IEEE P802.11
Wireless LANs

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| LB225 11ax D1.0 Comment Resolution OMI and Operation Mode |
| Date: 2017-07-10 |
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Abstract

This submission proposes resolutions for multiple comments related to TGax D1.0 with the following CIDs :

* 7617.

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: 1), Add 20MHz only device in VHT BSS and HT BSS; 2), Change the NSS calculation formula; 3), Add more explanation text

Interpretation of a Motion to Adopt

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

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

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

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| --- | --- | --- | --- | --- | --- |
| **CID** | **PP** | **LL** | **Comment** | **Proposed Change** | **Resolution** |
| 7617 | 188 | 17 | NSS behavior is not harmonized with HE Capabilities element. | Change the nomative behavior to make them consistent. | **Revised****Generally agree with the commenter.****TGax editor makes changes as shown in 11-17/1067r1 under 7617.**  |

**Discussion:**

In 201707 F2F meeting, it was calrified that 20MHz only HE STA is VHT STA and the behavior of an HE AP with associated 20MHz only HE STAs is defined. However the behavior of 20MHz ony HE STAs associated with VHT AP or HT AP is missing. This contribution adds the related behavior.

In 802.11mc, the implementation of VHT introduces the feature that the NSS support at 160/80+80MHz is less the the NSS support at 20/40/80MHz.

Supported VHT-MCS and NSS Set field in VHT Capabilities Information field is defined as:



Where VHT-MCS Map is defined as:

****

The NSS support of a VHT STA is defined in:

****

A VHT AP/STA can announce different NSS support at 160/80+80MHz from NSS support at 20/40/80MHz in VHT Capabilities element, i.e. NSS aupport at 160/80+80MHz is ½ or ¾ of NSS support at 20/40/80MHz. A VHT STA/AP can also announce smaller NSS for power save by unicast/broadcast Operating Mode field:

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With Such announcement, NSS at 20/40/80MHz and 160/80+80MHz are updated. The new NSS at 160/80+80MHz is still ½ or3/4 of the new NSS at 20/40/80MHz.



The Supported HE-MCS and NSS Set field in HE Capabilities element is defined as:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Rx HE-MCS MapFor <= 80 MHz  | (#5879) (#7576)Tx HE-MCS Map For <= 80 MHz | Rx HE-MCS Map For 160 MHz | (#5879) (#7576)Tx HE-MCS Map For 160 Mhz | Rx HE-MCS Map For 80+80 MHz | (#5879) (#7576)Tx HE-MCS Map For 80+80 Mhz |
| Octets: | 2 | 2 | 0 or 2 | 0 or 2 | 0 or 2 | 0 or 2 |

A HE AP/STA can announce different NSS support at 160/80+80MHz from NSS support at 20/40/80MHz in VHT Capabilities element. With additional HE MCS-NSS fields for 160/80+80MHz, HE NSS at 160/80+80MHz can be flexibly defined.

An HE STA/AP can announce smaller NSS for power save by unicast Operating Mode Control field:



Similar to VHT spec when Operating Mode Control is received, the new Rx NSS support at 160/80+80MHz of the STA which transmits OM Control should be figured out per the received Rx NSS value.

Oerating Mode Control field and Operating Mode field are separately defined by 802.11ax and 802.11ac. Operatiing Mode field can be in Beacon, Operation Mode Notification frame, etc. Oerating Mode Control field can be in MAC header of QoS data, QoS Null, Management frame. It seems that HE NSS and VHT NSS should be changed at the same time for power save.

Option 1 is that when Operating Mode field is transmitted by HE STA1 to HE STA2(s), both HE STA1’s HE Rx NSS and VHT Rx NSS are changed, and when Oerating Mode Control field is transmitted by HE STA1 to HE STA2, both HE STA1’s HE Rx NSS and VHT Rx NSS are changed. Under such option, another possibility (possibility 1) is that VHT NSS at 160MHz/80+80MHz is defined by a table which is similar to Table 9-75 in IEEE 802.11-2016 and HE NSS at 160MHz/80+80MHz are defined by a new formula, another possibility (possibility 2) is that HE NSS and VHT NSS at 160MHz/80+80MHz are defined by same formula.

Option 2 is the HE Operation Mode field, HE Operation Notification element, HE Operation Notification frame are defined. OMI Control, HE Operation Mode field are used for HE NSS, BW notification. Operation Mode field is used for VHT NSS, BW notification. With option 2, one NSS change operation may require multiple frame exchanges for VHT NSS change and HE NSS change.

The following text is based on possibility 1 under option 1.

**27.16 HE BSS operation**

**27.16.1 Basic HE BSS functionality**

*TGax editor: change 7th paragraph in subclause 27.16.1 as follows (CID 7617):*

A STA shall set the Supported Channel Width Set subfield of VHT Capabilities and HT Capabilities element it transmits to a value that indicates the same channel width capability as the channel width capability provided in the HE Capabilities element it transmits. In each valid 20MHz, 40MHz, 80MHz, a STA shall have same maximum NSS value defined by its HE Capabilities element as the maximum NSS value defined by its VHT Capabilities element. If a STA supports 160MHz, the Maximum NSS defined by its VHT Capabilities element at 160MHz shall not be more than the Maximum NSS defined by its HE Capabilities element at 160MHz. If a STA supports 80+80MHz, the Maximum NSS defined by its VHT Capabilities element at 80+80MHz shall not be more than the Maximum NSS defined by its HE Capabilities element at 80+80MHz. For every NSS in VHT Capabilities elements and HE Capabilities elements transmited by a STA, if the maximum HE MCS is more than or same as MCS9, the maximal VHT MCS is MCS9. Otherwise the maximal VHT MCS is same as HE MCS. A HE STA shall not transmit VHT Capabilities element with Supported Channel Width Set being 1 and Extended NSS BW Support being 3 or with Supported Channel Width Set being 2 and Extended NSS BW Support being 3.

**9.4.1.53 Operating Mode field**

*TGax editor: add the following paragraph in subclause 9.4.1.53 (CID 7617):*

The Rx NSS support as a function of received HE PPDU bandwidth at an HE STA transmitting an Operating Mode field is defined as

 floor(Rx-NSS-from-OMF × (HE-NSS-at-BW / Max-HE-NSS-at-80) ) (9-xxxa)

where

 Rx-NSS-from-OMF Rx NSS from received Operating Mode field

 HE-NSS-at-BW HE NSS at BW MHz from received Supported HE-MCS and NSS Set field

 Max-HE-NSS-at-80 Maximum VHT NSS from received Supported HE-MCS and NSS Set field

**9.2.4.6.4.3 Operating mode (OM) Control(#4727)**

*TGax editor: change subclause 9.2.4.6.4.3 as follows (CID 7617):*

If the Control ID subfield is 1, the Control Information subfield contains information related to the operating mode change of the STA transmitting the frame containing this information (see 27.8 (Operating mode indi-cation)). The format of the subfield is shown in Figure 9-15d (Control Information subfield format when Control ID subfield is 1).(#4740)



**Figure 9-15d—Control Information subfield format when Control ID subfield is 1**

The Rx NSS subfield indicates the maximum number of spatial streams, *NSS*, that the STA supports in reception(#7716, #5052) and is set to *NSS* – 1.

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

The Rx NSS support as a function of received HE PPDU bandwidth at an HE STA transmitting an OM Control Information subfield is defined as

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

where

 Rx-NSS-from-OMI Rx NSS from received Oerating Mode Control field

 HE-NSS-at-BW HE NSS at BW MHz from received Supported HE-MCS and NSS Set field

 Max-HE-NSS-at-80 Maximum HE NSS from received Supported HE-MCS and NSS Set field

The VHT operation bandwidth and the VHT NSS allowed by OMI at an HE STA transmitting an OM Control Information subfield are defined in Table 9-xxx.

Table 9-xxx Setting of the VHT Channel Width and VHT NSS at a HE STA transmitting the Operating Mode Control field

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Transmitted Operating Mode Control field | VHT Capabilities of STA transmitting the Operating Mode field | NSS Support of STA transmitting the Operating Mode field 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 MHz | Location of secondary 80 MHz center frequency if BSS bandwidth is 80+80 MHz |
| Channel Width | Supported Channel Width Set | 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. |
| 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. |
| ~~NOTE 11—2× Max VHT NSS support might be used for HT PPDUs (at 20 or 40 MHz PPDU bandwidth).~~ |

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; other-wise 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)

**10.7.12 Rate selection constraints for VHT STAs**

**10.7.12.1 Rx Supported VHT-MCS and NSS Set**

*TGax editor: change subclause 10.7.12.1 as follows (CID 7617):*

The Rx Supported VHT-MCS and NSS Set of a first VHT STA is determined by a second VHT STA for each <VHT-MCS, NSS> tuple NSS = 1, …, 8 and bandwidth (20 MHz, 40 MHz, 80 MHz, and 160 MHz or 80+80 MHz) from the Supported VHT-MCS and NSS Set field received from the first STA as follows:

* If support for the VHT-MCS for NSS spatial streams at that bandwidth is mandatory (see 21.5 (Parameters for VHT-MCSs)), then the <VHT-MCS, NSS> tuple at that bandwidth is supported by the first STA on receive.
* Otherwise, if the Max VHT-MCS For *n* SS subfield (*n* = NSS) in the Rx VHT-MCS Map subfield indicates support and the Rx Highest Supported Long GI Data Rate subfield is equal to 0, then
* the <VHT-MCS, NSS*>* tuple at that bandwidth is supported by the first STA on receive, except that if dot11VHTExtendedNSSBWCapable of the second STA is true, the supported bandwidth values and NSS values of each <VHT-MCS, NSS> tuple are updated according to Table 9-250 (Setting of the Supported Channel Width Set subfield and Extended NSS BW Support subfield at a STA transmitting the VHT Capabilities Information field) if no OMN has been received from the first STA, otherwise, according to Table 9-75 (Setting of the Channel Width subfield and 160/80+80 BW subfield at a VHT STA transmitting the Operating Mode field), wherein the VHT Capabilities Information field and the Operating Mode field have been transmitted by the first STA which is not HE STA, otherwise, if the second STA and first STA are both HE STAs, according to Table Table 9-xxx (Setting of the VHT Channel Width and VHT NSS at a HE STA transmitting the Operating Mode Control field), wherein the Operation Mode Control and the HE Capabilities element has been transmitted by the first STA.
* Otherwise, if the Max VHT-MCS For *n* SS subfield (*n* = NSS) in the Rx VHT-MCS Map subfield indicates support and the data rate for long GI of the MCS for NSS spatial streams at that bandwidth (expressed as the largest integer in Mb/s that is less than or equal to the data rate) is less than or equal to the rate represented by the Rx Highest Supported Long GI Data Rate subfield, then
* the <VHT-MCS, NSS> tuple at that bandwidth is supported by the first STA on receive, except that if dot11VHTExtendedNSSBWCapable of the second STA is true, the supported bandwidth values and NSS values of each <VHT-MCS, NSS> tuple are updated according to Table 9-250 (Setting of the Supported Channel Width Set subfield and Extended NSS BW Support subfield at a STA transmitting the VHT Capabilities Information field) if no OMN has been received from the first STA, otherwise, according to Table 9-75 (Setting of the Channel Width subfield and 160/80+80 BW subfield at a VHT STA transmitting the Operating Mode field), wherein the VHT Capabilities Information field and the Operating Mode field have been transmitted by the first STA which is not HE STA, otherwise, if the second STA and first STA are both HE STAs, according to Table Table 9-xxx (Setting of the VHT Channel Width and VHT NSS at a HE STA transmitting the Operating Mode Control field), wherein the Operation Mode Control and the HE Capabilities element has been transmitted by the first STA.
* Otherwise, the <VHT-MCS, NSS> tuple at that bandwidth is not supported by the first STA on receive.

The <VHT-MCS, NSS> tuples excluded by 10.7.12.3 (Additional rate selection constraints for VHT PPDUs) are also eliminated from the Rx Supported VHT-MCS and NSS Set.

A VHT STA shall not, unless explicitly stated otherwise, transmit a VHT PPDU unless the <VHT-MCS, NSS> tuple and bandwidth used are in the Rx Supported VHT-MCS and NSS Set of the receiving STA(s).

NOTE 1—Support for a <VHT-MCS, NSS> tuple at a given bandwidth implies support for both long GI and short GI on receive, if short GI is supported at that bandwidth.

NOTE 2—A STA can determine the expected interpretation of its Supported Channel Width Set and Channel Width and 160/80+80 BW and Extended NSS BW Support fields at a recipient by examining the VHT Extended NSS BW Capable field value in the Supported VHT-MCS and NSS Set field of the recipient.

**27.15.4 Rate selection constraints for HE STAs**

**27.15.4.1 Rx Supported HE-MCS and NSS Set**

*TGax editor: change subclause 27.15.4.1 as follows (CID 7617):*

The Rx Supported HE-MCS and NSS Set of a first HE STA is determined by a second HE STA for each <HE-MCS, NSS> tuple NSS = 1, …, 8 and bandwidth (20 MHz, 40 MHz, 80 MHz, and 160 MHz or 80+80 MHz) from the Supported HE-MCS and NSS Set field of the HE Capabilities element(#7587) received from the first STA as follows:

* If support for the HE-MCS for NSS spatial streams at that bandwidth is mandatory (see 28.5 (Parameters for HE-MCSs)(#5111)), then the <HE-MCS, NSS> tuple at that bandwidth is supported by the first STA on receive.
* Otherwise, if the Max HE-MCS For n SS subfield (n = NSS) in the Rx HE-MCS Map subfield indicates support and neither Operating Mode field nor Operating Mode Control field is received from the first HE STA, then
* The <HE-MCS, NSS> tuple at that bandwidth is supported by the first STA on receive as defined in 9.4.2.237.4 (Supported HE-MCS and NSS Set field(#5518))(#3526, #3354, #3461, #3775, #3858, #4301).
* Otherwise, if Operating Mode field is received from the first HE STA, then
* The The <HE-MCS, NSS> tuple at that bandwidth is supported by the first STA on receive as defined by by 9-xxxa.
* Otherwise, if Operating Mode Control field is received from the first HE STA, then
* The <HE-MCS, NSS> tuple at that bandwidth is supported by the first STA on receive as defined by 9-xxxb.
* Otherwise, the <HE-MCS, NSS> tuple at that bandwidth is not supported by the first STA on receive.

The <HE-MCS, NSS> tuples excluded by 27.15.4.3 (Additional rate selection constraints for HE PPDUs) can also be eliminated from the Rx Supported HE-MCS and NSS Set.

An HE STA shall not, unless explicitly stated otherwise, transmit a HE PPDU unless the <HE-MCS, NSS> tuple and bandwidth used are in the Rx Supported HE-MCS and NSS Set of the receiving STA(s).

**11.16 20/40 MHz BSS operation**

**11.16.1 Rules for operation in 20/40 MHz BSS**

*TGax editor: add the following paragraph at the end of 11.16.1:*

When trying to associated with a HT AP, a 20 MHz only HE STA shall do the following operations:

* the 20MHz only HE STA transmits (Re-)Association Request frame with the Supported Channel Width Set subfield in its HT Capabilities element HT Capabilities Info field being set to 0.

**11.40 VHT BSS operation**

**11.40.1 Basic VHT BSS functionality**

*TGax editor: add the following paragraph at the end of 11.40.1:*

When trying to associated with a VHT AP, a 20 MHz only HE STA shall do one of the following operations:

* Right after association, the 20MHz only HE STA transmits Operating Mode Notification frame to indicate 20MHz operation bandwidth, or
* the 20MHz only HE STA transmits (Re-)Association Request frame with Operating Mode Notification element to indicate 20MHz operation bandwidth.