_INFO-RSP* follows the one described in Table XX (a) and (b) of the section 6.3.22.2.7. In addition to transmitting the MS information to the target access station, the processes detailed in Table 1 (a) and (b) are to be performed. The successful MS network attachment at the target BS is sent to the old serving BS over the backbone as well as over the relay links. A MAC management message *HO_CPL* is used to inform the old access/serving stations and the target serving station of a successful MS network attachment at the target access station. The old access station can determine whether the handover is intra or inter MR-BS handover by reading the Target_BS_ID parameter of the MOB_HO-IND message.

[Editor's note: Insert Table 1 (a) and (b) of this contribution here]

[Insert the following at the end of subclause 6.3.22.2.3]

For an MR-network, if the current access station is an RS, a *MOB_HO-IND* message with HO_IND_type = 0b01 (indicating the handover cancellation) is forwarded to the current serving MR-BS and thus the normal operation communication can be resumed.

[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 so that MS information and resource related to the old access station and old path can be released.

Syntax	Size (bits)	Notes
HO_CPL_Message_format() {		
Management Message Type = TBD	TBD	
Old access station ID	48	
New access station ID	48	
Forward_indicator	1	To indicate whether the current MR-BS needs to forward this message to the current access RS or not. This bit is set to 1 if 1-hop relay link cannot be set up between the current access RS and the target access RS.
MS ID	48	
Padding	TBD	Padding to reach byte boundary
}		

References

[1] IEEE C802.16j-06/217, “Overview of the proposal for MS MAC handover procedure in an MR Network,” Nov. 2006
[2] IEEE C802.16j-06/220, “MS MAC Handover Procedure in an MR Network – Handover Execution,” Nov. 2006