IEEE P802.11
Wireless LANs

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| --- |
| Comment resolutions for 27.16.1 related to 6 Ghz band |
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Abstract

This submission proposes resolutions for multiple comments related to TGax D3.0 with the following CIDs (12 CIDs):

* 15120, 15166, 16446, 15177, 15647, 15154, 15831, 16396, 16447, 15161,
* 15827, 15828

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Inherits all CIDs from 11-18/1211r0 that are related to 6 GHz band. And incorporates suggestions and feedback received during the presentation in July F2F meeting and via e-mail. Changes compared to 1211r0’s counterparts are highlighted in green. Summary of the changes with respect to 11-18/1211r0 based on received feedback
	+ CIDs related to EDCA control are not included in this document and are covered in separate documents.
	+ Provided bulleted list of selective presence of HT Operation, VHT Operation, HE Operation depending on the band
	+ 6G STA does not transmit HT Capabilities and VHT Capabilities elements in the 6 GHz band. It rather includes those bits that are needed for its functionality in a newly created element, a.k.a., MPDU and A-MPDU Parameters element.
	+ 6 G STA shall not transmit other PPDUs formats except HE PPDUs and non-HT PPDUs.
	+ Used the same signalling as for VHT related to CCFS0, CCFS1.
	+ Added allowance of some elements in Neighbor Report.
* Rev 2: Incorporated additional feedback received during and after the presentation of Rev 1 document. Changes are highlighted. The main differences are listed below.
	+ Added resolutions for additional CIDs 15647, 15650, 15651, 15154, 15831, 16396, 16447 and removed 15832 and 15023.
	+ Removed 6 GHz Support field from HE PHY Capabilities IE. Indication of 6 GHz support is based on either transmission of the HE Capabilities element in the 6 GHz band, or if sending the HE Capabilities element in other bands then by using elements that contain the supported operating classes.
	+ Reduced Channel Width field from 4 bits to 2 bits as suggested by Robert. And the Control field now is 1 Byte.
	+ Removed redundant introductory paragraphs in the beginning of subclause 27.16.1a.
	+ Replaced 6G STA with 6 GHz STA as suggested by Kome
	+ Renamed MPDU and A-MPDU Parameters element to Extended HE Capabilities element and added its presence in the MGMT frame body subclauses instead of adding normative behaviour related to it as suggested by Robert.
	+ Removed normative spec related to FILS Discovery frame generation, and passive scanning, since the **discovery** will be covered in more detail in 11-18/1471.
	+ Added MIB variable and appropriate changes for the 6 GHz band in clause 28, and other subclauses and clarified when the 6 GHz Present field is present or not.
	+ Removed text related to out of band signalling which is going to be addressed in a separate document.
* Rev 3: Added CID 15161 as part of the resolutions and a couple of missing capabilities. Removed CIDs 15829 and 15650 as they are being resolved in other documents. Changes in this color.
* Rev 4: Added CIDs 15824, 15827, 15828 to the document. No changes to the resolution text as it already proposed changes that are satisfactory to resolve these CIDs as well.
* Rev 5: Removed CID 15824 as it is being resolved in another document. Incorporated suggestions received offline from Mark, Huizhao, et.al. Changes still in yellow color.
* Rev 6: Copy paste error. Switched from NO to YEs, for extended HE capabilities element for the extendability.

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.***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 15120 | Abhishek Patil | 369.47 | Spec covers details on 2.4GHz and 5GHz operation but doesn't provide any guidance on the BSS operation in 6GHz | As in comment | Revised –Agree in principle with the comment. Proposed resolution is to provide operation details for the 6 GHz band.TGax editor to make the changes shown in 11-18/1211r6 under all headings that include CID 15120. |
| 15166 | Alfred Asterjadhi | 369.47 | HE BSS Operation needs some changes to enable 6 Ghz setup, operation, and everything that comes with it. Same consideration for the HE Operation element. And the HE Capabilities. | Will submit a proposal. | Revised –Agree in principle with the comment. Proposed resolution is to provide additional details on the BSS setup, operation, and signaling for 6 GHz operation.TGax editor to make the changes shown in 11-18/1211r6 under all headings that include CID 15166. |
| 16446 | Matthew Fischer | 371.27 | Missing a reference to 6 GHz operation. | Change "5 GHz" to "5 GHz or 6 GHz" | Revised –Agree in principle with the comment. Proposed resolution is to include a statement that refers the reader to the subclause 27.16.2 where the channelization rules for the 6 GHz operation are defined.TGax editor to make the changes shown in 11-18/1211r6 under all headings that include CID 16446. |
| 15177 | Alfred Asterjadhi | 242.00 | TPC is missing to the list. Please add it. Also for the 6 GHz case please ensure that the STAs have mandatory support for it. | Will submit a proposal. | Revised –Agree in principle with the comment. Proposed resolution amended TPC subclause and specified that TPC is mandatory for a STA operating in the 6 GHz band.TGax editor to make the changes shown in 11-18/1211r6 under all headings that include CID 15177. |
| 15647 | GEORGE CHERIAN |  | Need to specify 6GHz operation for 11ax. | As in the comment | Revised –Agree in principle with the comment. Proposed resolution adds details for the operation in the 6 GHz band.TGax editor to make the changes shown in 11-18/1211r6 under all headings that include CID 15647. |
| 15154 | Albert Petrick | 156.56 | For 6 GHz Table 9-262aa (HE PHY Capabilities Information field format)  -- add support reserved for 6 GHz. The channelization bandwidth for 6 GHz is expected to be the same at 5 GHz.(20, 40, 80+80, 160Mhz)  B6 is reserved but should be reserved for 6 GHz operation combined with Bits (Bo - B5) | Update Table 9-262aa HE PHY Capabilities with channel BWs for the 6 GHz band based on the channel BWs used for the 5 GHz band. | Revised –Agree in principle with the comment. Proposed resolution accounts for the suggested change.TGax editor to make the changes shown in 11-18/1211r6 under all headings that include CID 15154. |
| 15831 | Laurent Cariou | 156.24 | Channel width set is defined to describe channel width support at 2.4 and 5GHz. Now that 6GHz is supported, we should consider including bandwidth support at 6GHz as well. | Change the table to enable indicating channel width support at 6GHz | Revised –Agree in principle with the comment. Proposed resolution accounts for the suggested change.TGax editor to make the changes shown in 11-18/1211r6 under all headings that include CID 15831. |
| 16396 | Massinissa Lalam | 154.46 | With the added support of the 6GHz band, it would be useful to replace the Dual Band Support field with an equivalent field. Indeed, knowing from the association which band a station supports may help in subsequent steering operations, enabling a better network efficiency.A possible implementation could be a "BandSupport" subfield using 3 bits from the HE PHY Capabilities Information filed which are reserved in D3.0 and allocate one bit per band supported (e.g. B78 indicating 2.4GHz support , B79 indicating 5 GHz support, B80 indicating 6 GHz support, the minimum condition being that this "BandSupport" subfield cannot be zero). | As in comment. | Revised –The Dual Band Support field was removed from the HE Capabilities element (please refer to D3.2). However, the corresponding MIB variable “dot11HEDualBandImplemented” is still there. The proposed resolution is to remove the MIB variable as well.TGax editor to make the changes shown in 11-18/1211r6 under all headings that include CID 16396. |
| 16447 | Matthew Fischer | 377.17 | Missing a reference to 6 GHz operation. | Here and in many other places throughout the draft, update references to include mention of 6 GHz operation. There are at least 49 places that mention 5 GHz. Most of them also need to mention 6 GHz. | Revised –Agree in principle with the comment. Proposed resolution accounts for the suggested change.TGax editor to make the changes shown in 11-18/1211r6 under all headings that include CID 16447. |
| 15161 | Albert Petrick | 41.16 | "In the (HE) STA clause 4.3.14a -- it states the HE STA operates in the bands between 1 GHz and 7.125 GHz. The 6 GHz band may use the existing channel BWs as in the 5 GHz band. BW (20, 40, 80 and 160 MHz). If the TG goal is to include the 6 GHz band option with specifications in the final ammendment, the draft should be updated while the TG and WG is developing the specification and working with the regulatory bodies e.g., FCC |  | Revised –Agree in principle with the comment. Proposed resolution adds the 6 Ghz band classifier in the appropriate subclauses of clause 28.TGax editor to make the changes shown in 11-18/1211r6 under all headings that include CID 15161. |
| 15827 | Laurent Cariou | 244.56 | As we are using a new operating class for 6GHz channels, the equations in Table 11-24 can not work properly in case the 2 segments and CCFS of an 80+80MHz are in different bands (5 and 6GHz) | Modify the equations of Table 11-24, for instance as proposed in doc 18-397r0 | Revised –Proposed resolution is to provide the CCFS signaling in the HE Operation element as part of a 6 GHz operation information field, which is separate from the lower band functionalities.TGax editor to make the changes shown in 11-18/1211r6 under all headings that include CID 15827. |
| 15828 | Laurent Cariou | 244.56 | As we are using a new operating class for 6GHz channels, the equations in Table 11-26 can not work properly in case the 2 segments and CCFS of an 80+80MHz are in different bands (5 and 6GHz) | Modify the equations of Table 11-26, for instance as proposed in doc 18-397r0 | Revised –Proposed resolution is to provide the CCFS signaling in the HE Operation element as part of a 6 GHz operation information field, which is separate from the lower band functionalities.TGax editor to make the changes shown in 11-18/1211r6 under all headings that include CID 15828. |

**Discussion: *The document covers the 6 GHz BSS Setup and operation.***

* HE Operation element

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 15120, 15166, 15824):***

The operation of HE STAs in an HE BSS is controlled by:

1. The HT Operation element and the HE Operation element when operating in the 2.4 GHz band,
2. The HT Operation element, the VHT Operation element (if present), and the HE Operation element when operating in the 5 GHz band, and
3. The HE Operation element when operating in the 6 GHz band.

 The format of the HE Operation element is defined in Figure 9- 589cq (HE Operation element format).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Element ID Extension | HE Operation Parameters | BSS Color Information | Basic HE-MCS And NSS Set | VHT Operation Information | Max Co-Located BSSID Indicator(#11742) | 6 GHz Operation Information |
| Octets: | 1 | 1 | 1 | 3(#11374) | 1(#11374) | 2 | 0 or 3 | 0 or 1 | 0 or 4 |
| HE Operation element format |

The Element ID, Length, and Element ID Extension fields are defined in 9.4.2.1 (General).

The format of the HE Operation Parameters field is defined in Figure 9-589cr (HE Operation Parameters field format).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0       B2 | B3 | B4      B13 | B14 | B15 | B16 | B17 | B18     B23 |
|  | Default PE Duration | TWT Required | TXOP Duration RTS Threshold | VHT Operation Information Present | Co-Hosted BSS(#11742) | ER SU Disable(#11261) | 6 GHz Present | Reserved |
| Bits: | 3 | 1 | 10 | 1 | 1 | 1 | 1 | 6(#11374) |
| * HE Operation Parameters field format
 |

**TGax Editor: *Insert the paragraph below after the 9th paragraph (#CID 15120, 15166):***

The 6 GHz Present field indicates the presence of the 6 GHz Operation Information field and is set to 1 if the 6 GHz Operation Information field is present and is set to 0 otherwise.

The 6 GHz Present field is set to 1 when the AP sends the HE Operation element in the 6 GHz band. *(#15120, 15166)*

**TGax Editor: *Insert the paragraphs below at the end of this subclause (#CID 15120, 15166):***

The 6 GHz Operation Information field is present when the 6 GHz Present field is 1 and provides channel and bandwidth information related to 6 GHz operation (see X.Y (6 GHz channelization)). The structure of the 6 GHz Operation Information field is defined in Figure 9-XXX (6 GHz Operation Information field).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Primary Channel | Control | Channel Center Frequency Segment 0 | Channel Center Frequency Segment 1 |
| Octets: | 1 | 1 | 1 | 1 |

The Primary Channel field indicates the channel number of the primary channel in the 6 GHz band.The Control field is defined in Figure 9-AAA (Channel Control field).

|  |  |  |
| --- | --- | --- |
|  | B0         B1 | B2 B7 |
|  | Channel Width | Reserved |
| Bits: | 2 | 6 |
| Figure 9-AAA Control field |

The Channel Width field is 2 bits in length and indicates the BSS bandwidth and is set to 0 for 20 MHz, 1 for 40 MHz, 2 for 80 MHz, and 3 for 80+80 or 160 MHz.

The Channel Center Frequency Segment 0 field indicates the channel center frequency index for the 20, 40, or 80, or 80+80 MHz channel on which the HE BSS operates in the 6 GHz band. When the channel width is 80+80 or 160 MHz then it indicates the channel center frequency index of the primary 80 MHz.

The Channel Center Frequency Segment 1 field indicates the channel center frequency index of the 160 MHz channel on which the HE BSS operates in the 6 GHz band. When the channel width is 80+80 MHz then it indicates the channel center frequency index of the secondary 80 MHz.*(#15120, 15166)*

* 1. HE BSS operation

27.19.1 Basic HE BSS functionality

**TGax Editor: *Change the paragraphs below of this subclause as follows (#CID 16446, 15824):***

A STA that sets dot11HEOptionImplemented to true shall set dot11HighThroughputOptionImplemented to true when operating in the 2.4 GHz band. A STA that sets dot11HEOptionImplemented to true shall set dot11VeryHighThroughputOptionImplemented and dot11HighThroughputOptionImplemented to true when operating in the 5 GHz band. A non-AP STA that sets dot11HEOptionImplemented to true shall set dot11MultiBSSIDImplemented to true. A STA that sets dot11HEOptionImplemented to true shall set dot11VeryHighThroughputOptionImplemented and dot11HighThroughputOptionImplemented to false when operating in the 6 GHz band.*(#16446, 15824)*

**TGax Editor: *Change the paragraphs below of this subclause as follows (#CID 16446, 15824):***

An HE STA shall determine the channelization using the information in the Primary Channel field of the HT Operation element when operating in 2.4 GHz and the combination of the information in the Primary Channel field in the HT Operation element and the Channel Center Frequency Segment 0 and Channel Center Frequency Segment 1 subfields in the VHT Operation Information field in the VHT Operation element when operating in 5 GHz (see 21.3.14 (Channelization)). An HE STA determines the channelization as defined in 27.19.2 when operating in 6 GHz.*(#16446, 15824)*

An HE STA shall not transmit an A-MPDU in an HE PPDU to a STA that exceeds the maximum A-MPDU length capability indicated in the HE Capabilities, VHT Capabilities, and HT Capabilities element received from the recipient STA. The maximum A-MPDU length capability is obtained as a combination of the Maximum A-MPDU Length Exponent subfields in the HE Capabilities and VHT Capabilities element if the recipient STA has transmitted the VHT Capabilities; otherwise it is obtained from a combination of the Maximum A-MPDU Length Exponent subfields in the HE Capabilities and the HT Capabilities element.

An HE STA shall follow the rules defined in 11.40 (VHT BSS operation) for channel selection, determining scanning requirements, channel switching, NAV assertion and antenna indication when operating in 5 GHz unless explicitly stated otherwise in Clause 27.

**TGax Editor: *Insert a new subclause as follows (#CID 15120, 15166, 15122, 15177, 15647, 15827, 15828):***

27.16.1a HE BSS functionality in 6 GHz band

 (#13670)A HE STA that has a value of true for dot11HE6GOptionImplemented shall be capable of operating in the 6 GHz band.

An HE STA with dot11HE6GOptionImplemented equal to true and operating in the 6 GHz band is a 6 GHz HE STA.

A 6 GHz HE AP shall indicate support for at least 80 MHz channel width.

A 6 GHz HE AP shall set the Co-Hosted BSS subfield in HE Operation element it transmits to 0.

A 6 GHz HE STA shall not transmit any of the HT Capabilities, VHT Capabilities, HT Operation, VHT Operation elements or the VHT Operation Information fields.

A 6 GHz HE STA shall not transmit to another 6 GHz STA an MPDU in an HE PPDU that exceeds the maximum MPDU length capability indicated in the Extended HE Capabilities element received from the receiving STA.

An 6 GHz HE AP or an 6 GHz HE mesh STA that operates in the 6 GHz band shall set the 6 GHz Present field to 1 in the HE Operation elements it transmits. The HE AP or HE mesh STA shall set the Channel Width subfield, the Channel Center Frequency Segment 0, and the Channel Center Frequency Segment 1 subfields of the 6 GHz Operation Information field as defined in Table XX-YY (6 GHz HE BSS bandwidth), based on the Rx HE-MCS Map  80 MHz, Rx HE-MCS Map 160 MHz, and Rx HE-MCS Map 80+80 MHz fields.

|  |
| --- |
| Table XX-YY--6 GHz HE (#6508)BSS bandwidth(11ac) |
| 6 GHz Operation Information Channel Width field | 6 GHz Operation Information Center Frequency Segment 1 subfield (Ed)(M188) | (#6508)BSS bandwidth |
| 0 | 0 | 20 MHz |
| 1 | 0 | 40 MHz |
| 2 | 0 | 80 MHz |
|  (M188)3 | CCFS1 > 0 and| CCFS1 - CCFS0 | = 8 | 160 MHz |
|  (M188)3 | CCFS1 > 0 and| CCFS1 - CCFS0 | > 16 | 80+80 MHz |
| NOTE 1—CCFS0 represents the value of the Channel Center Frequency Segment 0 subfield.NOTE 2—CCFS1 represents the value of the Channel Center Frequency Segment 1 subfield. |

A 6 GHz HE STA shall determine the BSS channelization using the information in the Primary Channel field in the 6 GHz Operation Information field in the HE Operation element when operating in 6 GHz band (see 28.3.22.2 (Channel allocation in the 6 GHz band)).

A STA shall not transmit HT PPDUs in the 6 GHz band. A STA shall not transmit VHT PPDUs in the 6 GHz band. A STA shall not transmit DSSS, HR/DSSS, ERP-OFDM PPDUs in the 6 GHz band.

An HE STA that operates in the 6 GHz band shall set dot11SpectrumManagementRequired to true and operate as defined in 11.7 (TPC procedures).*(#15120, 15166, 15177, 14824, 15827, 15828)*

**TGax Editor: *Insert the following subclause (#CID 15120, 15166):***

**9.4.2.xxx Extended HE Capabilities element**

An HE STA in the 6 GHz band declares its extended capabilities by transmitting the Extended HE Capabilities element. The Extended HE Capabilities element is defined in Table 9-xxx1 (Extended HE Capabilities element format).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Element ID | Length | Element ID Extension | Capabilities Information |
| Octets: | 1 | 1 | 1 | 2 |

**Table 9-xxx1 Extended HE Capabilities element format**

The structure of the Capabilities Information field is defined in Figure 9-xxx2 (Capabilities Information field format).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 B2 | B3 B5 | B6 B8 | B9 B10 | B11 | B12 | B13 |  B14 B23 |
|  | Minimum MPDU Start Spacing | Maximum A-MPDU Length Exponent | Maximum MPDU Length | SM Power Save | RD Responder | Rx Antenna Pattern Consistency | Tx Antenna Pattern Consistency | Reserved |
| Bits: | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 |

**Figure 9-xxx2 Capabilities Information field format**

The Minimum MPDU Start Spacing subfield is defined in 9.4.2.55.3 (A-MPDU Parameters field).

The Maximum A-MPDU Length Exponent subfield is defined in Table 9-272.

The Maximum MPDU Length subfield is defined in Table 9-272.

The SM Power Save subfield is defined in defined in Table 9-184.

The RD Responder subfield is defined in defined in Table 9-187.

The Rx Antenna Pattern Consistency subfield is defined in defined in Table 9-272.

The Tx Antenna Pattern Consistency subfield is defined in defined in Table 9-272.(#15120, 15166)

**TGax Editor: Insert the row below to Table 9-94 (Element IDs) as follows (#CID 15120, 15166):**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Extended HE Capabilities | 255 | <ANA> | YES |  |

**11.7 TPC procedures**

***TGax Editor: Change the paragraphs below of this subclause as follows (#CID 15177):***

Regulations that apply to the 5 GHz and 6 GHz bands in most regulatory domains require RLANs operating in the 5 GHz and 6 GHz band to use transmitter power control, involving specification of a regulatory maximum transmit power and a mitigation requirement for each allowed channel. This standard describes such a mechanism, referred to as transmit power control (TPC).*(#15177)*

This subclause describes TPC procedures intended to satisfy needs in many regulatory domains and other frequency bands. These procedures might be useful for other purposes (e.g., reduction of interference, range control, reduction of power consumption).

**10.11 A-MSDU operation**

**TGax Editor: *Change the following paragraph (#CID 15120, 15166):***

The length of an A-MSDU transmitted in a VHT PPDU or an HE PPDU is limited by the maximum MPDU size supported by the recipient STA (see 10.12.5 (Transport of A-MPDU by the PHY data service)).

NOTE 1—An A-MSDU that meets the A-MSDU length limit for transmission in a VHT PPDU or an HE PPDU might exceed the A-MSDU length limit for an HT PPDU, in which case it cannot be retransmitted in an HT PPDU.*(#15120, 15166)*

NOTE 2—Support for A-MSDU aggregation does not affect the maximum size of MSDU transported by the MA-UNITDATA primitives.

* HE PHY Capabilities Information field

The subfields of the HE PHY Capabilities Information field are defined in Table 9-262aa (Subfields of the HE PHY Capabilities Information field).

**TGax Editor: *Change the table below as follows(#CID 15120, 15154, 15166, 15831):***

|  |
| --- |
| * Subfields of the HE PHY Capabilities Information field(#11466)
 |
| Subfield | Definition | Encoding |
| Supported Channel Width Set | B0 indicates support for a 40 MHz channel width in the 2.4 GHz band.B1 indicates support for a 40 MHz and 80 MHz channel width in the 5 GHz band or in the 6 GHz band.B2 indicates support for a 160 MHz channel width in the 5 GHz band or in the 6 GHz band.B3 indicates support for a 160/80+80 MHz channel width in the 5 GHz band or in the 6 GHz band.If a non-AP STA operates with 20 MHz channel width and 20 MHz In 40 MHz HE PPDU In 2.4 GHz subfield is 1, then B4 indicates support of 242-tone RUs in a 40 MHz HE MU PPDU in the 2.4 GHz band. Otherwise, B4 is reserved.If a non-AP STA operates with 20 MHz channel width and 20 MHz In 160/80+80 MHz HE PPDU subfield is set to 0, then B5 indicates support of 242-tone RUs in a 40 MHz and 80 MHz HE MU PPDU in the 5 GHz band or in the 6 GHz band. If a non-AP STA operates with 20 MHz channel width and 20 MHz In 160/80+80 MHz HE PPDU subfield is set to 1, then B5 indicates support of 242-tone RUs in a 40 MHz, 80 MHz, 160 MHz, and 80+80 MHz HE MU PPDU in the 5 GHz band or in the 6 GHz band. Otherwise, B5 is reserved.B6 is reserved.B0 and B4 are applicable to 2.4 GHz band operation and reserved for 5 GHz and 6 GHz band operation.B1, B2, B3 and B5 are applicable to 5 GHz and 6 GHz band operation and reserved for 2.4 GHz band operation. | B0 is set to 0 if not supported. B0 set to 1 if supported.B1 is set to 0 if not supported, i.e., it indicates a 20 MHz-only non-AP HE STA in 5 GHz band or 6 GHz band. B1 set to 1 if supported. NOTE 1—For an AP, B1 is set to 1.B2 is set to 0 if not supported. B2 set to 1 if supported. If B2 set to 1 then B1 is set to 1.B3 is set to 0 if not supported. B3 is set to 1 if supported. If B3 set to 1 then B2 is set to 1.B4 is set to 0 if not supported. B4 set to 1 if supported.B5 set to 0 if not supported. B5 set to 1 if supported.NOTE 2—B4 is set to 0, if a non-AP STA operates with 20 MHz channel width and the 20 MHz In 40 MHz HE PPDU In 2.4 GHz subfield is 0.NOTE 3—If a non-AP STA operates with 20 MHz channel width and the 20 MHz In 160/80+80 MHz HE PPDU subfield is set to 0, then the 242-tone RU in a 160 MHz and 80+80 MHz HE MU PPDU in the 5 GHz band or 6 GHz band is not supported. *(#15120, 15154, 15166, 15831)* |
| … |  |  |

TGax Editor: Insert the following rows in its appropriate location in Table 9-31, Table 9-33, Table 9-34, Table 9-35, Table 9-36, Table 9-37, and Table 9-38, maintaining row order:

|  |  |  |
| --- | --- | --- |
| <ANA> | Extended HE Capabilites | The Extended Capabilities element is present if dot11HEOptionImplemented and dot116GOptionImplemented are true. |

**C.3 MIB Detail**

**TGax Editor: *Change Dot11StationConfigEntry as follows:***

Dot11StationConfigEntry ::= SEQUENCE

 {

 …,

 dot11FutureChannelGuidanceActivated TruthValue,

 dot11HEOptionImplemented TruthValue,

 dot11HE6GOptionImplemented TruthValue,

 dot11OBSSNarrowBWRUinOFDMATolerated TruthValue,

 dot11SRGAPOBSSPDMinOffset Integer,

 dot11SRGAPOBSSPDMaxOffset Integer

 }

…

**TGax Editor: *Insert the following after the dot11FutureChannelGuidanceActivated OBJECT-TYPE element in the Dot11StationConfig TABLE:***

dot11HE6GOptionImplemented OBJECT-TYPE

 SYNTAX TruthValue

 MAX-ACCESS read-only

 STATUS current

 DESCRIPTION

 "This is a capability variable.

 Its value is determined by device capabilities.

 This attribute indicates whether the entity is capable of operating in the 6 GHz band."

::= { dot11StationConfigEntry <ANA>}

**28. High Efficiency (HE) PHY specification**

**TGax Editor: *Change the following paragraphs of this clause (#CID 16447, 15161):***

* Introduction to the HE PHY

Clause 28 (High Efficiency (HE) PHY specification) specifies the PHY entity for a high efficiency (HE) orthogonal frequency division multiplexing (OFDM) system. In addition to the requirements in Clause 28 (High Efficiency (HE) PHY specification), an HE STA shall be capable of transmitting and receiving PPDUs that are compliant with the mandatory requirements of the following PHY specifications:

* Clause 19 (High Throughput (HT) PHY specification) and Clause 21 (Very High Throughput (VHT) PHY specification) if the HE STA supports an operating channel width greater than or equal to 80 MHz and is operating in the 5 GHz band.
* Clause 19 (High Throughput (HT) PHY specification) and Clause 21 (Very High Throughput (VHT) PHY specification) transmission and reception on 20 MHz channel width (see 27.16.1 (Basic HE BSS functionality)) if(#15454) the 20 MHz-only non-AP HE STA is operating in the 5 GHz band.
* Clause 19 (High Throughput (HT) PHY specification) if(#15455) the HE STA is operating in the 2.4 GHz band.
* Clause 17 (OFDM PHY) if the HE STA is operating in the 6 GHz band*(#16447, 15161)*

…

The HE PHY is based on the VHT PHY defined in Clause 21 (Very High Throughput (VHT) PHY specification), which in turn is based on the HT PHY defined in Clause 19 (High Throughput (HT) PHY specification), which in turn is further based on the OFDM PHY defined in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) in the 5 GHz band. The HE PHY is based on HT PHY defined in Clause 19 (High Throughput (HT) PHY specification), which in turn is based on the OFDM PHY defined in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) in the 2.4 GHz band. The HE PHY is based on the OFDM PHY defined in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) in the 6 GHz band.*(#16447, 15161)*

An HE STA shall support the following features:

* Transmission and reception of an HE SU PPDU that consists of a single RU spanning the entire PPDU bandwidth.
* Transmission and reception of an HE ER SU PPDU that consists of a 242-tone RU spanning the entire primary 20 MHz PPDU bandwidth.
* Binary convolutional coding (transmit and receive). Binary convolutional coding is not used in the following cases:
* An HE SU PPDU with a bandwidth greater than 20 MHz
* An RU of size greater than 242 subcarriers in an HE MU PPDU or an HE TB PPDU
* An HE SU PPDU with number of spatial streams greater than 4
* An RU allocated to a single user in an HE MU PPDU or for an HE TB PPDU with a number of spatial streams greater than 4
* An HE SU PPDU using HE-MCSs 10 or 11
* An RU in an HE MU PPDU or an HE TB PPDU using HE-MCSs 10 or 11
* LDPC coding (transmit and receive) in all supported HE PPDU types, RU sizes, and number of spatial streams if the STA supports transmitting and receiving in channel bandwidths greater than 20 MHz.
* LDPC coding (transmit and receive) in all supported HE PPDU types, RU sizes, and number of spatial streams if the STA declares support for transmitting or receiving more than 4 spatial streams.
* LDPC coding (transmit and receive) in all supported HE PPDU types, RU sizes, and number of spatial streams if the STA declares support for HE-MCSs 10 and 11 (transmit and receive).
* Single spatial stream HE-MCSs 0 to 7 (transmit and receive) in all supported channel widths and RU sizes for HE SU PPDUs.
* 0.8 µs and 1.6 µs GI duration on both HE-LTF and Data field symbols of an HE SU PPDU and HE ER SU PPDU if a 2x HE-LTF is used (transmit and receive).
* 3.2 µs GI duration on both HE-LTF and Data field symbols of an HE SU PPDU and HE ER SU PPDU if a 4x HE-LTF is used (transmit and receive).
* 1.6 µs GI duration on the HE-LTF and Data field symbols when the 1x HE-LTF is used (receive) for full bandwidth UL MU-MIMO if the HE STA supports UL MU-MIMO.(#16052)
* HE SU PPDUs with 0.8 µs GI duration on both the HE-LTF and Data field symbols when the HE-LTF is a 4x HE-LTF(#15968) if the STA supports HE ER SU PPDUs with 0.8 µs GI duration on both the HE-LTF and Data field symbols when the HE-LTF is a 4x HE-LTF(#15968) (transmit and receive).
* Single spatial stream HE-MCSs 0 to 2 in primary 20 MHz channel for HE ER SU PPDUs.
* HE ER SU PPDU is not used in the following cases:
* Number of spatial streams greater than 1
* HE-MCS greater than 2 when 242 subcarriers are used in the Data field OFDM symbols
* HE-MCS greater than 0 when 106 subcarriers are used in the Data field OFDM symbols
* Bandwidth greater than 20 MHz
* 20 MHz channel width and all RU sizes and locations applicable to the 20 MHz channel width in 2.4 GHz, 5 GHz and 6 GHz bands (transmit and receive).*(#16447, 15161)*

An HE AP shall support the following features:

* Transmission of an HE MU PPDU where none of the RUs utilize MU-MIMO (DL OFDMA).
* Reception of an HE TB PPDU where none of the RUs utilize MU-MIMO (UL OFDMA).
* Transmission of an HE MU PPDU consisting of a single RU spanning the entire PPDU bandwidth and utilizing MU-MIMO (DL MU-MIMO), provided the AP is capable of transmitting 4 or more spatial streams.
* Transmission of the HE-SIG-B field in an HE MU PPDU at HE-MCSs 0 to 5.
* Single spatial stream HE-MCSs 0 to 7 (transmit) in all supported channel widths and RU sizes for HE MU PPDUs (transmit) or HE TB PPDUs (receive).
* 40 MHz and 80 MHz channel widths and all RU sizes and locations applicable to the 40 MHz and 80 MHz channel width in 5 GHz and 6 GHz band (transmit and receive).*(#16447, 15161)*
* 0.8 µs and 1.6 µs GI duration on the HE-LTF and Data field symbols of an HE MU PPDU if a 2x HE-LTF is used (transmit).
* Reception of an HE TB PPDU with a 2x HE-LTF and with 1.6 µs GI duration on the HE-LTF and Data field symbols.
* (#16052)Reception of an HE TB PPDU with a 4x HE-LTF and with 3.2 µs GI duration on the HE-LTF and Data field symbols.
* Transmission of an HE MU PPDU with a 4x HE-LTF and with 3.2 µs GI duration on the HE-LTF and Data field symbols.
* HE MU PPDUs with 0.8 µs GI duration on both the HE-LTF and Data field symbols when the 4x HE-LTF is used if the HE AP supports HE ER SU PPDUs with 0.8 µs GI duration on both the HE-LTF and Data field symbols when the HE-LTF is a 4x HE-LTF(#15968) (transmit).

An HE AP may support the following features:

* MU-MIMO transmission on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth (DL MU-MIMO within OFDMA).
* MU-MIMO reception on an RU in an HE TB PPDU where the RU spans the entire PPDU bandwidth (UL MU-MIMO).
* MU-MIMO reception on an RU in an HE TB PPDU where the RU does not span the entire PPDU bandwidth (UL MU-MIMO within OFDMA).
* Reception of the payload on an RU in an HE MU PPDU where RU spans the entire PPDU bandwidth or a 106-tone RU within 20 MHz PPDU bandwidth.
* 40 MHz channel width in the 2.4 GHz band (transmit and receive). If it is supported then all RU sizes and locations applicable to 40 MHz channel width are supported in 2.4 GHz band (transmit and receive).
* 160 MHz and 80+80 MHz channel widths and 2×996-tone RU size applicable to the 160/80+80 MHz channel width in the 5 GHz and 6 GHz band (transmit and receive).*(#16447, 15161)*
* Transmission of an HE MU PPDU with preamble puncturing.
* HE MU PPDUs with 0.8 µs GI duration on both the HE-LTF and Data field symbols when the 4x HE-LTF is used if the STA does not support HE ER SU PPDUs with 0.8 µs GI duration on both the HE-LTF and Data field symbols when the HE-LTF is a 4x HE-LTF(#15968) (transmit).

A non-AP HE STA shall support the following features:

* Reception of an HE MU PPDU where the RU allocated to the non-AP STA is not utilizing MU-MIMO (DL OFDMA).
* Transmission of an HE TB PPDU where the RU allocated to the non-AP STA is not utilizing MU-MIMO (UL OFDMA).
* Reception of an HE MU PPDU consisting of a single RU spanning the entire PPDU bandwidth and utilizing MU-MIMO (DL MU-MIMO). The maximum number of spatial streams per user the non-AP STA can receive in the DL MU-MIMO transmission shall be equal to the minimum of 4 and the maximum number of spatial streams supported for reception of HE SU PPDUs. The non-AP STA shall be able to receive its intended spatial streams in a DL MU-MIMO transmission with a total number of spatial streams of at least 4.
* Responding with the requested beamforming feedback in an HE sounding procedure with the maximum number of space-time streams in the HE NDP that the non-AP STA can respond to being at least 4.
* Reception of the HE-SIG-B field in an HE MU PPDU at HE-MCSs 0 to 5.
* Single spatial stream HE-MCSs 0 to 7 in all supported channel widths and RU sizes for HE MU PPDUs (receive) or HE TB PPDUs (transmit).
* 40 MHz and 80 MHz channel widths and all RU sizes and locations applicable to the 40 MHz and 80 MHz channel widths in the 5 GHz and 6 GHz band (transmit and receive) except for a 20 MHz-only non-AP HE STA in which case the 40 MHz and 80 MHz channel widths, 996-tone RU, and 484-tone RU sizes in 5 GHz and 6 GHz band are not applicable.*(#16447, 15161)*
* A 20 MHz operating non-AP HE STA shall support 26-, 52-, and 106-tone RU sizes on locations allowed in 28.3.2.8 (RU restrictions for 20 MHz operation) in the primary 20 MHz channel within 40 MHz and the primary 20 MHz channel within 80 MHz channel widths in the 5 GHz and 6 GHz band (transmit and receive).*(#16447, 15161)*
* Reception of an HE MU PPDU with a 2x HE-LTF and with 0.8 µs GI duration on the HE-LTF and Data symbols.
* Reception of an HE MU PPDU with a 2x HE-LTF and with 1.6 µs GI duration on the HE-LTF and Data symbols.
* Transmission of an HE TB PPDU with a 2x HE-LTF and with 1.6 µs GI duration on the HE-LTF and Data field symbols.
* (#16052)Reception of an HE MU PPDU with a 4x HE-LTF and with 3.2 µs GI duration on the HE-LTF and Data field symbols.
* Transmission of an HE TB PPDU with a 4x HE-LTF and with 3.2 µs GI duration on the HE-LTF and Data field symbols.
* HE MU PPDUs with 0.8 µs GI duration on both the HE-LTF and Data field symbols when the 4x HE-LTF is used if the non-AP HE STA supports HE ER SU PPDUs with 0.8 µs GI duration on both the HE-LTF and Data field symbols when the HE-LTF is a 4x HE-LTF(#15968) (receive).

A non-AP HE STA may support the following:

* Transmission of an HE MU PPDU with a single RU spanning the entire PPDU bandwidth or a 20 MHz HE MU PPDU with a single 106-tone RU in the primary 20 MHz channel.
* 40 MHz channel width in the 2.4 GHz band (transmit and receive). If 40 MHz channel width in the 2.4 GHz band is supported then all RU sizes and locations applicable to 40 MHz channel width are supported. Not applicable to a 20 MHz-only non-AP HE STA.
* For a 20 MHz-only non-AP HE STA, 26-, 52-, 106-, and 242-tone RU sizes on locations allowed in 28.3.2.8 (RU restrictions for 20 MHz operation) in the primary 20 MHz channel within 40 MHz channel width in the 2.4 GHz band if the 20 MHz-only non-AP HE STA does not support the HE subchannel selective transmission operation described in 27.7.7 (HE subchannel selective transmission).
* For a 20 MHz-only non-AP HE STA, 26-, 52-, 106-, and 242-tone RU sizes on locations allowed in 28.3.2.8 (RU restrictions for 20 MHz operation)(#Ed) in any 20 MHz channel within 40 MHz channel width in the 2.4 GHz band if(#15421) the 20 MHz-only non-AP HE STA supports the HE subchannel selective transmission operation(#Ed) as described in 27.7.7 (HE subchannel selective transmission).
* For a 20 MHz-only non-AP HE STA, 26-, 52-, 106-, and 242-tone RU sizes on locations allowed in 28.3.2.8 (RU restrictions for 20 MHz operation)(#Ed) in any 20 MHz channel within 40 MHz, 80 MHz, 160 MHz, and 80+80 MHz channel widths in the 5 GHz and 6 GHz band if(#15422) the 20 MHz-only non-AP HE STA supports the HE subchannel selective transmission operation(#Ed) as described in 27.7.7 (HE subchannel selective transmission).*(#16447, 15161)*
* For a 20 MHz operating non-AP HE STA, 26-, 52-, 106-, and 242-tone RU sizes on locations allowed in 28.3.2.8 (RU restrictions for 20 MHz operation) in the primary 20 MHz channel within 160 MHz and 80+80 MHz channel widths in the 5 GHz and 6 GHz band.*(#16447, 15161)*
* 160 MHz and 80+80 MHz channel width and 2×996-tone RU size applicable to the 160 MHz and 80+80 MHz channel width in the 5 GHz and 6 GHz band (transmit and receive). Not applicable to a 20 MHz-only non-AP HE STA.*(#16447, 15161)*
* MU-MIMO reception on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth (DL MU-MIMO within OFDMA). The maximum number of spatial streams per user in the DL MU-MIMO within OFDMA transmission that the non-AP STA can receive shall be a minimum of 4 and the maximum number of spatial streams supported for reception of HE SU PPDUs. The total number of spatial streams in the DL MU-MIMO within OFDMA transmission that the non-AP STA can receive shall be at least 4.
* MU-MIMO transmission on an RU in an HE TB PPDU where the RU spans the entire PPDU bandwidth (UL MU-MIMO). If supported, then the non-AP HE STA shall support transmitting UL MU-MIMO where the total space-time streams summed across all users is less than or equal to 8.
* MU-MIMO transmission on an RU in an HE TB PPDU where the RU does not span the entire PPDU bandwidth (UL MU-MIMO within OFDMA). If supported, then the non-AP HE STA shall support transmitting UL MU-MIMO where the total space-time streams summed across all users is less than or equal to 8.
* For a non-AP HE STA capable of up to 80 MHz channel width, when operating with 80 MHz channel width, the reception of a 160 MHz or 80+80 MHz HE MU PPDU, or the transmission of a 160 MHz or 80+80 MHz HE TB PPDU where the assigned RU is in the primary 80 MHz channel.
* HE MU PPDUs with 0.8 µs GI duration on both the HE-LTF and Data field symbols when the 4x HE-LTF is used if the non-AP HE STA does not support HE ER SU PPDUs with 0.8 µs GI duration on both the HE-LTF and Data field symbols if(#15423) the HE-LTF is a 4x HE-LTF(#15968) (receive).
* Support for non-HT format

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| --- |
| * Mapping of the HE PHY parameters for non-HT operation
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| HE PHY Parameter | 2.4 GHz operation defined by Clause 15 (DSSS PHY specification for the 2.4 GHz band designated for ISM applications) | 2.4 GHz operation defined by Clause 16 (High rate direct sequence spread spectrum (HR/DSSS) PHY specification) | 2.4 GHz operation defined by Clause 18 (Extended Rate PHY (ERP) specification) | 5 GHz and 6 GHz operation defined by Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) *(#16447, 15161)* | Parameter List |
| L\_LENGTH | LENGTH | LENGTH | LENGTH | LENGTH | TXVECTOR/RXVECTOR |
| L\_DATARATE | DATARATE | DATARATE | DATARATE | DATARATE | TXVECTOR/RXVECTOR |
| TXPWR\_LEVEL\_INDEX | TXPWR\_LEVEL\_INDEX | TXPWR\_LEVEL\_INDEX | TXPWR\_LEVEL\_INDEX | TXPWR\_LEVEL\_INDEX | TXVECTOR |
| RSSI | RSSI | RSSI | RSSI | RSSI | RXVECTOR |
| SERVICE | SERVICE | SERVICE | SERVICE | SERVICE | TXVECTOR/RXVECTOR |
| RCPI | RCPI | RCPI | RCPI | RCPI | RXVECTOR |
| CH\_BANDWIDTH\_IN\_NON\_HT | discarded | discarded | CH\_BANDWIDTH\_IN\_NON\_HT | CH\_BANDWIDTH\_IN\_NON\_HT | TXVECTOR/RXVECTOR |
| DYN\_BANDWIDTH\_IN\_NON\_HT | discarded | discarded | DYN\_BANDWIDTH\_IN\_NON\_HT | DYN\_BANDWIDTH\_IN\_NON\_HT | TXVECTOR/RXVECTOR |
| OPERATING\_CHANNEL | discarded | discarded | discarded | OPERATING\_CHANNEL | PHYCONFIG\_VECTOR |

* 20 MHz operating non-AP HE STAs

An HE AP in 5 GHz and 6 GHz band shall be able to interoperate with non-AP HE STAs, regardless of the indicated value of B1 in the Channel Width Set subfield in the HE PHY Capabilities Information field in the HE Capabilities element (see 9.4.2.241.3 (HE PHY Capabilities Information field)). *(#16447, 15161)*

A 20 MHz operating non-AP HE STA shall support tone mapping of 26-tone RU, 52-tone RU, 106-tone RU and 242-tone RU for a 20 MHz HE PPDU (see Table 28-6 (Data and pilot subcarrier indices for RUs in a 20 MHz HE PPDU)) in the 2.4 GHz, 5 GHz, and 6 GHz frequency bands. *(#16447, 15161)*

…

A 20 MHz operating non-AP HE STA shall support tone mapping of 26-tone RU, 52-tone RU, and 106-tone RU for 40 MHz HE PPDU (see Table 28-7 (Data and pilot subcarrier indices for RUs in a 40 MHz HE PPDU)) in the 5 GHz and 6 GHz frequency band, and for 80 MHz HE PPDU (see Table 28-8 (Data and pilot subcarrier indices for RUs in an 80 MHz HE PPDU)) in the 5 GHz and 6 GHz frequency band with the exception of RUs that are restricted from operation as specified in 28.3.2.8 (RU restrictions for 20 MHz operation). *(#16447, 15161)*

…

A 20 MHz operating non-AP HE STA may support tone mapping of 242-tone RU for the reception of 40 MHz HE MU PPDU (see Table 28-7 (Data and pilot subcarrier indices for RUs in a 40 MHz HE PPDU)) in the 2.4 GHz, 5 GHz and and 6 GHz frequency bands, and 80 MHz, 80+80 MHz and 160 MHz HE MU PPDU (see Table 28-8 (Data and pilot subcarrier indices for RUs in an 80 MHz HE PPDU)) in the 5 GHz and 6 GHz frequency band. This support is indicated in the Channel Width Set subfield in the HE PHY Capabilities Information field of the HE Capabilities element (see 9.4.2.241.3 (HE PHY Capabilities Information field)). *(#16447, 15161)*

* RU restrictions for 20 MHz operation

An HE AP shall not allocate to a 20 MHz operating non-AP HE STA a 242-tone RU in a 40 MHz, 80 MHz, 160 MHz or 80+80 MHz HE MU PPDU transmitted in the 5 GHz and 6 GHz band unless the non-AP HE STA has B5 of the Channel Width Set subfield of the HE PHY Capabilities Information field equal to 1 in the HE Capabilities element it transmits. *(#16447, 15161)*

* Pre-correction accuracy requirements

The absolute transmit power accuracy is applicable for the entire range of transmit power that the STA is capable of. The RSSI accuracy requirements shall be applied to receive signal level range from 82 dBm to 20 dBm in 2.4 GHz and 82 dBm to 30 dBm in 5 GHz and 6 GHz. The requirements are for nominal (room) temperature conditions. The RSSI shall be measured during the reception of the non-HE portion of the HE PPDU preamble. *(#16447, 15161)*

* Transmit center frequency and symbol clock frequency tolerance

Transmit center frequency and the symbol clock frequency for all transmit antennas and frequency segments shall be derived from the same reference oscillator. The symbol clock frequency and transmit center frequency maximum tolerance shall be ±20 ppm in the 5 GHz and 6 GHz band, and ±25 ppm in the 2.4 GHz band(#15155). HE TB PPDU format is subject to additional requirements as defined in 28.3.14 (Transmit requirements for an HE TB PPDU). *(#16447, 15161)*

* Receiver maximum input level

The receiver shall provide a maximum PER of 10% at a PSDU length of 2048 octets for BPSK modulation with DCM or 4096 octets for all other modulations, for a maximum input level of 30 dBm in 5 GHz and 6 GHz band and 20 dBm in 2.4 GHz band, measured at each antenna for any baseband HE modulation. *(#16447, 15161)*

*

Protocol Implementation Conformance Statement (PICS) -proforma

**TGax Editor: *Change the rows of the tables below of this clause (#CID 16447):***

* PICS proforma—IEEE Std 802.11-<year>

Change B.4.3 as follows:

|  |
| --- |
| * IUT configuration
 |
| Item | IUT configuration | References | Status | Support |
|  | What is the configuration of the IUT? |  |  |  |
| \* CFOFDM | Orthogonal frequency division multiplexing (OFDM) PHY | — | O.2CFHT5G:MCFTVHT:MCFHE:M | Yes  No  |
| ... |  |  |  |  |
| \*CFHT | High throughput (HT) PHY | 9.4.2.56 (HT Capabilities element) | O.2CFVHT:MCFHE:M | Yes  No  |
| ... |  |  |  |  |
| \*CFHT2G4 | HT operation in the 2.4 GHz band | Clause 19 | CFHT:O.6CFHE:M | Yes  No  N/A  |
| \*CFHT5G | HT operation in the 5 GHz band | Clause 19 | CFHT:O.6CFVHT:MCFHE:M | Yes  No  N/A  |
| .. |  |  |  |  |
| \*CFVHT | Very High Throughput (VHT) features | 9.4.2.158 (VHT Capabilities element) | O.2CFHE:M | Yes  No  |
| ... |  |  |  |  |
| \*CFESM | Extended spectrum management | 10.21.3 (Operation with operating classes) | OCFVHT OR CFTVHT:M | Yes  No  |
| \*CFHE | High efficiency (HE) operation | 9.4.2.241 (HE Capabilities element) | OCFHE20:MCFHE80:M | Yes  No  |
| \*CFHE2G4 | HE operation in 2.4 GHz band | Clause 28 | O.8 | Yes  No  |
| \*CFHE5G | HE operation in 5 GHz band | Clause 28 | O.8 | Yes  No  |
| \*CFHE6G | HE operation in 6 GHz band | Clause 28 | O.8 | Yes  No *(#16447)* |
| \*CFHE20 | HE operation with 20 MHz only | Clause 28 | CFIndepSTA and CFHE:M | Yes  No  |
| \*CFHE80 | HE operation with capability of 80 MHz or wider channel width | Clause 28 | CFAP and CFHE and CFVHT:MCFIndepSTA and CFHE and CFVHT:M  | Yes  No  |

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| --- |
| * HE PHY features
 |
| Item | Protocol capability | References | Status | Support |
|  | Are the following PHY protocol features supported? |  |  |  |
| HEP1 | PHY operating modes |  |  |  |
| HEP1.1 | Operation according to Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) (Orthogonal frequency division multiplexing (OFDM) PHY specification), Clause 19 (High Throughput (HT) PHY specification) (High Throughput) and/or Clause 21 (Very High Throughput (VHT) PHY specification)  | 28.1.1 (Introduction to the HE PHY) | CFHE5G and (CFAP or CFHE80):M | Yes  No  N/A  |
| HEP1.2 | Operation according Clause 19 (High Throughput (HT) PHY specification) (High Throughput) in 5 GHz | 28.1.1 (Introduction to the HE PHY) | CFHE5G and CFHE20: M | Yes  No  N/A  |
| HEP1.3 | Operation according Clause 19 (High Throughput (HT) PHY specification) (High Throughput) in 2.4 GHz | 28.1.1 (Introduction to the HE PHY) | CFHE2G4:M | Yes  No  N/A  |
| HEP1.4 | Operation according Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) (Orthogonal frequency division multiplexing (OFDM) PHY specification) in 6 GHz | 28.1.1 (Introduction to the HE PHY) | CFHE6G: M | Yes  No  N/A *(#16447)* |
| HEP2 | HE PPDU format | 28.1.4 (PPDU formats) |  |  |
| \*HEP2.1 | HE SU PPDU | 28.1.4 (PPDU formats) |  | Yes  No  N/A  |
| HEP2.2 | HE ER SU PPDU | 28.1.4 (PPDU formats) |  | Yes  No  N/A  |
| HEP2.3 | HE MU PPDU | 28.1.4 (PPDU formats) |  | Yes  No  N/A  |
| HEP2.4 | HE TB PPDU | 28.1.4 (PPDU formats) |  | Yes  No  N/A  |
| HEP3 | BSS bandwidth |  |  |  |
| \*HEP3.1 | 20 MHz operation | 27.16 (HE BSS operation) | CFHE: M | Yes  No  N/A  |
| \*HEP3.2 | 40 MHz operation | 27.16 (HE BSS operation) | CFHE80 and (CFHE5G or CFHE6G):M*(#16447)*CFHE2G4:O | Yes  No  N/A  |
| \*HEP3.3 | 80 MHz operation | 27.16 (HE BSS operation) | CFHE80 and (CFHE5G or CFHE6G):M*(#16447)* | Yes  No  N/A  |
| \*HEP3.4 | 160 MHz operation | 27.16 (HE BSS operation) | CFHE80 and (CFHE5G or CFHE6G):OHEP3.5:M*(#16447)* | Yes  No  N/A  |
| \*HEP3.5 | 80+80 MHz operation | 27.16 (HE BSS operation) | CFHE80 and (CFHE5G or CFHE6G):O*(#16447)* | Yes  No  N/A  |
| HEP4 | PHY timing information |  |  |  |
| HEP4.1 | Values in 20 MHz channel | 28.3.8 (Timing-related parameters) | CFHE:M | Yes  No  N/A  |
| HEP4.2 | Values in 40 MHz channel | 28.3.8 (Timing-related parameters) | CFHE:M | Yes  No  N/A  |
| HEP4.3 | Values in 80 MHz channel | 28.3.8 (Timing-related parameters) | CFHE:M | Yes  No  N/A  |
| HEP4.4 | Values in 160 MHz channel | 28.3.8 (Timing-related parameters) | HEP3.4:M | Yes  No  N/A  |
| HEP4.5 | Values in 80+80 MHz channel | 28.3.8 (Timing-related parameters) | HEP3.5:M | Yes  No  N/A  |
| HEP5 | STBC | 28.3.11.10 (Space-time block coding) | CFHE:O | Yes  No  N/A  |
| HEP6 | Tone allocation |  |  |  |
| \*HEP6.1 | 26-tone RU mapping | 28.3.2.2 (Resource unit, guard and DC subcarriers), 28.3.2.3 (Null subcarriers) and 28.3.2.4 (Pilot subcarriers) | CFHE:M | Yes  No  N/A  |
| \*HEP6.2 | 52-tone RU mapping | 28.3.2.2 (Resource unit, guard and DC subcarriers), 28.3.2.3 (Null subcarriers) and 28.3.2.4 (Pilot subcarriers) | CFHE:M | Yes  No  N/A  |
| \*HEP6.3 | 106-tone RU mapping | 28.3.2.2 (Resource unit, guard and DC subcarriers), 28.3.2.3 (Null subcarriers) and 28.3.2.4 (Pilot subcarriers) | CFHE:M | Yes  No  N/A  |
| \*HEP6.4 | 242-tone RU mapping | 28.3.2.2 (Resource unit, guard and DC subcarriers), 28.3.2.3 (Null subcarriers) and 28.3.2.4 (Pilot subcarriers) | CFHE80:MCFHE20:O | Yes  No  N/A  |
| \*HEP6.5 | 484-tone RU mapping | 28.3.2.2 (Resource unit, guard and DC subcarriers), 28.3.2.3 (Null subcarriers) and 28.3.2.4 (Pilot subcarriers) | CFHE80 and HEP3.2:M | Yes  No  N/A  |
| \*HEP6.6 | 996-tone RU mapping | 28.3.2.2 (Resource unit, guard and DC subcarriers), 28.3.2.3 (Null subcarriers) and 28.3.2.4 (Pilot subcarriers) | CFHE80 and HEP3.3:MCFHE80 and HEP3.4:M | Yes  No  N/A  |
| \*HEP6.7 | 2996-tone RU mapping | 28.3.2.2 (Resource unit, guard and DC subcarriers), 28.3.2.3 (Null subcarriers) and 28.3.2.4 (Pilot subcarriers) | CFHE80 and HEP3.4:M | Yes  No  N/A  |
| HEP7 | Coding |  |  |  |
| HEP10.1 | BCC with 4 or fewer spatial streams | 28.3.11.5.1 (Binary convolutional coding and puncturing) | (HEP6.1 or HEP6.2 or HEP6.3 or HEP6.4):M(HEP3.1 and HEP2.1):M | Yes  No  N/A  |
| HEP10.2 | LDPC with more than 4 spatial streams | 28.3.11.5.2 (LDPC coding) | CFHE80:MCFHE20:M | Yes  No  N/A  |
| HEP10.3 | LDPC with 4 or fewer spatial streams | 28.3.11.5.2 (LDPC coding) | (HEP6.5 or HEP6.6 or HEP6.7):M((HEP3.2 or HEP3.3 or HEP3.4 or HEP3.5) and HEP2.1):M(HEP6.1 or HEP6.2 or HEP6.3 or HEP6.4):O(HEP3.1 and HEP2.1):OCFHE20: O | Yes  No  N/A  |
| HEP11 | Coding and modulation schemes |  |  |  |
| HEP11.1 | For 26-, 52-, 106-, 242-, 484- and 996-tone mapping |  |  |  |
| \*HEP11.1.1 | HE-MCS with Index 0-7 and *NSS* = 1 | 28.5 (Parameters for HE-MCSs) | CFHE: M | Yes  No  N/A  |
| \*HEP11.1.2 | HE-MCS with Index 0-8 and *NSS* = 1 | 28.5 (Parameters for HE-MCSs) | HEP11.1.1:O | Yes  No  N/A  |
| \*HEP11.1.3 | HE-MCS with Index 0-9 and *NSS* = 1 | 28.5 (Parameters for HE-MCSs) | HEP11.1.2:O | Yes  No  N/A  |
| \*HEP11.1.4 | HE-MCS with Index 0-7 and *NSS* = 2 | 28.5 (Parameters for HE-MCSs) | CFHE:O | Yes  No  N/A  |
| \*HEP11.1.5 | HE-MCS with Index 0-8 and *NSS* = 2 | 28.5 (Parameters for HE-MCSs) | HEP11.1.4:O | Yes  No  N/A  |
| \*HEP11.1.6 | HE-MCS with Index 0-9 and *NSS* = 2 | 28.5 (Parameters for HE-MCSs) | HEP11.1.5:O | Yes  No  N/A  |
| \*HEP11.1.7 | HE-MCS with Index 0-7 and *NSS* = 3 | 28.5 (Parameters for HE-MCSs) | CFHE:O | Yes  No  N/A  |
| \*HEP11.1.8 | HE-MCS with Index 0-8 and *NSS* = 3 | 28.5 (Parameters for HE-MCSs) | HEP11.1.7:O | Yes  No  N/A  |
| HEP11.1.9 | HE-MCS with Index 0-9 and *NSS* = 3 | 28.5 (Parameters for HE-MCSs) | HEP11.1.8:O | Yes  No  N/A  |
| \*HEP11.1.10 | HE-MCS with Index 0-7 and *NSS* = 4 | 28.5 (Parameters for HE-MCSs) | CFHE:O | Yes  No  N/A  |
| \*HEP11.1.11 | HE-MCS with Index 0-8 and *NSS* = 4 | 28.5 (Parameters for HE-MCSs) | HEP11.1.10:O | Yes  No  N/A  |
| HEP11.1.12 | HE-MCS with Index 0-9 and *NSS* = 4 | 28.5 (Parameters for HE-MCSs) | HEP11.1.11:O | Yes  No  N/A  |
| \*HEP11.1.13 | HE-MCS with Index 0-7 and *NSS* = 5 | 28.5 (Parameters for HE-MCSs) | CFHE:O | Yes  No  N/A  |
| \*HEP11.1.14 | HE-MCS with Index 0-8 and *NSS* = 5 | 28.5 (Parameters for HE-MCSs) | HEP11.1.13:O | Yes  No  N/A  |
| HEP11.1.15 | HE-MCS with Index 0-9 and *NSS* = 5 | 28.5 (Parameters for HE-MCSs) | HEP11.1.14:O | Yes  No  N/A  |
| \*HEP11.1.16 | HE-MCS with Index 0-7 and *NSS* = 6 | 28.5 (Parameters for HE-MCSs) | CFHE:O | Yes  No  N/A  |
| \*HEP11.1.17 | HE-MCS with Index 0-8 and *NSS* = 6 | 28.5 (Parameters for HE-MCSs) | HEP11.1.16:O | Yes  No  N/A  |
| HEP11.1.18 | HE-MCS with Index 0-9 and *NSS* = 6 | 28.5 (Parameters for HE-MCSs) | HEP11.1.17:O | Yes  No  N/A  |
| \*HEP11.1.19 | HE-MCS with Index 0-7 and *NSS* = 7 | 28.5 (Parameters for HE-MCSs) | CFHE:O | Yes  No  N/A  |
| \*HEP11.1.20 | HE-MCS with Index 0-8 and *NSS* = 7 | 28.5 (Parameters for HE-MCSs) | HEP11.1.19:O | Yes  No  N/A  |
| HEP11.1.21 | HE-MCS with Index 0-9 and *NSS* = 7 | 28.5 (Parameters for HE-MCSs) | HEP11.1.20:O | Yes  No  N/A  |
| \*HEP11.1.22 | HE-MCS with Index 0-7 and *NSS* = 8 | 28.5 (Parameters for HE-MCSs) | CFHE:O | Yes  No  N/A  |
| \*HEP11.1.23 | HE-MCS with Index 0-8 and *NSS* = 8 | 28.5 (Parameters for HE-MCSs) | HEP11.1.22:O | Yes  No  N/A  |
| HEP11.1.24 | HE-MCS with Index 0-9 and *NSS* = 8 | 28.5 (Parameters for HE-MCSs) | HEP11.1.23:O | Yes  No  N/A  |
| HEP11.2 | For 242-, 484- and 996-tone plan |  |  |  |
| \*HEP11.2.1 | HE-MCS with Index 0-10 and *NSS* = 1 | 28.5 (Parameters for HE-MCSs) | CFHE80: O | Yes  No  N/A  |
| HEP11.2.2 | HE-MCS with Index 0-11 and *NSS* = 1 | 28.5 (Parameters for HE-MCSs) | HEP11.2.1:O | Yes  No  N/A  |
| \*HEP11.2.3 | HE-MCS with Index 0-10 and *NSS* = 2 | 28.5 (Parameters for HE-MCSs) | CFHE80: O | Yes  No  N/A  |
| HEP11.2.4 | HE-MCS with Index 0-11 and *NSS* = 2 | 28.5 (Parameters for HE-MCSs) | HEP11.2.3:O | Yes  No  N/A  |
| \*HEP11.2.5 | HE-MCS with Index 0-10 and *NSS* = 3 | 28.5 (Parameters for HE-MCSs) | CFHE80: O | Yes  No  N/A  |
| HEP11.2.6 | HE-MCS with Index 0-11 and *NSS* = 3 | 28.5 (Parameters for HE-MCSs) | HEP11.2.5:O | Yes  No  N/A  |
| \*HEP11.2.7 | HE-MCS with Index 0-10 and *NSS* = 4 | 28.5 (Parameters for HE-MCSs) | CFHE80: O | Yes  No  N/A  |
| HEP11.2.8 | HE-MCS with Index 0-11 and *NSS* = 4 | 28.5 (Parameters for HE-MCSs) | HEP11.2.7:O | Yes  No  N/A  |
| \*HEP11.2.9 | HE-MCS with Index 0-10 and *NSS* = 5 | 28.5 (Parameters for HE-MCSs) | CFHE80: O | Yes  No  N/A  |
| HEP11.2.10 | HE-MCS with Index 0-11 and *NSS* = 5 | 28.5 (Parameters for HE-MCSs) | HEP11.2.9:O | Yes  No  N/A  |
| \*HEP11.2.11 | HE-MCS with Index 0-10 and *NSS* = 6 | 28.5 (Parameters for HE-MCSs) | CFHE80: O | Yes  No  N/A  |
| HEP11.2.12 | HE-MCS with Index 0-11 and *NSS* = 6 | 28.5 (Parameters for HE-MCSs) | HEP11.2.11:O | Yes  No  N/A  |
| \*HEP11.2.13 | HE-MCS with Index 0-10 and *NSS* = 7 | 28.5 (Parameters for HE-MCSs) | CFHE80: O | Yes  No  N/A  |
| HEP11.2.14 | HE-MCS with Index 0-11 and *NSS* = 7 | 28.5 (Parameters for HE-MCSs) | HEP11.2.13:O | Yes  No  N/A  |
| \*HEP11.2.15 | HE-MCS with Index 0-10 and *NSS* = 8 | 28.5 (Parameters for HE-MCSs) | CFHE80: O | Yes  No  N/A  |
| HEP11.2.16 | HE-MCS with Index 0-11 and *NSS* = 8 | 28.5 (Parameters for HE-MCSs) | HEP11.2.15:O | Yes  No  N/A  |

**TGax Editor: *Remove the row that starts with “dot11HEDualBandImplemented” from the dot11PHYTable, which is part of Table 28-51 (#CID 16396).***

ASN.1 encoding of the MAC and PHY MIB

* MIB Detail

**TGax Editor: *Change the entries below below of this clause (#CID 16447, 16396):***

Dot11PhyHEEntry ::=

 SEQUENCE {

 dot11HECCAIndicationMode INTEGER,

*#16396)* dot11HECurrentChannelWidthSet Unsigned32,

 dot11HEPuncturedPreambleRxImplemented Unsigned32,

 dot11HEPuncturedPreambleRxActivated Unsigned32,

 dot11HEDeviceClass TruthValue,

 dot11HELDPCCodingInPayloadImplemented TruthValue,

 dot11HELDPCCodingInPayloadActivated TruthValue,

 dot11HESUPPDUwith1xHELTFand0point8GIlmplemented TruthValue,

 dot11HESUPPDUwith1xHELTFand0point8GIActivated TruthValue,

 dot11HESUPPDUandHEMUPPDUwith4xHELTFand0point8GIlmplemented

 TruthValue,

 dot11HESUPPDUandHEMUPPDUwith4xHELTFand0point8GIActivated

 TruthValue,

 dot11HEERSUPPDUwith4xHELTFand0point8GIImplemented TruthValue,

 dot11HEERSUPPDUwith4xHELTFand0point8GIActivated TruthValue,

 dot11HEERSUPPDUwith1xHELTFand0point8GIImplemented TruthValue,

 dot11HEERSUPPDUwith1xHELTFand0point8GIActivated TruthValue,

 dot11MidambleRxMaxNSTS Unsigned32 (0..3),

 dot11HENDPwith4xHELTFand3point2GIImplemented TruthValue,

 dot11HENDPwith4xHELTFand3point2GIActivated TruthValue,

 dot11HESTBCTxLessThanOrEqualTo80Implemented TruthValue,

 dot11HESTBCTxLessThanOrEqualTo80Activated TruthValue,

 dot11HESTBCRxLessThanOrEqualTo80Implemented TruthValue,

 dot11HESTBCRxLessThanOrEqualTo80Activated TruthValue,

 dot11HESTBCTxGreaterThan80Implemented TruthValue,

 dot11HESTBCTxGreaterThan80Activated TruthValue,

 dot11HESTBCRxGreaterThan80Implemented TruthValue,

 dot11HESTBCRxGreaterThan80Activated TruthValue,

 dot11HEDopplerTxImplemented TruthValue,

 dot11HEDopplerTxActivated TruthValue,

 dot11HEDopplerRxImplemented TruthValue,

 dot11HEDopplerRxActivated TruthValue,

 dot11HEDCMImplemented TruthValue,

 dot11HEDCMActivated TruthValue,

 dot11HEFullBWULMUMIMOImplemented TruthValue,

 dot11HEFullBWULMUMIMOActivated TruthValue,

 dot11HEPartialBWULMUMIMOImplemented TruthValue,

 dot11HEPartialBWULMUMIMOActivated TruthValue,

 dot11HEPartialBWDLMUMIMOImplemented TruthValue,

 dot11HEPartialBWDLMUMIMOActivated TruthValue,

 dot11HEULMUPayloadImplemented TruthValue,

 dot11HEULMUPayloadActivated TruthValue,

 dot11SRPbasedSRSupportImplemented TruthValue,

 dot11SRPbasedSRSupportActivated TruthValue,

 dot11HEPowerBoostFactorImplemented TruthValue,

 dot11HEPowerBoostFactorActivated TruthValue,

 dot11HEPartialBWERSUPayloadImplemented TruthValue,

 dot11HEPartialBWERSUPayloadActivated TruthValue

 }

*(#16396)*

dot11HECurrentChannelWidthSet OBJECT-TYPE

 SYNTAX Unsigned32 (0..6)

 MAX-ACCESS read-only

 STATUS current

 DESCRIPTION

 "This is a status variable.

 This attribute specifies the channel width set, equal to 0 for a 40 MHz channel width in the 2.4 GHz band, equal to 1 for a 40 MHz and 80 MHz channel width in the 5 GHz band or in the 6 GHz band, equal to 2 for a 160 MHz channel width in the 5 GHz band or in the 6 GHz band, equal to 3 for a 160/80+80 MHz channel width in the 5 GHz band or in the 6 GHz band, equal to 4 for 242-tone RUs in a 40 MHz HE MU PPDU in the 2.4 GHz band, equal to 5 for 242-tone RUs in a 40 MHz, 80 MHz, 160 MHz, and 80+80 MHz HE MU PPDU in the 5 GHz band or in the 6 GHz band, and the value 6 is reserved."

::= { dot11PhyHEEntry 3 }*(#16447)*

dot11PhyHEComplianceGroup OBJECT-GROUP

 OBJECTS {

*(#16396)* dot11HECurrentChannelWidthSet,

 dot11HEPuncturedPreambleTxImplemented,

 dot11HEPuncturedPreambleTxActivated,

 dot11HEPuncturedPreambleRxImplemented,

 dot11HEPuncturedPreambleRxActivated,

 dot11HEDeviceClass,

 dot11HELDPCCodingInPayloadImplemented,(#15129)

 dot11HELDPCCodingInPayloadActivated,(#15129)

 dot11HESUPPDUwith1xHELTFand0point8GIlmplemented,

 dot11HESUPPDUwith1xHELTFand0point8GIActivated,

 dot11HESUPPDUandHEMUPPDUwith4xHELTFand0point8GIlmplemented,

 dot11HESUPPDUandHEMUPPDUwith4xHELTFand0point8GIActivated,

 dot11HEERSUPPDUwith4xHELTFand0point8GIImplemented,

 dot11HEERSUPPDUwith4xHELTFand0point8GIActivated,

 dot11HEERSUPPDUwith1xHELTFand0point8GIImplemented,

 dot11HEERSUPPDUwith1xHELTFand0point8GIActivated,

 dot11MidambleRxMaxNSTS,

 dot11HENDPwith4xHELTFand3point2GIImplemented,

 dot11HENDPwith4xHELTFand3point2GIActivated,

 dot11HESTBCTxImplemented,

 dot11HESTBCTxActivated,

 dot11HESTBCRxImplemented,

 dot11HESTBCRxActivated,

 dot11HEDopplerTxImplemented,

 dot11HEDopplerTxActivated,

 dot11HEDopplerRxImplemented,

 dot11HEDopplerRxActivated,

 dot11HEDCMImplemented,

 dot11HEDCMActivated,

 dot11HEFullBWULMUMIMOImplemented,

 dot11HEFullBWULMUMIMOActivated,

 dot11HEPartialBWULMUMIMOImplemented,

 dot11HEPartialBWULMUMIMOActivated,

 dot11HEPartialBWDLMUMIMOImplemented,

 dot11HEPartialBWDLMUMIMOActivated,

 dot11HEULMUPayloadImplemented,

 dot11HEULMUPayloadActivated,

 dot11SRPbasedSRSupportImplemented,

 dot11SRPbasedSRSupportActivated,

 dot11HEPowerBoostFactorImplemented,

 dot11HEPowerBoostFactorActivated,

 dot11HEPartialBWERSUPayloadImplemented,

 dot11HEPartialBWERSUPayloadActivated }

 STATUS current

 DESCRIPTION

 "Attributes that configure the HE PHY."

 ::= { dot11Groups 103 }