IEEE P802.11  
Wireless LANs

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | Some MAC/PHY Layering Issues | | | | | | Date: 2022-02-28 | | | | | | Author(s): | | | | | | Name | Affiliation | Address | Phone | email | | Brian Hart | Cisco Systems |  |  | [brianh@cisco.com](mailto:brianh@cisco.com) | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |

Abstract

This submission proposes resolutions for the following comments from comment collection on P802.11be D1:

4627, 4628, and 4629

The baseline used in this document is D1.2.

NOTE – Set the Track Changes Viewing Option in the MS Word to “All Markup” to clearly see the proposed text edits.

**Revision History:**

R0: Initial version.

R1: Reduced MAC changes, added OMI parameters.

R2: Inserted doc#

R3: Extended to address, using MIB variables, all concerning usages of “element” in clause 36

R4: Streamlined changes to PHY clause

R5: Changes on 2/28 call: simplified language for requirements on UL/DL MIMO given 4SS, descoped TX mask language; still a TBD for INACTIVE\_SUBCHANNELS

R7: Resolved TBD by inserting PHYCONFIG\_VECTOR parameter DISABLED\_SUBCHANNEL\_BITMAP and MIB variable dot11EHTDisabledSubchannelBitmap.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 4627 | 36.3.3.1.1 | 371.28 | This para has the 802.11 arch back to front, and leads to circular logic. What should happen: Step 1) PHY declares its capabilities via a MIB variable. Step 2) MLME reads the PHY's capabilities. Step 3) MLME may opt to prune PHY capabilities according to policy; Step 4: the MLE/MAC advertises this (pruned) list as this STA's PHY capabilities to peer STAs. What is happening here: the MAC is magically discovers what the PHY is capable of, and then magically lets the PHY know. | 1) If not already present in Table 36-68, define a MIB variable so the PHY can express if the PHY is capable of this particular feature or not. This is required. 2) If we really think that the MLME may want the PHY to disable this particular feature(!?), then give the MAC a MIB variable to use to control the PHY to disable/enable this particular feature. Or not. Add language connecting the dots. | Revised. See changes under 4627 in 21/1672R<motionedRevision> that substantially implement the commenter’s proposal. |
| 4628 | 36.3.3.2.2 | 372.41 | This para has the 802.11 arch back to front, and leads to circular logic. What should happen: Step 1) PHY declares its capabilities via a MIB variable. Step 2) MLME reads the PHY's capabilities. Step 3) MLME may opt to prune PHY capabilities according to policy; Step 4: the MLE/MAC advertises this (pruned) list as this STA's PHY capabilities to peer STAs. What is happening here: the MAC is magically discovers what the PHY is capable of, and then magically lets the PHY know. | 1)If not already present in table 36-68, define a MIB variable so the PHY can express if the PHY is capable of this particular feature or not. This is required. 2) If we really think that the MLME may want the PHY to disable this particular feature(!?), then give the MAC a MIB variable to use to control the PHY to disable/enable this particular feature. Or not. Repeatedly apply 1) and 2) to each instance of "Capabilties" in this section until we don't see "Capabilties" anywhere in this section (currently 9x). Add language connecting the dots. | Revised. See changes under 4627 in 21/1672R<motionedRevision> that substantially implement the commenter’s proposal.  Note to TGbe editor: these changes are implemented under CID4627. No further change required. |
| 4629 | 36.3.3.2.4 | 373.04 | This para has the 802.11 arch back to front, and leads to circular logic. What should happen: Step 1) PHY declares its capabilities via a MIB variable. Step 2) MLME reads the PHY's capabilities. Step 3) MLME may opt to prune PHY capabilities according to policy; Step 4: the MLE/MAC advertises this (pruned) list as this STA's PHY capabilities to peer STAs. What is happening here: the MAC is magically discovers what the PHY is capable of, and then magically lets the PHY know. | 1) If not already present in Table 36-68, define a MIB variable so the PHY can express if the PHY is capable of this particular feature or not. This is required. 2) If we really think that the MLME may want the PHY to disable this particular feature(!?), then give the MAC a MIB variable to use to control the PHY to disable/enable this particular feature. Or not. Add language connecting the dots. | Revised. See changes under 4627 in 21/1672R<motionedRevision> that substantially implement the commenter’s proposal.  Note to TGbe editor: these changes are implemented under CID4627. No further change required. |

***Discussion***

The 802.11 architecture is well captured in the following two figures.

Diagram

Description automatically generated

Diagram, timeline

Description automatically generated

The benefits of the ISO Seven Layer Model is:

* One layer (or sublayer) can be swapped out for another layer (e.g., 802.11 for 802.3)
* Layering conforms to good software development practice
  + Each layer/sublayer can be thought of an object, with public/private constants, variables, and methods
  + Each method has a clear **and complete** interface
  + No method needs to “silently reach into another object’s private variables” to complete its task
* A “divide and conquer” approach is possible:
  + **During standardization, relatively independent teams can work in parallel on their own layer/sublayer**
  + During product development, relatively independent teams can work in parallel on their own layer/sublayer
  + These teams might even reside in different companies so that the complete product is composed of components from different companies

For instance, when this design approach is applied to capability advertisement, it operates as follows:

* The PLME declares its capabilities via PHY MIB variables
  + i.e., the PHY (including the PLME) is the source of truth for the PHY
* The MLME reads the PHY capabilities from “Implemented” PHY MIB variables via the PLME-GET primitive
* The MLME transmits the PHY-related fields of the EHT Capabilities element with the Implemented version of the capability variable.
* For each PHY MIB capability (“Implemented”) variable associated with an “Activated” variable, the MLME may apply its own policy (e.g., perhaps, as part of OMN/OMI signaling, the MLME determines to operate the PHY in a reduced capability mode in order to save power). The MLME shares this policy with the PLME by configuring the associated “Activated” read-write MIB variable
* The MLME uses the MAC and PHY data plane to transmit its EHT Capabilities element in an MMPDU in an MPDU in a PSDU in a PPDU
* NOTE: A STA can signal less than its full PHY capabilities even for a “read-only” MIB variable if the MIB variable is marked as “dynamic” since then, from 36.4.2 (PHY MIB), such a MIB variables may still be edited by the PLME (but, from VHT for example, this feature is not used: Activated variables are dynamic and read-write).

Corollaries:

* The PHY data plane does transmit the EHT Capabilities element, but only understands it as an opaque PSDU.
* Rather, the PLME/PHY is aware of the PHY-related fields of the EHT Capabilities element through its own read-only “Implemented” PHY MIB variables.

BTW, the main standardized information flows between MAC and PHY are:

* PLME-CHARACTERISTICS.request/confirm so that, upon request, PLME can send its constants to MLME
* Read only (“Implemented”) parameters in the PHY MIB so the PHY can report its capabilities
* PHY-CONFIG.request(PHYCONFIG\_VECTOR) so the MAC can dynamically configure the PHY
* Read/write (“Activated”) parameters in the PHY MIB (to allow the MAC or an external mgmt. entity to manage the STA)
* PHY-TXSTART(TXVECTOR) and PHY-RXSTART(RXVECTOR) for per PPDU parameters
  + Also TRIG\_VECTOR, but this seems to be missing a primitive (needs a new REVme comment).

For instance, if the MLME determines to send a OMN frame to a peer STA modify its own **operating bandwidth**, then the MLME also needs to notify its collocated PHY using MIB variables.

For instance, if the MLME determines to send a OMN frame to a peer STA modify its own number of **spatial streams**, then the MLME also needs to notify its collocated PHY using MIB variables.

***Text changes***

***TGbe editor, please make the following changes under CID 4627 as shown by Word track changes***

35.10 (#4627)Rules related to the PHY interface ofan EHT STA

35.10.2a (#4627)Contents of the EHT PHY Capabilities Information field and Supported EHT-MCS And NSS Set field

The EHT MAC determines the capabilities of its EHT PHY by using the PLME-GET primitive to read the EHT PHY MIB attributes (see Table 36-68—EHT PHY MIB attributes). The subfields in the EHT PHY Capabilities Information field in the EHT Capabilities element shall be set as follows:

* Support For 320 MHz In 6 GHz = b2int(dot11EHTSupportFor320MHzImplemented)
* Support for 242-tone RU In BW Wider Than 20 MHz = b2int(dot11EHTSupportFor242ToneRUInBWWiderThan20Implemented)
* NDP With 4x EHT-LTF And 3.2 µs GI = b2int(dot11EHTNDPwith4xEHTLTFand3point2GIImplemented)
* Partial Bandwidth UL MU-MIMO = b2int(dot11EHTPartialBWULMUMIMOImplemented)
* SU Beamformer = b2int(dot11EHTSUBeamformerImplemented)
* SU Beamformee = b2int(dot11EHTSUBeamformeeImplemented)
* Beamformee SS (≤ 80 MHz) = dot11EHTBeamformeeSSLessThanOrEqualTo80 - 1
* Beamformee SS (= 160 MHz) = dot11EHTBeamformeeSSEqualTo160 - 1
* Beamformee SS (= 320 MHz) = dot11EHTBeamformeeSSEqualTo320 - 1
* Number Of Sounding Dimensions (≤ 80 MHz) = dot11EHTNumberSoundingDimensionsLessThanOrEqualTo80 - 1
* Number Of Sounding Dimensions (= 160 MHz) = dot11EHTNumberSoundingDimensionsEqualTo160 - 1
* Number Of Sounding Dimensions (= 320 MHz) = dot11EHTNumberSoundingDimensionsEqualTo320 - 1
* Ng = 16 SU Feedback = b2int(dot11EHTNG16SUFeedbackImplemented)
* Ng = 16 MU Feedback = b2int(dot11EHTNG16MUFeedbackImplemented)
* Codebook Size (ϕ, ψ) = {4,2} SU Feedback = b2int(dot11EHTCodebookSizePhi4Psi2SUFeedbackImplemented)
* Codebook Size (ϕ, ψ) = {7,5} MU Feedback = b2int(dot11EHTCodebookSizePhi7Psi5MUFeedbackImplemented)
* Triggered SU Beamforming Feedback = b2int(dot11EHTTriggeredSUBeamformingFeedbackImplemented)
* Triggered MU Beamforming Partial BW Feedback = b2int(dot11EHTTriggeredMUBeamformingPartialBWFeedbackImplemented)
* Triggered CQI Feedback = b2int(dot11EHTTriggeredCQIFeedbackImplemented)
* Partial Bandwidth DL MU-MIMO = b2int(dot11EHTPartialBWDLMUMIMOImplemented)
* EHT PSR-Based SR Support = b2int(dot11EHTPSRBasedSRImplemented)
* Power Boost Factor Support = b2int(dot11EHTPowerBoostFactorImplemented)
* EHT MU PPDU With 4x EHT-LTF And 0.8 µs GI = b2int(dot11EHTMUPPDUwith4xEHTLTFand0point8usecGIImplemented)
* Max Nc = dot11EHTMaxNc - 1
* Non-Triggered CQI Feedback = b2int(dot11EHTNonTriggeredCQIFeedbackImplemented)
* Tx 1024-QAM And 4096-QAM < 242-tone RU Support = b2int(dot11EHTTx1024QAMand4096QAMLessThan242ToneRUImplemented)
* Rx 1024-QAM And 4096-QAM < 242-tone RU Support = b2int(dot11EHTRx1024QAMand4096QAMLessThan242ToneRUImplemented)
* Maximum Number Of Supported EHT-LTFs = b2int(dot11EHTExtraLTFsImplemented) + 2×(dot11EHTMaxNumberOfSupportedEHTLTFsForSU-1) + 8×(dot11EHTMaxNumberOfSupportedEHTLTFsForMUandND)-1)
* Support Of MCS 15 = b2int(dot11EHTMCS15For52p26and106p26MRUImplemented) + 2×b2int(dot11EHTMCS15For484p242MRUImplemented) + 4×b2int(dot11EHTMCS15For996p484and996p484p242MRUImplemented) + 8×b2int(dot11EHTMCS15For3x996MRUImplemented)
* Support Of EHT DUP (MCS 14) In 6 GHz = b2int(dot11EHTDupImplemented)
* Support For 20 MHz Operating STA Receiving NDP With Wider Bandwidth = b2int(dot11EHT20MHzOperatingSTARxNDPwithWiderBWImplemented)
* Non-OFDMA UL MU-MIMO (BW ≤ 80 MHz) = b2int(dot11EHTNonOFDMAULMUMIMOLessThanOrEqualto80Implemented)
* Non-OFDMA UL MU-MIMO (BW = 160 MHz) = b2int(dot11EHTNonOFDMAULMUMIMOEqualto160Implemented)
* Non-OFDMA UL MU-MIMO (BW = 320 MHz) = b2int(dot11EHTNonOFDMAULMUMIMOEqualto320Implemented)
* MU Beamformer (BW ≤ 80 MHz) = b2int(dot11EHTMUBeamformerLessThanOrEqualTo80Implemented)
* MU Beamformer (BW = 160 MHz) = b2int(dot11EHTMUBeamformerEqualTo160Implemented)
* MU Beamformer (BW = 320 MHz) = b2int(dot11EHTMUBeamformerEqualTo320Implemented)

The function b2int returns 1 if the input is true and 0 if the input is false.

Table 9-401j (Subfield of the EHT PHY Capabilities Information field) defines constraints on certain fields which in turn are constraints on the associated PHY MIB variables.

The EHT-MCS Map (20 MHz-Only Non-AP STA) field in the Supported EHT-MCS And NSS Set field in the EHT Capabilities element, if present, shall be set to dot11EHTSupportedEhtMcsAndNssSet20MhzOnlyStaImplemented.

The EHT-MCS Map (BW ≤ 80 MHz, Except 20 MHz-Only Non-AP STA) field in the Supported EHT-MCS And NSS Set field in the EHT Capabilities element, if present, shall be set to the first three octets of dot11EHTSupportedEhtMcsAndNssSetImplemented. The EHT-MCS Map (BW = 160 MHz) field in the Supported EHT-MCS And NSS Set field in the EHT Capabilities element, if present, shall be set to the second three octets of dot11EHTSupportedEhtMcsAndNssSetImplemented. The EHT-MCS Map (BW = 320 MHz) field in the Supported EHT-MCS And NSS Set field in the EHT Capabilities element, if present, shall be set to the third three octets of dot11EHTSupportedEhtMcsAndNssSetImplemented.

36.2.4 PHYCONFIG\_VECTOR

The PHYCONFIG\_VECTOR carried in a PHY-CONFIG.request primitive for an EHT PHY contains an OPERATING\_CHANNEL parameter, which identifies the operating or primary channel. The PHY shall set dot11CurrentPrimaryChannel to the value of this parameter.

The PHYCONFIG\_VECTOR carried in a PHY-CONFIG.request primitive for an EHT PHY contains a CHANNEL\_WIDTH parameter, which identifies the operating channel width and takes one of the values 20 MHz, 40 MHz, 80 MHz, 160 MHz, and 320 MHz. (#4624)The PHY shall set dot11EHTCurrentChannelWidth to the value of this parameter.

The PHYCONFIG\_VECTOR carried in a PHY-CONFIG.request primitive for an EHT PHY contains a CENTER\_FREQUENCY\_SEGMENT\_0 parameter, which identifies the center frequency of the channel and takes a value between 1 and 255. The PHY shall set dot11EHTCurrentChannelCenterFrequencyIndex0 to the value of this parameter.

The PHYCONFIG\_VECTOR carried in a PHY-CONFIG.request primitive for an EHT PHY contains a DISABLED\_SUBCHANNEL\_BITMAP parameter, which identifies the 20 MHz subchannels that are punctured in an EHT BSS. The PHY shall set dot11EhtDisabledSubchannelBitmap to the value of this parameter.

36.3.3.1.1 Supported RU/MRU sizes in DL MU-MIMO(#2699)

***TGbe editor, at D1.3P493L19, change:***

(#4627)A STA that sets the Partial Bandwidth DL MU-MIMO subfield of the EHT PHY Capabilities Information field in the EHT Capabilities element that it transmits to 1, where, as defined in 35.10.2a ((#4627)Contents of the EHT PHY Capabilities Information field and Supported EHT-MCS And NSS Set field), this subfield is determined in turn by dot11EHTPartialBWDLMUMIMOImplemented, shall support receiving an RU/MRU in an EHT PPDU where MU-MIMO is employed in the RU/MRU, the RU/MRU size being greater than or equal to 242 tones, and where there are multiple RUs/MRUs within the PPDU bandwidth.

36.3.3.1.2 Maximum number of spatial streams in an EHT MU PPDU

***TGbe editor, at D1.3P493L27, change:***

(#4627)An EHT STA shall support the reception of non-OFDMA DL MU-MIMO transmissions with a maximum number of spatial streams (per user) that is the minimum of 4 and the maximum number of spatial streams supported for reception of an EHT MU PPDU that is sent to that STA as an SU transmission. The maximum number of spatial streams supported for reception of an EHT MU PPDU when sent to a STA as part of an SU transmission is indicated for various bandwidths in the Supported EHT-MCS And NSS Set field in the EHT Capabilities element, where, as defined in 35.10.2a ((#4627)Contents of the EHT PHY Capabilities Information field and Supported EHT-MCS And NSS Set field), this field is determined in turn by dot11EHTSupportedEhtMcsAndNssSet20MhzOnlyStaImplemented for a 20 MHz-only non-AP STA and by dot11EHTSupportedEhtMcsAndNssSetImplemented for other STAs.

(#1307)(#1554)(#4627)For EHT MU PPDUs using bandwidth less than or equal to 80 MHz, a non-AP EHT STA shall support the reception of DL MU-MIMO transmissions with the total number of spatial streams (across all users) that is supported for the reception of an EHT MU PPDU up to the value indicated by the Beamformee SS ( ≤ 80 MHz) subfield in the EHT PHY Capabilities Information field in the EHT Capabilities element, where, as defined in 35.10.2a ((#4627)Contents of the EHT PHY Capabilities Information field and Supported EHT-MCS And NSS Set field), this subfield is determined in turn by dot11EHTBeamformeeSSLessThanOrEqualTo80.

(#4627)For EHT MU PPDUs using bandwidth equal to 160 MHz, a non-AP EHT STA shall support the reception of DL MU-MIMO transmissions with the total number of spatial streams (across all users) that is supported for the reception of an EHT MU PPDU up to the value indicated by the Beamformee SS (= 160 MHz) subfield in the EHT PHY Capabilities Information field in the EHT Capabilities element, where, as defined in 35.10.2a ((#4627)Contents of the EHT PHY Capabilities Information field and Supported EHT-MCS And NSS Set field), this subfield is determined in turn by dot11EHTBeamformeeSSEqualTo160.

(#4627)For EHT MU PPDUs using bandwidth equal to 320 MHz, a non-AP EHT STA shall support the reception of DL MU-MIMO transmissions with the total number of spatial streams (across all users) that is supported for the reception of an EHT MU PPDU up to the value indicated by the Beamformee SS (= 320 MHz) subfield in the EHT PHY Capabilities Information field in the EHT Capabilities element, where, as defined in 35.10.2a ((#4627)Contents of the EHT PHY Capabilities Information field and Supported EHT-MCS And NSS Set field), this subfield is determined in turn by dot11EHTBeamformeeSSEqualTo320.

(#4627)If dot11EHTSUBeamformeeImplemented is true, the minimum value for each of the Beamformee SS ( ≤ 80 MHz), Beamformee SS (= 160 MHz) and Beamformee SS (= 320 MHz) subfields is 3, because the minimum value of each of dot11EHTBeamformeeSSLessThanOrEqualTo80, dot11EHTBeamformeeSSEqualTo160 and dot11EHTBeamformeeSSEqualTo320 is 4.

(#1329)(#4627)The support by an EHT AP of EHT non-OFDMA DL MU-MIMO transmission on an RU or MRU size greater than or equal to 242 tones in a bandwidth up to 80 MHz, 160 MHz or 320 MHz is indicated in the respective MU beamformer (BW ≤ 80 MHz), (BW = 160 MHz) or (BW = 320 MHz) subfield in the EHT PHY Capabilities Information field in the EHT Capabilities element, where each of these subfields is determined in turn by dot11EHTMUBeamformerLessThanOrEqualTo80Implemented, dot11EHTMUBeamformerEqualTo160Implemented, or dot11EHTMUBeamformerEqualTo320Implemented, respectively (see 35.10.2a ((#4627)Contents of the EHT PHY Capabilities Information field and Supported EHT-MCS And NSS Set field)). The number of spatial streams that an EHT AP supports for transmission from a single STA in an EHT PPDU with bandwidth up to 80 MHz, 160 MHz or 320 MHz is determined from the transmit-related subfields for the respective bandwidth in the Supported EHT-MCS And NSS Set field in the EHT Capabilities element sent by the AP, where this field is determined in turn by dot11EHTSupportedEhtMcsAndNssSetmplemented. An EHT AP shall set dot11EHTMUBeamformerLessThanOrEqualTo80Implemented, dot11EHTMUBeamformerEqualTo160Implemented, and dot11EHTMUBeamformerEqualTo320Implemented to true if the AP supports at least four spatial streams for the transmission to a single STA in a bandwidth of up to 80 MHz, 160 MHz or 320 MHz, the MU beamformer (BW ≤ 80 MHz), (BW = 160 MHz) or (BW = 320 MHz), respectively; and accordingly the MU beamformer (BW ≤ 80 MHz), (BW = 160 MHz) or (BW = 320 MHz) subfield indicates support of EHT non-OFDMA DL MU-MIMO transmission in the respective bandwidth.

36.3.3.2.2 Supported RU sizes in UL MU-MIMO

***TGbe editor, at D1.3P494L15, change:***

(#4627)An AP that sets the Partial Bandwidth UL MU-MIMO subfield of the EHT PHY Capabilities Information field in the EHT Capabilities element that it transmits to 1 where, as defined in 35.10.2a ((#4627)Contents of the EHT PHY Capabilities Information field and Supported EHT-MCS And NSS Set field), this subfield is determined in turn by dot11EHTPartialBWULMUMIMOImplemented, shall support receiving an RU/MRU in an EHT TB PPDU where MU-MIMO is employed in an RU/MRU, the RU/MRU size being greater than or equal to 242 tones, and where there are multiple RUs/MRUs within the PPDU bandwidth.

(#2788)(#3279)(#4627)The support by an EHT AP of EHT non-OFDMA UL MU-MIMO reception of an RU or MRU size greater than or equal to 242 tones in a bandwidth up to 80 MHz, 160 MHz or 320 MHz is indicated in the respective Non-OFDMA UL MU-MIMO (BW ≤ 80 MHz), (BW = 160 MHz) or (BW = 320 MHz) subfield in the EHT PHY Capabilities Information field in the EHT Capabilities element, where each of these subfields is determined in turn by dot11EHTNonOFDMAULMUMIMOLessThanOrEqualto80Implemented, dot11EHTNonOFDMAULMUMIMOEqualto160Implemented, or

dot11EHTNonOFDMAULMUMIMOEqualto320Implemented, respectively (see 35.10.2a ((#4627)Contents of the EHT PHY Capabilities Information field and Supported EHT-MCS And NSS Set field)). The number of spatial streams that an EHT AP supports for reception from a single STA in an EHT PPDU with bandwidth up to 80 MHz, 160 MHz or 320 MHz is determined from the receive-related subfields for the respective bandwidth in the Supported EHT-MCS And NSS Set field in the EHT Capabilities element sent by the AP, where this field is determined in turn by dot11EHTSupportedEhtMcsAndNssSetmplemented. An EHT AP shall set dot11EHTNonOFDMAULMUMIMOLessThanOrEqualto80Implemented, dot11EHTNonOFDMAULMUMIMOEqualto160Implemented, and

dot11EHTNonOFDMAULMUMIMOEqualto320Implemented to true if the AP supports the reception of at least four spatial streams from a single STA in a bandwidth of up to 80 MHz, 160 MHz or 320 MHz; and accordingly, the Non-OFDMA UL MU-MIMO (BW ≤ 80 MHz), (BW = 160 MHz) or (BW = 320 MHz) subfield indicates support of EHT non-OFDMA UL MU-MIMO reception in the respective bandwidth.

(#4627)A non-AP STA that sets the Partial Bandwidth UL MU-MIMO subfield of the EHT PHY Capabilities Information field in the EHT Capabilities element that it transmits to 1, where, as defined in 35.10.2a ((#4627)Contents of the EHT PHY Capabilities Information field and Supported EHT-MCS And NSS Set field), this subfield is determined by dot11EHTPartialBWULMUMIMOImplemented, shall support transmitting an RU/MRU in an EHT TB PPDU where UL MU-MIMO is employed in the RU/MRU, the RU/MRU size being greater than or equal to 242 tones, and where there are multiple RUs/MRUs within the PPDU bandwidth.

36.3.3.2.4 Maximum number of spatial streams in UL MU-MIMO

***TGbe editor, at D1.3P494L49, change:***

A non-AP STA shall support transmitting an EHT TB PPDU using MU-MIMO where:

— The number of spatial streams allocated to the non-AP STA ranges from 1 to N, where N is the smaller of 4 and the maximum number of spatial streams supported by the non-AP STA for SU transmissions.

(#3155)(#7176)The total number of spatial streams for the EHT TB PPDU summed across all the scheduled users using MU-MIMO is less than or equal to 8.

(#4627)The maximum number of spatial streams supported by a STA for SU transmissions is indicated in theSupported EHT-MCS And NSS Set field in the EHT Capabilities element where, as defined in 35.10.2a ((#4627)Contents of the EHT PHY Capabilities Information field and Supported EHT-MCS And NSS Set field), this field is determined in turn by the maximum number of spatial streams supported among the transmit-related subfields of dot11EHTSupportedEhtMcsAndNssSet20MhzOnlyImplemented for a 20 MHz-only non-AP STA and by the maximum number of spatial streams supported among the transmit-related subfields of dot11EHTSupportedEhtMcsAndNssSetmplemented for other STAs.

36.3.13.3.3 LDPC coding

***TGbe editor, at D1.3P600L58, change:***

(#4627)LDPC is the only FEC coding scheme in the EHT PPDU Data field for RUs or MRUs with more than 242 tones(#1292). LDPC is the only FEC coding scheme in the EHT PPDU Data field for EHT-MCSs 10 to 14(#2648)(#4631). Support for LDPC coding (for both transmit and receive) is mandatory for an EHT STA that supports at least one of:

* EHT 40/80/160/320 MHz PPDU bandwidths for SU transmission,
* more than four spatial streams,
* any EHT-MCS from 10 to 13, or
* EHT-MCS 14.

Otherwise, support of LDPC coding for either transmit or receive is optional. An EHT STA supports the transmission and reception of LDPC encoded EHT PPDUs if the STA sets the LDPC Coding In Payload subfield of the (#4631)HE Capabilities element (see 9.4.2.248 (HE Capabilities element)) to 1, where, as defined in 35.10.2a ((#4627)Contents of the EHT PHY Capabilities Information field and Supported EHT-MCS And NSS Set field), this subfield is determined in turn by dot11HELDPCCodingInPayloadImplemented.

36.3.19.1.2 Additional restrictions for puncturing in EHT PPDU

***TGbe editor, at D1.3P640L60, change:***

(#4639)(#7257)(#8142)(#4627)For preamble puncturing in EHT MU PPDU, EHT TB PPDU, and non-HT duplicated PPDU, the signal leakage from the occupied subchannels to the punctured subchannels shall follow the restrictions as described below subject to the puncturing pattern in EHT MU PPDU, EHT TB PPDU, and non-HT duplicated PPDU, respectively. The puncturing pattern in an EHT MU PPDU is indicated by the punctured channel information in U-SIG field(#5657). The puncturing pattern in an EHT TB PPDU and non-HT duplicated PPDU is determined by the Disabled Subchannel Bitmap field in the EHT Operation element defined in 9.4.2.311 (EHT Operation element) and signaled to the PHY via the DISABLED\_SUBCHANNEL\_BITMAP parameter in the PHYCONFIG\_VECTOR.

Table 36-68—EHT PHY MIB attributes

|  |  |  |
| --- | --- | --- |
| Managed object | Default value/  Range | Operational  semantics |
| **dot11PHYEHTTable** | | |
| ***TGbe editor, at the end of this section, insert:*** | | |
| dot11EHTDisabledSubchannelBitmap | 0 / 0…65535 | Dynamic |

Annex C

***TGbe editor, at D1.3P721L6, change:***

Dot11PhyEHTEntry ::=

SEQUENCE {

dot11EHTCurrentChannelWidth INTEGER,

dot11EHTSupportFor320MHzImplemented TruthValue,

dot11EHTNonOFDMAULMUMIMOLessThanOrEqualto80Implemented TruthValue,

dot11EHTNonOFDMAULMUMIMOEqualto160Implemented TruthValue,

dot11EHTNonOFDMAULMUMIMOEqualto320Implemented TruthValue,

dot11EHTPartialBWULMUMIMOImplemented TruthValue,

dot11EHTMUPPDUwith4xEHTLTFand0point8usecGIImplemented TruthValue,

dot11EHTPSRBasedSRImplemented TruthValue,

dot11EHTPowerBoostFactorImplemented TruthValue,

dot11EHTTx1024QAMand4096QAMLessThan242ToneRUImplemented TruthValue,

dot11EHTRx1024QAMand4096QAMLessThan242ToneRUImplemented TruthValue,

dot11EHTExtraLTFsImplemented TruthValue,

dot11EHTMaxNumberOfSupportedEHTLTFsForSU INTEGER,

dot11EHTMaxNumberOfSupportedEHTLTFsForMUandNDP INTEGER,

dot11EHTMCS15For52p26and106p26MRUImplemented TruthValue,

dot11EHTMCS15For484p242MRUImplemented TruthValue,

dot11EHTMCS15For996p484and996p484p242MRUImplemented TruthValue,

dot11EHTMCS15For3x996MRUImplemented TruthValue,

dot11EHTDupImplemented TruthValue,

dot11EHTSupportFor242ToneRUInBWWiderThan20Implemented TruthValue,

dot11EHT20MHzOperatingSTARxNDPwithWiderBWImplemented TruthValue,

(#7574)dot11MSOFDMEDthreshold Unsigned32,

(#4627)dot11EHTSupportedEhtMcsAndNssSet20MhzOnlyStaImplemented OCTET STRING,

dot11EHTSupportedEhtMcsAndNssSet20MhzOnlyActivated OCTET STRING,

dot11EHTSupportedEhtMcsAndNssSetImplemented OCTET STRING,

dot11EHTSupportedEhtMcsAndNssSetActivated OCTET STRING,

dot11EHTDisabledSubchannelBitmap Unwsigned32

}

***TGbe editor, at D1.3P726L57, insert:***

(#4627)dot11EHTSupportedEhtMcsAndNssSet20MhzOnlyImplemented OBJECT-TYPE

SYNTAX OCTET STRING (SIZE(4))

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

For a 20 MHz-only non-AP STA, this attribute indicates the implemented EHT MCSs and NSSs. The encoding is the same as the EHT-MCS Map (20 MHz-Only Non-AP STA) field when present in the Supported EHT-MCS and NSS Set field in the EHT Capabilities element.

Reserved for a STA that is not a 20 MHz-only non-AP STA."

::= { dot11PhyEHTEntry 23 }

dot11EHTSupportedEhtMcsAndNssSet20MhzOnlyStaActivated OBJECT-TYPE

SYNTAX OCTET STRING (SIZE(4))

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"This is a control variable.

It is written by the MLME.

For a 20 MHz-only non-AP STA, this attribute indicates the activated EHT MCSs and NSSs. The encoding is the same as the EHT-MCS Map (20 MHz-Only Non-AP STA) field when present in the Supported EHT-MCS and NSS Set field in the EHT Capabilities element.

Reserved for a STA that is not a 20 MHz-only non-AP STA."

::= { dot11PhyEHTEntry 24 }

dot11EHTSupportedEhtMcsAndNssSetmplemented OBJECT-TYPE

SYNTAX OCTET STRING (SIZE(9))

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

For a STA that is not a 20 MHz-only non-AP STA, this attribute indicates the implemented EHT MCSs and NSSs. The encoding is the same as the EHT-MCS Map (BW ≤ 80 MHz, Except 20 MHz-Only Non-AP STA) field when present followed by the EHT-MCS Map (BW = 160 MHz) field when present followed by the EHT-MCS Map (BW = 320 MHz) field when present in the Supported EHT-MCS and NSS Set field in the EHT Capabilities element.

Reserved for a 20 MHz-only non-AP STA."

::= { dot11PhyEHTEntry 25 }

dot11EHTSupportedEhtMcsAndNssSetActivated OBJECT-TYPE

SYNTAX OCTET STRING (SIZE(9))

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"This is a control variable.

It is written by the MLME.

For a STA that is not a 20 MHz-only non-AP STA, this attribute indicates the activated EHT MCSs and NSSs. The encoding is the same as the EHT-MCS Map (BW ≤ 80 MHz, Except 20 MHz-Only Non-AP STA) field when present followed by the EHT-MCS Map (BW = 160 MHz) field when present followed by the EHT-MCS Map (BW = 320 MHz) field when present in the Supported EHT-MCS and NSS Set field in the EHT Capabilities element.

Reserved for a 20 MHz-only non-AP STA."

::= { dot11PhyEHTEntry 26 }

dot11EHTDisabledSubchannelBitmap OBJECT-TYPE

SYNTAX Unsigned32 (1..65535)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This is a status variable.

It is written by the PHY. This attribute specifies the Disabled Subchannel Bitmap which is a 16-bit bitmap where the lowest numbered bit corresponds to the 20 MHz subchannel that lies within the BSS bandwidth and that has the lowest frequency of the set of all 20 MHz subchannels within the BSS bandwidth. Each successive bit in the bitmap corresponds to the next higher frequency 20 MHz subchannel. A bit in the bitmap is set to 1 to indicate the corresponding 20 MHz

subchannel is punctured and set to 0 to indicate the corresponding 20 MHz subchannel is not punctured."

DEFVAL { 0 }

::= { dot11PhyEHTEntry 27 }

***TGbe editor, also change the following entries in Annex C:***

dot11EHTNonOFDMAULMUMIMOLessThanOrEqualto80Implemented OBJECT-TYPE SYNTAX TruthValue

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

In an AP, this attribute, when true, indicates that the AP is capable of receiving non-OFDMA UL MU-MIMO in an EHT TB PPDU of band- width equal to any one of 20, 40 or 80 MHz.

Reserved for a non-AP STA.

This capability is disabled otherwise." DEFVAL { false }

::= { dot11PhyEHTEntry 3 }

dot11EHTNonOFDMAULMUMIMOEqualto160Implemented OBJECT-TYPE SYNTAX TruthValue

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

In an AP, this attribute, when true, indicates that the AP is capable of receiving non-OFDMA UL MU-MIMO in an EHT TB PPDU of band- width 160 MHz.

Reserved for a non-AP STA.

This capability is disabled otherwise." DEFVAL { false }

::= { dot11PhyEHTEntry 4 }

dot11EHTNonOFDMAULMUMIMOEqualto320Implemented OBJECT-TYPE SYNTAX TruthValue

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

In an AP, this attribute, when true, indicates that the AP is capable of receiving non-OFDMA UL MU-MIMO in an EHT TB PPDU of band- width 320 MHz.

Reserved for a non-AP STA.

This capability is disabled otherwise." DEFVAL { false }

::= { dot11PhyEHTEntry 5 }

dot11EHTTx1024QAMand4096QAMLessThan242ToneRUImplemented OBJECT-TYPE SYNTAX TruthValue

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

In a non-AP STA, this attribute, when true, indicates that the support for transmitting EHT TB PPDUs using 1024-QAM and 4096-QAM in a 26, 52, and 106-tone RU as well as 52+26 and 106+26-tone MRU by the non-AP STA is the same as indicated in the Tx EHT-MCS Map (≤ 80 MHz) subfield in the EHT PHY Capabilities Infor- mation field in the EHT Capabilities element.

This capability is disabled otherwise, in which case the non-AP STA does not support transmitting EHT TB PPDUs using 1024-QAM and 4096-QAM in a 26, 52, and 106-tone RU as well as 52+26 and 106+26-tone MRU regardless of the indication in the Tx EHT-MCS Map (≤ 80 MHz) subfield in the EHT PHY Capa- bilities Information field in the EHT Capabilities element.

Reserved for an AP."

DEFVAL { false }

::= { dot11PhyEHTEntry 10 }

dot11EHTBeamformeeSSLessThanOrEqualTo80 OBJECT-TYPE SYNTAX Unsigned32 (4..8)

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

If dot11EHTSUBeamformeeImplemented is true, this attribute indicates the maximum number of spatial streams that the STA can receive in an EHT sounding NDP of bandwidth equal to any one of 20, 40 or 80 MHz. This attribute also indicates the maximum total number of spatial streams over all users that can be sent in a DL MU-MIMO trans- mission in an EHT MU PPDU of bandwidth equal to any one of 20, 40 or 80 MHz, on an RU/MRU that includes that STA, where the RU/MRU might or might not span the entire PPDU bandwidth."

Reserved if dot11EHTSUBeamformeeImplemented is false.

DEFVAL { 4 }

::= { dot11EHTTransmitBeamformingConfigEntry 11 }

dot11EHTBeamformeeSSEqualTo160 OBJECT-TYPE SYNTAX Unsigned32 (4..8)

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

If dot11EHTSUBeamformeeImplemented is true, this attribute indicates the maximum number of spatial streams that the STA can receive in an EHT sounding NDP of bandwidth equal to 160 MHz. This attribute also indicates the maximum total number of spatial streams over all users that can be sent in a DL MU-MIMO transmission in an EHT MU PPDU of bandwidth equal to 160 MHz, on an RU/MRU that includes that STA, where the RU/MRU might or might not span the entire PPDU bandwidth.

Reserved if dot11EHTSUBeamformeeImplemented is false."

DEFVAL { 4 }

::= { dot11EHTTransmitBeamformingConfigEntry 12 }

dot11EHTBeamformeeSSEqualTo320 OBJECT-TYPE SYNTAX Unsigned32 (4..8)

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

If dot11EHTSUBeamformeeImplemented is true, this attribute indicates the maximum number of spatial streams that the STA can receive in an EHT sounding NDP of bandwidth equal to 320 MHz. This attribute also indicates the maximum total number of spatial streams over all users that can be sent in a DL MU-MIMO transmission in an EHT MU PPDU of bandwidth equal to 320 MHz, on an RU/MRU that includes that STA, where

the RU/MRU might or might not span the entire PPDU bandwidth.

Reserved if dot11EHTSUBeamformeeImplemented is false.

" DEFVAL { 4 }

::= { dot11EHTTransmitBeamformingConfigEntry 13 }

dot11EHTNumberSoundingDimensionsLessThanOrEqualTo80 OBJECT-TYPE SYNTAX Unsigned32 (4..8)

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

If dot11EHTSUBeamformerImplemented is true, this attribute indicates the maximum number of spatial streams the beam- former can transmit in an EHT sounding NDP with PPDU bandwidth equal to any one of 20, 40 or 80 MHz.

Reserved if dot11EHTSUBeamformerImplemented is false."

DEFVAL { 4 }

::= { dot11EHTTransmitBeamformingConfigEntry 14 }

dot11EHTNumberSoundingDimensionsEqualTo160 OBJECT-TYPE SYNTAX Unsigned32 (4..8)

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

If dot11EHTSUBeamformerImplemented is true, this attribute indicates the maximum number of spatial streams the beam- former can transmit in an EHT sounding NDP with PPDU bandwidth equal to

160 MHz.

Reserved if dot11EHTSUBeamformerImplemented is false " DEFVAL { 4 }

::= { dot11EHTTransmitBeamformingConfigEntry 15 }

dot11EHTNumberSoundingDimensionsEqualTo320 OBJECT-TYPE SYNTAX Unsigned32 (4..8)

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

If dot11EHTSUBeamformerImplemented is true, this attribute indicates the maximum number of spatial streams the beam- former can transmit in an EHT sounding NDP with PPDU bandwidth equal to

320 MHz.

Reserved if dot11EHTSUBeamformerImplemented is false." DEFVAL { 4 }

::= { dot11EHTTransmitBeamformingConfigEntry 16 }

dot11EHTSupportFor242ToneRUInBWWiderThan20Implemented OBJECT-TYPE SYNTAX TruthValue

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

In a non-AP STA, this attribute, when true, indicates that the non-AP STA is capable of receiving a 242-tone RU in a PPDU with a bandwidth larger than 20 MHz.

This capability is disabled in a non-AP STA otherwise.

Reserved in an AP."

DEFVAL { false }

::= { dot11PhyEHTEntry 20}

dot11EHTSUBeamformeeImplemented OBJECT-TYPE SYNTAX TruthValue

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

In an AP, this attribute, when true, indicates that opera- tion as an SU beamformee is supported in the AP.

This capability is disabled in an AP otherwise.

Set to true for a non-AP STA."

DEFVAL { false }

::= { dot11EHTTransmitBeamformingConfigEntry 2 }

dot11EHTMUBeamformerLessThanOrEqualTo80Implemented OBJECT-TYPE SYNTAX TruthValue

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

In an AP, this attribute, when true, indicates that the AP supports non-OFDMA DL MU- MIMO transmission and the required MU sounding for PPDU bandwidths equal to any one of 20, 40 or 80 MHz.

This capability is disabled in an AP otherwise.

Reserved for a non-AP STA."

DEFVAL { false }

::= { dot11EHTTransmitBeamformingConfigEntry 3 }dot11EHTMUBeamformerEqualTo160Implemented OBJECT-TYPE SYNTAX TruthValue

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

In an AP, this attribute, when true, indicates that the AP supports non-OFDMA DL MU- MIMO transmission and the required MU sounding for PPDU bandwidth equal to

160 MHz.

This capability is disabled in an AP otherwise.

Reserved for a non-AP STA."

DEFVAL { false }

::= { dot11EHTTransmitBeamformingConfigEntry 4 }

dot11EHTMUBeamformerEqualTo320Implemented OBJECT-TYPE SYNTAX TruthValue

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

In an AP, this attribute, when true, indicates that the AP supports non-OFDMA DL MU- MIMO transmission and the required MU sounding for PPDU bandwidth equal to

320 MHz.

This capability is disabled in an AP otherwise.

Reserved for a non-AP STA."

DEFVAL { false }

::= { dot11EHTTransmitBeamformingConfigEntry 5 }

dot11EHTPartialBWDLMUMIMOImplemented OBJECT-TYPE SYNTAX TruthValue

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

In a non-AP STA, this attribute, when true, indicates that the non-AP STA supports receiv- ing DL MU-MIMO on an RU/MRU in an EHT MU PPDU where the RU/MRU does not span the entire PPDU bandwidth.

This capability is disabled in a non-AP STA otherwise.

Reserved for an AP."

DEFVAL { false }

::= { dot11EHTTransmitBeamformingConfigEntry 6 }

dot11EHTMaxNc OBJECT-TYPE

SYNTAX Unsigned32 (1..8) MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

If dot11EHTSUBeamformeeImplemented is true, this attribute indicates the maximum number of columns (Nc) supported by the EHT beamformee for the EHT compressed beamforming/CQI.

Reserved if dot11EHTSUBeamformeeImplemented is false."

::= { dot11EHTTransmitBeamformingConfigEntry 21 }

dot11EHTNDPwith4xEHTLTFand3point2GIImplemented OBJECT-TYPE SYNTAX TruthValue

MAX-ACCESS read-only STATUS current DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

If dot11EHTSUBeamformeeImplemented is true, this attribute, when true, indicates that the EHT beamformee supports receiving an EHT sounding NDP using 4x EHT-LTF and 3.2 microseconds guard

interval duration.

If dot11EHTSUBeamformeeImplemented is true, this capability is disabled otherwise.

Reserved if dot11EHTSUBeamformeeImplemented is false."

DEFVAL { false }

::= { dot11EHTTransmitBeamformingConfigEntry 22 }