Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**HO Optimization Flags**
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Re:	Response to HO Ad-Hoc Call for Contributions on IEEE 80.16e/D3
Abstract	HO Optimization Flags
Purpose	Provide for a mechanism to optimize handover handshaking when MSS service and/or operational context are made available to a Target BS prior to MSS HO processing
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HO Optimization Flags

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Problem:

The current mobility model requires re-entry handshaking processing similar to the normal network entry procedures outlined in the fixed mode use, with a very few optimizations currently thrown in. Reduction of the re-entry handshaking process can provide significant and valuable HO processing latency time savings. Many tens of milliseconds may be saved in processing by utilizing information that may be made available to Target BS over the backbone network prior to MSS HO processing. Time savings achieved will vary greatly by the depth and timeliness of these backbone network provisions and the method of application of their savings. Indeed, it is not possible to reliably predict all backbone HO optimization models that may be envisaged for the wide variety of network deployment likely for 802.16 mobile networks, especially given the limited scope available to 16e to investigate the implications of various models. However, by addressing the combination of effects on message optimizations we can provide solution mechanisms suitable to current and future optimization strategies without having to encompass the entirety of the backbone and network configuration and optimization mechanisms that may be developed now, or in the future.

Remedy:

Based on availability of MSS service and operational context provisioning over the backbone network to a Target BS prior to or during MSS HO processing, certain portions of the normal entry handshaking process may be partially or completely omitted, or delayed to a post-HO period of lowered performance criticality. This is never to say that necessary management messaging during network re-entry, messaging that may jeopardize network security or performance integrity, may ever be tolerated. However, when timely information available and provisioned to the Target BS through the backbone network reliably eliminates the need for these re-entry handshaking management messages, we should provide a mechanism to take advantage of this opportunity.

For which messages may the Target BS obtain adequate and timely information to elect omission of certain network re-entry management message processing? And how would the Target BS go about notifying the MSS that the relevant messages need not be processed during a current HO attempt?

This contribution does not posit that necessary PHY related entry activity may be omitted: scanning, synchronization, and RNG-REQ/RSP. However, all re-entry management messages after may have the opportunity, under certain optimized scenarios, of being omitted: SBC; PKM; REG; Network Address Acquisition (for managed MSS); Time of Day Acquisition (for managed MSS); TFTP (optional). Creating appropriate optional notification flags as RNG-RSP TLVs seems a ready enough mechanism for a Target BS to notify an MSS of which re-entry processing steps will be required during the current HO attempt. Given that all of the subsequent management messages may face optimization redundancy, application to RNG-RSP seems even more appropriate. In fact, providing the flags allows for optimization in any conceivable network deployment and HO optimization model that affects re-entry management messages, with little effect to current re-entry model structures, SDL diagramming, and no effect to legacy support. Also, this mechanism avoids the necessity of having to create many new logical concepts and constructs in the standard to accommodate the myriad (bewildering) number of likely network deployment models and optimization strategies, while still accomplishing the necessary support for those mechanisms.

In support of these changes, we should also clarify the language that non-contention based ranging is synonymous with 'invited' ranging and only requires the single RNG-REQ/RSP loop, not two loops as is normally required in contention based ranging activity.

Also, we need to add support for an HMAC tuple in RNG-REQ to provide simple authentication to the Target BS when, through some mechanism, the MSS has previously obtained appropriate PKM security keying and may skip the PKM processing. The HMAC tuple prevents certain types of security attacks (cloning??, Trojan horse??) on the network.

Remedy 1:
Make non-contention based ranging re-entry processing synonymous with 'invited' initial ranging step in 'd' document. This clarifies that only a single RNG-REQ/RSP step need be performed when non-contention based ranging is used.
[In 6.3.20.4 Network entry/re-entry, page 52, lines 13-22, modify as]:
MSS and Target BS shall conduct Ranging per 6.3.9.5 to begin network entry/re-entry except as MSS may take advantage of a non-contention based MSS Initial Ranging opportunity if present. Non-contention based MSS Initial Ranging, as part of the MSS re-entry process, shall be considered the same as Invited Initial Ranging as defined in 6.3.9.5, except that the MSS RNG-REQ message will use MSS MAC Address instead of Basic CID, which will not have been sent at the time of the RNG-REQ management message, and the Target BS shall return the MSS Basic CID and Primary CID in the RNG-RSP management message. Just as in the Invited Initial Ranging request/response sequence, the non-contention based MSS Initial Ranging sequence need only be comprised of a single RNG-REQ/RSP management message pair. However, additional RNG-REQ/RSP management message sequences, as part of a subsequent non-contention based initial ranging allocation or normal bandwidth allocation, may be necessary as defined in 6.3.9.5. Unlike Initial Ranging in 6.3.9.5, the Target BS may elect to delay additional refinement of the physical link quality parameter settings through additional RNG-REQ/RSP sequencing in order to expedite HO processing.

If MSS RNG-REQ includes an Serving BS ID and Target BS had not previously received MSS information over the backbone (see section Backbone network HO procedures), then Target BS may make an MSS information request of Serving BS over the backbone network and Serving BS may respond. Regardless of having received MSS information from Serving BS, Target BS may request MSS information from another network management entity via the backbone network. Network re-entry proceeds per 6.3.9.5 except as may be shortened by Target BS possession of MSS information obtained from Serving BS over the backbone network.

Remedy 2:
Add HMAC Tuple language to HO Processing section to support optimized omission of PKM processing.
[In 6.3.20.4 Network entry/re-entry, page 52, lines 24-26, modify as]:
If MSS RNG-REQ included an Serving BS ID and Target BS had previously received an backbone message (see section Backbone network HO procedures) containing MSS information, MSS and Target BS shall use the embedded TLV PKM-REQ information and the re-authorization process as defined in 7.2. If the normal PKM initial network entry process as defined in 7.2 is to be abridged or omitted, then the MSS shall include the HMAC Tuple as the last message item in the RNG-REQ management message. If the required HMAC Tuple is invalid or omitted in the RNG-REQ management message, than the full PKM REQ/RSP sequence must be completed and cannot be omitted.

Remedy 3:

Add HMAC Tuple support to RNG-REQ to support optimized omission of PKM processing.
[In 6.3.2.3.5 Ranging Response (RNG-RSP) message, page 9, line 43, append to end of section]:
The following parameter shall be included in the RNG-REQ message when the MSS is attempting to perform network re-entry or hand-over and the MSS has a valid HMAC Tuple necessary to expedite security authentication:

    HMAC Tuple (see 11.1.2)

The HMAC Tuple shall be the last attribute in the message.

Remedy 4:
Add HO Process Optimization flags language and support for optimization activities to 6.3.20.4 Network entry/re-entry.
[In 6.3.20.4 Network entry/re-entry, page 52, lines 10-47, modify as]:
Unless otherwise indicated in this section, MSS mobile network entry/re-entry is processed according to 6.4.9. For purposes of this process, MSS network re-entry and hand-over are synonymous.

MSS and Target BS shall conduct Ranging per 6.3.9.5 to begin network entry/re-entry except as MSS may take advantage of a non-contention based MSS Initial Ranging opportunity if present.

The MSS shall signal the Target BS of a current HO attempt by including a Serving BS ID in the RNG-REQ management message.

If MSS RNG-REQ includes an Serving BS ID and Target BS had not previously received MSS information over the backbone (see section Backbone network HO procedures), then Target BS may make an MSS information request of Serving BS over the backbone network and Serving BS may respond. Regardless of having received MSS information from Serving BS, Target BS may request MSS information from another network management entity via the backbone network.

-Network re-entry proceeds per 6.3.9.5 except as may be shortened by Target BS possession of MSS information obtained from Serving BS over the backbone network.

For the Target BS to notify an MSS seeking HO entry through the Target BS of re-entry process management messages that may be omitted during the current HO attempt due to the availability of MSS service and operational context information obtained over the backbone network, the Target BS shall place an HO Process Optimization TLV in the RNG-RSP indicating which management messages may be omitted. The Target BS shall not direct the omission of any re-entry process management messages that would abridge the security or integrity of Normal Operation of the communications as established through an unabridged Initial Entry.

Regardless of the HO Process Optimization TLV settings, the Target BS may elect to use MSS service and operational information obtained over the backbone network to build and send unsolicited SBC-RSP and/or REG-RSP management messages to update MSS operational information. Target BS re-entry unsolicited response management messages may be grouped into the same DL frame transmission.

For a security keying process that has not been determined to be omitted in the HO Process Optimization TLV settings, Iif MSS RNG-REQ included includes an Serving BS ID and Target BS had has previously received an backbone message (see section Backbone network HO procedures) containing MSS information, MSS and

Target BS shall use the embedded TLV PKM-REQ information and the re-authorization process as defined in 7.2.

~~If Target BS had previously received an backbone message (see section Backbone network HO procedures),~~ The Target BS may use ~~the embedded TLV REG-REQ & DSA-REQ~~ information obtained over the backbone network to build and send an unsolicited REG-RSP message. The REG-RSP message may include New_CID, Old_CID and Connection_Info TLVs. Target BS may ignore only the first REG-REQ message received if it sends an unsolicited REG_RSP message. MSS is not required to send an REG-REQ if it receives an unsolicited REG-RSP prior to MSS attempt to send REG-REQ.

~~If MSS RNG-REQ included an Serving BS ID, MSS and Target BS may skip Time of day process.~~

~~If MSS RNG-REQ included an Serving BS ID, MSS may skip the MSS configuration file download procedure.~~

~~If MSS received a REG-RSP message that included New_CID, Old_CID, and Connection_Info TLVs, MSS and Target BS may skip the establish connections procedure.~~

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

Remedy 5:
Add HO Process Optimization flags language to RNG-RSP section.
[In 6.3.2.3.6 Ranging Response (RNG-RSP) message, page 10, line 22, append to end of section]:
The following TLV parameter shall be included in the RNG-RSP message when the MSS is attempting to perform network re-entry or hand-over and the Target BS wishes to identify re-entry process management messages that may be omitted during the current HO attempt:

HO Process Optimization—identifies re-entry process management messages that may be omitted during the current HO attempt due to the availability of MSS service and operational context information obtained over the backbone network. The Target BS shall not direct the omission of any re-entry process management messages that would abridge the security or integrity of Normal Operation of the communications as established through an unabridged Initial Entry.

Remedy 6:
Add HO Process Optimization flags to RNG-RSP TLV table.
[In 11.6 RNG-RSP TLVs for re-establishment of Service Flows, page 106, line 13, append to Table 320a—RNG-RSP Message Encodings; editor will make appropriate allocation of numbering nn for Type]:

Name	Type	Length	Value
HO Process Optimization	nn	1	For each Bit location, a value of '0' indicates the associated re-entry management messages shall be required processing, a value of '1' indicates the re-entry management message

			may be omitted
			Bit #0: SBC-REQ/RSP management messages re-entry omit during current re-entry processing
			Bit #1: PKM-REQ/RSP management message re-entry omit during current re-entry processing
			Bit #2 : REG-REQ/RSP management message re-entry omit during current re-entry processing
			Bit #3 : Network Address Acquisition management messages re-entry omit during current re-entry processing
			Bit #4 : Time of Day Acquisition management messages re-entry omit during current re-entry processing
			Bit #5 : TFTP management messages re-entry omit during current re-entry processing