Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Enhancement to the BS-initiated Handover**
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Re:	This contribution is response to call for contribution about IEEE802.16e-D2
Abstract	This contribution is to propose a network-assisted BS-initiated HO in order to make it short the HO execution time.
Purpose	Discuss and Adopt the advanced feature for BS-initiated HO in the IEEE802.16e group.
Notice	
Release	
Patent Policy and Procedures	

Enhancement of BS initiated Handover

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1. Problem Statement

Currently, a hand-over (HO) procedure can be initiated by MSS or BS in IEEE P802.16e/D2. The MSS-initiated HO generally begins by sending a MOB-MSSHO-REQ message after an MSS detects a need to hand-over based on the result of prior scanning operations. Then its Serving BS asks the neighbor BSs whether they can afford to serve the MSS with appropriate QoS and bandwidth (HO-pre-notification and HO-pre-notification-response handshake). On the other hand, the BS-initiated HO is decided by the Serving BS, which then performs a HO-pre-notification and HO-pre-notification-response handshake with its neighbor BSs. Including the resulting list of possible Target BSs, the Serving BS sends a MOB-BSHO-REQ message to the MSS. This message initiates the scanning operation with the listed BSs in order to select the best candidate. Measured CINR mean values for the BSs which are contained in the MOB-MSSHO-RSP message are then sent to its Serving BS. And finally, the MSS sends a MOB-HO-IND message to notify its Serving BS of the beginning of its hand-over to a selected Target BS.

The BS-initiated HO requires the two procedures – HO-pre-notification/HO-pre-notification-response transaction (say SLP handshake hereafter) and scanning – after a HO decision is made. Compared with the MSS-initiated HO which requires only the SLP handshake, it may take more time to complete HO. Moreover, the number of candidate Target BSs resulted from the SLP handshake may be larger than that from the scanning. This means that the scanning operation for the candidate BSs in the MOB-BSHO-REQ message may also consume a lot of time. Consequently, the BS-initiated HO – may be quite urgent caused either by load balancing or severe uplink channel degradation – takes relatively more time than the MSS-initiated HO. In order to solve this problem, we propose a network-assisted HO option that saves some time to perform the BS-initiated HO.

2. Proposed Remedy

The network-assisted HO has the following features deviating from the normal BS-initiated HO procedure:

1. A Serving BS may send HO-confirm backbone messages to all the candidate BSs decided by the SLP handshake and included in the MOB-BSHO-REQ message. This makes the candidate BSs schedule the MSS and reserve UL resource for it.

2. When an MSS receives a MOB-BSHO-REQ message with a Network-Assisted-HO-supported flag set, it may skip a MOB-MSSHO-RSP message and immediately send a MOB-HO-IND with its Target_BS_ID set to a predefined value, which notifies its Serving BS of its intent to do the network-assisted HO.

3. The MSS may then scan the candidate BSs. If it can find any candidate BS with suitable CINR value, it may synchronize with the BS and do the network re-entry procedure even before scanning all the candidate BSs. Of course, it may select the best candidate BS after completing the scanning operation.

4. The MSS doesn't need to go back to its Serving BS, since there is no need to send any message to the Serving BS. That can save additional time for synchronization, DL_MAP/UL_MAP read, and Ranging, if needed.

5. After or during the network re-entry procedure, the selected Target BS has to communicate with the Serving BS for

various reasons such as authenticating the MSS and obtaining its context. Then the Serving BS sends HO-withdraw messages to the candidate BSs except the actual Target BS. That message serves to explicitly notify them that the reserved resources for the MSS are no longer needed, so that they shall release the resources.

The advantages of the proposed network-assisted HO are as follows,

- Backbone operations such as the SLP handshake and its subsequent UL scheduling can be executed parallel to the MSS's Scanning operation.

- MSS may not scan all the candidate Target BSs.

- MSS doesn't need to send any messages to its Serving BS after the Scanning operation.

- If MSS should hand-over to a BS other than the selected Target BS because of some problems during normal HO, it should send RNG-REQ messages in a random access fashion. Even in such a case, the network-assisted HO can provide Fast_UL_raning_IE's, if the re-selected Target BS is in the candidate list.

The possible shortcoming is the waste of reserved resources of the candidate BSs except the selected Target BS. Since the Serving BS sends HO-withdraw messages to the BSs immediately after noticing the final selection of the Target BS, the reservation can be kept to a minimum.

3. Proposed Text Changes

6.3.2.3.53 BS HO Request (MOB_BSHO-REQ) message

[Modify Table 92g in Page 23, Line 10 – MOB_BSHO-REQ Message format as follows]

Table 92g --- MOB_BSHO-REQ Message Format

Syntax	Size	Notes
MOB_BSHO-REQ_Message_Format() {		
Management message type = 52		
Network Assisted HO supported	1 bit	Indicates that the BS supports Network Assisted HO
For(j=0; j<N_Recommended; j++) {		N_Recommended can be derived from the known length of the message
Neighbor BS-ID	48 bits	
Service level prediction	8 bits	
}		
reserved	7 bits	Reserved; shall be set to zero
}		

A BS shall generate MOB-BSHO-REQ messages in the format shown in Table 92g. The following parameters shall be included in the MOB-BSHO-REQ message:

Network Assisted HO supported

This 1-bit flag indicates that the Serving BS supports the Network-Assisted HO features. The MSS may select any BS among the recommended BSs without notifying the Serving BS of a selected Target BS. The following applies;

            0 = Network Assisted HO is not supported

            1 = Network Assisted HO is supported

For each recommended neighbor BS, the following parameter shall be included:

Neighbor BS-ID

    Same as the Base Station ID parameter in the DL-MAP message of neighbor BS. This may include the Serving BS.

Service level prediction

This value indicates the level of service the MSS can expect from this BS. The following encodings apply:

    0 = No service possible for this MSS

    1 = Some service is available for one or several Service Flows authorized for the MSS.

    2 = For each authorized Service Flow, a MAC connection can be established with QoS specified by the AuthorizedQoSParamSet.

    3 = No service level prediction available.

[Modify the paragraphs in Page 46, Line 1 thorough 16:]

6.3.20.2.2 HO decision & initiation

A hand-over begins with a decision for an MSS to hand-over its air interface, service flow, and network attachment from a Serving BS to a Target BS. The decision may originate either at the MSS, the Serving BS, or on the network. The HO Decision begins with a notification of MSS intent to hand-over through either MOB-MSSHO-REQ or MOB-BSHO-REQ MAC Management messages. The HO notification is recommended, but not required. The HO notification may originate with either the Serving BS or MSS. Acknowledgement with MOB_BSxxxHO-RSP of a notification is required, but one with MOB_MSSHO-RSP is recommended but not required.

If an MSS that transmitted a MOB_MSSHO-REQ message detects an incoming MOB_BSHO-REQ message, it shallmay respond with a MOB_MSSHO-RSP message and ignore its own request. Similarly, a BS that transmitted a MOB_BSHO-REQ message shall ignore any MOB_MSSHO-REQ messages from the same MSS and shall await a MOB_MSSHO-RSP message or MOB_HO-IND message, or retry the MOB_BSHO-REQ message.

[Insert the following paragraph in Page 46, Line 32 as follows]

If **Network Assisted HO supported** flag is set to "1" in MOB-BSHO-REQ message, MSS may perform a hand-over to any BS among the recommended BSs in MOB_BSHO-REQ without notifying the Serving BS of a selected Target BS. As an acknowledgement to the MOB-BSHO-REQ message, the MSS may send a MOB-HO-IND message with its Target BS ID set to a pre-defined value other than any valid BS identifier. A MOB-MSSHO-RSP message may not be sent in this case. The Serving BS may send HO-confirm messages to the recommended BSs even before receiving the MOB-HO-IND message in order to make the BSs to reserve Fast_UL_ranging_IE for the MSS. This reserved UL resource may be released by the explicit backbone message, HO-withdraw.

[Insert the following to the end of D.2.10 in Page 103, Line 25:]

D.2.11. HO-withdraw message

This message may be sent from the Serving BS to the neighbor BSs, which are selected as recommended Target BSs by the Serving BS but not chosen as the actual Target BS by the specified MSS. The message is typically valid when the Network-Assisted HO is performed. The message serves to explicitly notify the BSs that HO event is not supposed to happen to them, thus they shall release the UL resources reserved for the MSS. The message contains the following information:

Field	Size	Notes
Global Header	152-bit	
For (j=0; J<NUM Records; j++)		
MSS unique identifier	48-bit	48-bit universal MAC address of the MSS (as provided to the BS on the RNG-REQ message)
}		
Security field	TBD	A means to authenticate this message

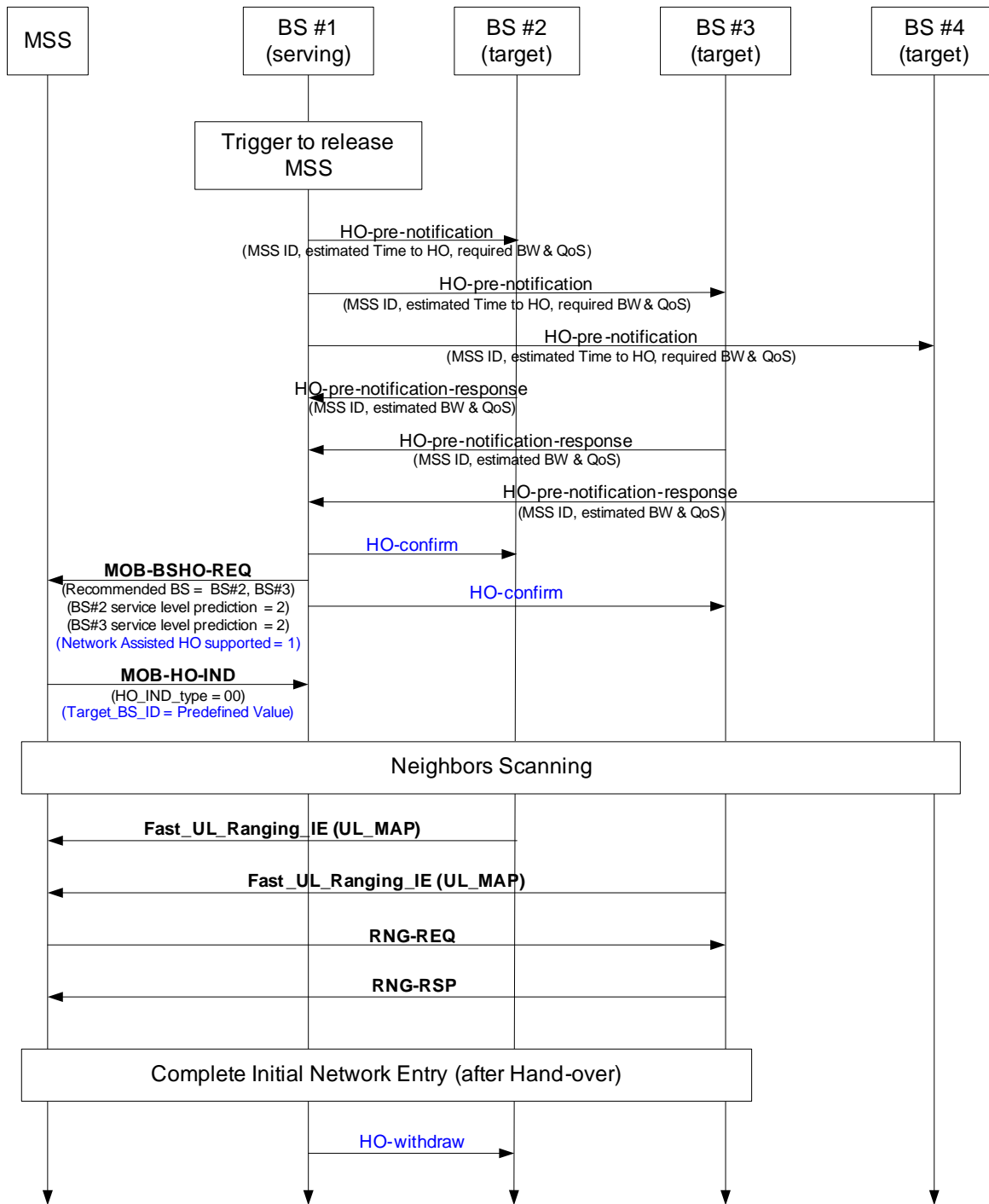*[Add the following figure to the end of E.1 in Page 116, Line 51:]*

Figure E.11 Example Network-assisted HO process by BS request and MSS decision of Target BS