### IEEE P802.11 Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 11be D1.0 CR for EHT OM part II | | | | |
| Date: 2021-07-27 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Po-Kai Huang | Intel Corporation | 2200 Mission College Blvd, Santa Clara, CA 950542200 |  | po-kai.huang@intel.com |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Abstract

This submission proposes resolutions for the following CIDs:

8156

6606, 5799, 8155, 5800

4164

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Add CID 8156
* Rev 2: Editorial revision on adding equation number
* Rev 3: Move OMN statement together with 11ax description.
* Rev 4: Changes based on the discussion during the call.

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 TGbe D1.0 Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGbe D1.0 Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 8156 | Yunbo Li | 9.2.4.6a.8 | 72.31 | "spatia"-->"spatial" | as in comment | Revised –  We do the editorial fix.  TGbe editor to make the changes shown in 11-21/1209r4 under all headings that include CID 8064. |
| Comments on greater than 80 MHz | | | | | | |
| 6606 | Po-Kai Huang | 35.7.1 | 299.07 | Describe how to convert RX NSS to RX NSS for a given EHT-MCS | As in comment. | Revised –  Agree with the commenter.  TGbe editor to make the changes shown in 11-21/1249r4 under all headings that include CID 6606. |
| 5799 | Lei Huang | 9.2.4.6a.8 | 72.32 | Currently, only how to determine the maximum Rx NSS for non-EHT PPDU bandwidths greater than 80 MHz if the operating channel width of the STA is greater than 80 MHz is defined. However, it is unclear how to determine the maximum Rx NSS for EHT PPDU bandwidths greater than 80 MHz if the operating channel width of the STA is greater than 80 MHz. | define how to determine the maximum Rx NSS for EHT PPDU bandwidths greater than 80 MHz if the operating channel width of the STA is greater than 80 MHz. | Revised –  Agree with the commenter.  TGbe editor to make the changes shown in 11-21/1249r4 under all headings that include CID 6606. |
| 8155 | Yunbo Li | 9.2.4.6a.8 | 72.31 | The spatial streams for EHT PPDU bandwidths greater than 80MHz is missing | as in comment | Revised –  Agree with the commenter.  TGbe editor to make the changes shown in 11-21/1249r4 under all headings that include CID 6606. |
| 5800 | Lei Huang | 9.2.4.6a.8 | 73.01 | According to EHT Capabilities element, maximum Tx NSS depends on PPDU bandwidth. However, maximum Tx NSTS indicated in EHT OM Control subfield and OM Control subfield is independent of PPDU bandwidth. It is better to align both so that maximum Tx NSTS indicated in EHT OM Control subfield and OM Control subfield may depend on PPDU bandwidth as well. | define how to determine the maximum Tx NSTS for different EHT PPDU bandwidths in a similar manner to maximum Rx NSS. | Rejected –  We note that 11ax also defines different Tx NSTS indication for different bandwidth but the OM description does not have further bifurcation other than the following.  *A non-AP STA sets the Tx NSTS subfield to NSTS – 1, where NSTS is the maximum number of space-time streams that the non-AP STA supports in transmission.*  For 11be, we already have the following.  *The Tx NSTS Extension subfield in EHT OM Control subfield together with the Tx NSTS subfield in OM subfield indicates the maximum number of space-time streams, NSTS, that the STA supports in transmission, where the Tx NSTS Extension subfield provides the MSB of the and the TX NSTS subfield provides the three LSBs of the NSTS, and is set to NSTS-1* |

**Discussion:**

**Baseline text**

1. *If the operating channel width of the STA is less than or equal to 80 MHz, then the Rx NSS subfield indicates the maximum number of spatial streams, NSS, that the STA supports in reception and is set to NSS – 1.*
2. *If the operating channel width of the STA is greater than 80 MHz, then the Rx NSS subfield indicates the maximum number of spatial streams, NSS, that the STA supports in reception for PPDU bandwidths less than or equal to 80 MHz and is set to NSS – 1.*
3. *If the operating channel width of the STA is greater than 80 MHz, then the maximum number of spatial streams that the STA supports in reception for PPDU bandwidths greater than 80 MHz is defined in 26.9 (Operating mode indication).*
4. *A non-AP STA sets the Tx NSTS subfield to NSTS – 1, where NSTS is the maximum number of space-time streams that the non-AP STA supports in transmission.*

***EHT Text:***

1. *If the operating channel width of the STA is less than or equal to 80 MHz, then the Rx NSS Extension subfield in the EHT OM Control subfield together with the Rx NSS subfield in the OM Control subfield indicate the maximum number of spatial streams, Nss, that the STA supports in reception, where the Rx NSS Extension subfield provides the MSB of the Nss and the Rx NSS subfield provides the three LSBs of the Nss, and is set to Nss -1.*
2. *If the operating channel width of the STA is greater than 80 MHz, then the Rx NSS Extension subfield in the EHT OM Control subfield together with the Rx NSS subfield in the OM Control subfield indicate the maximum number of spatial streams, Nss, that the STA supports in reception, where the Rx NSS Extension subfield provides the MSB of the and the Rx NSS subfield provides the three LSBs of the , for PPDU bandwidths less than or equal to 80 MHz and is set to Nss-1.*
3. *If the operating channel width of the STA is greater than 80 MHz, then the maximum number of spatial streams that the STA supports in reception for non-EHT PPDU bandwidths greater than 80 MHz is defined in 26.9 (Operating mode indication).*
4. *The Tx NSTS Extension subfield in EHT OM Control subfield together with the Tx NSTS subfield in OM subfield indicates the maximum number of space-time streams, Nsts, that the STA supports in transmission, where the Tx NSTS Extension subfield provides the MSB of the Nsts and the TX NSTS subfield provides the three LSBs of the Nsts, and is set to Nsts-1.*

Summary based on the texts above

|  |  |  |
| --- | --- | --- |
|  | Tx | Rx |
| Operating channel width <= 80 MHz  Use only OM Control | Cover all PPDU format in 4 | Cover all PPDU format in 1 |
| Operating channel width <= 80 MHz  Use EHT OM Control combined with OM control | Cover all PPDU format in 8 | Cover all PPDU format in 5 |
| Operating channel width > 80 MHz  Use only OM Control | Cover all PPDU format in 4 | Cover all PPDU format with bandwidths less than or equal to 80 MHz in 2  Cover all non-EHT PPDU format with bandwidths > 80 MHz in 3  Miss EHT PPDU format with bandwidths > 80 MHz |
| Operating channel width > 80 MHz  Use EHT OM Control combined with OM control | Cover all PPDU format in 8 | Cover all PPDU format with bandwidths less than or equal to 80 MHz in 6  Cover all non-EHT PPDU format with bandwidths > 80 MHz in 7  Miss EHT PPDU format with bandwidths > 80 MHz |

To address the gaps, we propose to follow the 11ax formula (shown below) and extend that to EHT.

If the operating channel width of the STA is greater than 80 MHz, then the maximum number of spatial  
streams that the STA supports in reception for a given HE-MCS as a function of the received HE PPDU  
bandwidth *BW* at an HE STA transmitting an OM Control subfield is defined in Equation (26-4).  
floor (*Rx-NSS-from-OMI* × (*Max-HE-NSS-at-BW* / *Max-HE-NSS-at-80*)) (26-4)  
where  
*- Rx-NSS-from-OMI* is Rx NSS from the OM Control subfield transmitted by the STA

-*Max-HE-NSS-at-BW* is the maximum NSS among all HE-MCS at *BW* MHz from the Supported HE-MCS  
 And NSS Set field transmitted by the STA as described in 26.15.4 (Rate selection constraints for HE STAs)

- *Max-HE-NSS-at-80* is the maximum NSS among all HE-MCS at 80 MHz from the Supported HE-MCS  
 And NSS Set field transmitted by the STA  
NOTE—If the operating channel width of the STA is greater than 80 MHz, then the Rx NSS subfield indicates the maximum number of spatial streams for PPDU bandwidths that are equal to or less than 80 MHz. If the operating channel  
width of the STA is less than or equal to 80 MHz, then the Rx NSS subfield indicates the maximum number of spatial  
streams, *NSS*, that the STA supports in reception.

**Propose:**

***TGbe editor: Insert the following after the paragraph “If the operating channel width of the STA is greater than 80 MHz, then the maximum number of spatia streams that the STA supports in reception for non-EHT PPDU bandwidths..” in 9.2.4.6a.8 EHT OM Control(#6606)***

If the operating channel width of the STA is greater than 80 MHz, then the maximum number of spatial streams that the STA supports in reception for EHT PPDU bandwidths greater than 80 MHz is defined in 35.7 (Operating mode indication).

***TGbe editor: Insert the following at the end of 35.7 Operating mode indication(#6606)***

If the operating channel width of the STA is greater than 80 MHz, then the maximum number of spatial streams that the STA supports in reception for a given EHT-MCS as a function of the received EHT PPDU bandwidth BW at an EHT STA transmitting only an OM Control subfield or an EHT OM Control subfield combined with an OM Control subfield is defined in Equation (xx-x).

floor (*Rx-NSS-from-OMI* × (*Max-EHT-NSS-at-BW* / *Max-EHT-NSS-at-80*)) (xx-x)

where

* *Rx-NSS-from-OMI* is *Nss* indicated by the Rx NSS subfield in the OM Control subfield (see 9.2.4.6a.2 OM Control) or indicated by the Rx NSS Extension subfield in the EHT OM Control subfield combined with the Rx NSS subfield in the OM Control subfield (see 9.2.4.6a.8 EHT OM Control) transmitted by the STA
* *Max-EHT-NSS-at-BW* is the maximum NSS among all EHT-MCS at BW MHz from the Supported EHT-MCS And NSS Set field (see 9.4.2.295c.4 Supported EHT-MCS And NSS Set field) transmitted by the STA
* *Max-EHT-NSS-at-80* is the maximum NSS among all EHT-MCS at 80 MHz from the Supported EHT-MCS And NSS Set field (see 9.4.2.295c.4 Supported EHT-MCS And NSS Set field) transmitted by the STA

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| OMN comments | | | | | | |
| 4164 | Alfred Asterjadhi | 35.7.1 | 299.28 | Clause 26.9 says that an HE STA (which EHT STA is one) may change OM by using OMN procedure. But OMN procedure has not defined anything for these extra functionalities. Hence, we need to clarify whether and how OMN switch is performed by EHT STAs with these expanded capabilities. | As in comment. | Revised –  A EHT STA is an HE STA, so rules defined in 26.9 apply for the OMN mechanism defined in 11.40 Notification of operating mode changes.  We provide necessary change to support EHT PPDU when OMN is used.  TGbe editor to make the changes shown in 11-21/1249r4 under all headings that include CID 4164. |

**Discussion:**

**Baseline text:**

*A STA in which dot11OperatingModeNotificationImplemented is true shall set the Operating Mode  
Notification field in the Extended Capabilities element to 1. A VHT STA shall set  
dot11OperatingModeNotificationImplemented to true.*

*An HE STA can change its operating mode setting using either operating mode notification as described in  
11.42 (Notification of operating mode changes), or the operating mode indication (OMI) procedure  
described in this subclause.*

**Propose for CID 4164:**

***TGbe editor: Modify 9.4.1.53 Operating Mode field as follows (track change on) (#4164)***

* Operating Mode field

The Operating Mode field is present in the Operating Mode Notification frame (see 9.6.22.4 (Operating Mode Notification frame format)) and Operating Mode Notification element (see 9.4.2.165 (Operating Mode Notification element)).

The Operating Mode field for a non-S1G STA is shown in Figure 9-164 (Operating Mode field format when it is carried in a non-S1G PPDU).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B0 B1 | B2 | B3 | B4 B6 | B7 |
|  | Channel Width | 160/80+80 BW | No LDPC | Rx NSS | Rx NSS Type |
| Bits: | 2 | 1 | 1 | 3 | 1 |
| * Operating Mode field format when it is carried in a non-S1G PPDU | | | | | |

The Operating Mode field in an S1G PPDU is shown in Figure 9-165 (Operating Mode field format when it is carried in an S1G PPDU).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 B2 | B3 B4 | B5 B6 | B7 |
|  | Channel Width | Reserved | Rx NSS | Rx NSS Type |
| Bits: | 3 | 2 | 2 | 1 |
| * Operating Mode field format when it is carried in an S1G PPDU | | | | |

The STA transmitting this field indicates its current operating channel width and the number of spatial streams it can receive using the settings defined in Table 9-103 (Subfield values of the Operating Mode field).

|  |  |
| --- | --- |
| * Subfield values of the Operating Mode field | |
| Subfield | Description |
| Channel Width | If the Rx NSS Type subfield is 0, indicates the supported channel width:  In a VHT STA, see Table 9-104 (Setting of the Channel Width subfield and 160/80+80 BW subfield at a VHT STA transmitting the Operating Mode field)  In a TVHT STA:  Set to 0 for TVHT\_W  Set to 1 for TVHT\_2W and TVHT\_W+W  Set to 2 for TVHT\_4W and TVHT\_2W+2W  The value 3 is reserved.  In an S1G STA:  Set to 0 for 1 MHz  Set to 1 for 2 MHz  Set to 2 for 4 MHz  Set to 3 for 8 MHz  Set to 4 for 16 MHz  Reserved for values 5-7  Reserved if the Rx NSS Type subfield is 1. |
| 160/80+80 BW | This subfield, combined with the Channel Width subfield, the Supported Channel Width Set subfield and the Supported VHT-MCS and NSS Set subfield indicates whether 80+80 MHz and 160 MHz operation is supported.  In a VHT STA, see Table 9-104 (Setting of the Channel Width subfield and 160/80+80 BW subfield at a VHT STA transmitting the Operating Mode field).  In a TVHT STA, this field is reserved.  In a STA with dot11VHTExtendedNSSBWCapable either equal to false or not present, this field is set to 0. |
| No LDPC | Set to 1 to indicate that the STA transmitting this field prefers not to receive LDPC-encoded PPDUs; set to 0 otherwise. |
| Rx NSS | If the STA that transmits the Operating Mode field (STA1) and the receiver of the Operating Mode field (STA2) are not both HE STAs and if the Rx NSS Type subfield is 0, then this field, combined with other information described in 9.4.2.157.3 (Supported VHT-MCS and NSS Set field), indicates the maximum number of spatial streams that STA1 can receive.(11ax)  (11ax)If the STA that transmits the Operating Mode field (STA1) and the receiver of the Operating Mode field (STA2) are both HE STAs and if the Rx NSS Type subfield is 0, then the following apply:   * The value of this field, combined with other information described in 9.4.2.157.3 (Supported VHT-MCS and NSS Set field), indicates the maximum number of spatial streams that the HE STA can receive in a VHT PPDU. * The value of this field, combined with other information described in 9.4.2.248.4 (Supported HE-MCS And NSS Set field), indicates the maximum number of spatial streams that STA1 can receive in an HE PPDU. * If both STAs are also EHT STAs, then the value of this field, combined with other information described in 9.4.2.295c.4 (Supported EHT-MCS And NSS Set field), indicates the maximum number of spatial streams that STA1 can receive in an EHT PPDU.   If the Rx NSS Type subfield is 1, this field indicates the maximum number of spatial streams that the STA can receive as a beamformee in an SU PPDU using a beamforming steering matrix derived from a VHT Compressed Beamforming report with Feedback Type subfield indicating MU in the corresponding VHT Compressed Beamforming frame sent by the STA.  In a non-S1G STA:  Set to 0 for *NSS* = 1  Set to 1 for *NSS* = 2  …  Set to 7 for *NSS* = 8  In an S1G STA:  Set to 0 for *NSS* = 1  Set to 1 for *NSS* = 2  Set to 2 for *NSS* = 3  Set to 3 for *NSS* = 4  NOTE—In a STA with dot11VHTExtendedNSSBWCapable equal to true, NSS might be further modified for VHT PPDUs per Table 9-104 (Setting of the Channel Width subfield and 160/80+80 BW subfield at a VHT STA transmitting the Operating Mode field). In an HE STA with dot11VHTExtendedNSSBWCapable equal to true, NSS might be further modified for HE PPDUs per Equation (9-5).(11ax) In an EHT STA with dot11VHTExtendedNSSBWCapable equal to true, NSS might be further modified for EHT PPDUs per Equation (9-xx). |
| Rx NSS Type | Set to 0 to indicate that the Rx NSS subfield carries the maximum number of spatial streams that the STA can receive in any PPDU.  Set to 1 to indicate that the Rx NSS subfield carries the maximum number of spatial streams that the STA can receive as a beamformee in an SU PPDU using a beamforming steering matrix derived from a VHT Compressed Beamforming report with the Feedback Type subfield indicating MU in the corresponding VHT Compressed Beamforming frame sent by the STA.  NOTE—An AP always sets this field to 0. |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| * Setting of the Channel Width subfield and 160/80+80 BW subfield at a VHT STA transmitting the Operating Mode field | | | | | | | | | | |
| Transmitted Operating Mode field | | VHT Capabilities of STA transmitting the Operating Mode field | | NSS support of STA transmitting the Operating Mode field as a function of the VHT PPDU (×Max VHT NSS) (see requirements R4 and R4) | | | | | Location of 160 MHz center frequency if BSS bandwidth is 160 MHz | Location of secondary 80 MHz center frequency if BSS bandwidth is 80+80 MHz |
| Channel width | 160/80+80 BW | Supported Channel Width Set | Extended NSS BW Support | 20 MHz | 40 MHz | 80 MHz | 160 MHz | 80  +80 MHz |
| 0 | 0 | 0-2 | 0-3 | 1 |  |  |  |  |  |  |
| 1 | 0 | 0-2 | 0-3 | 1 | 1 |  |  |  |  |  |
| 2 | 0 | 0-2 | 0-3 | 1 | 1 | 1 |  |  |  |  |
| 2 | 1 | 0 | 1 | 1 | 1 | 1 | 1/2 |  | CCFS2 |  |
| 2 | 1 | 0 | 2 | 1 | 1 | 1 | 1/2 | 1/2 | CCFS2 | CCFS2 |
| 2 | 1 | 0 | 3 | 1 | 1 | 1 | 3/4 | 3/4 | CCFS2 | CCFS2 |
| 2 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |  | CCFS1 |  |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1/2 | CCFS1 | CCFS2 |
| 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 3/4 | CCFS1 | CCFS2 |
| 2 | 1 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | CCFS1 | CCFS1 |
| 2 | 1 | 2 | 0 | 1 | 1 | 1 | 1 | 1 | CCFS1 | CCFS1 |
| 2 | 1 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | CCFS1 | CCFS1 |
| R4: NSS support is rounded down to the nearest integer.  R4: The maximum NSS supported is 8. | | | | | | | | | | |
| NOTE 1—Max VHT NSS is defined per MCS in 9.4.2.157.3 (Supported VHT-MCS and NSS Set field). | | | | | | | | | | |
| NOTE 2—1/2× or 3/4× Max VHT NSS support might end up being 0, indicating no support. | | | | | | | | | | |
| NOTE 3—Any other combination than the ones listed in this table is reserved. | | | | | | | | | | |
| NOTE 4—CCFS1 refers to the Channel Center Frequency Segment 1 field of the most recently transmitted VHT Operation element. | | | | | | | | | | |
| NOTE 5—CCFS2 refers to the Channel Center Frequency Segment 2 field of the most recently transmitted HT Operation element. | | | | | | | | | | |
| NOTE 6—CCFS1 is nonzero when the current BSS bandwidth is 160 MHz or 80+80 MHz and the NSS support is at least Max VHT NSS. CCFS2 is zero in this case. | | | | | | | | | | |
| NOTE 7—CCFS2 is nonzero when the current BSS bandwidth is 160 MHz or 80+80 MHz and the NSS support is less than Max VHT NSS. CCFS1 is zero in this case. | | | | | | | | | | |
| NOTE 8—At most one of CCFS1 and CCFS2 is nonzero. | | | | | | | | | | |
| NOTE 9—A supported multiple of Max VHT NSS applies to both transmit and receive. | | | | | | | | | | |
| NOTE 10—Some combinations of Supported Channel Width Set and Extended NSS BW support might not occur in practice. | | | | | | | | | | |
| NOTE 11—2× Max VHT NSS support might be used for 20 MHz or 40 MHz HT PPDU. | | | | | | | | | | |

(11ax)The maximum number of spatial streams that the STA supports in reception for a given HE-MCS as a function of the received HE PPDU bandwidth at an HE STA transmitting an Operating Mode field is defined as

* floor (*Rx-NSS-from-OMF* × (*Max-HE-NSS-at-BW* / *Max-HE-NSS-at-80*))

where

*Rx-NSS-from-OMF* is Rx NSS from the Operating Mode field transmitted by the STA

*Max-HE-NSS-at-BW* is the maximum NSS among all HE-MCS at *BW* MHz from the Supported HE-MCS And NSS Set field transmitted by the STA

*Max-HE-NSS-at-80* is the maximum *NSS* among all HE-MCS at 80 MHz from the Supported HE-MCS And NSS Set field transmitted by the STA

NOTE—For operating mode between two HE STAs, the Rx NSS subfield indicates the maximum number of spatial streams at channel widths less than or equal to 80 MHz.

The maximum number of spatial streams that the STA supports in reception for a given EHT-MCS as a function of the received EHT PPDU bandwidth at an EHT STA transmitting an Operating Mode field is defined as

(9-xx) floor (*Rx-NSS-from-OMF* × (*Max-EHT-NSS-at-BW* / *Max-EHT-NSS-at-80*))

where

*Rx-NSS-from-OMF* is *Nss* from the Operating Mode field transmitted by the STA

*Max-EHT-NSS-at-BW* is the maximum NSS among all EHT-MCS at *BW* MHz from the Supported EHT-MCS And NSS Set field transmitted by the STA

*Max-EHT-NSS-at-80* is the maximum *NSS* among all EHT-MCS at 80 MHz from the Supported EHT-MCS And NSS Set field transmitted by the STA

NOTE—For operating mode between two EHT STAs, the Rx NSS subfield in the Operating Mode field indicates the maximum number of spatial streams at channel widths less than or equal to 80 MHz.