Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**IEEE 802.16e HO options for forcing and suggesting HO**
Date Submitted	**2003-09-04**
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Re:	The contribution corresponding to commentary 109 sub-item 3
Abstract	This contribution is to provide an option of forcing handoff or suggesting handoff, and option for the MSS to reject a suggestion. And this contribution is an answer for commentary 109 which had been discussed in the last meeting.
Purpose	Handoff Ad Hoc draft proposal for the IEEE802.16e group.
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IEEE 802.16e HO options for forcing and suggesting HO

Sungjin Lee, Jungje Son, Changhoi Koo

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1. Introduction

Current draft document [1] describes mainly focused on basic HO procedures from HO initiation to initial entry completion with new BS. According to the current HO AdHoc draft document [1], it is assumed that the MSS should handoff to target BS if the MSS or BS decide to trigger HO procedure once at the initial step of HO. Therefore, the MSS that is once decided to trigger HO procedure and send MOB_HO_REQ message to Serving BS could not cancel or reject the HO procedure, nevertheless the HO environment is changed.

The most case of the HO environment change is the irregularity of MSS movement direction. In mobile environment, the MSS irregularly moves toward inbound or outbound of the cell. In that case, even if the MSS or BS once decide to trigger HO procedure based on a HO condition at the initial step, the condition could be changed at any time while the HO procedure is being proceeded between MSS, Serving BS and Target BS. The scenario for this practical case is shown in Figure 1.

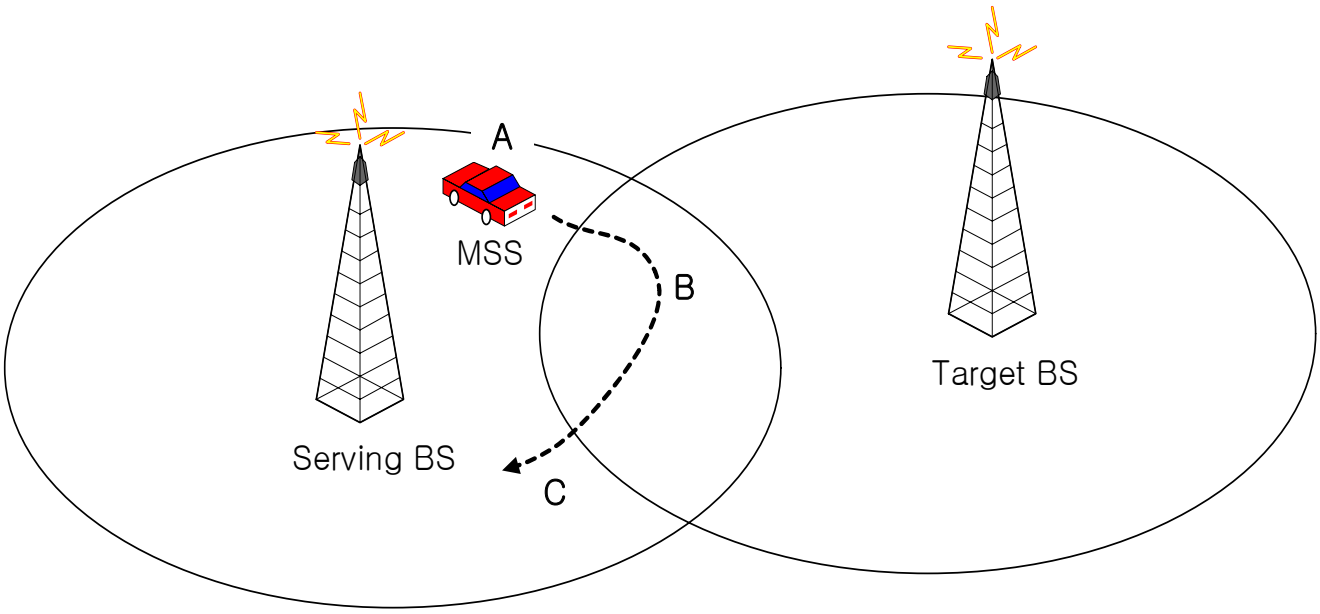

Fig1. Scenario of MSS turns back movement case

In figure 1, the MSS decided to trigger HO process when arrives at the location A so that it starts scanning neighbor BSs after exchanging MOB_MOB_REQ and MOB_SCN_RSP messages with serving BS. At the next step the MSS arrives at B lIocation and send MOB_HO_REQ message to Serving BS and wait until it receives MOB_HO_RSP message from Serving BS including Target BS information that is gathered from HO_notifications and response HO procedure. The Serving BS exchanges HO_notification

and response messages with Target BSs and then send the MOB_HO_RSP message toward MSS in the cell. At this time, the MSS moves back to location C and recognize that it is not in the HO situation anymore. Since there could be many cases that is needed to stop or cancel HO procedure depends on the situation changes, although the HO process is already started. In order to provide the functionality of HO cancellation in the HO condition changes such as scenario described in Fig 1, we propose cancellation option using extended MOB_HO_IND message in current HO AdHoc draft document. We also propose reject option in addition to cancel option in order to provide reject functionality for MSS to reject the unsatisfied contents and parameters that are included in MOB_HO_RSP message.

On the other side, the BS also needs to force the HO of MSS in some cases such as load balancing between BSs. The HO described in current HO AdHoc document is only considering normal HO case that the Serving BS provides information of target BSs and the MSS is supposed to handoff to target BS choosing one of the target BS listed in the MOB_HO_RSP. Since there need to clarify the meaning of MOB_HO_RSP transmitted from the BS whether the BS is just suggesting available target BS list or restrict the decision of MSS and force the MSS to handoff to target BS, we also propose forced HO functionality to provide clear meaning of BS initiated message. The cancel, reject and forcing functionality we simply addressed above are not include new message format, but insert a couple of bits in the messages which is currently defined and formed in HO ADHoc draft document[1].

2. Proposed Options to Force and Cancel the HO

To extend current HO functionality for some cases not covered current draft[1] we utilize existing messages as listed below.

- **MOB_HO_IND**
  - Serving BS release (existing)
  - HO cancel option (proposed)
  - HO reject option (proposed)
- **MOB_HO_RSP**
  - HO suggesting option (existing)
  - HO forcing option (proposed)
- **HO_notification_confirm**
  - HO notification confirm (existing)
  - HO cancel (proposed)

1.1 MOB_HO_IND

To extend current MOB_HO_IND message format in [1], we define additional two bits, HO_IND_type field, into MOB_HO_IND as the table 1.

Table 1. HO_IND_type field

Bits	option	Meaning
00	Serving BS release	Report from MSS to BS that the MSS received MOB_HO_RSP message correctly and will handoff to target BS so that the BS can release the connection with the MSS.
01	HO cancel	The MSS cancel the HO and continues to connect to the serving BS
10	HO reject	MOB_HO_RSP is received correctly but not satisfy the MSS requirements to handoff.
11	reserved	Reserved for the future use.

1.1.1 Serving BS release

Same with existing MOB_HO_IND message in [1]. Report that the MSS received MOB_HO_RSP and would start HO procedure with Target BS listed in MOB_HO_RSP message. The BS can release the connection with the MSS

1.1.2 HO cancel option

The MSS cancel the HO procedure. All the process related the HO of the MSS are requested to stopped and canceled. The MOB_HO_IND message include this HO cancel option can be transmitted to the BS at any time in the HO procedure not only after receiving MOB_HO_RSP as [1]. However, if the MOB_HO_RSP is transmitted with forcing HO option, the MSS cannot use this cancel option.

1.1.3 HO reject option

The MSS received MOB_HO_RSP message correctly but not satisfy with the target BS list so that the MSS reject the MOB_HO_RSP then send target BS list again. However, if the MOB_HO_RSP is transmitted with forcing HO option, the MSS cannot use this reject option.

1.2 MOB_HO_RSP

To extend current MOB_HO_RSP message format in [1], we define additional one bit, HO_type field, into MOB_HO_RSP as the table 1.

Table 2. HO_type field

Bits	option	Meaning
0	Suggesting HO	The BS transmit MOB_HO_RSP message with suggested target BS information but there is no restriction about HO
1	Forcing HO	The BS transmit MOB_HO_RSP message with restricted target BS information so that the MSS should handoff to one of the target BS.

1.2.1 Forcing HO

If this option is included in the MOB_HO_RSP message, The MSS should try handoff to the target BS listed in the MOB_HO_RSP message and cannot cancel or reject this MOB_HO_RSP.

1.2.2 HO suggestion

If this option is included in the MOB_HO_RSP message, the MSS can choose one target BS from the target BS list of MOB_HO_RSP message.

1.3 HO_notification_confirm

To extend current HO_notification-confirm message to provide the HO cancel functionality, we define one bit notification_type field into HO_notification-confirm message as Table 3.

Table 3. Conirmation_type field

Bits	option	Meaning
0	HO notification confirm	Same as existing HO_notification-confirm message in HO ADHoc draft document.
1	HO cancel	HO is cancelled. The MSS will not handoff to the target BS

1.3.1 HO notification confirm

If confirmation_type field is set to '0' the HO_notification-confirm message works as the notification of HO. Upon receiving this meesage, the target BS should be ready for the handoff.

1.3.2 HO cancel

If confirmation_type field is set to '1' the HO_notification-confirm message notify that the HO is cancelled. Therefore the target BS that is received this message does not wait until the handoff occurs. If the target BS reserved resources for the upcoming handoff, it should be released.

3. Text to be inserted to standard

1.3.1.2.2.3 HO cancellation

After the MSS or BS initiate HO, the MSS can cancel the HO at any time if the MSS is still connected to the serving BS and as far as the HO is not completed yet. The MSS cancel the HO by transmitting the MOB_HO_IND message with the HO_cancel option (HO_Type=01)

~~1.2.1.2.2.3~~1.3.1.2.2.4 Termination with the serving BS

After the [MSS/BS]HO-REQ/HO-RSP handshake is completed, the MSS may begin the actual HO. This is done by sending a HO-IND MAC message with the serving BS release option (HO_type=00).

Upon reception of a HO-IND MAC message, the BS may check the HO_type field. If the HO_type field has the value of 00(serving BS release option), the BS may close all connections and discard MAC state machines and MPDUs associated with the MSS.

1.3.1.2.2.5 HO rejection

Upon reception of a HO-IND MAC message, the BS may check the HO type field. If the HO type field has the value of 01(HO reject option), the BS may reconfigure target BS list and retransmit MOB_HO-RSP

message including new target BS list

6.2.2.3.48 HO Response (MOB_HO-RSP) message

Either an MSS or a BS shall transmit an MOB_HO-RSP message upon reception of MOB_HO-REQ message. The message shall be transmitted on the basic CID.

Table 56ai--- MOB_HO-RSP Message Format

Syntax	Size	Notes
MOB_HO-RSP_Message_Format(){		
Management Message Type=53	8 bits	
HO type	1bit	
Estimated HO time	8 bits	
N_Recommended	8 bits	
For (j=0;j<N_NEIGHBORS;j++){		
Neighbor BS-ID	48 bits	
service level prediction	8 bits	This parameter exists only when the message is sent by the BS
}		
}		

A BS or MSS shall generate MOB_HO-RSP messages in the format shown in Table 56ai. The following parameters shall be included in the MOB_HO-RSP message,

HO_type – the type of this MOB_HO-RSP message whether it is forcing HO or suggesting HO
0 = Suggesting HO
1 = Forcing HO
Estimated HO time – Estimated number of frames until the HO will take place. A value of zero in this parameter signifies that this parameter should be ignored.
N_Recommended – Number of recommended neighbor BS

For each recommended neighbor BS, the following parameters shall be included,
Neighbor BS-ID – Same as the **Base Station ID** parameter in the DL-MAP message of neighbor 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 the MSS.

2 = Service with QoS specified at ASA server (for the MSS identified by the 48-bit MAC address) is available.

6.2.2.3.49 HO Indication (MOB_HO-IND) message

An MSS shall transmit a MOB_HO-IND message for final indication that it is about to perform a HO. When MSS cancel the HO, the MSS also shall transmit a MOB_HO-IND message with HO_IND type field value of 01. The message shall be transmitted on the basic CID.

Table 56aj—MOB_HO-IND Message Format

Syntax	Size	Notes
MOB_HO-IND_Message_Format(){		
Management Message Type=54	8 bits	
HO_IND_type	2 bits	00 : Serving BS release 01 : HO cancel 10 : HO reject 11 : reserved
TLV Encoded Information	Variable	TLV specific
Target_BS_ID	48 bits	
}		

An MSS shall generate MOB_HO-IND messages in the format shown in Table 56aj. If Privacy is enabled, the MOB_HO-IND message shall include the following TLV value,

HMAC Tuple (see 11.4.10 in IEEE 802.16-2001) – The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender).

C.2.7 HO-notification-confirm message

This message is sent from one BS to another BS, typically in response to an *HO-notification-response* message. The message servs to provide the BS that sent the *HO-notification-response* message with information about the level of service and capability. The message contains the following information:

Table C8—HO-notification-confirm Message

Syntax	Size	Notes
Global Header	152-bit	
For (j=0;j<Num Records;j++){		

MSS unique identifier	48 bit	
QoS Estimated	8 bit	
BW Estimated	8 bit	
Notification confirm	1 bit	0 : notification confirm 1 : HO cancel
}		
Security field	TBD	
CRC field	32 bit	

D.1 Handoff MSCs

D.1.1 Neighbor advertisement

D.1.2 Handoff

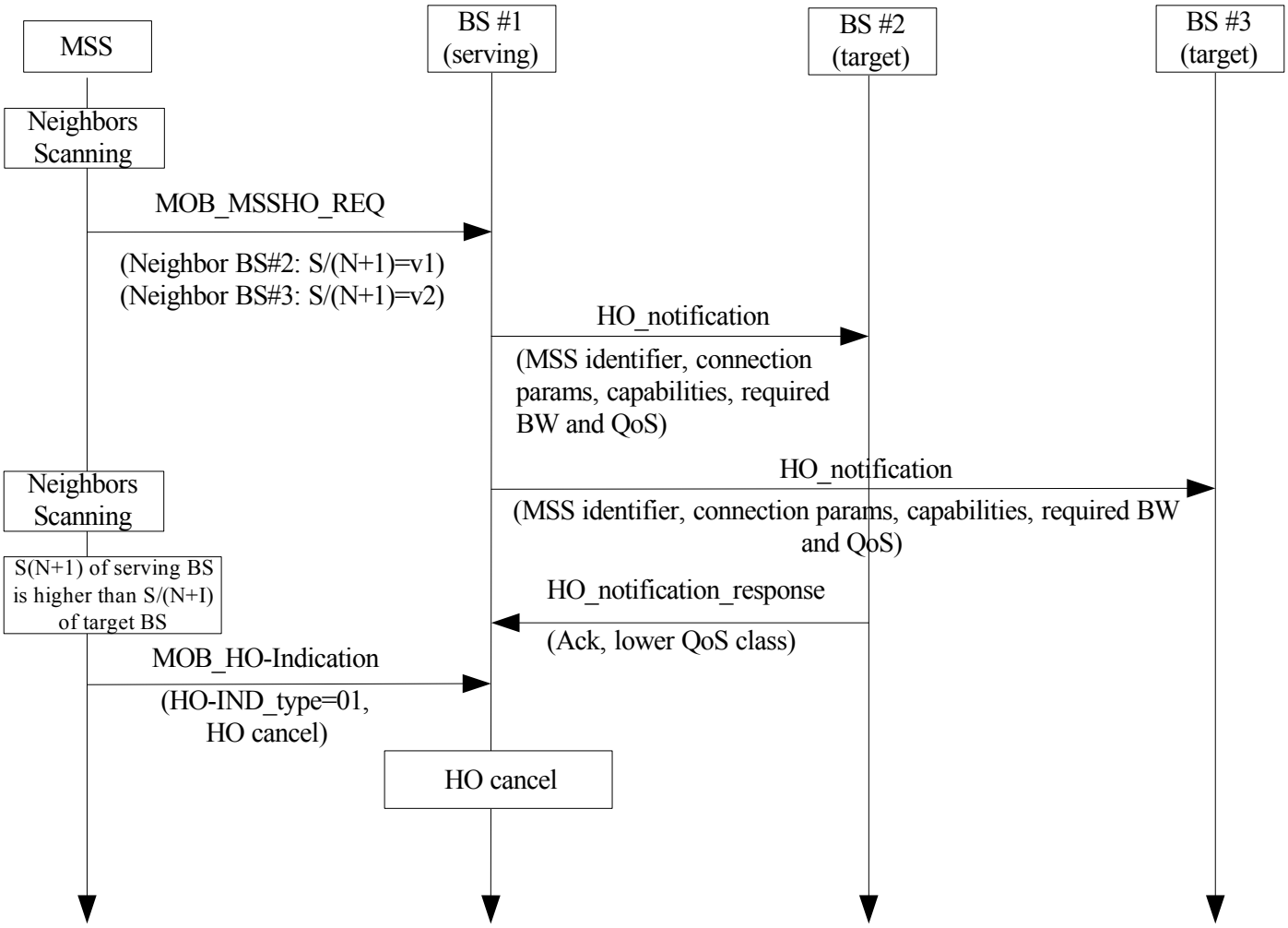

Figure D.4 – HO cancellation before HO_notification-confirm

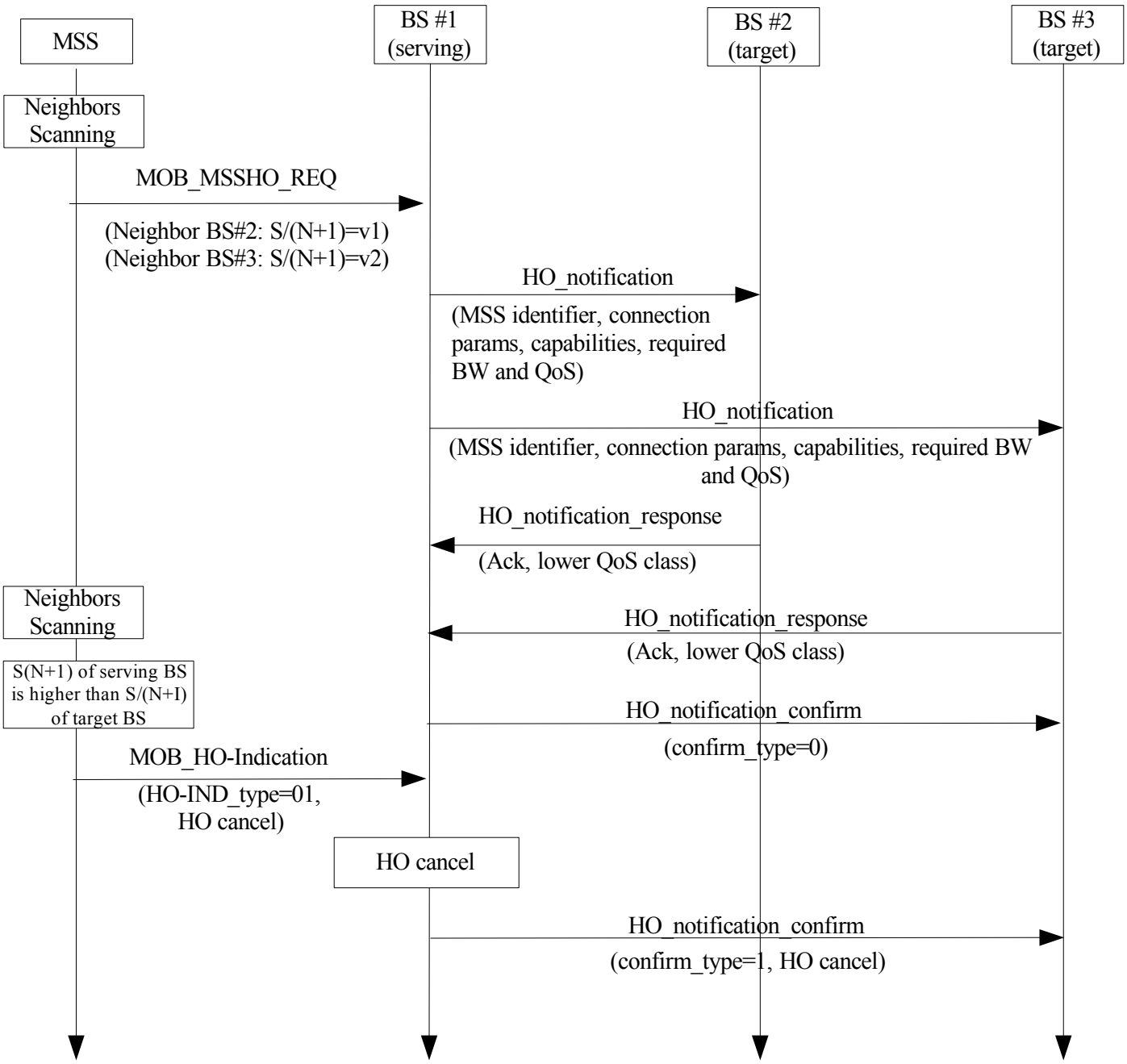

Figure D.5 – HO cancellation after HO_notification-confirm