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Source(s)	Yuval Lomnitz, Hassan Yaghoobi	Intel Corp	yuval.lomnitz@intel.com, hassan.yaghoobi@intel.com
	Tal Kaitz, Ran Yaniv	Alvarion	tal.kaitz@alvarion.com, ran.yaniv@alvarion.com
	Dave Pechner, Doug Dahlby, Todd Chauvin	ArrayComm Inc.	dpechner@arraycomm.com, dahlby@arraycomm.com, chauvin@arraycomm.com
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Abstract	This contribution introduces clarifications for OFDMA private maps		
Purpose	Adopt into P802.16d/D5 corrigenda		
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Clarify OFDMA AAS private maps

Dave Pechner, Doug Dahlby

1 Problem Statement

The 802.16d standard refers to private maps in association with AAS operation, for example in section 6.3.7.6.1, without defining what private maps are, how they may be used, or whether support for private maps is mandatory. In particular, there is no specification of where private maps may occur in the DL subframe, or whether their PHY burst allocation refers to the frame containing the private map, or a subsequent frame.

The current definition of DL maps (both regular and compressed) suggest that there is only a single DL map per frame, and that this DL map must occur immediately following the FCH. Therefore, by this interpretation, the current standard does not support private maps.

Section 8.4.4.2 states:

" The FCH contains the DL_Frame Prefix as described in 8.4.4.3, and specifies the length of the DL-MAP message that immediately follow the DL_Frame_Prefix and the repetition coding used for the DL-MAP message."

This eludes to the fact that the DL Map must be directly after the FCH and that there is only one DL MAP.

In addition, Figure 219 illustrates a single DL map pointing to all zones.

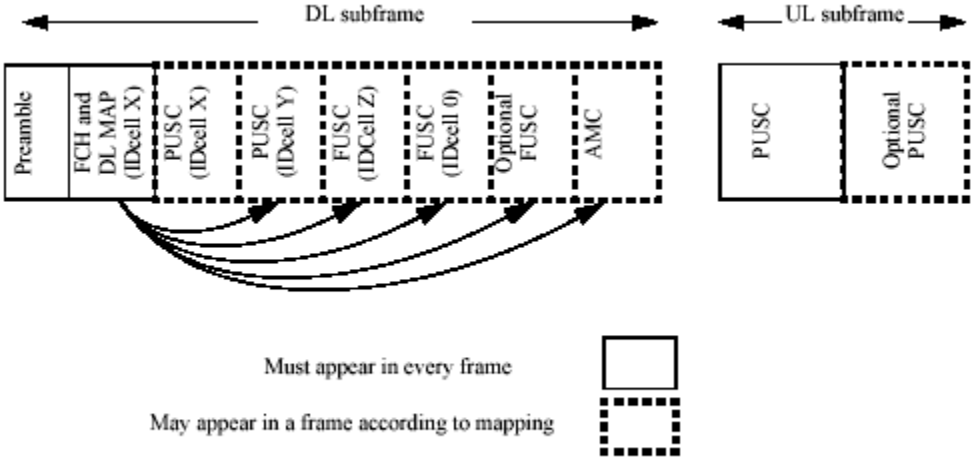

Figure 219—Illustration of OFDMA frame with multiple zones

Section 8.4.4.3 states:

" DL-Map_Length - Defines the length in slots of the DL-Map message that follows immediately the DL_Frame_Prefix."

Again, alludes to the fact that there is a single DL map and it directly follows the FCH.

Section 8.4.5.6 States:

"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."

Therefore, this requires that a compressed map directly follow the FCH, and therefore only a single compressed map may exist.

2 Proposed Solution

It is proposed to allow compressed maps to exist anywhere within an AAS Zone. When located in an AAS zone, the private map can be pointed to by a broadcast map, a DLFP message, or another private map in a previous frame. If the private map shares an allocation with other management messages or a data PDU, then the private map must be the first element in the allocation. Private maps are only allowed to use unicast CID values. Allocations pointed to by a private map must occur within the same AAS zone as the private map. Both UL and DL allocations are relative to the next frame.

In addition, a dedicated single-IE private map is defined that eliminates excess overhead from the regular compressed map. This single IE map is pointed to by a broadcast map or private compressed map which defines the values of several fields that will be constant for the duration of the private map chain. The following overhead is removed:

1. Map Length – Not required due to deterministic map length
2. Frame Duration – Acquired by the map that initiated the private map chain. Assumed constant for the duration of the private map chain.
3. Frame Number – Acquired by the map that initiated the private map chain. Counted by the SS for the duration of the private map chain.
4. DCD Count – Optionally included. Only required if DCD count changes
5. Operator ID – Acquired by the map that initiated the private map chain. Assumed constant for the duration of the private map chain.
6. Sector ID – Acquired by the map that initiated the private map chain. Assumed constant for the duration of the private map chain.
7. DL IE Count – Not required, always one IE.
8. NCID – Not required.
9. CID – Only required in first map of private map chain.
10. Boosting – Not required.
11. UCD Count – Optionally included. Only required in first UL map of private map chain.

12. Allocation Start Time – UL start time relative to TTG plus an integer number of symbol times.

Removal of these fields reduces the size of a single IE private map from 33 bytes for a compressed UL/DL map, to 15 bytes.

3 Proposed Text Changes

[Modify section 8.4.5.6]

8.4.5.6 Compressed maps

In addition to the standard DL-MAP and UL-MAP formats described in 6.3.2.3.2 and 6.3.2.3.4, the DLMAP 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. A compressed UL-MAP shall only appear after a compressed DL-MAP. The presence of a compressed UL-MAP is indicated by a bit in the compressed DL-MAP data structure.

The compressed map must occur directly after the DL Frame Prefix, or can be used as a private map in an AAS zone. When located in an AAS zone, the private map can be pointed to by a broadcast map, a DLFP message, or another private map in a previous frame. Other restrictions of private maps include:

- The private map must be the first message in a PHY burst
- Private maps are only allowed to use unicast CID values.
- Allocations pointed to by a private map must occur within the same AAS zone as the private map.
- Both UL and DL allocations included in the private map are relative to the next frame + frame offset value negotiated with the SS (see 11.8.3.7.6).

When a private map chain is started that has UL IE, an AAS_UL_IE must be included in the first UL map so the AAS zone information is known by the SS. This information only needs to be included in the first private map of a private map chain, or after any parameters in the AAS zone is changed. The DL zone information is expected to be static for the duration of the private map chain, however, a AAS_DL_IE can be included to change the DL AAS zone parameters.

The private map is an optional feature that can be negotiated between the SS and BS. In addition, There is a capability bit to indicate if a MSS can support private map chains. This is to support applications that utilize private maps but do not require chains.

[Add new section 8.4.5.8]

8.4.5.8 Optional Reduced AAS Private Maps

Reduced AAS private maps are based upon the compressed map format, however they are specifically designed to support a single unicast IE per map. Their use is identical to compressed private maps, however, fields have been removed that are not require to support a single IE. The reduced AAS private map will be pointed to by a broadcast map or private compressed map which will define the values of several fields that will be constant for the duration of the private map chain. The behavior of the compressed map fields that are not present in the reduced AAS private map are described below:

1. Frame Duration – Acquired by the map that initiated the private map chain. Assumed constant for the duration of the private map chain.
2. Frame Number – Acquired by the map that initiated the private map chain. Counted by the SS for the duration of the private map chain.
3. DCD Count – Optionally included. Only required if DCD count changes
4. Operator ID – Acquired by the map that initiated the private map chain. Assumed constant for the duration of the private map chain.
5. Sector ID – Acquired by the map that initiated the private map chain. Assumed constant for the duration of the private map chain.

6. CID – Only required in first map of private map chain.
7. UCD Count – Optionally included. Only required in first UL map of private map chain.
8. Allocation Start Time – UL start time relative to TTG plus an integer number of symbol times.

8.4.5.8.1 Reduced AAS Private DL-MAP

The Reduced AAS private DL-MAP format is presented in Table XXX. The reduced AAS private DL-MAP message eliminates the fields that are not relevant since the message is targeted to a single CID. The DL_PermBase of the zone containing the assigned DL allocation is assumed to have the same value as the zone in which the compressed private DL-MAP message is located.

Table XXX—Reduced AAS private DL-MAP message format

Syntax	Size	Notes
Reduced_AAS_Private_DL-MAP() {		
Compressed map indicator	2 bits	Set to binary 11 for compressed format
Reserved	1 bit	Shall be set to zero
UL-MAP appended	1 bit	
Compressed Map Type	2 bits	Shall be set to 0b11 for reduced private map
Multiple IE	1 bit	1 = Multiple IE Mode
If (Multiple IE) {		
NUM IE	8 bits	NUM IE set to 1 if not in multiple IE mode
}		
For (ii = 1:NUM IE) {		
CID Included	1 bit	1 = CID included The CID shall be included in the first compressed private MAP if it was pointed to by a DL-MAP IE with INC_CID == 0 or by a DL-MAP IE with a multicast CID.
DCD Count Included	1 bit	1 = DCD Count included The DCD count is expected to be the same as in the broadcast map that initiated the private map chain. The DCD count can be included in the private map if it changes.
PHY modification Included	1 bit	1 = included.
H-ARQ Enabled	1 bit	1 = H-ARQ Enabled
If (CID Included) {		
CID	16 bits	
CQICH_Control_IE()	4 / 16 bits	
}		
If (H-ARQ Enabled) {		
N_{SCH}	4 bits	
ACK Allocation Index	6 bits	See 6.3.2.3.43.7.5
H-ARQ Control IE()	4 / 8 bits	
Reserved	2 bits	Must be zero
}		
If (DCD Count Included) {		
DCD Count	8 bits	
}		
If (PHY modification Included) {		
Preamble Select	1 bit	0 = Frequency shifted preamble 1 = Time shifted preamble
Preamble Shift Index	4 bits	Updated preamble shift index to be used starting with the frame

		specified by the Frame Offset.
Reserved	3 bits	Set to zero
}		
DIUC / N_{EP}	4 bits	DIUC except for H-ARQ (only burst profile DIUCs allowed) N_{EP} used for H-ARQ
Frame Offset	3 bits	
If (current zone permutation is FUSC or optional FUSC) {		
Zone symbol offset	8 bits	
}		
OFDMA Symbol Offset	8 bits	
Subchannel Offset	8 bits	
No.OFDMA symbols	7 bits	
No. Subchannels	7 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
Reserved	1 bit	
CRC-32	32 bits	
} (end NUM IE loop)		
Padding	variable	Padding depends upon H-ARQ options and if UL reduced map is appended. Padding should not be included in DL reduced map if UL reduced map is appended.
}		

Compressed map indicator
A value of binary 11 in this field indicates the presence of a compressed map or private AAS map.

UL-MAP appended
A value of 1 indicates a private UL-MAP (see 8.4.5.6.2) is appended to the current private DL-MAP data structure.

Compressed Map Type
Defines the type of compressed map.

CID Included
Specifies if a CID is included. The CID shall be included in the first compressed private MAP if it was pointed to by a DL-MAP IE with INC_CID == 0 or by a DL-MAP IE with a multicast CID.

DCD Count Included
Specifies if a DCD count is included. DCD Count is only required if the DCD count is changed.

Phy Modification Included
Indicates if a preamble modifier is included

H-ARQ Enabled
Indicates if G-ARQ control and CQICH Control IEs are included

Connection Identifier (CID)
Represents the assignment of the IE to a unicast address.

Preamble Select
Specifies the preamble type

Preamble Shift Index
The preamble shift index in time or frequency, as specified by the Preamble Select field.

DCD Count
Matches the value of the configuration change count of the DCD, which describes the downlink burst profiles that apply to this map.

DIUC
DIUC used for the burst.

Frame Offset
The frame in which the burst is located. A value of zero indicates an allocation in the subsequent frame.
Zone symbol offset
The offset of the OFDMA symbol in which the zone containing the burst starts, measured in OFDMA symbols from beginning of the downlink frame referred to by the Frame Offset.
OFDMA Symbol offset
The offset of the OFDMA symbol in which the burst starts, measured in OFDMA symbols from beginning of the downlink frame referred to by the Frame Offset.
Subchannel offset
The lowest index OFDMA subchannel used for carrying the burst, starting from subchannel 0.
No. OFDMA Symbols
The number of OFDMA symbols that are used (fully or partially) to carry the downlink PHY Burst.
No. of subchannels
The number of subchannels with subsequent indexes, used to carry the burst.
Repetition coding Indication
Indicates the repetition code used inside the allocated burst.

8.4.5.8.2 Reduced AAS Private UL-MAP

The Reduced AAS private UL-MAP format is presented in Table YYY. The message may only appear after a Reduced AAS private DL-MAP message to which it shall be appended.

Table YYY— Reduced AAS private UL-MAP message format

Syntax	Size	Notes
Reduced_AAS_Private_UL-MAP() {		
For (ii = 1: NUM IE) {		
AAS zone configuration Included	1 bit	1 = AAS zone configuration included. AAS configuration should be included in the first UL map of a private map chain to define the UL AAS Zone.
AAS zone position Included	1 bit	1 = AAS zone position included. AAS zone position should be included in the first UL map of a private map chain to define the UL AAS Zone and any time the UL AAS zone is changed.
UCD Count Included	1 bit	1 = UCD Count included. The UCD count should be included in the first allocation of a private map chain.
PHY modification Included	1 bit	1 = Preamble shift index included.
Power Control Included	1 bit	1 = Power control value included
if (AAS Zone Config Included) {		
Permutation	2 bits	0b00 = PUSC permutation 0b01 = FUSC permutation 0b10 = AMC permutation 0b11 = Reserved
UL_PermBase	7 bits	
Preamble Indication	2 bits	0b00 - 0 symbols 0b01 - 1 symbols 0b10 - 2 symbols 0b11 - 3 symbols
Padding	5 bits	
}		
if (AAS Zone Position Included) {		
Zone Symbol Offset	8 bits	
Zone Length	8 bits	
}		
if (UCD Count Included) {		

UCD Count	8 bits	
} (end of NUM IE)		
if (PHY modification Included) {		
Preamble Select	1 bit	0 = Frequency shifted preamble 1 = Time shifted preamble
Preamble Shift Index	4 bits	Updated preamble index to be used starting the with the frame specified by the Frame Offset
Reserved	3 bits	Set to zero
}		
if (Power Control Included) {		
Power Control	8 bits	Signed integer in 0.25 dB units
}		
if (H-ARQ Enabled) {		
H-ARQ_Control_IE()	4 / 8 bits	
}		
UIUC / N_{EP}	4 bits	UIUC except for H-ARQ (only burst profile UIUCs allowed) N_{EP} used for H-ARQ Only burst profile UIUCs allowed
Frame Offset	3 bits	
Slot Offset	12 bits	
Duration	10 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
Padding Bits	variable	
}		
}		

AAS Zone Configuration Included
Indicates if AAS Zone configuration information is included. This should be included in the first UL map of a private map chain.

AAS Zone Position Included
Indicates if AAS Zone position information is included. This should be included in the first UL map of a private map chain or any time the AAS Zone start or duration is modified.

UCD Count Included
Indicates if UCD Count is included. This should be included in the first UL map of a private map chain.

Phy Modification Included
Indicates if a preamble modifier is included

Power Control Included
Indicates if a SS power control byte is included

Preamble Select
Specifies the preamble type

Preamble Shift Index
The preamble shift index in time or frequency, as specified by the Preamble Select.

Power Control
The change in transmit power level that the SS should apply starting on the frame specified by the Frame Offset.

Permutation
Defines the permutation used within the UL AAS Zone

UL_PermBase
Permutation Base for specified UL AAS Zone

Preamble Indication
Defines the number of UL AAS preambles to be used before each UL burst in the AAS Zone.

Zone Symbol offset
The symbol offset of the UL AAS Zone. This is referenced to the DL preamble of the subsequent frame, and consists of an integer symbol offset specified here, as well as the addition of the TTG known from DCD messages. If TTG is not present in the DCD (for FDD) it is assumed to be zero.This is referenced to the 'Allocation Start Time' field in the UL-MAP.

Zone Length
The duration of the UL AAS Zone, specified in number of OFDMA symbols.

UCD Count
Matches the value of the configuration change count of the UCD, which describes the uplink burst profiles that apply to this map.

UIUC
UIUC used for the burst.

Frame Offset
The frame in which the burst is located. A value of zero indicates an allocation in the subsequent frame.

Slot offset
The offset to the starting location of the uplink burst from the beginning of the UL AAS zone in slots.

Duration
The duration of the UL burst, specified in slots

Repetition coding Indication
Indicates the repetition code used inside the allocated burst.

[Modify section 11.8.3.7.6]

11.8.3.7.6 OFDMA AAS private map support

This field indicates the AAS private map parameters supported by a WirelessMAN-OFDMA SS.

Type	Length	Value	Scope
155	1	bit #0: H-ARQ MAP Capability bit #1: private map support bit #2: Reduced private map support bit #3: Private Map Chain Enable bit #4: Private Map DL frame offset 0: support compressed private maps with Frame Offset = 0 1: support compressed private maps with Frame Offset = 1 bit #5: Private Map UL frame offset 0: support compressed private maps with Frame Offset = 0 1: support compressed private maps with Frame Offset = 1 Bits #6-7: private map chain concurrency 0 indicates no limit 1-3 indicate maximum concurrent private map chains	SBC-REQ (see 6.3.2.3.23) SBC-RSP (see 6.3.2.3.24)

- Private map chain enable indicates if a private map is allowed to point to another private map. If not enabled, private map chains are not allowed.
- The frame offset value indicates the frame offset the SS can support with private maps. A value of 0 indicates the private map allocations are for the subsequent frame (one frame in the future), a value of 1 indicates it is for two frames in the future. When used with compressed private maps, these fields are required to be used. When used with reduced private maps, these are minimum values and the actual frame offset is defined by the frame offset field in the private map.
- The concurrency field indicates how many parallel private map chains can be supported by a SS.