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Re:	Response to HO Ad-Hoc Call for Contributions on IEEE 80.16e/D3
Abstract	HO Optimization Flags – HO Ad-Hoc Consensus Contribution
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. Such optimization however shall not compromise network security or HO performance integrity. However, when timely information available and provisioned on a 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 network entry activity steps be omitted: scanning, synchronization, and RNG-REQ/RSP. However, all subsequent re-entry management messages may have the opportunity, under certain optimized scenarios, of being omitted: SBC REQ/RSP; PKM REQ/RSP; REG REQ/RSP; 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 and RNG-RSP to provide simple authentication to the Target BS and MSS 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 (replay??, cloning??, Trojan horse??) on the network. Also extend the HMAC Tuple RNG-Rxx invocation language to support authentication of IDLE Mode ranging activity.

Make changes to RNG-REQ management message TLV items invocation language to clarify that only to be included in non-contention ranging opportunities. This will make sure we don't force contention based ranging opportunities to size to the maximum potential BW allocation size for a potential RNG-REQ including all possible TLV items, and that we instead move that burden to the invited ranging opportunities with requested/scaled appropriate BW.

Make HO Process language revisions to support inclusion of SBC-RSP and REG-RSP items as TLV items in non-contention based RNG-RSP management messages. This is in additional mechanism to allowing for unsolicited SBC-RSP and REG-RSP messages and their inclusion in the same DL frame as each other and the RNG-RSP.

And since we may be omitting the Network Address Acquisition process of HO re-entry, we can add a Traffic Pending flag into the RNG-RSP to support MSS self-imposed delay in re-acquiring a new Network Address, and corresponding Target BS filtering/suppression of network traffic that might trigger MSS re-acquisition of Network Address until some future time when Target BS has completed transfer of pre-HO cached pending DL data.

One of the outcomes of potentially eliminating all re-entry management messages after RNG-REQ/RSP is that now Target BS cannot tell, from the presence of Serving BS ID alone in the RNG-REQ, whether the MSS is requesting actual HO or just performing a ranging or Association event. We can correct this by placing a HO Indication TLV item into the RNG-REQ to identify actual HO attempts. All relevant reference locations to the use of Serving BS ID alone to identify HO must be changed.

We can also add HO Process Optimization flag language into MOB_BSHO-REQ and MOB_BSHO-RSP management messages to give indication of likely HO process management messages that may be omitted and optimization of HO.   MSS can use the information to prioritize interest in the HO decision process.

Adding the PHY specific Preamble Index to MOB_BSHO-REQ and MOB_BSHO-RSP management messages provides MSS information useful in obtaining faster synchronization with the Target BS. For the OFDMA PHY, availability of the Preamble Index may allow MSS synchronization with the Target BS in only one or two symbols. The information may also be provided (through other contributions) through the NBR-ADV as well. The MSS needs to provide the Preamble Index in the MOB_MSSHO-REQ and MOB_HO-IND messages to specify the specific Target BS and Preamble Index combination, for OFDMA the unique PHY attachment point, that it is referencing for HO decision evaluation or HO indication.
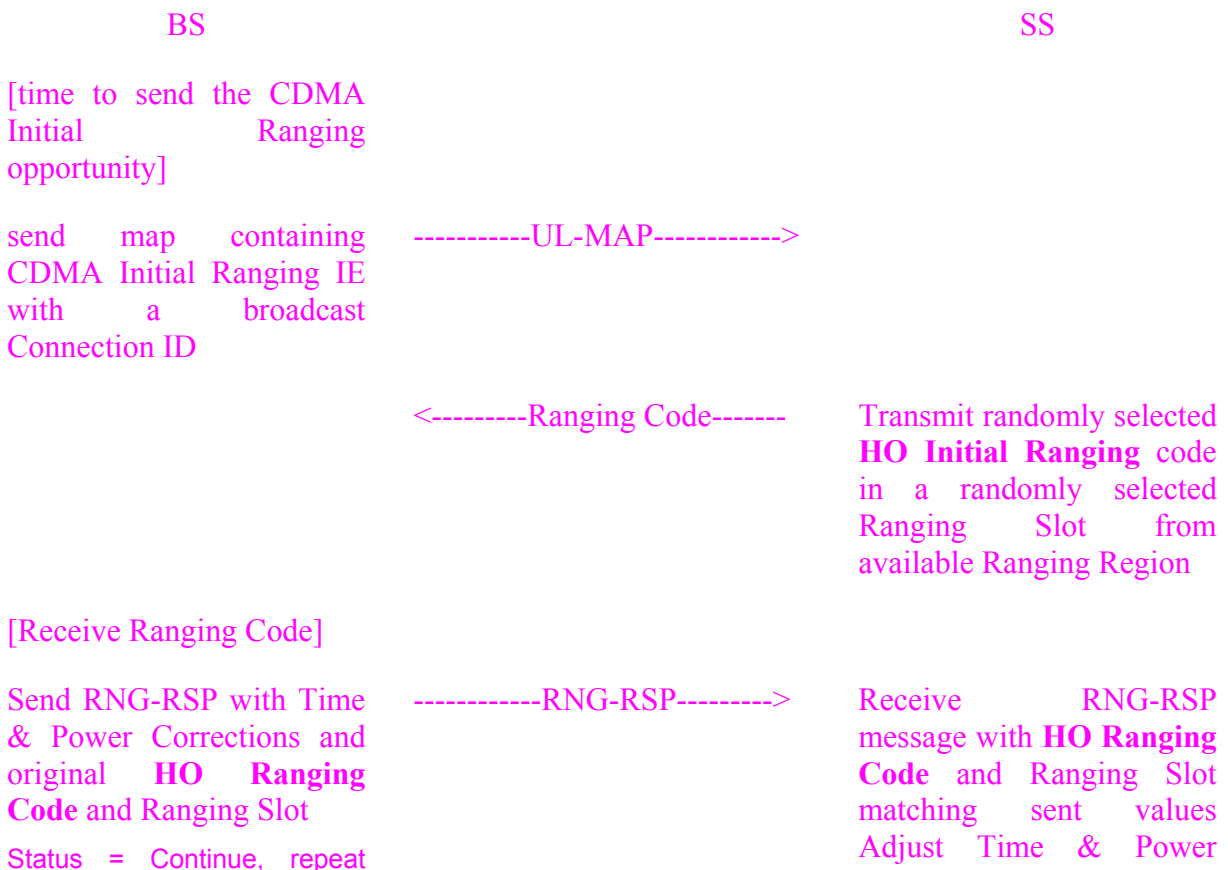
For certain macrodiversity deployment models using OFDMA, during HO, it will be necessary to supply the Target BS and Preamble Index during RNG-REQ as TLV items. The Target BS and Preamble Index

combination uniquely define the OFDMA PHY attachment and assist the Target BS in determining valid MSS targeting of the RNG-REQ message in a shared key environment.

Changes related to Reply Comments:

[Fong, Mo-Han] Add clarification to whether HO Indication is required for non-contention based ranging since the target BS must have known that the MSS is performing handover, from the fact that the target BS sends a Fast_UL_ranging_IE to allocate the UL resource.

[Phil] You are correct, in some respects. I believe the point of the differentiated OFDMA HO Ranging Code allocation would be to provide a mechanism to notify the Target BS of a pending HO RNG-REQ so the Target BS could allocate an appropriately sized, non-contention based UL slot tied to the original HO Ranging Code and Ranging Slot. This is not the same as a Fast_IE, but it would let us skip an essentially wasted RNG-REG/RSP sequence where the MSS would not be able to identify that it was in process of HO, and would not have space in the normal Initial Entry Ranging UL BW allocation to accomodate all of the HO specific RNG-REQ TLV items to inform the Target BS. Just using the regular Initial Ranging codes, the extra RNG-REQ/RSP pair would be required. Per 6.3.6.5 Contention-based CDMA Bandwidth Requests for WirelessMAN-OFDMA, page 150, line 46, it is not that the BS won't use the CDMA_Alloc_IE; the benefit of using the HO Ranging Code is that the Target BS can make its first focused UL BW allocation the right size to handle the oversized HO RNG-REQ that includes all of that extra HO TLV info. So, the call flow would look like (see revised table of call flow for OFDMA HO Entry/Re-Entry Process using HO Ranging Codes, embedded in the discussion of the contribution, taken from Table 119).

BS		SS
[time to send the CDMA Initial Ranging opportunity]		
send map containing CDMA Initial Ranging IE with a broadcast Connection ID	-----------UL-MAP------------>	
	<---------Ranging Code-------	Transmit randomly selected **HO Initial Ranging** code in a randomly selected Ranging Slot from available Ranging Region
[Receive Ranging Code]		
Send RNG-RSP with Time & Power Corrections and original **HO Ranging Code** and Ranging Slot Status = Continue, repeat	------------RNG-RSP--------->	Receive RNG-RSP message with **HO Ranging Code** and Ranging Slot matching sent values Adjust Time & Power

cycle   parameters

Status = Success, move on

[time to send the next map]

send   map   containing   ------------UL-MAP----------->
anonymous   UL   BW
allocation   suitable   for   HO
processing   of   RNG-REQ
including   HO   specific
TLVs,   with   original   **HO
Ranging   Code**   and
Ranging Slot

[begin normal HO Process
RNG-REQ/RSP   MAC
management messaging]

                            <----------RNG-REQ----------   Transmit   RNG-REQ,
                                                              including any HO specific
                                                              TLVs, and continue with
                                                              regular   or   optimized
                                                              network entry/re-entry

Also, the MSS would still want to include the HO Indication TLV in RNG-REQ so the Target BS could
then tell that it really was a 16e mobile device attempt HO instead of a 16d fixed device inadvertently using
one of the HO Ranging codes, thinking it to be just a regular Initial Ranging code.

By the way, looking at 6.3.6.4 Contention-based focused Bandwidth Requests for WirelessMAN-OFDM, it
may be possible to introduce HO Ranging Code allocations for OFDM as well, though the low number of
slots seems to make this problematic. I will have to talk this over with an OFDM PHY guy.

Following sections specify text changes to the D3 draft:

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 management
message handshaking process 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. The Target BS shall include a valid HMAC Tuple as the last message item in the RNG-RSP if it instructs the MSS, through the HO Process Optimization TLV, that the PKM-REQ/RSP sequence may 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 Request (RNG-REQ) 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, or when the MSS is conducting ranging while in Idle Mode. The parameter shall only be included in non-contention based ranging opportunities:

  HMAC Tuple (see 11.1.2)

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

Remedy 4:
Add HMAC Tuple support to RNG-RSP to support optimized omission of PKM processing.
[In 6.3.2.3.6 Ranging Response (RNG-RSP) message, page 10, line 22, append to end of section]:
The following parameter, necessary to expedite security authentication, shall be included in the RNG-RSP message when the BS notifies the MSS through the HO Process Optimization TLV that the PKM-REQ/RSP sequence may be omitted for the current HO re-entry attempt, or when the BS wishes to acknowledge a valid HMAC Tuple in the acknowledged RNG-REQ management message:

  HMAC Tuple (see 11.1.2)

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

Remedy 5:

Add HO Process Optimization flags language and support for optimization activities to 6.3.20.4 Network entry/re-entry. Make change in reference in this section to support using HO Indication TLV in RNG-REQ to identify HO attempt in progress versus the previous use of Serving BS ID alone. Add language support for inclusion of SBC-RSP and REG-RSP items as TLV items in non-contention based RNG-RSP management messages. This is in additional mechanism to allowing for unsolicited SBC-RSP and REG-RSP messages and their inclusion in the same DL frame as each other and the RNG-RSP.

[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~~3~~.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 TLV and HO Indication TLV in the RNG-REQ management message. The MSS shall not include a HO Indication TLV in the RNG-REQ management message unless actually in the process of conducting an HO attempt.

If MSS RNG-REQ includes an Serving BS ID and HO Indication, 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 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 re-entry management messages may be omitted. The Target BS shall not direct the omission of any re-entry process management messages that would compromise 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, or to include 11.7 REG-RSP specific or 11.8 SBC-RSP specific message items as TLV items in the RNG-RSP. Target BS may ignore only the first corresponding REQ management ~~REG-REQ~~ message received if it sends an unsolicited SBC-RSP or unsolicited REG-~~-~~RSP message. MSS is not required to send the ~~an REG~~ complimentary REQ management message if it receives an unsolicited SBC-RSP or unsolicited REG-RSP management message prior to MSS attempt to send the corresponding ~~REG~~ REQ management message. Target BS re-entry unsolicited response management messages may be grouped into the same DL frame transmission and may be grouped into the same DL frame transmission with the RNG-RSP. However, unsolicited SBC-RSP and unsolicited REG-RSP may not be grouped together into the same DL frame transmission when the PKM-REQ/RSP management message process is required. The integrity of the 6.3.9.5 sequence process must be preserved.

For a security keying process that has not been determined to be omitted in the HO Process Optimization TLV settings, ~~I~~iif MSS RNG-REQ ~~included~~ includes a~~n~~ Serving BS ID and HO Indication, and Target BS ~~had~~ has ~~previously~~ received a~~n~~ 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),~~ If MSS RNG-REQ includes a Serving BS ID and HO Indication, and Target BS has received a backbone message (see section Backbone network HO procedures) containing MSS information, the Target BS may use ~~the embedded TLV REG-REQ & DSA-REQ~~ MSS service and operational information obtained over the backbone network to build and send ~~an unsolicited~~a REG-RSP management message~~.~~ ~~The REG-RSP message may~~that includes Service Flow remapping information in 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.~~

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

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

Remedy 6:
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, and the MSS service and operational status post-HO completion. The Target BS shall not direct the omission of any re-entry process management messages that would compromise the security or integrity of Normal Operation of the communications as established through an unabridged Initial Entry. Regardless of the HO Process Optimization 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.

Remedy 7:
Add HO Process Optimization flags to RNG-RSP TLV table including support for Full State Transfer and Data Pending flags.
[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, a value of '1' indicates the re-entry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the Target BS may send unsolicited SBC-RSP and/or REG-RSP management messages Bit #0: Omit SBC-REQ/RSP management messages during current re-entry processing Bit #1: Omit PKM-REQ/RSP management message during current re-entry processing Bit #2 : Omit REG-REQ/RSP management during current re-entry processing Bit #3 : Omit Network Address Acquisition management messages during current re-entry processing Bit #4 : Omit Time of Day Acquisition management messages during current re-entry processing Bit #5 : Omit TFTP

| | | | management messages during current re-entry processing

Bit #6 : Full service and operational state transfer or sharing between Serving BS and Target BS (ARQ, timers, counters, MAC state machines, etc…)

Bit #7 : post-HO re-entry MSS DL data pending at Target BS |
|---|---|---|---|

Remedy 8:
Correct language invoking Serving BS ID and other new TLV items in RNG-REQ section to clarify that only to be included in non-contention ranging opportunities.
[In 6.3.2.3.5 Ranging Request (RNG-REQ) message, page 10, line 8, modify as]:
The following parameter shall be included in the RNG-REQ message when the MSS is attempting to perform re-entry, association or hand-over. The parameter shall only be included in non-contention based ranging opportunities:

Serving BS ID

The BS ID of the BS to which the MSS is currently connected (has completed the registration cycle and is in Normal Operation). Serving BS ID shall not be included if interval timer is timed-out (Serving BS ID AGINGTIMER, see Table 264a). Inclusion of Serving BS ID in the RNG-REQ message signals to the Target BS that the MSS is currently connected to the network through the serving BS and is performing association or is in the process of either hand-over or network re-entry.

Remedy 9:
Make change in reference in this section to support using HO Indication TLV in RNG-REQ to identify HO attempt in progress versus the previous use of Serving BS ID alone.
[In 6.3.2.3.8 Registration Response (REG-RSP) message, page 11, line 1, append as]:
For mobile subscribers in Normal Operation, and, if the information is available to create CID update, Target BS shall include CID_update TLVs in the REG-RSP for MSS recognized by the Target BS as performing network re-entry by the presence of a Serving BS ID and HO Indication in the RNG-REQ.

Remedy 10:
For certain macrodiversity deployment models using OFDMA, during HO, it will be necessary to supply the Target BS and Preamble Index during RNG-REQ as TLV items. The Target BS and Preamble Index combination uniquely define the OFDMA PHY attachment and assist the Target BS in determining valid MSS targeting of the RNG-REQ message in a shared key environment.
[In 6.3.2.3.5 Ranging Request (RNG-REQ) message, page 9, line 43, append as]:
Target_BS_ID – Same as the Base Station ID parameter in the DL-MAP message of Target BS. This may include the Serving BS.
Preamble Index
    The index for the PHY profile specific preamble for the Target BS. Preamble Index is PHY specific for SCa and OFDMA. The value of Preamble Index shall be ignored and a value of '0x00' shall be used for OFDM PHY.

Remedy 11:

For certain macrodiversity deployment models using OFDMA, during HO, it will be necessary to supply the Target BS and Preamble Index during RNG-REQ as TLV items. The Target BS and Preamble Index combination uniquely define the OFDMA PHY attachment and assist the Target BS in determining valid MSS targeting of the RNG-REQ message in a shared key environment. Add items to RNG-REQ TLV table.

[In 11.5 RNG-REQ TLVs for re-establishment of Service Flows, page 105, line 3, append to Table 318a— RNG-REQ Message Encodings; editor will make appropriate allocation of numbering oo and pp for Type]:

Name	Type	Length	Value
Target_BS_ID	oo	6	Same as the Base Station ID parameter in the DL-MAP message of Target BS. This may include the Serving BS.
Preamble Index	pp	1	The index for the PHY profile specific preamble for the Target BS. Preamble Index is PHY specific for SCa and OFDMA. The value of Preamble Index shall be ignored and a value of '0x00' shall be used for OFDM PHY.

Remedy 12:

Add HO Indication TLV flag language to RNG-REQ section.

[In 6.3.2.3.5 Ranging Request (RNG-REQ) message, page 9, line 43, append as]:

The following TLV parameter shall be included in the RNG-REQ message when the MSS is attempting to perform re-entry or hand-over:

  HO Indication—indicates the MSS is currently attempting to HO to the BS.

Remedy 13:

Add HO Indication TLV flag to RNG-REQ TLV table.

[In 11.5 RNG-REQ TLVs for re-establishment of Service Flows, page 105, line 3, append to Table 318a— RNG-REQ Message Encodings; editor will make appropriate allocation of numbering oo for Type]:

Name	Type	Length	Value
HO Indication	oo	1	Presence of item in message indicates the MSS is currently attempting to HO to the BS, regardless of value

Remedy 14:

The MSS needs to provide the Preamble Index in the MOB_MSSHO-REQ messages to specify the specific Target BS and Preamble Index combination, for OFDMA the unique PHY attachment point, that it is referencing for HO decision evaluation or HO indication.

[In 6.3.2.3.55 MSS HO Request (MOB-MSSHO-REQ) message, page 27, line 26, modify as]:

HMAC Tuple (see 11.~~4.11~~1.2 in IEEE Standard P802.16 ~~REVd/D3~~-2004) – The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender).

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~~ Neighbor BS
> **Preamble Index**
> The index for the PHY profile specific preamble for the Neighbor BS. Preamble Index is PHY specific for SCa and OFDMA. The value of Preamble Index shall be ignored and a value of '0x00' shall be used for OFDM PHY.
> **BS CINR mean**
> This parameter indicates the carrier to noise and interference ratio measured by the MSS from the particular BS. The value shall be interpreted as an unsigned byte with units of 1dB.

Remedy 15:
The MSS needs to provide the Preamble Index in the MOB_MSSHO-REQ messages table to specify the specific Target BS and Preamble Index combination, for OFDMA the unique PHY attachment point, that it is referencing for HO decision evaluation or HO indication.
[In 6.3.2.3.55 MSS HO Request (MOB-MSSHO-REQ) message, page 26, line 56, modify Table 92i—MOB-MSSHO-REQ Message Format]:

Table 92i—MOB-MSSHO-REQ Message Format

Syntax	Size	Notes
MOB-MSSHO-REQ_Message_Format() {		
Management Message Type = 53	8 bits	
For (j=0 ; j<N_Recommended ; j++) {		N_Recommended can be derived from the known length of the message.
Neighbor BS-ID	48 bits	
Preamble Index	8 bits	The index for the PHY profile specific preamble for the Neighbor BS. Preamble Index is PHY specific for SCa and OFDMA. The value of Preamble Index shall be ignored and a value of '0x00' shall be used for OFDM PHY.
BS CINR mean	8 bits	
Service level prediction	8 bits	
}		
Estimated HO start	8 bits	The estimated HO time shall be the time for the recommended ~~target~~ Target BS.
HMAC Tuple	21 bytes	See 11.~~4.11~~1.2
}		

Remedy 16:
Add HO Process Optimization flag language into MOB_BSHO-REQ management message to give indication of likely HO process management messages that may be omitted and optimization of HO. Add PHY specific Preamble Index to MOB_BSHO-REQ message to provide to MSS information useful in obtaining faster synchronization with the Target BS.
[In 6.3.2.3.54 BS HO Request (MOB-BSHO-REQ) message, page 26, line 32, modify as]:
Neighbor BS-ID

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

Preamble Index
   The index for the PHY profile specific preamble. Preamble Index is PHY specific for SCa and OFDMA. The value of Preamble Index shall be ignored and a value of '0x00' shall be used for OFDM PHY.

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.

HO Process Optimization
   HO Process Optimization is provided as part of this message is indicative only. HO process requirements may change at time of actual HO. For each Bit location, a value of '0' indicates the associated re-entry management messages shall be required, a value of '1' indicates the re-entry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the Target BS may send unsolicited SBC-RSP and/or REG-RSP management messages
      Bit #0: Omit SBC-REQ/RSP management messages during current re-entry processing
      Bit #1: Omit PKM-REQ/RSP management message during current re-entry processing
      Bit #2: Omit REG-REQ/RSP management during current re-entry processing
      Bit #3: Omit Network Address Acquisition management messages during current re-entry processing
      Bit #4: Omit Time of Day Acquisition management messages during current re-entry processing
      Bit #5: Omit TFTP management messages during current re-entry processing
      Bit #6: Full service and operational state transfer or sharing between Serving BS and Target BS (ARQ, timers, counters, MAC state machines, etc…)

HMAC Tuple (see 11.~~4.11~~.1.2 in IEEE Standard P802.16- ~~REVd/D3~~ 2004) – The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender).

Remedy 17:
Add HO Process Optimization TLV flag item into MOB_BSHO-REQ management message to give indication of likely HO process management messages that may be omitted and optimization of HO. Add PHY specific Preamble Index to MOB_BSHO-REQ message to provide to MSS information useful in obtaining faster synchronization with the Target BS.
[In 6.3.2.3.54 BS HO Request (MOB-BSHO-REQ) message, page 25, line 55, modify Table 92h—MOB-BSHO-REQ Message Format]:

Table 92h—MOB-BSHO-REQ Message Format

Syntax	Size	Notes
MOB-BSHO-REQ_Message_Format() {		
Management Message Type = 52	8 bits	
Network Assisted HO supported	1 bits	Indicates that the BS supports Network

		Assisted HO
For (j=0 ; j<N_Recommended ; j++) {		Neighbor base stations shall be presented in an order such that the first presented is the one most recommended and the last presented is the least recommended. N_Recommended can be derived from the known length of the message.
Neighbor BS-ID	48 bits	
Preamble Index	8 bits	The index for the PHY profile specific preamble. Preamble Index is PHY specific for SCa and OFDMA. The value of Preamble Index shall be ignored and a value of '0x00' shall be used for OFDM PHY.
Service level prediction	8 bits	
HO Process Optimization	8 bits	HO Process Optimization is provided as part of this message is indicative only. HO process requirements may change at time of actual HO. For each Bit location, a value of '0' indicates the associated re-entry management messages shall be required, a value of '1' indicates the re-entry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the Target BS may send unsolicited SBC-RSP and/or REG-RSP management messages Bit #0: Omit SBC-REQ/RSP management messages during current re-entry processing Bit #1: Omit PKM-REQ/RSP management message during current re-entry processing Bit #2 : Omit REG-REQ/RSP management during current re-entry processing Bit #3 : Omit Network Address Acquisition management messages during current re-entry processing Bit #4 : Omit Time of Day Acquisition management messages during current re-entry processing Bit #5 : Omit TFTP management messages during current re-entry processing Bit #6 : Full service and operational state transfer or sharing between Serving BS and Target BS (ARQ, timers, counters, MAC state machines, etc…)

}		
reserved	7 bits	Reserved; shall be set to zero
HMAC Tuple	21 bytes	See 11.~~4.11~~1.2
}		

Remedy 18:

Add HO Process Optimization flag language into MOB_BSHO-RSP management message to give indication of likely HO process management messages that may be omitted and optimization of HO. Add PHY specific Preamble Index to MOB_BSHO-RSP message to provide to MSS information useful in obtaining faster synchronization with the Target BS.

[In 6.3.2.3.56 BS HO Response (MOB-BSHO-RSP) message, page 28, line 33, modify as]:

Neighbor BS-ID

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

Preamble Index

The index for the PHY profile specific preamble. Preamble Index is PHY specific for SCa and OFDMA. The value of Preamble Index shall be ignored and a value of '0x00' shall be used for OFDM PHY.

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.

HO Process Optimization

HO Process Optimization is provided as part of this message is indicative only. HO process requirements may change at time of actual HO. For each Bit location, a value of '0' indicates the associated re-entry management messages shall be required, a value of '1' indicates the re-entry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the Target BS may send unsolicited SBC-RSP and/or REG-RSP management messages

Bit #0: Omit SBC-REQ/RSP management messages during current re-entry processing

Bit #1: Omit PKM-REQ/RSP management message during current re-entry processing

Bit #2: Omit REG-REQ/RSP management during current re-entry processing

Bit #3: Omit Network Address Acquisition management messages during current re-entry processing

Bit #4: Omit Time of Day Acquisition management messages during current re-entry processing

Bit #5: Omit TFTP management messages during current re-entry processing

Bit #6: Full service and operational state transfer or sharing between Serving BS and Target BS (ARQ, timers, counters, MAC state machines, etc…)

HMAC Tuple (see 11.~~4.11~~1.2 in IEEE Standard P802.16- ~~REVd/D3~~ 2004) – The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender).

Remedy 19:

Add HO Process Optimization TLV flag item into MOB_BSHO-RSP management message to give
indication of likely HO process management messages that may be omitted and optimization of HO. Add
PHY specific Preamble Index to MOB_BSHO-RSP message to provide to MSS information useful in
obtaining faster synchronization with the Target BS.

[In 6.3.2.3.56 BS HO Response (MOB-BSHO-RSP) message, page 27, line 54, modify Table 92j—MOB-BSHO-RSP Message Format]:

Table 92j—MOB-BSHO-RSP Message Format

Syntax	Size	Notes
MOB-BSHO-RSP_Message_Format() {		
Management Message Type = 54	8 bits	
Estimated HO start	8 bits	
For (j=0 ; j<N_Recommended ; j++) {		Neighbor base stations shall be presented in an order such that the first presented is the one most recommended and the last presented is the least recommended. N_Recommended can be derived from the known length of the message.
Neighbor BS-ID	48 bits	
Preamble Index	8 bits	The index for the PHY profile specific preamble. Preamble Index is PHY specific for SCa and OFDMA. The value of Preamble Index shall be ignored and a value of '0x00' shall be used for OFDM PHY.
service level prediction	8 bits	
HO Process Optimization	8 bits	HO Process Optimization is provided as part of this message is indicative only. HO process requirements may change at time of actual HO. For each Bit location, a value of '0' indicates the associated re-entry management messages shall be required, a value of '1' indicates the re-entry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the Target BS may send unsolicited SBC-RSP and/or REG-RSP management messages Bit #0: Omit SBC-REQ/RSP management messages during current re-entry processing Bit #1: Omit PKM-REQ/RSP management message during current re-entry processing Bit #2 : Omit REG-REQ/RSP management during current re-entry processing Bit #3 : Omit Network Address Acquisition management messages during current re-entry processing

			Bit #4 : Omit Time of Day Acquisition management messages during current re-entry processing Bit #5 : Omit TFTP management messages during current re-entry processing Bit #6 : Full service and operational state transfer or sharing between Serving BS and Target BS (ARQ, timers, counters, MAC state machines, etc…)
}			
HMAC Tuple		21 bytes	See 11.4.111.2
}			

Remedy 20:
The MSS needs to provide the Preamble Index in the MOB_HO-IND messages to specify the specific Target BS and Preamble Index combination, for OFDMA the unique PHY attachment point, that it is referencing for HO indication.
[In 6.3.2.3.57 HO Indication (MOB-HO-IND) message, page 29, line 17, modify as]:
An MSS shall generate MOB-HO-IND messages in the format shown in Table 92k. The following parameters shall be included in the message:

Target_BS_ID – Same as the Base Station ID parameter in the DL-MAP message of Target BS. This may include the Serving BS.
Preamble Index
    The index for the PHY profile specific preamble for the Target BS. Preamble Index is PHY specific for SCa and OFDMA. The value of Preamble Index shall be ignored and a value of '0x00' shall be used for OFDM PHY.

If Privacy is enabled, the MOB-HO-IND message shall include the following TLV value,

HMAC Tuple (see 11.4.111.2 in IEEE Standard P802.16 -REVd/D3-2004) – The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender).

Remedy 21:
The MSS needs to provide the Preamble Index in the MOB_HO-IND messages table to specify the specific Target BS and Preamble Index combination, for OFDMA the unique PHY attachment point, that it is referencing for HO indication.
[In 6.3.2.3.57 HO Indication (MOB-HO-IND) message, page 28, line 58, modify Table 92k—MOB-HO-IND Message Format]:

Table 92k—MOB-HO-IND Message Format

Syntax	Size	Notes
MOB-HO-IND_Message_Format() {		
Management Message Type = 56	8 bits	
HO_IND_type	2 bits	00: Serving BS release 01: HO cancel 10: HO reject

		11: reserved	
Target_BS_ID	48 bits	Applicable only when HO_IND-type is set to 00.
Preamble Index	8 bits	The index for the PHY profile specific preamble for the Neighbor BS. Preamble Index is PHY specific for SCa and OFDMA. The value of Preamble Index shall be ignored and a value of '0x00' shall be used for OFDM PHY.
HMAC Tuple	21 bytes	See 11.4.111.2
}			

Remedy 22:
Add new backbone messages to support HO Process Optimization use of Bit#7 MSS DL data pending.
[Add new Inter-base station message "D.2.XX MSS-Data-Forwarding Message" to Informative annex; editor to allocate appropriate numbering]:
This message is sent from the former Serving BS or other network entity to the new Serving BS to forward pre-HO MSS DL data pending MAC SDUs to the new Serving BS. This message is typically used when MSS requests the Serving BS to releases the Serving BS with data forwarding. The message originator shall stop forwarding MSS MAC SDUs in this way on reception of a backbone Stop-Data-Forwarding Message.

Table DX– MSS-Data-Forwarding Message

Syntax	Size	Notes
Global Header	152 bits	
Length	16 bits	The length in bytes of the MAC SDU including the Global Header, MSS unique identifier, and Security field.
MSS unique identifier	48 bits	48-bit unique identifier used by MSS on initial network entry
MAC SDU	*variable*	
Security field	TBD	A means to authenticate this message

Remedy 23:
Add new backbone messages to support HO Process Optimization use of Bit#7 MSS DL data pending.
[Add new Inter-base station message "D.2.XX Stop-Data-Forwarding Message" to Informative annex; editor to allocate appropriate numbering]:
This message is sent from the new Serving BS, former Target BS of a successful HO, to the originator of the MSS-Data-Forwading Message backbone message instructing the termination of MSS's MAC SDU forwarding.

Table DX– Stop-Data-Forwarding Message

Syntax	Size	Notes
Global Header	152 bits	
MSS unique identifier	48 bits	48-bit unique identifier used by MSS on initial network entry
Action	TBD	TBD
Security field	TBD	A means to authenticate this message