To:
Roger Marks
Chair, IEEE 802.16 Working Group
r.b.marks@ieee.org

Reference: TWG Inter-Operability Problem Reports (IOPRs 50310, 52121, 52430, 53947, 53958)

July 1, 2010

Subject: Liaison Statement to IEEE 802.16 WG on modifications to the IEEE Std 802.16 needed to support WiMAX certification.

Dear Dr. Marks,

In the course of development and validation of product certification test cases based on IEEE Std 802.16, the WiMAX Forum TWG has identified critical issues with the 802.16 specification that impede product interoperability. The WiMAX Forum TWG believes these issues require clarification and/or correction. TWG respectfully requests that the IEEE 802.16 working group take the following actions.

- Review the attached problem statements and/or WiMAX contemplated remedies for each one of the problem statements (see Annexes)
- Develop a remedy for each one of the issues
- Inform the WiMAX Forum TWG of the results of IEEE 802.16 working group's actions on this matter.

Should the IEEE 802.16 working group develop any specific remedy in response to the problems identified in the Annex(es), and should these remedies be incorporated into IEEE Std 802.16, the WiMAX Forum Technical Working Group (TWG) would appreciate further communication giving specific details of the remedies including affected IEEE Std 802.16 sections.

Thank you very much for your attention to this matter of mutual importance.

Sincerely,

Wonil Roh
Chair, WiMAX Forum Technical Working Group (TWG)

Annex A Clarify the usage of BS initiated Handover (IOPR 50210)

A.1 Interoperability Problem Statement

The purpose of this IOPR document is to clarify usage of BS initiated handover process. Currently the IEEE802.16 standard draft does not limit the BS to send MOB-BSHO_REQ message to the MS for initiating handover to a new candidate target BS without any scanning report.

If the BS sends MOB-BSHO_REQ to the MS without any scan reports, this can cause possible performance degradation on the MS side, since the new target BS that has been selected by the previous serving BS without scan report can have worse channel conditions that the serving BS.

A.2 Possible Changes in IEEE Std 802.16

[Modify the paragraph in section 6.3.2.3.47 on page 221 in 802.16-2009 as indicated] {Page 225 in REV2/D9a}

6.3.2.3.47 MOB_BSHO-REQ (BS HO request) message

The BS may transmit a MOB_BSHO-REQ message when it wants to initiate an HO. ~~An MS receiving this message may scan recommended neighbor BSs in this message.~~ When the BS indicates one or more possible target BSs in the recommended neighbor BS list of the MOB_BSHO-REQ message, the BS shall not include a neighbor BS if the BS did not receive at least one MOB_SCN-REP message that includes the up-to-date scanning results of the neighbor BS. The determination of up-to-date is left to vendors' implementation and is out of scope of this standard. The message shall be transmitted on the Basic CID. See Table 150.

Annex B NDnS Implementation Problem (IOPR 52121)

B.1 Interoperability Problem Statement

There are already WiMAX deployments and mobiles having no support for NDnS. So any implementation must have this “backward compatibility” provisions.

The standard does not contain a capability exchange for NDnS or guidance for this issue.

B.2 Possible Changes in IEEE Std 802.16

6.3.2.3.23 SBC-REQ (SS basic capability request) message

…
An SS shall generate SBC-REQ messages including the following parameter:
Basic CID *(in the MAC header)*
The connection identifier in the MAC header is the Basic CID for this SS, as assigned in the RNG-RSP message.

All other parameters are coded as TLV tuples.

The Basic Capabilities Request contains the SS Capabilities Encodings (11.8) that are necessary to acquire NSP information and for effective communication with the SS during the remainder of the initialization protocols. NSP information is solicited in the SBC-REQ message when the SBC-REQ includes the SIQ TLV (11.8.9) with bit bit 0 set to 1.

The SS shall include the SIQ TLV in the Basic Capability Request if the SS received the NSP Change Count TLV as part of the DCD and ~~The following parameter shall be included in the Basic Capability Request if~~ the SS ~~is intended~~ intends to solicit NSP information:

Service Information Query (see 11.8.9)

The following parameter shall be included in the Basic Capabilities..

Annex C Clarifications for sounding region TLV within the UCD (IOPR 52430)

C.1 Interoperability Problem Statement

The purpose of this IOPR document is to provide needed clarifications into the current release of the IEEE 802.16 standard with respect to sounding region TLV which is sent via UCD. Currently the definition of the region via TLV is missing information in compare to the definition via the map IE. The misalignment should be fixed by adding the missing information to the TLV in the UCD

C.2 Possible Changes in IEEE Std 802.16

Bite [3:9] in TLV 213, Sounding region in the UCD should be aligned with the sounding zone allocation IE：

Name	Type (1 byte)	Length	Value
Sounding region	213	*5/10*	For 5 bytes per each sounding region Bits #0: reserved Bits #1-2: PAPR Reduction/Safety zone Bits #3-9: num subchannels with subsequent indexes that are used for the PAPR reduction/ safety zone. For Sounding Zone allocations this field defines the shift value (u) used for decimation offset and cyclic shift index. Bits #10-16: num OFDMA symbols Bits #17-23: subchannel offset Bits #24-31: OFDMA symbol offset Bit #32~34, Parameter d that defines periodicity of 2^d frames Bit #35~39, Allocation phase expressed in frames, 0 ≤ Allocation Phase < periodicity (=2^d)

Annex D UL Coverage Enhancement for MAC management messages and BR Header (IOPR 53947)

D.1 Interoperability Problem Statement

In IEEE 802.16-2009, HARQ which brings benefits to extend downlink/uplink coverage can be applied for management messages as well as data. For coverage extension, HARQ is required for RNG-REQ, SBC-REQ and BRH messages. However, HARQ can be used to transmit the management message only after exchanging the SBC-REQ/RSP messages because HARQ parameters are negotiated through the SBC-REQ/RSP messages.
Moreover, if the MS wants to receive uplink resources using existing HARQ UL-MAP IEs, it requires basic CID. But, during network (re)entry, the MS does not have any CID.
Even further, BS cannot distinguish between HARQ-applied burst and HARQ-non-applied bursts unless it allocates uplink resources using different MAP IE (i.e., using normal UL-MAP IE or HARQ UL-MAP IE).

D.2 Possible Changes in IEEE Std 802.16

[Adopt the following changes in section 6.3.10.3 in IEEE802.16-2009:]

6.3.10.3 OFDMA-based ranging

The WirelessMAN-OFDMA PHY specifies a ranging subchannel and a set of special pseudonoise ranging codes. Subsets of codes shall be allocated in the UCD channel encoding for initial ranging, periodic ranging requests, ~~and~~ BRs, and Initial/HO/BR Ranging Code set 1 (see Types 219, 220 and 221 in Table 571) so that the BS can determine the purpose of the received code by the subset to which the code belongs. An example of ranging channel in OFDMA frame structure is specified in Figure 228.

[Add following new section 6.3.10.3.1.1 right before section 6.3.10.3.2 in the middle of page 352, in IEEE802.16-2009 as follows:]

6.3.10.3.1 Contention-based initial ranging and automatic adjustments

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6.3.10.3.1.1 OFDMA- initial ranging with soft combining

An MS may send a ranging code from the Initial Ranging Code set 1 which is defined by Type 219 in Table 571 to perform Initial Network Entry. The MS shall use random backoff with the *Ranging Backoff Start* and *Ranging Backoff End* described in the UCD message when it sends the Initial Ranging Code set 1.

When the BS responds to an Initial Ranging Code set 1, and PHY corrections are

not needed, the BS shall provide at least 25 bytes of uplink bandwidth by transmitting a CDMA_Allocation_IE for the MS to transmit RNG-REQ message. The MS shall use the bandwidth to send the MAC PDU carrying RNG-REQ message on Ranging CID with MS MAC address TLV and MAC Version TLV, Generic MAC Header, and MAC CRC-32.

To request retransmission of the RNG-REQ, the BS shall send a CDMA Allocation IE with the same ranging attributes (frame number index, ranging code, ranging symbol, and ranging subchannel) which were sent in the original CDMA Allocation_IE. The process of retransmitting the CDMA_Allocation_IE shall be terminated by the frame N+15 where N is the frame number when the MS sends a Ranging Code. When the MS receives the UL bandwidth allocation by the same CDMA_Allocation_IE before T3 expires, the MS shall transmit the same MAC PDU that carries the RNG-REQ corresponding to the ranging attributes in the CDMA_Allocation_IE . In this case, the BS should perform soft combining to achieve combining gain on the UL bursts transmitted by the MS as per the allocation made with the same CDMA_Allocation_IE.

Upon expiration of T3 timer, the MS may either transmit a ranging code to the BS or perform the BS re-selection procedure as described in 6.3.21.2.1.

Upon successful reception of the RNG-REQ message with Ranging CID, the BS may respond with the RNG-RSP message. The RNG-RSP message shall include Ranging Status TLV with a status either of *Success* or *Abort*. If the Ranging Status TLV in the RNG-RSP message is *Abort*, the MS may perform the cell reselection procedure defined in section 6.3.21.2.1.

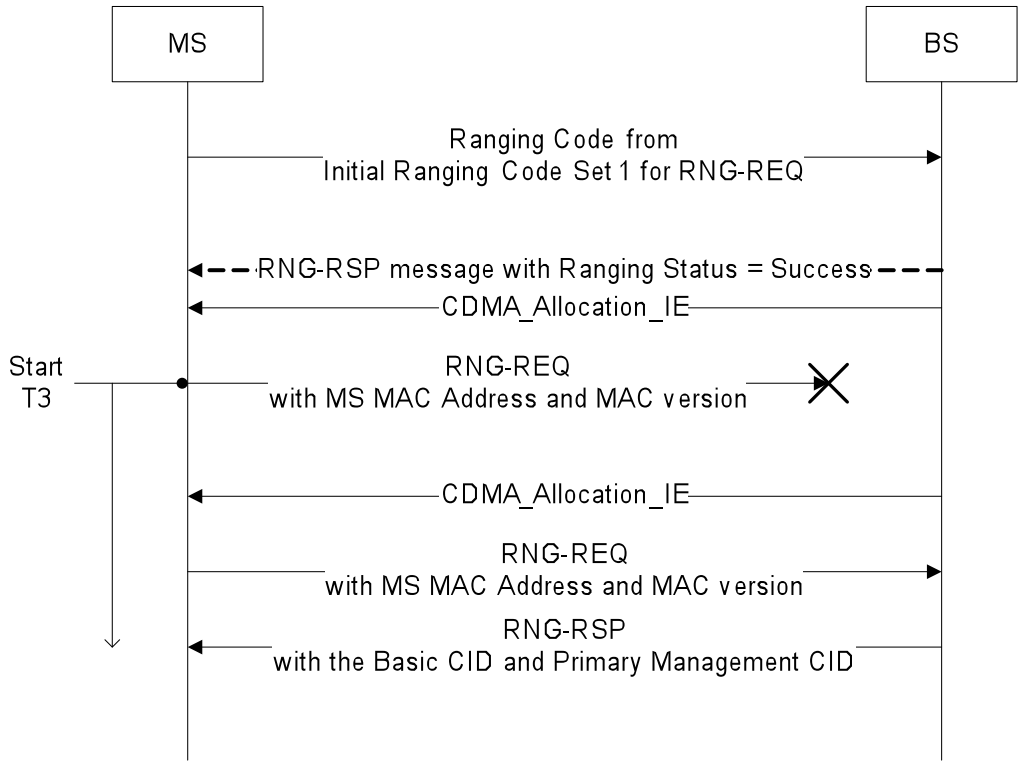

Figure XX— Message flows during Initial network entry with ranging code from the Initial Ranging Code set 1

[Adopt the following changes in section 6.3.10.4 in IEEE802.16-2009:]

6.3.10.4 CDMA HO ranging and automatic adjustment

An MS that wishes to perform HO ranging shall take a process similar to that defined in the initial ranging section with the following modifications.
In CDMA HO ranging process, ~~the~~ random selection is used instead of random backoff and the CDMA HO ranging code is used instead of the initial ranging code. The code is selected from the HO ranging domain as defined in 8.4.7.3.
The MS may select a code from HO Ranging Code Set 1 (Type 220 in Table 571) to perform OFDMA HO ranging with soft combining as defined in 6.3.10.4.2.
Alternatively, if the BS is prenotified for the upcoming HO MS, it may provide bandwidth allocation information to the MS using Fast Ranging IE to send a RNG-REQ message.

[Add following new section 6.3.10.4.2 right before section 6.3.11 in page 358, in IEEE802.16-2009 as follows:]

6.3.10.4.2 OFDMA HO ranging with soft combining

An MS may send a ranging code from the HO Ranging Code set 1 (see Type 220 in Table 571) in order to perform network re-entry during HO, network re-entry from idle mode or Location Update.

When the BS responds to a code from HO Ranging Code set 1, and PHY corrections are not needed, the BS shall provide at least 24 bytes of uplink bandwidth by transmitting a CDMA_Allocation_IE for the MS to transmit RNG-REQ message. The MS shall use the bandwidth to send the MAC PDU carrying RNG-REQ message on Ranging CID with MS MAC address TLV, Generic MAC Header, GMSH and MAC CRC-32.

To request retransmission, the BS shall transmit a CDMA_Allocation_IE with the same ranging attributes (frame number index, ranging code, ranging symbol, and ranging subchannel) which were sent in the original CDMA Allocation_IE. The retransmission process shall be terminated by the frame N+15 where N is the frame number when the MS sends a Ranging Code. When the MS receives a CDMA_Allocation_IE with the parameters set to the same values as the original CDMA_Allocation_IE before T3 expires, the MS shall transmit the same MAC PDU. The BS should perform combining processing on the UL bursts allocated by the same CDMA_Allocation_IE which will carry the same RNG-REQ message.

Upon expiration of T3 timer, the MS may either transmit a ranging code to the BS or perform the cell reselection procedure as described in 6.3.21.2.1.

Upon successful reception of the first RNG-REQ message with Ranging CID, the BS may respond with the first RNG-RSP message. The first RNG-RSP message shall include Ranging Status TLV with a status either of *Success* or *Abort*. If the Ranging Status TLV in the first RNG-RSP message is *Abort*, the MS may perform the cell reselection procedure defined in section 6.3.21.2.1.

If the required TLV message elements cannot be accommodated in the uplink bandwidth assigned for the first RNG-REQ message, the MS shall indicate required additional bandwidth using GMSH in the first RNG-REQ message. If the GMSH is included in the first RNG-REQ message and the BS allocates bandwidth for the second RNG-REQ message, the BS shall perform the allocation for the second RNG-REQ message by using HARQ UL-MAP IE with the Basic CID assigned by RNG-RSP message which was sent in response to first RNG-REQ message.

When the MS sends the second RNG-REQ message through uplink resources allocated by HARQ UL-MAP IE, the CID field in the MAC header shall contain the Primary Management CID.

If uplink resources allocated by HARQ UL-MAP IE are not sufficient to send the second RNG-REQ message which shall include at least MAC Version TLV, the MS may fragment the second RNG-REQ message using a Fragmentation Subheader (FSH). If the RNG-REQ message is fragmented, the MS shall start the T3 timer at the transmission of the first fragment of the second RNG-REQ message. If the second RNG-REQ message is fragmented, the BS shall respond with a RNG-RSP message after it receives all fragments of the RNG-REQ message.

If T3 timer expires after transmission of the second RNG-REQ message, the MS shall either retransmit the second RNG-REQ message, or perform the BS re-selection procedure as described in 6.3.21.2.1.

When the BS responds to successful reception of the second RNG-REQ message, the BS shall respond with the second RNG-RSP message which shall include the Ranging Status TLV with a status either of *Success* or *Abort*. If the Ranging Status TLV in the second RNG-RSP message is *Abort*, the MS may perform the cell reselection process defined in section 6.3.21.2.1.

If the MS has transmitted a ranging code from the HO Ranging Code set 1, the HARQ capability of HARQ set 1 defined in the OFDMA parameter set TLV shall be used for HARQ operations for second RNG-REQ until the completion of the capability negotiation through SBC-REQ/RSP process.

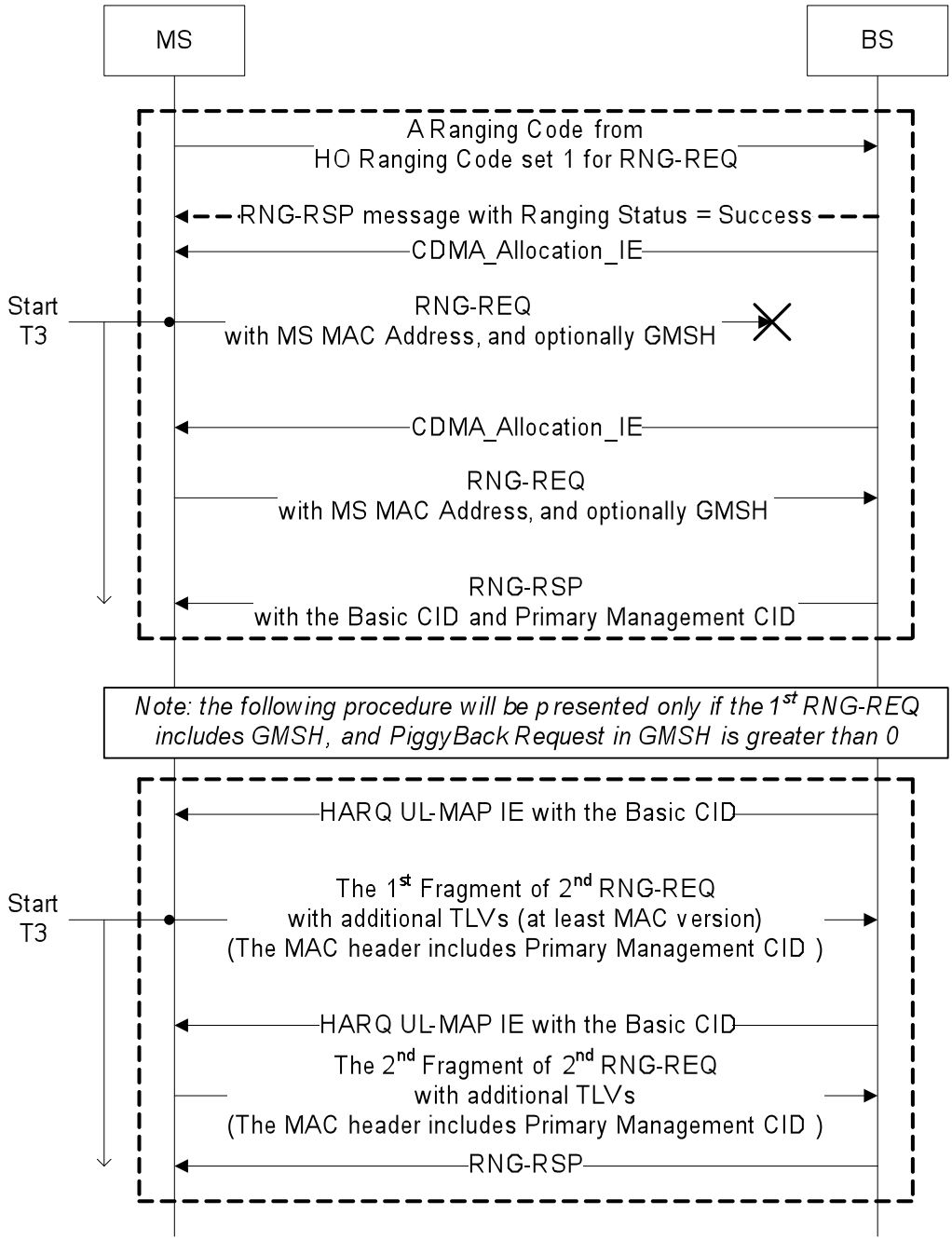

Figure XY— Message flows during Network Re-Entry during HO, Network Re-Entry from Idle Mode, or Location Update with a ranging code from the HO Ranging Code set 1

[Add following new section 6.3.2.3.23.1 right after section 6.3.2.3.23 in page 132, in IEEE802.16-2009 as follows:]

6.3.2.3.23 SBC-REQ (SS basic capability request) message

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6.3.2.3.23.1 HARQ support

When the BS has successfully received a ranging code from the *Initial/HO*

Ranging Code set 1 (see Types 219 or 220 in Table 571) from the MS, the BS should use HARQ UL-MAP IE with Basic CID rather than normal UL-MAP IE to allocate uplink bandwidth for the SBC-REQ message.

When the MS sends the SBC-REQ message using uplink resources allocated by HARQ UL-MAP IE, the MS shall set the CID field in the MAC header to the Primary Management CID. If uplink resources allocated by HARQ UL-MAP IE are not sufficient to send the SBC-REQ message, the MS may fragment the SBC-REQ message using Fragmentation Subheader (FSH). If the SBC-REQ message is fragmented, the MS shall start the T18 timer when it transmits the first fragment of the SBC-REQ message. If the BS responds to a SBC-REQ message which is fragmented, the BS shall respond with a SBC-RSP message after it receives all the fragments of the SBC-REQ message.

When the MS transmits SBC-REQ message using the UL allocation specified by HARQ UL-MAP IE, the BS shall use Chase combining HARQ on the UL burst containing the SBC-REQ message. In this case, The BS shall use HARQ capability of the HARQ set 1 defined in the OFDMA parameter set TLV for HARQ operations until completion of the capability negotiation through SBC-REQ/RSP.

[Add following new section 6.3.6.5.1 right after section 6.3.6.5 in page 301, in IEEE802.16-2009 as follows:]

6.3.6.5 Contention-based CDMA BRs for WirelessMAN-OFDMA

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6.3.6.5.1 Contention-based CDMA bandwidth requests using soft combining

When the BS allocates uplink bandwidth in response to receiving a ranging code from BR Ranging Code set 1 (see Type 221 in Table 571), the BS shall perform the allocation by using the CDMA_Allocation_IE. If the MS receives an uplink burst allocation in the CDMA_Allocation_IE, the MS shall transmit a BR header as described in 6.3.6.5.
To request the MS to retransmit the bandwidth request, the BS shall transmit a CDMA_Allocation_IE with the same ranging attributes (frame number index, ranging code, ranging symbol, and ranging subchannel) transmitted in the original CDMA_Allocation_IE. When the MS receives the CDMA_Allocation_IE with the same parameters sent in the original CDMA_Allocation_IE, the MS shall transmit the same BR header corresponding to the ranging attributes in the CDMA allocation IE. The CDMA allocation retransmission process shall be terminated by the frame N+15 where N is the frame number when the MS sends the BR Ranging Code. The BS should perform soft combining on subsequent BRH transmissions in the UL bursts in the allocations made with the same CDMA_Allocation_IE within 16 frames.

[Update Table 38 in section 6.3.2.3, page 79, in IEEE802.16-2009 as follows:]

Table 38— MAC management messages

Type	Message name	Message description	Connection
…			
4	RNG-REQ	Ranging request	Initial ranging, ~~or~~ basic or Primary management
…			
26	SBC-REQ	SS basic capability request	Basic or Primary management
…			

[Adopt the following changes in Table 571, page 1179, in IEEE802.16-2009 as follows:]

Table 571—UCD PHY-specific channel encodings—WirelessMAN-OFDMA

Name	Type (1 byte)	Length	Value
…			
Start of ranging codes group	155	1	Indicates the starting number, S, of the group of codes used for this UL. If not specified, the default value shall be set to zero. All the ranging codes used on this UL shall be between S and ((S+O+N+M+L+K+J+H) mod 256) where N is the number of initial ranging codes M is the number of periodic ranging codes L is the number of BR codes O is the number of HO ranging codes H is the number of HO ranging codes in HO Ranging Code set 1 J is the number of BR ranging codes in BR Ranging Code set 1 K is the number of Initial ranging codes in Initial Ranging Code set 1 The range of values is $0 \leq S \leq 255$.
…			
Initial Ranging Code set 1	219	1	Number of Initial ranging CDMA codes for soft combining. Possible values are 0–255. Default value is 0
HO Ranging Code set 1	220	1	Number of HO ranging CDMA codes for soft

			combining. Possible values are 0–255. Default value is 0
BR Ranging Code set 1	221	1	Number of BR ranging CDMA codes for soft combining Possible values are 0–255. Default value is 0

[Adopt the following changes in page 982, in IEEE802.16-2009 as follows:]

The number of available codes is 256, numbered 0..255. Each BS uses a subgroup of these codes, where the
subgroup is defined by a number S, $0 \le S \le 255$. The group of codes shall be between S and
$((S + O + N + M + L+K+J+H) \bmod 256)$.

- The first N codes produced are for initial ranging. Clock the PRBS generator $144 \cdot (S \bmod 256)$ times to $144 \cdot ((S + N) \bmod 256) - 1$ times.
- The next M codes produced are for periodic ranging. Clock the PRBS generator $144 \cdot ((N + S) \bmod 256)$ times to $144 \cdot ((N + M + S) \bmod 256) - 1$ times.
- The next L codes produced are for BRs. Clock the PRBS generator $144 \cdot ((N + M + S) \bmod 256)$ times to $144 \cdot ((N + M + L + S) \bmod 256) - 1$ times.
- The next O codes produced are for HO ranging. Clock the PRBS generator $144 \cdot ((N + M + L + S) \bmod 256)$ times to $144 \cdot ((N + M + L + O + S) \bmod 256) - 1$ times.

For the MS and BS supporting OFDMA- initial ranging with soft combining (see 6.3.10.3.1.1), OFDMA HO ranging with soft combining (see 6.3.10.4.2 and 6.2.2.3.23.1), and Contention-based CDMA bandwidth requests using soft combining (see 6.3.6.5.1), the corresponding codes shall be generated by the following methods.

- The next K codes produced are for initial ranging code for soft combining. Clock the PRBS generator $144 \cdot ((N + M + L + O + S) \bmod 256)$ times to $144 \cdot ((K+ N + M + L + O + S) \bmod 256) - 1$ times.
- The next J codes produced are for BR ranging code for soft combining. Clock the PRBS generator $144 \cdot ((K+ N + M + L + O + S) \bmod 256)$ times to $144 \cdot ((J+ K+ N + M + L + O + S) \bmod 256) - 1$ times.
- The next H codes produced are for HO ranging for soft combining. Clock the PRBS generator $144 \cdot ((J+ K+ N + M + L + O + S) \bmod 256)$ times to $144 \cdot ((H+ J+ K+ N + M + L + O + S) \bmod 256) - 1$ times.

[Adopt the following changes in Table 554, page 1141, in IEEE802.16-2009 as follows:]

Table 554—Parameters and constants (continued)

System	Name	Time reference	Minimum value	Default value	Maximum value
…					
SS,	T3	Ranging response	—	OFDMA:	200 ms

MS		reception timeout following the transmission of a ranging request.		60 msec: RNG-RSP after CDMA ranging or RNG-REQ during initial or periodic ranging 50 msec: RNG-RSP after RNGREQ during HO to negotiated target BS 200 msec: RNG-RSP after RNGREQ during HO to non-negotiated target BS 200 msec: RNG-RSP after RNGREQ during location update or re-entry from idle mode 80 msec: RNG-RSP after CDMA raning using Initial/HO Ranging Code set 1 during initial ranging/ handover/ location update/ re-entry from idle mode 100 msec: RNG-RSP after RNG-REQ on the Primary Management Connection during initial ranging/ handover/ location update/ re-entry from idle mode	

…					
SS	T18	Wait for SBC-RSP timeout.	—	50 ms: when SBC-REQ is on the Basic Connection. 100 ms: when SBC-REQ is on the Primary Management Connection.	<< T9
…					

Annex E Capability negotiation for Load Balancing (IOPR 53958)

E.1 Interoperability Problem Statement

In case a BS use Preamble Index Override or Ranging Abort Timer in RNG-RSP message, the BS need to be sure the MS supports the feature. If the MS does not support the parameters, it will simply discard the parameters.

E.2 Possible Changes in IEEE Std 802.16

Please consider modifying the section **11.7.8.11**, page 1212, in IEEE Std 802.16-2009 as follows

11.7.8.11 Extended capability

The extended capability field specifies extended capability support for the specified features. For each bit, a
value of 0 indicates “not supported” while 1 indicates “supported.” If the TLV is not transmitted, the default
value of each mentioned capability is “not supported.”

Type	Length	Value	Scope

49	1	Bit 0: Indicates the capability to support ARQ Map Last Bit concept and the optimized Sequence Block as defined in Table 170. The feature is enabled only in case both MS and BS support it. Bit 1: Indicates the capability to sup-port BS_Controlled_HO (see 6.3.21.2.2). If the MS does not support this capability, it may ignore the BS_Controlled_HO flag in the DCD. Bit 2: Indicates support for Group parameter Create/Change TLV (11.13.39) **Bit 3: Indicates support for Preamble Index Override (see 6.3.2.3.6)** **Bit 4: Indicates support for Ranging Abort Timer (see 6.3.2.3.6)** Bits ~~3~~**5**–7:*Reserved*, set to zero.	REG-REQ, REG-RSP