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Title	**Primitives for Multicast and Broadcast Services**	
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Re:	Call for comments	
Abstract	This contribution proposes some primitives for multicast and broadcast services	
Purpose	Adoption	
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Torsten Fahldieck (Alcatel)

1. Introduction

Multicast and broadcast services MBS are defined as a group of terminals which receive the same content on the same connection. Furthermore all terminals are registered to the same multicast or broadcast service and use the same connection parameters and security associations. **802.16e-2005** defines two types of multicast broadcast services MBS, single BS MBS and multi BS MBS. Single-BS access is defined as multicast or broadcast services which are limited to one base station. Multi-BS access is defined as the multicast or broadcast services which spawn over a group of basestations called the MBS zone. The MBS zone is a typically a geographical area. In a MBS zone all MBS connections use the same connection parameters like CID or SA. Terminals, which use only MBS connections, do not reregister during movement inside a MBS zone. The multi-BS MBS mode itself can be classified into two deployment cases. One type, called the simple case, where only MBS connection parameters are unique inside the MBS zone, the other type which provides additionally macro diversity for MBS connections inside the MBS zone.

1.1 Benefi of macro diversity

Figure 1 shows an example with three terminals and two basestations. Assuming the 3 MS's are registered to a multicast group. MS1 and MS2 are located close to BS 1 and could use a high performance coding scheme like QAM64. MS3 is located far from BS1 and can only use a low performance coding scheme like QPSK. Due to the nature of multicast broadcast connection, all MS's have to use the same coding scheme for the MBS connection, in this case QPSK. If the base stations in this MBS zone would provide macro diversity, MS1 would be able receive the data from BS1 and BS2 by performing radio frequency combining. The combination of both signals results in the use of a more performing coding scheme. This is a performance improvement for the MS3 as well as for the whole multicast group. Furthermore macro diversity provides less service degradation during movement.

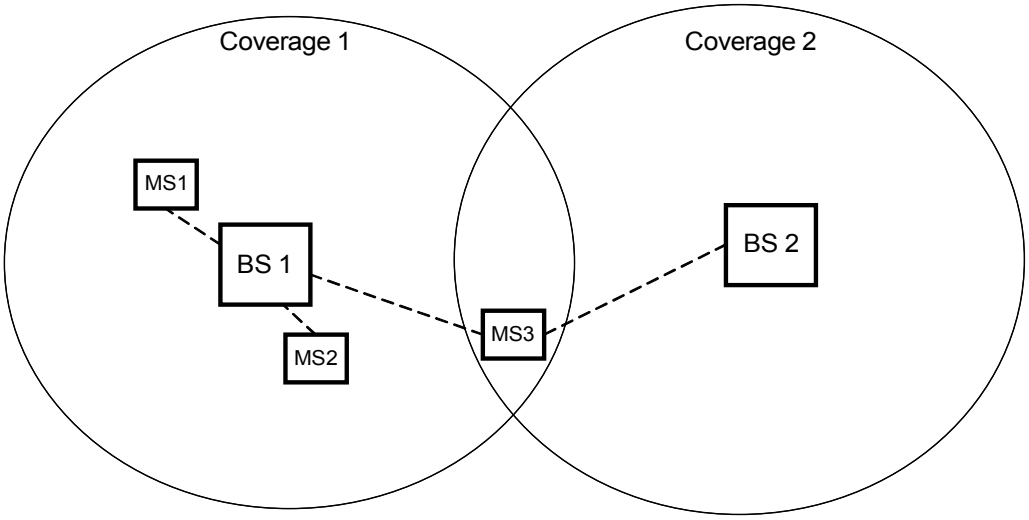

Figure 1

1.2 Requirement for macro diversity

To accomplish macro diversity over a group of base stations, several requirements have to be fulfilled as listed below:

Downlink frames contain a range which is exclusively reserved for MBS connections, called the MBS portion
Unique CID's and Logical channel ID's for MBS connections on all BS inside the MBS zone
MBS portion inside downlink frame shall fulfil following requirements:
- Same position inside downlink frame
- Same size

MBS bursts inside the MBS portion shall fulfil following requirements:
- Same symbols
- Same subchannels
- Same coding scheme
- Same upper layer data
  - Same MAC PDU's inside bursts (figure 3)

The first two bullets are already defined in IEEE Std 802.16e-2005.
All requirements listed above have to be maintained by a central entity in a MBS zone called the MBS server. The MBS server assigns the necessary connection parameters like CID for the MBS flows from a range which is reserved for MBS flows. Furthermore the MBS server transfers necessary information about the MBS portions to all base stations in the MBS zone, to force the base stations to generate unique MBS portions on a per frame basis. Figure 2 shows an example of two neighbour BS which belongs to the same MBS zone.

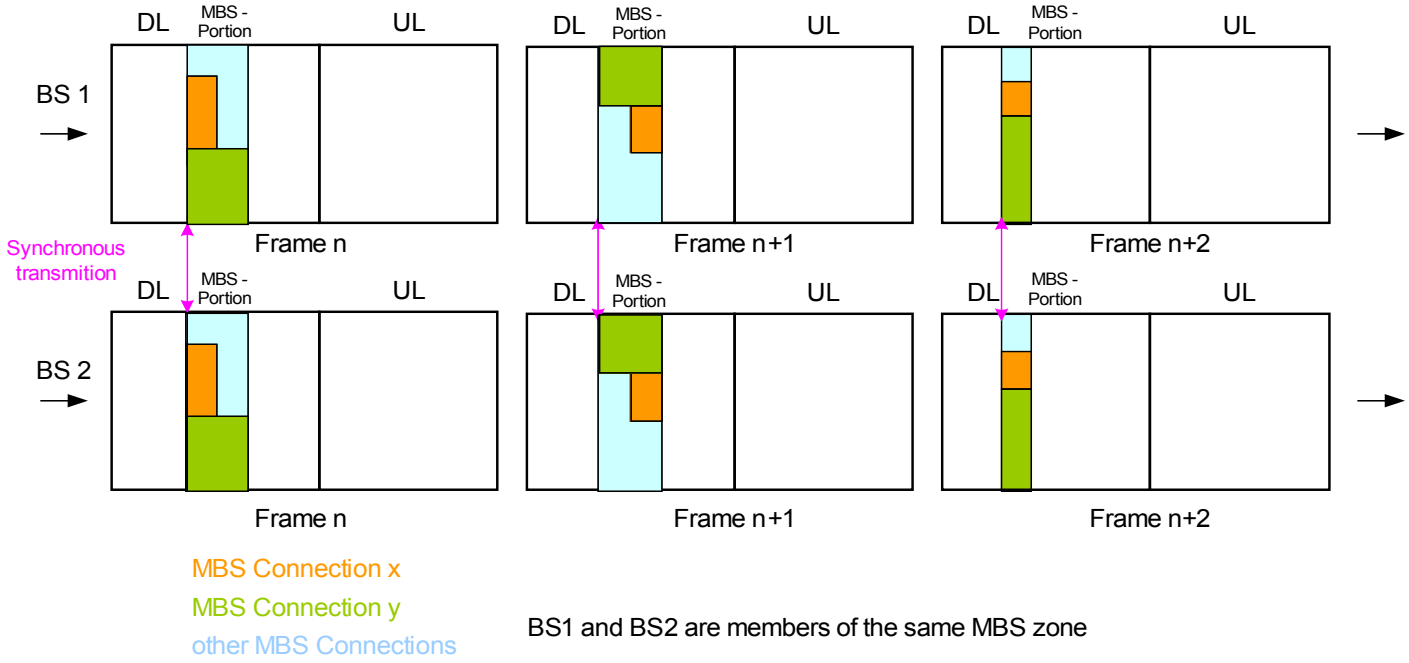

Figure 2: Synchronous MBS portions in MBS zone

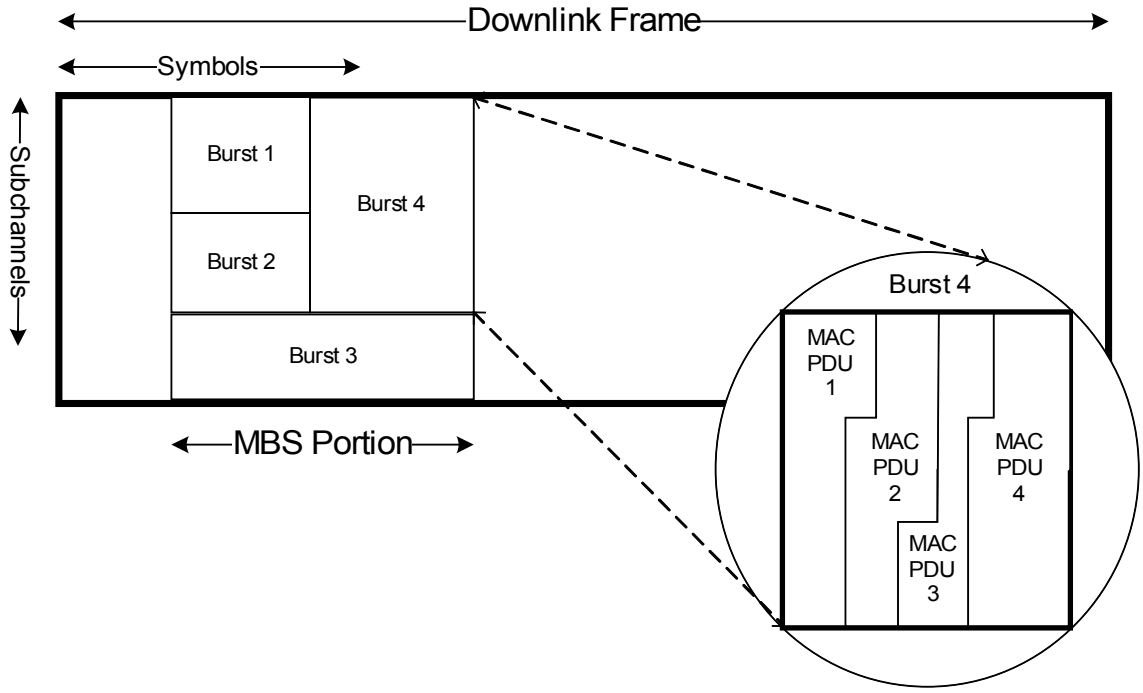

Figure 3: MBS Portion

2. Proposed Solution

To fulfil the requirements for MBS a functional entity called MBS server is needed. This entity is located in the Network Control and Management Subsystem NCMS and maintains its dedicated MBS zone. The MBS server has to perform functions like classification, fragmentation, scheduling. Two different types of MBS can be determined.

> Simple MBS without macro diversity:
> The MBS server assigns the connection parameters for the MBS flows, like CID, logical flow ID, security association in a centralized manner. The MS's which use MBS connections do not reconnect during movement inside an MBS zone. There may be service degradation during movement due to interference of non synchronized MBS bursts.
> Enhanced MBS with macro diversity:
> Additional to the functionality listed above, the MBS server sends information to all BS's inside the MBS zone, which enables the BS's to generate unique MBS portions.

First the MBS server queries all base stations in its domain by sending a *C-MBS-REQ(Capability)* primitive to every basestation (figure 4, point 1). The basestation informs the MBS server about its MBS capability by sending a *C-MBS-RSP (Capability)* primitive (point 2). According to the received capability information the MBS server decided which type of MBS (with or without macro diversity) shall be used its MBS zone. The mechanism for configuring the MBS zone like type and size is specific to the vendor implementation or operator configuration and out of scope of this contribution. The MBS server sends a *C-MBS-REQ(Set)* primitive to every basestation with the appropriate configuration parameters like MBS type and MBS zone identifier (point 3). The basestation replies with a C-MBS-*RSP(Set)* primitive (point 4). When a MBS connection is set up, MBS server and basestation exchange *C-SFM-REQ/RSP* primitives in the same manner as for unicast flows (points 5 and 6). The exchanged service flow primitives include additional MBS specific parameters like CID, flow channel ID and SA. These values are already assigned by the MBS server. If macro diversity is used in the MBS zone the MBS server sends out *C-MBS-NOTIFY(Layout)* primitives to all BS in the MBS zone (7). The MBS server sends the *C-MBS-NOTIFY(Layout)* primitives on a per fame basis. For every downlink frame which shall contain a MBS portion, the MBS server send one corresponding *C-MBS-NOTIFY(Layout)* primitive. The *C-MBS-NOTIFY(Layout)* primitive is not acknowledged by the basestations. This allows the MBS server to broadcast or multicast these primitives. The *C-MBS-NOTIFY(Layout)* primitive contains all necessary information for the BS to generate a MBS portion which is unique in the whole MBS zone. For synchronization purposes the *C-MBS-NOTIFY(Layout)* primitive contains a time reference. With this time reference the base station is able to evaluate the appropriate frame in which the MBS portion has to be incorporate. The MBS server is responsible for sending the *C-MBS-NOTIFY(Layout)* primitive and the MBS data packet in a manner, that all basestations are able to incorporate the appropriate MAC PDU's in the MBS portions synchronous. If a *C-MBS-NOTIFY(Layout)* primitive is not received in time by a BS due to network failure, the BS shall approximate autonomously an MBS portion. For synchronizing the upper layers, the MBS data flows shall contain time reference information. Based on this time references and the BS resident time reference, every BS is able to fill the MBS portion with data content, which is unique in the MBS zone. The assignment of timing information to upper layer data packets is out of the scope of 802.16g.

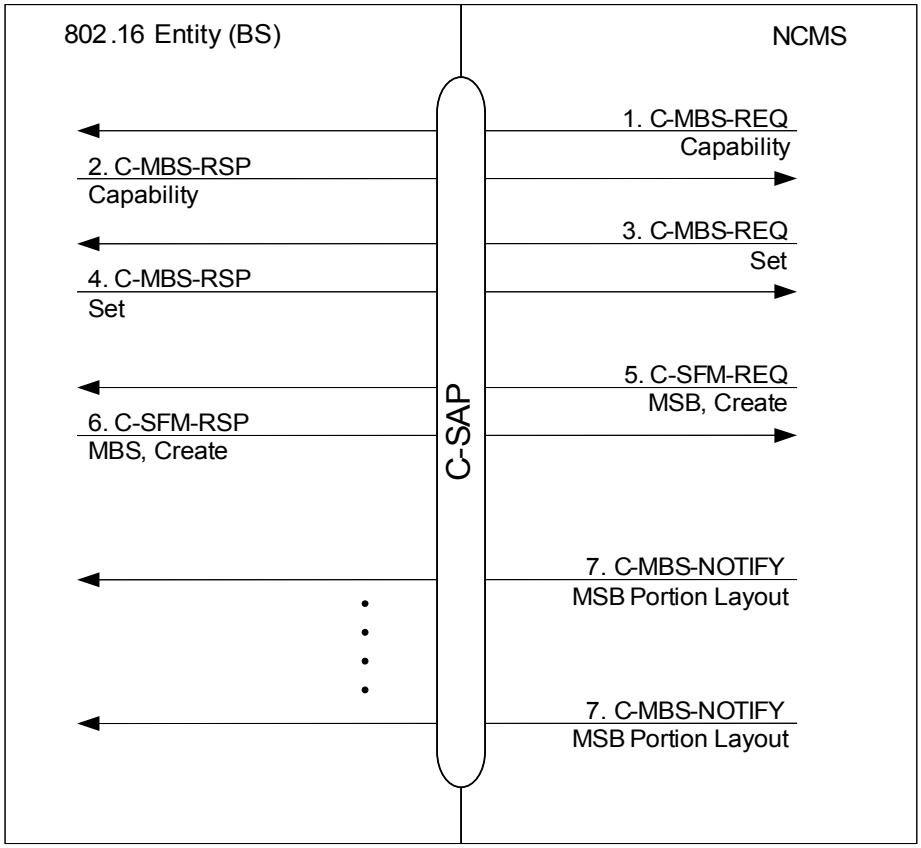

Figure 4 Example primitive flow for MBS

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3. Proposed Text Changes

[Append the text to section 14.1.1 to end of Function list]

MBS – Multicast Broadcast Service

[Append the text to section 14.2.11.1.1 after as follow]

In case of MBS flow creation originated by NCMS, the service flow information shall additionally contain the connection identifier CID, Logical Channel ID and security association.

[Append the text to section 14.2.11.1.2 as follow]

In case of MBS flow set originated by NCMS, the service flow information shall additionally contain the connection identifier CID, Logical Channel ID and security association.

[Append the text to section 14.2.11.2.1 as follow]

In case of MBS flow creation originated by NCMS, the service flow information shall additionally contain the connection identifier CID, Logical Channel ID and security association.

[Append the text to section 14.2.11.2.2 as follow]

In case of MBS flow set originated by NCMS, the service flow information shall additionally contain the connection identifier CID, Logical Channel ID and security association.

[*Add section 14.2.12 as follow*]

14.2.12 Multicast and Broadcast Service Management

14.2.12.1 MBS Capability Discovery

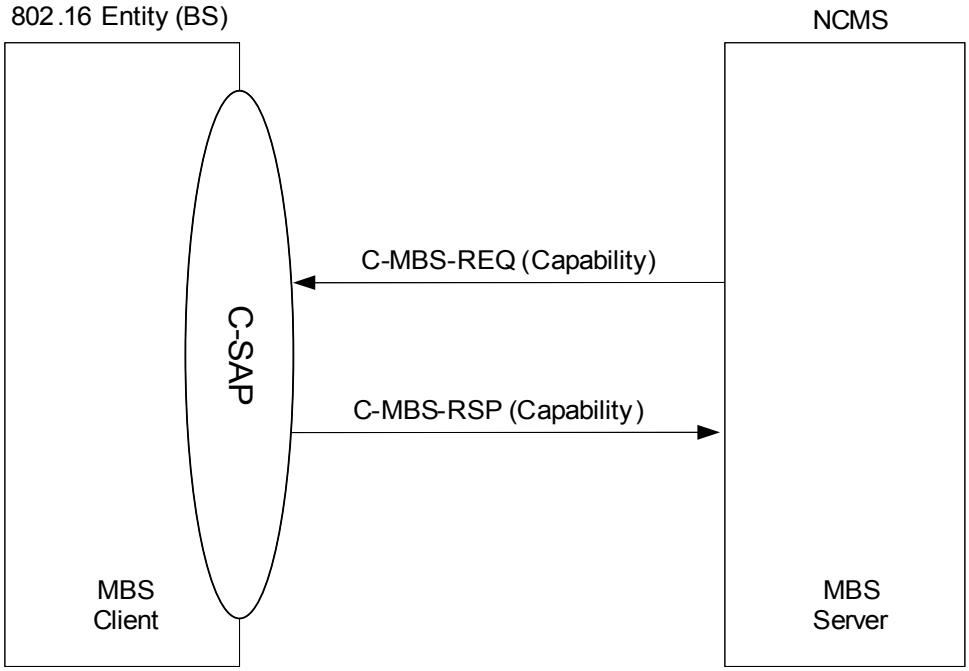

Figure 520 C-MBS-REQ (Capability) and C-MBS-RSP (Capability) primitives flow

14.2.12.1.1 C-MBS-REQ (Capability)

14.2.12.1.1.1 Function

This primitive is originated by the NCMS to a BS, to discover its MBS capability of the BS.

14.2.12.1.1.2 Semantics of this primitive

C-MBS-REQ
(
Message_ID,
Operation_Type (Action),
Action_Type (Capability),
Object ID (BS_ID),
)

Operation_Type
Action
Object ID

Object identifier.

Action Type

Capability

14.2.12.1.1 C-MBS-RSP (Capability)

14.2.12.1.1.1 Function

This primitive is send by a BS to the NCMS in response to a C-MBS-REQ (Capability). The primitive includes the information about the MBS capability of the BS.

14.2.12.1.1.2 Semantics of this primitive

C-MBS-RSP

(
Message_ID,
Operation_Type (Action),
Action_Type (Capability),
Object ID (NCMS Node_ID),
Attribute_List:
MBS Capability Information
)

Operation_Type

Action

Object ID

NCMS Node_ID.

Action Type

Capability

MBS Capability Information

Name	Valid Range	Description
MBS-Capability Information	0-255	Type of MBS capability Bit#0: Type1, simple MBS capability, no macro diversity Bit#1: Type2, full MBS capability, macro diversity

14.2.12.2 MBS Configuration Management

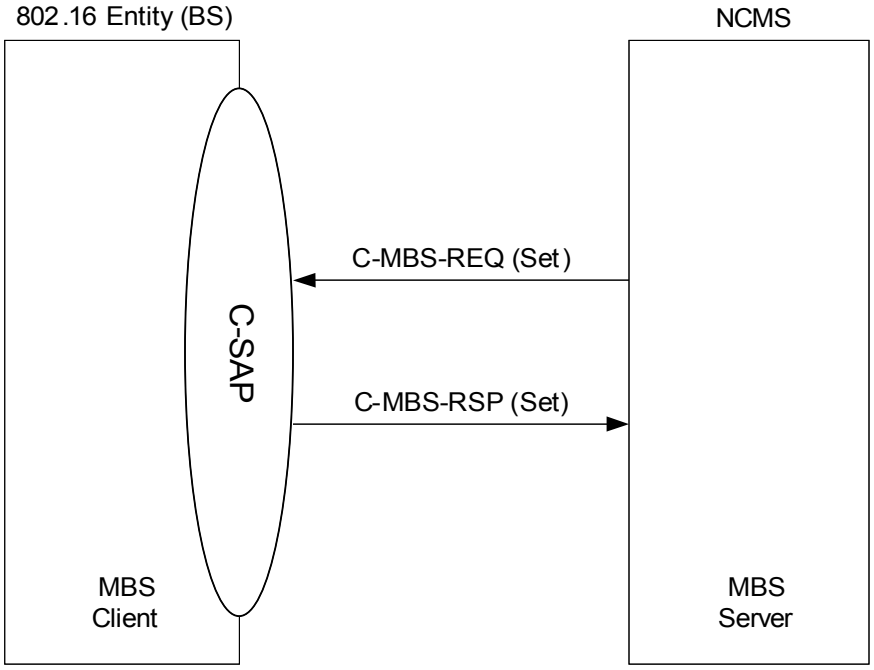

Figure 521 C-MBS-REQ (Set) and C-MBS-RSP (Set) primitives flow

14.2.12.2.1 C-MBS-REQ (Set)

14.2.12.2.1.1 Function

This primitive is send by the NCMS to a BS, to configure the MBS of the BS.

14.2.12.2.1.2 Semantics of this primitive

C-MBS-REQ
(
Message_ID,
Operation_Type (Action),
Action_Type (Set),
Object ID (BS_ID),
Attribute_List:
MBS Zone
MBS Type
)

Operation_Type

Action
Object ID
Object identifier.
Action Type
Set
MBS Zone
ID of the MBS zone as defined in IEEE Std 802.16e-2005 section 6.3.23.2.4
MBS Type
Type of MBS mode which shall be used. Two MBS types are defined:
Type 1 for MBS without macro diversity,
Type 2 for MBS with macro diversity

14.2.12.2.1 C-MBS-RSP (Set)

14.2.12.2.1.1 Function

This primitive is send by a BS to the NCMS in response to a C-MBS-REQ (Set) primitive.

14.2.12.2.1.2 Semantics of this primitive

C-MBS-RSP
(
Message_ID,
Operation_Type (Action),
Action_Type (Set),
Object ID (NCMS Node_ID),
Attribute_List:
MBS Error parameter information
)

Operation_Type
Action
Object ID
Object identifier.
Action Type
Set
MBS Error parameter information
Failed reason

14.2.12.3 MBS Macro Diversity Management

14.2.12.3.1 C-MBS-Notify (Layout)

14.2.12.3.1.1 Function

This primitive is originated by the MBS Server and send to all BS's which belong to the appropriate MBS zone and it is only send if type2 MBS capability is used in the MBS zone. The C-MBS-NOTIFY (Layout) primitive

is send from the MBS server to the BS's on a per 802.16 downlink frame basis. The MBS-Portion-Layout primitive may send via a broadcast or multicast connection to the 802.16 entities and is not acknowledged. The BS has to generate a MBS portion as part of the 802.16 downlink frame according to information elements received by the C-MBS-NOTIFY (Layout) primitive. Several sets of information elements define the position size and layout of the MBS portion. The tuple MBS portion symbol/subchannel and offset/size specify the start portion and size of the MBS portion itself. The primitive contains list of bust definitions which specifies the position and size of all bursts inside the MBS portion. Every burst definition contains furthermore a list of MAC PDU definitions which specifies all MAC PDU's inside a burst. In addition the primitive contains a time reference for synchronization purposes.

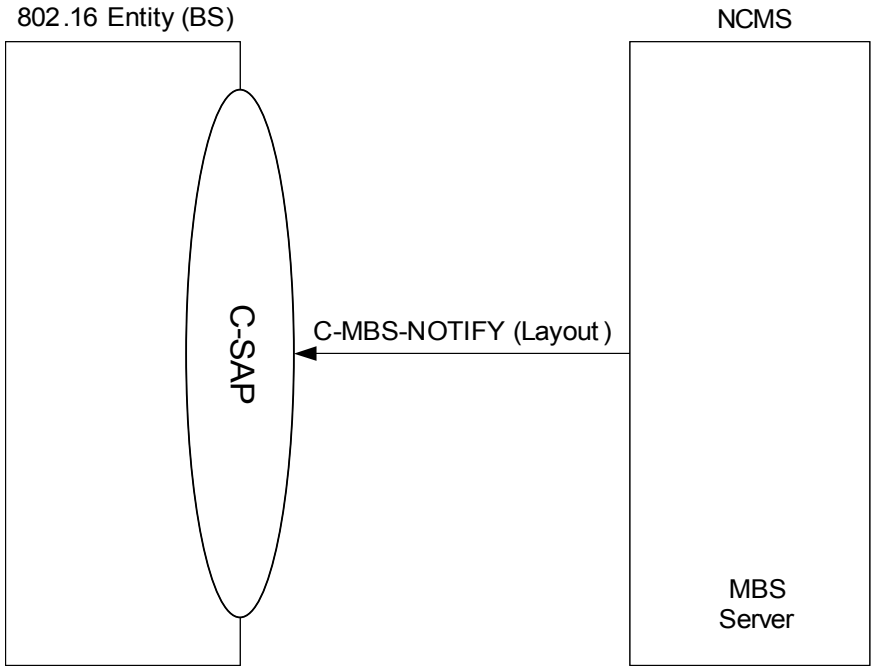

Figure 522 C-MBS-NOTIFY (Layout) primitive flow

14.2.12.3.1.2 Semantics of this primitive

The parameters of this primitive are as follows:

C-MBS-NOTIFY (Layout)
(
Message_ID,
Operation_Type (Notify),
Action_Type (MBS Portion Layout),
Object ID (BS_ID),

Layout Attribute List
MBS Portion Symbol Offset
MBS Portion Subchannel Offset
MBS Portion Number of Symbols
MBS Portion Number of Subchannels
Time Reference
List of Burst Attributes
(
Burst Symbol Offset
Burst Subchannel Offset
Burst No of symbols
Burst No of subchannels
Coding Scheme
List of MAC PDU Attributes
(
CID
Logical Flow ID
MAC PDU Size
)
)
)

Operation_Type
Notify
Object ID
Object identifier.
Action Type
MBS Portion layout
MBS Portion Symbol Offset
MBS Portion Symbol Offset defines the start position of the MBS portion inside the downlink frame in number of OFDMA symbols.
MBS Portion Subchannel Offset
MBS Portion Subchannel Offset defines the start position of the MBS portion inside the downlink frame in number of OFDMA subchannels.
MBS Portion No of symbols
MBS Portion No of symbols defines the size of the MBS portion inside the downlink frame in number of OFDMA symbols.
MBS Portion No of subchannels
MBS Portion No of subchannels defines the size of the MBS portion inside the downlink frame in number of OFDMA subchannels.
Time reference
The time reference contains the current absolute time in the MBS server plus a static offset. It shall be derived from an absolute time reference. The static offset shall be equal or larger than the longest transport delay between MBS server and BS inside an MBS zone. Based on this time value and its own time reference, BS shall incorporate the MBS portion in the appropriate downlink frame. To incorporate the appropriate upper layer data into the MBS portion, the upper layer packets of MBS data flows shall be time stamped. The assignment of time stamp information to data packets is out of the scope of IEEE Std 802.16g.
List of Burst Attributes

The list contains a set of parameters for every burst.

Burst Symbol Offset

MBS Portion Symbol Offset defines the start position of a burst inside the MBS portion of a downlink frame in number of OFDMA symbols. The Burst Symbol Offset is defined relative to the position of the MBS portion.

Burst Subchannel Offset

MBS Portion Subchannel Offset defines the start position of a burst inside the MBS portion of a downlink frame in number of OFDMA subchannels. The burst subchannel Offset is defined relative to the position of the MBS portion.

Burst No of symbols

The burst No of symbols defines the size of the burst inside the MBS portion of a downlink frame in number of OFDMA symbols.

Burst No of subchannels

The burst No of subchannels defines the size of the burst inside the MBS portion of a downlink frame in number of OFDMA subchannels.

Coding Scheme

This information element defines the coding scheme of the burst.

List of MAC PDU Attributes

The list contains a set of parameters for every MAC PDU.

CID

This information element defines the CID of the MAC PDU.

Logical Flow ID

This information element defines the Logical Flow ID of the MAC PDU.

MAC PDU size

This information element defines the size of the MAC PDU in bytes. The order of the MAC PDU's inside a burst is given by the list order.

5 References

[1] IEEE 802.16e-2005 Air Interface for Fixed and Mobile Broadband Wireless Access Systems

[2] IEEE P802.16g/D4 Air Interface for Fixed and Mobile Broadband Wireless Access Systems - Management Plane Procedures and Services
http://www.wirelessman.org/private/drafts/netman/P80216g_D4.zip