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| --- | --- |
| Project | **IEEE 802.16 Broadband Wireless Access Working Group <**<http://ieee802.org/16>**>** |
| Title | **Proposed Amendments to IEEE Std 802.16-2012 to Support <1.25 MHz Channels** |
| Date Submitted | **2017-01-12** |
| Source(s) | Doug Gray, EPRI | E-mail: dgray.tcs@gmail.com\*<<http://standards.ieee.org/faqs/affiliationFAQ.html>> |
| Re: | IEEE 802.16s GRIDMAN Task Group Discussions  |
| Abstract | Draft of proposed amendments to IEEE Std 802.16-2012 as amended by 802.16n, p, and q. This revision combines proposed modifications for both MAC and PHY layers into a single document |
| Purpose | This document is intended to facilitate the GRIDMAN Task Group discussions leading to a consensus on proposed amendments to IEEE Std 802.16 in support of channel BWs <1.25 MHz |
| Notice | *This document does not represent the agreed views of the IEEE 802.16 Working Group or any of its subgroups*. It represents only the views of the participants listed in the “Source(s)” field above. It is offered as a basis for discussion. It is not binding on the contributor(s), who reserve(s) the right to add, amend or withdraw material contained herein. |
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IEEE Standard for Air Interface for

Broadband Wireless Access Systems—

Draft Amendment 802.16s:
Support for Channel Bandwidths Less Than 1.25 MHz

3. Definitions

*Add the following definition:*

**Band AMC:** aka ‘adjacent subcarrier permutation’ is a permutation scheme in which the entire channel is split into non-overlapping groups of nine contiguous physical subcarriers each group comprising one pilot subcarrier and eight data subcarriers.

**6.3.2.1 MAC header formats**

*Change the paragraph as indicated:*

The MAC header formats are defined in Table 6-1 except for the MAC header formats for DL MAP and UL MAP MAC messages for channel bandwidth less than 1.25 MHz in which case the MAC header formats are defined in paragraph 6.3.2.1.1.2.

*Insert the following subclause:*

**6.3.2.1.1.2 MAC header format for DL MAP and UL MAP MAC messages when the channel bandwidth is <1.25 MHz**

The header of the DLMAP MAC message shall be of the format defined in Table 6-6. the DLMAP is always the first burst in the DLSF so it can be identified as DLMAP directly. CID indication is therefore not needed at the receiver side .The modified GMAC header consists of 1 byte length field and 1 byte for HCS field.

*Insert Table 6-6 as indicated:*

Table 6-6 - Modified DLMAP header for channel bandwidths <1.25 MHz

|  |  |
| --- | --- |
| LEN (8) | HCS (8) |

The header of the ULMAP MAC message shall be of the format defined in Table 6-Y. The ULMAP, if present, is the first data burst in the DLSF after DL-MAP, but it may not always be present in a frame in which case, the first burst may carry data traffic. Conflict will be avoided by setting HT = 1 to identify the burst as ULMAP.

The modified UL MAP has reserved 7 bits for ULMAP length indication as it cannot exceed 128 bytes.

*Insert Table 6-7 as indicated:*

Table 6-7: Modified ULMAP header for channel bandwidths <1.25 MHz

|  |  |  |
| --- | --- | --- |
| HT (1) | LEN (7) | HCS(8) |

**6.3.2.3 MAC management messages**

*Change the following paragraph as indicated:*

A set of MAC management messages are defined. These messages shall be carried in the Payload of the MAC PDU. All MAC management messages except for DL MAP and UL MAP messages for channel bandwidth <1.25 MHz, begin with a Management Message Type field and may contain additional fields. MAC management messages on the basic, broadcast, and initial ranging connections shall be neither fragmented nor packed. MAC management messages on the primary management connection may be packed and/or fragmented. MAC management messages on the fragmentable broadcast connection may be fragmented. For the OFDM, and OFDMA PHYs, management messages carried on the initial ranging, broadcast, fragmentable broadcast, basic, and primary management connections shall have CRC usage enabled. The format of the management messages except for DL MAP and UL MAP messages for channel bandwidth below 1.25 MHz is given in Figure 6-27. The DL MAP and UL MAP MAC messages for channel bandwidth <1.25 MHz do not include a management type field. The encoding of the Management Message Type field is given in Table 6-51. MAC management messages shall not be carried on transport connections. MAC management messages that have a Type value specified in Table 6-51 as reserved, or those not containing all required parameters or containing erroneously encoded parameters, shall be silently discarded. In case of MAC management messages with multiple presentations of the same TLV and/or encoded parameter information, the last presentation shall be used, unless otherwise specified that multiple presentations are allowed (e.g., Downlink\_Burst\_Profile TLV in DCD message), in which case all presentations shall be used.

*Note: The following Table numbers in clause 6 will increase by 2 to account for added tables 6-6 and 6-7*

**6.3.2.3.2 DL-MAP (Downlink map) message**

The DL-MAP message defines the access to the DL information. If the length of the DL-MAP message is a nonintegral number of bytes, the LEN field in the MAC header is rounded up to the next integral number of bytes. The message shall be padded to match this length, but the SS shall disregard the 4 pad bits. The DL-MAP message format is shown in Table 6-53a for channel bandwidths ≥1.25 MHz and in Table 6-53b for channel bandwidths <1.25 MHz

*Change title for Table 6-53 as indicated:*

**Table 6-53a—DL-MAP message format for channel bandwidths ≥1.25 MHz**

*Change following paragraph as indicated:*

A BS shall generate DL-MAP messages in the format shown in Table 6-53a, including all of the following parameters:

*Insert Table 6-53b as indicated:*

**Table 6-53b—DL-MAP message format for channel bandwidth <1.25 MHz**

|  |  |  |
| --- | --- | --- |
| **Syntax** | **Size** | **Notes** |
| **(bit)** |
|  |  |
|  |  |  |
| DL-MAP\_Message\_Format() { | — | — |
|  |  |  |
| 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 | Padding to reach byte boundary. |
|  |  |  |
| } | — | — |
|  |  |  |
| } | — | — |
|  |  |  |

**6.3.2.3.4 UL-MAP (UL map) message**

*Change the paragraph as indicated:*

The UL-MAP message allocates access to the UL channel. The UL-MAP message shall be as shown in Table 6-55a for channel bandwidths ≥1.25 MHz and in Table 6-55b for channel bandwidths <1.25 MHz.

*Change Table 6-55 title as indicated:*

**Table 6-55a—UL-MAP message format for channel bandwidths ≥1.25 MHz**

*Insert Table 6-55b as indicated:*

**Table 6-55b—UL-MAP message format for channel bandwidths <1.25 MHz**

|  |  |  |
| --- | --- | --- |
| **Syntax** | **Size** | **Notes** |
| **(bit)** |
|  |  |
|  |  |  |
| UL-MAP\_Message\_Format() { | — | — |
|  |  |  |
| 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 | Padding to reach byte boundary. |
|  |  |  |
| } | — | — |
|  |  |  |
| } | — | — |
|  |  |  |

*Change the 6.3.3.5.2 heading as indicated:*

**6.3.3.5.2 CRC32 calculation for OFDMA mode for DL MAP and UL MAP Messages for channel bandwidths ≥1.25 MHz.**

*Add the following subclause:*

**6.3.3.5.3 CRC8 calculation for OFDMA mode for DL MAP and UL MAP messages for channel bandwidths <1.25 MHz.**

The data (input) bytes shall not be flipped as in OFDM mode.

The CRC8 shall be calculated using the following standard generator polynomial of degree 8:

$$G\left(X\right)=X^{8}+ X^{2 }+X+1$$

Where the hexadecimal representation of truncated *G*(X) is 0x07

At the transmitter the following procedure is applied:

1. At the receiver the initial remainder is preset to all 0s and the input bytes shall be fed into thr CRC engine MSB first. Initial value of CRC register is 0
2. The first bit of the first field (MSB of the first byte of the MAC header) corresponds to the *XN*–1 term and the last bit of the last field corresponds to the *X*0 term, where *N* is the number of bits in the input data sequence.
3. The resulting polynomial multiplied by *X8* divided by *G(X)* is
4. The remainder bit sequence is complemented
5. The 8 bits of the CRC value are placed in the CRC field
6. When divided by *G(X),* this polynomial shall result in the absence of transmission errors in a zero remainder value

**8.1.3 Duplexing techniques and PHY Type parameter encodings**

*Change the following paragraph as indicated:*

Both FDD and TDD are supported. The duplexing method shall be reflected in the PHY Type parameter (11.4.1) as shown in Table 8-2. For channel bandwidths less than 1.25 MHz only TDD shall be supported.

**8.1.4.4.7 DL modulation**

*Change the following paragraphs as indicated:*

To maximize utilization of the airlink, the PHY uses a multilevel modulation scheme. The modulation constellation can be selected per subscriber based on the quality of the RF channel. If link conditions permit, then a more complex modulation scheme can be utilized to maximize airlink throughput while still allowing reliable data transfer. If the airlink degrades over time, possibly due to environmental factors, the system can revert to the less complex constellations to allow more reliable data transfer.

In the DL, the BS shall support QPSK and 16-QAM modulation and, optionally, 64-QAM for channel BWs ≥1.25 MHz and shall support QPSK, 16-QAM, and 64QAM for channel BWs <1.25 MHz

**8.1.5.3.7 UL modulation**

*Change the following paragraph as indicated:*

The modulation used on the UL channel shall be variable and set by the BS. QPSK shall be supported, while 16-QAM and 64-QAM are optional for channel BWs ≥1.25 MHz and QPSK, 16-QAM, and 64QAM shall be supported for channel BWs <1.25 MHz, with the mappings of bits to symbols identical to those described in 8.1.4.4.7.

**8.4.2.3 Primitive parameters**

*Change the following paragraph as indicated:*

The following four primitive parameters characterize the OFDMA symbol:

—*BW:* The nominal channel bandwidth.

—*N*used: Number of used subcarriers (which includes the DC subcarrier).

—*n*: Sampling factor. This parameter, in conjunction with *BW* and *N*used determines the subcarrier spacing and the useful symbol time. This value is set as follows: for channel bandwidths that are a multiple of 1.75 MHz, then *n* = 8/7; else, for channel bandwidths that are a multiple of any of 1.25, 1.5, 2, or 2.75 MHz, then *n* = 28/25; then 28/25 for channel BWs 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00, 1.05, 1.10, 1.15, 1.20 MHz, then 55/25 for channel BWs 0.35, 0.40, 0.45, 0.50 MHz, then 82/25 for channel BWs 0.20, 0.25, 0.30 MHz then 109/25 for channel BWs 0.10, 0.15 MHz else, for channel bandwidths >1.25 MHz not otherwise specified, then *n* = 8/7.

—*G*: This is the ratio of CP time to “useful” time. The following values shall be supported: 1/32, 1/16, 1/8, and 1/4.

**8.4.5.1 DL-MAP PHY Synchronization field**

**8.4.5.2 Frame duration codes**

*Change the contents of Table 8-113 as indicated:*

**Table 8-113—OFDMA frame duration (*TF* ms) codes**

|  |  |  |
| --- | --- | --- |
| **Code (N)** | **Frame duration (ms)** | **Frames per second** |
| 0 | *Reserved* | N/A |
| 1 | 2 | 500 |
| 2 | 2.5 | 400 |
| 3 | 4 | 250 |
| 4 | 5 | 200 |
| 5 | 8 | 125 |
| 6 | 10 | 100 |
| 7 | 12.5 | 80 |
| 8 | 20 | 50 |
| 9 | 25 | 40 |
| 10 | 40 | 25 |
| 11 | 50 | 20 |
| 12-254 | *Reserved* |
| 255 | *Infinity* | 0 |

**8.4.5.3 DL-MAP IE format**

*Change the following paragraph as indicated:*

The OFDMA DL-MAP IE defines a two-dimensional allocation pattern as defined in Table 8-114a for channel bandwidths ≥ 1.25 MHz and Table 8-114b for channel bandwidths <1.25 MHz.

*Change the title for Table 8-114 as indicated:*

**Table 8-114a—OFDMA DL-MAP IE format for channel bandwidths ≥1.25 MHz**

**Repetition Coding Indication**

Indicates the repetition code used inside the allocated burst. Repetition shall be used only for DIUC indicating QPSK modulation.

*Insert Table 8-114b as indicated:*

**Table 8-114b—OFDMA DL-MAP IE format for channel bandwidths <1.25 MHz**

|  |  |  |
| --- | --- | --- |
| **Syntax** | **Size** | **Notes** |
| **(bit)** |
|  |  |
|  |  |  |
| DL-MAP\_IE() { | — | — |
|  |  |  |
| **DIUC** | 4 | — |
|  |  |  |
| if (DIUC == 14) { | — | — |
|  |  |  |
| **Extended-2 DIUC dependent IE** | — | — |
|  |  |  |
| } Else if (DIUC == 15) { | — | — |
|  |  |  |
| **Extended DIUC dependent IE** | *variable* | See 8.4.5.3.2 and 8.4.5.3.2.1 |
|  |  |  |
| } else { | — | — |
| **No of slots** | 8 | — |
| } | — | — |
|  |  |  |

*Insert the following after Table 8-114:*

**DIUC**

DIUC used for the burst.

**CID**

The connection identifier that represents the assignment of the IE to a broadcast, multicast, or unicast address.

**No. of slots**

The number of slots that are used to carry the DL PHY burst.

**8.4.5.3.1 DIUC allocation**

*Change the following paragraph as indicated:*

Table 8-115a defines the DIUC encoding that shall be used in the DL-MAP IEs for channel bandwidths ≥ 1.25 MHz and Table 8-115b for channel bandwidths <1.25 MHz.

*Change the title for Table 8-115 as indicated:*

**Table 8-115a—OFDMA DIUC values for channel bandwidths <1.25 MHz**

*Insert Table 8-115b as indicated:*

**Table 8-115b—OFDMA DIUC values for channel bandwidths <1.25 MHz**

|  |  |
| --- | --- |
| **DIUC** | **Usage** |
|  |  |
| 0–12 | Different burst profiles including QPSK ½ repetition 2 |
|  |  |
| 13 | Reserved |
|  |  |
| 14 | Extended-2 DIUC IE |
|  |  |
| 15 | Extended DIUC |

**8.4.5.4 UL-MAP IE format**

*Change the following paragraphs as indicated:*

The OFDMA UL-MAP IE defines UL bandwidth allocations. UL bandwidth allocations are specified either as block allocations (subchannel by symbol) with an absolute offset or as an allocation with duration in slots with either a relative or absolute slot offset. Block allocations are used for fast feedback (UIUC = 0), HARQ ACK CH region (UIUC-11 (Extended-2 UIUC) with Type = 8), CDMA ranging and BR allocations (UIUC = 10 and 12) as well as PAPR/safety zone allocations (UIUC = 13). Slot allocations are used for all other UL bandwidth allocations. For UL allocations in non-AAS zones, the starting position for the allocation is determined considering the prior allocations appearing in the UL-MAP. For UL allocations in an AAS UL zone, the starting position is included in the UL IE indicating an absolute slot offset from the beginning of the AAS zone. If an OFDMA UL-MAP IE with UIUC = 0 or UIUC = 11, (Extended-2) with Type = 8 or UIUC = 10 or UIUC = 12 or UIUC = 13 exists, it shall always be allocated first. In FDD/H-FDD, if uplink allocation is made for FDD MSs in the other UL Group (that is, the UL Group different from the UL-MAP belongs to), OFDMA UL-MAP IE with UIUC 11 with Type = 13 shall be used to notify that allocation.

For the first OFDMA UL-MAP IE with UIUC other than 0, UIUC = 11 (Extended-2) with Type = 8, or UIUC = 10 or UIUC = 12, or UIUC = 13, the allocation shall start at the lowest numbered nonallocated subchannel on the first nonallocated OFDMA symbol defined by the Allocation Start Time field of the UL-MAP message that is not allocated with UIUC = 0 or UIUC = 11 (Extended-2) with Type = 8 or UIUC = 12 or UIUC = 13 (see Figure 8-45 for an example). These IEs shall represent the number of slots provided for the allocation. For allocations not in an AAS zone, each allocation IE shall start immediately following the previous allocation and shall advance in the time axis. If the end of the UL zone has been reached, the allocation shall continue at the next subchannel at first OFDMA symbol allocated to that zone that is not allocated with UIUC = 0 or UIUC = 11 (Extended-2) with Type = 8 or UIUC = 10 or UIUC = 12 or UIUC = 13. A UIUC shall be used to define the type of UL access and the burst type associated with that access. A burst descriptor shall be specified in the UCD for each UIUC to be used in the UL-MAP. For further details on allocations in an UL AAS zone, see 8.4.4.7.

The format of the UL-MAP IE is defined in Table 8-172a IEs for channel bandwidths ≥ 1.25 MHz and Table 8-172b for channel bandwidths <1.25 MHz.

*Change the title for Table 8-172 as indicated:*

**Table 8-172a—OFDMA UL-MAP IE format for channel bandwidths ≥1.25 MHz**

*Insert Table 8-172b as indicated:*

**Table 8-172b—OFDMA UL-MAP IE format for channel bandwidths <1.25 MHz**

| **Syntax** | **Size** | **Notes** |
| --- | --- | --- |
| **(bit)** |
|  |  |
|  |  |  |
| UL-MAP\_IE() { | — | — |
|  |  |  |
| **CID** | 16 | — |
|  |  |  |
| **UIUC** | 4 | — |
| if (UIUC == 9) { | — | — |
| **Power Correction**  | 8 | In a step of .25 dB |
|  } | — | — |
|  else if (UIUC == 10) { |  |  |
|  |  | BR/periodic ranging over one symbol |
|  } |  |  |
| Else if (UIUC == 11) { |  |  |
|  |  |  |
| **Extended UIUC 2 dependent IE** | *variable* | See 8.4.5.4.34.2 |
|  |  |  |
| } | — | — |
|  |  |  |
| else if (UIUC == 12) { | — | — |
|  |  |  |
|  |  | Initial ranging/Handover Ranging over two |
|  |  | symbols |
|  |  |  |
| } else if (UIUC == 13) { | — | — |
|  |  |  |
| **PAPR\_Reduction\_and\_Safety\_-** | 8 |  |
| **Zone\_ \_IE** |  |  |
|  |  |  |
| } else if (UIUC == 14) { | — | — |
|  |  |  |
| **CDMA\_Allocation\_IE()** | 20 | — |
|  |  |  |
| } else if (UIUC == 15) { | — | — |
|  |  |  |
| **Extended UIUC-dependent IE** | *variable* | See 8.4.5.4.34.1. |
|  |  |  |
| } else if (UIUC == 0) { | — | — |
|  |  |  |
| **FAST-FEEDBACK\_Allocation\_IE()** | 32 | — |
|  |  |  |
| } else { | — | — |
|  |  |  |
| **Duration** | 10 | In OFDMA slots (see 8.4.3.1). |
|  |  |  |

**8.4.5.4.1 UIUC allocation**

*Change the title for Table 8-173 as indicated:*

**Table 8-173a—OFDMA UIUC values for channel bandwidths ≥1.25 MHz**

*Insert Table 8-173b as indicated:*

**Table 8-173b—OFDMA UIUC values for channel bandwidths <1.25 MHz**

|  |  |
| --- | --- |
| **UIUC** | **Usage** |
| 0 | Fast-feedback channel |
|  |  |
| 1–8 | Different burst profiles (Data Grant Burst Type) Including QPSK ½ with repetition 2 |
| 9 | Power control IE |
| 10 | CDMA BR/PR |
| 11 | Extended UIUC 2 IE |
|  |  |
| 12 | CDMA Initial ranging/Handover ranging |
|  |  |
| 13 | PAPR reduction allocation, safety zone, Sounding Zone |
|  |  |
| 14 | CDMA Allocation IE |
|  |  |
| 15 | Extended UIUC |

**8.4.5.4.2 PAPR Reduction/Safety Zone/Sounding Zone Allocation IE**

*Change the title for Table 8-174 as indicated:*

**Table 8-174a—PAPR Reduction/Safety Zone/Sounding Allocation IE format for channel bandwidths ≥1.25 MHz**

*Insert Table 8-174b as indicated*

**Table 8-174b—PAPR Reduction/Safety Zone/Sounding Allocation IE format for channel bandwidths <1.25 MHz**

**Table 8-174b—PAPR Reduction/Safety Zone Zone Allocation IE format**

|  |  |  |  |
| --- | --- | --- | --- |
| **Syntax** | **Size** |  | **Notes** |
| **(bit)** |  |
|  |  |  |
|  |  |  |
| PAPR\_Reduction\_Safety\_ \_IE() { | — | — |
|  |  |  |
| **OFDMA symbol offset** | 8 | — |
|  |  |  |

**8.4.5.4.3 CDMA Allocation UL-MAP IE format**

Table 8-175a and Table 8-175b define~~s~~ the UL-MAP IE for allocation of bandwidth to a user that requested bandwidth using a CDMA request code. This IE is identified by UIUC =14.

*Change the title for Table 8-175 as indicated:*

**Table 8-175a—CDMA Allocation IE format for channel bandwidths ≥1.25 MHz**

*Insert Table 8-175b as indicated*

**Table 8-175b—CDMA Allocation IE format for channel bandwidths <1.25 MHz**

|  |  |  |
| --- | --- | --- |
| **Syntax** | **Size** | **Notes** |
| **(bit)** |
|  |  |
|  |  |  |
| CDMA\_Allocation\_IE() { | — | — |
|  |  |  |
| **Duration** | 4 | — |
|  |  |  |
| **UIUC** | 4 | UIUC for transmission |
|  |  |  |
| **Frame Number Index** | 4 | LSBs of relevant frame number |
| **Ranging Code** | 8 | — |

|  |  |
| --- | --- |
|  |  |

**8.4.6.1 Downlink**

**8.4.6.1.1 Preamble**

The first symbol of the DL transmission is the preamble. For each FFT size, three different preamble carrier-sets are defined, differing in the allocation of subcarriers. Those subcarriers are modulated using a boosted BPSK modulation with a specific pseudo-noise (PN) code.

*Change the following paragraph as indicated:*

For 128-FFT size, the PN series modulating the preamble carrier-set is defined in Table 8-302. For the preamble symbol, there will be 10 guard band subcarriers on each side of the spectrum resulting in 108 subcarriers for the DL preamble. To support channel bandwidths from 100 kHz to 500 kHz with sampling factors defined in 8.4.2.3 it shall be necessary to scale the DL preamble to one-half, one-third, and one-quarter, 54, 36, and 27 subcarriers respectively.

The modulation used on the preamble is defined in 8.4.9.4.3.1.

*Insert paragraph after Table 8-302*

Scaled DL preambles in support of smaller channel bandwidths are defined:

* **1/4- DL Preample**: Each of the 114 possible candidates in Table 8-302 are of length 36, the first 27 bits can be mapped into 27 consecutive subcarriers
* **1/3-DL Preamble**: The following 34 sequences satisfy the PAPR constraint of less than 4 dB, while ensuring the auto and cross correlation gains are better than 3 dB; 5, 8, 11, 12, 16, 20, 22, 28, 31, 32, 33, 41, 43, 47, 50, 52, 57, 58, 59, 63, 72, 76, 77, 78, 85, 88, 90, 91, 94, 96, 100, 101, 102, 103. Adding 1 zero to either side provides a length 36 sequence.
* **1/2-DL Preamble**: Adding an additional 8 zeros to either side of the 1/3-DL Preamble provides a length 54 sequence

The following 12 sequences meet both the constraints: **17, 21, 25, 35, 38, 39, 45, 73, 87, 88, 89, and 97.**

**8.4.6.2 Uplink (UL)**

**8.4.6.3 Optional adjacent subcarrier permutations for AMC**

*Change the following paragraph as indicated:*

A BS may change from the distributed subcarrier permutation, described in 8.4.6.1 and 8.4.6.2, to the adjacent subcarrier permutation when changing from non-AAS to AAS-enabled traffic to support AAS adjacent subcarrier user traffic in the cell. Alternatively, the adjacent subcarrier permutation can be used to take advantage of the structure of the adjacent subcarrier permutation in parts of the DL subframe that are indicated accordingly by the DL-MAP and UL subframe that are indicated accordingly by the UL-MAP. After this change, the BS shall only transmit/receive traffic using the adjacent subcarrier permutation during the allocated period. The BS shall always return to the distributed subcarrier permutation at the beginning of a new DL subframe for channel bandwidth ≥1.25 MHz but not for channel bandwidth <1.25 MHz. Note that an AAS-enabled SS, which does not provision the same permutation (PUSC/FUSC or adjacent) for AAS traffic selected by the BS for this purpose, is not capable of using its AAS capabilities with this BS.

**8.4.7.3 Ranging codes**

*Insert new subclause 8.4.7.3.1 as follows:*

**8.4.7.3.1 Ranging codes for reduced subcarriers for channel bandwidths from 100 kHz to 500 kHz**

CDMA Code set #1

CDMA Code set #1 consists of 96 bit sequences generated by truncating the original 144 bit code sequences bits. The 96 bit code sequences are spread across 4 symbols (27x4) for periodic ranging and repeated over 8 symbols (27x4, 27x4) for initial ranging. A length 27 sequence is created by splitting length-96 into 4 parts and each part length-24 is appended with 3 zeros to make length-27 for each symbol. This is described in figure 8-9a.

**Figure 8-9a: Band AMC 27 subcarrier MAP for initial and periodic ranging**

CDMA Code set #2

CDMA Code set #2 consists of 96 bit sequences generated by truncating the original 144 bit code sequences bits. The 96 bit code sequences are spread across 3 symbols (27x3) for periodic ranging and repeated over 6 symbols (27x3, 27x3) for initial ranging. A length 36 sequence is created by splitting length-96 into 3 parts and each part length-32 is appended with 4 zeros to make length-36 for each symbol. This is described in figure 8-9b.

**Figure 8-9b: Band AMC 36 subcarrier MAP for initial and periodic ranging**

CDMA Code set #3

CDMA Code set #3 consists of 96 bit sequences generated by truncating the original 144 bit code sequences. The 96 bit code sequences are spread across 2 symbols (54x2) for periodic ranging and repeated over 4 symbols (54x2, 54x2) for initial ranging. A length 54 sequence is created by splitting length-96 into 2 parts and each part length-48 is appended with 6 zeros to make length-54 for each symbol. This is described in figure 8-9c.



**Figure 8-9c: Band AMC 54 subcarrier MAP for initial and periodic ranging**

**8.4.14.1.1 Receiver sensitivity**

*Change Table 8-87 as indicated:*

**Table 8-87-Receiver SNR assumption (BER = 10-6)**

|  |  |  |
| --- | --- | --- |
| **Modulation** | **Coding Rate** | **Receiver SNR (dB)** |
| QPSK | 1/2 | 5 |
| 3/4 | 8 |
| 16QAM | 1/2 | 10.5 |
| 3/4 | 14 |
| 64QAM | 1/2 | 16 |
| 2/3 | 18 |
| 3/4 | 20 |
| 5/6 | 22 |

*Insert new subclause 12.9 as follows:*

12.9 WirelessMAN OFDMA TDD Sub-1.25 MHz Channel Bandwidths

This subclause defines system requirements for systems operating with channel bandwidths less than 1.25 MHz.

To maintain sufficient subcarrier spacing in support of moderate mobility requirements and intercarrier interference requirements, Channel Subgroups 1, 2, and 3 shall use only a subset of the available subchannels. Groups 1 and 2 shall use Band AMC 1x6 permutation (1 subcarrier x 6 symbols). Group 3 and Group 4 shall use Band AMC and either 2x3 or 1x6 permutation.

**Table 12-41a—Profile definitions 0.10 MHz to 0.15 MHz BW Channel Subgroup 1**

| **Identifier** | **Channel Subgroup 1 Description** |
| --- | --- |
| OFDMA\_ProfSM1 | 1/4-DL Preamble-Band AMC-27 subcarrier MAP for initial & periodic ranging |
| OFDMA\_ProfS1 | WirelessMAN-OFDMA 0.10 MHz channel basic PHY TDD profile, AMC 1x6 |
| OFDMA\_ProfS2 | WirelessMAN-OFDMA 0.15 MHz channel basic PHY TDD profile, AMC 1x6 |

**Table 12-41b—Profile definitions 0.20 MHz to 0.30 MHz BW Channel Subgroup 2**

| **Identifier** | **Channel Subgroup 2 Description** |
| --- | --- |
| OFDMA\_ProfSM2 | 1/3-DL Preamble-Band AMC-36 subcarrier MAP for initial & periodic ranging |
| OFDMA\_ProfS3 | WirelessMAN-OFDMA 0.20 MHz channel basic PHY TDD profile, AMC 1x6 |
| OFDMA\_ProfS4 | WirelessMAN-OFDMA 0.25 MHz channel basic PHY TDD profile, AMC 1x6 |
| OFDMA\_ProfS5 | WirelessMAN-OFDMA 0.30 MHz channel basic PHY TDD profile, AMC 1x6 |

**Table 12-41c—Profile definitions 0.35 MHz to 0.50 MHz BW Channel Subgroup 3**

| **Identifier** | **Channel Subgroup 3 Description** |
| --- | --- |
| OFDMA\_ProfSM3 | 1/2-DL Preamble-Band AMC-54 subcarrier MAP for initial & periodic ranging |
| OFDMA\_ProfS6 | WirelessMAN-OFDMA 0.35 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS7 | WirelessMAN-OFDMA 0.40 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS8 | WirelessMAN-OFDMA 0.45 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS9 | WirelessMAN-OFDMA 0.50 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |

**Table 12-41d—Profile definitions 0.55 MHz to 1.20 MHz BW Channel Subgroup 4**

| **Identifier** | **Channel Subgroup 4 Description** |
| --- | --- |
| OFDMA\_ProfSM |

|  |
| --- |
| WirelessMAN-OFDMA basic packet PMP MAC profile for 128FFT |

 |
| OFDMA\_ProfS10 | WirelessMAN-OFDMA 0.55 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS11 | WirelessMAN-OFDMA 0.60 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS12 | WirelessMAN-OFDMA 0.65 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS13 | WirelessMAN-OFDMA 0.70 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS14 | WirelessMAN-OFDMA 0.75 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS15 | WirelessMAN-OFDMA 0.80 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS16 | WirelessMAN-OFDMA 0.85 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS17 | WirelessMAN-OFDMA 0.90 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS18 | WirelessMAN-OFDMA 0.95 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS19 | WirelessMAN-OFDMA 1.00 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS20 | WirelessMAN-OFDMA 1.05 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS21 | WirelessMAN-OFDMA 1.10 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS22 | WirelessMAN-OFDMA 1.15 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |
| OFDMA\_ProfS23 | WirelessMAN-OFDMA 1.20 MHz channel basic PHY TDD profile, AMC 1x6 or 2x3 |

**Table 12-42—Channel Subgroups 1, 2, and 3 details**

|  |  |  |  |
| --- | --- | --- | --- |
| **Channel Subgroup** | **Description** | **Subcarrier Spacing** | **Used subchannels/ Total subchannels** |
| 1 | 0.10 MHz Channel | 3.406 kHz | 1/4 (25%) |
| 0.15 MHz Channel | 5.109 kHz |
| 2 | 0.20 MHz Channel | 5.125 kHz | 1/3 (33.3%) |
| 0.25 MHz Channel | 6.406 kHz |
| 0.30 MHz Channel | 7.688 kHz |
| 3 | 0.35 MHz Channel | 6.016 kHz | 1/2 (50%) |
| 0.40 MHz Channel | 6.875 kHz |
| 0.45 MHz Channel | 7.734 kHz |
| 0.50 MHz Channel | 8.594 kHz |

12.9.1 WirelessMAN-OFDMA Power class profiles

**Table 12-43—Power classes**

|  |  |
| --- | --- |
| **Class Identifier** | **Tx power dBm** |
| Class 1 | 17 ≤ PTx,max < 20 |
| Class 2 | 20 ≤ PTx,max < 23 |
| Class 3 | 23 ≤ PTx,max < 30 |
| Class 4 | 30 ≤ PTx,max |

**Table 12-44a—Minimum performance requirements for subgroup 1 profiles**

| **Capability** | **Minimum performance** |
| --- | --- |
| Channel bandwidth | 0.100 MHz reference |
| Operation mode | Licensed bands |
| BER performance threshold, BER = 10-6 (using all available subchannels)QPSK-1/2QPSK-3/416-QAM-1/216-QAM-3/464-QAM-2/3 64-QAM-3/4 64-QAM-5/6 (if supported)For other channel BWs in this group add 10Log(ChannelBW in MHz/0.100)Add to sensitivity if using less than allowed number of subchannels 10Log(Used subchannels/Allowed subchannels) | ≤-106.3 dBm≤-104.3 dBm≤-101.8 dBm≤ -98.3 dBm≤ -96.3 dBm≤ -94.3 dBm |
| Reference frequency tolerance BS SS-to-BS synchronization tolerance | ≤ ± 1 x 10-6≤ 2 Hz |
| Frame duration code set | {7,8,9,11} |
| Spectrum mask | Local regulation |

**Table 12-44b—Minimum performance requirements for subgroup 2 profiles**

| **Capability** | **Minimum performance** |
| --- | --- |
| Channel bandwidth | 0.200 MHz reference |
| Operation mode | Licensed bands |
| BER performance threshold, BER = 10-6 (using all available subchannels)QPSK-1/2QPSK-3/416-QAM-1/216-QAM-3/464-QAM-2/3 64-QAM-3/4 64-QAM-5/6 (if supported)For other channel BWs in this group add 10Log(ChannelBW in MHz/0.200)Add to sensitivity if using less than allowed number of subchannels 10Log(Used subchannels/Allowed subchannels) | ≤-103.3 dBm≤-101.3 dBm≤ -98.8 dBm≤ -95.3 dBm≤ -93.3 dBm≤ -91.3 dBm |
| Reference frequency tolerance BS SS-to-BS synchronization tolerance | ≤ ± 1 x 10-6≤ 2 Hz |
| Frame duration code set | {6,8,9,11} |
| Spectrum mask | Local regulation |

**Table 12-44c—Minimum performance requirements for subgroup 3 profiles**

| **Capability** | **Minimum performance** |
| --- | --- |
| Channel bandwidth | 0.350 MHz reference |
| Operation mode | Licensed bands |
| BER performance threshold, BER = 10-6 (using all available subchannels)QPSK-1/2QPSK-3/416-QAM-1/216-QAM-3/464-QAM-2/3 64-QAM-3/4 64-QAM-5/6 (if supported)For other channel BWs in this group add 10Log(ChannelBW in MHz/0.350)Add to sensitivity if using less than allowed number of subchannels 10Log(Used subchannels/Allowed subchannels) | ≤-100.8 dBm≤ -98.8 dBm≤ -96.3 dBm≤ -92.8 dBm≤ -90.8 dBm≤ -88.8 dBm |
| Reference frequency tolerance BS SS-to-BS synchronization tolerance | ≤ ± 1 x 10-6≤ 2 Hz |
| Frame duration code set | {4,6,7,8,9} |
| Spectrum mask | Local regulation |

**Table 12-44c—Minimum performance requirements for subgroup 4 profiles**

| **Capability** | **Minimum performance** |
| --- | --- |
| Channel bandwidth | 0.550 MHz ref |
| Operation mode | Licensed bands |
| BER performance threshold, BER = 10-6 (using all available subchannels)QPSK-1/2QPSK-3/416-QAM-1/216-QAM-3/464-QAM-2/3 64-QAM-3/4 64-QAM-5/6 (if supported)For other channel BWs in this group add 10Log(ChannelBW in MHz/0.550)Add to sensitivity if using less than allowed number of subchannels 10Log(Used subchannels/Allowed subchannels) | ≤ -98.8 dBm≤ -96.8 dBm≤ -94.3 dBm≤ -90.8 dBm≤ -88.8 dBm≤ -86.8 dBm |
| Reference frequency tolerance BS SS-to-BS synchronization tolerance | ≤ ± 1 x 10-6≤ 2 Hz |
| Frame duration code set | {4,6,7,8,9} |
| Spectrum mask | Local regulation |

**Additional Material for Discussion Purposes**

**OFDMA frame duration (*TF* ms) codes and channel profiles**

| **Code (N)** | **Frame duration (ms)** | **Frames per second** | **Subgroup 1 0.10-0.15 MHz** | **Subgroup 2 0.20-0.30 MHz** | **Subgroup 3 0.35-0.50 MHz** | **Subgroup 4 0.55-1.20 MHz** |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | *Reserved* | N/A |  |  |  |  |
| 1 | 2 | 500 |  |  |  |  |
| 2 | 2.5 | 400 |   |  |  |  |
| 3 | 4 | 250 |  |  |  |  |
| 4 | 5 | 200 |  |  | X | X |
| 5 | 8 | 125 |  |  |  |  |
| 6 | 10 | 100 |  | X | X | X |
| 7 | 12.5 | 80 | X |  | X | X |
| 8 | 20 | 50 | X | X | X | X |
| 9 | 25 | 40 | X | X | X | X |
| 10 | 40 | 25 |  |  |  |  |
| 11 | 50 | 20 | X | X |  |  |
| 12-254 | *Reserved* |  |  |  |  |
| 255 | *Infinity* | 0 |  |  |  |  |

| **Channel Plan for sub 1.25 MHz Channels** |
| --- |
| **Nominal Channel BW** | **Sampling Factor** | **Sampling Clock Frequency** | **Subcarrier Spacing** | **Permutation (AMC2X3 - 3, AMC1X6 - 6)** | **Total # of****Sub channels** | **% of sub channels used in Network** | **Occupied BW1 (includes DC subcarrier)** | **% Nominal Channel BW1** | **# Data+Pilot Sub carriers** | **Samples per 5 ms Frame** | **Rss2 (QPSK-1/2)** |
| **Group 1** | **Slot definition in DL and UL: AMC 1x6, 1 SC in 6 symbols** |
| 0.100 MHz | 4 9/25  | 0.436 MHz | 3.406 kHz | 6 | 12 | 25.0% | 0.095 MHz | 95.38% | 27 | 2180 | -106.3 dBm |
| 0.150 MHz | 4 9/25  | 0.654 MHz | 5.109 kHz | 6 | 12 | 25.0% | 0.143 MHz | 95.38% | 27 | 3270 | -104.6 dBm |
| ***0.100 MHz Alternative (If 3.406 kHz subcarrier is considered too small)*** |
| *0.100 MHz* | *6 11/25*  | *0.644 MHz* | *5.031 kHz* | *6* | *12* | *16.7%* | *0.096 MHz* | *95.59%* | *18* | *3220* | *-106.4 dBm* |
| **Group 2** | **Slot definition in DL and UL: AMC 1x6, 1 SC in 6 symbols** |
| 0.200 MHz | 3 7/25  | 0.656 MHz | 5.125 kHz | 6 | 12 | 33.3% | 0.190 MHz | 94.81% | 36 | 3280 | -103.3 dBm |
| 0.250 MHz | 3 7/25  | 0.820 MHz | 6.406 kHz | 6 | 12 | 33.3% | 0.237 MHz | 94.81% | 36 | 4100 | -102.3 dBm |
| 0.300 MHz | 3 7/25  | 0.984 MHz | 7.688 kHz | 6 | 12 | 33.3% | 0.284 MHz | 94.81% | 36 | 4920 | -101.5 dBm |
| **Group 3** | **Slot definition in DL and UL: AMC 1x6, 1 SC in 6 symbols, or AMC 2x3, 1 SC in 3 symbols** |
| 0.350 MHz | 2 1/5  | 0.770 MHz | 6.016 kHz | 6 | 12 | 50.0% | 0.331 MHz | 94.53% | 54 | 3850 | -100.8 dBm |
| 0.400 MHz | 2 1/5  | 0.880 MHz | 6.875 kHz | 6 | 12 | 50.0% | 0.378 MHz | 94.53% | 54 | 4400 | -100.3 dBm |
| 0.450 MHz | 2 1/5  | 0.990 MHz | 7.734 kHz | 6 | 12 | 50.0% | 0.425 MHz | 94.53% | 54 | 4950 | -99.8 dBm |
| 0.500 MHz | 2 1/5  | 1.100 MHz | 8.594 kHz | 6 | 12 | 50.0% | 0.473 MHz | 94.53% | 54 | 5500 | -99.3 dBm |
| **Group 4** | **Slot definition in DL and UL: AMC 1x6, 1 SC in 6 symbols, or AMC 2x3, 1 SC in 3 symbols** |
| 0.550 MHz | 1 3/25 | 0.616 MHz | 4.813 kHz | 3 | 6 | 100% | 0.525 MHz | 95.38% | 108 | 3080 | -98.8 dBm |
| 0.600 MHz | 1 3/25 | 0.672 MHz | 5.250 kHz | 3 | 6 | 100% | 0.572 MHz | 95.38% | 108 | 3360 | -98.4 dBm |
| 0.650 MHz | 1 3/25 | 0.728 MHz | 5.688 kHz | 3 | 6 | 100% | 0.620 MHz | 95.38% | 108 | 3640 | -98.1 dBm |
| 0.700 MHz | 1 3/25 | 0.784 MHz | 6.125 kHz | 3 | 6 | 100% | 0.668 MHz | 95.38% | 108 | 3920 | -97.8 dBm |
| 0.750 MHz | 1 3/25 | 0.840 MHz | 6.563 kHz | 3 | 6 | 100% | 0.715 MHz | 95.38% | 108 | 4200 | -97.5 dBm |
| 0.800 MHz | 1 3/25 | 0.896 MHz | 7.000 kHz | 3 | 6 | 100% | 0.763 MHz | 95.38% | 108 | 4480 | -97.2 dBm |
| 0.850 MHz | 1 3/25 | 0.952 MHz | 7.438 kHz | 3 | 6 | 100% | 0.811 MHz | 95.38% | 108 | 4760 | -96.9 dBm |
| 0.900 MHz | 1 3/25 | 1.008 MHz | 7.875 kHz | 3 | 6 | 100% | 0.858 MHz | 95.38% | 108 | 5040 | -96.7 dBm |
| 0.950 MHz | 1 3/25 | 1.064 MHz | 8.313 kHz | 3 | 6 | 100% | 0.906 MHz | 95.38% | 108 | 5320 | -96.4 dBm |
| 1.000 MHz | 1 3/25 | 1.120 MHz | 8.750 kHz | 3 | 6 | 100% | 0.954 MHz | 95.38% | 108 | 5600 | -96.2 dBm |
| 1.050 MHz | 1 3/25 | 1.176 MHz | 9.188 kHz | 3 | 6 | 100% | 1.001 MHz | 95.38% | 108 | 5880 | -96.0 dBm |
| 1.100 MHz | 1 3/25 | 1.232 MHz | 9.625 kHz | 3 | 6 | 100% | 1.049 MHz | 95.38% | 108 | 6160 | -95.8 dBm |
| 1.150 MHz | 1 3/25 | 1.288 MHz | 10.063 kHz | 3 | 6 | 100% | 1.097 MHz | 95.38% | 108 | 6440 | -95.6 dBm |
| 1.200 MHz | 1 3/25 | 1.344 MHz | 10.500 kHz | 3 | 6 | 100% | 1.145 MHz | 95.38% | 108 | 6720 | -95.4 dBm |

1. Must comply with spectral mask for OOBE (FCC part 27) – need to validate
2. Defined as: -174dBm/Hz + NF + Implementation Loss + SNR + 10Log(occupied BW in Hz), where NF= 8dB, ImpLoss = 5dB, and SNR for BER<10-6 = 5dB (per 8.4.14.1.1)