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Title	<b>Handover of Mobile Relay Station</b>	
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Re:	Response to Call for Technical Contributions regarding IEEE 802.16j (IEEE 802.16j-07/007r2).	
Abstract	This document proposes a handover solution for the Mobile RS with its attached MS.	
Purpose	Add the proposed spec changes in the 802.16j Baseline Document (IEEE 802.16j-06/026r2)	
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# Handover of Mobile Relay Station

## Introduction

In an MMR network, a Mobile RS is generally mounted on the vehicle and connected with an MR-BS or other RS via a wireless relay link. MRS provides a fixed wireless access link to MS/SS devices on the vehicle. Moreover, it shall have the capability of handover between neighboring access stations. When a Mobile RS is moving across the coverage of two neighboring access stations, both MRS and its attached MS may experience a handover process. Basically, there are two sorts of MRS handover scenarios in an MR network:

- target access station and serving access station have the same preamble (no scanning, no conventional handover occurred, e.g. transparent MRS performs intra-MR-BS handover)
- the preamble of the target access station is different from that of the serving access station (the procedure is similar to that of an MS, e.g. MRS performs inter-MR-BS handover)

The former case normally is an intra-MR-BS handover. MRS may not need to perform scanning and network re-entry procedures. The handover may be triggered by MR-BS when another potential target access station could provide better radio link quality to the MRS than that of the serving access station. The MRS intra-MR-BS handover may be conducted by the serving MR-BS updating the MAP.

In the second case, MRS may perform the handover procedures similar to that of MS handover defined in 6.3.22.2. In addition, the MRS's attached MSs may also experience handover. When MRS is performing some handover procedures, such as scanning or ranging with the potential target access station, the connection between MRS the serving access station would be interrupted. During this period, all MSs attached to MRS can not send/get data to/from the serving MR-BS. The service continuity of the attached MSs may be interrupted.

This contribution proposes a handover approach and mechanism for transparent Mobile Relay Stations. It not only fully complies with existing handover process defined in IEEE802.16e, but also maintains the service continuity of the MS attached to the MRS.

## Proposed Solution

This contribution proposes a handover solution for the MRS inter-MR-BS handover scenario. In the in-band relay scheme, when Mobile RS is moving across two neighboring access stations, both MRS and its attached MS may experience a handover process. As illustrated in Figure 1, In order to maintain the service continuity of MS, it is proposed to divide the handover process into several steps:

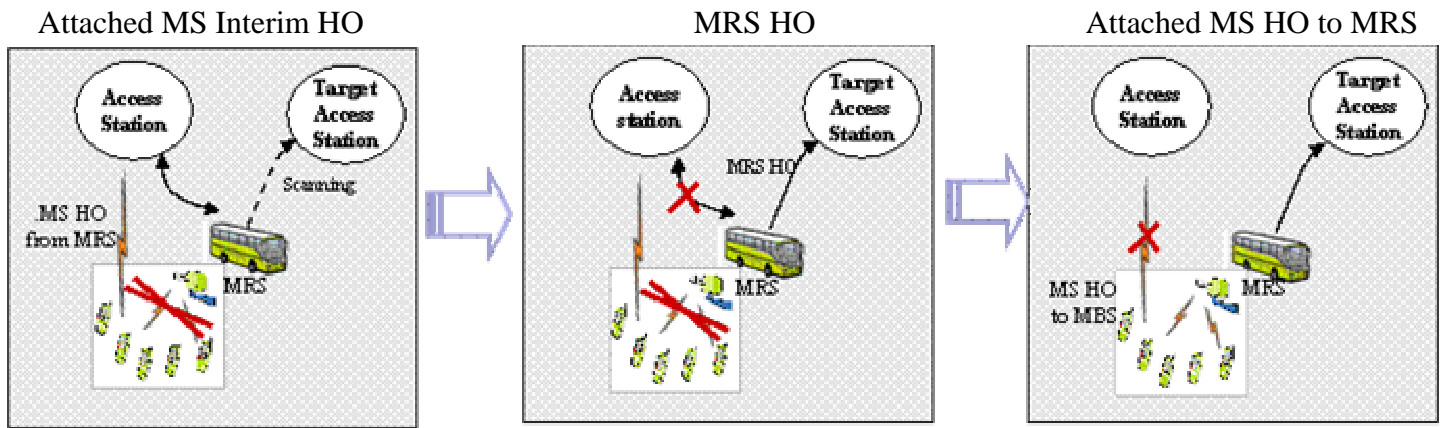
- **MS interim HO.** Before MRS tries to scan potential target MR-BS or RS, the attached MS handover from its access MRS to the target access station, which could be the serving MR-BS or other neighboring RS with better signal quality. This handover could be triggered by decreasing the MRS power level or initiated by the serving MR-BS. If the MRS and the target access station have different preambles, the MS would follow the handover process as defined in section 6.3.22.2.
- **MRS HO.** Following the completion of MS intra-MR-BS HO from MRS to the interim target access station (serving MR-BS or other RS), MRS shall performs cell selection by scanning neighboring target stations. If the HO decision is successfully initiated, MRS would follow the other procedures defined in 6.3.22.2 to complete the HO from the access station to target access station. If the HO trigger condition is not satisfied or it is failed to make the HO decision, the HO process will be canceled and the MRS shall

re-connect with the access station. During MRS HO process, MS keeps communication with the interim target access station rather than the MRS.

- **MS HO to MRS.** After MRS completes the handover process, the quality of the radio link between the on board MS and the MRS would be better than others. Therefore, MS performs the handover from current serving station to MRS. If the MRS and the serving station have different preambles, the MS would follow the handover process as defined in section 6.3.22.2.

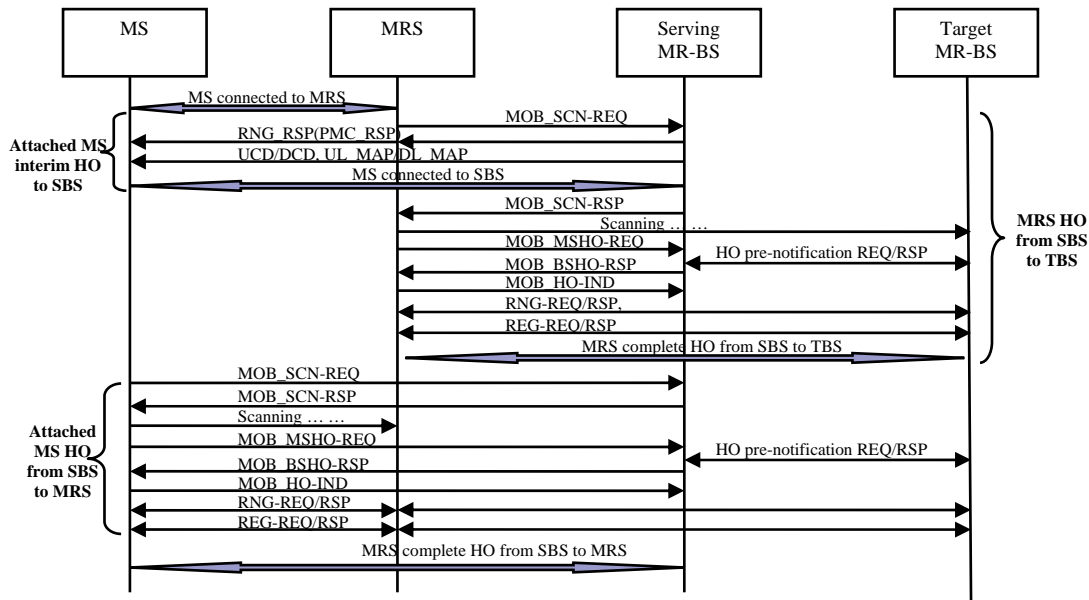
The Mobile RS (MRS) handover process deals with handover of the MRS along with all the attached MSs to a target access station. During the handover process, the MRS performs the procedures with the access station and the target access station in the similar way as an MS does.

The proposed solution is designed for HO of the transparent MRS. And both MRS and its attached MS shall basically follow the similar handover process as described in section 6.3.22.2.



**Figure 1 MRS handover process**

Figure 2 illustrates an exemplary proposed handover procedure for transparent MRS inter-MR-BS handover with its attached MS between two neighboring BSs. Generally, the handover process consists of three steps.



**Figure 2 Procedures of transparent MRS handover with its attached MS**

1. MRS sends MOB\_SCN-REQ to the serving MR-BS to request to perform scanning.
2. The serving MR-BS updates the power and the radio resource allocation by sending the updated RNG\_RSP and UL\_MAP/DL\_MAP to the MSs attaching to the MRS.
3. MR-BS sends MOB\_SCN-RSP to MRS to initiate MRS scanning.
4. MRS performs scanning potential Target MR-BS.
5. When the HO criterion is met, MRS sends MOB\_MSHO-REQ to the Serving MR-BS to request to initiate handover.
6. Upon getting MOB\_MSHO-REQ message from MRS, the Serving MR-BS shall negotiate with the potential target MR-BS to exchange the related parameters over the backbone network.
7. The Serving MR-BS sends MOB\_BSHO-RSP to the MRS to acknowledge the handover request from MRS.
8. MRS transmits MOB\_HO-IND to the serving MR-BS as the indication that MRS handoff from the serving MR-BS to the target MR-BS.
9. MRS performs ranging with the target MR-BS by sending RNG-REQ and getting RNG-RSP message from the target MR-BS.
10. MRS performs network re-entry by exchanging the messages of REG-REQ and REG-RSP with the target MR-BS.
11. The MS performs the handover procedures as defined in 6.3.22.2 to handoff from the serving MR-BS to the MRS.

## Conclusion

This proposal provides a solution for the handover of MRS with its attached MS. It can support the handover of transparent MRS, and requires less modification on the existing handover procedures defined in IEEE Std. 802.16e. The service continuity of the MRS's attached MS can be maintained.

## Proposed text changes

+++++++ start text proposal ++++++

*[Make the indicated modifications to section 6.3.22:]*

### 6.3.22 MAC layer handover procedures

This subclause contains the procedures performed during handover (HO).

An MS shall be capable of performing handover using the procedures defined in 6.3.22.2.

[A Mobile RS shall be capable of performing handover using the procedures defined in 6.3.22.2.](#)

The handover process defined in this subclause may be used in a number of situations. Some examples are as follows:

- When the MS or the MRS moves and (due to signal fading, interference levels, etc.) needs to change the BS to which it is connected in order to provide a higher signal quality;
- When the MS or the MRS can be serviced with higher QoS at another BS;

The handover decision algorithm is beyond the scope of the standard.

*[Insert the new subcluse 6.3.22.4]*

#### 6.3.22.4 Mobile RS HO

The subclause defines the MRS HO process in which an MRS with its attached MS migrates from the air-interface provided by the serving station to the air-interface provided by the target station. The HO process consists of the following stages:

- Interim HO of the attached MS. All MSs attached to the MRS performs handover from the MRS to another access station (e.g. serving MR-BS) that provide the access to the attached MS when MRS performs neighboring scanning and other handover procedures;
- MRS HO. MRS performs scanning and other handover procedures that are similar to the MS handover procedures defined in 6.3.22.2, and synchronize to the target station as the HO decision indicates;
- Attached MS handover back to MRS. The MS originally attached to the MRS performs the procedures defined in 6.3.22.2 to handover to the MRS from other stations. The handover can be triggered by either MOB\_MSHO-REQ or MOB\_BSHO-REQ.

+++++ *End of text proposal* +++++

## Reference

- [1] IEEE C802.16j-06/051, Recommendations on IEEE802.16j Technical Requirements