**IEEE 802.15**

**Wireless Specialty Networks (WSN)**

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| Project | IEEE P802.15 Working Group for Wireless Specialty Networks (WSN) | |
| Title | **IEEE 802.16me PtMP MAC changes** | |
| Date Submitted | [16 September 2025] | |
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| Re: | [] | |
| Abstract | [Optimization of the Allocation IE message] | |
| Purpose | [Changes and corrections in 802.16me PtMP MAC] | |
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This document outlines proposed changes to the ieee802.16t standard

1. Allocation Message Format Changes – Modified to reduce overhead.
2. Super frame and Scheduling Window

# Allocation Message Format changes to reduce Overhead

## Bit-Size reduction of Slot Offset and Slots fields in Allocation IE format

The 802.16t standard specifies **fixed bit-sizes** for the Slotoffset and Slots fields in the **Allocation IE** format**.** According to **Table 6-330—Allocation IE format**, both Slot Offset and Slots fields are represented using **10 bits** each, regardless of the actual number of addressable slots in the subframe.

## Extract From P802.16t\_D7.0 1.pdf draft

Table 6-330 Allocation IE format.A white sheet with black text and red text

AI-generated content may be incorrect.

A white sheet with black text

AI-generated content may be incorrect.

## Proposed change

The proposed change employs a dynamic bit-width mechanism for encoding the Slot Offset and Slots fields. Both the BS and MS compute the minimum number of bits required to represent these fields based on the total number of addressable slots in the subframe.

This approach significantly **reduces signaling overhead** by allocating only the necessary number of bits for these fields.

**Calculation Logic**

**Definitions:**

S = Number of slots per subframe (either DL or UL)

C = Number of subchannels in the subchannel group

N = Total number of addressable slots in the group = S × C

**Bit Width Formula:**

Bits\_required = ceil(log2​(N))

Both BS and MS compute this identically, ensuring consistent decoding and encoding.

**Examples**

1. Single Subchannel (C = 1), 10 Slots (S = 10):

N = 10×1 = 10

Bits required = ceil(log2(10)) = 4

2. Two Subchannels (C = 2), 10 Slots (S = 10):

N = 10×2 = 20

Bits required = ceil(log2(20)) = 5

3. General Case:

For C = 15, S = 4:

N = 15×4 = 60

Bits required = ceil(log2(60)) = 6

### Proposed Allocation IE format (proposed change are highlighted RED)

|  |  |  |
| --- | --- | --- |
| Syntax | Size  (Bit) | Notes |
| Allocation \_IE () { | \_\_ | \_\_ |
| Direction | 1 | 0: Downlink, 1: Uplink  1: Uplink |
| DIUC/UIUC | 4 | DIUC or UIUC, based on Direction |
| Repetition | 3 | Values 0 to 7. Repetition factor is 2^value. |
| CID | 8 | Connection Identifier |
| If(DIUC/UIUC == 0/1/2/3/4/5/6) { |  | DIUC/UIUC is set to MCS , Data allocations |
| { |  |  |
| Allocation Type | 1 | 0: Instantaneous/Bulk  1: SPS |
| Frame offset | 3 | Start frame offset (used for UL Allocations and SPS for DL-UL) |
| if ((Allocation Type == Instantaneous) || (Allocation Type == Bulk) { |  |  |
| Allocation bitmap | 8 | Indicates the presence/absence of allocation within the frames of the super frame. One bit is assigned to each frame in the super frame.  1: present  0: absent.  MSB Bit 7 is mapped to the first frame of the super frame and bit 0 is mapped to the last frame. |
| for each (active frame) { |  | Active frames are the sum of allocated frames within the super frame (sum of all 1s in the allocation bitmap) |
| Slot offset | variable | Slot offset within the frame.  variable bits size = CEIL(LOG2 (N)) , where N = total addressable slots |
| Slots | variable | Allocated slots.  variable bits size = CEIL(LOG2 (N)) , where N = total addressable slots |
| } |  |  |
| } |  |  |
| else if (Allocation Type == SPS) { |  |  |
| Slot offset | variable | Slot offset within the frame.  variable bits size = CEIL(LOG2 (N)) , where N = total addressable slots |
| Slots | variable | Allocated slots.  variable bits size = CEIL(LOG2 (N)) , where N = total addressable slots |
| Interval | 4 | Number of frames in the interval. Ranges from 1 to 15 frames |
| } |  |  |
| } else { |  | DIUC/UIUC is not set to MCS , other allocation IEs |
| If (Direction==0) { |  | Downlink |
| If(DIUC == 7) { |  |  |
| Extended-2 DIUC dependent IE } |  |  |
| else if (DIUC == 8) { |  |  |
| Extended DIUC dependent IE } | *variable* | See 8.4.5.3.2 and 8.4.5.3.2.1 |
| } else { |  | Uplink |
| if (UIUC == 7) { |  |  |
| SubchannelGroup Relocation IE } |  | Table 6-334 |
| else if (UIUC == 8) { |  |  |
| Power Correction} | 8 | In a step of 0.25 dB |
| else if (UIUC == 9) |  | BR/periodic ranging over one symbol |
| else if (UIUC == 10) { |  |  |
| Extended UIUC 2 dependent IE } | *variable* | See 8.4.5.4.34.2 |
| else if (UIUC == 11) |  | Initial ranging/Handover Ranging over two  symbols |
| else if (UIUC == 12) { |  |  |
| PAPR\_Reduction\_and\_Safety\_Zone\_\_IE } | 8 |  |
| else if (UIUC == 13) { |  |  |
| CDMA\_Allocation\_IE() } | 20 |  |
| else if (UIUC == 14) { |  |  |
| Extended UIUC-dependent IE } | *variable* | See 8.4.5.4.34.1 |
| } |  |  |
| } |  |  |
| } |  |  |

### Summary

Both BS and MS use the same logic to compute the number of bits required for slotoffset and slots, ensuring consistency and compatibility.

Since these parameters (Slotoffset and Slots) are repeated across multiple IEs—**and repeated within each Allocation IE for every active frame in the case of Bulk or Instantaneous allocation**—**reducing their bit-width can result in significant overall bandwidth savings**.

By making the bit-width adaptive to the actual number of slots in the configuration, this approach optimizes bandwidth usage, especially when there are large number of IEs.

# Super frame and Scheduling window

The 802.16t standard does not mention a Scheduling Window; instead, it uses the term Superframe, which serves a similar purpose of looking ahead into multiple frames for scheduling and control. Refer to section **6.3.37.4.3** Frame duration and Super-frame duration and **6.3.37.4.6 BS Scheduler** of **P802.16t\_D7.0 1.pdf** document.

## Extract From P802.16t\_D7.0 1.pdf draft

**6.3.37.4.6 BS Scheduler**

The BS scheduler shall schedule future frames as follows:

— Instantaneous allocations within a time spanning one super-frame.

— NB-UGS/SPS occurring across superframes within the validity period.

— Bulk allocations within an interval that spans one superframe may be one-time or repetitive with

validity period.

## Proposed Change

By defining the term **'scheduling window'**, we can revise the paragraph to reflect this terminology.

Here is the revised paragraph.

**6.3.37.4.6 BS Scheduler**

The BS scheduler is capable of scheduling into the future. The number of future frames over which the BS scheduler allocates resources is called the scheduling window. The Allocation message shall carry the DL and UL allocation information for all the frames in the scheduling window.

The BS scheduler shall schedule future frames as follows:

— **Instantaneous allocations** that occur within the duration of the scheduling window.  
— **NB-UGS/SPS allocations** that occur within their defined validity period.  
— **Bulk allocations** that occur within the scheduling window, which may be either one-time or repetitive, with a specified validity period.

## Description of Proposed implementation

Super frame is fixed one second in duration and it’s used for synchronization between AIRM (BSC) and the BSs. Between BS and remotes , proposed implementation uses a different term called “scheduling window”. The scheduling window size or duration can be dynamically varying depending on the traffic scenarios.

Even though both **Superframe** and **Scheduling Window** both involve looking into multiple frames in the future, they are indeed **fundamentally different** in **purpose** in proposed implementation**.**

## Summary

| **Term** | **Duration** | **Purpose** | **Flexibility** | **Used Between** |
| --- | --- | --- | --- | --- |
| **Superframe** | Static (1 second) | System synchronization , interference management and resource assignment planning over frames lasting for a second. | Fixed | AIRM ↔ BS |
| **Scheduling Window** | Dynamic and adaptive | Resource allocation planning over multiple frames | Dynamic | BS ↔ Remotes |