Project	**IEEE 802.16j Mobile Multihop Relay Task Group**
Title	**MS Handover Support in Transparent / Non-Transparent Relay Mode**
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Re:	IEEE 802.16j-06_034: “Call for Technical Proposals regarding IEEE Project P802.16j”
Abstract	The mechanism and procedures of MS HO with RS involved are proposed in this document
Purpose	This document is provided as the input for the IEEE802.16j.
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MS Handover Procedure in Relay Mode

1. Introduction

The document is to describe the intra / inter MR-BS handover as an input for call for technical contribution of the IEEE 80216j. The MS HO in MR network can be classified into two categories, inter MR-BS handover and intra MR-BS handover. For inter MR-BS handover, MS or RS handovers between two RSs controlled by different MR-BSs or between an MR-BS and an RS controlled by another different MR-BS. For intra MR-BS handover, MS handovers between two RSs controlled by the same MR-BS or between an MR-BS and one of its subordinate RSs. MS shall conduct IEEE802.16e-2005 compliant HO procedures for backward compatibility.

2. Overview of the proposed solutions

This proposal gives MS handover schemes in transparent relay and non-transparent relay mode.

In transparent relay operation, MS associated to RS is located within the coverage of MR-BS, and the DL control signal from BS can directly reach MS without RS relaying. RS does not transmit preamble and MAPs. All MSs are synchronized to MR-BS via its preamble, and get DL / UL MAP directly. MS synchronizes to the same preamble before and after the intra-BS handover, and thus no actual handover procedure is performed in MS side. For inter MR-BS handover, MS performs a legacy 16e handover procedure.

As for non-transparent relay, RS has to take the responsibility to transmit a preamble and also MAP at the beginning of the DL sub-frame. Therefore, a MS recognizes it as a BS. MS performs legacy 16e handover procedures and synchronizes to different preambles before and after the intra / inter-BS handover.

Target access station selection is a key step for MR-BS handover to decide a suitable path for a specified MS. Legacy IEEE 802.16e handover decision is based on the access link quality. However, for multi-hop relaying, only access link quality is not enough for the optimal target access station selection. It shall be decided based on the whole path selection from MS to BS, including factors such as quality of radio link (CINR,…), MS power level, multi-hop bandwidth efficiency, hop counts, traffic load and etc. This access station selection is conducted as that MS / RS reports the link status information, and MR-BS makes the final decision as to the selection. The path selection and target access station decision algorithms are beyond the scope of the standard.

For HO access station selection, MR-BS may optionally maintain a candidate set for HO convenience, where the candidate set includes a list of candidate stations that are the potential access stations close to a given MS.

Proposed Text Changes

[Insert the section and figure as follows]

6.3.22.2.10 HO process in MR network

Handover strategies are given to adapt to supported transparent relay and non-transparent relay frame structures. MR-BS makes the determination as to the optimal HO target access station selection. MR-BS may optionally maintain a candidate set for HO convenience, where the candidate set includes a list of candidate stations that are the potential access stations close to a given MS

6.3.22.2.10.1 HO process in transparent relay mode

6.3.22.2.10.1.1 Intra MR-BS HO in transparent relay mode

The intra MR-RS HO transition from one access station to another is performed without invocation of HO procedures described in 6.3.22.2. An intra MR-BS HO example is illustrated in fig. xx. RS performs ink quality measurement and reports to MR-BS per 6.3.25.1. MR-BS makes the decision on optimal access station selection, where the decision is based on the access / relay link qualities, hop counts, and other factors. The path selection and target access station decision algorithms are beyond the scope of the standard. After MR-BS decides to initiate an intra MR-BS HO, it sends RNG_RSP to the given MS for power level, timing advance adjustment to let MS adapt to the target access station.

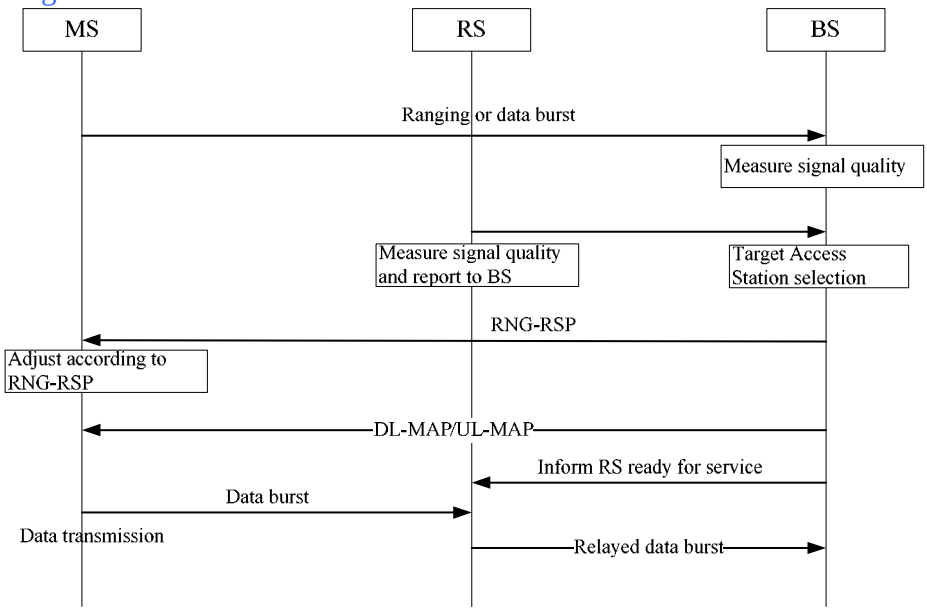

Figure xx - Example of Intra MR-BS HO Process

6.3.22.2.10.1.2 Inter MR-BS HO in transparent relay mode

MS conducts legacy 16e handover procedures from the serving MR cell to the neighbor MR cell per 6.3.22.2. At network reentry, MS shall conduct Handover Ranging per 6.3.10.3.3. Candidate access station performs channel quality measurement and report per 6.3.25.1. Then target MR-BS evaluates and decides the handover target access station, and send RNG_RSP message for MS adjustment, where the procedures are the same as the above intra MR-BS handover.

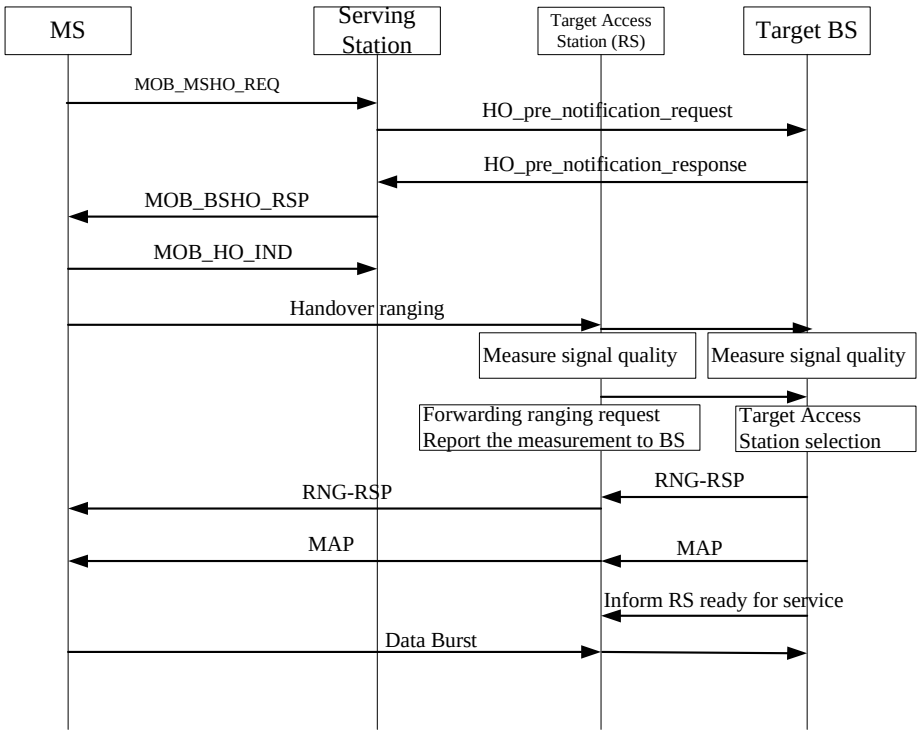

Figure xx. Example of Inter MR-BS HO Process

6.3.22.2.10.2 HO process in non-transparent relay mode

6.3.22.2.10.2.1 Intra MR-BS HO in non-transparent relay mode

This section introduces the intra MR-BS HO in non-transparent relay mode.
RS performs ink quality measurement and reports to MR-BS per 6.3.25.1. MS scans and/or associates with one or more neighbor stations and evaluates the performances for handover target access station selection, where these stations could be BS or its subordinate RSs.

- **Initialize a legacy handover procedure**

When MOB_MSHO-REQ is sent by a MS, the MS may indicate one or more candidate access stations. This MOB_MSHO-REQ message shall be relayed to the serving station, if its access station is a RS. Serving station evaluates the candidate access stations for optimal target access station selection to decide whether RS or BS, or which RS is required for a specified MS access relaying in the initialization or the handover process. The selected candidate access station information may be included into MOB_BSHO-RSP message. This message shall be relayed to the MS, if its access station is a RS.

- **Complete the legacy handover process**

MS performs synchronization to target, ranging, and network re-entry per 6.3.22.2.2. If the handover target is RS, MS just takes it as a BS to conduct legacy handover process. All involved messages shall be forwarded by RS to the MS or BS.

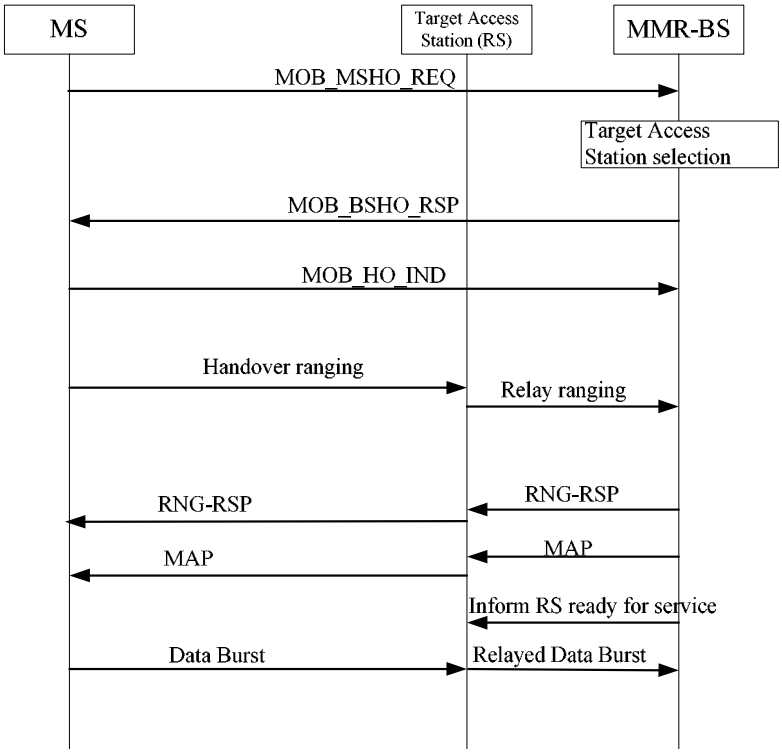

Figure xx, Example of Intra MR-BS Handover from MR-BS to RS

6.3.22.2.10.2.2 Inter MR-BS HO in non-transparent relay mode

This section introduces the intra MR-BS HO in non-transparent relay mode.
RS performs ink quality measurement and reports to MR-BS per 6.3.25.1. MS scans and/or associates with one or more neighbor stations and evaluates the performances for handover target access station selection, where these stations could be BS or its subordinate RSs.

- **Candidate access link quality monitor**

  In the cell reselection, MS conduct performance evaluation for each candidate access station. This link quality information shall be sent to the serving station with / without relaying. Serving station may obtain RS- neighbor BS link status and also the optimal path for each RS to neighbor BS through the exchange of backbone message. Considering RS- neighbor BS path quality and statuses from the neighbor BS, and MS-RS link quality report from MS, BS make a decision as to the optimal target access station selection to make the whole path from MS to BS optimal. The selected candidate access station information may be included into MOB_BSHO-RSP message. This message shall be relayed to the MS, if its access station is a RS.

- **Complete the legacy handover process**

  MS performs synchronization to target, ranging, and network re-entry. If the handover target is RS, MS just takes it as a BS to conduct legacy handover process, except that all messages shall be forwarded by RS with two or more hops to the MS or BS.

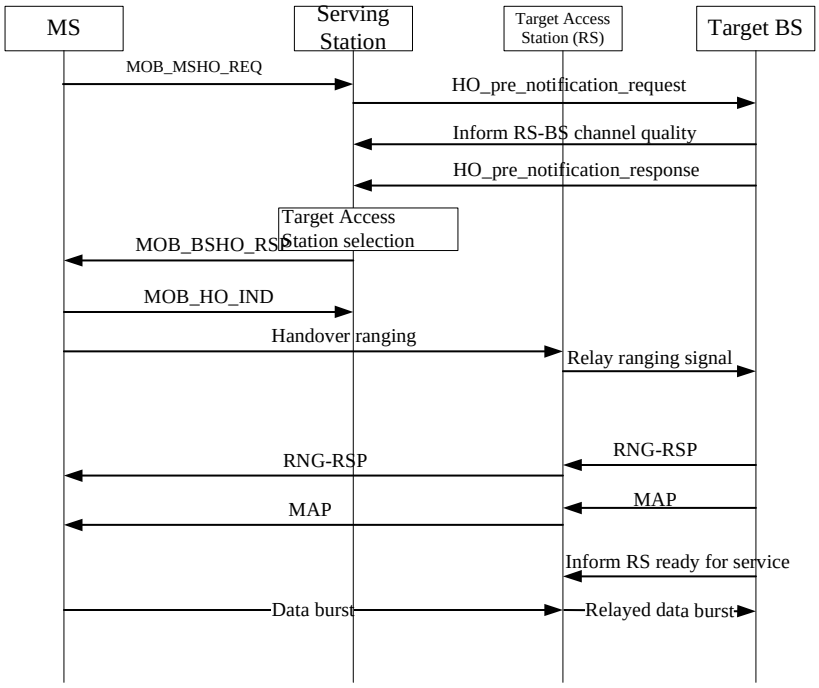

Figure xx, Example of Inter MR-BS Handover

[Insert the text after 6.3.25:]

6.3.25.1 Channel measurement and report

For the network entry and handover, RS monitors and measures MS signal quality (e.g. RSSI, CINR,) within its coverage. The measurement may be scheduled periodically or requested by the serving station or itself. These measurement reports are forwarded to the serving station via RS_LQM message. For saving bandwidth, RS only reports the measurement results if the link quality is more than a threshold. MR-BS may also measure the signal quality of the same MS. This process need not occur in conjunction with any other network entry or HO procedures.

6.3.2.3 MAC management messages

[Insert the following text into this section]

RS Link Quality Measurement (RS_LQM) message

RS is required to measure the link quality between MS and itself periodically or requested by MR-BS or RS. RS may report the measurement results to the MR-BS. These information shall be used for the optimal target access station selection.

The format of the RS_LQM message is depicted as follows Table.

Table - RS_LQM message

Syntax	Size	Notes
RS_LQM_Message_format(){	-	-
Management Message Type=xx	8 bits	-

RS ID	48 bits	Relay station identification.
Number_of_MS	8 bits	Number of MSs measured by this RS
For(j=0;j<Number_of_MS; j++){	-	-
Ranging Code		Optional, CDMA code, only used in the MS initialization and link measurement
MS CID	16 bits	Optional, to identify MS, used except MS initialization and link measurement
Number_of_Metrics	8 bits	Number of metrics measured for a specified MS
Measurement Metrics	8 bits	Bitmap indicating measurement metrics: Bit 0: CINR mean Bit 1: RSSI mean Bit 2: Power level Bit 3: Timing advance Bit 4: Frequency Bits 5-7: Reserved
If (Measurement metric[Bit 0]==1)	-	-
Station CINR mean	8 bits	-
If (Measurement metric[Bit 1]==1)	-	-
Station RSSI mean	8 bits	-
If (measurement metric[Bit 2]==1)	-	-
Power level	8 bits	-
If (measurement metric[Bit 3]==1)	-	-
Timing advance	8 bits	-
If (measurement metric[Bit 3]==1))	-	-
Frequency	8 bits	-
TLV encoded information	variable	Optional
}	-	-
}	-	-

References

[1] IEEE 802.16j-06_016r1, “Proposed Technical Requirements Guideline for IEEE 802.16 Relay TG”
[2] IEEE 802.16j-06_017r2, “Table of Contents of Task Group Working Document”
[3] IEEE C802.16j-06_005r1, “Handover Schemes in IEEE802.16j”