Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**HO Drop Scenarios in IEEE 802.16e**
Date Submitted	**2003-09-04**
Source(s)	Hyunjeong Kang, Jungje Son Changhoi Koo, Samsung Electronic, Suwon P.O.Box 105, 416, Maetan-3dong, Paldal-gu, Suwon-si,Gyeonggi-do, Korea 442-742 Voice: +82-31-279-5091 Fax: +82-31-279-5130 hyunjeong.kang@samsung.com jungje.son @samsung.com chkoo@samsung.com
Re:	The contribution corresponding to commentary 109 sub-item 4
Abstract	This contribution proposes the drop scenarios for the Handoff ad-hoc group of the IEEE 802.16e. This contribution describes a drop detection mechanism, target BS selection scheme during drop situation and fast drop recovery mechanisms.
Purpose	Propose the drop scenarios for the IEEE802.16e Handoff Ad hoc group
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.
Patent Policy and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures <http://ieee802.org/16/ipr/patents/policy.html>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair <mailto:chair@wirelessman.org> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

HO Drop Scenarios in IEEE 802.16e

Hyunjeong Kang, Jungje Son and Changhoi Koo

SAMSUNG Electronics

1 Introduction

During HO request procedures in 802.16e system, MSS may detect its drop from its serving BS. In this drop case, MSS shall find a new target BS for resuming current communication. Unlike the usual case in that the dropped MSS searches all frequency bands for finding its new target BS, we propose a mechanism in that the dropped MSS can monitoring different and limited neighbor BSs sets according to the drop scenarios. This mechanism also includes fast drop recovery schemes with those the MSS can experience more tolerable delay at drop situation.

2 Proposed Drop Scenarios

For efficient HO and MSS operation we propose a drop detection scheme, a mechanism for searching a target BS from neighbor BSs list at each drop scenario and a fast drop recovery scheme by which MSS can restart its communication with a new detected target BS.

2.1 Drop detection

According to [1], the MSS may detect a drop by exceeding the RNG_REQ retries limit allowed for the periodic ranging mechanism. This existing scheme, only checking unsuccessful ranging, may be long in detecting a drop. Therefore we propose another drop detection scheme, in this scheme the MSS can recognize a drop situation by consecutively receiving downlink frames with errors

In this proposed drop detection scheme, the MSS, upon receiving a downlink frame from its serving BS, performs CRC(cyclic redundancy check) in the frame. If the MSS receives a bad downlink frame with intolerable errors, it increases the consecutive_bad_frame(TBD values) by one. This consecutive_bad_frame indicates how many bad downlink frames consecutively received. When this consecutive_bad_frame exceeds Maximum_Bad_Frames(TBD values), the MSS can detect a drop.

2.2 Searching target BS

After detecting a drop situation, the MSS shall perform the steps for finding a new target BS and making network re-entry with the target BS.

During HO request procedure, there can be several drop scenarios as shown in Figure A. At each drop scenario, the MSS can use different neighbor BSs lists from which seeking for its new target BS.

Drop scenario a: MSS can detect a drop immediately after receiving MOB_NBR_ADV message from a serving BS

Drop scenario b: In case of MSS initiated HO, MSS can detect a drop before receiving MOB_HO_RSP message from a serving BS, this message is a response to MOB_MSSHO_REQ message.

Drop scenario c: In case of BS initiated HO, MSS can detect a drop before receiving MOB_HO_RSP message from a serving BS, this message is a request of BS-initiated HO.

Drop scenario d: MSS can detect a drop immediately after receiving MOB_HO_RSP message from a serving BS

Drop scenario e: MSS can detect a drop immediately after sending MOB_HO_IND message to a serving BS

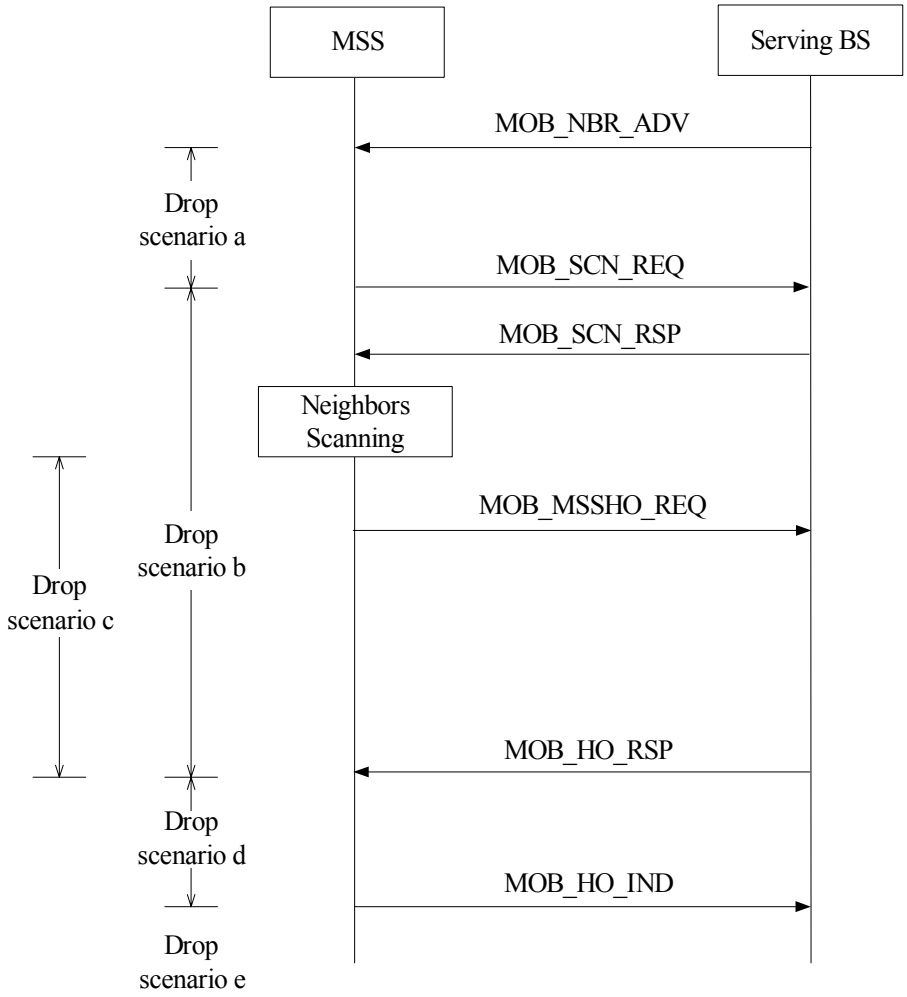

Figure AAA. Proposed drop situations during HO request procedure

2.2.1 Drop scenario a

The MSS, upon receiving the MOB_NBR_ADV message from its serving BS, can decode this message to find out information about the parameters of neighbor BSs. When the MSS has detected its drop immediately after receiving the message, it monitors neighbor BSs one by one from neighbor BSs list recorded in the message. When the MSS chooses one neighbor BS as new target BS, it shall attempt network re-entry with the target BS. If the MSS cannot select a target BS, it may scan all frequency bands for finding a target BS.

2.2.2 Drop scenario b

After receiving MOB_NBR_ADV message from its serving BS, the MSS can request a scanning interval using the MOB_SCN_REQ message. The BS shall respond the scanning interval in the MOB_SCN_RSP message. The MSS, upon reception of the scanning interval in the MOB_SCN_RSP, shall use the interval to find neighbor BSs and to scan SINRs of the neighbor BSs.

The MSS may initiate a HO by transmitting a MOB_MSSHO_REQ message. This transmitted MOB_MSSHO_REQ message includes possible HO target BSs list from SINR quality point of view. Therefore the MSS, upon detecting a drop before receiving MOB_HO_RSP message to its serving BS, may know the possible HO target BSs list and the SINR of each possible HO target BS. The MSS monitors the neighbor BSs in the possible HO target BSs list one by one from that SINR is high. When the MSS chooses a neighbor BS as new target BS, it shall attempt network re-entry with the target BS. If the MSS cannot choose a target BS, it may scan all the frequency bands for finding a target BS.

2.2.3 Drop scenario c

In a case of BS initiated HO, the dropped MSS, upon detecting a drop before receiving MOB_HO_RSP message from its serving BS, may find a new target BS from its neighbor BSs. These neighbor BSs are the neighbors included in MOB_NBR_ADV message. The MSS monitors these neighbor BSs one by one from that SINR is high. When the MSS selects a neighbor BS as new target BS, it shall attempt network re-entry with the target BS. If the MSS cannot choose a target BS, it may scan all the frequency bands for finding a target BS.

2.2.4 Drop scenario d

The MSS, upon detecting a drop immediately after receiving MOB_HO_RSP message from its serving BS, may know the target BSs list included in MOB_HO_RSP message. In the target BSs list, some neighbor BSs are recommended by the serving BS as proper target BSs from QoS or service level point of view. The dropped MSS monitors these neighbor BSs in the target BSs list, one by one from that service level is high. When the MSS chooses a neighbor BS as new target BS, it shall attempt network re-entry with the target BS. If the MSS cannot choose a target BS, it may scan all the frequency bands for finding a target BS.

2.2.5 Drop scenario e

After receiving MOB_HO_RSP message, the MSS selects one neighbor BS as new target BS from the target BSs list of MOB_HO_RSP message. For notifying HO toward the selected target BS, the MSS sends MOB_HO_IND message including the selected target BS information. The MSS, upon detecting a drop immediately after sending MOB_HO_IND message to its serving BS, may monitor the selected target BS's frequency band. If the MSS cannot synchronize with the selected target BS, it may try to find a new target BS from the target BSs list in MOB_HO_RSP message.

2.3 Fast drop recovery

When the MSS performs re-entry with a new target BS, the new target BS does not know the MSS's drop situation. Therefore the dropped MSS can notify its drop experience to the new target BS for fast drop recovery. For the purpose, we propose the mechanism like drop ranging code and drop time slot.

2.3.1 Drop ranging code

When the MSS performs re-entry with a new target BS, it synchronizes with the target BS. The target BS sends downlink and uplink parameters like DL_MAP, UL_MAP, DCD, UCD messages. During ranging, the MSS sends RNG_REQ message with drop ranging code. Upon this RNG_REQ message with drop ranging code,

the target BS can know the MSS's drop situation and support call resuming procedures for the fast drop recovery of the MSS.

To notify drop situation, 802.16e system may use one ranging code from the code set allocated to ranging. Therefore MSS, supporting 802.16e mechanism, may use the ranging code when it detects a drop. In this case, the ranging code shall not have any effects on the 802.16a system using the existing ranging codes.

2.3.2 Drop time slot

When the MSS performs re-entry with a new target BS, it synchronizes with the target BS. The target BS sends downlink and uplink parameters like DL_MAP, UL_MAP, DCD, UCD messages. Especially the target BS may provide drop ranging offset information in the UL_MAP. Therefore the MSS may use the drop ranging offset information in the UL_MAP for notifying its drop to the target BS. The target BS, upon receiving RNG_REQ message from the MSS at drop ranging offset, can know the MSS' s drop situation and support call resuming procedures for the fast drop recovery of the MSS.

3 Text to be inserted into standard

1.3.1.2.3 Drops and corrupted HO attempts

A drop is defined as the situation where an MSS has stopped communication with its serving BS (either in the downlink, or in the uplink) before the normal HO sequence outlined in Cell Selection and Termination with the serving BS has been completed.

An MSS can detect a drop by its failure to demodulate the downlink, or by exceeding the RNG-REQ retries limit allowed for the periodic ranging mechanism. A BS can detect a drop by exceeding the RNG-REQ retries limit allowed for the periodic ranging mechanism.

An MSS can detect a drop by consecutively receiving bad downlink frames. At consecutive bad frame detection mechanism, the MSS performs the steps as shown in figure BBB. Values of the consecutive_bad_frame and the Maximum_Bad_Frames in figure BBB may be specified at table 118 (see "Part 16: Air Interface for Fixed Broadband Wireless Access Systems" section 10.1).

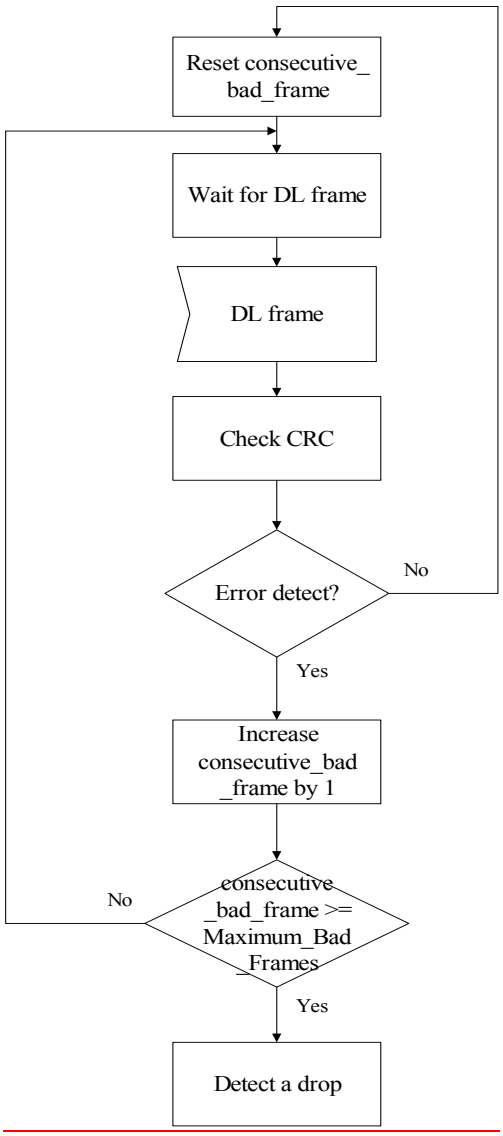

Figure BBB. Drop detection: by consecutive bad frames - SS

When the MSS has detected a drop, it shall attempt network re-entry with its preferred target BS as outlined in section Re-entry with the target BS. When the BS has detected a drop, it shall react as if a HO-IND MAC message has been received from the dropped MSS. To choose its preferred target BS, the MSS may monitor different neighbor BSs sets according to its drop detection point as shown in Table XXX.

Table XXX. Monitoring Range for Finding its Preferred Target BS

MSS Drop Scenarios	Target BS Monitoring Range
After receiving MOB_NBR_ADV and before performing neighbor scanning	Neighbor BSs in MOB_NBR_ADV message
After performing neighbor scanning and before receiving MOB_HO_RSP (case of MSS-initiated HO)	Neighbor BSs recorded in MOB_MSSHO_REQ message after performing neighbor scanning
After performing neighbor scanning and before receiving MOB_HO_RSP (case of BS-initiated HO)	Neighbor BSs in MOB_NBR_ADV message, to which neighbor scanning is performed
After receiving MOB_HO_RSP and before sending	Neighbor BSs in MOB_HO_RSP message

MOB_HO_IND	
After sending MOB_HO_IND	Selected neighbor BS as a target BS by MSS

1.3.1.2.3.1 Re-entry with the target BS

When re-entry with the target BS takes place, the target BS as well as all neighbor BSs are aware of the HO in progress (except in a drop situation). At re-entry, the MSS performs the steps as shown in Figure 0b6.

1.3.1.2.3.1.1 Synchronize with downlink and obtain parameters

For MSS that have used their scanning interval to synchronize with target BS and have decoded the NBR_ADVmessage, this stage should be immediate. In other situations this procedure defaults to the one specified for initial network entry.

For dropped MSS's call resuming, the MSS can send the ranging request using already known drop_ranging_code or allocated drop_ranging_offset.

The drop_ranging_code for dropped MSS's ranging request can be selected from existing ranging code set (-"The 16: Air Interface for Fixed Broadband Wireless Access Systems –Amendment 2: Medium Access Control Modifications and Additional Physical Layer Specifications for 2-11GHz" section 8.5.7.3.) (Note : The drop ranging code should be specified)

The drop_ranging_offset may be allocated by the target BS's UL_MAP including drop_ranging_IE as shown in Table YYY.

Table YYY. Drop_Ranging_IE

Drop_Ranging_IE {	size	notes
UIUC	4bits	TBD
Drop ranging offset	12bits	Indicates the start time of the burst relative to the Allocation Start Time given in the UL_MAP message.
Reserved	4bits	
}		

1.3.1.2.3.1.3 Ranging and uplink parameters adjustment

For MSS's that have used their scanning interval to do ranging with target BS this stage should be immediate. Otherwise, this stage is similar to the one performed at initial network entry. During this stage the MSS is assigned a new basic and primary management CID in the target BS.

The dropped MSS may send RNG_REQ message with drop ranging code for ranging with the new target BS. The target BS, upon receiving this RNG_REQ message, performs fast call resuming procedures for the MSS. Figure CCC shows the example of ranging message flow using drop ranging code.

The dropped MSS may send RNG_REQ message using drop ranging offset for ranging with the new target BS. The target BS, upon receiving this RNG_REQ message at drop ranging offset, can support fast call resuming procedures for the MSS. The example of ranging message flow using drop_ranging_IE is as shown in Figure DDD.

As opposed to initial network entry, where this stage is performed on contention basis, here the ranging opportunity may be allocated individually by the BS based on an MSS's 48-bit MAC address identifier. This identifier is forwarded to the target BS via the backbone network (see section Backbone network HO procedures). This is done using the Fast_UL_ranging_IE() (see Fast ranging (Paging) Information Element) in the UL-MAP. When an initial ranging opportunity is not allocated individually, this procedure defaults to the one specified for initial network entry.

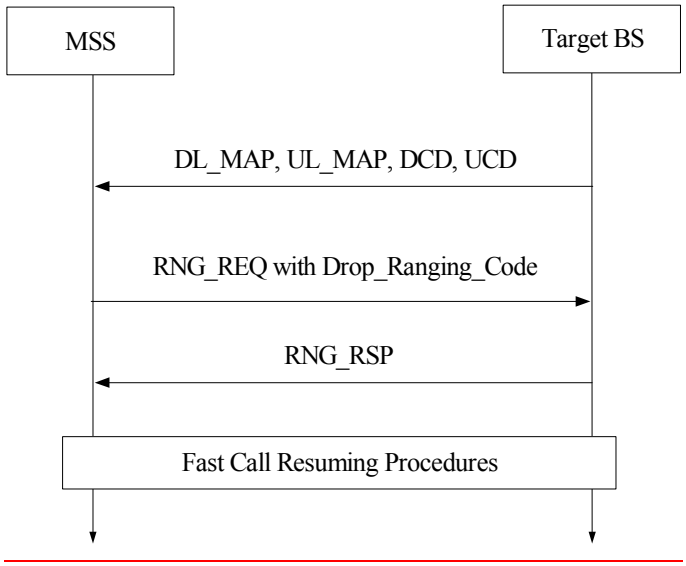

Figure CCC. Example of ranging message flow using Drop_Ranging_Code

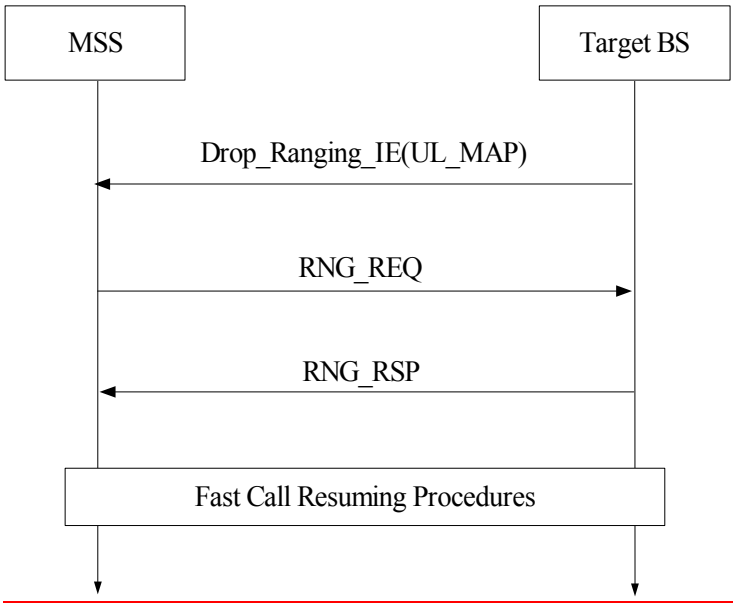

Figure DDD. Example of ranging message flow using Drop_Ranging_IE

Reference

[1] IEEE C802.16e-03/07r3 “IEEE 802.16e Handoff Draft”