IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| D2.0 Comment Resolution –Clause 22.3.8.2.3 ~ 22.3.8.2.5 | | | | |
| Date: May 2nd 2012 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Minho Cheong | ETRI |  | +82-42-860-5635 | minho@etri.re.kr |
|  |  |  |  |  |

Abstract

This document provides resolutions for CID 4220, 5161, 4086, 4087, 4244, 4692, 5164, 5165, 5476, 5273, 5166, 5477, 5478, 5167, 5169 and 5168.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **CID** | | **Page** | | **Clause** | **Comment** | **Proposed change** | **Resolution** |
| 4220 | | 206.01 | | 22.3.8.2.3 | Relation between TXVECTOR fields and PLCP header fields should be made explicit in the PLCP header fields. E.G. relate the MCS in the PCLP header to the one specified in the TXVECTOR | Add a reference to the TXVECTOR fields, especially those who serve the MAC, such as Group ID | REVISE.  See 12/0336r0. |
| <Discussion>  It seems not needed again here because it is already described in clause 22.3.4.5 (Construction of VHT-SIG-A) that these sub-field values in VHT-SIG-A can be set by obtaining parameters from the TXVECTOR, that is,  The VHT-SIG-A field consists of two symbols, VHT-SIG-A1 and VHT-SIG-A2, as defined in 22.3.8.2.3 (VHT-SIG-A definition.   * Obtain the CH\_BANDWIDTH, STBC, GROUP\_ID, PARTIAL\_AID (SU only), NUM\_STS, GI\_TYPE, FEC\_CODING, MCS (SU only), BEAMFORMED (SU only), NUM\_USERS from the TXVECTOR. Add the reserved bits, append the calculated CRC, then append the  tail bits as shown in 22.3.8.2.3 (VHT-SIG-A definition)   Instead, I’ve found that there was a missing parameter in clause 22.3.4.5, that is, TXOP\_PS\_NOT\_ALLOWED in the TXVECTOR.    **TGac editor: modify the D2.1 text from P185L26, as follows**  The VHT-SIG-A field consists of two symbols, VHT-SIG-A1 and VHT-SIG-A2, as defined in 22.3.8.2.3 (VHT-SIG-A definition.   * Obtain the CH\_BANDWIDTH, STBC, GROUP\_ID, PARTIAL\_AID (SU only), NUM\_STS, GI\_TYPE, FEC\_CODING, MCS (SU only), BEAMFORMED (SU only), NUM\_USERS and TXOP\_PS\_NOT\_ALLOWED from the TXVECTOR. Add the reserved bits, append the calculated CRC, then append the  tail bits as shown in 22.3.8.2.3 (VHT-SIG-A definition) | | | | | | | |
| 5161 | | 206.07 | | 22.3.8.2.3 | The fields in Table 22-11 are somewhat artificially defined to be able to keep both SU and MU information in single tabele | Several of the fields in Table 22-11 have a very artifical definition that is the result of trying to keep both SU and MU information in a single table. E.g: NSTS/Partial AID - there is no reason these should be in the same field. A better and more readable approach would be to have one table for VHT-SIG-A for the case of SU and one table for VHT-SIG-A for the case of MU. Split Table 22-1 accordingly. | REJECT.  See 12/0336r0. |
| <Discussion>  It is one of criticially important feature to keep both SU and MU information in a common table as possible to enable more efficient design of the transmitter, because a VHT STA can be used for either SU or MU depending on its environments.    **TGac editor: No change** | | | | | | | |
| 4086 | | | 206.18 | 22.3.8.2.3 | "NOTE--For some but not all users to have space time block coding is not allowed."  It reads like this note is trying to be normative. | Add reference to subclause that defines this rule. | ACCEPT.  See 12/0336r0. |
| <Discussion>  Clause 22.3.10.4 (Space-time block coding) describes the followings in it:  “In an MU transmission, if STBC is applied to any user, STBC shall be applied to all users.”    **TGac editor: modify the D2.1 text from P206L15, as follows**  Set to 1 if all spatial streams of all users have space time block coding and set to 0 if no spatial stream of any user has space time block coding.  NOTE—For some but not all users to have space time block coding is not allowed as defined in 22.3.10.9.4 (Space-time block coding). | | | | | | | |
| 4087 | | | 206.21 | 22.3.8.2.3 | There's a lot of "In an SU PPDU" and "In an MU PPDU" in table 22-11, without defining how this condition is determined. | Add a note to the table indicating how the differentiation between SU and MU ppdu is determined, based on the contents of the VHT SIG field. | REJECT.  See 12/0336r0. |
| <Discussion>  Table 22-12 desribes how to set the sub-field values in the VHT-SIG-A field on transmitter’s side. How to differentiate between SU and MU PPDU based on the contents of the VHT-SIG-A field may be done at the receiver, which seems beyond the scope of Table 22-12 (definition of VHT-SIG-A field) in the specification.    **TGac editor: No change** | | | | | | | |
| 4244 | | | 206.28 | 22.3.8.2.3 | The term MU[x] NSTS is used in Figure 22-12 VHT-SIG-A1 structure, while not explained in the Description part of NSTS in Table 22-11 | Explain MU[x] NSTS in the Description part of NSTS in Table 22-11. | REVISE.  See 12/0336r0. |
| <Discussion>  Strictly speaking, Figure 22-12 has some error in it regaring the order of representing array values of N\_STS for MU transmission if we assume that *x* value in MU[*x*] means conventionally the user index *u*. Bit positions of array values of N\_STS may not be mapped in the increasing order of *u*, because user index *u* may not match to USER\_POSITION array value *p*, whose relation to each other is already described in Table 22-11, that is, *p*=USER\_POSITION[*u*]. So, we need some change in Figure 22-12 (VHT-SIG-A1 structure) accordingly.    **TGac editor: modify the D2.1 text from P205L29, as follows**   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | B0     B1 | B2 | B3 | B4    B9 | B10    B12 | B13    B15 | B16    B18 | B19    B21 | B22 | B23 | | Composit Name: | BW | Reserved | STBC | Group ID | NSTS/Partial AID | | | | TXOP\_PS\_NOT  \_ALLOWED | Reserved | | SU Name: | SU NSTS | Partial AID | | | | MU Name: | MU[USER\_POSITION=0] NSTS | MU[USER\_POSITION=1] NSTS | MU[USER\_POSITION=2] NSTS | MU[USER\_POSITION=3] NSTS | | Bits: | 2 | 1 | 1 | 6 | 3 | 3 | 3 | 3 | 1 | 1 | | * VHT-SIG-A1 structure | | | | | | | | | | | | | | | | | | |
| 4692 | 206.50 | | | 22.3.8.2.3 | It is not clear how to match Partial AID to B13 -- B21. Does B13 match BSSID39/RA39/PID0 or BSSID47/RA47/PID8? | Clarify it. | ACCEPT.  See 12/0336r0. |
| <Discussion>  It can be easily known that PARTIAL\_AID[0:8] is mapped to B13 to B21 of VHT-SIG-A1 field from Table 9-19 (Settings for the TXVECTOR parameters GROUP\_ID and PARTIAL\_AID)    **TGac editor: modify the D2.1 text from P206L51, as follows**  B13-B21  Partial AID: Set to the value of the TXVECTOR parameter PARTIAL\_AID. Partial AID provides an abbreviated indication of the intended recipient(s) of the PSDU (see 9.17a (Group ID and partial AID in VHT PPDUs)). PARTIAL\_AID[0] is mapped to B13. | | | | | | | |
| 5164 | | | 208.03 | 22.3.8.2.3 | Clarify the 96 complex numbers do not include pilots | This paragraph mentions "96 complex numbers generated by these steps", where the "steps" includes pilot insertion. With pilots, there would be more than 96 numbers. Add the words "(before pilot insertion)" after "these steps" | ACCEPT.  See 12/0336r0. |
| <Discussion>  What the commenter pointed out is correct. 96 is the number before pilot insertion.    **TGac editor: modify the D2.1 text from P207L61, as follows**  The VHT-SIG-A field is composed of two symbols, VHT-SIG-A1 and VHT-SIG-A2, each containing 24 data bits, as shown in Table 22-12 (Fields in the VHT-SIG-A field). VHT-SIG-A1 is transmitted before VHT-SIG-A2. The VHT-SIG-A symbols shall be BCC encoded at rate, R = 1/2, interleaved, mapped to a BPSK constellation, and have pilots inserted following the steps described in 18.3.5.6 (Convolutional encoder), 18.3.5.7 (Data interleaving), 18.3.5.8 (Subcarrier modulation mapping), and 18.3.5.9 (Pilot subcarriers), respectively. The first and second half of the stream of 96 complex numbers generated by these steps (before pilot insertion) is divided into two groups of 48 complex numbers, where  respectively. | | | | | | | |
| 5165 | | | 208.14 | 22.3.8.2.3 | Mathematical description of VHT-SIG-A does not meet general format (24) | the general format does not include a summation over symbols. Specify first and second symbol instead (similar to VHT-LTF) | ACCEPT.  See 12/0336r0. |
| <Discussion>  It seems better to be consistent with mathematical representations of other fields such asVHT-STF, VHT-LTF, L-SIG and so on, all of which use a general form of Equation (22-9).    **TGac editor: modify the D2.1 text from P208L12, as follows**  Replace the summation & *wTSYML(t-nTSYML)* just by *wTSYML(t)* in the following equation.  Replace *(t-nTSYML)* in exponent operation just by *t* in the following equation as well.  (22-24) | | | | | | | |
| 5476 | | | 209.22 | 22.3.8.2.4 | In addition to improving AGC, VHT-STF field can be used for another purposes. | Change "The purpose of the VHT-STF field" to "The main purpose of the VHT-STF field" | ACCEPT.  See 12/0336r0. |
| <Discussion>  It seems a little better not to strictly limit its purpose as the commenter pointed out, because it may be kind of implementation issue.    **TGac editor: modify the D2.1 text from P209L20, as follows**  The main purpose of the VHT-STF field is to improve automatic gain control estimation in a MIMO transmission. | | | | | | | |
| 5273 | | | 210.28 | 22.3.8.2.4 | The parameter N(sub-script)SR is not defined for equation (44) | Copy definition of N(sub-script)SR from P197L58. or state "N(sub-script)SR is defined in 22.3.7" | REVISE.  See 12/0336r0. |
| <Discussion>  It seems better to refer to the definition of *NSR* here as the commenter pointed out.  In addition, there are additional places which also need this, that is, for the waveform of the L-STF, L-LTF, VHT-LTF, VHT-SIG-B and Data packet of VHT format.    **TGac editor: modify the D2.1 text from P210L14, as follows**  (22-29)  where  *NSR* is defined in Table 22-5 (Timing-related constants)  is defined in Table 22-6 (Frequently used parameters)  **TGac editor: modify the D2.1 text from P201L18, as follows**  (22-16)  where  *NSR* is defined in Table 22-5 (Timing-related constants)  represents the cyclic shift for transmit chain  with a value given in Table 22-10 (Cyclic shift values for L-STF, L-LTF, L-SIG and VHT-SIG-A fields of the PPDU)  **TGac editor: modify the D2.1 text from P202L09, as follows**  (22-19)  where  *NSR* is defined in Table 22-5 (Timing-related constants)  represents the cyclic shift for transmitter chain  with a value given in Table 22-10 (Cyclic shift values for L-STF, L-LTF, L-SIG and VHT-SIG-A fields of the PPDU)  **TGac editor: modify the D2.1 text from P213L30, as follows**  (22-38)  where  *NSR* is defined in Table 22-5 (Timing-related constants)  is defined in Table 22-6 (Frequently used parameters)  **TGac editor: modify the D2.1 text from P216L45, as follows**  (22-43)  where  *NSR* is defined in Table 22-5 (Timing-related constants)  is defined in Table 22-6 (Frequently used parameters)  **TGac editor: modify the D2.1 text from P239L34, as follows**  (22-92)  where  *NSR* is defined in Table 22-5 (Timing-related constants)  *pn* is defined in 18.3.5.10 (OFDM modulation) | | | | | | | |
| 5166 | | | 211.08 | 22.3.8.2.5 | Unclear sentence | The meaning of the sentence "The transmitter provides training for the space time streams (spatial mapper inputs) used for the transmission of the PSDU" is not clear. Propose to delete the sentence and replace with "For each tone, the MIMO channel is an N\_RX x N\_STS matrix, with N\_RX the number of receive antennas and N\_STS the number of space-time streams used for transmission of the PSDU". | REVISE.  See 12/0336r0. |
| 5477 | | | 211.12 | 22.3.8.2.5 | Matrix P is not defined. | Change "matrix P" to "matrix P\_VHTLTF". The same problem is also in Line 14. | ACCEPT.  See 12/0336r0. |
| 5478 | | | 211.13 | 22.3.8.2.5 | Matrix R is not defined. | Change "matrix R" to "matrix R\_VHTLTF". The same problem is also in Line 14 | ACCEPT.  See 12/0336r0. |
| <Discussion>  Regarding CID 5166, It may be helpful to mention the size of the MIMO channel matrix to be estimated by receiving the VHT-LTF field as the commenter pointed out. But, some modifications are also needed to make it more readable.  Resolutions to CID 5477 and CID 5478 are quite straightforward.    **TGac editor: modify the D2.1 text from P210L52, as follows**  The VHT Long Training (VHT-LTF) field provides a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs) and the receive chains. The transmitter provides training for *NSTS, total* space time streams (spatial mapper inputs) used for the transmission of the PSDU. For each tone, the MIMO channel to be estimated is an *NRX* x *NSTS, total* matrix, with *NRX* the number of receive anteannas. All VHT transmissions have a preamble that contains a single section of VHT-LTF symbols, where the data tones of each VHT-LTF symbol are multiplied by entries belonging to a matrix *PVHTLTF*, to enable channel estimation at the receiver. The pilot tones of each VHT-LTF symbol are multiplied by the entries of a matrix *RVHTLTF* defined in the following text. The multiplication of the pilot tones in the VHT-LTF symbol by the *RVHTLTF* matrix instead of the *PVHTLTF* matrix is to allow receivers to track phase and frequency offset during MIMO channel estimation using the VHT-LTF. The number of VHT-LTF symbols, *NVHTLTF*, is a function of the total number of space-time streams  as shown in Table 22-13 (Number of VHT-LTFs required for different numbers of space time streams). As a result, the VHT-LTF field consists of one, two, four, six or eight symbols that are necessary for the demodulation of the VHT-SIG-B and Data fields in the PPDU or for channel estimation in an NDP. | | | | | | | |
| 5167 | | | 213.22 | 22.3.8.2.5 | Improve Figure 22-15 | Make following change: - Add curly bracket under the IFFT blocks stating that these are N\_TX transmit chains - Replace [Qk]\_NSTS with [Qk]\_(1:N\_STS,total) | ACCEPT.  See 12/0336r0. Refer to 12/0335r1. |
| <Discussion>  As the commenter pointed out, [Qk] 1:NSTS,total is the correct expression.  FYI, this resolution is already covered by that of CID 5155, which was already passed in task group motion in March 2012. Refer to 12/0335r1 (D2.0-comment-resolution-clause-22.3.8.2.1~22.3.8.2.2).    **TGac editor: modify the D2.1 text from P213L01, as follows**  Change [Qk] 1:NSTS in Figure 22-15 into [Qk] 1:NSTS,total. | | | | | | | |
| 5169 | | | 215.05 | 22.3.8.2.5 | Number of bits in VHT-SIG-B is ambiguous for MU | The number of bits listed here are per user. Clarify the text accordingly. | ACCEPT.  See 12/0336r0. |
| <Discussion>  It seems helpful for clearer understanding to modify as suggested.    **TGac editor: modify the D2.1 text from P214L42, as follows**  The VHT-SIG-B field is one symbol and contains 26 bits in a 20 MHz PPDU, 27 bits in a 40 MHz PPDU and 29 bits in 80 MHz, 160 MHz and 80+80 MHz PPDUs per each user. | | | | | | | |
| 5168 | | | 215.06 | 22.3.8.2.5 | Confusing terminology fields/subfields | This paragraph refers to both the "fields in the VHT-SIG-B field" and "subfields" as meaning the same thing. Harmonize terminology. | See 12/0336r0. |
| <Discussion>  It needs to harmonize terminology in a systematic way.  FYI, current terminology for “field” and “subfield” are suggested by Brian and agreed in task group during the comment resolution on D0.1 in 2011, which is described in detail in Figure 22-10, Equation (22-8) and Equation (22-9), that is,  **Field** : L-STF, L-LTF, L-SIG, VHT-SIG-A, VHT-STF, VHT-LTF, VHT-SIG-B, (Service), Data packet  **Fields** : Pre-VHT modulated fields (L-STF, L-LTF, L-SIG, VHT-SIG-A), VHT modulated fields (VHT-LTF, VHT-SIG-B, (Service), Data packet), when mentioning any kind of multiple fields.  **Subfield** : each symbol of VHT-SIG-A field, each symbol of VHT-LTF field (from Equation (22-9)),  Some bits portion in a Field (e.g., Group ID in the VHT-SIG-A field)  It has not been determined yet about naming of some bits portion in a Field (e.g., RATE in the L-SIG field, Group ID in the VHT-SIG-A field, MCS in the VHT-SIG-B field, CRC in the Service field). In my personal opinion, it seems not a bad idea to name that also as **Subfield** from experience, even though there might still remain a little duplicate usage especially for parts of the VHT-SIG-A field, that is, VHT-SIG-A1 is a Subfield (from the definition in Equation (22-9)) and Group ID in VHT-SIG-A1 is also a Subfield. But, it seems better to allow those little duplicate usage rather than introduction of additional new term which is not familiar to most of 802.11ac participants.    **TGac editor: modify the D2.1 text from P197L65, as follows**  is *TSYM* for VHT-Data, that is *TSYML* when not using the short guard interval (Short GI subfield of VHT-SIG-A is 0) and *TSYMS* when using the short guard interval (Short GI subfield of VHT-SIG-A is 1).  **TGac editor: modify the D2.1 text from P198L55, as follows**  is the guard interval duration used for each OFDM symbol in the field. For L-STF and VHT-STF,  but it can be omitted from Equation (22-9) due to the periodic property of L-STF and VHT-STF over every 0.8 µs. For L-SIG, VHT-SIG-A, VHT-LTF and VHT-SIG-B fields, . For the L-LTF field, . For the Data field,  when not using the short guard interval (Short GI subfield of VHT-SIG-A2 is 0) and  when using the short guard interval (Short GI subfield of VHT-SIG-A2 is 1). ,  and  are given in Table 22-5 (Timing-related constants).  **TGac editor: modify the D2.1 text from P202L48, as follows**  In a VHT PPDU, the Rate subfield shall be set to represent 6 Mb/s for the 20 MHz channel spacing column of Table 18-6 (Contents of the SIGNAL field).  In a non-HT duplicate PPDU, the Rate subfield is defined in 18.3.4.2 (RATE field) using the L\_DATARATE parameter in the TXVECTOR.  The Length subfield shall be set as specified by Equation (22-20).  **TGac editor: modify the D2.1 text from P202L64, as follows**  A STA shall not transmit a VHT PPDU if the Length value calculated using Equation (22-20) exceeds 4095 octets.  The LSB of the binary expression of the Length value shall be mapped to B5. In a non-HT duplicate PPDU, the Length subfield is defined in 18.3.4.3 (PLCP LENGTH field) using the L\_LENGTH parameter in the TXVECTOR.  The Reserved subfield shall be set to 0.  The Parity subfield has the even parity of bits 0-16.  The Tail subfield shall be set to 0.  The L-SIG field shall be encoded, interleaved and mapped (#5153)following the steps described in 18.3.5.6 (Convolutional encoder), 18.3.5.7 (Data interleaving), and 18.3.5.8 (Subcarrier modulation mapping). The stream of 48 complex numbers generated by these steps is (#5153)denoted by . Pilots shall be inserted as described in 18.3.5.9.(#5153) The time domain waveform of the L-SIG field shall be as given by Equation (22-21).  **TGac editor: modify the D2.1 text from P206L01, as follows**  The VHT-SIG-A field contains the subfields listed inTable 22-12 (Subfields in the VHT-SIG-A field).   |  |  |  |  |  | | --- | --- | --- | --- | --- | | * Subfields in the VHT-SIG-A field | | | | | | Symbol | Bit | Subfield | Number of bits | Description | | VHT-SIG-A1 | B0-B1 | BW | 2 | Set to 0 for 20 MHz, 1 for 40 MHz, 2 for 80 MHz, 3 for 160 MHz and 80+80 MHz | | B2 | Reserved | 1 | Reserved. Set to 1. | | B3 | STBC | 1 | Set to 1 if all spatial streams of all users have space time block coding and set to 0 if no spatial streams of any user has space time block coding  NOTE—For some but not all users to have space time block coding is not allowed. | | B4-B9 | Group ID | 6 | In an SU PPDU, the Group ID subfield is set as defined in 9.17a (Group ID and partial(#4829) AID in VHT PPDUs).  In an MU PPDU the Group ID subfield(#4829) is set as defined in 22.3.11.4 (Group ID  ) | | B10-B21 | NSTS/Partial AID | 12 | For an MU PPDU: NSTS is divided into 4 user positions of 3 bits each. User position *p*, where , uses bits B()-B(). The space-time streams of user u are indicated at user position  where  and the notation A[*b*] denotes the value of array A at index *b*. Zero space-time streams are indicated at positions not listed in the USER\_POSITION array.  Set to 0 for 0 space time streams  Set to 1 for 1 space time stream  Set to 2 for 2 space time streams  Set to 3 for 3 space time streams  Set to 4 for 4 space time streams  Values 5-7 are reserved  For an SU PPDU:  B10-B12  Set to 0 for 1 space time stream  Set to 1 for 2 space time streams  Set to 2 for 3 space time streams  Set to 3 for 4 space time streams  Set to 4 for 5 space time streams  Set to 5 for 6 space time streams  Set to 6 for 7 space time streams  Set to 7 for 8 space time streams  B13-B21  Partial AID: Set to the value of the TXVECTOR parameter PARTIAL\_AID. Partial AID provides an abbreviated indication of the intended recipient(s) of the PSDU (see 9.17a (Group ID and partial(#4829) AID in VHT PPDUs)). | | B22 | TXOP\_PS\_NOT\_ALLOWED | 1 | Set to 0 by VHT AP if it allows non-AP VHT STAs in TXOP power save mode to enter Doze state during a TXOP.  Set to 1 otherwise.  The bit is reserved and set to 1 in VHT PPDUs transmitted by a non-AP VHT STA. | | B23 | Reserved | 1 | Set to 1 | | **VHT-SIG-A2** | B0 | Short GI | 1 | Set to 0 if short guard interval is not used in the Data field.  Set to 1 if short guard interval is used in the Data field. | | B1 | Short GI NSYM Disambiguiation | 1 | Set to 1 if short guard interval is used and *NSYM* mod 10 = 9, otherwise set to 0. *NSYM* is defined in 22.4.3 (TXTIME and PSDU\_LENGTH calculation  ). | | B2 | SU/MU[0] Coding | 1 | For an SU PPDU, B2 is set to 0 for BCC, 1 for LDPC  For an MU PPDU, if the MU[0] NSTS subfield is non-zero, then B2 indicates the coding used for user 0; set to 0 for BCC and 1 for LDPC. If the MU[0] NSTS subfield is 0, then this subfield is reserved and set to 1. | | B3 | LDPC Extra OFDM Symbol | 1 | Set to 1 if the LDPC PPDU encoding process (if an SU PPDU), or at least one LPDC user’s PPDU encoding process (if an MU PPDU), results in an extra OFDM symbol (or symbols) as described in 22.3.10.5.4 (LDPC coding  ) and 22.3.10.5.5 (Encoding process for MU PPDUs  ). Set to 0 otherwise. | | B4-B7 | SU MCS/MU[1-3] Coding | 4 | For an SU PPDU:  MCS index  For an MU PPDU:  If the MU[1] NSTS subfield is non-zero, then B4 indicates coding for user 1: set to 0 for BCC, 1 for LDPC. If NSTS for user 1 is 0, then B4 is reserved and set to 1.  If the MU[2] NSTS subfield is non-zero, then B5 indicates coding for user 2: set to 0 for BCC, 1 for LDPC. If the MU[2] NSTS subfield is 0, then B5 is reserved and set to 1.  If the MU[3] NSTS subfield is non-zero, then B6 indicates coding for user 3: set to 0 for BCC, 1 for LDPC. If the MU[3] NSTS subfield is 0, then B6 is reserved and set to 1.  B7 is reserved and set to 1 | | B8 | Beamformed | 1 | For an SU PPDU:  Set to 1 if a Beamforming steering matrix is applied to the waveform in an SU transmission as described in 20.3.11.11.2 (Spatial mapping), set to 0 otherwise.  For an MU PPDU:  Reserved and set to 1 | | B9 | Reserved | 1 | Reserved and set to 1 | | B10-B17 | CRC | 8 | CRC calculated as in 20.3.9.4.4 (CRC calculation for HT-SIG) with c7 in B10. Bits 0-23 of HT-SIG1 and bits 0-9 of HT-SIG2 are replaced by bits 0-23 of VHT-SIG-A1 and bits 0-9 of VHT-SIG-A2 respectively. | | B18-B23 | Tail | 6 | Used to terminate the trellis of the convolutional decoder. Set to 0. |   NOTE—Integer subfields are represented in unsigned binary format with the least significant bit in the lowest numbered bit position.  **TGac editor: modify the D2.1 text from P210L46, as follows**  As indicated by Equation (22-8) and Equation (22-29), the duration of the VHT-STF field is  regardless of the Short GI subfield setting in VHT-SIG-A.  **TGac editor: modify the D2.1 text from P214L36, as follows**  As indicated by Equation (22-8) and Equation (22-38), the duration of each VHT-LTF symbol is  regardless of the Short GI subfield setting in VHT-SIG-A.  **TGac editor: modify the D2.1 text from P214L36, as follows**  The VHT-SIG-B field is one symbol and contains 26 bits in a 20 MHz PPDU, 27 bits in a 40 MHz PPDU and 29 bits in 80 MHz, 160 MHz and 80+80 MHz PPDUs. The subfields in the VHT-SIG-B field are listed in Table 22-14 (Subfields in the VHT-SIG-B field). For subfields consisting of multiple bits, the LSB of the value occupies the lowest numbered bit of the subfield. For example, for an MU transmission using MCS 5 (0101 in binary) in 20 MHz bandwidth, the VHT-SIG-B field bits are set as follows: B16=1, B17=0, B18=1 and B19=0.   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | * Subfields in the VHT-SIG-B field | | | | | | | | | Subfield | MU PPDU Allocation (bits) | | | SU PPDU Allocation (bits) | | | Description | |  | 20 MHz | 40 MHz | 80 MHz, 160 MHz,  80+80 MHz | 20 MHz | 40 MHz | 80 MHz  ,  160 MHz,  80+80 MHz |  | | VHT-SIG-B Length | B0-B15  (16) | B0-B16  (17) | B0-B18  (19) | B0-B16  (17) | B0-B18  (19) | B0-B20  (21) | Length of A-MPDU pre-EOF padding in units of 4 octets | | MCS | B16-B19  (4) | B17-B20  (4) | B19-B22  (4) | N/A | N/A | N/A |  | | Reserved | N/A | N/A | N/A | B17-B19  (3) | B19-B20  (2) | B21-B22  (2) | All ones | | Tail | B20-B25  (6) | B21-B26  (6) | B23-B28  (6) | B20-B25  (6) | B21-B26  (6) | B23-B28  (6) | All zeros | | Total # bits | 26 | 27 | 29 | 26 | 27 | 29 |  |   NOTE—Varying the VHT-SIG-B Length subfield size ensures that a consistent maximum PPDU duration of approximately 5.46 ms (the maximum PPDU duration from the L-SIG field) is maintained across all channel widths with both SU and MU formats.  The VHT-SIG-B Length subfield shall be set using Equation (22-42)  (22-42)  where  APEP\_LENGTH is the TXVECTOR parameter APEP\_LENGTH (in octets)  NOTE—The number of octets represented by the VHT-SIG-B Length subfield will not exceed the PSDU\_LENGTH determined by Equation (22-108), Equation (22-109) and Equation (22-110) by more than 3 octets.  The VHT-SIG-B bits for an NDP transmission in various channel widths shall be set as defined in Table 22-15 (VHT-SIG-B bits in NDP for various channel widths).  **TGac editor: modify the D2.1 text from P216L39, as follows**  The 800 ns guard interval is always applied to the VHT-SIG-B symbol, regardless of the value of the Short GI subfield in VHT-SIG-A. The time domain waveform for the VHT-SIG-B field in a VHT PPDU shall as specified in Equation (22-43).  **TGac editor: modify the D2.1 text from P219L31, as follows**  The number of OFDM symbols in the Data field is determined by the Length subfield in L-SIG (see Equation (22-20)), the preamble duration and the setting of the Short GI subfield in VHT-SIG-A (see 22.3.8.2.3 (VHT-SIG-A definition)  **TGac editor: modify the D2.1 text from P220L40, as follows**   |  |  |  | | --- | --- | --- | | * SERVICE field | | | | Bits | Subfield | Description | | B0-B6 | Scrambler Initialization | Set to 0 | | B7 | Reserved | Set to 0 | | B8-B15 | CRC | CRC calculated over VHT-SIG-B (excluding tail bits) |   **TGac editor: modify the D2.1 text from P221L19, as follows**  The value of the CRC subfield shall be the ones complement of  Equation (22-55).  (22-55)  where    *N* is the number of bits over which the CRC is generated; 20 for 20 MHz, 21 for 40 MHz and 23 for 80 MHz/160 MHz/80+80 MHz  is bit *i* of VHT-SIG-B  are initialized values that are added modulo 2 to the first 8 bits of VHT-SIG-B  is the CRC generating polynomial    Figure 20-8 shows the operation of the CRC. First, the shift register is reset to all ones. The bits are then passed through the XOR operation at the input. When the last bit has entered, the output is generated by shifting the bits out of the shift register, *c7* first, through an inverter.  As an example, if bits {*m0*, … *m22*} are given by {1 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1}, the CRC bits {*c7*, … *c0*} are {0 0 0 1 1 1 0 0}.  The CRC subfield is transmitted with *c7* first. Hence, *c7* is mapped to B8 of the SERVICE field, *c6* is mapped to B9, …, and *c0* is mapped to B15 of the SERVICE field.  **TGac editor: modify the D2.1 text from P222L06, as follows**  The Data field shall be encoded using either the binary convolutional code (BCC) defined in 22.3.10.5.2 (BCC encoder parsing operation) and 22.3.10.5.3 (Binary convolutional coding and puncturing), or the low density parity check (LDPC) code defined in 22.3.10.5.4 (LDPC coding). The encoder is selected by the SU/MU[0] Coding, MU[1] Coding, MU[2] Coding, or MU[3] Coding subfield in VHT-SIG-A, as defined in 22.3.8.2.3 (VHT-SIG-A definition). When BCC FEC encoding is used, the number of encoders is determined by rate-dependent parameters as defined in 22.5 (Parameters for VHT MCSs). The operation of the BCC FEC is described in 22.3.10.5.2 (BCC encoder parsing operation) and 22.3.10.5.3 (Binary convolutional coding and puncturing). The operation of the LDPC coder is described in 22.3.10.5.4 (LDPC coding). Support for the reception of a BCC encoded Data field is mandatory.  **TGac editor: modify the D2.1 text from P223L36, as follows**  In addition, if  computed in Equation (20-41) in step (d) of 20.3.11.7.5 (LDPC PPDU encoding process) is greater than , then the LDPC Extra OFDM Symbol subfield of VHT-SIG-A2 shall be set to 1. Otherwise, the LDPC Extra OFDM Symbol subfield of VHT-SIG-A2 shall be set to 0.  LDPC codes used in MU PPDUs shall also follow the definitions in 20.3.11.7 (LDPC codes). Refer to 22.3.10.5.5 (Encoding process for MU PPDUs) for a description of the LDPC encoding process for MU PPDUs.  **TGac editor: modify the D2.1 text from P225L18, as follows**  In addition, if *NSYM* computed in Equation (22-63) is greater than  computed in Equation (22-61), then the LDPC Extra OFDM Symbol subfield of VHT-SIG-A2 shall be set to 1. Otherwise, the LDPC Extra OFDM Symbol subfield of VHT-SIG-A2 shall be set to 0.  **TGac editor: modify the D2.1 text from P236L44, as follows**  This subclause defines a set of optional robust transmission techniques that are applicable only when using STBC coding. In this case, *NSS,u* spatial streams for user *u* are mapped to *NSTS,u* space-time streams. These techniques are based on STBC. When the VHT-SIG-A STBC subfield is 1, a symbol operation shall occur between the constellation mapper and the spatial mapper as defined in this subclause.  **TGac editor: modify the D2.1 text from P240L07, as follows**  is the guard interval duration.  when not using the short guard interval (Short GI subfield of VHT-SIG-A2 is 0) and  when using the short guard interval (Short GI subfield of VHT-SIG-A2 is 1).  and  are given in Table 22-5 (Timing-related constants).  **TGac editor: modify the D2.1 text from P241L20, as follows**  When the TXVECTOR parameter FORMAT is NON\_HT and the TXVECTOR parameter NON\_HT\_MODULATION is NON\_HT\_DUP\_OFDM, the transmitted PPDU shall be a non-HT duplicate. Non-HT duplicate transmission is used to transmit to non-HT OFDM STAs, HT STAs, or VHT STAs that may be present in a part of a 40 MHz, 80 MHz or 160 MHz channel. The VHT-SIG-A, VHT-STF, VHT-LTF and VHT-SIG-B fields are not transmitted. The L-STF, L-LTF, and L-SIG fields shall be transmitted in the same way as in the VHT transmission, with the exceptions for the Rate and Length subfields listed in 22.3.8.1.4 (L-SIG definition)  **TGac editor: modify the D2.1 text from P242L54, as follows**  The MU-MIMO steering matrix  can be determined by the beamformer using the beamforming feedback matrices for subcarrier *k* from beamformee *j*, *Vk,j,* and SNR information fpr subcarrier *k* from beamformee *j*, *SNRk,j*, where . The steering matrix that is computed (or updated) using new beamforming feedback matrices and new SNR information from some or all of participating beamformees might replace the existing steering matrix for the next MU-MIMO data transmission. When there is feedback information from more than *Nu* STAs available at the beamformer, the beamformer may choose a beamformee group of *Nu* STAs for an MU transmission for which the steering matrix can be designed to reduce interference between the signals intended for different beamformees. The beamformee group for the MU transmission is signaled using the Group ID subfield in VHT-SIG-A (see 22.3.8.2.3 (VHT-SIG-A definition) and 22.3.11.4 (Group ID)).  **TGac editor: modify the D2.1 text from P243L43, as follows**  A value in the Group ID subfield in VHT-SIG-A (see 22.3.8.2.3 (VHT-SIG-A definition)) in the range 1 to 62 indicates an MU(Ed) PPDU. Prior to transmitting an(#4234) MU(Ed) PPDU, group assignments have been established by the AP for MU-MIMO capable STAs using the Group ID Management frame as defined in 8.5.23.3 (Group ID Management frame format).  When a STA receives a Group ID Management frame, the STA's MLME configures the following lookup tables in the PHY using the PHYCONFIG\_VECTOR parameter GROUP\_ID\_MANAGEMENT:   * group ID(#4829) to Membership Status, denoted by MembershipStatusInGroupID[*g*] for * group ID(#4829) to User Position, denoted by UserPositionInGroupID[*g*] for   When a STA that has these lookup tables configured receives an(#4234) MU PPDU with the Group ID subfield in VHT-SIG-A1 for which MembershipStatusInGroupID[*k*] is equal to 1, where *k* is the group ID in VHT-SIG-A1, then the number of space time streams for that STA is indicated in the MU[UserPositionInGroupID[*k*]] NSTS subfield in VHT-SIG-A1. The space time streams for the STA follow the space time streams indicated by the MU[0] NSTS, MU[1] NSTS, …, MU[3] NSTS subfields in VHT-SIG-A1.  For group IDs whose corresponding Membership Status subfield is set to 1 in the Group ID Management frame, the User Position subfield determines which of the four sets of 3 bits in the NSTS subfield in VHT-SIG-A corresponds to the user in an MU transmission. When an MU PPDU is received, each STA identifies whether it is a member of the group for this PPDU by detecting the Group ID subfield in VHT-SIG-A. If a STA finds that it is a member of the group for the MU PPDU, the STA reads the number of space-time streams from its corresponding 3 bits in the NSTS subfield in VHT-SIG-A as determined by the group definition of the corresponding group ID. At this point, a STA is also able to identify which space-time streams correspond to its own signal and which streams correspond to interference. For an MU transmission, VHT-LTF symbols are used to measure not only the channel for a beamformee’s designated signals but also to measure the channel for the interfering signals at the beamformee. While receiving an MU transmission, it is recommended that the receiver uses its channel knowledge to all spatial streams (including those that are interference) to do receive processing, in order to reduce potential interference from other users' space-time streams.  **TGac editor: modify the D2.1 text from P244L42, as follows**  NOTE—The number of VHT-LTF symbols in the NDP is determined by the SU NSTS subfield in VHT-SIG-A.  The VHT NDP PPDU has the following properties:   * uses the VHT PPDU format but without the Data field * is an SU PPDU as indicated by the VHT-SIG-A field * has the data bits of the VHT-SIG-B field set to a fixed bit pattern (see 22.3.8.2.6 (VHT-SIG-B definition))   **TGac editor: modify the D2.1 text from P261L03, as follows**  A typical PLCP receive procedure is shown in Figure 22-30 for VHT format. A typical state machine implementation of the receive PLCP is given in Figure 22-31. This receive procedure and state machine do not describe the operation of optional features, such as LDPC, STBC or partial AID(#4829). If the detected format indicates a NON\_HT PPDU(#4734), refer to the receive procedure and state machine in Clause 18. If the detected format indicates an HT PPDU format, refer to the receive procedure and state machine in Clause 20. Further, through station management (via the PLME) the PHY is set to the appropriate frequency, as specified in 22.4 (VHT PLME). Other receive parameters, such as RSSI and indicated DATARATE, may be accessed via the PHY-SAP.  Upon the PMD receiving the transmitted PLCP preamble, PMD\_RSSI.indication shall report a receive signal strength to the PLCP. This activity is indicated by the PLCP to the MAC via a PHY-CCA.indication. A PHY-CCA.indication(BUSY, channel-list) is also issued as an initial indication of reception of a signal as specified in 22.3.19.5 (CCA sensitivity  ). The channel-list parameter of the PHY-CCA.indication is absent when the operating channel width is 20 MHz and the channel-list parameter includes the element “primary” when the operating channel width is 40 MHz, 80 MHz, 160 MHz or 80+80 MHz.  The PMD primitive PMD\_RSSI is issued to the PLCP, which records the received RSSI value. The PLCP includes the most recently received RSSI value in the PHY-RXSTART.indication(RXVECTOR) primitive issued to the MAC.  After the PHY-CCA.indication(BUSY, channel-list) is issued, the PHY entity shall begin receiving the training symbols and searching for L-SIG in order to set the maximum duration of the data stream. If the check of the L-SIG parity bit is not valid, a PHY-RXSTART.indication is not issued, and instead the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation). If a valid L-SIG parity bit is indicated, the VHT PHY shall maintain PHY-CCA.indication(BUSY, channel-list) for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (), for all supported modes, unsupported modes, Reserved VHT-SIG-A Indication, invalid VHT-SIG-A CRC and invalid L-SIG Length subfield value. An invalid L-SIG Length subfield value is defined as a value not following Equation (22-20). Reserved VHT-SIG-A Indication is defined as a VHT-SIG-A with Reserved bits equal to 0 or MU[*u*] NSTS subfields (*u* = 0, 1, 2, 3) set to 5-7 or Short GI subfield set to 0 and Short GI NSYM Disambiguation subfield set to 1, or a combination of MCS and NSTS not included in 22.5 (Parameters for VHT MCSs) or any other VHT-SIG-A field bit combinations that do not correspond to modes of PHY operation defined in Clause 22. If the VHT-SIG-A indicates an unsupported mode, the PHY shall issue the error condition PHY-RXEND.indication(UnsupportedRate). If the VHT-SIG-A indicates an invalid CRC or Reserved VHT-SIG-A Indication or if the L-SIG Length subfield is invalid, the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation).  After receiving a valid L-SIG and VHT-SIG-A indicating a supported mode, the PHY entity shall begin receiving the VHT training symbols and VHT-SIG-B. If the received group ID(#4829) in VHT-SIG-A has a value indicating an SU PPDU (see 9.17a (Group ID and partial(#4829) AID in VHT PPDUs)), the PHY entity may choose not to decode VHT-SIG-B. If VHT-SIG-B is not decoded, subsequent to an indication of a valid VHT-SIG-A CRC, a PHY-RXSTART.indication(RXVECTOR) shall be issued. The RXVECTOR associated with this primitive includes the parameters specified in Table 22-1 (TXVECTOR and RXVECTOR parameters).  If the Group ID subfield in VHT-SIG-A has a value indicating an MU PPDU (see 9.17a (Group ID and partial(#4829) AID in VHT PPDUs)), the PHY shall decode VHT-SIG-B. If the VHT-SIG-B indicates an unsupported mode, the PHY shall issue the error condition PHY-RXEND.indication(UnsupportedRate).  If VHT-SIG-B was decoded the PHY may check the VHT-SIG-B CRC in the SERVICE field. If the VHT-SIG-B CRC in the SERVICE field is not checked a PHY-RXSTART.indication(RXVECTOR) shall be issued. The RXVECTOR associated with this primitive includes the parameters specified in Table 22-1 (TXVECTOR and RXVECTOR parameters).  Following training and signal fields, the coded PSDU (C-PSDU) (which comprises the scrambled and coded PLCP SERVICE field, PSDU and pad) shall be received. The number of symbols in the C-PSDU is determined by Equation (22-101)  .      where      The value of the PSDU\_LENGTH parameter returned in the RXVECTOR using BCC encoding is calcualted using Equation (22-102). The value of the PSDU\_LENGTH parameter returned in the RXVECTOR for an NDP is 0.      where  is given by Equation (22-101)  denotes the largest integer smaller than or equal to  is defined in Table 22-6 (Frequently used parameters)  is defined in Table 22-6 (Frequently used parameters)  and  are defined in Table 22-5 (Timing-related constants)  For an SU PPDU, the SU/MU[0] Coding subfield of VHT-SIG-A2 indicates the type of coding. The PHY entity shall use an LDPC decoder to decode the C-PSDU if this bit is 1, otherwise a BCC decoder shall be used. For an MU transmission, the SU/MU[0] Coding, MU[1] Coding, MU[2] Coding and MU[3] Coding subfields of VHT-SIG-A2 indicate the type of coding for user 0, 1, 2 and 3, respectively. The PHY entity shall use an LDPC decoder to decode the C-PSDU for the respective user if its bit for its C-PSDU is 1. A BCC decoder shall be used otherwise. When an LDPC decoder is to be used,  can be computed by Equation (22-57) using  obtained from Equation (22-103).        where  LDPC Extra OFDM Symbol and STBC are subfields in VHT-SIG-A (see Table 22-12 (Subfields in the VHT-SIG-A field))(#4221)  The value of the PSDU\_LENGTH parameter returned in the RXVECTOR using LDPC encoding is calculated using Equation (22-104).      where  is given by Equation (22-103)  is defined in Table 22-6 (Frequently used parameters)  is defined in Table 22-5 (Timing-related constants)  If VHT-SIG-B is decoded and the VHT-SIG-B CRC in the SERVICE field is checked and not valid, the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation). If the VHT-SIG-B field is decoded and the VHT-SIG-B CRC subfield is checked and valid, a PHY-RXSTART.indication(RXVECTOR) shall be issued. The RXVECTOR associated with this primitive includes the parameters specified in Table 22-1 (TXVECTOR and RXVECTOR parameters).  If signal loss occurs during reception prior to completion of the PSDU reception, the error condition PHY-RXEND.indication(CarrierLost) shall be reported to the MAC. After waiting for the end of the PSDU as determined by Equation (), the PHY shall set PHY-CCA.indication(IDLE) and return to the RX IDLE state.  The received PSDU bits are assembled into octets, decoded, and presented to the MAC using a series of PHY-DATA.indication(DATA) primitive exchanges. Any final bits that cannot be assembled into a complete octet are considered pad bits and discarded. After the reception of the final bit of the last PSDU octet, and possible padding and tail bits, the receiver shall be returned to the RX IDLE state, as shown in Figure 22-31. | | | | | | | |