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Source(s)	Kamran Etemad, Intel Nadav Lavi, Alvarion Philip Barber, Huawei	mailto: kamran.etemad@intel.com nadav.lavi@alvarion.com pbarber@huawei.com
Re:	P802.16Rev2/D3, LB26b	
Abstract	MBS definitions and procedures in the REV2 D3 draft need adjustments and some errors need to be fixed.	
Purpose	Adoption toward REV2/D3	
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Proposed Clarifications and Improvements to MBS Definitions and Procedure in 802.16REV2

Kamran Etemad (Intel)
Nadav Lavi (Alvarion)
Phillip Barber (Huawei)

ProbleSS with Current REV2 D3 text:

Considering the realistic deployments and operators requirements for MBS, the MBS text in REV2D3 requires some technical corrections and clarifications as follows:

1. Multi-BS MBS should be generalized to cover semi-synchronous multi-BS multicasting.
2. Single BS MBS can be considered as special case of multi-BS MBS and its not needed
3. Text needs to be clear about the parameters which need to be the same across all BS with the same zone with macro-diversity is enabled or disabled.
4. Considering most MBS deployment involve many content channels in each MBS service, the current text more clearly specify
   - How parameters associated with multiple MBS content channels and their updates can efficiently conveyed to subscribed users at the time of service initiated and subsequent updates.
   - How to minimize signaling interaction with the network while a user in idle mode switches among content channels.
   - How to minimize signaling interaction and latency with for updating MCID's for user as they cross the MBS Zones.
   - How to allow power efficiency by selectively discarding undesired content in a multi-channel MBS burst.
5. The text also need to offer allow means of delivering MBS parameters at upper layers if supported by the network.
6. The use case and value add of LCID need to be clarified.

Proposed Remedies and Text Clarifications:

6.3.2.3.52 MBS_MAP (multicast and broadcast service map) message:

[Replace the first paragraph in 6.3.2.3.52 with:]

The BS shall send an MBS_MAP message on the Broadcast CID to specify the location and size of multi-BS MBS data bursts which are located in frames that are from 2 to 5 frames in the future from the frame containing the MBS MAP message. If present, an MBS_MAP message shall be located at the first symbol and the first subchannel in the MBS. The MBS_MAP message format is presented in Table 153. This message includes the MBS_DATA_IE, Extended_MBS_DATA_IE and MBS_DATA_Time_Diversity_IE which define the access information for the MBS burst. See Tables 153, 154, 155 and 156.

[In 6.3.2.3.52, modify the text after the table as:]

> **MBS DIUC Change Count** It is used to notify the Burst Profile used for multi-BS MBS data has been changed. If MBS_DIUC_Change_Count change, SS should wait until receiving DCD message unless Downlink Burst Profile TLV is included in MBS_MAP message.

The following TLV may be included in MBS_MAP message:

> **Downlink Burst Profile** Downlink Burst Profile is used for the definition of MBS DIUC. The MBS DIUC overrides the DIUC in DCD message for the MBS portion of the frame. If MBS DIUC is not defined by MBS MAP message, DIUC in DCD message shall be used instead. See Table 154, Table 155, and Table 156.
>
> **MCID_Preallocation [see section 11.1.13.1] :** is used by the BS's in one MBS-Zone to provide information about changes in mapping of current MCID's in the selected other MBS Zones.
>
> **MCID-Continuity [see section 11.1.13.2] :** is used by the BS's in one MBS-Zone to show consistency of MCID's mapping used in selected other MBS Zones.

[Modify 6.3.13 as:]

6.3.13 Establishment of multicast connections

The BS may establish a DL multicast and broadcast service by creating a multicast connection with each SS to be associated with the service. Any available traffic CID value may be used for the service (i.e., there are no dedicated CIDs for multicast transport connections). To ensure proper multicast operation, the CID used for the service is the same for all SSs on the same channel that participate in the connection. The SSs need not be aware that the connection is a multicast connection. However, for multicast and broadcast services which utilize MBS specific features, the multicast connection shall be established using a multicast CID.

The data transmitted on the connection with the given CID shall be received and processed by the MAC of each involved SS. Thus, each multicast or broadcast SDU is transmitted only once per BS channel. Since a multicast connection is associated with a service flow, it is associated with the QoS and traffic parameters for that service flow. ARQ is not applicable to multicast connections. If a DL multicast connection is to be encrypted, each SS participating in the connection shall have an additional security association (SA), allowing that connection to be encrypted using keys that are independent of those used for other encrypted transmissions between the SSs and the BS.

[Replace the 6.3.23 in its entirety as:]

6.3.23 Multicast and broadcast service (MBS)

Multicast and Broadcast Services provides an efficient method for concurrent transport of data common to a group of users, using a common multicast CID. MBS service is offered in the downlink only and may be coordinated and optionally synchronized among a group of BS to allow macro-diversity.

The service flows associated with MBS have certain QoS parameters and may require encryption performed using a globally defined sequence of TEKs. Since a multicast connection is associated with a service flow, it is associated with the QoS and traffic parameters for that service flow. All service flows to transmit the same MBS flows, created on any SS, shall have the same service flow management encodings for QoS parameter set (11.13.4)**.**

Service flows to carry MBS data are instantiated on individual SS participating in the service while in Normal Operation. During such instantiation the SS learns the parameters that identify the service and associated service flows. Each BS capable of providing MBS service belongs to a certain MBS Zone, which is a set of BS where the same CID and same SA is used for transmitting the content of certain service flow(s). Each MBS Zone is identified by a unique MBS_Zone ID.

To ensure proper multicast operation on networks of BS employing MBS, the CIDs used for common MBS content and service shall be the same for all BS within the same MBS-Zone. This allows the SS which has already registered with a service to be seamlessly synchronized with MBS transmissions within an MBS_Zone without communicating in the UL or re-registering with other BS within that MBS-Zone. The MBS_Zone ID's shall not be reused across any two adjacent MBS zones.

ARQ and HARQ are not applicable to multicast connections as there is no feedback from the SS at layer 1 or layer 2. However MBS may be used with time-diversity enabled allowing a HARQ like behavior, where some HARQ parameters are used for MBS bursts to allow proper sequencing and time diversity combining when MBS bursts are retransmitted, without requiring any layer 1 or layer 2 acknowledgements from the SS.

Logical Channel IDss, which pairs with Multicast CID in the Extended MBS DATA IE, is allocated to each MBS Contents ID value in the order that it is included in the MBS Contents IDs TLV(11.13.37). As a result, an SS can receive multiple MBS messages for an MBS connection with different MBS contents distinguished by Logical Channel ID belonging to a Multicast CID. The BS shall allocate MBS SDUs in the order defined in the Extended MBS DATA IE.

If a DL multicast connection is to be encrypted, each SS participating in the connection shall have an additional security association (SA) allowing that connection to be encrypted using keys that are independent of those used for other encrypted transmissions between the SS and the BS.

Multicast and broadcast service flows may be encrypted at the application layer or MAC or both. Upper layer encryption may be employed to prevent non-authorized access to multicast and broadcast content. MBS may provide access control against theft of service by enforcing data encryption based on advanced encryption standard with counter mode encryption (AES-CTR) defined in NIST Special Publication 800-38A and FIPS 197. Details of MBS security are defined in 7.8.3.

For all BSs that belong to the same MBS Zone, the following coordination shall be assured:

- Mapping of SDUs into the MBS Bursts should be identical, and the same SDU's shall be transmitted in the same frame in all BS in the same MBS Zone;
- Packets of the MBS content shall be classified and mapped to SDUs identically at each BS within the MBS Zone;
- SDU fragment sequence number and fragmentation size across frame transmissions must be identical.

Coordination in the MBS Zone assures that the SS may continue to receive MBS transmissions from any BS that is part of the MBS Zone, regardless of the SS operating mode—Normal Operation, Idle Mode—without need for the SS to register to the BS from which it receives the transmission.

In addition to coordination, MBS transmissions may optionally be synchronized across all BS's within an MBS Zone. This option enables an SS to receive the multicast or broadcast transmission from multiple BS using macro-diversity, and thereby improve the reliability of reception. When Macro-diversity is enabled additional parameter may also be required to be the same across BS's if macro-diversity is used, see section 6.3.23.2

A BS may provide the SS with MBS content locally within its coverage and independently of other BSs. The single BS provision of MBS is therefore a configuration where an MBS Zone is configured to consist of one BS only. This configuration may be provided as one of the possible cases of multi-BS MBS. In this case, the BS may use any multicast CID value for providing the MBS service, independently of other BSs. In single-BS-MBS access, the SS receives the MBS data from its serving BS, and the SS should not expect the service flow for this MBS connection to continue should the SS leave the serving BS.

6.3.23.1 Establishment and maintenance of MBSs

Establishment of MBSs with respect to certain service flow is always performed when SS is in Normal Operation with to a serving BS. MBSs are associated with multicast and broadcast service flows. Multicast and broadcast service flows are not dedicated to the specific SS and are maintained even though the SS is either in awake/sleep mode or in the idle mode. When an SS is registered at a BS for receiving MBS, multicast and broadcast service flows shall be instantiated as multicast connections. Data of multicast and broadcast service flows may be transmitted from BS and received at SS also regardless of what mode the SS is currently in. The BS may establish a DL MBS by creating a multicast and broadcast service flows when the service commences. Mapping of multicast and broadcast SFIDs to CIDs shall be known to all BSs belonging to the same MBS zone. The method of making all BS in the same MBS Zone aware of MBS flows and associated MBS Service Flows—including multicast CID assignment, QoS parameter set, and Classification Rule(s)—is outside the scope of the standard. As the classification and transmission of MBS flows may be supported on a BS in an MBS Zone regardless of the presence or absence of any SS in Normal Operation receiving the service, the BS may retain MBS service flow management encodings sufficient to do classification and scheduling of received MBS flows, even when no SS participating in the service is active on the BS.

When the SS registers at the BS for receiving multicast and broadcast services, the BS or SS may initiate the DSA procedure with respect to multicast and broadcast connections. Such knowledge may be used to initiate bi-directional upper layers communication between the SS and the network for the purpose of configuration of multicast/broadcast service. After successful configuration, the SS shall reuse the same configuration when it moves to another BS without re-configuration.

During communication to the BS the SS may learn the MBS_Zone ID. The SS may continue to receive MBS transmissions from any BS that is part of the MBS Zone, regardless of the SS operating mode—Normal Operation, Idle Mode—without need for update to any service flow management encoding for the MBS flow.

Should the SS transit to a new MBS Zone while in Normal Operation, and provided that SS MBS service flow management encodings have not otherwise been updated using the method provided in section 6.3.23.1.1, as part of the handover the BS may include CID_Update in REG-RSP encoding TLV in the RNG-RSP to provide updated service flow management encodings for any affected MBS flow.

When an SS in Idle mode migrates to a BS advertising another MBS_Zone, the SS is expected to have the MBS service flow management encodings updated at that BS, to acquire update on one or more of multicast CID Target SAID parameter, Packet Classification Rule parameter(s), MBS Zone Identifier Assignment parameter, and MBS contents IDs, to provide for further reception of MBS content. If the SS has not received such information from the serving MBS_Zone as described in section 6.3.23.1.1, the SS may conduct location update to acquire updated MBS service flow management encodings, or may conduct re-entry from Idle mode. The BS may include CID_Update in REG-RSP encoding TLV in the RNG-RSP to provide updated service flow management encodings for any affected MBS flow.

During a Dynamic Service Addition procedure, the BS may include the MBS contents IDs TLV (11.13.37) in the DSA-REQ or DSA-RSP message to establish an MBS service flow for multiple MBS contents. . The BS may include MBS Contents Identifier TLV in DSA-REQ/RSP to establish an MBS connection with multiple MBS contents.

The SS shall not include the MBS_Zone ID or MBS contents IDs in a DSA-REQ message.

6.3.23.1.1 MCID Pre-allocation

To allow seamless transition from one MBS Zone to another without any interruption of MBS data service and operation, some or all BSs within an MBS Zone may distribute MBS configuration information about the neighboring MBS Zones using MCIDs Update Information TLV (section 11.1.13) in the MBS_MAP message. MBS Pre-allocation or MCID Continuity TLV indicates to the SS whether the MCIDs used for

existing services in the current MBS Zone shall be updated upon movement to another zone or not (same MCID is used in the target MBS Zone for the same content).

When the SS receives the MCID Pre-allocation TLV it stores the zone information and the MCID values (current MCID and new MCID). When the SS receives the MCID Continuity TLV, it stores the zone information and the MCID value.

Upon detection of MBS Zone change to MBS-Zone ID captured in the MBS Pre-allocation or MCID Continuity TLV in the serving MBS Zone the SS shall not request the new MCIDs from target MBS Zone and shall use the stored MBS configuration information when available.

If the SS has no MCID information regarding the new MBS Zone, then the SS is required to acquire MCID context through the other procedures, e.g., location-update, handover, or network-entry.
If the SS has an indication that the MCID has no continuity in the target MBS zone then the SS shall delete the MCID and MBS Zone Identifier Assignment related to the MCID, while the corresponding MBS service flows become provisioned but not active.

If the SS holds provisioned MBS service-flows and it moves to another MBS Zone then the SS shall perform MCID update procedure only for the provisioned service-flows.

6.3.23.2 Performance enhancement with macro diversity
Multiple BS's participating in the same multi-BS-MBS service MAY be time and frequency synchronized in the transmissions of common MBS data to allow macro diversity gain at the SS. When macro-diversity is enabled the MBS bursts positions and dimensions as well as PHY parameters shall be the same across all BS's within the same MBS Zone. In addition to the coordination parameters identified in 6.3.23.1, macro-diversity synchronization requires that all BS's within the same MBS Zone shall use the same:

- DUIC parameters associated with each MBS Burst including FEC Type, Modulation Type, and Repetition Coding;
- Mapping of SDUs to PDU (order of the SDUs and fragments) including Sub Headers;
- Mapping of PDUs to bursts;
- Order of bursts in the zone/region;
- MAP construction

The way that multiple BSs accomplish the synchronized transmission (which implies performing functions like classification, fragmentation, scheduling at a centralized point called the MBS Server) is outside the scope of the standard.

6.3.23.3 Power saving operation To facilitate power efficient reception of MBS data, an MBS MAP IE may be placed in the DL-MAP to point to the location of a dedicated MBS region allocation in the DL subframe. The purpose of this IE is to do the initial direction of the SS to the MBS allocation, and to redirect any SS that has lost synchronization with MBS allocations back to the next MBS allocation.

6.3.23.4 Multicast and broadcast zone (MBS_Zone)
Different CIDs or different SAs may be used in different service areas for the same multicast and broadcast service flow. A multicast and broadcast zone identifier (MBS_ZONE_ID) is used to indicate a service area through which a CID and SA for a broadcast and multicast service flow are valid. A BS that supports Multi-BS Access MBS shall include the MBS zone identifier(s) as a MBS zone identifier list in the DCD message (see Table 543). The MBS zone identifier shall not be '0'..

When the MBS zone identifier list appears in DCD settings TLV in MOB_NBR-ADV message with only one value of '0', then the neighbor BS is not affiliated with any MBS zone.

In case BS sends DSA for establishment of connection for MBS, MBS_ZONE shall be encoded in the DSA message (see 11.13.29). If an SS in Idle mode moves into BSs in the same MBS zone, the SS does not have

to re-enter the network to re-establish a connection or a connection defined by MBS Contents Identifier to monitor the multicast and broadcast service flow. However, if an SS moves into a different MBS zone, the SS may need to update service flow management encodings for the multicast and broadcast service flow. One BS may have multiple MBS zone IDs for different MBS services.

8.4.5.3.12 MBS MAP IE

[Modify 8.4.5.3.12 after the table as:]

> **Macro diversity enhanced** Indicates if macro-diversity is used for access to MBS. If this value is 1, the type of access is Multi-BS Access with Macro-Diversity. If this value is 0, it indicates that Macro-diversity is not used.
>
> **Next MBS_MAP_IE Frame Offset** The Next MBS_MAP_IE Frame Offset value is lower 8 bits of the frame number in which the BS shall transmit the next MBS MAP IE frame.

~~For the case of multi-BS MBS, an~~ The MBS MAP message shall be located at the first subchannel and first OFDMA symbol of the MBS region ~~DL permutation zone reserved for MBS~~ that is specified by the MBS MAP IE when 'Macro diversity enhanced' is set to 1. This MBS Region ~~DL permutation zone for MBS~~ shall be located in the same frame as the MBS MAP IE that specifies it. The location of this MBS Region ~~DL permutation zone for MBS~~ within the frame is specified by 'OFDMA Symbol Offset' in MBS MAP IE ~~when 'Macro diversity enhanced' is set to 1~~.

[Modify 11.13.23 as:]

11.13.23 MBS service TLV

This TLV indicates whether the MBS service is being requested or provided for the connection that is being set up. A value of 1 indicates that an MBS service limited to the serving BS is being ~~Single-BS-MBS is~~ requested and a value of 2 indicates m~~M~~ulti-BS-MBS is being requested. If SS or BS wants to initiate MBS service, DSA-REQ with MBS service TLV shall be used. The DSA-RSP message shall contain the acceptance or rejection of request and if there is no available MBS, MBS service value shall~~may~~ be set to 0. ~~ARQ shall not be enabled for this connection.~~

Type	Length	Value	Scope
[145/146].4	1	0: No available MBS 1: ~~Single-BS-MBS~~ MBS in Serving BS Only 2: ~~Multi-BS-MBS~~ MBS in a multi-BS Zone	DSA-REQ DSA-RSP DSA-ACK

[Insert new Section 11.1.13]

11.1.13 MCID_ Update Management Encoding

The TLV encodings defined in this sub clause are specific to the MBS_MAP (6.3.2.3.52) MAC and SII-ADV (6.3.2.3.58) management message.

11.1.13.1 MCID Pre-allocation

This field indicates the new MCID within a certain target MBS Zone ID. The TLV enables to provide information regarding several MBS zones and the MCID used in them.

Type	Length (bytes)	Value	Scope
131	*Variable (1+N×4)*	MBS_ZONE_ID, Current_MCID(1), New_MCID (1), … Current_MCID(N), New_MCID (N),	MBS_MAP, SII-ADV

Value of 0xffff in the New_MCID field indicates that the Current_MCID is not available for the same service in the MBS Zone indicated by the TLV.

11.1.13.2 MCID Continuity

This field indicates a certain MCID stays the same in one or more MBS Zones.

Type	Length (bytes)	Value	Scope
130	*Variable (1+N×2)*	MBS_Zone_ID Current_MCID(1), …., Current_MCID(N1)	MBS_MAP SII-ADV

If the TLV only includes the MBS_Zone_ID then all MCIDs within the current MBS Zone stays the same in the MBS Zone indicated by the TLV.

6.3.2.3.58 Service Identity Information (SII-ADV) message

[Add to the end of section 6.3.2.3.58]

MCID_Preallocation (see 11.1.13.1) : is used by the BSs in one MBS-Zone to provide information about changes in mapping of current MCIDs in the select other MBS Zones as determined by the serving MBS-Zone.

MCID-Continuity (see 11.1.13.2) : is used by the BS's in one MBS-Zone to show consistency of MCID's mapping used in select other MBS Zones as determined by the serving MBS Zone. .

[Insert row values for 'MCID Pre-allocation', Type 131, and 'MCID-Continuity', Type 130 into Table 529]