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Re:	"IEEE 802.16-12-400-00-Gdoc," in response to Letter Ballot Recirc #37b on P802.16n/D3
Abstract	Comments on multicast operation in GRIDMAN Draft Standard
Purpose	To discuss and adopt the proposed text in the draft amendment document on GRIDMAN
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Clarification on multicast operation over IEEE 802.16n

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1. Introduction

This document provides clarification on multicast operation over IEEE 802.16n to recognize and distinguish the multicast service between HR multicast operation and other multicast operation.

2. References

[1] IEEE 802.16-12-0132-00, GRIDMAN System Requirement Document including SARM annex, January 2012.
[2] IEEE P802.16n™/D3, Air Interface for Broadband Wireless Access Systems - Draft Amendment: Higher Reliability Networks, June 2012.
[3] IEEE P802.16.1a™/D3, WirelessMAN-Advanced Air Interface for Broadband Access Systems - Draft Amendment: Higher Reliability Networks, June 2012.
[4] EEE P802.16Rev3/D6, IEEE Draft Standard for Local and metropolitan area networks; Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems," April 2012.
[5] IEEE P802.16.1™/D6, IEEE Draft for WirelessMAN-Advanced Air Interface for Broadband Wireless Access Systems, April 2012.

3. Proposed Text on the IEEE 802.16n Amendment Draft Standard

[----------Start of Text Proposal----------]

[Remedy1: change line#17-#21, page 7 in P802.16n as follows:]

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

[Remedy2: change line#1-#3, page 8 in P802.16n as follows:]

HR multicast service flow update mapping info is used by the BS' 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.

[Remedy3: change line#9, page8 - line#8, page 10 in P802.16n as follows:]

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 11.13.48)

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 11.13.49)

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

HR Multicast Indication cycle (see 11.13.50)

Indicates 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 11.13.48)

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 11.13.49)

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

HR Multicast Indication cycle (see 11.13.50)

Indicates 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 HR-Network, BS may include the following parameters for the purposes of multicast management in DSC-REQ message.

HR Multicast Group Zone ID (see 11.13.48)

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 11.13.49)

Indicates multicast group for the connection to overwrite that is associated with the service flow in

DSC-REQ.

HR Multicast Indication cycle (see 11.13.50)

Indicates 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 11.1.13)

HR multicast service flow update mapping info is used by the BS' 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.

[Remedy4: change line#11, page35-line1, page36 in P802.16n as follows:]

6.3.2.3.99.27 HR-MG-IND (High Reliable Multicast Group Indication) message

An HR-BS providing multicast service in HR-Network transmits HR-MG-IND message in the beginning of available interval in HR multicast indication cycle. This message indicates whether there is DL multicast traffic for a specific multicast group. There are two formats for the HR-MG-IND message, indicated by the indication type field. If the indication type is set to "0," this message indicates the multicast traffic transmission offset directly. Otherwise, MGIND bitmap indicates a subgroup of multicast group and further information will be transmitted by HR-MT-IND described in 6.3.2.3.99.28.

Table 229ee - HR-MG-IND message format

Syntax	Size (bit)	Notes
HR-MG-IND message format () {		
Management Message Type == xx	8	
Indication type	1	0b0: full MGID indication 0b1: MGIND+MTIND indication
if (Indication type == 0b0) {		
Num MGID	5	Number of multicast group to indicate multicast traffic is transmitted.
for(i=0:<Num_MGID;i++){		

Table 229ee - HR-MG-IND message format

Syntax	Size (bit)	Notes
HR Multicast Group ID	16	-
Action Code	3	if bit0=1, perform network entry or exit sleep mode if bit1=1, perform ranging procedure with ranging purpose indication ~~bit#5~~bit#6 set to 1 and Extended Ranging Purpose Indication for HR-Network is set to 0x00 if bit2=1, receiving multicast traffic

[Remedy5: change 4th row in Table 229ff-HR-MT-IND message format, page38 in P802.16n as follows:]

Action Code	3	if bit0=1, perform network entry or exit sleep mode if bit1=1, perform ranging procedure with ranging purpose indication ~~bit#5~~bit#6 set to 1 and Extended Ranging Purpose Indication for HR-Network is set to 0x00 if bit2=1, receiving multicast traffic

[Remedy6: change line#9-#12, page52 in P802.16n as follows:]

11.1.17 HR multicast service flow update mapping info

The TLV encodings defined in this subclause are specific to the RNG-RSP (6.3.2.3.6) and MOB_NBR-ADV (6.3.2.3.42) MAC management message. This TLV indicates the mapping of HR Multicast Group ID used in the current HR Multicast group zone to new HR Multicast Group ID within a neighboring HR Multicast group zone and information regarding the HR-Multicast MAP transmission in the neighbor HR Multicast group Zone.

Type	Length (byte)	Value	Scope
116	Variable (3+Nx4)	See Table 671a - HR Multicast Service flow update mapping info definition	RNG-RSP, MOB_NBR-ADV

Table 671a - HR Multicast service flow update mapping info definition

Field	Length (bits)	Note
HR Multicast Group Zone ID	12	Multicast zone identifier for current HR Multicast Group Zone
Neighboring_HR_Multicast Group_ZONE_ID	12	Multicast Group zone identifier for neighboring Multicast Group Zone
HR Multicast Indication Cycle of neighboring HR Multicast Group Zone		HR Multicast Indication Cycle for neighboring HR Multicast Group Zone It indicates the start of HR multicast indication cycle in unit of 8 LSB of frame number. HR Multicast indication cycle is unique to HR multicast group zone and it consists of multicast available interval and multicast unavailable interval. 1st frame of HR multicast indication cycle is the multicast available interval and rest frames are the multicast unavailable interval.
List of HR Multicast Group ID Mappings	variable (Nx4)	Current_HR_MGID(1), New_HR_MGID(1), ..., Current_HR_MGID(N), New_HR_MGID(N)

A value of 0xFFFF in the New_HR_MGID field indicates that the service flow corresponding to Current_HR_MGID is not available in the HR Multicast Zone identified by the TLV.

[Remedy7: change line#2-#4, page54 in P802.16n as follows:]

11.4 DCD management message encodings

11.4.7 DCD channel encodings

Insert the following row at the end of Table 679 -DCD channel encodings :

Name	Type (1 byte)	Length	Value (Variable length)	PHY Scope
HR Multicast group zone identifier	158	2	This parameter shall include HR multicast zone identifier with which BS is associated. An HR Multicast Group Zone identifier is 12bits long. Bits 11 through 0 are the HR Multicast Group Zone Identifier, bits 16 through 13 are set to 0 in each byte. The HR Multicast Group Zone identifier shall not be '0'. When the parameter is part of a compound DCD_settings TLV (refer to 11.18.1), a value of 0 means that the neighbor BS is not affiliated with any HR Multicast Group zone	All
HR Multimode Indication	159	1	Indicates whether the BR/RS is HR-MS acting as BS/RS or HR-BS acting as RS Bit 0: the BS/RS is neither HR-MS acting as BS/RS nor HR-BS acting as RS Bit 1: the BS/RS is HR-MS acting as BS/ RS Bit 2: the BS/RS is HR-BS acting as RS Bit 3-7: reserved	All
HR Multicast Indication cycle	160	1	HR Multicast Indication cycle indicates the start of HR multicast indication cycle in unit of 8 LSB of frame number. HR Multicast indication cycle is unique to HR multicast group zone and it consists of multicast available interval and multicast unavailable interval. 1st frame of HR multicast indication cycle is the multicast available interval and rest frames are the multicast unavailable interval.	All

[Remedy8: change 6th row in Table 686 - RNG-REQ message encodings in page56 in

P802.16n as follows:]

Action Code for HR Multicast	31	1	Bit0: multicast service flow update Bit1: location update due to HR multicast zone change Bit2: multicast security key update Bit3-7: Reserved	

[Remedy9: change 5th-6th rows in Table 713 - Service flow encodings in page59 in P802.16n as follows:]

~~zz~~	HR Multicast Group ID
zz+1	HR Multicast Indication Cycle assignment

[Remedy10: change line#23, page59 - line#22, page60 in P802.16n as follows:]

11.13.47 HR multicast service

This TLV indicates whether the multicast service is being requested or provided for the connection that is being setup. A value of 1 indicates that an multicast service limited to the serving BS is being requested and a value of 2 indicates multi-BS Multicast regardless of proving macro-diversity. The DSA-RSP message shall contain the acceptance or rejection of request and if there is no available multicast, multicast service value shall be set to 0.

Type	Length (byte)	Value	Scope
[145/146].59	1	0: No available multicast service 1: Multicast in Serving BS Only 2: Multicast in a multi-BS Zone supporting 3-255: Reserved	DSA-REQ, DSA-RSP, DSA-ACK, DSC-REQ, DSC-RSP

11.13.48 HR Multicast Group Zone Identifier Assignment parameter

The DSA-REQ/RSP message may contain the value of this parameter to specify an HR Multicast Group Zone identifier. This parameter indicates an HR Multicast Group zone through which the connection or virtual connection for the associated service flow is valid.

Type	Length (byte)	Value	Scope
[145/146].60	2	HR Multicast group zone identifier (bits 11 through 0 are the HR Multicast Group Zone Identifier, bits 15 through 12 are set to 0)	REG-REQ, REG-RSP, DSA-REQ, DSA-RSP, DSC-REQ, DSC-RSP

11.13.49 HR Multicast Group Identifier Assignment parameter

The DSA-REQ/RSP message may contains the value of this parameter to specify an HR Multicast Group identifier. This parameter indicates an HR Multicast Group ID through which the connection or virtual connection for the associated service flow is valid.

Type	Length (byte)	Value	Scope
[145/146].zz	2	HR Multicast group identifier	DSA-REQ, DSA-RSP, DSC-REQ

11.13.50 HR Multicast Indication Cycle Assignment parameter

The DSA-REQ/RSP message may contains the value of HR multicast indication cycle to specify HR Multicast Indication Cycle. This parameter indicates the start of HR multicast indication cycle in unit of 8 LSB of frame number. HR Multicast Indication cycle is unique to HR multicast group zone and consists of multicast available interval and multicast unavailable interval. 1st frame of HR multicast indication cycle is the multicast available interval and rest frames are the multicast unavailable interval.

Type	Length (byte)	Value	Scope
[145/146].zz+1	1	HR Multicast Indication Cycle in unit of 8 LSB of frame number.	DSA-REQ, DSA-RSP, DSC-REQ

[Remedy11: change line#8-line#15, page107 in P802.16n as follows:]

An HR-BS may provide the HR-MS with multicast content locally within its coverage and independently of other HR-BSs. The single HR-BS provision of multicast is therefore a configuration where an HR Multicast Zone is configured to consist of a single HR-BS only. In this case, the HR-BS uses any CID providing multicast service, independently of other HR-BSs, so the HR-MS received the multicast data from its serving HR-BS, and the HR-MS

should not expect the service flow for this multicast connection to continue when the HR-MS leaves the serving HR-BS' coverage. However, if the HR-MS moves to an HR-BS that is transmitting the same multicast flow in another HR Multicast Group Zone, HR-MS may update its service flow management encodings to continue to receive the same multicast flows.

To ensure proper multicast operation on networks of HR-BS employing multicast, the HR Multicast Group ID used for common multicast content and service shall be the same for all HR-BSs within the same HR Multicast Group Zone. This allows the HR-MS which has already registered with a service to be seamlessly synchronized with multicast transmissions within an HR Multicast Group Zone without communicating in the UL or re-registering with other HR-BS within that HR Multicast Group Zone.

The HR Multicast Group Zone identifier shall not be "0."

When the HR Multicast Group Zone identifier list appears in DCD setting TLV in MOB_NBR-ADV message with only one value of "0," then the neighbor BS is not affiliated with any HR Multicast group zone. An HR Multicast group zone that is adjacent to another HR Multicast group zone is a neighbor HR Multicast group zone to that multicast group zone.

[Remedy12: change line#16-line#20, page108 in P802.16n as follows:]

The DSA, DSC and DSD messages are used to establish, change, and delete multicast service flows respectively. The HR-BS shall send the DSA-REQ/RSP to the HR-MS with the relevant multicast parameters including HR Multicast Group ID.

To receive multicast data, an HR-MS receives the multicast allocation information in the multicast control channel (i.e., HR multicast assignment MAP).

[Remedy13: change line#3, page 109-line#16, page111 in P802.16n as follows:]

16.8.1.2 Multicast communication in normal operation mode

When an HR-MS moves across HR Multicast group zone boundaries in Active Mode or Sleep Mode, the HR-MS performs the handover procedure as described in 6.3.21.

When the HR-MS transits to a new HR Multicast Group Zone while in Active Mode or Sleep Mode, the HR-MS shall send RNG-REQ message described in 6.3.2.3.5 with Ranging Purpose Indication Bit 6 setting to 1 and Extended Ranging Purpose Indication = 0x00 with Action Code for HR Multicast bit0 setting to 1 at the target HR-BS. In response to the request for HR multicast service flow update, the HR-BS shall transmit RNG-RSP message described in 6.3.2.3.6, which may include HR multicast service flow update mapping info to provide updated service flow management encodings for any affected multicast flow as part of the handover procedure.

16.8.1.3 Multicast communication operation in idle mode

When an HR-MS in Idle mode moves to an HR-BS which does not belong to HR-MS' previous HR Multicast Group Zone, the HR-MS is expected to update the HR multicast service flow management encodings at that HR-BS to provide continuous reception of multicast content. The HR-MS may obtain the multicast information in the target HR Multicast group zone through MOB_NBR-ADV message described in 6.3.2.3.42 in the HR Multicast Group Zonee of the service HR-BS. If the idle mode HR-MS has not received such information from the serving HR Multicast Group Zone, the HR-MS shall use location update procedure to acquire updated HR multicast service flow management encodings. In order to perform the multicast location update process, the HR-MS shall transmit RNG-REQ message described in 6.3.2.3.5 with the Ranging Purpose Indication Bit 6 setting to 1 and Extended Ranging Purpose Indication = 0x00 with Action Code for HR Multicast bit0 setting to 1.

In addition to changing the HR multicast group zone, when the HR-MS detects current paging zone changes, the bit1

of the action code for HR multicast is set to 1. In the case of performing multicast security key update, the bit2 of the action code for HR multicast is set to 1. In response to the request for multicast location update, the HR-BS shall transmit RNG-RSP message described in 6.3.2.3.6, which may include the HR Multicast Group Zone identifier, Multicast Indication Cycle, and HR Multicast Group ID to provide update service flow management encodings for any affected multicast flow(s).

HR-BS providing multicast service transmits HR multicast indication cycle using DCD and DSA/ DSC messages. The HR multicast indication cycle is unique to HR multicast group zone and it consists of multicast available interval and multicast unavailable interval. Multicast available interval is the first frame of each HR multicast indication cycle. In the multicast available interval, the HR-BS providing multicast service transmits HR-MG-IND message described in 6.3.2.3.99.27 and HR-MT-IND message described in 6.3.2.3.99.28 during multicast available interval of the HR multicast indication cycle in an HR multicast group zone. HR-MG-IND and HR-MT-IND message are used to indicate

- multicast service establishment/change/release
- whether the multicast traffic is transmitted after those messages are transmitted
- to perform network entry or exit sleep mode to transmit multicast related message to change/
- release multicast service and update multicast security key.
- to perform multicast service flow update using ranging procedure

HR Multicast indication cycle included in DCD message is used for multicast service establishment.
During multicast service establishment/change using DSA/DSC message, new HR multicast indication cycle may be transmitted.

During multicast available interval, HR-BS transmits HR-MG-IND message in the beginning of available interval to indicate multicast traffic of one or more specific HR multicast groups will transmit. HR-MG-IND message includes an indication whether HR-MT-IND message will be transmitted. If the HR -MT-IND message is transmitted after transmitting HR-MG-IND using frame offset, MGIND bitmap indicates a multicast subgroup which is included in the HR-MT-IND message. Multicast group is divided into some subgroups (i.e., length of MGIND bitmap) and each subgroup has following number of multicast groups:

$$\text{Number of multicast groups in a subgroup} = \frac{2^{ML}}{M}$$

where ML is the length of HR Multicast Group ID, M is the length of MGIND bitmap and N-th bit in MGIND bitmap indicates a subgroup of multicast groups from $\left(2^{ML} \times \frac{N}{M}\right)$ to $\left(2^{ML} \times \frac{N+1}{M}\right) - 1$.

HR-MT-IND message is transmitted in the offset included in HR-MG-IND message after transmitting HR-MG-IND message and it indicates whether multicast traffic of specific multicast group will transmit. The multicast group is indicated based on the MGIND bitmap in HR-MG-IND message and MTIND bitmap in HR-MT-IND message.

N-th bit in MGIND bitmap indicates the value of log$M$ MSB of HR Multicast Group ID and Q-th bit in MTIND bitmap indicates the value of log$K$ LSB of HR Multicast Group ID. For the indicated HR Multicast Group ID, according to the action code, HR-MSs, member of the HR Multicast Group, perform network entry or receive multicast traffic.

16.8.2 Multicast Protocol Features and Functions

16.8.2.1 Downlink control channel for multicast communication

HR-multicast control channel (i.e., HR-Multicast DL MAP IE) carries configuration information (including

allocation/change/releasement) for multicast communication for one HR multicast group zone in an HR-BS. In HR-Multicast DL MAP, allocation period indicates a period of persistent allocation of multicast resource and Lifetime is a timer indicating the next instance of HR-Multicast DL MAP IE. During the allocation period, transmission indication indicates whether multicast resource is fragmented. If the transmission indication(*TI*) is set to 00, it indicates no fragmented traffic is transmitted until the next allocation instance. If *TI* is set to 01, it indicates the first fragmented traffic and more fragmented traffic is expected to transmit until the *TI* is set to 11. More fragmented traffic is transmitted with the value of *TI* setting to 10 or 11. If *TI* is set to 10, it indicates more fragmented traffic is transmitting until it is set to 11. If *TI* is set to 11, no more fragmented traffic (i.e., last fragmented traffic) is transmitted. Unless the Lifetime expires, this HR-Multicast DL MAP excluding the value of *TI* does not change during the allocation duration. At the time the Lifetime expires, the HR-Multicast DL MAP shall change or release the allocation.

[----------End of Text Proposal----------]