| Project | IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16> |
|---|---|
| Title | AAS Private Maps for OFDM PHY |
| Date Submitted | 2004-11-15 |
| Source(s) | Ran Yaniv, Tal Kaitz, Naftali Chayat, Vladimir Yanover    Alvarion    tal.kaitz@alvarion.com, ran.yaniv@alvarion.com |
| Re: | IEEE P802.16e/D5 |
| Abstract | This contribution introduces compressed private maps for OFDM PHY |
| Purpose | Adopt into P802.16d/D5 corrigenda |
| Notice | This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein. |
| Release | The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16. |
| Patent Policy and Procedures | The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures <http://ieee802.org/16/ipr/patents/policy.html>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair <mailto:chair@wirelessman.org> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>. |

# AAS private maps for OFDM PHY

**Ran Yaniv, Tal Kaitz, Naftali Chayat, Vladimir Yanover**

*Alvarion Ltd.*

# 1   Introduction

The 802.16REVd OFDM PHY supports the use of regular DL-MAP and UL-MAP messages as private maps in AAS mode. These messages result in a large amount of overhead. For example, in addition to the MAC and map headers, a DL-MAP_IE for describing a data burst requires 32 bits for DL and 48 bits for UL, and a PHYMOD_IE for specifying the preamble shift requires 48 bits for DL and 64 bits for UL. These overheads can be significantly reduced by adding support for compressed private maps and by defining certain rules and assumptions for their operation.

In this contribution we present two types of compressed private maps – standard and reduced. In both types, the generic MAC header is omitted. The standard compressed private map follows the scheme used in the OFDMA PHY and eliminates some of the map header fields. The reduced private map is a lean form of the standard compressed format that supports a single IE. This single IE may describe an allocation in a future frame other than the next frame.

# 2   Proposed Solution

It is proposed to add support for compressed private maps that may exist anywhere within an AAS Zone. In these compressed private maps, the generic MAC header is omitted and a reduced form of the Base-Station ID is used. A broadcast map, a DLFP message, or another private map in a previous frame can point to the private map.  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. 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 private 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.   DCD Count – Optionally included.  Only required if DCD count changes

3. Base Station ID – Acquired by the map that initiated the private map chain. Assumed constant for the duration of the private map chain.
4. CID – Only required in first map of private map chain.
5. UCD Count – Optionally included.  Only required in first UL map of private map chain.
6. Allocation Start Time – UL start time relative to TTG plus an integer number of symbol times.

# 3   Proposed Text Changes

*[Modify section 8.3.6.2, page 463 lines 50-57 as follows]*

**Start Time**

If transmitted in the frame broadcast DL-MAP message, this field ~~I~~indicates the start time, in units of symbol duration, relative to the start of the first symbol of the PHY PDU (including preamble) where the DL-MAP message is transmitted. If transmitted in a compressed AAS private map (see section 8.3.6.6), this field indicates the start time, in units of symbol duration, relative to the beginning of the subsequent downlink frame (including preamble). The end of the last allocated burst is indicated by allocating an End of Map burst (DIUC = 14) 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 (if present).

*[Add new section 8.3.6.6]*

**8.3.6.6 Compressed AAS Private Maps**

When appearing in a private map message within an AAS zone, the standard DL-MAP and UL-MAP formats described in 6.3.2.3.2 and 6.3.2.3.4 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. 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.

A broadcast map, an AAS-DLFP message, or another private map in a previous frame can point to the compressed private map.  Other restrictions of compressed 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.
- Private maps may only describe allocations within the AAS portion of the sub-frame.
- Both UL and DL allocations included in the private map are relative to the next frame + frame offset value negotiated with the SS (see 11.8.3.6.6).

A modification to the 'Preamble Time Shift' (as defined by in 8.3.6.2.7 and 8.3.6.3.7) shall also apply to allocations in subsequent private maps in the private map chain, until modified again or until the end of the private map chain.

The compressed private map is an optional feature that can be negotiated between the SS and BS.

### 8.3.6.6.1 Compressed DL-MAP

The compressed private DL-MAP format is presented in Table AAA. The message presents the same information as the standard format with one exception. In place of the DL-MAP's 48-bit Base Station ID, the compressed format provides a subset of the full value. When the compressed format is used, the full 48-bit Base Station ID shall be published in the DCD.

**Table AAA—Compressed DL-MAP message format**

| Syntax | Size | Notes |
|---|---|---|
| Compressed_ 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 | 1 bit | Shall be set to 0 for compressed private map |
|    Map message length | 11 bits | |
|    DCD Count | 8 bits | |
|    Base Station ID | 4 bits | 4 LSB of BS ID. The burst specified by the DLFP shall not be decoded if these bits do not match those of the BS on which it is registered |
|    Sector ID | 8 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 |
|    } | | |
|    HCS | 8 bits | |
| } | | |

**Compressed map indicator**
> A value of binary 11 in this field indicates the map message conforms to the compressed format described here. A value of binary 00 in this field indicates the map message conforms to the standard format described in 6.3.2.3.2. Any other value is an error.

**UL-MAP appended**
> A value of 1 indicates a compressed UL-MAP (see 8.3.6.6.2) is appended to the current compressed 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 8-bit HCS value.

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

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

**HCS**
> A HCS value, as defined in 6.3.2.1.1, is appended to the end of the compressed map(s) data. The HCS is computed across all bytes of the compressed map(s) starting with the byte containing the Compressed map indicator, and including appended UL-MAP, if present.

### 8.3.6.6.2 Compressed UL-MAP

The compressed UL-MAP format is presented in Table BBB. The message may only appear after a compressed DL-MAP message to which it shall be appended. The message presents the same information as the standard format with the exception that the Generic MAC header and the Uplink Channel ID are omitted.

**Table BBB—Compressed UL-MAP message format**

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

**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 UL-MAP.

## *[Add new section 8.3.6.7]*

### 8.3.6.7 Reduced Compressed AAS Private Maps

Reduced compressed 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 standard 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. DCD Count – Optionally included.  Only required if DCD count changes
2. Base Station ID – Acquired by the map that initiated the private map chain.  Assumed constant for the duration of the private map chain.
3. CID – Only required in first map of private map chain.
4. UCD Count – Optionally included.  Only required in first UL map of private map chain.
5. Allocation Start Time – UL start time relative to TTG plus an integer number of symbol times.

### 8.3.6.7.1 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.

**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** | 1 bit | Shall be set to 1 for AAS reduced private map |
| **CID Included** | 1 bit | 1 = CID included<br>The CID shall be included in the first compressed private MAP if it was pointed to by a DL-MAP IE with a multicast CID. |
| **DCD Count Included** | 1 bit | 1 = DCD Count included<br>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. |
| If (CID Included) { | | |
| **CID** | 16 bits | |
| } | | |
| If (DCD Count Included) { | | |
| **DCD Count** | 8 bits | |
| } | | |
| If (PHY modification Included) { | | |
| **Preamble Time Shift** | 8 bits | Updated preamble time shift to be used starting with the frame specified by the Frame Offset. |
| } | | |
| **DIUC** | 4 bits | |
| **Preamble Present** | 1 bit | |
| **Start Time** | 11 bits | |
| **Duration** | 10 bits | |
| **Frame Offset** | 3 bits | |
| *Reserved* | 3 bits | |
| **HCS** | 8 bits | |
| } | | |

**Compressed map indicator**
> A value of binary 11 in this field indicates the presence of a compressed map.

**UL-MAP appended**
> A value of 1 indicates a reduced compressed private UL-MAP (see 8.3.6.7.2) is appended to the current private DL-MAP data structure.

**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 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

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

**Preamble Time Shift**
> The preamble time shift for subsequent DL allocations, as defined in 8.6.3.2.7.

**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.

**Preamble Present**
> If set, the indicated burst shall start with the short preamble.

**Start Time**

      Indicates the start time, in units of symbol duration, relative to the beginning of the downlink frame referred to by the 'Frame Offset' field (including preamble). The time instants indicated by the Start Time values are the transmission times of the first symbol of the burst including preamble (if present).

**Duration**

      Indicates the duration, in units of OFDM symbols, of the allocation. The duration is inclusive of the preamble contained in the allocation.

**Frame Offset**

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

**HCS**

      A HCS value, as defined in 6.3.2.1.1, is appended to the end of the compressed map(s) data. The HCS is computed across all bytes of the compressed map(s) starting with the byte containing the Compressed map indicator and including appended UL-MAP, if present.


### 8.3.6.7.2 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() { | | |
|    UCD Count Included | 1 bit | 1 = UCD Count included.<br>The UCD count should be included in the first allocation of a private map chain. |
|    PHY modification Included | 1 bit | 1 = Preamble time shift included. |
|    Power Control Included | 1 bit | 1 = Power control value included |
|    if (UCD Count Included) { | | |
|      UCD Count | 8 bits | |
|    } | | |
|    if (PHY modification Included) { | | |
|      Preamble Time Shift | 8 bits | Updated preamble time shift to be used starting with the frame specified by the Frame Offset. |
|    } | | |
|    if (Power Control Included) { | | |
|      Power Control | 8 bits | Signed integer in 0.25 dB units |
|    } | | |
|    UIUC | 4 bits | |
|    Start Time | 11 bits | |
|    Duration | 10 bits | |
|    Subchannel Index | 5 bits | |
|    Midamble Repetition Interval | 2 bits | |
|    Frame Offset | 3 bits | |
|    *Reserved* | 2 bits | Set to zero |
|   } | | |
| } | | |


**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 Time Shift**

The preamble time shift for subsequent UL allocations, as defined in 8.6.3.2.7.

**Power Control**

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

**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.

**Start Time**

Indicates the start time of the allocation, in units of symbol duration. This is referenced to the beginning of the frame that is defined by the 'Frame Offset' field, 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.

**Duration**

Indicates the duration, in units of OFDM symbols, of the allocation. The duration is inclusive of the preamble contained in the allocation.

**Subchannel Index**

See table 211.

**Midamble Repetition Interval**

Indicates the preamble repetition interval in OFDM symbols, as defined in 8.3.6.3.

**Frame Offset**

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


*[Add new section 11.8.3.6.6]*

### 11.8.3.6.6 OFDM AAS private map support

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

| Type | Length | Value | Scope |
|------|--------|-------|-------|
| 155 | 1 | bit #0:  regular private map support<br>bit #1:  compressed and reduced private map support<br>bit #2:  Private Map DL frame offset<br>   0: support compressed private maps with Frame Offset = 0<br>   1: support compressed private maps with Frame Offset = 1<br>bit #3:  Private Map UL frame offset<br>   0: support compressed private maps with Frame Offset = 0<br>   1: support compressed private maps with Frame Offset = 1<br>Bits #4-6: private map chain concurrency<br>   0 indicates no limit<br>   1-7 indicate maximum concurrent private map chains<br>Bit #7: reserved | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

- 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.
- The concurrency field indicates how many parallel private map chains can be supported by a SS.