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Title	**Handover Optimization: Reduction in HO interruption latency for IEEE 802.16eRev2**
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Re:	IEEE 802.16 Rev2
Abstract	Within the framework, IEEE standard 802.16 Rev2we propose a handover optimization method for 802.16 Rev2
Purpose	To discuss and include the proposal in 802.16 Rev2
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Reduction in HO interruption latency for IEEE 802.16e Rev2

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1. Introduction

There are ongoing efforts in 802.16 Rev2 maintenance group to improve the overall handover performance. This contribution outlines a technique to improve the handover interruption latency. A considerable, around 15-20%, latency improvement is achieved using this technique.
We propose that the proposed method below be included in IEEE 802.16e Rev 2.

2. HO Background in existing IEEE 802.16e & subsequent revisions

Current Existing Handover (HO) techniques, in Mobile WiMax technology involves two steps in handover procedure i.e. the two steps being the handover preparation step and handover execution step. Figure 1 shows the existing, optimized signaling flow for the MS initiated hard handover, intra FA, non-collocated, fully optimized network reentry procedure that uses RNG_REQ/RES signaling message [1]. As shown in the Figure 1, the HO involves three nodes MS, Serving BS and Target BS. The figure below shows the handover procedures and processing time estimated in frames.

HO preparation time is defined as the time delay from the time to decide handover by either MS or serving BS to when the MS sends the MOB_HO_IND message to serving BS. The interruption time is a time delay from when MS transmits the MOB_HO_IND message to its serving BS and then does not transmit or receive the traffic data anymore to when the MS starts to exchange the traffic data with its target BS as shown in Figure 1.

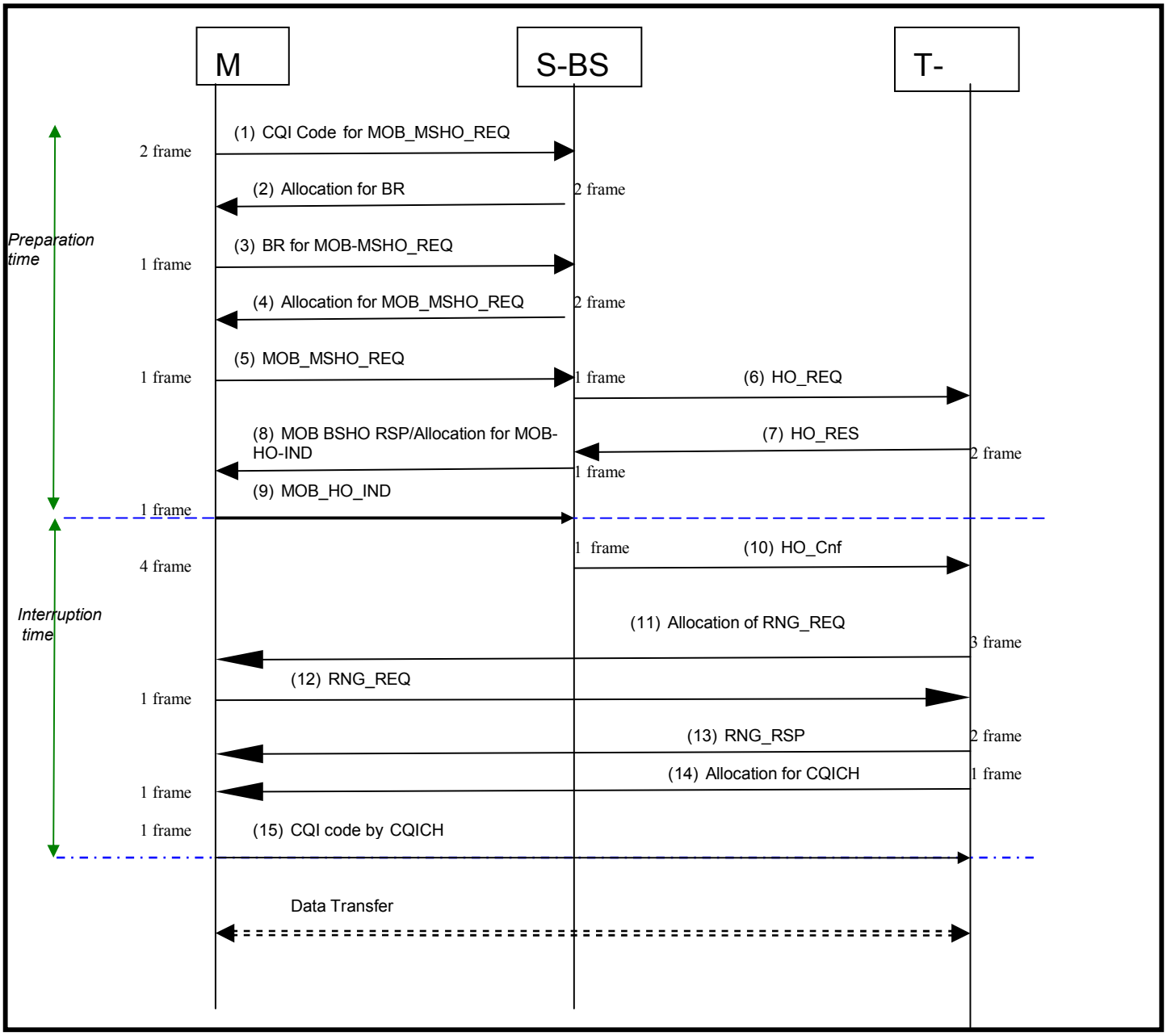

Figure 1 MS initiated hard handover, intra FA, non-collocated Handover Scenario

In the scenario of figure 1, the handover interruption latency of the Reference WirelessMAN OFDMA system is shown in terms of frame numbers [1]. Please note that 4 frames elapse during the attempt to read the 'allocation for RNG-REQ' message.

3. Proposed method for HO interruption time Reduction

Figure 2 shows the MSC for the proposed handover method. This method minimizes the handover interruption time upto 2 to 3frames (around 20% improvement) as shown in figure 2.

This Proposal shifts one of the signaling flow from the handover step 2 (interruption time) to the step 1 (preparation time). Moreover, this message, "Allocation for RNG_REQ" is piggybacked over backbone between BS-S and BS-T. This message is further piggybacked by the BS-S to the MS in the message MOB_BSHO_RSP/Allocation for MOB_HO_IND as an IE. This results in considerable reduction of HO

interruption time as well as processing time at MS. This in tern results in a lesser buffer requirement at MS during HO interruption phase.

The message from BS-T to MS: "Allocation for RNG_REQ" is shifted from interruption step (fig1) to HO preparation step as shown in figure 2. This means that the BS-T allocates the exact UL slot (code, frame number etc, for MS in advance. The UL slot IE carries information such as code, sub-channel, frame number etc to the MS. BS-T allocates k consecutive frame numbers for MS in which it can make a dedicated request. Value of k could be 1 to 2 frames. The number of frames allocated by BS-T shall take into consideration the action time. The UL Slot IE is, then piggybacked by BS-Ts to BS-S in HO_RSP message. BS-S then piggybacks this IE in MOB_HO_RES message as shown in figure 2. This way, with exact allocation the MS avoids having to search & decode and process the allocation IE in UL MAP, sent by target BS, as shown in Figure 1.

MS having received the UL slot IE, constructs the ranging request message based on this IE, selects the BS for handover, synchronizes with selected target BS, sends the MOB_HO_IND message to the serving BS. MS then immediately sends the dedicated ranging request to target BS in a given frame number.

The procedure is explained as shown in figure 2 MSC.

1. The Target BSs allocates the 'UL slot IE' to the MS with all the required information (code, frame number etc). This is complete UL slot IE information that a MS needs in order to make a dedicated ranging request.
2. The target BSs piggybacks the "UL Slot IE" IE with the HO_Res messages that is intended for the serving BS over the backbone interface.
3. The Serving BS, upon reception of this message from all the relevant target BSs, piggybacks these IEs to MS with the MS_BSHO_RSP message, over the air interface. MS_BSHO_RSP message may contain more than one UL Slot IEs allocated by the number of Target BSs.
4. The MS, upon reception of 'UL slot' IEs, selects the target BS and makes sure it has synchronizes with BS-T, reads the current frame number. MS then terminates the connection with BS-S in MOB_HO_IND message and immediately sends the RNG_REQ message in the given frame number (UL Slot IE) to selected BS-T in the UL slot acquired earlier. MS may send MOB_HO_IND message to S-BS and RNG_REQ message to T-BS in any order as follows. MS may send the RNG_REQ message to T-BS just prior to sending the MOB_HO_IND or it may send it in parallel and or normally.

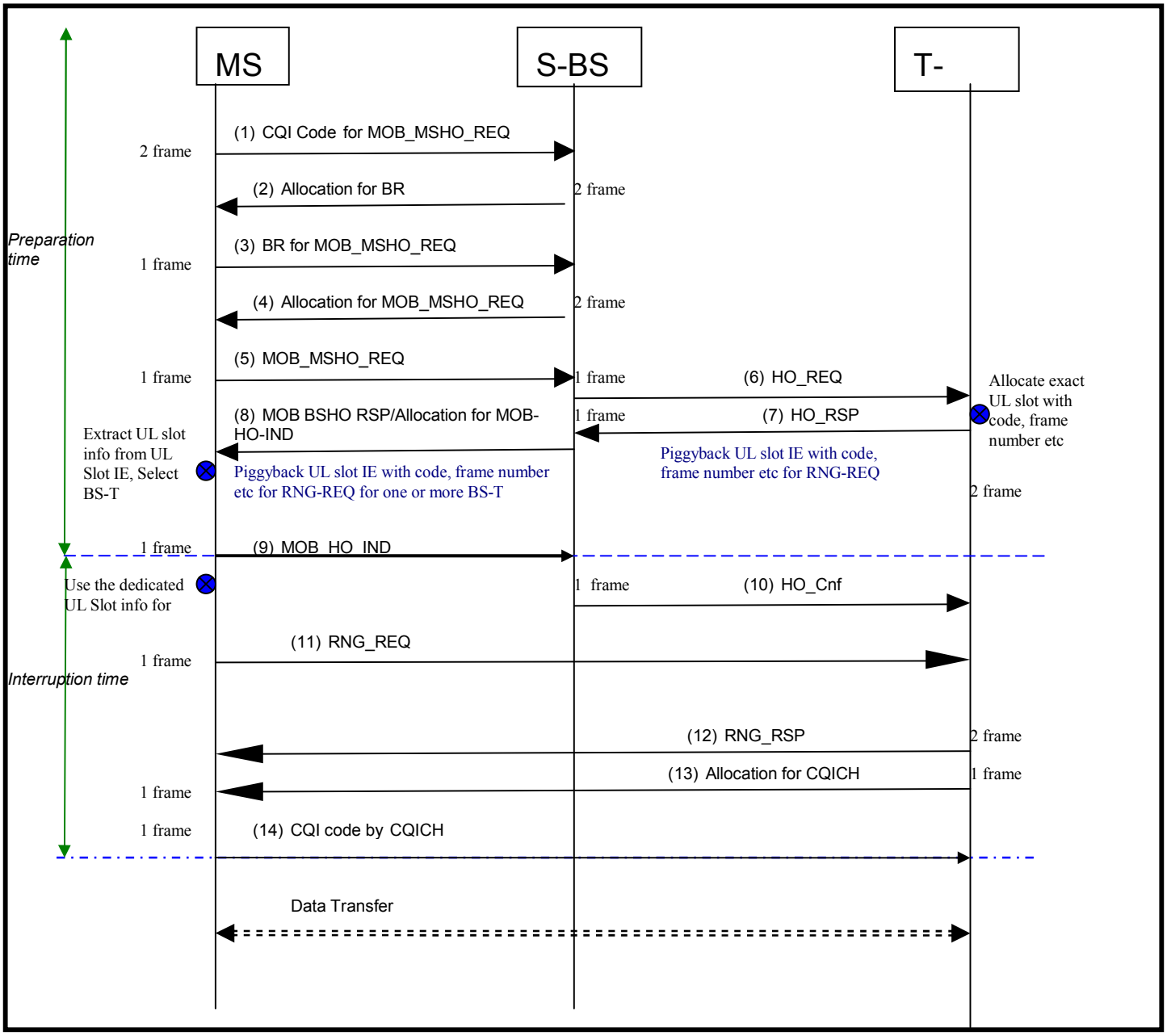

Figure 2: Showing the 'UL slot allocation' of T-BS in HO preparation phase.

New IEs are needed. MOB_BSHO_RSP message and HO_RSP message carries 'UL Slot IE'. Additionally a new 1-Bit indicator 'Allocation for BS-T RNG_REQ' in the MOB_BSHO_RSP message is required. If it is enabled then MS reads the piggybacked message IE, extracts the UL slot information for each target BS and then selects the Target BS and uses this slot to make a ranging request to the selected BS-T.

3.4 Proposal

We propose that the proposed method be included in the IEEE802.16 Rev2.

References

[1] ITU-R document R03-WP8F-C-1199MSW-E[1]

[2] WiMAX Forum Network Architecture – Stage 3 – Detailed Protocols and Procedures - Release 1.1.0

[3] NWG_R1.1.0-Stage-3-Annex-R6-R8-ASN-Anchored-Mobility-Scenarios