Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Changes in IEEE 802.16ab-01/01, Section 8.3.4.4.**
Date Submitted	**2001-07-13**
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Re:	
Abstract	**Changes suggested in IEEE 802.16ab-01/01, Section 8.3.4.4.**
Purpose	This document is submitted in response for the Call for Comments IEEE 802.16ab-01/02
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Changes in IEEE 802.16ab-01/01, Section 8.3.4.4.

(OFDM PHY Burst Definition and MAP Messages)

References

[1] IEEE P802.16/D3-2001. Local and Metropolitan Area Networks—Part 16: Standard Air Interface for Fixed Broadband Wireless Access Systems. 2001-05-25

8.3.4.4.1. Uplink Channel Descriptor (UCD) Message Parameters for 2- 11 GHz OFDM PHY

The format of the UCD message is defined in [1] 6.2.2.4.1 Uplink Channel Descriptor (UCD) Message , Table 12.

All the parameters listed there are relevant.

TLV Encoded information for the overall channel is specific to the OFDM PHY. It should contain the following parameters

- Symbol Rate
- Frequency
- FFT Size Code
- Tx/Rx Gap
- Rx/Tx Gap
- SS Transition Gap

See TBD for the specification of possible values of the above parameters.

Burst Descriptor TLV (Type = 1) is used to mark the start of the envelope of Overall Channel / Burst Profile set of parameters

TLV Encoded information for the Burst Profile is specific to the OFDM PHY. It should contain the following parameters

- Modulation Type
- FEC Code Type
- Preamble Type = None | Long | Short | Mid-amble

See TBD for the specification of possible values of the above parameters.

8.3.4.4.2 Downlink Channel Descriptor (DCD) Message Parameters for 2- 11 GHz OFDM PHY

The format of the UCD message is defined in [1] 6.2.2.4.1 Uplink Channel Descriptor (UCD) Message , 13. All the parameters listed there are relevant.

TLV Encoded information for the overall channel is specific to the OFDM PHY. It should contain the following parameters:

BS Transmit Power	Signed in units of 1 dBm
Burst FDD/TDD Frame duration	The number of PSs contained in a Burst FDD or TDD frame.

Burst Descriptor TLV is used to mark the start of the envelope of Overall Channel / Burst Profile set of parameters

- Modulation Type
- FEC Code Type
- Preamble Type = None | Long | Short | Mid-amble

TLV Encoded information for the Burst Profile is specific to the OFDM PHY, see 6.2.2.4.1.

8.3.4.4.3. Mini-slot Definition

All the time intervals (e.g. frame duration and MAP parameters) are represented as an integer number of time slots.

Physical Slot (PS) is equal to 4GI (GI = OFDM Guard Interval Size).

The Mini-Slot Size = PS * 2^M is used as the measurement unit where M = 0 ..7 is broadcasted by the BS in the Mini-Slot Size field of UCD messages.

8.3.4.4.4. Frame Structure

Frame means interval that starts from the beginning of the first symbol of the FCH burst (see 8.3.4.4.4.2) containing the DL-MAP message and lasts up to the start of the first symbol of the FCH burst containing the next DL-MAP message.

This definition does not require the frames to be of the same size.

The frame interval contains both transmissions (PHY PDUs) of BS and SSs and intervals of silence (gaps). The frame length is encoded in the Frame Length Code in the PHY Synchronization Field, see 8.3.4.4.5.1. This field allows for the reception of the next

PHY PDU consists of one or several bursts, each one transmitted with fixed PHY parameters. The bursts MAY be separated by mid-ambles.

If a burst contains DL-MAP message, it should be of special format called FCH (Frame Control Header), see 8.3.4.4.4.2 for details.

8.3.4.4.4.1. Preambles

The burst MAY start from a preamble that can be of one of the following types:

- Long

Used in the cases when there is no exact information on the timing of the burst s arrival e.g. when SS is transmitting first time trying to synchronize with BS

- Short

Used in the cases when there is exact information on the timing of the burst s arrival.

- Mid-amble

Inserted for synchronization purposes between consequent bursts.

See TBD for the definition of the abovementioned waveforms.

8.3.4.4.4.2. FCH Burst and DL Frame prefix

A special PHY burst format (FCH or Frame Control Header) is used for DL Frame prefix to make possible initial synchronization and acquisition of DL and UL channels parameters. Before such a burst there is always a long preamble and ***FCH symbol*** that contains ***DL Frame Prefix***. FCH symbol may contain also MAC messages, such as DL-MAP, UL-MAP, DCD, UCD, and MAC padding that includes octets 0xFF to complete the OFDM symbol.

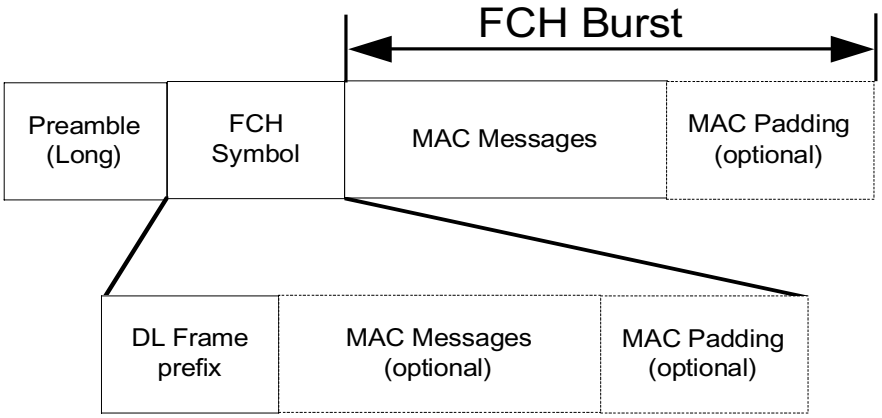

Figure 1. FCH Burst

FCH symbol is transmitted at the well-known modulation/coding. It contains the **DL Frame Prefix** information on the PHY parameters and length of the immediately following ***FCH Burst.*** FCH symbol MAY contain also DL-MAP, UL-MAP, UCD and DCD messages. The next burst should not be separated from the FCH by mid-amble.

The next figure describes the structure of DL Frame Prefix:

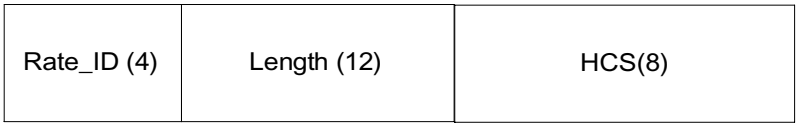

Figure 2. DL Frame Prefix

The following are the fields of DL Frame Prefix.

Rate_ID: Field that defines the modulation / coding parameters of the following burst. Encoding is TBD.

Length: Number of 48 subcarrier slots in the following FCH burst (for the FFT-64 mode it is simply a number of symbols).

HCS: An 8-bit Header Check Sequence used to detect errors in the DL Frame Prefix. The generator polynomial is $g(D)= D^8 + D^2 + D + 1$

FCH burst MUST contain at least DL-MAP message.

8.3.4.4.5. DL-MAP Message

Two format options are suggested for the DL-MAP message. The first format (Management Message Type = 2) is identical to the one defined in [1] The second (Management Message Type = 29) is similar to the OFDMA DL-MAP message. They differ in the format of MAP elements.

The format of the DL-MAP message is defined in [1] 6.2.2.4.3 Downlink Map (DL-MAP) Message.

DL-MAP elements define the physical parameters and the start time for DL PHY bursts.

8.3.4.4.5.1. Synchronization Field

The following is the structure of PHY Synchronization Field of the DL-MAP message.

Field	Size, bits	Meaning
Frame Duration Code	8	The allowable frame duration Codes are given by the table [TBD]
Frame Number	24	The Frame Number is incremented by 1 every frame and eventually wraps around to zero

The following codes are used

Code = N	Meaning
0	UNDEFINED. Means that the frame lasts up to the arrival of the next DL-MAP message
1 — 128	The frame duration is equal to N*128 mini-slots
129 - 255	The frame duration is equal to (N-64)*256 mini-slots

Note that the frame duration is always an integer number of OFDM symbol duration. The GI = 2 usec provides the values from 256 usec to 32768 usec with step 256 usec and then up to 97792 usec

8.3.4.4.5.2. DL_MAP_Information_Element Format, Option 1

DL_MAP_Information_Element ([1] , Table 14) has the following format:

Syntax	Size	Notes
DL-MAP_Information_Element() {		
DIUC	4	
Start Time	12	
}		

- **Downlink Interval Usage Code**

A four-bit Uplink Interval Usage Code (DIUC) shall be used to define the burst type associated with that access. The Interval Usage Code shall be one of the values defined in the Table 1.

- **Start Time**

Indicates the start time, in units of symbol duration, relative to the start of the PHY PDU where the DL-MAP message is transmitted. Consequently the first IE will have an offset of 0. The end of the last allocated burst is indicated by allocating a NULL burst (CID = 0 and UIUC = 10) with zero duration. The time instants indicated by the Start Time values are the transmission times of the first symbol of the burst including preamble.

For OFDM with 48 subcarriers for 3.5 MHz channel the allocation range may be estimated as 2^{12} * 18 usec = 73728 usec.

8.3.4.4.5.3. DL_MAP_Information_Element Format, Option 2

This is a definition similar to OFDMA type.

DL_MAP_Information_Element ([1] , Table 14) has the following format:

Syntax	Size	Notes
DL-MAP_Information_Element() {		
DIUC	4	
Slot Offset	12	
Subchannel Offset	4	
Number of Slots	12	
}		

Slot Offset

Relative to the beginning of the first symbol of the PHY PDU that contains the DL-MAP message

Subchannel Offset

Number of groups of 48 subcarriers

Number of Slots
One slot is defined as a group of 48 subcarriers for the duration of one OFDM symbol

The allocation range for OFDM with 48 subcarriers for 3.5 MHz channel may be estimated as 2^{12} * 18 usec = 73728 usec.

8.3.4.4.5.4. DIUC Values

The following table contains DIUC values used in **DL-MAP_Information_Element.**

Table 1. DIUC Values

DIUC	Usage
0	Same (well known) burst profile as for FCH
1- 4	Burst types without preamble
5 —8	Burst types with short preamble
9 — 12	Burst types with long preamble
13	Gap
14	End of Map
15	Extended DIUC (TBD)

The Burst Profile with DIUC=0 must be configured with the parameters

<<< TBD >>>

8.3.4.4.6. UL-MAP Message

8.3.4.4.6.1. Format of the UL-MAP message

The format of the UL-MAP message is defined in [1] , 6.2.2.4.4 Uplink Map (UL-MAP) Message (Table 15).

8.3.4.4.6.2. UL-MAP Elements

UL-MAP elements (PHY Specific Section) define the physical parameters and the start time for UL PHY bursts. The format of UL-MAP elements is the following:

Table 2. UL-MAP Element

Name	Size, bits	Notes
CID	16	
UIUC	4	
Offset	12	

- **Connection Identifier (CID)**

Represents the assignment of the IE to a unicast, multicast, or broadcast address. When specifically addressed to allocate a bandwidth grant, the CID may be either the Basic CID of the SS or a Traffic CID for one of the connections of the SS.

- **Uplink Interval Usage Code (UIUC)**

A four-bit Uplink Interval Usage Code (UIUC) shall be used to define the type of uplink access and the burst type associated with that access. A Burst Descriptor shall be included for

each Interval Usage Code that is to be used in the UL-MAP. The Interval Usage Code shall be one of the values defined in.

- **Offset**

The offset indicates the start time, in units of mini-slots, of the burst relative to the Allocation Start Time given in the UL-MAP message. Consequently the first IE will have an offset of 0. The end of the last allocated burst is indicated by allocating a NULL burst (CID = 0 and UIUC = 10) with zero duration. The time instants indicated by the offsets are the transmission times of the first symbol of the burst including preamble.

8.3.4.4.6.3. UIUC Values

Table 3. UIUC Values

DIUC	Usage
0	Well known burst profile
1	SBP (Subcarrier Based polling) Slot
2 — 11	Burst types with short preamble
11 — 12	Burst types with long preamble
13	Gap
14	End of Map
15	Extended UIUC (TBD)

The Burst Profile with UIUC=0 must be configured with the parameters

<<< TBD >>>

8.3.4.4.7. DL-UL-MAP Message

A single MAP message is defined, that covers both uplink and downlink directions. The following is the format of this message

Syntax	Size	Notes
DL-MAP_Message_Format() {		
Generic_MAC_Header()		
Management Message Type = 28		
PHY Synchronization Field		
Base Station ID		
Number of DL-MAP Elements n		
Number of UL-MAP Elements m		
UCD Count		
Allocation Start Time		
Begin PHY Specific Section {		
for (i = 1; i < n; i++) {		
DL_MAP_Information_Element()		
}		
Begin PHY Specific Section {		
for (i = 1; i < m; i++) {		
UL_MAP_Information_Element()		
}		

}		
}		

The meaning of the parameters is the same as in 8.3.4.4.6 , 8.3.4.4.7.

8.3.4.4.8. MAP Relevance and Synchronization

All the timing information in DL-MAP, UL-MAP, DL-UL-MAP is relative. The following time instants are used as a reference for the timing information

- DL-MAP and the correspondent part of DL-UL-MAP: the start of the first symbol of PHY PDU where the message is transmitted
- UL-MAP and the correspondent part of DL-UL-MAP: the start of the first symbol of PHY PDU where the message is transmitted + Allocation Start Time value