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Re:	Response to the call for technical proposal regarding IEEE Project 802.16j (i.e., IEEE 802.16j-07/007r2, "Call for Technical Comments and Contributions regarding IEEE Project P802.16j", Feb 02, 2007).
Abstract	This contribution describes MDHO and FASS for MMR network
Purpose	The contribution is provided as input for the IEEE 802.16j amendment
Notice	
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Patent Policy and Procedures	

Macro Diversity Handover and Fast Access Station Switching for MMR Networks – Initiation to Termination

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1. Introduction

In this proposal, we discuss the MAC MDHO and FASS handover decision to termination procedures and corresponding MAC management messages over relay links so that an IEEE 802.16e compliant MS can handover seamlessly within an IEEE 802.16j network.

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In the simple HO mode the MS communicates with just one access station, which allows only low speed mobility (portability or simple mobility). For higher speed mobility (full mobility) FASS and MDHO are implemented. In MDHO mode MS can communicate simultaneously with all active stations in a diversity active set. In uplink (downlink), active access stations or network (MS) are capable of diversity combining of received signals. In contrast to MDHO, in FASS the data are sent to all active stations in diversity active set but without diversity combining and the data are processed in anchor station only. An advantage of this handover type is not having to use explicit handover signaling messages when anchor station is changed.

2. Problem Statement

Due to the introduction of RSs in to the network infrastructure, there are two main categories of MDHO or FASS handover, as discussed in contribution [1]:

(1) Intra MR-BS handover the diversity set is updated among a group of RSs or the MR-BS controlled by the same serving MR-BS which consists of four cases:
Case 1: the current anchor station and target anchor station is MR-BS ;
Case 2: the current anchor station is RS and target anchor station is MR-BS ;

Case 3: the current anchor station is MR-BS and target anchor station is RS ;
Case 4: the current anchor station and target anchor station is the same RS ;
Case 5: the current anchor station and target anchor station is the different RSs ;

(2) Inter MR-BS handover if the diversity set is updated among a group of RSs controlled by the multiple MR-BSs which consists of four cases:
Case 6: the current anchor station and target anchor station is the different MR-BSs ;
Case 7: the current anchor station is MR-BS and target anchor station is RS controlled by the different MR-BS ;
Case 8: the current anchor station is RS and target anchor station is MR-BS in a different MR-cell ;
Case 9: the current anchor station and target anchor station are the different RSs and also they are located in different MR-cells.

The signaling between the involved access stations occurs over the wireless relay links as well as over the wired backbone. .In MMR networks, to make RSs more efficient and simpler, new MAC management messages over relay links are required. Handover procedure can be different depending on the coordination between an MR-BS and its subordinate RSs with regards to broadcast control messages such as preamble, FCH, DL-MAP, UL-MAP, DCD and UCD. In a synchronous broadcast system only the MR-BS transmits all the broadcast control messages or RSs in the same MR-cell would forward the same broadcast control messages. In asynchronous broadcast system a RS can transmit its own preamble, FCH, DL-MAP, UL-MAP, DCD, and UCD. The contribution discusses the MDHO handover and FASS handover in MR-cell network and defines the MAC handover procedure for an asynchronous broadcast system. The proposed MAC handover procedure and MAC messages will enable 802.16e compliant MS to handover seamlessly following the handover procedure defined in sub-clause 6.3.22 of 802.16e-2005. The proposed schemes in this contribution will address handover decision, initiation, execution and termination. . In contribution [1] we address handover network topology acquisition.

3.1 Macro diversity handover and fast access station switching

The MDHO or FASS capability can be enabled or disabled in the REG-REQ/RSP message exchange. With MDHO or FASS enabled, the MS shall perform the following stages:

--- MDHO Decision: A MDHO begins with a decision for an MS to transmit to and receive from multiple MR-BS and/or RSs at the same time. A MDHO can start with either MOB_MSHO-REQ message by the MS or MOB_BSHO-REQ message by the anchor station.

--- FASS Decision: A FBSS handover begins with a decision for an MS to receive/transmit data from/to the anchor station that may change within the Diversity Set. A FASS handover can be triggered by either MOB_MSHO-REQ by the MS or MOB_BSHO-REQ message by the anchor station.

--- Diversity Set Selection/Update: An MS may scan the neighbor stations and to select those stations that are suitable to be included in the diversity set. The MS shall report the selected stations. The diversity set update procedure shall be performed by the anchor station and the MS.

--- Anchor Station Selection/Update: an MS is required to continuously monitor the signal strength of the stations that are included in the diversity set. The MS shall select one station from its current Diversity Set to be the Anchor station and reports the selected anchor station on CQICH or MOB_MSHO-REQ messages.

3.2 MDHO/FASS decision and initiation

The MR-BS or RS supporting MDHO or FASS shall broadcast the DCD message that includes the H_Add Threshold and H_Delete Threshold. These thresholds are used by the FASS/MDHO capable MS to determine if

MOB_MSHO-REQ should be sent. When long term CINR of a anchor station is less than H_Delete Threshold, the MS shall send MOB_MSHO-REQ to require dropping this anchor station from the diversity set; when long-term CINR of a neighbor MR-BS or RS is higher than H_Add Threshold, the MS shall send MOB_MSHO-REQ to require adding this neighbor MR-BS or RS to the diversity set.

As defined in IEEE 802.16e-2005, MOB_BSHO-REQ and MOB_BSHO-RSP messages include the following information about possible target access stations for a particular MS:

--- Service level prediction
--- Preamble index/subchannel index
--- HO process optimization
--- Network assisted HO supported
--- HO authorization policy support

This information was obtained over the backbone in 802.16e network, however it may need to be obtained over the relay links as well as the backbone. Therefore we may define two new MAC management messages MR_HOINFO-REQ and MR_HOINFO-RSP in order to exchange the information about the potential stations in diversity set.

3.3 Diversity Set update for MDHO/FBSS

When MOB_MSHO-REQ is sent by an MS, the MS may provide a possible list of MR-BSs and/or RSs to be included in the MS' Diversity Set. The MS may evaluate the possible list of MR-BSs and/or RSs through the received MOB_NBR-ADV message, and previously performed signal strength measurement, propagation delay measurement, scanning, ranging, and association activity as discussed in contribution [1]. When MOB_BSHO-RSP is sent by the Anchor station in the MS's current Diversity Set, the MR-BSs may provide a list of MR-BSs or RSs recommended for incorporation into the MS' Diversity Set.

An MS and the potential access stations in the diversity set shall conduct ranging by exchanging RNG-REQ and RNG-RSP. An MS can indicate a handover attempt by sending RNG-REQ message which includes a station ID TLV and sets bit number of the ranging purpose indication TLV set to 1.

Upon receiving such a RNG-REQ message, the potential stations may request the MS for information if it has not received yet. Because the MS information may need to be obtained over the relay links as well as over the backbone, we define two new MAC management messages MR_MSINFO-REQ and MR_MSINFO-RSP for informing the MS information.

3.4 MDHO/FBSS handover termination

In IEEE 802.16e-2005, the old anchor BS is informed over the backbone of the the successful MS network attachment at the diversity set. However in 802.16j, this attachment may be informed over the relay links as well as the backbone, so we propose a new MAC management message MR_HO-IND. This information is used to inform the old anchor station of the successful MS network attachment at a new anchor MR-BS and/or RS.

3. Summary of New MAC management messages

The following table lists the proposed new MAC management messages for stations in an 802.16j network for handover decision to termination procedures.

Table 1 : new MAC management messages over relay links

New MAC messages	MS handover phase	Descriptions
MR_HOINFO-REQ MR_HOINFO-RSP	MDHO/FASS decisi and initiation	These two messages are used to pass the handover related information of potential target anchor station to the current anchor station over relay links
MR_MSINFO-REQ MR_MSINFO-RSP	Handover execution	These messages are used to pass MS information to new anchor and target anchor station when actual handover is performed.
MR_HO-IND	Handover terminatio	This message is used to notify successful handover to the current anchor station and to the target anchor station.

4. Proposed text change

[Insert the following at the end of subclause 6.3.22.xx]

6.3.2.22.xx MDHO/FASS decision and initiation

An MS initiates handover by transmitting a MOB_MSHO-REQ message. Upon receiving MOB_MSHO-REQ, the anchor access station responses it with a MOB_BSHO-RSP message. If an anchor access RS receives MOB_MSHO-REQ, it may relay the received MOB_MSHO-REQ message to a serving MR-BS or response with a MOB_MSHO-RSP message after collecting necessary information. If the serving MR-BS receives the relayed MOB_MSHO-REQ, it generates and transmits a MOB_BSHO-RSP message to the anchor access RS so that the anchor access RS forwards the received MOB_BSHO-RSP to the MS as a response.

The MOB_BSHO-REQ/RSP messages contain the recommended target active stations list for a diversity set and their information related to handover support. These information can be gathered over the relay links as well as over the wired backbone and MR network. The information maybe obtained over the relay links using MR_HOINFO-REQ/RSP messages which include a possible target active station of a diversity set and HO process optimization information as well as the expected service level of an MS at each active access station.

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

6.3.2.3.xx Multiple relay handover information request (MR_HOINFO-REQ)message

An active access station sends this message to obtain handover related information on the recommended active access stations.

Syntax	Size (bits)	Notes
MR_HOINFO-REQ_Message_format() {	-	-
Management message type = TBD	TBD	
MS_ID	48	
SF_indicator	1	Set to 1 to indicate that the MS's service flow informatio is included
If(SF_indicator = = 1) {		
N_SF		Number of admitted service flows for the MS
For(i=0;i<N_SF;i++){		
TLV encoded information	variable	
}		
}		
N_recommended_active_stations	8	
For(i=0;i<N_recommended_active_stations;i++ {		
Recommended_target_active_station_ID	48	
}		
padding	variable	Padding to byte boundary
}		

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

6.3.2.3.xx Multiple relay handover information response (MR_HOINFO-RSP)message

This message response to a MR_HOINFO-REQ message

Syntax	Size (bits)	Notes
MR_HOINFO-RSP_Message_format () {	-	-
Management Message Type = TBD	TBD	
MS_ID	48	
N_recommended_active_station	8	
For(i=0; i<N_recommended_active_station;i+ {		
Recommended_active_station_ID	48	
TLV_encoded_information	variable	
}		
Padding	TBD	Padding to reach byte

		boundary
}		

[Insert the following at the end of 6.3.22]

6.3.22.xx MDHO/FASS execution

In MR networks, an MS and a target anchor access station shall conduct ranging by exchanging RNG-REQ/RSP messages. To notice an MS of possible omission of re-entry process management messages, the target anchor access station includes a HO Process Optimization TLV in the RNG-RSP message. As indicated in the HO Process Optimization TLV settings, the target anchor access station may use the previously obtained MS service and operational context information.

The target anchor access RS may make an MS information request by sending a MR_MSINFO-REQ message to its serving MR-BS. Upon receiving the MR_MSINFO-REQ message, the serving MR-BS sends a MR_MSINFO-RSP message with the MS information. The serving MR-BS may obtain the MS information via the wired backbone network or over the relay links. If a new anchor access RS and an old anchor access RS has 1-hop relay link, the new anchor access RS may send a MR_MSINFO-REQ message to the old anchor access RS and the old anchor access RS responds with a MR_MSINFO-RSP message.

[Insert a new subclause following subclause 6.3.2.3.xx]

6.3.2.3.xx Multiple relay mobile station information request (MR_MSINFO-REQ)message

The target anchor access station issues this message to obtain the mobile station information.

Syntax	Size (bits)	Notes
MR_MSINFO-REQ_Message_format() {	-	-
Management message type = TBD	TBD	
Old_anchor_station	48	
HO_ID_Indicator	1	
If(HO_ID_Indicator = =1) {		
HO_ID	8	
}		
Else {		
MS_ID	48	
}		
N_old_active_stations		Number of in Diversity Set
For (i=0;i<N_old_active_stations i++) {		
Station ID	48	
Information field indicator	TBD	Each bit indicates if the corresponding field is require to appear in

		MR_MSINFO_RSP - Bit#0: basic CID - Bit#1: primary managemen CID - Bit#2: secondary management CID - Bit#3: CID update - Bit#4: information on SBC - Bit#5: information on REG - Bit#6: information on PKM - Bit#7: reserved
}		
Padding	TBD	Padding to reach byte boundary
}		

[Insert a new sub-clause following sub-clause 6.3.2.3.yy]

6.3.2.3.xx Multiple relay mobile station information response (MR_MSINFO-RSP)message

This message is the response message to a MR_MSINFO-REQ message

Syntax	Size (bits)	Notes
MR_MSINFO-REQ_Message_format () {	-	-
Management Message Type = TBD	TBD	
HO_ID_indicator	1	
If (HO_ID_indicator = = 1) {		
HO_ID	8	
}		
Else{		
MS_ID	48	
}		
N_old_active_stations		Number of in Diversity Set
For (i=0;i<N_old_active_stations i++) {		
Information field indicator	TBD	Each bit indicates if the corresponding field is required to appear in MR_MSINFO_RSP - Bit#0: basic CID - Bit#1: primary management CID

		- Bit#2: secondary management CID - Bit#3: CID update - Bit#4: information on SB - Bit#5: information on RE - Bit#6: information on PKM - Bit#7: reserved
If information field indicator Bit #0 = = 1{		
Basic ID	16	
}		
If information field indicator Bit #1 = = 1){		
Primary management CID	16	
}		
If information field indicator Bit #2 = = 1) {		
Secondary management CID	16	
}		
If information field indicator Bit #3 = = 1) {		
N_CID	TBD	
For(i=0;i<N_CID;i++) {		
SFID	32	
CID	16	
}		
}		
TLV encoded information	variable	
}		
Padding	TBD	Padding to reach byte boundary
}		

[Insert the following at the end of 6.3.22]

6.3.22.x x MDHO/FBSS handover termination

Upon receiving a MOB_HO-IND message with HO_IND type =0b00 from an MS, the old anchor access RS shall relay it to the old serving anchor MR-BS and may start its resource retain time timer. Upon expiration of resource retain time timer or receiving the successful MS network attachment, the old anchor access RS shall remove all the MS context information. An old serving anchor 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. The successful MS network attachment at a target anchor station is informed to the old anchor access station, old serving anchor station, target serving anchor station by transmitting MR_HO_IND message over the relay links.

[Insert a new sub-clause following sub-clause 6.3.2.3.yy]

6.3.2.3.xx Multiple relay mobile station information response (MR_HO-IND)message

This message is to inform mobile station network attachment to a target anchor access station.

Syntax	Size (bits)	Notes
MR_HO-IND_Message_format() {	-	-
Management message type = TBD	TBD	
MS_ID	48	
}		

5. Reference

[1] IEEEC802.16j-07_199, “MDHO and FASS for MMR Networks - Topology Acquisition,” March, 2007.