

IEEE Standard for Air Interface for Broadband Wireless Access Systems—

Amendment 2: Higher Reliability Networks

IEEE Computer Society
and the
IEEE Microwave Theory and Techniques Society

Sponsored by the
LAN/MAN Standards Committee

IEEE
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IEEE Std 802.16n™-2013
(Amendment to
IEEE Std 802.16™-2012)

IEEE Standard for Air Interface for Broadband Wireless Access Systems—

Amendment 2: Higher Reliability Networks

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Approved 6 March 2013
IEEE-SA Standards Board



Recognized as an American National Standard

Abstract: Enhancements to the WirelessMAN-OFDMA air interface to support higher reliability networks are specified in this amendment to IEEE Std 802.16-2012.

Keywords: amendment, broadband wireless access, BWA, GRIDMAN, higher reliability networks, IEEE 802.16TM, IEEE 802.16nTM, IMT-2000 radio interface, mobile broadband, OFDMA, orthogonal frequency-division multiple access, WirelessMAN-OFDMA Air Interface, wireless metropolitan area networks

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PDF: ISBN 978-0-7381-8424-1 STD98237
Print: ISBN 978-0-7381-8425-8 STDPD98237

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Participants

This standard was developed by the IEEE 802.16 Working Group on Broadband Wireless Access, which develops the WirelessMAN[®] Standard for Wireless Metropolitan Area Networks.

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Tim Godfrey, *Treasurer*

Primary development was carried out by the Working Group's GRIDMAN Task Group, with the following Leadership Team:

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The following individuals participated in the IEEE 802.16 Working Group during various stages of the standard's development. Since the initial publication, many IEEE standards have added functionality or provided updates to material included in this standard. Included is a historical list of participants who have dedicated their valuable time, energy, and knowledge to the creation of this standard.

IEEE 802.16 Standards	Date approved by IEEE	Officers at the time of Working Group Letter Ballot
IEEE Std 802.16-2001	6 December 2001	Roger B. Marks , <i>Working Group Chair, Task Group Chair, Technical Editor</i> Brian Kiernan , <i>Working Group Vice Chair</i> Carl Bushue , <i>Working Group Secretary</i> Carl Eklund , <i>MAC Chair</i> Jay Klein , <i>PHY Chair</i> Carl Eklund, Kenneth Stanwood, Stanley Wang , <i>MAC Editors</i> Jay Klein, Lars Lindh , <i>PHY Editors</i>
IEEE Std 802.16c™-2002 (amendment)	12 December 2002	Roger B. Marks , <i>Working Group Chair</i> Paul F. Struhsaker , <i>Working Group Vice Chair</i> Dean Chang , <i>Working Group Secretary</i> Kenneth Stanwood , <i>Task Group Chair</i> Carl Eklund , <i>Technical Editor</i>
IEEE Std 802.16a™-2003 (amendment)	29 January 2003	Roger B. Marks , <i>Working Group Chair</i> Carl Eklund , <i>Vice Chair</i> Dean Chang , <i>Working Group and Task Group Secretary</i> Brian Kiernan , <i>Task Group Chair</i> Nico van Waes , <i>Technical Editor</i> Brian Eidson , <i>Lead SCA PHY Editor</i>
IEEE Std 802.16-2004	24 June 2004	Roger B. Marks , <i>Working Group Chair</i> Kenneth Stanwood , <i>Vice Chair</i> Dean Chang , <i>Working Group Secretary</i> Gordon Antonello , <i>Task Group d Chair</i> Itzik Kitroser , <i>Chief Technical Editor</i> Robert Nelson , <i>Assistant Editor</i> Brian Eidson , <i>SCA PHY Editorial Contributor</i> Nico van Waes , <i>Former Chief Technical Editor</i>
IEEE Std 802.16f™-2005 (amendment)	22 September 2005	Roger B. Marks , <i>Working Group Chair</i> Kenneth Stanwood , <i>Vice Chair</i> Dean Chang , <i>Working Group Secretary</i> Phillip Barber , <i>Task Group Chair</i> Changhoi Koo , <i>Task Group Vice Chair</i> Itzik Kitroser , <i>Task Group Vice Chair</i> Joey Chou , <i>IEEE 802.16f Chief Technical Editor</i>
IEEE Std 802.16e™-2005 and IEEE Std 802.16-2004/Cor1-2005 (amendment and corrigendum)	7 December 2005 (amendment) and 8 November 2005 (corrigendum)	Roger B. Marks , <i>Working Group Chair</i> Kenneth Stanwood , <i>Vice Chair</i> Dean Chang , <i>Working Group Secretary</i> Brian Kiernan , <i>Task Group e Chair</i> Ronald Murias , <i>Chief Technical Editor</i> Itzik Kitroser , <i>Assistant Editor</i> Jose Puthenkulam , <i>Assistant Editor</i> Jonathan Labs , <i>Maintenance Task Group Chair</i> Itzik Kitroser , <i>Chief Technical Editor</i> Kenneth Stanwood , <i>Former Maintenance Task Group Chair</i>

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IEEE Std 802.16g™-2007 (amendment)	December 2007	Roger B. Marks , <i>Working Group Chair</i> Jose Puthenkulam , <i>Vice Chair, Co-Editor</i> Peiyong Zhu , <i>Secretary</i> Phillip Barber , <i>Task Group Chair</i> Achim Brandt , <i>Chief Technical Editor</i>
IEEE Std 802.16-2009	May 2009	Roger B. Marks , <i>Working Group Chair</i> Peiyong Zhu , <i>Secretary</i> Jonathan Labs , <i>Maintenance Task Group Chair</i> Joseph Schumacher , <i>Chief Technical Editor</i> Joey Chou , <i>Assitant Editor</i> Itzik Kitroser , <i>Assitant Editor</i> Ronald Murias , <i>Assitant Editor</i> Scott Probasco , <i>Assitant Editor</i>
IEEE Std 802.16j™-2009 (amendment)	May 2009	Roger B. Marks , <i>Working Group Chair</i> Jose Puthenkulam , <i>Working Group Vice Chair</i> Peiyong Zhu , <i>Working Group Secretary</i> Mitsuo Nohara , <i>Task Group Chair</i> Peiyong Zhu , <i>Task Group Vice Chair</i> Mike Hart , <i>Task Group Vice Chair</i> Jung Je Son , <i>Chief Technical Editor</i>
IEEE Std 802.16h™-2010 (amendment)	June 2010	Roger B. Marks , <i>Working Group Chair</i> Jose Puthenkulam , <i>Working Group Vice Chair</i> Peiyong Zhu , <i>Working Group Secretary</i> Herbert Ruck , <i>Working Group Secretary</i> Scott Probasco , <i>Working Group Secretary</i> Mariana Goldhamer , <i>Task Group Chair</i> Harry Bims , <i>Task Group Vice Chair</i> Barry Lewis , <i>Task Group Vice Chair</i> Paul Piggin , <i>Task Group Vice Chair</i> Harry Bims , <i>Task Group Secretary</i> Jung Je Son , <i>Chief Technical Editor</i>
IEEE Std 802.16m™-2011 (amendment)	March 2011	Roger B. Marks , <i>Working Group Chair</i> Jose Puthenkulam , Rakesh Taori , <i>Working Group Vice Chairs</i> Herbert Ruck , Scott Probasco , Erik Colban , <i>Working Group Secretaries</i>
IEEE Std 802.16™-2012	June 2012	Roger B. Marks , <i>Working Group Chair</i> Rakesh Taori , <i>Working Group Vice Chair</i> Erik Colban , Harry Bims , <i>Working Group Secretaries</i>
IEEE Std 802.16p™-2012 (amendment)	Sept 2012	Roger B. Marks , <i>Working Group Chair</i> Rakesh Taori , <i>Working Group Vice Chair</i> Erik Colban , Harry Bims , <i>Working Group Secretaries</i>

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Carl Eklund
Roger Eline
Avraham Freedman
Marianna Goldhammer
Zion Hadad
David Johnston
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Introduction

This introduction is not part of IEEE Std 802.16n-2013, IEEE Standard for Air Interface for Broadband Wireless Access Systems—Amendment 2: Higher Reliability Networks.

This amendment specifies enhancements to the WirelessMAN-OFDMA Air Interface of IEEE Std 802.16, specifying enhanced mechanisms to support Higher Reliability Networks. As of the approval date, the applicable version of IEEE Std 802.16 is IEEE Std 802.16-2012, as amended by IEEE Std 802.16p-2012 and IEEE Std 802.16n-2013.

Conformance test methodology

The multipart conformance test documents for IEEE Std 802.16 are designated by “IEEE Standard 802.16/ConformanceXX.”

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IEEE Standard for Air Interface for Broadband Wireless Access Systems—

Amendment 2: Higher Reliability Networks

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NOTE—The editing instructions contained in this amendment define how to merge the material contained herein into the existing base standard IEEE Std 802.16™. The editing instructions are shown in ***bold italic***. Four editing instructions are used: ***change***, ***delete***, ***insert***, and ***replace***. ***Change*** is used to make small corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using ~~strike-through~~ (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make large changes in existing text, subclauses, tables, or figures by removing existing material and replacing it with new material. Editorial notes will not be carried over into future editions because the changes will be incorporated into the base standard.¹

¹Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

1. Overview

Insert new subclause 1.8 as follows:

1.8 Support for high reliability networks

A high reliability (HR) network implements features that enable increased robustness and alternate radio path establishment in a degraded network, in the case of failure of one or more infrastructure nodes or network connectivity.

In order to support high reliability in WirelessMAN-OFDMA, multi-mode operation of base station as a relay and mobile station as a relay, direct communication between MSs, forwarding of MS traffic to the network and another MS by other MS, standalone network, local forwarding bypassing backhaul links, path management against single point of failures by providing alternative radio and backhaul paths, and enhanced multicast-based service among a group of mobile stations are supported.

Those distinct functionalities in HR Networks support the mission critical application, including Public Safety, Avionics, Airport Surface, and Smart Grid.

3. Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary: Glossary of Terms & Definitions* should be consulted for terms not defined in this clause.²

Change the following definition:

infrastructure station: An MR-BS, ~~or~~ RS, HR-BS, or HR-RS. *See also:* **multihop relay base station (MR-BS), relay station (RS), high reliability base station (HR-BS), high reliability relay station (HR-RS).**

Insert the following new definitions:

affected HR-BS: An HR-BS that is experiencing a failure of its backhaul connection to the backbone network. *See also:* **high reliability base station (HR-BS).**

high reliability base station (HR-BS): A base station that is a subset of base station (BS) features and functions and additionally supports the WirelessMAN-High Reliability Air Interface. *See also:* **base station (BS).**

high reliability mobile station (HR-MS): A subscriber station capable of performing the WirelessMAN-OFDMA subset of mobile station (MS) features and functions and additionally implementing the WirelessMAN-High Reliability Air Interface. *See also:* **mobile station (MS).**

high reliability network (HR-Network): A network compliant with High Reliability Air Interface System.

high reliability relay station (HR-RS): A relay station that is a subset of relay station (RS) features and functions and additionally supports the WirelessMAN-High Reliability Air Interface.

high reliability station (HR-station): An HR-MS, HR-BS, or HR-RS.

²The *IEEE Standards Dictionary: Glossary of Terms & Definitions* is available at <http://shop.ieee.org/>.

radio path redundancy: The ability to provide alternative paths between base stations, relay stations, and subscriber stations.

4. Abbreviations and acronyms

Insert the following new abbreviations and acronyms:

FBIS	forwarding between infrastructure stations
FCZ	forwarding control zone
HR	high reliability
PPDR	public protection and disaster relief
SPOF	single point of failure

6. MAC common part sublayer

6.3 Data/Control plane

6.3.2 MAC PDU formats

6.3.2.3 MAC management messages

Change Table 6-51 in 6.3.2.3 as indicated:

Table 6-51—MAC management messages

Type	Message name	Message description	Connection
~~110–255~~		<i>Reserved</i>	
<u>110</u>	<u>MM-ADV</u>	<u>Multimode Advertisement message</u>	<u>Broadcast</u>
<u>111</u>	<u>MM-BS-REQ</u>	<u>Multimode Base station Request message</u>	<u>Primary</u>
<u>112</u>	<u>MM-BS-RSP</u>	<u>Multimode Base station Response message</u>	<u>Primary</u>
<u>113</u>	<u>MM-BS-CMD</u>	<u>Multimode Base station Command message</u>	<u>Primary</u>
<u>114</u>	<u>MM-RS-REQ</u>	<u>Multimode Relay Request message</u>	<u>Primary</u>
<u>115</u>	<u>MM-RS-RSP</u>	<u>Multimode Relay Response message</u>	<u>Primary</u>
<u>116</u>	<u>MM-RL-REQ</u>	<u>Multimode Release Request message</u>	<u>Primary</u>
<u>117</u>	<u>MM-RL-RSP</u>	<u>Multimode Release Response message</u>	<u>Primary</u>
<u>118</u>	<u>MM-STAT-REP</u>	<u>Multimode Status Report message</u>	<u>Primary</u>
<u>119</u>	<u>DC-LC-REQ</u>	<u>Direct Communication Link Creation Request</u>	<u>Primary</u>
<u>120</u>	<u>DC-LC-RSP</u>	<u>Direct Communication Link Creation Response</u>	<u>Primary</u>

Table 6-51—MAC management messages (continued)

Type	Message name	Message description	Connection
<u>121</u>	<u>DC-LD-REQ</u>	<u>Direct Communication Link Deletion Request</u>	<u>Primary</u>
<u>122</u>	<u>DC-LD-RSP</u>	<u>Direct Communication Link Deletion Response</u>	<u>Primary</u>
<u>123</u>	<u>DC-LR-REQ</u>	<u>Direct Communication Link Report Request</u>	<u>Primary</u>
<u>124</u>	<u>DC-LR-RSP</u>	<u>Direct Communication Link Report Response</u>	<u>Primary</u>
<u>125</u>	<u>NCI</u>	<u>Network Configuration Information (for BS-controlled FTN)</u>	<u>Broadcast by forwarding HR-MS</u>
<u>126</u>	<u>PM-NBR-REQ</u>	<u>Neighboring Alternate Path Request Message</u>	<u>Primary</u>
<u>127</u>	<u>PM-NBR-REP</u>	<u>Neighboring Alternate Path Response Message</u>	<u>Primary</u>
<u>128</u>	<u>PM-SAC-REQ</u>	<u>Switched Access Control Request Message</u>	<u>Primary</u>
<u>129</u>	<u>PM-SAC-RSP</u>	<u>Switched Access Control Response Message</u>	<u>Primary</u>
<u>130</u>	<u>HR-RNG-CMD</u>	<u>Neighbor discovery command</u>	<u>Primary management</u>
<u>131</u>	<u>HR-RNG-REP</u>	<u>Neighbor discovery report</u>	<u>Primary management</u>
<u>132</u>	<u>FN-CONFIG-CMD</u>	<u>BS-controlled FTN configuration</u>	<u>Primary management</u>
<u>133</u>	<u>FN-RNG-FLU</u>	<u>Forwarding Ranging Follow-up</u>	<u>Primary</u>
<u>134</u>	<u>F-MAP</u>	<u>Forwarding MAP (for BS-controlled FTN)</u>	<u>Broadcast by forwarding HR-MS</u>
<u>135</u>	<u>HR-MG-IND</u>	<u>High Reliable Multicast Group Indication</u>	<u>Broadcast</u>
<u>136</u>	<u>HR-MT-IND</u>	<u>High Reliable Multicast Traffic Indication</u>	<u>Broadcast</u>
<u>137</u>	<u>PI</u>	<u>Paging Indicator</u>	<u>Broadcast</u>
<u>138</u>	<u>MSPG-GRP</u>	<u>MS Paging Group List (to add/delete)</u>	<u>Primary</u>
<u>139</u>	<u>MSPG-PG</u>	<u>MS Paging Group Configuration</u>	<u>Multicast</u>
<u>140</u>	<u>HR-PCC</u>	<u>High Reliable Power Control Configuration</u>	<u>Primary</u>
<u>141–255</u>	<u>—</u>	<u>Reserved</u>	<u>—</u>

6.3.2.3.5 RNG-REQ (ranging request) message

Change the text in 6.3.2.3.5 RNG-REQ (ranging request) message as follows:

.....

The following TLV parameter shall be included in the RNG-REQ message when the MS is attempting to perform reentry, HO, or location update:

Ranging Purpose Indication

The presence of this item in the message indicates the following MS action:

If Bit 0 is set to 1, in combination with a serving BSID, it indicates that the MS is currently attempting to HO or reentry; or, in combination with a Paging

Controller ID, indicates that the MS is attempting network reentry from idle mode to the BS.

If Bit 1 is set to 1, it indicates that the MS is initiating the idle mode location update process.

Bit 2: Seamless HO indication. When this bit is set to 1 in combination with other included information elements, it indicates the MS is initiating ranging as part of seamless HO procedure.

Bit 3: Ranging Request for Emergency Call Setup. When this bit is set to 1, it indicates MS action of Emergency Call Process.

Bit 4: MBS update. When this bit is set to 1, the MS is currently attempting to perform location update due to a need to update service flow management encodings for MBS flows.

Bit 5: Network Reentry from idle mode of MS which has entered idle mode in AAI-only ABS.

~~Bit 6-7: Reserved~~

Bit 6: Ranging Request for HR Network. When this bit is set to 1, it indicates the HR-MS is currently attempting to perform ranging as a part of HR-Network operation.

Bit 7: Reserved

Insert the following text at the end of 6.3.2.3.5 RNG-REQ (ranging request) message:

The following parameter shall be included in the RNG-REQ message when the MS is attempting to perform ranging as a part of operation in HR-Network:

Extended Ranging Purpose Indication for HR-Network (see 11.5)

Indicates the ranging purpose of the MS during operating for HR-Network.

The following parameter shall be included in the RNG-REQ message when the MS is attempting to perform ranging request for HR multicast (HR multicast service flow update or location update due to crossing HR Multicast Group zone or multicast security key update):

Action Code for HR Multicast (see 11.5)

Indicates the ranging purpose of the MS during receiving multicast service in HR-Network.

The following TLV parameter shall be included in the RNG-REQ message when the MS is attempting to perform Network reentry for FBIS operation:

FBIS_Configuration_Parameters (see 11.5)

Compound TLV that provides parameters for FBIS initiation and operation.

6.3.2.3.6 RNG-RSP (ranging response) message

Insert the following text at the end of 6.3.2.3.6 RNG-RSP (ranging response) message as follows:

The following parameters shall be included only if these conditions are true: (1) Bit 6 of the ranging purpose indication is set to 1; (2) the Extended Ranging Purpose Indication for HR-Network is 0x00; (3) Bit 0 of the Action Code for HR Multicast in the RNG-REQ message is set to 1.

HR multicast service flow update mapping info (see 11.1.18)

HR multicast service flow update mapping info is used by the BSs in one HR multicast zone to provide consistency of HR Multicast Group ID mapping used in other HR multicast zone as determined by the serving HR multicast zone.

6.3.2.3.9 Privacy key management (PKM) messages (PKM-REQ/PKM-RSP)

Change Table 6-63 as indicated:

Table 6-63—PKM message codes

Code	PKM message type	MAC management message name
0–2	<i>Reserved</i>	—
3	SA Add	PKM-RSP
4	Auth Request	PKM-REQ
5	Auth Reply	PKM-RSP
6	Auth Reject	PKM-RSP
...	...	...
...	...	...
35	PKMv2 AK Transfer Ack	PKM-REQ
~~36–255~~	~~<i>Reserved</i>~~	—
<u>36</u>	<u>DirectComms_KeyAgreement_MSG #1</u>	<u>PKM-RSP</u>
<u>37</u>	<u>DirectComms_KeyAgreement_MSG #2</u>	<u>PKM-REQ</u>
<u>38</u>	<u>DirectComms_KeyAgreement_MSG #3</u>	<u>PKM-RSP</u>
<u>39</u>	<u>PKIDirectComms_KeyAgreement_MSG #1</u>	<u>PKM-RSP</u>
<u>40</u>	<u>PKIDirectComms_KeyAgreement_MSG #2</u>	<u>PKM-REQ</u>
<u>41</u>	<u>PKIDirectComms_KeyAgreement_MSG #3</u>	<u>PKM-RSP</u>
<u>42–255</u>	<u><i>Reserved</i></u>	—

6.3.2.3.10 DSA-REQ message

Insert the following text at the end of 6.3.2.3.10 DSA-REQ message:

When an MS commences multicast service in HR-Network, the following parameters shall be included in the DSA-REQ message:

HR Multicast Group Zone ID (see 11.13.51)

Indicates multicast group zone IDs for the connection that is associated with the service flow in DSA-REQ in HR-Network.

HR Multicast Group ID (see 11.13.52)

Indicates the multicast group for the connection that is associated with the service flow in DSA-REQ.

HR Multicast Indication cycle (see 11.13.53)

Indicates the multicast indication cycle for the multicast in HR-Network.

6.3.2.3.11 DSA-RSP message

Insert the following text at the end of 6.3.2.3.11 DSA-RSP message:

When an MS commences multicast service in HR-Network, the BS shall include the following parameters in the DSA-RSP message:

HR Multicast Group Zone ID (see 11.13.51)

Indicates multicast group zone IDs for the connection that is associated with the service flow in DSA-RSP in HR-Network.

HR Multicast Group ID (see 11.13.52)

Indicates the multicast group for the connection that is associated with the service flow in DSA-RSP.

HR Multicast Indication cycle (see 11.13.53)

Indicates the multicast indication cycle for the multicast in HR-Network.

6.3.2.3.13 DSC-REQ (DSC request) message

Insert the following text at the end of 6.3.2.3.13 DSC-REQ message:

In an HR-Network, BS may include the following parameters for the purposes of multicast management in DSC-REQ message:

HR Multicast Group Zone ID (see 11.13.51)

Indicates multicast group zone IDs for the connection to overwrite that is associated with the service flow in DSC-REQ in HR-Network.

HR Multicast Group ID (see 11.13.52)

Indicates the multicast group for the connection to overwrite that is associated with the service flow in DSC-REQ.

HR Multicast Indication cycle (see 11.13.53)

Indicates the multicast indication cycle to overwrite for the multicast in HR-Network.

6.3.2.3.42 MOB_NBR-ADV (neighbor advertisement) message

Insert the following text at the end of 6.3.2.3.42 MOB_NBR-ADV (neighbor advertisement) message:

HR multicast service flow update mapping info (see 11.1.18)

HR multicast service flow update mapping info is used by the BSs in one HR multicast zone to provide consistency of HR Multicast Group ID mapping used in other HR multicast zone as determined by the serving HR multicast zone.

HR Multimode Indication (see 11.4.1)

Indicates whether neighbor BS/RS is HR-MS acting as BS/RS or HR-BS acting as RS.

6.3.2.3.47 MOB_BSHO-REQ (BS HO request) message

Change Table 6-165 as indicated:

Table 6-165—MOB_BSHO-REQ message format

Syntax	Size (bits)	Notes
...	—	—
Mode	3	0b000: HO Request 0b001: MDHO/FBSS request: Anchor BS update with CID update 0b010: MDHO/FBSS request: Anchor BS update without CID update 0b011: MDHO/FBSS request: Diversity set update with CID update 0b100: MDHO/FBSS request: Diversity set update without CID update 0b101: MDHO/FBSS request: Diversity set update with CID update for newly added BS 0b110: MDHO/FBSS request: Diversity set update without CID update for newly added BS ~~0b111: Reserved.~~ <u>0b111: HO Request for HR-Network</u>
Padding	5	Shall be set to zero.
<u>if (Mode == 0b111) {</u>	==	==
<u>Extended HO Mode</u>	<u>2</u>	<u>0b00: Alternative Path</u> <u>0b01: FBIS Initiation</u> <u>0b10: FBIS Termination</u> <u>0b11: Reserved</u>
<u>}</u>	==	==
<u>if (Mode == 0b000 or 0b111){</u>	—	—
...	==	==
HO_authorization policy indicator	1	Indicates whether Seamless HO mode is supported 0: Not supported 1: Supported
Seamless HO mode flag	1	Indicates whether Seamless HO mode is supported 0: Not supported 1: Supported

Table 6-165—MOB_BSHO-REQ message format (*continued*)

Syntax	Size (bits)	Notes
<u>if (Mode == 0b111) {</u>	—	—
<u>if (Extended HO Mode == 0b00) {</u>	==	==
<u>Role</u>	1	<u>0b0: Stay as HR-MS</u> <u>0b1: Change to HR-RS</u>
<u>CDMA_code</u>	8	==
<u>Transmission_opportunity_offset</u>	8	==
<u>Basic CID</u>	16	==
<u>} else if (Extended HO Mode == 0b01) {</u>	==	==
<u>Primary Serving BS</u>	1	<u>0b0: the AMS shall set its primary serving BS as S-BS (Degraded HR-BS) after network reentry</u> <u>0b1: the AMS shall set its primary serving BS as T-BS (Target HR-BS) after network reentry</u>
<u>Switched Access Mode</u>	1	<u>0: Switched Access with fixed Switched Access Windows</u> <u>1: Switched Access with variable Switched Access Windows</u>
<u>if (Switched Access Mode==0) {</u>	==	==
<u>Switched Access Window Size</u>	8	<u>The size of fixed Switched Access Window in unit of frame</u>
<u>} else if (Switched Access Mode==1) {</u>	==	==
<u>Maximum Switched Access Window Size</u>	8	<u>Maximum size of Switched Access Window in unit of frame</u>
<u>}</u>	==	==
<u>Switching Access Start Time offset</u>	8	<u>Difference between Switching Access Start time and Action time in units of frames. The value of Switching Access Start time shall be calculated by adding this value with the value of Action time specified for this T-BS.</u>
<u>} else if (Extended HO Mode == 0b10) {</u>	==	==
<u>Termination Reason</u>	2	<u>0b00: Backbone recovery</u> <u>0b01: No connection for FBIS</u> <u>0b10: Link failures</u> <u>0b11: Reserved</u>
<u>} // End of if (Extended HO Mode)</u>	==	==
<u>} // End of if (HO Mode == 0b111)</u>	==	==
...	—	—

Change the definition for Action Time in MOB_BSHO-REQ message as indicated:

Action Time

For HO, this value is defined as number of frames until the Target BS allocates a dedicated transmission opportunity for RNG-REQ message to be transmitted by the MS using Fast_Ranging_IE. Dedicated allocation for transmission of RNG-REQ means that channel parameters for that BS learned by the MS before HO stay valid and can be reused during actual Network Re-entry without preceding CDMA-based Ranging. Final Action Time shall be decided by the Serving BS based on the information obtained from potential Target BSs over the backbone network. A value of zero indicates no opportunity to allocate Fast Ranging IE in any candidate target BS.

For MDHO/FBSS, this is the time of update of Anchor BS and/or Diversity Set. A value of zero in this parameter signifies that this parameter shall be ignored.

For Alternative Path, this is the wait time in units of 1 ms before the HR-MS performs fast network reentry to target station.

For Mode = 0b111 and Extended HO Mode = 0b00, the MOB_BSHO-REQ may contain the following TLV:

Neighbor BS Trigger (see 11.18.1)

6.3.2.3.48 MOB_MSHO-REQ (MS HO request) message

Change Table 6-166 as indicated:

Table 6-166—MOB_MSHO-REQ message format

Syntax	Size (bits)	Notes
...	—	—
Arrival Time Difference Indication	1	0: If the MS is transmitting this message to request HO. 1: If the MS is transmitting this message to send MDHO/FBSS request (i.e., Anchor BS update or Diversity Set update).
<u>FBIS Termination Indication</u>	<u>1</u>	<u>0: If the MS is transmitting this message to request HO</u> <u>1: If the MS is transmitting this message to send FBIS Termination request</u>
<u>if (FBIS Termination Indication == 1) {</u>	<u>==</u>	<u>==</u>
<u>Termination Reason</u>	<u>2</u>	<u>0b00: Backbone recovery</u> <u>0b01: No connection for FBIS</u> <u>0b10: Link failures</u> <u>0b11: Reserved</u>
<u>Reserved</u>	<u>5</u>	<u>==</u>
<u>} else {</u>	<u>==</u>	<u>==</u>
<u>Reserved</u>	<u>7</u>	<u>==</u>
<u>}</u>	<u>==</u>	<u>==</u>
...	<u>==</u>	<u>==</u>

6.3.2.3.60 R-link channel descriptor (RCD) message

Insert the following text after the fifth paragraph (before Table 6-182) of 6.3.2.3.60:

In addition, RCD message consists of TLVs that define the characteristics of relay link between an HR-BS acting as HR-RS or HR-MS acting as HR-RS and its superordinate station, with every instance of RS replaced by HR-BS acting as HR-RS or HR-MS acting as HR-RS.

6.3.2.3.63 RS configuration command (RS_Config-CMD) message

Insert the following text after the second paragraph (before Table 6-185) of 6.3.2.3.63:

In addition, RS_Config-CMD message consists of TLVs that provide configuration parameters that are applicable to an HR-BS acting as HR-RS or HR-MS acting as HR-RS, with every instance of RS replaced by HR-BS acting as HR-RS or HR-MS acting as HR-RS.

Insert the following text at the end of 6.3.2.3:

6.3.2.3.99 MAC management messages for HR-Network

6.3.2.3.99.1 MM-ADV (multimode advertisement) message

Infrastructure stations and HR-MSs acting as HR-BS or HR-RS may transmit MM-ADV message to support multimode operation in the following cases:

- When the backhaul link is down or up
- During relay link maintenance due to unavailable backhaul link, PHY/MAC layer parameters need to be reconfigured for the following:
 - Power down
 - Power reduction
 - FA change
- Multimode service establishment/release/change to inform subordinate stations to perform handover
- Report status information of multimode station

The MM-ADV message format shall be as shown in Table 6-227a.

Table 6-227a—MM-ADV message format

Syntax	Size (bits)	Notes
MM-ADV message format () {	=	=
Management Message Type = 110	8	=

Table 6-227a—MM-ADV message format (continued)

Syntax	Size (bits)	Notes
Action Type	4	Used to indicate the purpose of this message 0b0000: Reconfiguration of HR-BS/RS including multimode BS/RS 0b0001: Restart of HR-BS/RS including multimode BS/RS 0b0010: Power down (including FA down) of HR-BS/RS including multimode BS/RS 0b0011: Power reduction of HR-BS/RS including multimode BS/RS 0b0100: Backhaul link down of HR-BS 0b0101: Backhaul link up of HR-BS 0b0110: FA change of HR-BS/RS including multimode BS/RS 0b0111: Multimode service end of HR-MS 0b1000: Report status information of multimode station 0b1001–0b1111: <i>Reserved</i>
<i>Reserved</i>	4	=
TLV encodings for MM-ADV	<i>variable</i>	TLV-specific
}	=	=

All parameters according to action type are coded as TLV tuples, as defined in 11.32.1.

The following parameter shall be included if action type is set to 0b0000, 0b0001, 0b0010, and 0b0011, and may be included if action type is set to 0b0101, 0b0110, and 0b0111 in MM-ADV message:

Time to start the action

Expected time to start the action as represented by the 8 least significant bits of the frame number

The following parameter shall be included if action type is set to 0b0000, 0b0001, and 0b0011, and may be included if action type is set to 0b0010, 0b0100, and 0b0110 in MM-ADV message:

Time during action

Expected time during the action as represented by the 8 least significant bits of the frame number

The following parameters may be included only if action type is set to 0b0000 in MM-ADV message:

New DCD

New DCD setting that the BS will use after the reconfiguration

New UCD

New UCD setting that the BS will use after the reconfiguration

The following parameter shall be included only if action type is set to 0b0011 in MM-ADV message:

Tx Power Reduction

dB value of Tx power reduction, included in the DCD setting

The following parameter shall be included only if action type is set to 0b0110 in MM-ADV message:

FA index

FA index that the BS will use after changing FA, included in the DCD setting

6.3.2.3.99.2 MM-BS-REQ (multimode base station request) message

To request to transfer HR-BS role to a multimode HR-MS, the MM-BS-REQ message shall be sent from superordinate HR-BS to a multimode HR-MS.

The MM-BS-REQ message format shall be as shown in Table 6-227b.

Table 6-227b—MM-BS-REQ message format

Syntax	Size (bits)	Notes
MM-BS-REQ message format () {	—	—
Management Message Type = 111	8	—
Action code	2	Used to indicate the purpose of this message. 0b00: Request HR-BS role to the multimode HR-MS 0b01: Approval of the unsolicited MM-BS-RSP message by the multimode HR-MS. 0b10: Rejection of the unsolicited MM-BS-RSP message by the multimode HR-MS. 0b11: <i>Reserved</i> .
BS configuration indication	2	Indicates whether the superordinate HR-BS provides the recommended PHY parameters to multimode HR-MS or not. 0b00: There are no recommended PHY parameters. 0b01: There are no recommended PHY parameters. But, they must be equal to the PHY operational parameters of the superordinate HR-BS. 0b10: There are recommended PHY parameters. 0b11: <i>Reserved</i>
<i>Reserved</i>	4	Shall be set to zero
TLV encodings for MM-BS-REQ	<i>variable</i>	TLV-specific
}	—	—

All parameters according to BS configuration indication are coded as TLV tuples, as defined in 11.32.5.

The following parameters shall be included if BS configuration indication is set to 0b01 in MM-BS-REQ message:

DCD Configuration Change Count

Incremented by one (modulo 256) by the BS whenever any of the values of this channel descriptor change, except for the frame number for the OFDM PHY and the Available DL Radio Resources.

UCD Configuration Change Count

Incremented by one (modulo 256) by the BS whenever any of the values of this channel descriptor change, except for the Available UL Radio Resources.

The following parameters shall be included if BS configuration indication is set to 0b10 in the message:

Operator ID

Identifier of the network provider.

PHY Profile ID

For systems using OFDM or OFDMA, the bit-by-bit definition of the PHY Profile ID is shown in Table 6-160.

FA index

Frequency assignment index. This field is present only if the FA index indicator in PHY profile ID is set. Otherwise, the HR-MS acting as BS has the same FA Index or the center frequency as the superordinate BS.

BS EIRP

Signed Integer from –128 to 127 in unit of dBm. This field is present only if the BS EIRP indicator is set in PHY Profile ID. Otherwise, the BS has the same EIRP as the superordinate BS.

BS_ID

Recommended HR-BS ID parameter for HR-MS acting as BS.

Preamble Index/Subchannel Index

For the OFDMA PHY this parameter defines the PHY specific preamble. For the OFDM PHY, the 5 LSB contain the active DL subchannel index and the 3 MSB shall be *Reserved* and set to '0b000'. For OFDMA PHY, bit 7 is used to indicate the reuse factor for purpose of CINR measurement for handoff. A value of '0' indicates a reuse factor of 1 and a value of '1' indicates reuse factor of 3. For OFDMA PHY, bit 6 to bit 0 represent the preamble index.

Scheduling Service Supported

Bitmap to indicate if BS supports a particular scheduling service. 1 indicates support, 0 indicates not support:

Bit 0: Unsolicited grant service (UGS)

Bit 1: Real-time polling service (rtPS)

Bit 2: Non-real-time polling service (nrtPS)

Bit 3: Best effort (BE) service

Bit 4: Extended real-time polling service (ertPS)

If the value of bit 0 through bit 4 is 0b00000, it indicates no information on service available

Bits 5–7: *Reserved*; shall be set to zero

6.3.2.3.99.3 MM-BS-RSP (multimode base station response) message

After configuring HR-BS mode or expiring pre-provisioned BS configuration deadline, the MM-BS-RSP message shall be sent from multimode HR-MS to a superordinate HR-BS in response to an MM-BS-REQ message. The multimode HR-MS may send the MM-BS-RSP message in unsolicited manner with MM-BS_RSP_type = 0b00 (i.e., Request by multimode HR-MS in Unsolicited manner).

The MM-BS-RSP message format shall be as shown in Table 6-227c.

Table 6-227c—MM-BS-RSP message format

Syntax	Size (bits)	Notes
MM-BS-RSP message format () {	—	—
Management Message Type = 112	8	—
MM-BS_RSP_type	2	This indicates response type of MM-BS-RSP message. 0b00: Request by multimode HR-MS in Unsolicited manner 0b01: Approval of MM-BS-REQ 0b10: Rejection of MM-BS-REQ 0b11: <i>Reserved</i>
<i>Reserved</i>	6	Shall be set to zero
TLV encodings for MM-BS-RSP	<i>variable</i>	TLV-specific
}	—	—