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Re:	IEEE P802.16e/D8
Abstract	This contribution discusses some ambiguities in the handover procedure, as described in D8 and suggests clarifying text to resolve them
Purpose	Discuss and approve.
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Clarifications on Handover Procedure
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Introduction

The handover description section (section 6.3.21.2) has been drastically revised in D8. While many issues have been clarified, some parts of this section still remain ambiguous and need further clarification.

More specifically, in this contribution we address the following issues:

In the beginning of section 6.3.21.2.2 ("HO decision and intiation") the description about how a handover is initiated, what messages are exchanged and which are optional and which are mandatory is rather vague. New text is introduced to spell out the messages that may be exchanged depending on which side initiates the handover, and what messages should be generated as a response. (lines 6-9, 12-18)

In the last paragraph of section 6.3.21.2.2 ("HO decision and intiation") the statement about when the MS is released from the obligation to monitor DL traffic from the BS is ambiguous. The reference to the Resource Retain Timer is irrelevant. It is mentioned that the MS is not required to monitor any DL traffic after sending the MOB_HO_IND. New text is introduced to define when the BS should stop sending DL traffic to the MS prior to a HO. More specifically, since MOB_HO_IND can be a response to either MOB_BSHO_REQ or MOB_BSHO_RSP the BS should stop addressing any DL traffic to the MS when it sends either message. In the case that MOB_HO_IND is sent unsolicited (without any prior HO preparation/negotiation with the serving BS through MOB_BSHO_REQ/RSP) the BS can only (and should) stop sending DL traffic to the MS when it receives the MOB_HO_IND message. (lines 60-62)

The text in the beginning of the third and last paragraph of section 6.3.21.2.5 ("Termination with the serving BS") is both ambiguous and redundant. In particular, while the information is retained at the serving BS, it is stated that "this connection information can be used by the MS in order to perform expedited re-entry operation with target BS or the serving BS". (lines 45-48)
This statement is ambiguous and redundant for the following reasons:
⇒ The BS can decide to retain connection information and it indicates this through the Resource Retain Indication. This has been described in earlier parts of the text and need not be repeated here
⇒ At the opposite side, the MS will decide to retain its connection information and use it when connecting with the target BS based on what is indicated in HO Process Optimization and NOT based on the decision of the serving BS to retain the connection information (i.e. NOT based on the Resource Retain timer). This is also described in other parts of the text and needs not be repeated here.
⇒ The only case where connection information retention at the MS and at the serving BS side are related is when the MS decides to come back to the serving BS. This has also been described in earlier sections and need not be repeated here.

This contribution also includes some minor text changes in the text of sections 6.3.21.2.6 ("Drops during HO") and 6.3.21.2.7 ("Network entry/re-entry").

Proposed text changes:
[Change section 6.3.21.2.2, page 177, lines 7-9, lines 15-18, lines 61-62 in D8 as indicated]

6.3.21.2.2 HO decision & initiation
A handover begins with a decision for an MS to hand-over from a serving BS to a target BS. The decision may originate either at the MS, the serving BS, or on the network. ~~The HO may proceed with a notification through either MOB_MSHO-REQ or MOB_BSHO-REQ message s. The HO notification is recommended, but not required. Acknowledgement with MOB_BSHO-RSP of a notification is required.~~

When the HO decision originates at the MS, the HO may proceed with either a request (MOB_MSHO-REQ message) or a notification (MOB_HO_-IND message) sent to the BS. When the HO decision originates at the MS, request or notification is recommended but not required. If the MS elects to send a MOB_MSHO-REQ message to the BS, then the BS is required to respond with either a MOB_BSHO-RSP or a MOB_BSHO-REQ (see later paragraphs). When the HO decision originates at the BS the HO proceeds with a request (MOB_BSHO-REQ message) sent to the MS. The MS may respond with a MOB_HO-IND or a MOB_MSHO-REQ (see later paragraphs). This response from the MS is recommended but not required.

If an MS that transmitted a MOB_MSHO-REQ message detects an incoming MOB_BSHO-REQ message, it may respond with a MOB_MSHO-REQ or a MOB_HO-IND message and ignore its own previous request. A BS that transmitted a MOB_BSHO-REQ message and detects an incoming MOB_MSHO-REQ message from the same MS shall ignore its MOB_MSHO-REQ. ~~A BS that transmitted a MOB_BSHO-REQ message and detects an incoming MOB_HO-IND message from the same MS shall ignore its own previous request.~~

When MOB_MSHO-REQ is sent by an MS, the MS may indicate one or more possible target BS. When MOB_BSHO-REQ is sent by a BS, the BS may indicate one or more possible target BS. MS may evaluate possible target BS through previously performed scanning and Association activity.

Serving BS criteria for recommendation of target BS may include factors such as expected MS performance at potential Target BS and MS QoS requirements. Serving BS may obtain expected MS performance at potential Target BS through the exchange of backbone messages with that BS. Serving BS may negotiate location of common time interval where dedicated initial ranging transmission opportunity for the MS will be provided by all potential Target BSs. This information may be included into MOB_BSHO-RSP message.

Dedicated allocation for transmission of RNG-REQ means that channel parameters learned by the MS during Association of that BS are considered valid during sufficient time and can be reused for actual Network Re-entry without preceding CDMA Ranging. This parameter is provided to the Serving BS over the backbone.

If Network Assisted HO supported flag is set to "1" in MOB_BSHO-REQ message, MS 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 MS may send a MOB_HO-IND message with its target BSID set to "0x00000000".

When the serving BS, transmitted MOB_BSHO-REQ with Network Assisted HO supported flag = "1", receive MOB_HO-IND with target BS ID = "0x00000000", it may neglect target BS ID included in MOB_HO-IND message.

MS actual pursuit of hand-over to one of BSs specified in MOB_BSHO-RSP is recommended, but not required. MS may decide to attempt hand-over to a different BS that may or may not have been included in MOB_BSHO-RSP. If the MS signals rejection of serving BS instruction to HO through HO_IND_type field in the MOB_HO-IND set value of 0b10 (HO reject option), the BS may reconfigure the target BS list and retransmit MOB_BSHO-RSP message including a new target BS list.

Serving BS may notify one or more target BS over the backbone network of MS intent to hand-over to target BS. Serving BS may also send MS information to target BS over the backbone to expedite hand-over.

Once MS sends MOB_HO-IND with option HO_IND_type = 0b00 indicating commitment to HO and intent to release the serving BS, the MS shall not be expected to monitor serving BS DL traffic ~~after expiration of Resource retain timer~~. Therefore, any DL traffic that the BS sends to the MS after sending MOB_BSHO-REQ or MOB_BSHO-RSP is not guaranteed to be received by the MS.

[Change section 6.3.21.2.5, page 178, lines 45-48 as indicated:]

6.3.21.2.5 Termination with the Serving BS

After the hand-over request/response handshake has completed, the MS may begin the actual HO. At some stage during the HO process, the MS terminates service with the serving BS. This is accomplished by sending a MOB_HO-IND message with the HO_IND_type value indicating serving BS release.

If the HO_IND_type field specifies serving BS release, the BS shall start the Resource retain timer from value Resource_Retain_Time provided by BS in REG-RSP, BSHO-REQ, or BSHO-RSP messages. The serving BS shall retain the connections, MAC state machine and PDUs associated with the MS for service continuation until the expiration of Resource retain timer. Regardless of Resource retain timer, the serving BS shall close all connections and discard MAC state machine and MAC PDUs associated with the MS upon reception of a backbone message from the target BS indicating MS Network Attachment at target BS.

If the serving BS determines to retain the connection information of an MS which has sent MOB_HO-IND with HO_IND_type=0b00 and begun the actual HO, this connection information may be used by the MS in order to perform an expedited re-entry operation with target BS or the serving BS. The serving BS shall notify the MS of retention of MS connection information through Resource Retain Type in MOB_BSHORSP message or MOB_BSHO-REQ message during handover request/response handshake operation. If Resource Retain Type=1 and Resource Retain Time is not included as a TLV item in the message, then the serving BS and MS shall use the System Resource Retain Time timer.

[Change section 6.3.21.2.6, page 179, lines 5-11 and line 13 as indicated:]

6.3.21.2.6 Drops during HO
A drop is defined as the situation where an MS 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 MS 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 when the Number of retries limit allowed on inviting Ranging Requests for the periodic ranging mechanism is exceeded.

When the MS has detected a drop during network re-entry with a target BS, it may attempt network re-entry with a different target BS. In selecting the new target BS the MS can take into account the list of BSs included in its preferred target BS as presented in MOB_BSHO-REQ or MOB_BSHO-RSP,. Prior to the expiration of Resource Retain Timer, the MS may also attempt to resume and may include resuming communication with the Serving BS by sending MOBHO-IND message with HO_IND type = 0b01 (HO cancel). If it fails network re-entry with the BS that has been selected as the new its preferred Target BS, the MS shall perform initial entry procedure.

When attempting to re-connect to the new selected target BS, the MS shall perform CDMA ranging with Target BS using codes from HO codes domain, if available.

Upon Target BS sending RNG-RSP with 'ranging status'=success, Target BS shall provide CDMA_ALLOC_IE with appropriate UL allocation for RNG-REQ from MS. MS shall send RNG-REQ with MAC address and OMAC/HMAC. Target BS may now identify that HO attempt by MS was not coordinated with Serving BS and may request all relevant MS context from Serving BS. Using this info Target BS shall now send RNG-RSP with 'HO process optimization' bitmap and NW re-entry may continue as in the typical, non-drop case.

When the serving BS has detected a drop, it shall react as if a MOB_HO-IND message has been received with HO_IND_type indicating serving BS release.

[Change section 6.3.21.2.7, page 180, lines 46-52 in D8 as indicated:]
6.3.21.2.7 Network entry/re-entry
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If MS RNG-REQ includes a serving BSID and Ranging Purpose Indication TLV with bit #0 set to 1, and target

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BS has received a backbone message (see Backbone network HO procedures) containing MS information, the target BS may use MS service and operational information obtained over the backbone network to build and send a SBC-RSP, REG-RSP or RNG-RSP management message that includes service flow remapping information in New_CID, Old_CID and Connection_Info TLVs.

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During HO, the target BS may notify the MS, through the Bit#7 MS DL data pending element of the HO Process Optimization TLV item in RNG-RSP, of post-HO re-entry MS DL data pending. Upon MS successful re-entry at the target BS, now the new serving BS, and the new serving BS completing reception of any HO pending MS DL data retained and forwarded, the MS may re-establish IP connectivity and the new serving BS may send a backbone message to request the old serving BS or other network entity to stop forwarding pre-HO pending MS DL data.

Network entry/re-entry process completes with establishment of MS Normal Operations.

When the target BS has detected a failed HO entry/re-entry attempt, it may inform the serving BS of HO failure through a backbone message indicating Handover Failure.

For a managed MS, there is the possibility that entry at the new BS necessitates layer 3 protocol exchanges in order to retain IP connectivity. Such an MS should take appropriate steps to detect and respond to the change of BS (e.g. by performing Mobile IPv4 move detection and re-registration [RFC 3344], or Mobile IPv6 Binding Update [draft-ietf-mobileip-ipv6-24.txt]).