IEEE P802.11
Wireless LANs

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| **Resolution to Annex Z and HESIGB Comments** |
| **Date:** 2020-05-12 |

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Abstract

This submission proposes a resolution for Annex Z and HESIGB-related CIDs: 24373, 24386, 24387, 24388, 24431, 24506, 24507

Changes in R1: Addressed issues raised by commenter.

Changes in R2: Addressed clarification provided by commenter.

Changes in R3: Addressed further issues raised by commenter.

Interpretation of a Motion to Adopt

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

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

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

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| CID | Section# | Page#. Line# | Comment | Proposed Change | Resolution |
| 24373 | Z.2 | 777.63 | [Resubmission of comment withdrawn on D5.0] "to balance their load" -- this a consequence of the allocation rules in Figure 27-29--HE-SIG-B content channel for a 40 MHz PPDU to Figure 27-31--HE-SIG-B content channels and their duplication in a 160 MHz PPDU rather than any explicit attempt by the STA to balance the load | Delete ", to balance their load" at the referenced location and "to balance the load" in Z.5 | Revise. Load balancing is possible, but the commenter identifiers that the conection between Annex Z and the language in 27.3.11.83 is unclear, so change the language to “avoid/reduce disparity” and refer to NOTE 1 in 27.3.11.8.3 where the “reduce disparity” language ecomes from.See changes under CID 24373 in document 20/0769 <motioned Rev#> |

***Discussion***

Although it is true that the HESIGB allocation rules (in Section 27.3.11.8.3 Common field) define many constraints that cause the User fields for smaller RUs to be allocated to a specific CC, for RUs of size 484 and 996, a degree of freedom remains available to the AP that allows the AP to transmit the associated User fields in either HE Content Channel. Indeed, this particular example is crafted to include an RU of size 484 in order to highlight this particular characteristic.

The degree of freedom comes from language in 27.3.11.8.3 and specifically “If RU r is a 484-tone or larger RU, then the number of users allocated to 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—The exact dynamic split of User fields between the two content channels, N user (r, 1) and N user (r, 2), is not specified and might be used to reduce any disparity in the number of User fields between content channels.”

Since this connection is not optimally clear, and different language is used in the two places, a) align the language by changing “balance the load” to “avoid/reduce disparity” and b) insert cross references.

***TGax editor: under CID 24373, change***

Z.1 General

This annex provides a number of examples to illustrate the content of HE-SIG-B content channels (see 27.3.11.8).

Z.2 Example 1

The AP performs a dynamic split the User fields for the two MU-MIMO STAs on 484-tone RU 1 with 2

User fields assigned to HE-SIG-B content channel 1 and none to HE-SIG-B content channel 2, to avoid a disparity in the number of User fields between content channels (see NOTE 2 in 27.3.11.8.3 (Common field)) .

Z.5 Example 4

In the following example there is an 80 MHz or wider PPDU with the lowest 484-tone RU containing two users, and there are multiple other unlisted users which are variously split across the two HE-SIG-B content channels (e.g. because their RU sizes are up to 242 tones). For the two users in the 484-tone RU, Table Z-7 shows various dynamic split options that can be used to reduce the disparity in the number of User fields across the HE-SIG-B content channels (see NOTE 2 in 27.3.11.8.3 (Common field)) . The example shows just the associated RU Allocation subfields (i.e., a fragment of the HE-SIG-B field), which might be sent in one of three ways.

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| CID | Sec-tion# | Page#. Line# | Comment | Proposed Change | Resolution |
| 24386 | Z.5 | 780.10 | [Resubmission of comment withdrawn on D5.0] Why show both "LSB first" and "MSB first"? Should just use same hex conventions as rest of annex | Delete "MSB first: " and the line starting "LSB first:" wherever they appear in the cells of Table Z-7--RU Allocation subfields for different dynamic splits of User fields for the example of two MU-MIMO users in the lowest 484-tone RU of an 80 MHz or wider PPDU | Reject. Providing both versions was a compromise reached by task group members trying to balance two competing goals:1) To reflect the values in Table 27-26. Since these are MSb first, and some members were very troubled by seeing values that did not exactly match the earlier tabulated values, it was important for them to see the MSb first sequence, and 2) To echo the general style of other examples in the section and align specifically with the language in Section Z.1 “In the examples, the binary sequence of each HE-SIG-B field is in transmission order. For the entire contentof each HE-SIG-B content channel, the binary sequences are converted to hexadecimal ...” [i.e. LSb first]. This second consideration runs counter to the commenter’s proposed change.No other compromises were agreeable to the membership. |

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| CID | Sect ion# | Page#. Line# | Comment | Proposed Change | Resolution |
| 24387 | Z.5 | 780.10 | [Resubmission of comment withdrawn on D5.0] Why show both "LSB first" and "MSB first"? Should just use same hex conventions as rest of annex | Delete "LSB first: " and the line starting "MSB first:" wherever they appear in the cells of Table Z-7--RU Allocation subfields for different dynamic splits of User fields for the example of two MU-MIMO users in the lowest 484-tone RU of an 80 MHz or wider PPDU | Reject. Providing both versions was a compromise reached by task group members trying to balance two competing goals:1) To reflect the values in Table 27-26. Since these are MSb first, and some members were very troubled by seeing values that did not exactly match the earlier tabulated values, it was important for them to see the MSb first sequence, and 2) To echo the general style of other examples in the section and align specifically with the language in Section Z.1 “In the examples, the binary sequence of each HE-SIG-B field is in transmission order. For the entire contentof each HE-SIG-B content channel, the binary sequences are converted to hexadecimal ...” [i.e. LSb first]. This first consideration runs counter to the commenter’s proposed change.No other compromises were agreeable to the membership. |

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| CID | Sect ion# | Page#. Line# | Comment | Proposed Change | Resolution |
| 24388 | Z | 777.29 | [Resubmission of comment withdrawn on D5.0] "For the entire contentof each HE-SIG-B content channel, the binary sequences are converted to hexadecimal." -- this is useless, because (a) the endianness of the octets is not given (b) the endianness of the bits within octets is not given and (c) there is no SAP that carries the HE-SIG-B content channel, let alone one that takes octets/an octet string | Delete the cited text. Delete the HE-SIG-B fieldcontent in hexadecimal row in Table Z-2--HE-SIG-B content for example 1, Table Z-4--HE-SIG-B content for example 2, Table Z-6--HE-SIG-B content for example 3 | Revise. The commenter raises useful points. Engineers may view the HESIGB contents in a sniffer trace (e.g. radiotap header, etc) which uses a hex convention. However, the commenter correctly identifies that the Annex Z hex format is not defined – and indeed does not follow the typical presentation convention of sniffer traces. Accordingly the binary is converted to a more traditional hex format, and described as such via reference ot the PHY SAP, with intermediate working shown too, following the general approach of the Measurement Report of type LCI. Further, additional padding is provided in example 3, which was missing.See changes under CID 24388 in document 20/0769 <motioned Rev#> |

Hex is a useful format to provide since that is what is seen in sniffers but that hex is constructed and reported as hex digit pairs (nibble pairs) with the more significant nibble first. If the amendment provides hex values, then they should follow this same convention. Meanwhile, as an example, Annex Z labels the following LSb-first binary data “10010011” as 0x93 – i.e. the binary LSb is mapped to each nibble’s MSb and vice versa – which is an unconventional and thus a confusing/misleading mapping.

Since the conversion from variable-length bit fields to octets is non-trivial to express, we look to previous examples in 802.11. A good model is the Measurement Report of type LCI (location) which addresses similar issues (e.g. MSb-first fields that need to be converted to LSb-first, then divided into octets, then converted into bytes). Multiple baby steps were taken in order to end up with conventional hex, and without confusing anyone:



This direction is followed instead.

As well, in example 3, HE content channel 2 lacked enough padding to match the length of HE content channel 1, so this was added.

***TGax editor: under CID 24388, change***

Z.1 General

This annex provides a number of examples to illustrate the content of HE-SIG-B content channels.

HE-SIG-B content channels are padded to the same length and to an OFDM symbol boundary as defined in

27.3.11.8.5 (Encoding and modulation). For illustration simplicity, the examples do not include the com-

plete padding bits but only pad to make the two HE-SIG-B content channels equal in length and an integer

number of 4 bits. All the padding bits in the examples are set to 0.

In the examples, the binary sequence of each HE-SIG-B field is in transmission order. For the entire content

of each HE-SIG-B content channel, the binary sequences is converted to hexadecimal, listed in transmission order as pairs of hexadecimal digits, where the first bit transmitted is the LSb of the first transmitted octet and is listed as the LSb of the second hexadecimal digit.

Table Z-2

|  |  |  |
| --- | --- | --- |
|  | HE-SIG-B content channel 1  | HE-SIG-B content channel 2 |
| Common field | 10010011 00000011 1 1111 000000 | 01001110 11000011 1 1100 000000 |
| User fields | STA 1441  | 10000101101 0010 0101 0 1  | STA 1445  | 10100101101 0000 0001 0 0 |
|  | STA 1442  | 01000101101 0010 1001 0 1  | STA 1446  | 01100101101 0000 1110 0 0 |
|  | CRC & tail  | 0011 000000  | CRC & tail  | 1101 000000 |
|  | STA 1444  | 00100101101 100 1 0010 0 0  | STA 1447  | 11100101101 0000 0110 0 0 |
|  | STA 1443  | 11000101101 000 0 1100 0 0  | STA 1448  | 00010101101 0000 1010 0 0 |
|  | CRC & tail  | 1000 000000  | CRC & tail  | 1001 000000 |
|  | Padding  | 0 | Padding  | 0 |
| HE-SIG-B field content in binary, organized as octets (LSb first) | 10010011 00000011 11111000 00010000 10110100 10010101 01000101 10100101 00101001 10000000 01001011 01100100 10001100 01011010 00011000 01000000 0000 | 01001110 11000011 11100000 00010100 10110100 00000100 01100101 10100001 11000110 10000001 11001011 01000001 10000001 01011010 00010100 01001000 0000 |
| HE-SIG-B field content in binary, organized as octets (MSb first within each octet) | 11001001 11000000 00011111 00001000 00101101 10101001 10100010 10100101 10010100 00000001 11010010 00100110 00110001 01011010 00011000 00000010 0000 | 01110010 11000011 00000111 00101000 00101101 00100000 10100110 10000101 01100011 10000001 11010011 10000010 10000001 01011010 00101000 00010010 0000 |
| HE-SIG-B field content in hexadecimal, organized as octets | c9 c0 1f 08 2d a9 a2 a5 94 01 d2 26 31 5a 18 02 00  | 72 c3 07 28 2d 20 a6 85 63 81 d3 82 81 5a 28 12 00 |

Table Z-4—HE-SIG-B content for example 2

|  |  |  |
| --- | --- | --- |
|  | HE-SIG-B content channel 1  | HE-SIG-B content channel 2 |
| User fields  | STA 1449  | 10010101101 1000 0110 0 1  | STA 1451  | 11010101101 1000 0001 0 1 |
|  | STA 1450  | 01010101101 1000 1110 0 1  | CRC & tail  | 0101 000000 |
|  | CRC & tail  | 0011 000000  | Padding  | 000000000000000000000 |
| HE-SIG-B field content in binary, organized as octets (LSb first) | 10010101 10110000 11001010 10101101 10001110 01001100 0000 | 11010101 10110000 00101010 10000000 00000000 00000000 0000 |
| HE-SIG-B field content in binary, organized as octets (MSb first within each octet) | 10101001 00001101 01010011 10110101 01110001 00110010 0000 | 10101011 00001101 01010100 00000001 00000000 00000000 0000 |
| HE-SIG-B field content in hexadecimal, organized as octets | a9 0d 53 b5 71 32 00  | ab 0d 54 01 00 00 00  |

Table Z-6—HE-SIG-B content for example 3

|  |  |  |
| --- | --- | --- |
|  | HE-SIG-B content channel 1 | HE-SIG-B content channel 2 |
| Common field  | 00001011 11001110 0 1011 000000  | 11001110 11001110 0 1110 000000 |
| User fields  | STA 1452  | 00110101101 100 1 0001 0 1  | Padding  | 000000000000000000000 0000000000 00 |
|  | CRC & tail  | 1100 000000 |
|  |  Padding  | 00 |
| HE-SIG-B field content in binary, organized as octets (LSb first) | 00001011 11001110 01011000 00000110 10110110 01000101 11000000 0000 | 11001110 11001110 01110000 00000000 00000000 00000000 00000000 0000 |
| HE-SIG-B field content in binary, organized as octets (MSb first within each octet) | 11010000 01110011 00011010 01100000 01101101 10100010 00000011 0000 | 01110011 01110011 00001110 00000000 00000000 00000000 00000000 0000 |
| HE-SIG-B field content in hexadecimal, organized as octets | d0 73 1a 60 6d a2 03 00  | 73 73 0e 00 00 00 00 00  |

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| CID | Section# | Page#. Line# | Comment | Proposed Change | Resolution |
| 24431 | 27.3.11.8.4 |  | [Resubmission of comment withdrawn on D5.0] CID 20856. The reason for saying reserved not arbitrary is the usual one of allowing for future extension | In Table 27-28 delete "Set to an arbitrary value if the STA-ID subfield is 2046." throughout. In Table 27-29 change "If the STA-ID subfield is 2046, then the other subfields can be set to arbitrary values." to "If the STA-ID subfield is set to 2046, then the other subfields are reserved and set to 0." and add the same last row to Table 27-28 | Revise. Since HESIGB is neither scrambled nor has a random scrambling seed, leaving these fields arbitrary is a desirable degree of freedom; meanwhile inTable 27-29 this arbitrariness is defined via a NOTE whici is insufficient so change to language ein the body of the table like Table 27-28.See changes under CID 24431 in document 20/0769 <motioned Rev#> |

***Discussion***

The commenter makes comments that are true in a general sense and particularly relevant to the Data field but note that the Data field is a) scrambled and b) using a scrambler seed that varies randomly with retransmissions. Neither of these facilities is available here for the HESIGB field. Accordingly, listing these fields as permitting arbitrary values in certain cases does not preclude implementers using these subfields judiciously to reduce PAPR, which is a desirable degree of freedom. Meanwhile, historically IEEE 802.11 has exceedingly few examples of Reserved fields in SIG fields being reallocated, so it is unclear if future proofing of these deeply-buried SIG fields has practical value. For instance, current 802.11be discussions do not attempt to make use of these arbitrary fields.

At the same time the commenter, during further discussions, identifies that Table 27-29 uses a NOTE to mark fields as arbitrary and this should rather be normative. Accordingly, follow the conventions in Table 27-28 (copied below for reference)



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Table 27-29—User field format for a MU-MIMO allocation

|  |  |  |  |
| --- | --- | --- | --- |
| Bit  | Subfield | Number of bits | Description |
| B0–B10  | STA-ID  | 11 | Set to a value indicated from TXVECTOR parameter STA\_ID (see 26.11.1 (STA\_ID)). |
| B11–B14  | Spatial Configuration | 4  | Indicates the number of spatial streams for a user in an MU-MIMO allocation (see Table 27-30 (Spatial Configuration subfield encoding)).Set to an arbitrary value if the STA-ID subfield is 2046. |
| B15–B18  | HE-MCS  | 4  | Modulation and coding scheme. Set to n for HE-MCS n, where n = 0, 1, 2,…, 11 Values 12-15 are reservedSet to an arbitrary value if the STA-ID subfield is 2046. |
| B19  | Reserved  | 1  | Reserved and set to 0Set to an arbitrary value if the STA-ID subfield is 2046. |
| B20  | Coding  | 1  | Indicates whether BCC or LDPC is used. Set to 0 for BCC Set to 1 for LDPCSet to an arbitrary value if the STA-ID subfield is 2046. |
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| CID | Section# | Page#. Line# | Comment | Proposed Change | Resolution |
| 24506 | 27.3.11.8.4 | 583.28 | "Set to 1 if a beamforming steering matrix is appliedto the waveform in an SU transmission." -- err, but this is HE-SIG-B, which by definition is an MU transmission | Delete "in an SU transmission" | Revised. Language is changed to replace “SU transmission” by “non-MU-MIMO allocation” consistent with language used in the Table headings. Also related language in 27.3.1.1 and Tables 27-1 and 27-18 is addressed too. See changes under CID 24507 in 20/0769 r<motionedRevision> |
| 24507 | 27.3.11.8.4 | 583.28 | "Set to 1 if a beamforming steering matrix is appliedto the waveform in an SU transmission." -- err, but this is HE-SIG-B, which by definition is an MU transmission | Make changes that mirror those under CID 22391 in 19/1871r2 | Revised. Language is changed to replace “SU transmission” by “non-MU-MIMO allocation” consistent with language used in the Table headings. Also related language in 27.3.1.1 and Tables 27-1 and 27-18 is addressed too. See changes under CID 24507 in 20/0769 r<motionedRevision> |

***Discussion***

Although “SU transmission” is vague, 802.11, and elsewhere in 802.11ax, do have an association of “transmission” with “PPDU”. Meanwhile the Tables are labelled “User field format for a non-MU-MIMO allocation” and “User field format for a MU-MIMO allocation” so apply these terms.

Note that “SU transmission” is also used in the same way in 27.3.1.1, so address this via the “non-MU-MIMO allocation” term at the same time. Also in Table 27-1, employ this “non-MU-MIMO allocation” terminology in connection with “HE\_MU or HE\_TB PPDUs”.

Then Table 27-1 is using “SU transmission” to refer to a “non-MU-MIMO allocation” but that term doesn’t make much sense in the context of HE\_SU and HE\_SU\_ER so just use the traditional “HE modulated fields” term which makes more sense for a SU PPDU. Ditto use the “HE modulated fields” term in Table 27-18 where ”RU contains more than 1 user” is very strange for HE SU PPDU and HE ER SU PPDUs);

***TGax editor, under CID 24507, please change:***

Table 27-1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| BEAMFORMED | FORMAT is HE\_SU or HE\_ER\_SU | Set to 1 if a beamforming steering matrix is applied to the HE modulated fields. Set to 0 otherwise. | Y  | Y |
| FORMAT is HE\_MU or HE\_TB | For an RU with no more than 1 user allocated, set to 1 if a beamforming steering matrix is applied to this non-MU-MIMO allocation and set to 0 otherwise.For each user in an RU assigned to more than 1 user, always set to 0. | MU | O |

Section 27.3.1.1

The HE PHY supports DL MU-MIMO and UL MU-MIMO, for both the full bandwidth case as well as for the partial bandwidth case where MU-MIMO is used only on certain RUs in the PPDU. The combination of -non-MU-MIMO allocations in some RUs and MU-MIMO allocations on different RUs in one PPDU is also supported.

Table 27-18—HE-SIG-A field of an HE SU PPDU and HE ER SU PPDU (continued)

|  |  |  |  |
| --- | --- | --- | --- |
| B10  | Beamformed  | 1  | Set to 1 if a beamforming steering matrix is applied to the HE modulated fields. Set to 0 otherwise. |

Table 27-28 —User field format for a non-MU-MIMO allocation

Set to 1 if a beamforming steering matrix is applied to the waveform in a non-MU-MIMO allocation.