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Multiple Broadcast Maps for OFDMA PHY

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1 Introduction

In the current IEEE P802.16-2004 specification, a frame contains a single DL-MAP and UL-MAP, each transmitted at a single rate. This constraint may lead to large map overheads in many realistic scenarios. One example is AA (Adaptive Antenna) systems where the single broadcast map must be transmitted at a very robust rate in order to bridge the gap between AAS transmissions and broadcast transmissions.

Another example is a BS that supports efficient MSS power consumption. In this case, the BS may separate unicast MAC payloads to distinct PHY bursts and transmit a separate map element per payload. In such scenarios, DL maps are expected to be very large and significant overhead reduction can be achieved by matching the map rate to the payload rate.

An additional benefit of multiple broadcast maps is that map elements may be transmitted using different FEC types (CC, CTC, etc.) within a single frame.

Another limitation in the current standard is that there is no explicit indication of whether an IE with broadcast CID is designated to all MSS or MSS in certain mode of operation (Normal, Sleep or Idle). When a MSS is in Sleep mode – listening interval, or Idle Mode – paging interval, the MSS needs to decode the DL-MAP in order to receive unicast traffic (for sleep mode) or relevant broadcast traffic. However, when the MSS receives an IE with broadcast CID, the MSS has to demodulate and decode the DL OFDMA region assigned by this IE, even though the DL broadcast traffic carried in that OFDMA region is not designated to the MSS which operates in certain mode. This is not power efficient for MSS in Sleep and Idle Modes since the MSS has to demodulate and decode all DL broadcast traffic or messages.

In this contribution the concept of multiple broadcast maps is introduced. The overhead due to maps is analyzed for a typical AAS scenario. The proposal is then described followed by specific text changes. Backward compatibility to IEEE P802.16-2004 is maintained.

2 Example – Robust maps for AAS operation

Consider the following scenario: a BS utilizing an *N*-element adaptive antenna array is designed to provide coverage so that single-antenna users at the edge of the cell are capable of decoding data transmissions at rate *R* when optimal beamforming is employed at the transmitter. This implies that broadcast (non-beamformed) DL-MAP/UL-MAP messages must be transmitted at a rate of *R/N* to ensure that the farthest user can decode them. The inability to transmit the MAP messages at variable rates results in a large single map message transmitted to all users at the most robust rate *R/N* mandated by the farthest user.

As an example, let us assume:

- A 4-element antenna array (N=4).
- Rate distribution (QAM-64 ¾ to QPSK ½) throughout the cell assumes path loss exponent n=4.
- Basic data transmission rate of QPSK ½ (R=1 bit/subcarrier).
- Frame duration of 5msec.
- Bandwidth of 5MHz.
- TDD split at 60% of the frame duration.
- 30% of the users require maps at the robust rate (*R/N*).
- Maps are compressed, CID is not included.

Figure 1 depicts the overhead for maps transmitted at rate *R/N* as a function of the average payload length. The figure further shows how this overhead can be reduced by supporting two broadcast maps with different rates, the 1st is the robust rate of *R/N* and the 2nd is the rate *R*. The map overhead is calculated as a fraction of the overall DL sub-frame.

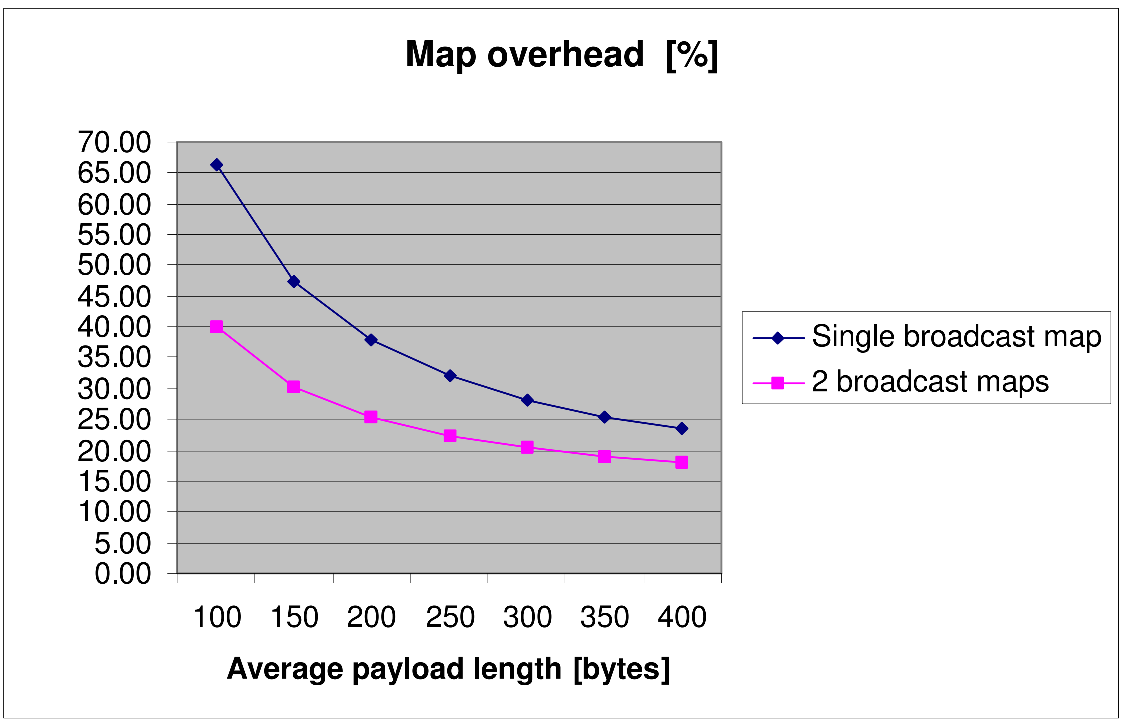

Figure 1 – Map overhead as a function of average payload length.

It should be noted that the benefits from going from a single broadcast map to two broadcast maps continue as still more broadcast maps are added, until the tradeoff crossover when the diminishing returns of providing close matches for the broadcast map transmission rates of all users is overcome by the overhead of adding additional maps.

3 Proposed solution

3.1 Broadcast messages for MSSs in specific operation modes

We define new CIDs to indicate broadcast transmissions that are intended for users in normal mode, sleep mode or idle mode.

3.2 Multiple DL-MAPs

According to [1], the DL-MAP message appears immediately following the FCH in a uni-dimensional frequency-first slot mapping order. The message begins with a generic MAC header[1] followed by an IE describing the burst containing an UL-MAP message (if one exists) and other IEs as required.

We propose to add support for multiple broadcast DL map messages, each transmitted as a separate PHY burst. The slots of these PHY bursts are ordered consecutively using the same uni-dimensional frequency-first mapping order defined in [1] for the regular DL-MAP PHY burst. The first IE in the mandatory DL-MAP (if exists) provides a description of the subsequent DL map messages. In addition, an MSS may support additional broadcast DL maps transmitted on DL zones other than the first zone. This is realized by specifying an IE describing the additional maps. The IE shall appear in the DL-MAP after the relevant zone-switch IE.

The first mandatory DL-MAP message in the frame is the same MAC management message defined in [1] (section 6.3.2.3.2). Since the constant part of this message need not be repeated in the subsequent DL map messages, these messages shall use a new trimmed version of the DL-MAP message (‘EXT-DL-MAP’).

The ordering of IEs within each DL map message is the same as defined for the mandatory DL-MAP message. The ‘include CID’ switch and preamble modifier are reset to their respective default values before processing each map message.

3.2.1 Support for multiple zones

Zone switch IEs shall only be specified in the first mandatory DL-MAP message. This eliminates contradictions and unneeded overhead. Note that this assumes that the zone switch IE specifies the starting OFDMA symbol number (otherwise an MSS having only partial visibility of the allocated IEs does not know the zone boundaries).

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[1] Compressed maps will be described in a separate section.

3.3 Multiple UL-MAPs

As specified in [1], the UL-MAP message is an independent PHY burst pointed to by the first IE in the DL-MAP. With multiple DL map messages, each DL map may use its first IE to point to a PHY burst carrying a UL-MAP message, so that multiple UL-MAPs are allowed.

The zone- switch IE in each of the maps should also carry the slot offset (relative to the beginning of the zone) to which the first IE following the zone switch is mapped. This avoids ambiguous interpretation of multiple zone switch IEs and ensures that the UL-MAP messages can be parsed independently.

A schematic example with four DL maps is illustrated in Figure 2.

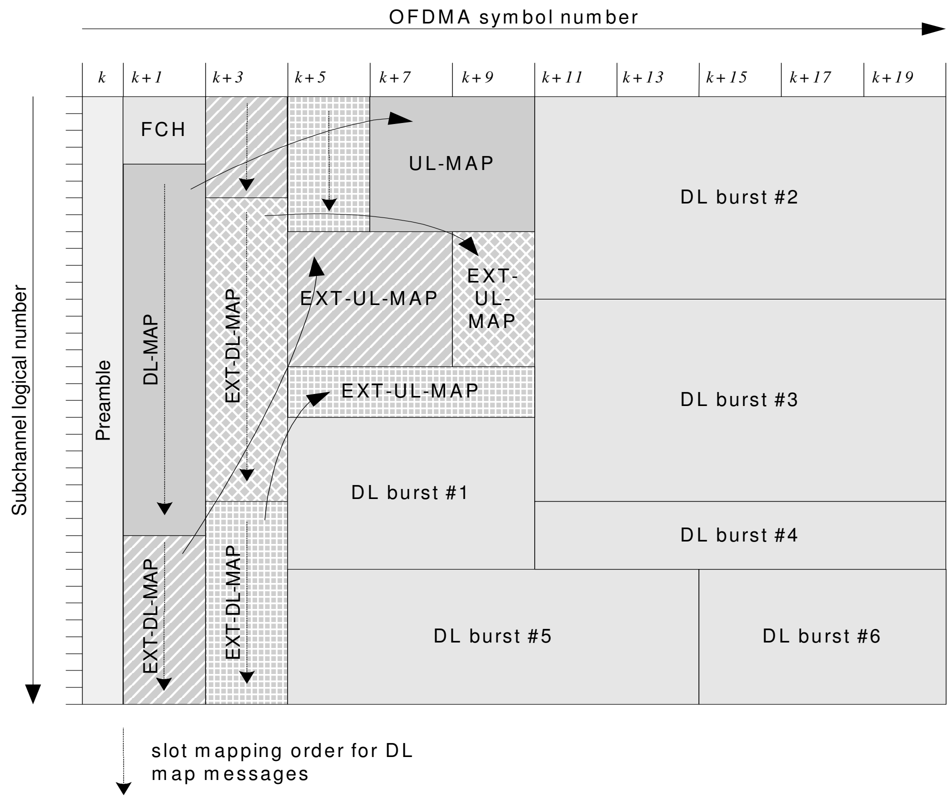

Figure 2 – Multiple broadcast map structure

3.4 Multiple compressed maps

Multiple broadcast maps may be compressed, provided that they are all either compressed or non-compressed. The first compressed map message in the frame is the one defined in section 8.4.5.6. Subsequent compressed DL map messages in the frame shall be trimmed so that the constant portion is not repeated. The missing fields are maintained from the last non-trimmed compressed map.

4 Detailed text changes

[Add new section 6.3.2.3.59]

6.3.2.3.59 Extended downlink map (EXT-DL-MAP) message

The EXT-DL-MAP message is a reduced form of DL-MAP. It may appear in a frame after a DL-MAP message in a manner that is PHY specific. DL-MAP fields that are omitted from EXT-DL-MAP are retained from the most recent DL-MAP message. A BS shall generate EXT-DL-MAP messages in the format shown in Table 107c. This message is only relevant to OFDMA PHY.

The encoding of the EXT-DL-MAP message is PHY-specification dependent. Refer to the appropriate PHY specification.

Table 107c—EXT-DL-MAP message format

Syntax	Size	Notes
EXT-DL-MAP Message Format() {		
Management Message Type = 64	8 bits	
Begin PHY specific section {		See applicable PHY section
for (*i* = 1; *i* <= *n*; *i*++) {		For each DL-MAP element 1 to n.
DL-MAP_IE()	*Variable*	See corresponding PHY specification
}		
}		
if !(byte boundary) {		
Padding Nibble	4 bits	Padding to reach byte boundary.
}		
}		

The order of DL-MAP_IEs in the EXT-DL-MAP message shall conform to the order defined for the DL-MAP message in section 6.3.2.3.2.

The logical order in which MAC PDUs are mapped to the PHY layer bursts in the downlink is defined as the order of increasing start time of all PHY bursts in the frame regardless of the DL map message in which they are described. If two or more PHY bursts have the same start time, the logical order is determined according to the order of appearance in the concatenation of DL-MAP and all EXT-DL-MAP messages.

One of the DL-MAP_IEs within the EXT-DL-MAP message may describe a burst containing an EXT-UL-MAP message. Such an IE (if exists) shall always appear first in the EXT-DL-MAP message.

[Add new section 6.3.2.3.60]

6.3.2.3.60 Extended uplink map (EXT-UL-MAP) message

The EXT-UL-MAP message is a modified form of UL-MAP that may only be described by an EXT-DL-MAP message in a manner that is PHY specific. The EXT-UL-MAP message shall be as shown in Table 107d. This message is only relevant to OFDMA PHY.

Table 107d—EXT-UL-MAP message format

Syntax	Size	Notes
EXT-UL-MAP Message Format() {		
Management Message Type = 65	8 bits	
Uplink Channel ID	8 bits	

UCD Count	8 bits	
Allocation Start Time	32 bits	
Map index	2 bits	
reserved	2 bits	
Begin PHY specific section {		See applicable PHY section
for (*i* = 1; *i* <= *n*; *i*++) {		For each UL-MAP element 1 to n.
UL-MAP_IE()	*Variable*	See corresponding PHY specification
}		
}		
if !(byte boundary) {		
Padding Nibble	4 bits	Padding to reach byte boundary.
}		
}		

The BS shall generate the UL-MAP with the following parameters:

Uplink Channel ID
The identifier of the uplink channel to which this message refers.
UCD Count
Matches the value of the Configuration Change Count of the UCD which describes the uplink burst profiles which apply to this map.
Allocation Start Time
Effective start time of the uplink allocation defined by the EXT-UL-MAP (units are PHY-specific, see 10.3).
Map index
EXT-UL-MAP messages shall be numbered consecutively starting from 1, in the same order in which the referencing EXT-DL-MAP messages appear in the frame.
Map IEs
The contents of a UL-MAP IE is PHY-specification dependent.

IEs define uplink bandwidth allocations. Each EXT-UL-MAP message shall contain at least one IE that marks the end of the last allocated burst. Ordering of IEs carried by the EXT-UL-MAP is PHY-specific.
The CID represents the assignment of the IE to either a unicast, multicast, or broadcast address. When specifically addressed to allocate a bandwidth grant, the CID shall be the Basic CID of the MSS. A UIUC shall be used to define the type of uplink access and the uplink burst profile associated with that access. An Uplink_Burst_Profile shall be included in the UCD for each UIUC to be used in the EXT-UL-MAP.

The logical order in which MAC PDUs are mapped to the PHY layer bursts in the uplink is defined as the order of UL-MAP_IEs in the EXT-UL-MAP message

[Add new section 8.4.4.8]

8.4.4.8 Optional Multiple Broadcast Maps

The BS may allocate dedicated PHY bursts, each containing a single EXT-DL-MAP message, for transmitting additional DL-MAP_IEs with different burst profiles to SSs that support multiple broadcast maps. The MSS may support either EXT-DL-MAP messages located in the first zone of the frame or EXT-DL-MAP messages in any of the zones within the frame as specified in 11.8.3.7.6. In each zone, all such bursts shall be allocated consecutively using the same uni-dimensional frequency-first slot mapping order used for the DL-MAP burst. For the first zone in the frame, the first burst containing an EXT-DL-MAP message shall be allocated starting at the slot immediately following the DL-MAP. For all subsequent zones, the first burst containing an EXT-DL-MAP message shall be allocated starting at the first subchannel of the first OFDMA symbol in the zone. An MSS is not required to decode EXT-DL-MAP messages while in idle mode.

Each EXT-DL-MAP message may also describe an EXT-UL-MAP message. If EXT-UL-MAP messages exist in the frame, an UL-MAP shall also exist. Rectangular allocations (UIUC=12,13) shall only be defined in the UL-MAP. An MSS that fails to decode an UL-MAP in the frame, it shall ignore all EXT-UL-MAP messages within the frame. All the allocations for a single MSS (including data, fast feedback, H-ARQ acks, etc.) shall be in the same UL map message in the frame.

The bursts containing the EXT-DL-MAP messages shall only be described by an EXT-DL-MAP-LIST_IE. This IE (if exists) shall immediately follow a STC_ZONE_IE to describe EXT-DL-MAP messages that are located in that zone. It shall appear as the first IE in the mandatory DL-MAP when describing EXT-DL-MAP messages located in the first zone within the frame.

The number of EXT-DL-MAP messages in a zone shall not exceed 3. The structure of the DL sub-frame with multiple broadcast maps is illustrated in figure 229a.

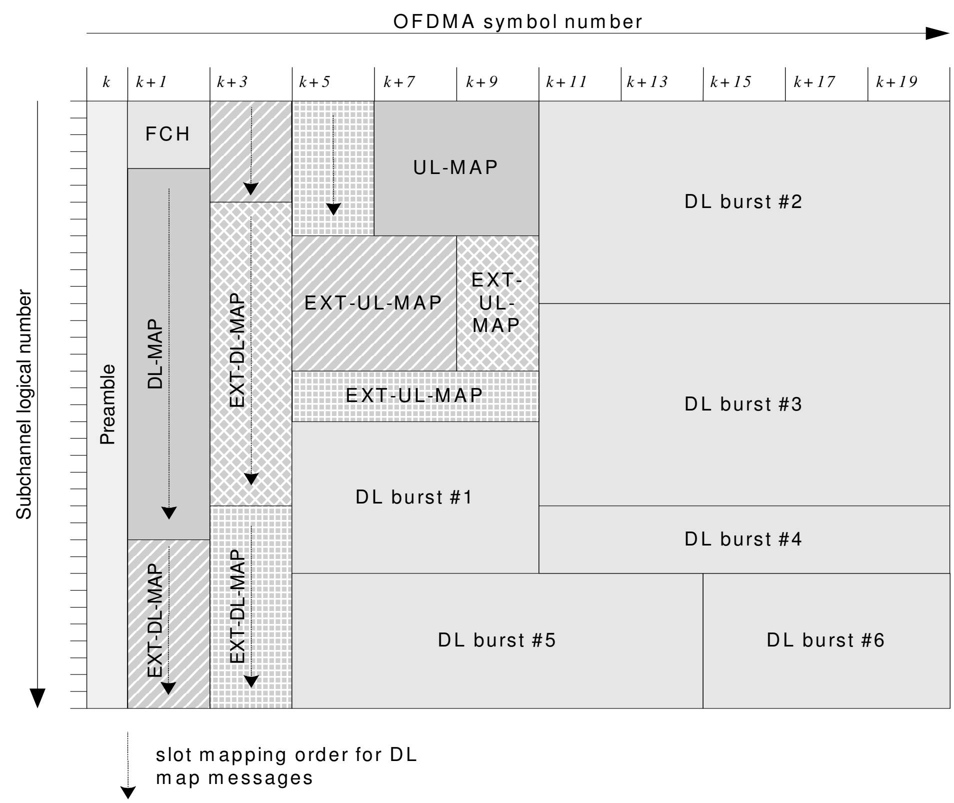

Figure 229a – Illustration of DL sub-frame structure with multiple broadcast maps in the first DL zone.

[Add new section 8.4.5.3.19]

8.4.5.3.19 EXT-DL-MAP-LIST_IE format

In the mandatory DL-MAP, the BS may transmit DIUC=15 with EXT-DL-MAP-LIST_IE() to describe the EXT-DL-MAP messages that exist within a zone in the frame. Each EXT-DL-MAP message shall be transmitted in a separate PHY burst and shall be the only message within the burst. These bursts are allocated in frequency first slot mapping order. This IE is defined in table 284j.

Table 284j—EXT-DL-MAP-LIST extended IE format

Syntax	**Size**	**Notes**
EXT-DL-MAP-LIST_IE() {		
Extended DIUC	4 bits	DL-MAP-UNI = 0xE
Length	4 bits	Length = 2*n
For (i=0; i< n; i++)		

DIUC	4 bits	
Number of slots	8 bits	
Repetition coding indication	2 bits	0b00 - No repetition coding 0b01 - Repetition coding of 2 used 0b10 - Repetition coding of 4 used 0b11 - Repetition coding of 6 used
Initial INC_CID	1 bit	Initial value of INC_CID that shall be assumed when processing this EXT-DL-MAP.
Reserved	1 bit	Shall be set to zero
}		
}		

DIUC
DIUC used for the i-*th* burst described by this IE.

Number of slots
Defines the length of the i-*th* burst in slots (including repetition code).

Repetition coding indication
Indicates the repetition code used inside the i-*th* burst.

[Add new section 8.4.5.3.20]

8.4.5.3.5.19 Skip IE

This IE is sent by BS in the DL-MAP message as a broadcast IE. This IE is used to toggle the enabling and disabling of processing of regions designated by IEs following the Skip_IE. The DL-MAP shall begin in the mode where processing of regions designated by IEs is enabled. The first appearance of the Skip_IE shall toggle this mode to disable processing of the regions described by following IEs. Any subsequent appearance shall toggle this mode.

[Section 8.4.5.3.3]

[Add the following text before the end of section 8.4.5.3.3]

AAS_DL_IE may only be specified in the DL-MAP message. The zone permutation and boundaries shall apply to all allocations described in the DL-MAP and in any EXT-DL-MAP messages that exist in the same frame.

[Section 8.4.5.3.4]

[Add the following text before the end of section 8.4.5.3.4]

Zone permutation changes shall only be specified in the DL-MAP message. The zone boundaries and permutation shall apply to all allocations described in the DL-MAP and in any EXT-DL-MAP messages that exist in the same frame. STC changes may be specified in EXT-DL-MAP messages, in which case any instructed permutation changes shall be ignored.

[Section 8.4.5.3.7]

[Modify the text on page 528, lines 25-30]

In the DL-MAP, a BS may transmit DIUC=15 with the CID-Switch_IE() to toggle the inclusion of the CID parameter in DL-MAP allocations. The DL-MAP shall begin in the mode where CIDs are not included. EXT-DL-MAP messages shall begin in the mode specified in the EXT-DL-MAP-LIST_IE. The first appearance of the CID-Switch_IE() shall toggle the DL-MAP mode to include CIDs. Any subsequent appearance of the CID-Switch_IE() shall toggle the DL-MAP / EXT-DL-MAP CID inclusion mode.

[Section 8.4.5.3.11]

[Modify the text on page 532, lines 28-32]

where c_k are the preamble tone values, and t is the time, elapsed since the beginning of the OFDMA symbol, with $0 < t < T_s$. The PHYMOD_DL_IE can appear anywhere in ~~the~~ DL-MAP/EXT-DL-MAP messages ~~map~~, and it shall remain in effect until another PHYMOD_DL_IE is encountered~~, or until the end of the DL map~~. The modifier shall be reset at the beginning of each DL-MAP/EXT-DL-MAP message.

[Section 8.4.5.4.6]

[Modify table 291 as follows]

Syntax	**Size**	**Notes**
AAS_UL_IE() {		
Extended UIUC	4 bits	AAS = 0x02
Length	4 bits	*variable* ~~Length = 0x03~~
Permutation	2 bits	0b00 = PUSC permutation 0b01 = Optional PUSC permutation 0b10 = adjacent-subcarrier permutation 0b11 = *Reserved*
OFDMA symbol offset	8 bits	
Preamble indication	2 bits	0b00 = No preamble 0b01 = Preamble used 0b10-0b11 = *Reserved*
First bin index	6 bits	When Permutation=0b10, this indicates the index of the first band allocated to this AMC segment.
Last bin index	6 bits	When Permutation=0b10, this indicates the index of the last band allocated to this AMC segment.
Include Slot offset	1 bit	
If (Include Slot offset == 1) {		
Slot offset	11 bits	The slot offset (according to data slot mapping order), relative to the start of the zone, from which to begin allocating data slots to subsequent allocations. Slot offset is set to zero if 'Include slot offset' = 0.
Reserved	5 bits	
}		
Else {		
Reserved	7 bits	
}		
}		

[Add the following text after table 291]

The BS shall set the 'Include Slot offset' field to zero in all AAS_IEs that appear in the UL-MAP that is described by an IE in the mandatory DL-MAP.

[Section 8.4.5.4.7]

[Modify table 292 as follows]

Syntax	Size	Notes
ZONE_IE() {		
Extended UIUC	4 bits	ZONE = 0x04
Length	4 bits	variable ~~Length = 0x02~~
OFDMA symbol offset	7 bits	
Permutation	2 bits	0b00 = PUSC permutation 0b01 = FUSC permutation 0b10 = Optional FUSC permutation 0b11 = Adjcent subcarrier permutation
PUSC UL_IDcell	7 bits	
Include Slot offset	1 bit	
If (Include Slot offset == 1) {		
Slot offset	11 bits	The slot offset (according to data slot mapping order), relative to the start of the zone, from which to begin allocating data slots to subsequent allocations. Slot offset is set to zero if 'Include slot offset' = 0.
Reserved	5 bits	
}		
Else {		
Reserved	7 bits	
}		
}		

[Add the following text after table 292]

The BS shall set the 'Include Slot offset' field to zero in all AAS_IEs that appear in the UL-MAP that is described by an IE in the mandatory DL-MAP.

[Section 8.4.5.4.21]

[Modify table 298h as follows]

Syntax	Size	Notes
UL_Fast_tracking_IE() {		
Extended UIUC	4 bits	Fast-Indication = 0x03
~~Number of~~ Length	4 bits	*Variable*
Map Index	2 bits	Index of EXT-UL-MAP to which this IE refers, or zero if this IE refers to the mandatory UL-MAP.
reserved	6 bits	Shall be set to zero.
for (i = 1; i <= n; i++) {		For each Fast Indication bytes 1 to n (n=Length-1)
Power correction	2 bits	Power correction indication: 00: no change; 01: +2dB; 10: -1dB; 11: -2dB
Frequency correction	4 bits	The correction is 0.1% of the carrier spacing multiplied by the 4-bit number interpreted as a signed integer (i.e. 1000: -8; … 0000: 0; … 0111: 7)
Time correction	2 bits	The correction is floor(2 / F_s) multiplied by: 00: 0; 01: 1; 10: -1; 11: Not used
}		
}		

[Section 8.4.5.6]

[Modify the text on page 550, lines 53-61]

In addition to the standard DL-MAP, EXT-DL-MAP, ~~and~~ UL-MAP, and EXT-UL-MAP formats described in 6.3.2.3.2, 6.3.2.3.59, ~~and~~ 6.3.2.3.4, and 6.3.2.3.60, these messages ~~the DL-MAP and UL-MAP~~ may conform to the format presented in the following subclauses. The presence of the compressed DL-MAP format is indicated by the contents of the most significant two bits of the first data byte following the DL Frame Prefix. These bytes overlay the HT and EC bits of a generic MAC header. When these bits are both set to 1 (an invalid combination for a standard header), the compressed DL-MAP format is present. The presence of the compressed DL-MAP mandates that all PHY bursts containing EXT-DL-MAP messages have compressed form as well. Similar to the DL-MAP message, the presence of a compressed EXT-DL-MAP is indicated by setting the most significant two bits of the first data byte of the message's PHY burst to 1. A compressed UL-MAP shall only appear after a compressed DL-MAP. A compressed EXT-UL-MAP shall only appear after a compressed EXT-DL-MAP. The presence of a compressed UL-MAP (EXT-UL-MAP) is indicated by a bit in the corresponding compressed DL-MAP (EXT-DL-MAP) data structure.

[Add new section 8.4.5.6.3]

8.4.5.6.3 Compressed EXT-DL-MAP

The compressed EXT-DL-MAP format is presented in Table 304a. The message is similar to the standard format of EXT-DL-MAP compressed DL-MAP except that the 'management message type' field is omitted.

Table 304a—Compressed EXT-DL-MAP message format

Syntax	Size	Notes
Compressed_EXT-DL-MAP () {		
Compressed map indicator	2 bits	Set to binary 11 for compressed format
Reserved	1 bit	Shall be set to zero
EXT-UL-MAP appended	1 bit	
Compressed map type	2 bits	Shall be set to 0b10
Map message length	10 bits	
DL IE Count	8 bits	
for (i=1; i <= DL IE Count; i++)		
DL-MAP_IE()	*variable*	
}		
If !(byte boundary) {		
Padding Nibble	4 bits	Padding to reach byte boundary.
}		
}		

Compressed map indicator
A value of binary 0b11 in this field indicates the map message conforms to the compressed format described here. A value of binary 0b00 in this field indicates the map message conforms to the standard format described in 6.3.2.3.59. Any other value is an error.

Compressed map type
This value shall be set to 0b10 here to differentiate from other types of compressed maps.

EXT-UL-MAP appended
A value of 1 indicates a compressed UL-MAP (see 8.4.5.2.6.2) is appended to the current compressed EXT-DL-MAP data structure.

Map message length
This value specifies the length of the compressed map message(s) beginning with the byte containing the Compressed map indicator and ending with the last byte of the compressed DL-MAP message if the UL-MAP appended bit is not set or the last byte of the UL-MAP compressed message if the UL-MAP appended bit is set. The length includes the computed 32-bit CRC value.

DL IE count
This field holds the number of IE entries in the following list of DL-MAP IEs.

A CRC-32 value is appended to the end of the compressed map(s) data. The CRC is computed across all bytes of the compressed map(s) starting with the byte containing the Compressed map indicator through the last byte of the map(s) as specified by the Map message length field. The CRC calculation is the same as that used for standard MAC messages.

[Add new section 8.4.5.6.4]

8.4.5.6.4 Compressed EXT-UL-MAP

The compressed EXT-UL-MAP format is presented in Table 304b. The message may only appear after a compressed EXT-DL-MAP message to which it shall be appended. The message presents the same information as the compressed UL-MAP with the addition of the 'Map index' field.

Table 304b — Compressed EXT-UL-MAP message format

Syntax	Size	Notes
Compressed_EXT-UL-MAP () {		
UCD Count	8 bits	
Allocation Start Time	32 bits	
Map index	2 bits	
reserved	2 bits	
while (map data remains){		
UL-MAP_IE()	*variable*	
}		
If !(byte boundary) {		
Padding Nibble	4 bits	Padding to reach byte boundary.
}		
}		

[Modify section 10.4, p. 274, line 37-60, text in Table 343 as shown below:]

Table 343 CIDs

CID	Value	Description
Initial Ranging	0x0000	Used by SS and BS during initial ranging process.
Basic CID	0x0001 – m	The same value is assigned to both the DL and UL connection.
Primary management	m+1 – 2m	The same value is assigned to both the DL and UL connection.
Transport CIDs, Secondary Mgt CIDs	2m+1 – 0xFE9F	For the secondary management connection, the same value is assigned to both the DL and UL connection.
Multicast CIDs	0xFEA0 – 0xFEFE	For the downlink multicast service, the same value is assigned to all MSSs on the same channel that participate in this connection.
AAS initial ranging CID	0xFEFF	A BS supporting AAS shall use this CID when allocating a Initial Ranging period for AAS devices.
Multicast polling CIDs	0xFF00 – 0xFFF~~D~~A	A BS may be included in one or more multicast polling groups for the purposes of obtaining bandwidth via polling. These connections have no associated service flow.
Normal mode multicast CID	0xFFFB	Used for transmission of DL broadcast information to normal mode MSS.
Sleep mode multicast CID	0xFFFC	Used for transmission of DL broadcast information to Sleep mode MSS
Idle mode multicast CID	0xFFFD	Used for transmission of DL broadcast information to Idle mode MSS.
Padding CID	0xFFFE	Used for transmission of padding information by SS and BS.
Broadcast CID	0xFFFF	Used for broadcast information that is transmitted on a downlink to all SS.

[Modify section 11.8.3.7.6]

Type	Length	Value	Scope
155	1	bit #0: H-ARQ Map capability bit #1: Support multiple broadcast maps in first DL zone of the frame bit #2: Support multiple broadcast maps in multiple DL zones within the frame bit #~~1~~ 3-7: reserved	SBC-REQ (see 6.3.2.3.23) SBC-RSP (see 6.3.2.3.24)

5 References

[1] IEEE P802.16-2004.