IEEE P802.11
Wireless LANs

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| **Resolution to CID 16624 (HESIGB)** |
| **Date:** 2018-10-17 |

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Abstract

This submission proposes a resolution for the following CID to the HESIGB subclause 28.3.10.8 (**1 CID**):

* 16624

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGax Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGax Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGax Editor: Editing instructions preceded by “TGax Editor” are instructions to the TGax editor to modify existing material in the TGax draft. As a result of adopting the changes, the TGax editor will execute the instructions rather than copy them to the TGax Draft.***

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| --- | --- | --- | --- | --- | --- | --- |
| 16624 | Pooya Monajemi | 28.3.10.8 | 477.28 | Spec is unclear since HESIGB description departs from convention used for every other 802.11 PHY: a) define contents, b) define encoding, c) define modulation | Change order to 28.3.10.8.1, 28.3.10.8.2, existing28.3.10.8.4, existing28.3.10.8.5, existing28.3.10.8.2, then existing28.3.10.8.3. | Revised: See changes in 18/1774r<motionedRevision#> |

***Discussion***

Most TX PHYs are visualized, and often implemented, as a series of blocks that transform the input to the output. The specification of a PHY achieves greatest clarity when it follows this convention. We see this convention pervasively in all the PHY sections of IEEE 802.11. For SIG fields, this convention appears as:

* First, define the fields (the binary data being transmitted)
* Second, define the encoding and interleaving
* Third, define the modulation

However, the current definition of HESIGB does not follow these conventions. In particular, section 28.3.10.8 has the following issues:

* 28.3.10.8.2 defines the field contents at a high level, but does not complete the description
* 28.3.10.8.2 describes the final modulation equation, but before the description of the field contents is complete
* 28.3.10.8.3 mixes information about content with the modulation
* 28.3.10.8.4 and 28.3.10.8.5 return to defining the field contents, which are later than their natural order

***Note to TGax editor and reader: The baseline of this change text is Draft P802.11ax\_D3.1 rtf and visio.zip. Editor instructions are carefully specified to promote consistency with any other (later) comment resolutions.***

**Changes in Rev1:**

1. Added coloring as follows:

*Changes in light green are classified by the author as editorial.*

*Changes in cyan are classified by the author as non-editorial: either a) technical or b) a not-perfectly-simple rewrite of technical matter. It is assumed that the changes align with how people have “read between the lines” in order to disambiguate the draft.*

1. Changed scope of comments so they didn’t overlap the coloring
2. Clarified comments as required, including why editorial vs not.
* **High Efficiency (HE) PHY specification**
* **Introduction**
* **HE PHY service interface**
* **HE PHY**
* **Introduction**
* **Subcarrier and resource allocation**
* **MU-MIMO**
* **HE PPDU formats**
* **Transmitter block diagram**
* **Overview of the PPDU encoding process**
* **HE modulation and coding schemes (HE-MCSs)**
* **Timing-related parameters**
* **HE preamble**
* **Introduction**
* **Cyclic shift**
* **L-STF**
* **L-LTF**
* **L-SIG**
* **RL-SIG**
* **HE-SIG-A**
* **HE-SIG-B**
* **General**

The HE-SIG-B field provides the OFDMA and DL MU-MIMO resource allocation information to allow the STAs to look up the corresponding resources to be used in the data portion of the frame.

***TGax editor: renumber this section to .2 and rename it as shown. Also insert a new first para as shown below.***

* **Format**

The HE-SIG-B field of a 20 MHz HE MU PPDU contains one HE-SIG-B content channel. The HE-SIG-B field of an HE MU PPDU that is 40 MHz or wider contains two HE-SIG-B content channels.

***TGax editor: modify first para of 28.3.10.8.2 and figure caption as shown below***

The format of an HE-SIG-B content channel is shown in Figure 28-25 (HE-SIG-B field encoding structure in each 20 MHz(#16841)). The HE-SIG-B content channel consists of a Common field, if present, followed by a User Specific field.

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| --- |
|  |
| * **Format of one Content Channel of the HE-SIG-B field when a Common field is present(#16841)**
 |

The Common field of an HE-SIG-B content channel contains information regarding the resource unit allocation such as the RU assignment to be used in the data portion in the frequency domain, the RUs allocated for MU-MIMO and the number of users in MU-MIMO allocations. The Common field is described in detail in 28.3.10.8.4 (HE-SIG-B common content).

The User Specific field of an HE-SIG-B content channel consists of zero or more User Block fields followed by padding (if present). Each User Block field is made up of two User fields that contain information for two STAs to decode their payloads. The last User Block field may contain information for one or two STAs depending on the number of users indicated by the RU Allocation field and the Center 26-tone RU field. See 28.3.10.8.5 (HE-SIG-B per user content) for a description of the contents of the User field.

If(#15502) the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 1 (indicating full bandwidth MU-MIMO transmission), the Common field is not present and the HE-SIG-B content channel consists of only the User Specific field.

If(#15503) the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 1 (indicating full bandwidth MU-MIMO transmission) and the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in the HE-SIG-A field of an HE MU PPDU is set to 0 (indicating 1 MU-MIMO user), the User Specific field in the HE-SIG-B field consists of a single User Block field containing one User field for a non-MU-MIMO allocation as shown in Table 28-25 (User field format for a non-MU-MIMO allocation)

***TGax editor: move the sixth and following paragraphs of 28.3.10.8.2 to a (new) section below “Encoding and Modulation” (shown by example below, assuming D3.1).***

***TGax editor: move section 28.3.10.8.4 to here, and renumber it to .3***

* **HE-SIG-B common content**

The Common field in the HE-SIG-B field carries the RU Allocation subfields. Depending on the PPDU bandwidth, the Common field can contain multiple RU Allocation subfields. The format of the Common field is defined in Table 28-23 (Common field).

|  |
| --- |
| * **Common field**
 |
| Subfield | Number of bits | Description |
| RU Allocation | *N* x 8 | Indicates the RU assignment to be used in the data portion in the frequency domain. It also indicates the number of users in each RU. For RUs of size greater than or equal to 106-tones that support MU-MIMO, it indicates the number of users multiplexed using MU-MIMO.Consists of *N* RU Allocation subfields:*N*= 1 for a 20 MHz and a 40 MHz HE MU PPDU*N*= 2 for an 80 MHz HE MU PPDU*N* = 4 for a 160 MHz or 80+80 MHz HE MU PPDU |
| Center 26-tone RU | 1 | This field is present only if(#15510) the value of the Bandwidth field of HE-SIG-A field in an HE MU PPDU is set to greater than 1.If the Bandwidth field of the HE-SIG-A field in an HE MU PPDU is set to 2, 4 or 5 for 80  MHz:Set to 1 to indicate that a user is allocated to the center 26-tone RU (see Figure 28-7 (RU locations in an 80 MHz HE PPDU(#16528))); otherwise, set to 0. The same value is applied to both HE-SIG-B content channels.If the Bandwidth field of the HE-SIG-A field in an HE MU PPDU is set to 3, 6 or 7 for 160 MHz or 80+80 MHz:For HE-SIG-B content channel 1, set to 1 to indicate that a user is allocated to the center 26-tone RU of the lower frequency 80 MHz; otherwise, set to 0.For HE-SIG-B content channel 2, set to 1 to indicate that a user is allocated to the center 26-tone RU of the higher frequency 80 MHz; otherwise, set to 0. |
| CRC | 4 | See 28.3.10.7.3 (CRC computation) |
| Tail | 6 | Used to terminate the trellis of the convolutional decoder. Set to 0 |
| NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position. |

***TGax editor: insert the following text and table as shown***

An RU Allocation subfield in the Common field of HE-SIG-B consists of 8 bits that carries information pertaining to RUs whose subcarrier indices meet the indicated condition in Table xxxa.

Table xxxa: Subcarrier indices addressed by each HE-SIG-B content channel for each PPDU bandwidth

|  |  |  |
| --- | --- | --- |
|  | HE-SIG-B content channel 1 | HE-SIG-B content channel 2 |
| 20 MHz PPDU | Subcarrier indices fall within [-122:122] | - |
| 40 MHz PPDU | Subcarrier indices fall within [244: 3] or overlap them if the RU is larger than 242 subcarriers | Subcarrier indices fall within [3:244] or overlap them if the RU is larger than 242 subcarriers |
| 80 MHz PPDU | First RU Allocation subfield: Subcarrier indices fall within [500:259] or overlap them if the RU is larger than 242 subcarriersSecond RU Allocation subfield: subcarrier indices fall within [17:258] or overlap them if the RU is larger than 242 subcarriers1 bit Center 26-tone RU subfield: fall in [16:4, 4:16].  | First RU Allocation subfield: subcarrier indices fall within [258:17] or overlap them if the RU is larger than 242 subcarriersSecond RU Allocation subfield: subcarrier indices fall within [259:500] or overlap them if the RU is larger than 242 subcarriers1 bit Center 26-tone RU subfield: fall in [16:4, 4:16]. |
| 160 MHz PPDU (and 80+80 MHz excepting that the tone ranges of the upper and lower 80 MHz segments are not contiguous) | First RU Allocation subfield: Subcarrier indices fall within [1012:771] or overlap them if the RU is larger than 242 subcarriersSecond RU Allocation subfield: subcarrier indices fall within [495:254] or overlap them if the RU is larger than 242 subcarriersThird RU Allocation subfield: Subcarrier indices fall within [12:253] or overlap them if the RU is larger than 242 subcarriersFourth RU Allocation subfield: subcarrier indices fall within [529:770] or overlap them if the RU is larger than 242 subcarriers1 bit Center 26-tone RU subfield: fall in [528:516, 508:496].  | First RU Allocation subfield: Subcarrier indices fall within [770:529] or overlap them if the RU is larger than 242 subcarriersSecond RU Allocation subfield: subcarrier indices fall within [253:12] or overlap them if the RU is larger than 242 subcarriersThird RU Allocation subfield: Subcarrier indices fall within [254:495] or overlap them if the RU is larger than 242 subcarriersFourth RU Allocation subfield: subcarrier indices fall within [771:1012] or overlap them if the RU is larger than 242 subcarriers1 bit Center 26-tone RU subfield: fall in [496:508, 516:528].. |

***TGax editor: move the following sentences from 28.3.10.8.3 to here (shown here as insertions then insert the highlighted text)***

If a single RU in an 40 MHz PPDU overlaps with more than one of the tone ranges [] or [3:244], it shall have an RU allocation subfield in the respective content channels for each of the ranges with which it overlaps.

If a single RU in an 80 MHz PPDU overlaps with more than one of the tone ranges [500:259], [258:17], [17:258] or [259:500], it shall have an RU allocation subfield in the respective content channels for each of the ranges with which it overlaps.

If a single RU in a 160 MHz PPDU overlaps with more than one of the tone ranges [1012:771], [770:529], [495:254], [253:12], [12:253], [254:495], [529:770] or [771:1012], the corresponding RU Allocation subfields in the respective content channels shall all refer to the same RU.

***TGax editor: change the following sentences as shown.***

Each 8 bit portion of the RU Allocation subfield in the Common field of a HE-SIG-B content channel indicates the following:

* The RU assignment to be used in subcarrier indices associated with the 8 bit RU Allocation subfield of the data portion in the frequency domain; that is, it indexes the size of the RUs and their placement in the frequency domain.
* The number of User fields in a 20 MHz BW within the HE-SIG-B content channel: the number of users multiplexed in the RUs indicated by the arrangement; For RUs of size 106 or 242 tones that support MU-MIMO and whose subcarrier indices are associated with the 8 bit RU Allocation subfield, it indicates the number of users multiplexed using MU-MIMO.
* For RUs of size greater than or equal to 484 tones, whose subcarrier indices are associated with the 8 bit RU Allocation subfield, it indicates the number of User fields listed in the User Specific portion of this HE-SIG-B content channel (and not in the User Specific portion of the other HE-SIG-B content channel).

Accordingly, each 8 bit portion of the RU Allocation subfield of a HE-SIG-B content channel indicates the number of associated User fields in the HE-SIG-B content channel.

The mapping of the 8-bit RU Allocation subfield to the RU assignment and the number of users per RU is defined in the Table 28-24 (RU Allocation subfield).

|  |
| --- |
| * **RU Allocation subfield**
 |
| 8 bits indices(B7 B6 B5 B4 B3 B2 B1 B0) | #1 | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | Number of entries |
| 00000000 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 1 |
| 00000001 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 52 | 1 |
| 00000010 | 26 | 26 | 26 | 26 | 26 | 52 | 26 | 26 | 1 |
| 00000011 | 26 | 26 | 26 | 26 | 26 | 52 | 52 | 1 |
| 00000100 | 26 | 26 | 52 | 26 | 26 | 26 | 26 | 26 | 1 |
| 00000101 | 26 | 26 | 52 | 26 | 26 | 26 | 52 | 1 |
| 00000110 | 26 | 26 | 52 | 26 | 52 | 26 | 26 | 1 |
| 00000111 | 26 | 26 | 52 | 26 | 52 | 52 | 1 |
| 00001000 | 52 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 1 |
| 00001001 | 52 | 26 | 26 | 26 | 26 | 26 | 52 | 1 |
| 00001010 | 52 | 26 | 26 | 26 | 52 | 26 | 26 | 1 |
| 00001011 | 52 | 26 | 26 | 26 | 52 | 52 | 1 |
| 00001100 | 52 | 52 | 26 | 26 | 26 | 26 | 26 | 1 |
| 00001101 | 52 | 52 | 26 | 26 | 26 | 52 | 1 |
| 00001110 | 52 | 52 | 26 | 52 | 26 | 26 | 1 |
| 00001111 | 52 | 52 | 26 | 52 | 52 | 1 |
| 00010y2y1y0 | 52 | 52 | - | 106 | 8 |
| 00011y2y1y0 | 106 | - | 52 | 52 | 8 |
| 00100y2y1y0 | 26 | 26 | 26 | 26 | 26 | 106 | 8 |
| 00101y2y1y0 | 26 | 26 | 52 | 26 | 106 | 8 |
| 00110y2y1y0 | 52 | 26 | 26 | 26 | 106 | 8 |
| 00111y2y1y0 | 52 | 52 | 26 | 106 | 8 |
| 01000y2y1y0 | 106 | 26 | 26 | 26 | 26 | 26 | 8 |
| 01001y2y1y0 | 106 | 26 | 26 | 26 | 52 | 8 |
| 01010y2y1y0 | 106 | 26 | 52 | 26 | 26 | 8 |
| 01011y2y1y0 | 106 | 26 | 52 | 52 | 8 |
| 0110y1y0z1z0 | 106 | - | 106 | 16 |
| 01110000 | 52 | 52 | - | 52 | 52 | 1 |
| 01110001 | 242-tone RU empty | 1 |
| 01110010 | 484-tone RU with zero User fields indicated in this RU Allocation subfield of the HE-SIG-B content channel | 1 |
| 01110011 | 996-tone RU with zero User fields indicated in this RU Allocation subfield of the HE-SIG-B content channel | 1 |
| 011101x1x0 | Reserved | 4 |
| 01111y2y1y0 | Reserved | 8 |
| 10y2y1y0z2z1z0 | 106 | 26 | 106 | 64 |
| 11000y2y1y0 | 242 | 8 |
| 11001y2y1y0 | 484 | 8 |
| 11010y2y1y0 | 996 | 8 |
| 11011y2y1y0 | Reserved | 8 |
| 111x4x3x2x1x0 | Reserved | 32 |
| If(#Ed) signaling RUs of size greater than 242 subcarriers, y2y1y0 = 000–111 indicates number of User fields in the HE-SIG-B content channel that contains the corresponding 8-bit RU Allocation subfield. Otherwise, y2y1y0 = 000–111 indicates number of STAs multiplexed in the 106-tone RU, 242-tone RU or the lower frequency 106-tone RU if there are two 106-tone RUs and one 26-tone RU is assigned between two 106-tone RUs. The binary vector y2y1y0 indicates 22 × y2 + 21 × y1 + y0 + 1 STAs multiplexed the RU.z2z1z0 = 000–111 indicates number of STAs multiplexed in the higher frequency 106-tone RU if there are two 106-tone RUs and one 26-tone RU is assigned between two 106-tone RUs. The binary vector z2z1z0 indicates 22 × z2 + 21 × z1 + z0 + 1 STAs multiplexed in the RU.Similarly, y1y0 = 00–11 indicates number of STAs multiplexed in the lower frequency 106-tone RU. The binary vector y1y0 indicates 21 × y1 + y0 + 1 STAs multiplexed in the RU.Similarly, z1z0 = 00-11 indicates the number of STAs multiplexed in the higher frequency 106-tone RU. The binary vector z1z0 indicates 21 × z1 + z0 + 1 STAs multiplexed in the RU.#1 to #9 (from left to the right) is ordered in increasing order of the absolute frequency.x1x0 = 00-11, x4x3x2x1x0 = 00000–11111.‘-’ means no STA in that RU. |

 In the table, the number of entries column refers to the number of 8 bits indices that refer to the same RU assignment to be used in the frequency domain but differ in the number of User fields per RU. The RU assignment and the number of User fields per RU together indicate the number of User fields in the User Specific field of HE-SIG-B.

Signaling for the center 26-tone RU in BW80 MHz follows the RU Allocation subfields. If(#15511) the Bandwidth field of the HE-SIG-A field in an HE MU PPDU is set to 2, 4 or 5 for 80 MHz, 1 bit is added to indicate if a user is allocated to the center 26-tone RU. The bit has the same value for both HE-SIG-B content channels. If(#15512) the Bandwidth field of HE-SIG-A field in an HE MU PPDU is set to 3, 6 or 7 for 160 MHz or 80+80 MHz, 1 bit in HE-SIG-B content channel 1 indicates whether a user is allocated to the center 26-tone RU of lower frequency 80 MHz, and 1 bit in HE-SIG-B content channel 2 indicates if a user is allocated to the center 26-tone RU of higher frequency 80 MHz.

The number of RU Allocation subfields in the Common field depends on the PPDU bandwidth

* If(#15513) the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0, for a 20 MHz and a 40 MHz PPDU, each HE-SIG-B content channel contains one RU Allocation subfield in the Common field followed by multiple User fields. The position of the User field in the User Specific field together with the 8-bit RU Allocation subfield indicates the RU assignment to each user.
* If(#15514) the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0 for an 80 MHz PPDU, each HE-SIG-B content channel contains two RU Allocation subfields for a total of 16 bits of RU allocation signaling, one each for the RUs in the two 20 MHz segments of the HE-SIG-B content channel. The position of the User field in the User Specific field together with the 8-bit RU Allocation subfield indicates the RU assignment to each user. The User fields corresponding to the first RU Allocation subfield are followed by the User fields indicated by the second RU Allocation subfield in the User Specific field.
* If(#15515) the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0 for a 160 MHz PPDU, each HE-SIG-B content channel contains four RU Allocation subfields for a total of 32 bits of RU allocation signaling, one each for the RUs in the four 20 MHz segments of the HE-SIG-B content channel. The position of the User field in the User Specific field together with the 8-bit RU Allocation subfield indicates the RU assignment to each user. The User fields for each of the 20 MHz segments in the content channel are arranged by the order in which their RU Allocation subfields appear in the Common field.

The pre-HE modulated fields (see Figure 28-22 (Timing boundaries for HE PPDU fields)) are not transmitted in 20 MHz subchannels in which the preamble is punctured.

The preamble is punctured in a 20 MHz subchannel *S1* of an HE MU PPDU if and only if one of the following conditions apply:

* The RU Allocation subfield value corresponding to the 20 MHz subchannel *S1* is B7…B0 = 01110001 (242-tone empty), or
* The RU Allocation subfield values corresponding to the 20 MHz subchannels *S1* and *S2* are both B7…B0 = 01110010 (484-tone RU with zero User fields indicated in this RU Allocation subfield of the HE-SIG-B content channel) where the 20 MHz subchannels *S1* and *S2* are adjacent to each other and comprise(#16084) the 40 MHz subchannel in which the 484-tone RU is located. In this case, the preamble is punctured in both 20 MHz subchannels *S1* and *S2*.(#16083)

NOTE—Preamble puncturing over the 40 MHz comprising of the adjacent 20 MHz subchannels *S1* and *S2* can also be indicated by using the value B7…B0 = 01110001 for both RU Allocation subfields corresponding to the 20 MHz subchannels *S1* and *S2*.

The center 26-tone RU in a preamble punctured 80 MHz, 160 MHz or 80+80 MHz HE MU PPDU shall not be allocated to a user if either of the two 20 MHz subchannels which the center 26-tone RU straddles have the preamble punctured.

In an HE MU PPDU, an RU that is not allocated to any user can be indicated using the Center 26-tone RU subfield in the HE-SIG-B Common field (see Table 28-23 (Common field)), certain RU Allocation subfield values in the HE-SIG-B Common field (see Table 28-24 (RU Allocation subfield)), or the value 2046 for the STA-ID subfield in the HE-SIG-B User field (see 27.11.1 (STA\_ID\_LIST) and 28.3.10.8.2 (Encoding and modulation)). Subcarriers in the HE-STF, HE-LTF and Data fields corresponding to such unallocated RUs shall not be modulated.

***TGax editor: Move the thirteenth para (shown below, assuming no change from D3.1) from the (old) Section 28.3.10.8.3***

If the RU size is 996 tones(#16812), for each HE-SIG-B content channel, the first 8-bit RU Allocation subfield used to signal that 996-tones RU may use entry 11010y2y1y0(#15949) as in Table 28-24 (RU Allocation subfield) with y2y1y0 indicating the number of User fields signaled in the corresponding content channel, while the second 8-bit RU Allocation subfield used to signal that 996-tones RU shall be set to 01110011.

***TGax editor: renumber the following section to .4 and insert the following table and text***

* **HE-SIG-B per user content**

The User Specific field in an HE-SIG-B content channel pertains to the users whose subcarrier indices meet the indicated condition in Table xxxb, and in the indicated order.

Table xxxb: Subcarrier indices addressed by each HE-SIG-B User Specific field for each PPDU bandwidth

|  |  |  |  |
| --- | --- | --- | --- |
|  | Row ID | HE-SIG-B content channel 1 | HE-SIG-B content channel 2 |
| 20 MHz PPDU (A) | A | Subcarrier indices fall within [-122:122] | - |
| 40 MHz PPDU (B or C) | B | Subcarrier indices fall within [244: 3]  | Subcarrier indices fall within [3:244]  |
| C | Users of RU 1 of an 484-tone RU, split according to the first 8 bit RU Allocation subfield  |
| 80 MHz PPDU ((D or E) then (F or G) then, if present, I) or H | D | Subcarrier indices fall within [500:259]  | Subcarrier indices fall within [258:17]  |
| E | Users of RU 1 of an 484-tone RU, split into content channels according to the first 8 bit RU Allocation subfield |
| F | Second RU Allocation subfield: subcarrier indices fall within [17:258] or overlap them if the RU is larger than 242 subcarriers | Second RU Allocation subfield: subcarrier indices fall within [259:500] or overlap them if the RU is larger than 242 subcarriers |
| G | Users of RU 2 of an 484-tone RU, split into content channels according to the second 8 bit RU Allocation subfield |
| H | Users of RU 1 of a 996-tone RU, split into content channels according to the second 8 bit RU Allocation subfield |
| I | 1 bit Center 26-tone RU subfield: subcarrier indices fall in [16:4, 4:16]. | 1 bit Center 26-tone RU subfield: subcarrier indices fall in [16:4, 4:16]. |
| 160 MHz PPDU (and 80+80 MHz excepting that the tone ranges of the upper and lower 80 MHz segments are not contiguous)( (((J or K) then (L or M) then, if present, U) or N) then (((O or P) then (Q or R) then, if present, U) or S) ) or T | J | Subcarrier indices fall within [1012:771] | Subcarrier indices fall within [770:529] |
| K | Users of RU 1 of an 484-tone RU, split into content channels according to the first 8 bit RU Allocation subfield |
| L | Second RU Allocation subfield: subcarrier indices fall within [495:254] or overlap them if the RU is larger than 242 subcarriers | Second RU Allocation subfield: subcarrier indices fall within [253:12] or overlap them if the RU is larger than 242 subcarriers |
| M | Users of RU 2 of an 484-tone RU, split into content channels according to the second 8 bit RU Allocation subfield |
| N | Users of RU 1 of a 996-tone RU, split into content channels according to the second 8 bit RU Allocation subfield |
| O | Third RU Allocation subfield: Subcarrier indices fall within [12:253] or overlap them if the RU is larger than 242 subcarriers | Third RU Allocation subfield: Subcarrier indices fall within [254:495] or overlap them if the RU is larger than 242 subcarriers |
| P | Users of RU 3 of an 484-tone RU, split into content channels according to the third 8 bit RU Allocation subfield |
| Q | Fourth RU Allocation subfield: subcarrier indices fall within [529:770] or overlap them if the RU is larger than 242 subcarriers | Fourth RU Allocation subfield: subcarrier indices fall within [771:1012] or overlap them if the RU is larger than 242 subcarriers |
| R | Users of RU 4 of an 484-tone RU, split into content channels according to the fourth 8 bit RU Allocation subfield |
| S | Users of RU 2 of a 996-tone RU, split into content channels according to the fourth 8 bit RU Allocation subfield |
| T | Users of RU 1 of a 2x996-tone RU, split into content channels according to the fourth 8 bit RU Allocation subfield |
| U | 1 bit Center 26-tone RU subfield: fall in [528:516, 508:496]. | 1 bit Center 26-tone RU subfield: fall in [496:508, 516:528].. |

***TGax editor: move paras 6, 11-15 from 28.3.10.8.3 (shown below, assuming no change from D3.1) excluding the “mapping” sentences (shown below via strikeout)***

Each signaling for the presence of the User field corresponding to a center 26-tone RU of the 80 MHz PPDU carries the same value in both HE-SIG-B content channels. If(#15506) assigned, the User field corresponding to the center 26-tone RU that spans subcarriers [16:4, 4:16] is carried as the last User field in the HE-SIG-B content channel 1.

If(#15509) assigned, the User field corresponding to the center 26-tone RU in the 80 MHz segments is carried as the last User field in their respective HE-SIG-B content channels.

If the RU size is 996 tones(#16812), for each HE-SIG-B content channel, the first 8-bit RU Allocation subfield used to signal that 996-tones RU may use entry 11010y2y1y0(#15949) as in Table 28-24 (RU Allocation subfield) with y2y1y0 indicating the number of User fields signaled in the corresponding content channel, while the second 8-bit RU Allocation subfield used to signal that 996-tones RU shall be set to 01110011.

The 80+80 MHz PPDU contains two HE-SIG-B content channels. The general structure is identical to the one of a 160 MHz PPDU. The only difference is that the tone ranges of the upper and lower four 20 MHz segments are not contiguous.

If the Bandwidth field in the HE-SIG-A field of an HE MU PPDU (see Table 28-19 (HE-SIG-A field of an HE MU PPDU)) takes values 4 or 5 (i.e. preamble puncturing is present), the content of content channel 1 and 2 shall be constructed as described above for an 80 MHz PPDU without preamble puncturing.

If the Bandwidth field in the HE-SIG-A field of an HE MU PPDU (see Table 28-19 (HE-SIG-A field of an HE MU PPDU)) takes values 6 or 7 (i.e. preamble puncturing is present), the content of content channel 1 and 2 shall be constructed as described above for an 160 MHz PPDU without preamble puncturing.

If preamble puncturing is present, then an RU that overlaps a punctured 20 MHz subchannel shall not be allocated.

The User Specific field consists of multiple User fields. The User fields follow the Common field of HE-SIG-B. The RU Allocation field in the Common field and the position of the User field in the User Specific field together identify the RU used to transmit a STA’s data. Multiple RUs addressed to a single STA shall not be allowed in the User Specific field. Therefore, the signaling that enables STAs to decode their data is carried in only one User field. An example for the mapping of the 8-bit RU Allocation subfield and the position of the User field to a STA’s data is illustrated in Figure 28-30 (An example of the mapping of the 8-bit RU Allocation subfield and the position of the User field to the STA's assignment for one 20 MHz channel). The RU Allocation subfield indicates an arrangement of one 106-tone RU followed by five 26-tone RUs and that the 106-tone RU contains three User fields, i.e., the 106-tone RU supports multiplexing of three users using MU-MIMO. The 8(#16066) User fields in the User Specific field thus map to the 6 RUs, with the first three User fields indicating MU-MIMO allocations in the first 106-tone RU followed by User fields corresponding to the each of the five 26-tone RUs.

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| * **An example of the mapping of the 8-bit RU Allocation subfield and the position of the User field to the STA's assignment for one 20 MHz channel**
 |

The contents of the User field differ depending on whether the field addresses a STA in a non-MU-MIMO allocation in an RU or a STA in an MU-MIMO allocation in an RU. Irrespective of whether the allocation is for a STA in a non-MU-MIMO or an MU-MIMO allocation, the size of the User field is the same.

The format of the User field for a non-MU-MIMO allocation is defined in Table 28-25 (User field format for a non-MU-MIMO allocation).

|  |
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| * **User field format for a non-MU-MIMO allocation**
 |
| * **Bit**
 | * **Subfield**
 | * **Number of bits**
 | * **Description**
 |
| B0–B10 | STA-ID | 11 | Set to a value of the element indicated from TXVECTOR parameter STA\_ID\_LIST (see 27.11.1 (STA\_ID\_LIST)). |
| B11–B13 | NSTS | 3 | Number of space-time streams.Set to the number of space-time streams minus 1. |
| B14 | Beamformed(#16038) | 1 | Use of transmit beamforming.Set to 1 if a beamforming steering matrix is applied to the waveform in an SU transmission.Set to 0 otherwise. |
| B15–B18 | MCS | 4 | Modulation and coding schemeSet to *n* for MCS*n*, where *n* = 0, 1 ,2 …., 11Values 12 to 15 are reserved |
| B19 | DCM | 1 | Indicates whether or not DCM is used.Set to 1 to indicate that the payload(#Ed) of the corresponding user of the HE MU PPDU is modulated with DCM for the MCS.Set to 0 to indicate that the payload of the corresponding user of the PPDU is not modulated with DCM for the MCS. |
| B20 | Coding | 1 | Indicates whether BCC or LDPC is used.Set to 0 for BCCSet to 1 for LDPC |
| NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position. |

The format of the User field for an MU-MIMO allocation is defined in Table 28-26 (User field for an MU-MIMO allocation).

|  |
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| * **User field for an MU-MIMO allocation**
 |
| * **Bit**
 | * **Subfield**
 | * **Number of bits**
 | * **Description**
 |
| B0–B10 | STA-ID | 11 | Set to a value of element indicated from TXVECTOR parameter STA\_ID\_LIST (see 27.11.1 (STA\_ID\_LIST)). |
| B11–B14 | Spatial Configuration | 4 | Indicates the number of spatial streams for a STA in an MU-MIMO allocation (see Table 28-27 (Spatial Configuration subfield encoding)). |
| B15–B18 | MCS | 4 | Modulation and coding scheme.Set to *n* for MCS*n*, where *n* = 0, 1, 2,…, 11Values 12 to 15 are reserved |
| B19 | Reserved | 1 | Reserved and set to 0 |
| B20 | Coding | 1 | Indicates whether BCC or LDPC is used.Set to 0 for BCCSet to 1 for LDPC |
| NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position. |

A User field for an MU-MIMO allocation includes a 4-bit Spatial Configuration subfield that indicates the number of spatial streams for each STA and the total number of spatial streams in the MU-MIMO allocation. The subfield shown in Table 28-27 (Spatial Configuration subfield encoding) is constructed by using the entries corresponding to the value of number of users (*Nuser*) multiplexed using MU-MIMO in an RU. If(#15516) MU-MIMO is used in an RU of size less than or equal to 242 subcarriers, the number of users (*Nuser*) in an MU-MIMO allocation is equal to the number of User fields per RU signaled for the RU in the RU Allocation subfield of a Common field. If(#15517) MU-MIMO is used in RUs of size greater than 242 subcarriers, User fields corresponding to the same MU-MIMO allocations are split into two HE-SIG-B content channels and the number of users (*Nuser*) is computed as the sum of the number of User fields indicated for the RU by the 8-bit RU Allocation subfield in each HE-SIG-B content channel. The User field positions are logically continuous with the first User field corresponding to the same RU in the second HE-SIG-B content channel following that of the last User field in the first HE-SIG-B content channel. The exact split of User fields between the two content channels is not specified.

For a given value of *Nuser*, the four bits of the Spatial Configuration subfield are used as follows: A STA with a STA-ID that matches the 11-bit ID signaled in the User field for an MU-MIMO allocation derives the number of spatial streams allocated to it using the row corresponding to the signaled 4-bit Spatial Configuration subfield and the column corresponding to the User field position in the User Specific field. The starting stream index for the STA is computed by summing the *NSTS* in the columns prior to the column indicated by the STA’s User field position.

|  |
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| * **Spatial Configuration subfield encoding**
 |
| * ***Nuser***
 | * **B3...B0**
 | * ***NSTS*[1]**
 | * ***NSTS*[2]**
 | * ***NSTS*[3]**
 | * ***NSTS*[4]**
 | * ***NSTS*[5]**
 | * ***NSTS*[6]**
 | * ***NSTS*[7]**
 | * ***NSTS*[8]**
 | * **Total *NSTS***
 | * **Number of entries**
 |
| 2 | 0000–0011 | 1–4 | 1 |  |  |  |  |  |  | 2–5 | 10 |
| 0100–0110 | 2–4 | 2 |  |  |  |  |  |  | 4–6 |
| 0111–1000 | 3–4 | 3 |  |  |  |  |  |  | 6–7 |
| 1001 | 4 | 4 |  |  |  |  |  |  | 8 |
| 3 | 0000–0011 | 1–4 | 1 | 1 |  |  |  |  |  | 3–6 | 13 |
| 0100–0110 | 2–4 | 2 | 1 |  |  |  |  |  | 5–7 |
| 0111–1000 | 3–4 | 3 | 1 |  |  |  |  |  | 7–8 |
| 1001–1011 | 2–4 | 2 | 2 |  |  |  |  |  | 6–8 |
| 1100 | 3 | 3 | 2 |  |  |  |  |  | 8 |
| 4 | 0000–0011 | 1–4 | 1 | 1 | 1 |  |  |  |  | 4–7 | 11 |
| 0100–0110 | 2–4 | 2 | 1 | 1 |  |  |  |  | 6–8 |
| 0111 | 3 | 3 | 1 | 1 |  |  |  |  | 8 |
| 1000–1001 | 2–3 | 2 | 2 | 1 |  |  |  |  | 7–8 |
| 1010 | 2 | 2 | 2 | 2 |  |  |  |  | 8 |
| 5 | 0000–0011 | 1–4 | 1 | 1 | 1 | 1 |  |  |  | 5–8 | 7 |
| 0100–0101 | 2–3 | 2 | 1 | 1 | 1 |  |  |  | 7–8 |
| 0110 | 2 | 2 | 2 | 1 | 1 |  |  |  | 8 |
| 6 | 0000–0010 | 1–3 | 1 | 1 | 1 | 1 | 1 |  |  | 6–8 | 4 |
| 0011 | 2 | 2 | 1 | 1 | 1 | 1 |  |  | 8 |
| 7 | 0000–0001 | 1–2 | 1 | 1 | 1 | 1 | 1 | 1 |  | 7–8 | 2 |
| 8 | 0000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1 |

If the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 1 (indicating full bandwidth MU-MIMO transmission), the number of STAs in the MU-MIMO group is indicated in the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in the HE-SIG-A field.

If the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0, for an MU-MIMO allocation of RU size greater than 242 subcarriers, the User fields are dynamically split between HE-SIG-B content channel 1 and HE-SIG-B content channel 2 and the split is decided by the AP (on a per case basis). See 28.3.10.8.4 (HE-SIG-B common content) and 28.3.10.8.5 (HE-SIG-B per user content) for more details.

If the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 1, for bandwidths larger than 20 MHz, the User fields are split equitably between two HE-SIG-B content channels, i.e., for a *k* user MU-MIMO PPDU,  User fields are carried in HE-SIG-B content channel 1 and  User fields in HE-SIG-B content channel 2.

The total number of spatial streams (total *NSTS*) is computed by summing all columns for the row signaled by the Spatial Configuration field and is indicated in Table 28-27 (Spatial Configuration subfield encoding) under the column Total *NSTS*.

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* **Encoding and modulation**

***TGax editor: move the 6th and following paragraphs of the (old) 28.3.10.8.2 Encoding and Modulation section to here, as shown.***

In each 20 MHz band, the bits in the Common field shall have CRC and tail bits appended and then be BCC encoded at rate *R* = 1/2. The CRC bits are computed as described in 28.3.10.7.3 (CRC computation). Padding is not added between the Common field and the User Specific field.

In the User Specific field, in any 20 MHz band, each User Block field shall have CRC and tail bits appended and then be BCC encoded at rate *R* = 1/2. If the number of User fields in the HE-SIG-B content channel is odd, CRC and tail bits are added after the last User field, which is not grouped. Padding bits are appended immediately after the tail bits corresponding to the last User Block field in each HE-SIG-B content channel to round up to the next multiple of number of data bits per HE-SIG-B symbol. The padding bits may be set to any value. Further padding bits are appended to each HE-SIG-B content channel so that the number of OFDM symbols after encoding and modulation in the HE-SIG-B content channel equals the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in the HE-SIG-A field for an HE MU PPDU. Thus, padding ensures that the HE-SIG-B content channels in different 20 MHz bands end at the same OFDM symbol. For both the Common field and User Block field, the information bits, tail bits and padding bits (if present) are BCC encoded at rate *R* = 1/2 using the encoder described in 17.3.5.6 (Convolutional encoder). If(#15504) the coding rate of the HE-SIG-B MCS is not equal to 1/2, the convolutional encoder output bits for each field are concatenated, then the concatenated bit streams are punctured as described in 17.3.5.6 (Convolutional encoder).

The coded bits are interleaved as in 28.3.11.8 (BCC interleavers). The interleaved bits are mapped to constellation points from the MCS specified in HE-SIG-A and have pilots inserted following the steps described in 17.3.5.8 (Subcarrier modulation mapping) and 17.3.5.9 (Pilot subcarriers), respectively. Each HE-SIG-B symbol shall have 52 data tones.

The guard interval used for HE-SIG-B shall be 0.8 μs.

The number of OFDM symbols in the HE-SIG-B field, denoted by *NSYM,*HE-SIG-B, shall be signaled by the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in the HE-SIG-A field of an HE MU PPDU (see 28.3.10.7.2 (Content)).

For the HE-SIG-B content channel *c* (*c* = 1 or 2), denote the complex number assigned to the *k-*th data subcarrier of the *n-*th symbol by *dk,n,c*. The time domain waveform for the HE-SIG-B field, transmitted on frequency segment *iSeg* and transmit chain *iTX*, is given by Equation (28-20).

*

where

** is the phase rotation value for HE-SIG-B field PAPR reduction. If(#15505) the HE-SIG-B field is modulated with MCS=0 and DCM=1, . For all other modulation schemes of HE-SIG-B field,

 **

 is given in Table 28-16 (Number of modulated subcarriers and guard interval duration values for HE PPDU fields)

*NSR* is given in Table 21-5 (Timing-related constants)

*T*HE-SIG-B is given in Table 28-12 (Timing-related constants)

*K*Shift(*i*) is defined in 21.3.8.2.4 (L-SIG definition)





*Pk* and *pn* are defined in 17.3.5.10 (OFDM modulation)

 is the number of OFDM symbols in the HE-SIG-B field

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In this way, in the absence of puncturing, HE SIG-B content channel 1 and HE SIG-B content channel 2 are transmitted on alternating 20 MHz channels as shown in Figure 28-26 (HE-SIG-B content channel for a 20 MHz PPDU), Figure 28-27 (HE-SIG-B content channel for a 40 MHz PPDU), Figure 28-28 (Mapping of the two HE-SIG-B content channels and their duplication in an 80 MHz PPDU if(#15507) the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0) and Figure 28-29 (Mapping of the two HE-SIG-B content channels and their duplication in a 160 MHz PPDU if(#15508) the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0),

***TGax editor: delete the section heading below and most of the following text as shown by Word track changes but keep a) the figures, which are referenced in the para above, and b) the text which is not marked as deleted, as continuing text in this section.***

***Note to reader, not to be added to the draft. The deleted text below is the only text that is not being moved. Instead, it is replaced by new Tables xxxa and xxxb.***

Figure 28-26 (HE-SIG-B content channel for a 20 MHz PPDU).

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|  |
| * **HE-SIG-B content channel for a 20 MHz PPDU**
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|  |
| * **HE-SIG-B content channel for a 40 MHz PPDU**
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| * **Mapping of the two HE-SIG-B content channels and their duplication in an 80 MHz PPDU if(#15507) the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0**
 |

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|  |
| * **Mapping of the two HE-SIG-B content channels and their duplication in a 160 MHz PPDU if(#15508) the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0**
 |

If the Bandwidth field in the HE-SIG-A field of an HE MU PPDU (see Table 28-19 (HE-SIG-A field of an HE MU PPDU)) takes values 4 or 5 (i.e. the preamble is punctured), the mapping of the HE-SIG-B content channels to 20 MHz segments shall be the same as for an 80 MHz PPDU (see Figure 28-28 (Mapping of the two HE-SIG-B content channels and their duplication in an 80 MHz PPDU if(#15507) the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0)), with the exception that punctured 20 MHz channels shall be excluded.

If the Bandwidth field in the HE-SIG-A field of an HE MU PPDU (see Table 28-19 (HE-SIG-A field of an HE MU PPDU)) takes values 6 or 7 (i.e. the preamble is punctured)the mapping of the HE-SIG-B content channels to 20 MHz segments shall be the same as for an 80 MHz PPDU (see Figure 28-29 (Mapping of the two HE-SIG-B content channels and their duplication in a 160 MHz PPDU if(#15508) the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0)), with the exception that punctured 20 MHz channels shall be excluded.