IEEE P802.11
Wireless LANs

|  |
| --- |
| **Resolution to CID 16624 (HESIGB)** |
| **Date:** 2018-11-07 |

|  |  |  |  |
| --- | --- | --- | --- |
| Brian Hart | Cisco Systems | 170 W Tasman Dr, San Jose CA 94087 | brianh@cisco.com |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

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.***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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***

***Process:*** Note that CID 16624 in D3 has already been motioned, as a rejection. The reason was “It seems there is no such convention of splitted description of coding and modulation. Likewise, there is no necessity to split coding and modulation into two subclauses in HE-SIG-B.” but this rejection reason does not address the strong convention of defining the field contents to be encoded in one place, before the coding/modulation description. Another potential consideration is that no one had prepared suitable change-text. Accordingly, this document contributes proposed change-text.

***Technical:*** 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 organization 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\_D3.2 rtf and visio.zip. Editor instructions are carefully specified to promote consistency with any other (later) comment resolutions.***

**Changes in Rev2:**

* The process history of this CID is added to the discussion (see above)
* The underlying text is re-based to D3.2
* A new coloring system is adopted:
	+ no-color (white background): text is unchanged or moved (if moved, this is identified via instructions to editor)
	+ green color (checking preferred): a rewrite of the language, potentially raising the level of description to align with the level of detail provided in the MAC sections, but no intent or expectation of a technical change. Duplicate material may also be deleted
	+ gray color (checking expected): technical change (usually minor and self-evident)
	+ yellow color: instructions to editor
* A new, explicit list of changes is provided
* A clean version of the final HESIGB section is provided at the end of this document. This is an unofficial version of course.

**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.

**Explicit list of changes**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Section** | **Page/Line wrt D3.2** | **Issue** | **Type**  | **Resolution** |
| .1 | 496/34, 496/62.5 | Uses non-standard term “data portion” when a standard term is available  | Spec hygiene | Replace by “HE modulated portion”. |
| .2 | 496/39 | Improper initial focus on modulation: “The HE-SIG-B field is separately encoded on each 20 MHz band.”  | Spec hygiene | Need to start with content: i.e. start by describing existence and number of content channels. Delete language around “separate encoding on each 20 MHz band” which belongs in the final modulation sub-section, and instead lead with content channel(s). |
| .2 | 496/42 | “if present” begs the question “under which circumstances” and should be answered ASAP. Also, we should be up front that this section actually describes two distinct formats.  | Spec hygiene | Move the paragraph with the answer forward to immediately after the question is raised. |
| .2 | 496/59 | Improper initial focus on modulation: “in each 20 MHz band.” | Spec hygiene | Need to start with content: i.e. start by describing existence and number of content channels. Delete language around “in each 20 MHz band” which belongs in the final modulation sub-section, and instead lead with content channel(s). |
| .2 | 497/2.5 | The final User block field may have 1 or 2 User fields but the language does not acknowledge this case: “Each User Block field is made up of two User fields” | Trivial technical inconsistency | Insert “non-final” modifier. Use “final” instead of “last” for symmetry (“non-last” is very unusual English). Replace “last” by “final” in connection with User Block fields in multiple places for consistent language. |
| .2 | 497/6 | Reference to “User field” skips two important layers and is an unduly narrow. | Spec hygiene | List all the fields described in the referenced section and which are alluded to in this introductory para: i.e. User Specific, User Block and User |
| .2 | 497/24 | The encoding and modulation of the field is described before the definition of contents to be encoded is complete. | Spec hygiene | Move the description of the encoding and modulation of the field to the end of the section, when the definition of contents to be encoded is complete |
| .4 | 503/4 | Opening sentence is not a good overview of the field (e.g. no mention of Center 26-tone RU). The first two sentences do not add anything beyond what is expressed in the following table. They are redundant. | Spec hygiene | Delete redundant sentences. |
| .4 | 503/16 | Great confusion is created by saying “RU Allocation [subfield] … N x 8”. The implication is that an RU Allocation subfield is 8N bits long | Clarity | Describe the first subfield as N x RU Allocation, so it is clear that the RU Allocation is 8 bits long. Re-emphasize this starting the description with “Consists of N x RU Allocation subfields … Each 8-bit RU Allocation subfield …” |
| .4 | 503/16 | Description of the RU Allocation field seeks to be high level but oversimplifies the definition of the field to the point of error. The idea that later paragraphs clarify the meaning of the field, but these later paragraphs have issues too. 1) “in the frequency domain” but one RU Allocation subfield on one CC only indicates a portion of the frequency domain.2) “It also indicates the number of users in each RU” is misleading since that is not the most direct purpose given load balancing; rather the more direct purpose is to indicate the number of User fields in this CC arising from this RU and RU Allocation subfield.3) “It also indicates the number of users in each RU” is not true for RUs of size 484 or larger since the RU Allocation field from both CCs is needed for that. 4) “It also indicates the number of users in each RU” is not true for the second RU Allocation subfield in a CC that describes an RU of size 996, since this must always report 0 users (the first RU Allocation subfield in a CC that describes an RU of size 996 defines the number of users – together with the RU allocation subfields in the other CC)5) “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” is not true as described for 3) and 4).  | Fix technical inconsistency | Instead, define the field completely and accurately the first time.1) Limit the scope of this definition to one CC and approx. 20 MHz2) Lead with how it reports the number of User fields3) Recognizing that there are exceptions for RUs of size 484 or larger and especially for RUs of size 996.4) Report accurately how the number of users in an RU may be determined, although this is secondary information (not a required part of the definition of the field) so place that at the end of the table.i.e.“Each 8-bit RU Allocation subfield in an HE-SIG-B content channel indicates, for RUs whose subcarrier indices comply with the indicated conditions in Table xxxa, the RU assignment to be used over approximately 20 MHz of the HE modulated portion of the PPDU.For the first RU Allocation subfield in an HE-SIG-B content channel that refers to an RU (see NOTE 2), the RU Allocation subfield indicates the number of users whose User fields are listed in the same HE-SIG-B content channel. This number is labelled *Nuser*(*r*,*cc*) for the r-th RU and cc-th HE-SIG-B Content Channel (see foot of table).For the non-first RU Allocation subfield in an HE-SIG-B content channel that refers to an RU (see NOTE 2), the RU Allocation subfield indicates zero additional users whose User fields are listed in the same HE-SIG-B content channel.” |
| .4 | 503/54 | This paragraph attempts to define the RU Allocation field but suffers as follows:1) The definition is limited to a “20 MHz PPDU”, which is insufficient for 40/80/160 MHz PPDUs, and there is nothing later that fills in the gap. Later comments assume this is trying to address 20/40/80/160 MHz but we will see that it falls short there too.2) “in the frequency domain” but, if this is seeking to define 40/80/160 MHz PPDUs, one RU Allocation subfield on one CC only indicates a portion of the frequency domain.3) At 503/57.5 and 503/61, the colon mid-bullet reads awkwardly and (frankly) like a copy/paste error. 4) If this is seeking to define 40/80/160 MHz PPDUs, “The number of User fields in a 20 MHz BW within the HE-SIG-B content channel” does not cover the case of RUs of size 484 or wider (see 3) and 4) in the prior row).5) “for RUs with 106 or more subcarriers that support MU-MIMO, it indicates one user if MU-MIMO is not used and the number of users multiplexed using MU-MIMO” seems to be missing an “otherwise”.6) If this is seeking to define 40/80/160 MHz PPDUs, “for RUs with 106 or more subcarriers that support MU-MIMO, it indicates one user if MU-MIMO is not used and the number of users multiplexed using MU-MIMO” does not cover the case of RUs of size 484 or wider (see 3) and 4) in the prior row). | Fix technical inconsistency | Delete para and move the definition to an updated Table 28-23. |
| .3, para 2,4,5,9,10,14 | 499/22 – 502/10 | 1) The contents of the RU Allocation field should be defined in one place, not spread over several sections..2) Long paragraphs with numbers are better presented via a table | Clarity | Convert the RU Allocation-related portion of .3 to a table and move to where the RU Allocation field is defined.  |
| .3 | 499/17-25 | Unclear to readers why the definition of RU Allocation field in a 40 MHz PPDU does not consider overlapped PPDUs | Clarity | Add note. |
| .3 | 499/6 | 1) The contents of the RU Allocation field should be defined in one place, not spread over several sections.2) It is confusing when a spec says the same thing in different ways: does it mean something different this time?  | Clarity | Either remove duplication or move to where the RU Allocation field is defined and highlight the restatement. Here the spec reports a special case which is probably worth highlighting, so do the move but also add cross references to where this special case is already spelt out. |
| .4 | 504/1 | The RU Allocation field is primarily reporting number of User fields in this CC. Determining the number of users per RU needs RU Allocation subfields from both CCs for RUs of size 484 or greater. But the language only talks about number of users. | Fix technical inconsistency | Replace “number of users” by “number of User fields per RU in the same HE-SIG-B content channel” |
| .4 | 504/9, 506/1 | Spec introduces an unnecessary term “8 bit indices”, which is just a value or range of values of the RU Allocation field. | Spec hygiene | Replace by “One or a range of entries of the RU Allocation subfield” and “RU Allocation subfield values” respectively. |
| .4 | 505/19 | “with zero User fields in this RU Allocation field” does not make sense since the RU Allocation field never carries User fields.  | Fix technical inconsistency | Instead the intent is “zero User fields in the same CC as this RU Allocation subfield” |
| .4 | 505/22.5 | “with zero User fields in this RU Allocation field” does not make sense since the RU Allocation field never carries User fields. Also RU996 is a little complicated since it is referenced by two RU Allocation subfields, and the first RU Allocation subfield lists the number of User fields in this CC, but the second RU Allocation subfield always reports 0 User fields | Fix technical inconsistency | Instead the intent is “zero (or zero additional) User fields in the same CC as this RU Allocation subfield” |
| .3 | 499/17-25 | An RU of size 484 in a 40 MHz PPDU will be described by two RU Allocation subfields, one in each CC. We need to be explicit that these refer to the same RU, but there is no language to that effect, although there is language for 80 and 160 MHz | Fix technical oversight | Add language, i.e. “If a single RU in a 40 MHz PPDU overlaps with more than one of the tone ranges [-244:-3] or [3:244], the corresponding RU Allocation subfields in the respective content channels shall all refer to the same RU.” |
| .3 | 500/1-3  | The contents of the RU Allocation field should be defined in one place, not spread over several sections. | Clarity | Move definitions related to RU Allocation field to the same section |
| .3 | 501/63-65 | The contents of the RU Allocation field should be defined in one place, not spread over several sections. | Clarity | Move definitions related to RU Allocation field to the same section |
| .3 | 500/1-3  | Language at 501/63-65 uses a superior template “the corresponding RU Allocation \*subfields\* in the respective content channels shall \*all\* refer to the same RU | Spec hygiene | Use the same template at 500/1-3 for consistency (pluralize subfield and insert “all”) |
| .3 | 502/5-10 | Spec language is opaque since:1) it uses different terms than 501/62-65 (“refer to the same RU” becomes “used to signal that 996 tones RU”2) it is unclear what problem it is solving, and 3) if this language solves all variants of the problem. | Clarity | Change the language to use “refer to the same RU”.Introduce the issue (of two RU Allocation fields referring to the same RU) when the RU Allocation field is first introduced via a note, and identify that the issue is confined to RUs of size 996 tones only.  |
| .3 | 502/5-10 | Spec language uses the awkward phrase “996 tones RU”  | Editorial | Take advantage of the indefinite and definite articles provided by English. i.e. “an RU … the RU” unambiguously refers to the same RU.  |
| .4 | 506/3.5 | “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.” is oversimplified since:1) the context is a single RU Allocation field (and implicitly in a single CC), which lacks a) the other RU Allocation subfields and b) the Center 26-tone RU fields2) HESIGB might have two User Specified fields (one per CC), but this language implies that there is only one User Specific field.3) Arguably the “RU assignment” does not affect the number of User fields, since the number of User fields equals the sum, over RUs, of the number of users per RU. Certainly it is true that whether individual RUs are narrower or wider – without changing the number of users per RU - has no direct impact. | Fix technical inconsistency | Rewrite correct these details, i.e.: “The number of User fields per RU indicated by the RU Allocation subfields and the Center 26-tone RU subfield of a HE-SIG-B content channel indicate the number of User fields in the User Specific field of the HE-SIG-B content channel.” |
| .4 | 507/1-7 | 1) Formatting does not clearly express the existence of multiple options. 2) The language is inconsistent: 2046 is called out explicitly, but not 0 for Center 26-tone RU | Spec hygiene | Convert to a bulleted list, and insert “the value 0 for” before “the Center 26-tone RU” |
| .5 | 507/10 – 511/38  | The contents of the User Specific field should be defined before the description of its encoding and modulation. | Clarity | Move definitions related to the User Specific field before the encoding and modulation section |
| .5 | 507/9.5 | “per user content” is used in one place only: this title.  | Spec hygiene | Use a term used more broadly: i.e. “user specific” content. |
| .3, para 2,4,5,9,10,14 | 499/22 – 502/10 | 1) The contents of the User Specific should be defined in one place, not spread over several sections.2) Long paragraphs with numbers are better presented via a table3) The level of detail provided for the arrangement of User fields is spartan and much lower than found in the MAC sections. | Clarity | Convert the User-specific-related portion of .3 to a table and move to where the User specific field is defined. Provide an introductory sentence. Also generalize the language to account for SIGB Compression equals 0 or 1. |
| .5 | 507/41-43 | The first two sentences are already well covered in section .2 and the figures therein. | Spec hygiene | Delete these two sentences |
| .5 | 507/43-44 | The third sentence “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.” is incomplete/misleading since 1) There is no RU Allocation field, only 1-4 RU Allocation \*subfields\*, and all are needed to identify the data of the last STA 2) it does not consider the Center 26-tone RU field3) It does not consider SIGB Compression = 14) This language does not attempt to specify the user position within an RU, yet that is vital too. Ultimately the user position within an RU is defined by the modulation equations especially the columns of “P” matrix. | Fix technical inconsistency | Delete and replace by comprehensive language:“The ordering of User fields within the User Specific field is as follows:First the User fields shall be ordered according to row as defined in Table xxxb Second, if the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0, then the User fields within each row shall be ordered by increasing frequency of RU (i.e. #1-#9 in Table 28-24 (RU Allocation subfield))Third, and without regard to the value of SIGB Compression field, the ordering of users’ User fields in the same RU shall follow the same user ordering as the index *u* in equations (28-37), (28-58) and (28-109)”Then it becomes fair to rewrite the sentence at issue: “NOTE: In this way, RU Allocation subfield(s) (if present), Center 26-tone RU field(s) (if present) and the position of a user’s User field in the User Specific field of an HE-SIG-B content channel indicate the user’s RU assignment and space time stream assignment.” |
| .5 | 507/45-46 | “… STAs to decode their data is carried in only one User field” matches plurals (STAs, their data) with a singular “only one User field” | Editorial | Rewrite so all nouns agree in number (singular) |
| .3, para 7, 12 | 500/7-10, 502/1-3,  | The contents of the User Specific field should be defined in one place, not spread over several sections. | Clarity | Move to where the User Specific field is defined.  |
| .3, para 15-16 excluding the “mapping” sentences | 502/17-19, 502/26-29 | When the Bandwidth field equals 4-7, it indicates that preamble puncturing is present. So having this as an “AND” condition is misleading/confusing | Spec hygiene | Convert the “preamble puncturing is present and” to “(i.e. preamble puncturing is present)”. |
| .3 | 502/2 | The “respective” in “80 MHz segments … respective HE-SIG-B contents channels” is ill-defined since segments are 80 MHz wide and contiguous but content channels are 20 MHz wide and alternating. Which one actually matches up with which one?  | Fix technical confusion | List “lower and upper segments” and “first and second content channels” so that “respectively” becomes meaningful. |
| .5 | 510/7.5-10 | “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.” is not expressed as clearly as can be.1) This is a definition of User field positions, so “defin\*” should be worked into the language2) “logically continuous” is clearer if the spec writes about the User fields in the same order that we they are logically ordered3) When using “same”, it is clearer if the thing it is the same as has already been mentioned.  | Editorial | Then reverse the first/last language; rewrite as “The User field positions within an RU are defined to be logically continuous: the last User field corresponding to an RU in the first HE-SIG-B content channel is immediately followed by the first User field in the second HE-SIG-B content channel that corresponds to the same RU.” |
| .5 | 510/4 | The previous usage of “dynamically split” is for SIGB Compression = 0. For SIGB Compression = 1, instead an “equitable split” is defined. However, this para applies to all values of SIGB Compression so “dynamic” is inappropriate. | Fix technical inconsistency | Delete “dynamically” here. |
| .5 | 510/10 | “The exact split of User fields between the two content channels is not specified.” has two problems:1) It is not true if SIGB Compression = 1, where an equitable split is defined, yet this language applies to all values of SIGB Compression.2) For SIGB Compression = 0, this language duplicates other language “and the split is decided by the AP (on a per case basis)” | Fix technical inconsistency and spec hygiene | Delete “The exact split of User fields between the two content channels is not specified.” |
| .3 | 499/3-7 | 1) This language asserts that a Common field is present even if SIGB Compression = 1.2) The arrangement of Common field then User Specific field is well established in .2 and it is duplicative to repeat this info here.3) The Common field (now) is well defined in the new .3 section, so does not need to be redefined here.4) The template for 80 and 160 MHz is fine: for this (modulation) section, we only need to describe the arrangement of content channels in the frequency domain. (Which is trivial for a 20 MHz PPDU) | Fix technical inconsistency and spec hygiene | Delete language that does not refer to the figure. |
| .3 | 499/9-15, 499/27-37 | The figure caption describes a HE-SIG-B content channel but the figure mandates a Common field even if SIGB Compression = 1 | Fix technical inconsistency | Fix this for both values of SIG Compression by inserting “if present” under Common field in the figure. |
| .3 | 499/27-36 | 1) This language asserts that a Common field is present even if SIGB Compression = 1.2) The arrangement of Common field then User Specific field is well established in .2 and it is duplicative to repeat this info here.3) The Common field (now) is well defined in the new .3 section, so does not need to be redefined here.4) The template for 80 and 160 MHz is fine: for this (modulation) section, we only need to describe the arrangement of content channels in the frequency domain.  | Fix technical inconsistency and spec hygiene | Delete language that does not refer to the figure or the mapping from CC1/2 to 20 MHz segments. |
| .3 | 500/13-31, 501/5-31 | The figure and caption do not address the case of SIGB Compression = 1 | Spec hygiene | Fix this for both values of SIG Compression by inserting “if present” under Common field in the figure, and striking out “if(#15508) the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0”. |
| .3, para 15-16  | 502/17-19, 502/26-29 | When the Bandwidth field equals 4-7, it indicates that preamble puncturing is present. So having this as an “AND” condition is misleading/confusing | Spec hygiene | Convert the “preamble puncturing is present and” to “(i.e. preamble puncturing is present)”. |

**XXXX**

* **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 HE modulated fields of the PPDU.

***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 28-28 (HE-SIG-B field encoding structure in each 20 MHz(#16841)(#16634)). The HE-SIG-B content channel consists of a Common field, if present, followed by a User Specific field.

***TGax editor: Move the 4th paragraph to here (shown by example below, assuming D3.2)***

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 the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0, the Common field is present in the HE-SIG-B content channel.(#15501)

|  |
| --- |
|  |
| * Format of an HE-SIG-B content channel(#16841)(#16634)

***TGax editor: change “last User Block” to “final “User Block”***  |

***TGax editor: update xref below to .3***

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 HE modulated portion of the PPDU, 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).

***TGax editor: update xref below to .4***

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 non-final User Block field is made up of two User fields that contain information for two STAs which is used to decode their payloads. The final 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 Specific field, User Block field and User field.

***TGax editor: Move the 4th paragraph to the 2nd para in this section. (This paragraph is shown by example as deleted below, assuming D3.2).***

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 28-26 (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) .5 section (The pre-moved paragraphs are shown by example below, assuming D3.2).***

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

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

The format of the Common field is defined in Table 28-23 (Common field).

|  |
| --- |
| * **Common field**
 |
| **Subfield** | **Number of bits** | **Description** |
| ***TGax editor: Insert the following text as shown.*** *N*  RU Allocation | *N*  8 | ***TGax editor: Move the last four lines to the top as shown (shown by example below, assuming D3.2).*** 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***TGax editor: Change the following text as shown.*** Each 8-bit RU Allocation subfield in an HE-SIG-B content channel indicates, for RUs whose subcarrier indices meet the conditions in Table xxxa, the RU assignment to be used over approximately 20 MHz of the HE modulated portion of the PPDU.For the first RU Allocation subfield in an HE-SIG-B content channel that refers to an RU (see NOTE 2), the RU Allocation subfield indicates the number of users whose User fields are listed in the same HE-SIG-B content channel. This number is labelled *Nuser*(*r*,*cc*) for the r-th RU and cc-th HE-SIG-B Content Channel (see foot of table).For the non-first RU Allocation subfield in an HE-SIG-B content channel that refers to an RU (see NOTE 2), the RU Allocation subfield indicates zero additional users whose User fields are listed in the same HE-SIG-B content channel. ***TGax editor: Move the following line and bulleted list to the top of this cell (shown by example as deleted text below, assuming D3.2).***  |
| 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 |
| The number of users sent within the *r*-th RU is largely determined from the RU size and *Nuser*(*r*,*cc*): 1) If the r-th RU has 26 or 52 tones, then no more than one user is sent within the RU 2) If the r-th RU has 106 or 242 tones, then the number of users sent within the RU equals *Nuser*(*r*,*cc*). 3) If the r-th RU has 484 or more tones, then the number of users sent within the RU equals the number of User fields for the RU, summed across both HE-SIG-B content channels: i.e. *Nuser*(*r*,1) + *Nuser*(*r*,2). NOTE 1: If the number of users per RU is greater than unity, then the users in the RU are multiplexed using MU-MIMO.NOTE 2: An RU of size 996 is referred to by two consecutive RU Allocation subfields. Smaller RU sizes are referred to by a single RU Allocation subfield. If a Common field is present in a 160 or 80+80 MHz PPDU, RUs of size 2x996 are not permitted (see section 28.3.2.5). |

***TGax editor: delete the following text (which is folded into the table above) and insert the table with caption as shown***

Table xxxa: Users associated with each RU Allocation subfield for each HE-SIG-B content channel and PPDU bandwidth

***Note to reader, not for inclusion in the draft: the subcarrier indices used here are extracted from fig 28-29 and paragraphs 2, 4, 5, 9, 10 and 14 in the old .3 section of D3.2.***

|  |  |  |
| --- | --- | --- |
| PPDU bandwidth | HE-SIG-B content channel 1 | HE-SIG-B content channel 2 |
| 20 MHz  | RU Allocation subfield: Subcarrier indices of a user’s RU fall within [-122:122] | Not present |
| 40 MHz  | RU Allocation subfield: Subcarrier indices of a user’s RU fall within [244: 3] (see NOTE) | RU Allocation subfield: Subcarrier indices of a user’s RU fall within [3:244] (see NOTE) |
| 80 MHz  | First RU Allocation subfield: Subcarrier indices of a user’s RU fall within [500:259] or overlap them if the RU is larger than 242 subcarriersSecond RU Allocation subfield: subcarrier indices of a user’s RU fall within [17:258] or overlap them if the RU is larger than 242 subcarriers1 bit Center 26-tone RU subfield: subcarrier indices of a user’s RU equal [16:4, 4:16].  | First RU Allocation subfield: subcarrier indices of a user’s RU fall within [258:17] or overlap them if the RU is larger than 242 subcarriersSecond RU Allocation subfield: subcarrier indices of a user’s RU fall within [259:500] or overlap them if the RU is larger than 242 subcarriers1 bit Center 26-tone RU subfield: subcarrier indices of a user’s RU equal [16:4, 4:16]. |
| 160 MHz (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 of a user’s RU fall within [1012:771] or overlap them if the RU is larger than 242 subcarriersSecond RU Allocation subfield: subcarrier indices of a user’s RU fall within [495:254] or overlap them if the RU is larger than 242 subcarriersThird RU Allocation subfield: Subcarrier indices of a user’s RU fall within [12:253] or overlap them if the RU is larger than 242 subcarriersFourth RU Allocation subfield: subcarrier indices of a user’s RU fall within [529:770] or overlap them if the RU is larger than 242 subcarriers1 bit Center 26-tone RU subfield: subcarrier indices of a user’s RU equal [528:516, 508:496].  | First RU Allocation subfield: Subcarrier indices of a user’s RU fall within [770:529] or overlap them if the RU is larger than 242 subcarriersSecond RU Allocation subfield: subcarrier indices of a user’s RU fall within [253:12] or overlap them if the RU is larger than 242 subcarriersThird RU Allocation subfield: Subcarrier indices of a user’s RU fall within [254:495] or overlap them if the RU is larger than 242 subcarriersFourth RU Allocation subfield: subcarrier indices of a user’s RU fall within [771:1012] or overlap them if the RU is larger than 242 subcarriers1 bit Center 26-tone RU subfield: subcarrier indices of a user’s RU equal [496:508, 516:528]. |
| NOTE: if a Common field is present in a 40 MHz PPDU, RUs of size 484 are not permitted (see section 28.3.2.5).  |

***TGax editor: move the first sentence of para 7 from 28.3.10.8.3 (shown below, assuming no change from D3.2) to here, then edit as marked***

As defined in Table 28-23 (Common field) and Table xxxa, each signaling for the presence of the User field corresponding to a center 26-tone RU in an 80 MHz PPDU carries the same value in both HE-SIG-B content channels.

***TGax editor: change the following sentence***

The mapping from the 8-bit RU Allocation subfield to the RU assignment and the number of User fields per RU in the same HE-SIG-B content channel is defined in the Table 28-24 (RU Allocation subfield).

|  |
| --- |
| * **RU Allocation subfield**
 |
| One or a range of entries of the RU Allocation subfield(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; contributes zero User fields in the same HE-SIG-B content channel as this RU Allocation subfield | 1 |
| 01110011 | 996-tone RU; contributes zero (or zero additional) User fields in the same HE-SIG-B content channel as this RU Allocation subfield | 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 the 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 |

***TGax editor: insert the following sentence***

If a single RU in a 40 MHz PPDU overlaps with more than one of the tone ranges [:3] or [3:244], the corresponding RU Allocation subfields in the respective content channels shall all refer to the same RU.***TGax editor: move the following sentences from 28.3.10.8.3 to here.***

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], the corresponding RU Allocation subfields in the respective content channels shall all refer to the same RU(#16811).

If a single RU in a 160 or 80+80 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: Move the thirteenth para (shown below, assuming no change from D3.2) from the (old) Section 28.3.10.8.3, and append the note.***

For an RU of size 996 tones(#16812), for each HE-SIG-B content channel, the first 8-bit RU Allocation subfield referring to the 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 referring to the sameRU shall be set to 01110011.

NOTE: From NOTE 2 in Table 28-23 (Common field), the above requirement addresses all the cases of RU Allocation subfields in the same HE-SIG-B content channel that refer to the same RU.

In Table 28-24 (RU Allocation subfield), the Number of entries column refers to the number of RU Allocation subfield values 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 number of User fields per RU indicated by the RU Allocation subfields and the Center 26-tone RU subfield of a HE-SIG-B content channel indicate the number of User fields in the User Specific field of the HE-SIG-B content channel.

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 and the bit shall have the same value for both HE-SIG-B content channels(#16309). 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 pre-HE modulated fields (see Figure 28-25 (Timing boundaries for HE PPDU fields if midamble is not present(#15568))) 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:

* B7–B0 of the RU Allocation subfield corresponding to the 20 MHz subchannel *S1* is 01110001 (242-tone empty)
* Preamble puncturing the 40 MHz comprising two adjacent 20 MHz subchannels *S1* and *S2* can be indicated by setting B7–B0 of the RU Allocation subfields corresponding to the 20 MHz subchannels *S1* and *S2* to 01110001
* B7–B0 of the RU Allocation subfields corresponding to the 20 MHz subchannels *S1* and *S2* are both 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)(#16085, #16484)

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:

***TGax editor: Update xref to .4***

* the value 0 for 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 modulated portion of the PPDUcorresponding to such unallocated RUs shall not be modulated.

***TGax editor: renumber the following section to .4 and rename***

* **HE-SIG-B user specific content**

The User Block field is defined in Table 28-25 (User Block field).

|  |
| --- |
| * **User Block field**
 |
| **Subfield** | **Number of bits** | **Description** |
| User field | *N*  21 | The User field format for a non-MU-MIMO allocation is defined in Table 28-26 (User field format for a non-MU-MIMO allocation). The User field format for a MU-MIMO allocation is defined in Table 28-27 (User field for an MU-MIMO allocation).*N*= 1 if it is the final User Block field, and if there is only one user in the final User Block field.*N*= 2 otherwise. |
| CRC | 4 | The CRC is calculated over bits 0 to 20 for a User Block field that contains one User field, and bits 0 to 41 for a User Block field that contains two User fields. See 28.3.10.7.3 (CRC computation). |
| Tail | 6 | Used to terminate the trellis of the convolutional decoder. Set to 0. |

(#16631)

***TGax editor: insert the following paragraph and table***

The User Specific field in an HE-SIG-B content channel shall include User fields for the users whose subcarrier indices meet the indicated condition in Table xxxb.

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

***Note to reader, not for inclusion in the draft: the subcarrier indeices used here are extracted from fig 28-29 and paragraphs 2, 4, 5, 9, 10 and 14 in the old .3 section of D3.2.***

|  |  |  |  |
| --- | --- | --- | --- |
| PPDU bandwidth (row ordering as a function of Row ID) | 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 RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| 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 RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| 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 RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| H | Users of RU 1 of a 996-tone RU, split into content channels according to the second RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| I | 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 RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| 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 RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| N | Users of RU 1 of a 996-tone RU, split into content channels according to the second RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| 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 if the SIGB Compression field equals 0, else equitably. |
| 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 RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| S | Users of RU 2 of a 996-tone RU, split into content channels according to the fourth RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| T | Users of RU 1 of a 2x996-tone RU, split into content channels according to the fourth RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| 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 the 10-11 para (shown below, assuming no change from D3.2) from the (old) Section 28.3.10.8.5. Update xref to .3 and make other chanfes as indicated.***

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 Table xxxb 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. See Table xxxb.

***TGax editor: edit the paragraph as follows. Also interrupt the paragraph before the paragraph completes.***

Multiple RUs addressed to a single STA shall not be allowed in the User Specific field. Therefore, the signaling that enables a STA to decode its data is carried in only one User field.

***TGax editor: insert the following paragraph and NOTE.***

The ordering of User fields within the User Specific field is as follows:

* First the User fields shall be ordered according to row as defined in Table xxxb
* Second, if the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0, then the User fields within each row shall be ordered by increasing frequency of RU (i.e. #1-#9 in Table 28-24 (RU Allocation subfield))
* Third, and without regard to the value of SIGB Compression field, the ordering of users’ User fields in the same RU shall follow the same user ordering as the index *u* in equations (28-37), (28-58) and (28-109)

NOTE: In this way, RU Allocation subfield(s) (if present), Center 26-tone RU field(s) and the position of a user’s User field in the User Specific field of a HE-SIG-B content channel indicate the user’s RU assignment and space time stream assignment.

***TGax editor: move paras 7 (excluding the first sentence), 12, 15-16 from 28.3.10.8.3 (shown below, assuming no change from D3.2) excluding the “mapping” sentences (shown below via strikeout), then edit as marked***

From Table xxxb, if(#15506) assigned, the User field corresponding to the center 26-tone RU in an 80 MHz PPDU that spans subcarriers [16:4, 4:16] is carried as the last User field in the HE-SIG-B content channel 1.

From Table xxxb, if(#15509) assigned, the User field corresponding to the center 26-tone RU in the lower and upper 80 MHz segments of a 160 or 80+80 MHz PPDU is carried as the last User field in the first and second HE-SIG-B content channels respectively.

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.

***TGax editor: continue from the earlier interrupted paragraph.***

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 28-33 (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 multi-plexing 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 fol-lowed by User fields corresponding to the each of the five 26-tone RUs.

|  |
| --- |
|  |
| * **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 28-26 (User field format for a non-MU-MIMO allocation).

|  |
| --- |
| * **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.NOTE—DCM is not applied in combination with STBC.(#15664) |
| B20 | Coding | 1 | Indicates whether BCC or LDPC is used.Set to 0 for BCCSet to 1 for LDPC |
| NOTE—If the STA-ID subfield is set to 2046, then the other subfields can be set to arbitrary values.(#15946) |

The format of the User field for an MU-MIMO allocation is defined in Table 28-27 (User field for an MU-MIMO allocation).

|  |
| --- |
| * **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 28-28 (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—If the STA-ID subfield is set to 2046, then the other subfields can be set to arbitrary values.(#15946) |

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 28-28 (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 (#16813)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 position within an RU are defined to be logically continuous: the last User field corresponding to an RU in the first HE-SIG-B content channel is immediately followed by the first User field in the second HE-SIG-B content channel that corresponds to the same RU.

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.

|  |
| --- |
| * **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.

***TGax editor: Move the 10-11 para to earlier in this section (shown below as deleted, assuming no change from D3.2)***

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 28-28 (Spatial Configuration subfield encoding) under the column Total *NSTS*.

***TGax editor: renumber the following section to .5***

* **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 by example below assuming D3.2.***

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 final 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 different 20 MHz bands ends(#16627) 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

***TGax editor: delete the section heading below and much of the following text as shown by Word track changes but keep a) the figures 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 replaced by new Tables xxxa and xxxb.***

The 20 MHz PPDU contains one HE-SIG-B content channel as shown in Figure 28-29 (HE-SIG-B content channel for a 20 MHz PPDU).

|  |
| --- |
|  |
| * **HE-SIG-B content channel for a 20 MHz PPDU**

***TGax editor: insert “if present” under “Common field” in figure above*** |

The 40 MHz PPDU contains two HE-SIG-B content channels, each occupying a 20 MHz frequency segment, as shown in Figure 28-30 (HE-SIG-B content channel for a 40 MHz PPDU). HE-SIG-B content channel 1 occupies the 20 MHz frequency segment that is lowest in frequency. HE-SIG-B content channel 2 occupies the 20 MHz frequency segment that is second lowest in frequency.

|  |
| --- |
|  |
| * **HE-SIG-B content channel for a 40 MHz PPDU**

***TGax editor: insert “if present” under “Common field” in figure above*** |

The 80 MHz PPDU contains two HE-SIG-B content channels each of which are duplicated once as shown in Figure 28-31 (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). HE-SIG-B content channel 1 occupies the 20 MHz frequency segment that is lowest in frequency and is duplicated on the 20 MHz frequency segment that is third lowest in frequency. HE-SIG-B content channel 2 occupies the 20 MHz frequency segment that is second lowest in frequency and is duplicated on the 20 MHz frequency segment that is fourth lowest in frequency.

|  |
| --- |
|  |
| * **Mapping of the two HE-SIG-B content channels and their duplication in an 80 MHz PPDU**

***TGax editor: insert “if present” under “Common field” in figure above*** |

The 160 MHz PPDU contains two HE-SIG-B content channels each of which are duplicated four times as shown in Figure 28-32 (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). HE-SIG-B content channel 1 occupies the 20 MHz frequency segment that is lowest in frequency and is duplicated on the 20 MHz frequency segments that are third, fifth and seventh lowest in frequency. HE-SIG-B content channel 2 occupies the 20 MHz frequency segment that is second lowest in frequency and is duplicated on the 20 MHz frequency segments that are fourth, sixth and eighth lowest in frequency.

|  |
| --- |
|  |
| * **Mapping of the two HE-SIG-B content channels and their duplication in a 160 MHz PPDU**

***TGax editor: insert “if present” under “Common field” in figure above*** |

The 80+80 MHz PPDU contains two HE-SIG-B content channels each of which are duplicated four times. 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. 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 28-31 (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 28-32 (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.(#16965)

Unofficial clean copy starts here

* **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 HE modulated fields of the PPDU.

**28.3.10.8.2 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.

The format of an HE-SIG-B content channel is shown in Figure 28-28 (HE-SIG-B field encoding structure in each 20 MHz(#16841)(#16634)). The HE-SIG-B content channel consists of a Common field, if present, followed by a User Specific 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 the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0, the Common field is present in the HE-SIG-B content channel.(#15501)

|  |
| --- |
|  |
| * Format of an HE-SIG-B content channel(#16841)(#16634)

***TGax editor: change “last User Block” to “final “User Block”***  |

***TGax editor: update xref below to .3***

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 HE modulated portion of the PPDU, 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).

***TGax editor: update xref below to .4***

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 non-final User Block field is made up of two User fields that contain information for two STAs which is used to decode their payloads. The final 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 Specific field, User Block field and User 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 28-26 (User field format for a non-MU-MIMO allocation).

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

The format of the Common field is defined in Table 28-23 (Common field).

|  |
| --- |
| * **Common field**
 |
| **Subfield** | **Number of bits** | **Description** |
| *N*  RU Allocation | *N*  8 | 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 PPDUEach 8-bit RU Allocation subfield in an HE-SIG-B content channel indicates, for RUs whose subcarrier indices meet the conditions in Table xxxa, the RU assignment to be used over approximately 20 MHz of the HE modulated portion of the PPDU.For the first RU Allocation subfield in an HE-SIG-B content channel that refers to an RU (see NOTE 2), the RU Allocation subfield indicates the number of users whose User fields are listed in the same HE-SIG-B content channel. This number is labelled *Nuser*(*r*,*cc*) for the r-th RU and cc-th HE-SIG-B Content Channel (see foot of table).For the non-first RU Allocation subfield in an HE-SIG-B content channel that refers to an RU (see NOTE 2), the RU Allocation subfield indicates zero additional users whose User fields are listed in the same HE-SIG-B content channel.  |
| 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 |
| The number of users sent within the *r*-th RU is largely determined from the RU size and *Nuser*(*r*,*cc*): 1) If the r-th RU has 26 or 52 tones, then no more than one user is sent within the RU 2) If the r-th RU has 106 or 242 tones, then the number of users sent within the RU equals *Nuser*(*r*,*cc*). 3) If the r-th RU has 484 or more tones, then the number of users sent within the RU equals the number of User fields for the RU, summed across both HE-SIG-B content channels: i.e. *Nuser*(*r*,1) + *Nuser*(*r*,2). NOTE 1: If the number of users per RU is greater than unity, then the users in the RU are multiplexed using MU-MIMO.NOTE 2: An RU of size 996 is referred to by two consecutive RU Allocation subfields. Smaller RU sizes are referred to by a single RU Allocation subfield. If a Common field is present in a 160 or 80+80 MHz PPDU, RUs of size 2x996 are not permitted (see section 28.3.2.5). |

Table xxxa: Users associated with each RU Allocation subfield for each HE-SIG-B content channel and PPDU bandwidth

|  |  |  |
| --- | --- | --- |
| PPDU bandwidth | HE-SIG-B content channel 1 | HE-SIG-B content channel 2 |
| 20 MHz  | RU Allocation subfield: Subcarrier indices of a user’s RU fall within [-122:122] | Not present |
| 40 MHz  | RU Allocation subfield: Subcarrier indices of a user’s RU fall within [244: 3] (see NOTE) | RU Allocation subfield: Subcarrier indices of a user’s RU fall within [3:244] (see NOTE) |
| 80 MHz  | First RU Allocation subfield: Subcarrier indices of a user’s RU fall within [500:259] or overlap them if the RU is larger than 242 subcarriersSecond RU Allocation subfield: subcarrier indices of a user’s RU fall within [17:258] or overlap them if the RU is larger than 242 subcarriers1 bit Center 26-tone RU subfield: subcarrier indices of a user’s RU equal [16:4, 4:16].  | First RU Allocation subfield: subcarrier indices of a user’s RU fall within [258:17] or overlap them if the RU is larger than 242 subcarriersSecond RU Allocation subfield: subcarrier indices of a user’s RU fall within [259:500] or overlap them if the RU is larger than 242 subcarriers1 bit Center 26-tone RU subfield: subcarrier indices of a user’s RU equal [16:4, 4:16]. |
| 160 MHz (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 of a user’s RU fall within [1012:771] or overlap them if the RU is larger than 242 subcarriersSecond RU Allocation subfield: subcarrier indices of a user’s RU fall within [495:254] or overlap them if the RU is larger than 242 subcarriersThird RU Allocation subfield: Subcarrier indices of a user’s RU fall within [12:253] or overlap them if the RU is larger than 242 subcarriersFourth RU Allocation subfield: subcarrier indices of a user’s RU fall within [529:770] or overlap them if the RU is larger than 242 subcarriers1 bit Center 26-tone RU subfield: subcarrier indices of a user’s RU equal [528:516, 508:496].  | First RU Allocation subfield: Subcarrier indices of a user’s RU fall within [770:529] or overlap them if the RU is larger than 242 subcarriersSecond RU Allocation subfield: subcarrier indices of a user’s RU fall within [253:12] or overlap them if the RU is larger than 242 subcarriersThird RU Allocation subfield: Subcarrier indices of a user’s RU fall within [254:495] or overlap them if the RU is larger than 242 subcarriersFourth RU Allocation subfield: subcarrier indices of a user’s RU fall within [771:1012] or overlap them if the RU is larger than 242 subcarriers1 bit Center 26-tone RU subfield: subcarrier indices of a user’s RU equal [496:508, 516:528]. |
| NOTE: if a Common field is present in a 40 MHz PPDU, RUs of size 484 are not permitted (see section 28.3.2.5).  |

As defined in Table 28-23 (Common field) and Table xxxa, each signaling for the presence of the User field corresponding to a center 26-tone RU in an 80 MHz PPDU carries the same value in both HE-SIG-B content channels.

The mapping from the 8-bit RU Allocation subfield to the RU assignment and the number of User fields per RU in the same HE-SIG-B content channel is defined in the Table 28-24 (RU Allocation subfield).

|  |
| --- |
| * **RU Allocation subfield**
 |
| One or a range of entries of the RU Allocation subfield(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; contributes zero User fields in the same HE-SIG-B content channel as this RU Allocation subfield | 1 |
| 01110011 | 996-tone RU; contributes zero (or zero additional) User fields in the same HE-SIG-B content channel as this RU Allocation subfield | 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 the 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 |

***TGax editor: insert the following sentence***

If a single RU in a 40 MHz PPDU overlaps with more than one of the tone ranges [:3] or [3:244], the corresponding RU Allocation subfields in the respective content channels shall all refer to the same RU.

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], the corresponding RU Allocation subfields in the respective content channels shall all refer to the same RU(#16811).

If a single RU in a 160 or 80+80 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.

For an RU of size 996 tones(#16812), for each HE-SIG-B content channel, the first 8-bit RU Allocation subfield referring to the 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 referring to the sameRU shall be set to 01110011.

NOTE: From NOTE 2 in Table 28-23 (Common field), the above requirement addresses all the cases of RU Allocation subfields in the same HE-SIG-B content channel that refer to the same RU.

In Table 28-24 (RU Allocation subfield), the Number of entries column refers to the number of RU Allocation subfield values 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 number of User fields per RU indicated by the RU Allocation subfields and the Center 26-tone RU subfield of a HE-SIG-B content channel indicate the number of User fields in the User Specific field of the HE-SIG-B content channel.

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 and the bit shall have the same value for both HE-SIG-B content channels(#16309). 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 pre-HE modulated fields (see Figure 28-25 (Timing boundaries for HE PPDU fields if midamble is not present(#15568))) 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:

* B7–B0 of the RU Allocation subfield corresponding to the 20 MHz subchannel *S1* is 01110001 (242-tone empty)
* Preamble puncturing the 40 MHz comprising two adjacent 20 MHz subchannels *S1* and *S2* can be indicated by setting B7–B0 of the RU Allocation subfields corresponding to the 20 MHz subchannels *S1* and *S2* to 01110001
* B7–B0 of the RU Allocation subfields corresponding to the 20 MHz subchannels *S1* and *S2* are both 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)(#16085, #16484)

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:

***TGax editor: Update xref to .4***

* the value 0 for 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 modulated portion of the PPDUcorresponding to such unallocated RUs shall not be modulated.

**28.3.10.8.4 HE-SIG-B user specific content**

The User Block field is defined in Table 28-25 (User Block field).

|  |
| --- |
| * **User Block field**
 |
| **Subfield** | **Number of bits** | **Description** |
| User field | *N*  21 | The User field format for a non-MU-MIMO allocation is defined in Table 28-26 (User field format for a non-MU-MIMO allocation). The User field format for a MU-MIMO allocation is defined in Table 28-27 (User field for an MU-MIMO allocation).*N*= 1 if it is the final User Block field, and if there is only one user in the final User Block field.*N*= 2 otherwise. |
| CRC | 4 | The CRC is calculated over bits 0 to 20 for a User Block field that contains one User field, and bits 0 to 41 for a User Block field that contains two User fields. See 28.3.10.7.3 (CRC computation). |
| Tail | 6 | Used to terminate the trellis of the convolutional decoder. Set to 0. |

(#16631)

***TGax editor: insert the following paragraph and table***

The User Specific field in an HE-SIG-B content channel shall include User fields for the users whose subcarrier indices meet the indicated condition in Table xxxb.

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

|  |  |  |  |
| --- | --- | --- | --- |
| PPDU bandwidth (row ordering as a function of Row ID) | 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 RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| 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 RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| 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 RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| H | Users of RU 1 of a 996-tone RU, split into content channels according to the second RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| I | 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 RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| 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 RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| N | Users of RU 1 of a 996-tone RU, split into content channels according to the second RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| 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 if the SIGB Compression field equals 0, else equitably. |
| 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 RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| S | Users of RU 2 of a 996-tone RU, split into content channels according to the fourth RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| T | Users of RU 1 of a 2x996-tone RU, split into content channels according to the fourth RU Allocation subfield if the SIGB Compression field equals 0, else equitably. |
| 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]. |

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 Table xxxb 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. See Table xxxb.

Multiple RUs addressed to a single STA shall not be allowed in the User Specific field. Therefore, the signaling that enables a STA to decode its data is carried in only one User field.

The ordering of User fields within the User Specific field is as follows:

* First the User fields shall be ordered according to row as defined in Table xxxb
* Second, if the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0, then the User fields within each row shall be ordered by increasing frequency of RU (i.e. #1-#9 in Table 28-24 (RU Allocation subfield))
* Third, and without regard to the value of SIGB Compression field, the ordering of users’ User fields in the same RU shall follow the same user ordering as the index *u* in equations (28-37), (28-58) and (28-109)

NOTE: In this way, RU Allocation subfield(s) (if present), Center 26-tone RU field(s) and the position of a user’s User field in the User Specific field of a HE-SIG-B content channel indicate the user’s RU assignment and space time stream assignment.

From Table xxxb, if(#15506) assigned, the User field corresponding to the center 26-tone RU in an 80 MHz PPDU that spans subcarriers [16:4, 4:16] is carried as the last User field in the HE-SIG-B content channel 1.

From Table xxxb, if(#15509) assigned, the User field corresponding to the center 26-tone RU in the lower and upper 80 MHz segments of a 160 or 80+80 MHz PPDU is carried as the last User field in the first and second HE-SIG-B content channels respectively.

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.

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 28-33 (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 multi-plexing 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 fol-lowed by User fields corresponding to the each of the five 26-tone RUs.

|  |
| --- |
|  |
| * **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 28-26 (User field format for a non-MU-MIMO allocation).

|  |
| --- |
| * **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.NOTE—DCM is not applied in combination with STBC.(#15664) |
| B20 | Coding | 1 | Indicates whether BCC or LDPC is used.Set to 0 for BCCSet to 1 for LDPC |
| NOTE—If the STA-ID subfield is set to 2046, then the other subfields can be set to arbitrary values.(#15946) |

The format of the User field for an MU-MIMO allocation is defined in Table 28-27 (User field for an MU-MIMO allocation).

|  |
| --- |
| * **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 28-28 (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—If the STA-ID subfield is set to 2046, then the other subfields can be set to arbitrary values.(#15946) |

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 28-28 (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 (#16813)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 position within an RU are defined to be logically continuous: the last User field corresponding to an RU in the first HE-SIG-B content channel is immediately followed by the first User field in the second HE-SIG-B content channel that corresponds to the same RU.

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.

|  |
| --- |
| * **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.

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 28-28 (Spatial Configuration subfield encoding) under the column Total *NSTS*.

**28.3.10.8.2.5 Encoding and modulation**

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 final 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 different 20 MHz bands ends(#16627) 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

The 20 MHz PPDU contains one HE-SIG-B content channel as shown in Figure 28-29 (HE-SIG-B content channel for a 20 MHz PPDU).

|  |
| --- |
|  |
| * **HE-SIG-B content channel for a 20 MHz PPDU**

***TGax editor: insert “if present” under “Common field” in figure above*** |

The 40 MHz PPDU contains two HE-SIG-B content channels, each occupying a 20 MHz frequency segment, as shown in Figure 28-30 (HE-SIG-B content channel for a 40 MHz PPDU). HE-SIG-B content channel 1 occupies the 20 MHz frequency segment that is lowest in frequency. HE-SIG-B content channel 2 occupies the 20 MHz frequency segment that is second lowest in frequency.

|  |
| --- |
|  |
| * **HE-SIG-B content channel for a 40 MHz PPDU**

***TGax editor: insert “if present” under “Common field” in figure above*** |

The 80 MHz PPDU contains two HE-SIG-B content channels each of which are duplicated once as shown in Figure 28-31 (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). HE-SIG-B content channel 1 occupies the 20 MHz frequency segment that is lowest in frequency and is duplicated on the 20 MHz frequency segment that is third lowest in frequency. HE-SIG-B content channel 2 occupies the 20 MHz frequency segment that is second lowest in frequency and is duplicated on the 20 MHz frequency segment that is fourth lowest in frequency.

|  |
| --- |
|  |
| * **Mapping of the two HE-SIG-B content channels and their duplication in an 80 MHz PPDU**

***TGax editor: insert “if present” under “Common field” in figure above*** |

The 160 MHz PPDU contains two HE-SIG-B content channels each of which are duplicated four times as shown in Figure 28-32 (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). HE-SIG-B content channel 1 occupies the 20 MHz frequency segment that is lowest in frequency and is duplicated on the 20 MHz frequency segments that are third, fifth and seventh lowest in frequency. HE-SIG-B content channel 2 occupies the 20 MHz frequency segment that is second lowest in frequency and is duplicated on the 20 MHz frequency segments that are fourth, sixth and eighth lowest in frequency.

|  |
| --- |
|  |
| * **Mapping of the two HE-SIG-B content channels and their duplication in a 160 MHz PPDU**

***TGax editor: insert “if present” under “Common field” in figure above*** |

The 80+80 MHz PPDU contains two HE-SIG-B content channels each of which are duplicated four times. 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. 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 28-31 (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 28-32 (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.(#16965)