IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| OMI Comment resolutions | | | | |
| Date: 2018-01-09 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Jarkko Kneckt | Apple Inc. | Cupertino, CA |  | jkneckt@apple.com |
| Guoqing Li | Apple Inc. |  |  |  |
| Chris Hartman | Apple Inc. |  |  |  |

Abstract

This submission contains comment resolutions for 30 CIDs related to the operating mode.

The following 30 CIDs are solved: 11378, 11683, 11685, 11686, 11997, 11999, 12028, 12185, 12186, 12220, 12417, 12807, 12808, 12838, 12839, 12840, 12842, 12981, 13038, 13039, 13170, 13757, 13812, 13928, 14135, 14136, 14137, 14331, 14332, 14347

The proposed change is based on TGax Draft 2.0.

Revision history:

R1: Resolutions to CIDs 13038 and 13039 are changed. OMI initial values are described in clause 27.15.

R2: Comment resolutions are

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 11378 | 287.08 | 27.8.1 | This section applies only to STAs that support OM Control operation. Move the sentences that indicate OM Control support (for AP/STA) to the beginning of this section | Move the sentence "An HE STA with dot11...." and the next paragraph "An HE AP shall set dot11..." to the beginning of this (27.8.1) section |

**Proposed Resolution:** Revised. Agree in principle.

Make the changes shown in this 11-17-0035r2 submission and identified for the CID 11378.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 11683 | 287.31 | 27.8.1 | The NSS now depends on the BW vs NSS formula. Add a reference to it. Ensure that this reference is properly applied throughout the subclause so that there is no inconsistency. | As in comment. |

**Proposed resolution:** Revised. Agree in principle.

Make the changes shown in this 11-17-0035r2 submission and identified for the CID 11683.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 11685 | 288.16 | 27.8.2 | "only" is missing in the second item. Also what is the difference between the first item (receiving the acknowledgment) and second item (expecting to receive the acknowledgment? If there is none then simplify the rule saying the change should be done only after the TXOP. If there is then keep as is, adding the "only" part as suggested | As in comment. |

**Proposed Resolution:** Rejected.

The difference is that when transitioning form higher to lower parameter values, the STA needs to be sure that the receiver has received the indication. When changing the parameter values from lower to higher, there is no risk of not being able to receive the transmissions due to mismatching ROM parameters. Because there is no risk of not being able to receive due to mismatching ROM parameters, the parameters change does not need to be only after the TXOP.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 11686 | 289.02 | 27.8.3 | Replace "Tx NSS" with "Tx NSTS". | As in comment. |

**Proposed Resolution:** Accepted

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 11997 | 286.22 | 27.8.1 | It is unnecessary to include this last sentence starting with "When a first STA transmit" since the latter received field will take precedence anyway as described and it is already stated that both OM Control and Operating Mode should not be in the same PPDU. | As suggested. |

**Proposed Resolution:** Rejected. The PPDU may carry many MPDUs at the same time and the explicit rule defines how two different elements interact.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 11999 | 287.12 | 27.8.1 | OM Control is optional. but this says it is mandatory for AP. Change the sentence to "An HE AP with dot11.... set to true shall implement" | As suggested. |

**Proposed resolution:** Rejected. The suggested text would allow the AP to set the dot11OMIOptionImplemented to other value than true. The 802.11ax task group has discussed and decided to set the OMI mandatory for the AP which the current normative text implements.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CID | Page | Clause | Comment | Proposed Change |
| 12028 | 60.63 | 9.2.4.6.4.3 | Currently, the maximum number of spatial streams a STA is configured to receive depends on the BW of the PPDU. In DL MU PPDU the STA receives only the RU as indicated by the preamble. When a STA receives only the RU allocated for it, the BW of the RU could control number of the spatial streams the STA is able to receive. When the NSS is controlled by the BW that RU uses, the number of spatial streams that are allocated to the STAs can be increased in 160MHz PPDUs. | In DL MU PPDU, please allow a receiver to use RX NSS based on the BW of the RU the STA is receiving. |

**Proposed resolution:** Rejected. The current rules for RX NSS settings allows STAs to configure the number of NSS it is capable to use are relatively simple. Changing the rules will create more complexity with only little benefits.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 12185 | 288.60 | 27.8.3 | Change "may use in response to a Trigger frame"to "will use for an HE TB PPDU sent in response to a Trigger frame" | As comment |

**Proposed Resolution:** Accepted.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 12186 | 288.62 | 27.8.3 | Change "indicates" to "to" | As comment |

**Proposed Resolution:** Accepted.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 12220 | 288.45 | 27.8.3 | TOM indication can be used to indicate suspend or resume responding to any variant of the Trigger frame and UMRS Control subfields. | Change to "The TOM indication allows the OMI initiator to suspend or resume responding to any variant of the Trigger frame and UMRS Control subfields" |

**Proposed Resolution:** Accepted.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 12417 | 136.24 | 9.4.2.237.2 | Change to: If +HTC-HE Support is 1 in a non-AP STA: Set to 1 if the non-AP STA supports reception of the OM Control field. Set to 0 otherwise. Reserved if +HTC-HE Support is 0 in a non-AP STA. An AP always sets OM Control Support to 1 | As in comment |

**Proposed Resolution:** Accepted

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 12807 | 288.19 | 27.8.2 | "An OMI initiator that is an HE AP should be capable of receiving within an operating channel width and with NSS that are up to the values of the most recently transmitted Channel Width subfield and Rx NSS sub- field that the OMI initiator has successfully indicated in the OM Control subfield or in the Operating Mode field sent to any associated STA." -- should honour promises made | Change "should" to "shall" in the cited text |

**Proposed Resolution:** Rejected. Many parts of the OMI parameters handling is written with should statements. For instance, OMI parameters change uses should statements instead of shall statements. In D1.0 Comment resolutions the should statements were considered to provide the appropriate level of support for the AP.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 12808 | 289.24 | 27.8.3 | "NOTE 1---The STA sets the UL MU Disable subfield to 1 to indicate that it will not respond to any variant of the Trigger frame and will not respond to a UMRS Control field." duplicates the para immediately above | Delete the cited text |

**Proposed Resolution:** Accepted.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 12838 | 286.64 | 27.8.1 | "An HE STA that receives a frame including an OM Control subfield is defined as an OMI responder." [...] "the OMI responder shall [...]". This makes OMI responder support mandatory, but it isn't for a non-AP STA | Change "An HE STA that receives a frame including an OM Control subfield is defined as an OMI responder." to "An HE STA with dot11OMIOptionImplemented equal to true that receives a frame including an OM Control subfield is defined as an OMI responder." |

**Proposed Resolution:** Accepted.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 12839 | 286.58 | 27.8.1 | "When a first STA transmit both OM Control field and Operating Mode field in different PPDUs to a second STA, the second STA shall use the most recently received one to decide the opering mode of the first STA. [...] An HE STA should not transmit an OM Control subfield and an Operating Mode field in the same PPDU." -- not clear what happens if send in same PPDU | Add to the end of the para "When a first STA transmits both an OM Control field and an Operating Mode field in the same PPDU to a second STA, the second STA shall use the most recently received one to decide the opering mode of the first STA. NOTE---An OM Control field is received before an Operating Mode field in the same MPDU." Change "transmit" to "transmits" at 286.57, add a space at the start of the sentence, and change "opering" to "operating" at 286.59, delete "An HE STA should not transmit an OM Control subfield and an Operating Mode field in the same PPDU. " at 287.16 |

**Discussion:** The standard denies the use of OM Control and OMI fields in the same PPDU to avoid STAs to indicate contradicting parameters. The STA can control the information elements that it locates to an MPDU quite easily. Thus, the use of contradicting parameters in a frame can be denied in the 802.11ax.

**Proposed Resolution:** Revised. Disagree in principle. The standard denies the use of OM Control and OMI fields in the same PPDU to avoid STAs to indicate contradicting parameters. The STA can control the information elements that it locates to an MPDU. Thus, the use of contradicting parameters in a frame should be denied in the 802.11ax standard.

Make the changes shown in this 11-17-0035r2 submission and identified for the CID 12839.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 12840 | 287.17 | 27.8.1 | "When a STA transmits both an OM Control field and Operating Mode field, then the OMI responder shall use the channel width and the RX NSS of the most recently OM Control field or Operating Mode field from the OMI initiator." -- duplicate of 286.58 | Delete the cited text |

**Proposed Resolution:** Revised.Agree in principle,the cited text is not needed.

Make the changes shown in this 11-17-0035r2 submission and identified for the CID 12840.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 12842 | 288.42 | 27.8.3 | It is not immediately obvious that TOMI is not a general indication like ROMI is, but is specific to HE TB PPDUs | After the first para add a "NOTE---TOM indication does not relate to transmissions in PPDUs other than HE TB PPDUs. An AP does not perform TOM indication as an OMI initiator.". Also delete "The" at the start of the first para and of the first para of the previous subclause |

**Proposed resolution:** Accepted

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 12981 | 60.56 | 9.2.4.6.4.3 | The text around equation (9-ax2) isn't clear. The Rx NSS field indicates the maximum number of spatial streams supported in reception. What is the purpose of the added text which mentions "for a given HE-MCS" but where the related equation has parameters depending on "among all HE-MCS" ? Please better explain how the result of equation (9-ax2) is A34used in practice (an example in a NOTE would definitely help). | As in comment |

**Discussion:** The ME-MCS and NSS set have support as defined in 27.15.4.1 Rx Supported HE-MCS and NSS Set. The MCS restrictions may affect the NSS or BW settings of the STA, as described in 17.15.4 clause. Reference to this clause is added to explain how the parameters are obtained.

**Proposed Resolution:** Revised. Agree in principle.

Make the changes shown in this 11-17-0035r2 submission and identified for the CID 12981.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 13038 | 288.54 | 27.8.3 | What is the initial state of UL MU Disable? | Specify the initial state of UL MU Disable, for example, at the successful completion of association, UL MU Disable is 0 |

**Proposed resolution:** Rejected. The clause 27.15.3 states that: NSS and BW selection is further constrained as defined in 27.8 (Operating mode indication),…“ Thus, when operating mode indication signaling is not performed, the NSS and BW are not constrained. UL MU Disable field follows the same logic. Unless UL MU is explicitly disabled, it is enabled.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 13039 | 286.55 | 27.8.1 | General comment on Operating Mode notification - at least one parameter, the UL MU Disable, can be signaled, and is only signaled, through the OM mechanism and this is problematic because this means that from the start of an association until the first time that OM is signaled, the state of UL MU Disable is not known. There are probably other OM functions that have a similar problem. | Explicitly specify the default initial value of each of the OM parameters. |

**Proposed Resolution:** Rejected. The clause 27.15.3 states that: NSS and BW selection is further constrained as defined in 27.8 (Operating mode indication),…“ Thus, when operating mode indication signaling is not performed, the NSS and BW are not constrained. UL MU Disable field follows the same logic. Unless UL MU is explicitly disabled, it is enabled.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 13170 | 60.13 | 9.2.4.6.4.3 | Use consistent terminology, BW or CW, and so on. Also does this table need to be here? Seems more appropriate to be moved to a normative subclause. A couple of "shall" in the Table suggest so. | As in comment. |

**Proposed Resolution:** Revised. Adree in principle. The table is moved to clause 27.8.

Make the changes shown in this 11-17-XXXXr0 submission and identified for the CID 13170.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 13757 | 61.04 | 9.2.4.6.4.3 | The sentence " NOTE--The Rx NSS subfield indicates the maximum number of spatial streams at bandwidths that are same as or narrower than 80 MHz." is written a bit awkward | Change the sentence to "NOTE--The Rx NSS subfield indicates the maximum number of spatial streams at bandwidths that are equal to less than 80 MHz." |

**Proposed Resolution:** Accepted.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 13812 | 61.07 | 9.2.4.6.4.3 | "The VHT channel width and the NHT NSS allowed at an HE STA ..."  This part of the text including the Table 9-18b (Settting of the VHT Channel Width and VHT NSS at a HE STA transmitting the OM Control subfield) should be moved to somewhere in subclause 27.8 since it does not directlt related to the setting of A-Control field with Control ID subfiled = 1. | As in the comment. |

**Proposed resolution:** revised. Agree in principle. Make the changes shown in this 11-17-0035r2 submission and identified for the CID 13812.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 13928 | 289.31 | 27.8.3 | "The OMI responder shall consider the OMI initiator as participating in UL MU operation for subsequent TXOPs when the UL MU Disable subfield is 0 in the received OM Control subfield with the following restrictions: -- The maximum NSTS that the OMI initiator can transmit in response to a Trigger frame or frame carrying a UMRS Control field is indicated in the Tx NSTS subfield of the OM Control subfield -- The maximum operating channel width over which the OMI initiator can transmit in response to a Trigger frame or frame carrying a UMRS Control field is indicated in the Channel Width subfield of the OM Control subfield" This paragraph is saying the same thing with the following two paragraphs. Remove this paragraph and change the following in the following two paragraphs. "When the UL MU Disable subfield is 0 in the received OM Control subfield, the OMI responder shall indicate a number of spatial streams..." "When the UL MU Disable subfield is 0 in the received OM Control subfield, the OMI responder shall indicate an RU allocation..." width specified in the Channel Width subfield of the OM Control subfield received from the OMI initiator and subject to the restrictions defined in 28.3.3 (OFDMA and SU tone allocation). | As in comment. |

**Proposed resolution:** Rejected. The above two sentences describe the OMI Initiator specific operation and the below two sentences describe the OMI requestor operation. Together the rules for the both sides make the complete description.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 14135 | 288.01 | 27.8.2 | The titles of 27.8.2 and 27.8.3 seems to be better to have matched each other to be consistent. For example, Receive operating mode (ROM) indication => ƒ indication like "Rules for transmit operating mode (TOM) indication". | as in comment |

**Proposed Resolution:**  Accepted. (Change the title of 27.8.2 to: “ Rules for receive operating mode (ROM) indication “)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 14136 | 289.02 | 27.8.3 | UL MU Disallow is not a right term. It should be "UL MU Disable" defined in Figure 9-15d | as in comment |

**Proposed Resolution:** Accepted.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 14137 | 289.21 | 27.8.3 | UMRS Control subfield? Or UMRS Control field? Two are mixed in use in 27.8.3. Use one consistent term. | as in comment |

**Proposed Resolution:** Revised. Agree in principle. Change all UMRS Control fields to UMRS Control subfield.

Make the changes shown in this 11-17-0035r2 submission and identified for the CID 14137.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 14331 | 287.42 | 27.8 | The UL MU Disable bit in the OM Control field is a bad design to lower down the whole network performance. Remove this bit and corresponding behavior in the spec. | as in the comment |
| 14332 | 287.42 | 27.8 | The UL MU Disable bit in the OM Control field is a bad design to lower down the whole network performance. Remove this bit and corresponding behavior in the spec. | as in the comment |
| 14347 | 60.38 | 9.2.4.6.4.3 | Remove UL MU Disable bit. It gives a backdoor for HE STA not to follow the scheduling instruction from AP and will affect the network performance. | as in the comment |

**Discussion:** The UL MU Disable bit has been discussed with great details in 802.11ax. The UL MU Disable field has been considered to enable a STA that is not capable to perform UL MU transmissions a possibility to obtain EDCA TXOPs similarly as the legacy STAs. Thus, this subfield ensures fairness for these STAs and improves system throughput by eliminating unsuccessful UL MU transmissions.

**Proposed Resolutions to CIDS14331, 14332 and 14347:** Rejected. The UL MU Disable field allows the STAs that are not capable to transmit UL MU transmissions to obtain EDCA TXOPs similarly as the legacy STAs and it improves system throughput by eliminating unsuccessful UL MU transmissions.

* OM Control(#4727)(#3104)

If the Control ID subfield is 1, the Control Information subfield contains information related to the operating mode (OM) change of the STA transmitting the frame containing this information (see 27.8 (Operating mode indication)). The format of the subfield is shown in Control Information subfield format when Control ID subfield is 1.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B0 B2 | B3 B4 | B5 | B6 B8 | B9 B11 |
|  | Rx NSS | Channel Width | UL MU Disable | Tx NSTS(#4733) | Reserved |
| Bits: | 3 | 2 | 1 | 3 | 3 |
| * Control Information subfield format when Control ID subfield is 1 | | | | | |

(#4740)

The Rx NSS subfield indicates the maximum number of spatial streams, *NSS*, that the STA supports in reception(#7716, #5052) in bandwidths that are equal or less than 80MHz [#11683] and is set to *NSS* – 1.

The Channel Width subfield indicates the operating channel width supported by the STA for both reception and transmission. It is set to 0 for primary 20 MHz, 1 for primary 40 MHz, 2 for primary 80 MHz, and 3 for 160 MHz and 80+80 MHz.(#6017)(#9939)(#5851, #7249, #9803, #7192)

Clause 27.8.1(General) provides details of the RX NSS support fpr bandwidths larger than 80 MHz. [#11683]



The UL MU Disable subfield indicates whether UL MU operation is suspended or resumed by a(#6260) non-AP STA. The UL MU Disable subfield is set to 1 to indicate that UL MU operation is suspended; otherwise it is set to 0 to indicate that UL MU operation is resumed. An AP sets the UL MU Disable subfield to 0.

The Tx NSTS subfield indicates the maximum number of space-time streams, *NSTS*, that the STA supports in transmission(#7717) and is set to *NSTS* – 1.(#4733, #9804)

**9.4.2.237.2 HE MAC Capabilities Information field**

**Table 9-262z—Subfields of the HE MAC Capabilities Information field**

|  |  |  |
| --- | --- | --- |
| Subfield | Definition | Encoding |
| OM Control Support(#4727) | Indicates support for (#6364)receiving an MPDU that contains an OM Control field(#4727). | If +HTC-HE Support is 1 in a non-AP STA:  Set to 1 if the non-AP STA supports reception of the OM Control field(#4727).  Set to 0 otherwise.  Reserved if +HTC-HE Support is 0 in a non-AP STA.  An AP always sets OM Control Support to 1 [#12417] |

* Operating mode indication
* General

An HE STA can change its operating mode setting using either operating mode notification (OMN) as described in 11.42 (Notification of operating mode changes), or the operating mode indication (OMI) procedure described in this subclause. [#12839, #12840] (#7051)(#7617)

OMI(#7051) is a procedure used between an OMI initiator and an OMI responder. An HE STA that transmits a frame including an OM Control subfield is defined as an OMI initiator. An HE STA with dot11OMIOptionImplemented equal to true [#12838] that receives a frame including an OM Control subfield(#7507) is defined as an OMI responder.

[#11378]

An HE STA may send to a STA that indicated value 1 in the OM Control Support field(#4727) in its HE Capabilities element an individually addressed(#7970) QoS Data, QoS Null or Class 3 Management frame that contains the OM Control subfield(#7507), after association, to indicate a change in its receive and/or transmit operating parameters. An HE STA with dot11OMIOptionImplemented equal to true implements the reception of an individually addressed QoS Data, QoS Null or Class 3 Management frame that contains the OM Control subfield that indicates a change in receive operating mode (ROM) and/or transmit operating mode (TOM) parameters(#4783).

(#7051)

The OMI initiator shall indicate a change in its ROM parameters by including the OM Control subfield(#7507) in a QoS Data, QoS Null or Class 3 Management frame(#5053, #5125) that solicits an immediate acknowledgement and is addressed to the OMI responder as defined in Receive operating mode (ROM) indication.

NOTE 1—Frames that solicit an immediate acknowledgement are, for example, QoS Null frames and QoS Data frames with ack policy Normal Ack or Implicit Block Ack Request(#5566) and Action frames.(#7024)(#7025)(#7026)(#7027)(#Ed)

The OMI initiator supports receiving PPDUs with a bandwidth up to the value indicated by the Channel Width subfield(#7198) and with a number of spatial streams, *Nss*, as indicated in the Rx NSS subfield of the OM Control subfield and calculated in the equation 9-ax2 in 27.8.2(Rules for Receive Operating Mode (ROM) Indication. [#11683]

[#13812, #13170, #13812](#7617)The Rx NSS support 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 as

floor (*Rx-NSS-from-OMI* × (*Max-HE-NSS-at-BW* / *Max-HE-NSS-at-80*)) (9-ax2)

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 HE NSS among all HE-MCS at *BW* MHz from the Supported HE-MCS and NSS Set field transmitted by the STA [#12981]as described in 27.15.4 (Rate selection constraints for HE STAs). [#12981]

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

NOTE—The Rx NSS subfield indicates the maximum number of spatial streams at bandwidths that are [#13757] equal or less [#13757] than 80 MHz.

The VHT channel width and the VHT NSS allowed at an HE STA transmitting an OM Control subfield are defined in Table 9–18b (Setting of the VHT Channel Width and VHT NSS at a HE STA transmitting the OM Control subfield)..

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table XX-XX Setting of the VHT Channel Width and VHT NSS at a HE STA transmitting the OM Control subfield | | | | | | | | | |
| OM Control subfield | VHT capabilities of STA transmitting OM Control subfield | | VHT NSS Support of STA transmitting the OM Control subfield as a function of the PPDU bandwidth (× Max VHT NSS) (see requirements R1 and R2) | | | | | Location of 160 MHz center frequency if BSS bandwidth is 160 MH | Location of secondary 80 MHz center frequency if BSS bandwidth is 80+80 MHz |
| Channel Width | Supported Channel Width | Extended NSS BW Support | 20 MHz | 40 MHz | 80 MHz | 160 MHz | 80+80 MHz |
| 0 | 0-2 | 0-3 | 1 |  |  |  |  |  |  |
| 1 | 0-2 | 0-3 | 1 | 1 |  |  |  |  |  |
| 2 | 0-2 | 0-3 | 1 | 1 | 1 |  |  |  |  |
| 3 | 0 | 1 | 1 | 1 | 1 | 1/2 |  | CCFS2 |  |
| 3 | 0 | 2 | 1 | 1 | 1 | 1/2 | 1/2 | CCFS2 | CCFS2 |
| 3 | 0 | 3 | 1 | 1 | 1 | 3/4 | 3/4 | CCFS2 | CCFS2 |
| 3 | 1 | 0 | 1 | 1 | 1 | 1 |  | CCFS1 |  |
| 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1/2 | CCFS1 | CCFS2 |
| 3 | 1 | 2 | 1 | 1 | 1 | 1 | 3/4 | CCFS1 | CCFS2 |
| 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | CCFS1 | CCFS1 |
| 3 | 2 | 0 | 1 | 1 | 1 | 1 | 1 | CCFS1 | CCFS1 |
| 3 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | CCFS1 | CCFS1 |
| R1: NSS support shall be rounded down to the nearest integer.  R2: The maximum NSS support shall be 8.  NOTE 1—Max VHT NSS as indicated by the value of the Rx NSS field. The Rx NSS field indicates the same Max HE NSS and Max VHT NSS. Max VHT NSS is at the BW indicated by VHT Capabilities element, for all allowed MCS values the Max VHT NSS values are same, but the supported NSS can be different.  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 value of the Channel Center Frequency Segment 1 field of the most recently transmitted VHT Operation element.  NOTE 5—CCFS2 refers to the value of 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. A supported multiple of Max HE NSS applies to receive  NOTE 10—Some combinations of Supported Channel Width Set and Extended NSS BW support might not occur in practice. | | | | | | | | | |

The OMI initiator shall indicate a change in its TOM parameters(#7051) by including the OM Control subfield(#7507) in a QoS Data, QoS Null or Class 3 Management frame(#5053, #5125) that solicits an immediate(#7182) acknowledgement frame and is addressed to the OMI responder as defined in Rules for transmit operating mode (TOM) indication.

A non-AP STA OMI initiator that sends an OM Control field with UL MU Disable subfield equal to 0, supports transmitting an HE TB PPDU with an RU allocation that is within the operating channel width indicated in the Channel Width subfield and with a number of space-time streams, *NSTS*, that is up to the value indicated by the Tx NSTS subfield of the OM Control subfield as defined in 27.8.3 (Transmit operating mode (TOM) indication).(#5851, #7249, #9803, #7192)

NOTE 2—To avoid possible frame loss, a first HE STA that sends an OM Control subfield to a second HE STA indicating reduced operating channel width and/or reduced active receive chains can continue with its current operating channel width and active receive chains until it infers that the second STA has processed this notification. The first HE STA might make this inference from either of the following:

* By receiving a frame addressed to itself from the second HE STA in a PPDU with a bandwidth and NSS that are less than or equal to the channel width and NSS, respectively, indicated in the OM Control subfield
* Based on the passage of time in some implementation dependent way, which is outside the scope of this Standard

NOTE 3—It might take a long time for a STA to change its operating mode following the transmission of the OM Control subfield and during that time the STA might not be able to receive frames resulting in frame loss. If a non-AP STA cannot tolerate frame loss during that period it can set the Power Management subfield of the Frame Control field of the frame which carries OM Control subfield to 1 to indicate that the STA has entered power save. When the non-AP STA has completed its operating mode change, it can send another frame (such as a QoS Null) with the Frame Control Power Management subfield set to 0 to indicate that the STA has exited power save.

* Rules for [14135] Receive operating mode (ROM) indication

ROM [#12842] indication allows the OMI initiator to adapt the maximum operating channel width and/or the maximum number of spatial streams, *Nss*,(#7051) it can receive from the OMI responder.

An OMI initiator that sends a frame that includes an(#6754) OM Control subfield(#7507) should change its OMI parameters, Rx NSS and Channel Width(#5196), as follows:

* When the OMI initiator changes a ROM parameter(#7051) from higher to lower, it should make the change for that parameter only after the TXOP in which it received(#3219) the immediate acknowledgement from the OMI responder.
* When the OMI initiator changes a ROM parameter(#7051) from lower to higher, it should make the change for that parameter after the TXOP in which it expects to receive acknowledgement from the OMI responder.(#3218)(#7247)

An OMI initiator that is an HE AP should be capable of receiving within an operating channel width and with *NSS* that are up to the values of the most recently transmitted Channel Width subfield and Rx NSS subfield that the OMI initiator has successfully indicated in the OM Control subfield or in the Operating Mode field sent to any associated STA.(#3077)(#6192)(#7023)(#5851, #7249, #9803, #7192)

NOTE—In the event of transmission failure of the frame containing the OM Control subfield(#7507), the OMI initiator attempts the recovery procedure defined in 10.22.2.7 (Multiple frame transmission in an EDCA TXOP).

(#3219)The OMI responder shall update the operating channel width and the maximum *NSS* values as obtained from the Channel Width(#7200) and Rx NSS subfields, respectively, of the most recently received OM Control subfield(#7507) sent by the OMI initiator to send SU PPDUs and to assign an RU allocation in sent MU PPDUs, subject to restrictions defined in 28.3.3 (OFDMA and SU tone allocation), addressed to the OMI initiator in subsequent TXOPs.(#5851, #7249, #9803, #7192)

After transmitting the acknowledgement(#7614)(#7031)(#3220)(#6157) for the frame containing the OM Control subfield(#7507), the OMI responder may transmit subsequent SU PPDUs or MU PPDUs that are addressed to the OMI initiator.

NOTE—A subsequent PPDU is a PPDU that is intended for the OMI initiator(#Ed) and need(#6758) not be the immediately following PPDU.

* Rules for transmit operating mode (TOM) indication(#7115)

TOM [#12842] indication allows the OMI initiator to suspend and resume [#12220] responding to any variant of the Trigger frame and UMRS Control subfields, or to adapt the maximum operating channel width and/or the maximum number of space-time streams(#9804), *NSTS*, it can transmit as a response to a Trigger frame and UMRS Control subfield sent by the OMI responder.

NOTE---TOM indication does not relate to transmissions in PPDUs other than HE TB PPDUs. An AP does not perform TOM indication as an OMI initiator. [#12842]

An OMI initiator that is a non-AP STA may indicate changes in its transmit parameters by sending a frame that contains the OM Control subfield(#7507) to the OMI responder. The OMI initiator shall set:

* The UL MU Disable subfield to 1 to indicate suspension of the UL MU operation (see **Error! Reference source not found.**; otherwise it shall set the UL MU Disable subfield to 0 to indicate resumption or continuation of participation in UL MU operation.
* An AP that is an OMI initiator shall set the UL MU Disable subfield to 0.
* The Tx NSTS subfield(#9804) to the maximum *NSTS*(#9804) that the STA will [#12185](#7029) use in response to a Trigger frame or frame carrying a UMRS Control subfield.(#7051)
* The Channel Width subfield to [#12186] the maximum operating channel width that the STA will use for an HE TB PPDU sent in response to a Trigger frame or frame carrying a UMRS Control subfield.(#5679)(#7028)(#7202)(#9725)(#7051)

An OMI initiator that sent the frame including the OM Control subfield should change its TOM parameters(#7051), Tx *NSTS ,*(#9804) [#11686] UL MU Disable [14136] and Channel Width, as follows:

* When the OMI initiator changes a TOM parameter(#7051) from higher to lower, it should make the change for that parameter only after the TXOP in which it received the immediate acknowledgement from the OMI responder.
* When the OMI initiator changes a TOM parameter(#7051) from lower to higher, it should make the change for that parameter only after the TXOP in which it expects to receive acknowledgement from the OMI responder.(#5199)

The TOM parameter UL MU Disable changes from higher to lower when its value changes from value 0 to value 1.(#5199)(#7051)

An OMI responder that successfully receives a frame containing an OM Control subfield(#7507) from an OMI initiator performs the following operations.(#4244)

(#4244)The AP OMI responder shall consider the non-AP STA OMI initiator as not responding to any Trigger frame variants or frames carrying a UMRS Control subfield(#6190) [#14137] for subsequent TXOPs (see 27.5.3 (UL MU operation)) when the UL MU Disable subfield is 1 in the received OM Control subfield(#7507)(#7051).

[#12808}(#6013)(#8085)(#8720)

NOTE —A device may have multiple radios that can result to difficult in-device coexistence challenges. The device might set UL MU Disable subfield to 1 if it has trouble responding to a Trigger frame or frame carrying a UMRS Control subfield [#14137] because the timing or high transmit power would cause interference with another radio in the device.(#5198)(#7051)

(#4244)The OMI responder shall consider the OMI initiator as participating in UL MU operation for subsequent TXOPs when the UL MU Disable subfield is 0 in the received OM Control subfield(#7507) with the following restrictions:

* The maximum *NSTS*(#9804) that the OMI initiator can transmit in response to a Trigger frame or frame carrying a UMRS Control subfield [#14137] is indicated in the Tx NSTS subfield(#9804) of the OM Control subfield(#7507)(#7051)
* The maximum operating channel width over which the OMI initiator can transmit in response to a Trigger frame or frame carrying a UMRS Control subfield [#14137] is indicated in the Channel Width subfield of the OM Control subfield(#7507)(#5851, #7249, #9803, #7192)

(#4244)The OMI responder shall indicate a number of spatial streams, *NSS*, in the Per User Info field of a Trigger frame, which contains the AID of the OMI initiator, that is less than or equal to the *NSTS*(#9804) that is calculated from the Tx NSTS subfield(#9804) of the OM Control subfield(#7507) received from(#6016) the OMI initiator.(#7051)

(#4244)The OMI responder shall indicate an RU allocation in the RU Allocation subfield of the Per User Info field of a Trigger frame or UMRS Control subfield [#14137] addressed to the OMI initiator, that is within the operating channel width(#3221)(#9726) specified in the Channel Width subfield of the OM Control subfield(#7507) received from(#6016) the OMI initiator and subject to the restrictions defined in 28.3.3 (OFDMA and SU tone allocation).(#5851, #7249, #9803, #7192)

**References:**