IEEE P802.11
Wireless LANs

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| Miscellaneous clarifications On HE PHY Part 1 |
| Date: 2017-09-12 |
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Abstract

This contribution addresses the following points.

* Clarification on definitions of 20 MHz-only non-AP HE STA and a non-AP HE STA with 20 MHz operating channel width.
* Clarification on particpation in 160/80+80 MHz OFDMA by a 20 MHz-only non-AP HE STA and a non-AP HE STA with 20 MHz operating channel width.
* Clarification on participation in 160/80+80 MHz OFDMA by a non-AP HE STA that is capable of up to 80 MHz channel width when operating with 80 MHz channel width.
* Fix HE PHY Capability, “HE SU PPDU With 1x HE-LTF And 0.8 us GI” to include HE ER SU PPDU.

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.***

1. ***Clarification on definitions of 20 MHz-only non-AP HE STA and a non-AP HE STA with 20 MHz operating channel width***

Discussion: In D1.3, a ‘20 MHz-only non-AP HE STA’ refers to a non-AP HE STA that operates with 20 MHz channel width because it supports only 20 MHz channel width.

A ‘non-AP HE STA that operates with 20 MHz channel width by reducing its operating channel width to 20 MHz using OMI’ (Operating Mode Indication) also exists in D1.3.

The D1.3 is very clear on ‘20 MHz-only non-AP HE STA’ participation in OFDMA transmissions (section 28.3.3.5). However, the D1.3 is silent on ‘non-AP HE STA that operates with 20 MHz channel width by reducing its operating channel width to 20 MHz using OMI’ participation in OFDMA transmissions.

To this end, we clarify that a ‘non-AP HE STA that operates with 20 MHz channel width by reducing its operating channel width to 20 MHz using OMI’ behaves as a 20 MHz-only non-AP HE STA and follows the tone mapping support of the latter.

Resolution:

***TGax Editor: Add the following definitions to the section 3.2 (Definitions specific to IEEE 802.11):***

**20 MHz-only non-AP HE STA:** A non-AP HE STA whose Channel Width Set subfield in the HE PHY Capabilites Information field of the HE Capabilities element indicates support of only 20 MHz channel width for the frequency band it is operating in.

**20 MHz operating non-AP HE STA:** A non-AP HE STA that is operating in 20 MHz channel width mode, such as a 20 MHz-only non-AP HE STA or an HE STA which reduced its operating channel width to 20 MHz using OMI (Operating Mode Indication).

***TGax Editor: Edit section 28.3.3.5 (20 MHz-only non-AP HE STAs) as follows:***

**28.3.3.5 ~~20 MHz-only~~ 20 MHz operating non-AP HE STAs**

A 20 MHz-only non-AP HE STA is a non-AP HE STA whose Channel Width Set subfield in the HE PHY Capabilites Information field of the HE Capabilities element (see 9.4.2.237.3) indicates support of only 20 MHz channel width for the frequency band it is operating in. A non-AP HE STA that is operating in 20 MHz channel width mode, such as a 20 MHz-only non-AP HE STA or an HE STA which reduced its operating channel width to 20 MHz using OMI (Operating Mode Indication), is a 20 MHz operating non-AP HE STA.

~~A 20 MHz-only non-AP HE STA operates with 20 MHz operating channel width only, in frequency bands between 1 GHz and 6 GHz(#8615, #9796).~~ ~~A 20 MHz-only non-AP HE STA operates in the primary 20 MHz channel as a mandatory mode(#8615).~~  A 20 MHz operating non-AP HE STA operates in the primary 20 MHz channel as a mandatory mode.

An HE AP in 5 GHz 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 9.4.2.237.3 (HE PHY Capabilities Information field)).(#8812, #9767, #9768) A ~~20 MHz-only non-AP HE STA~~ 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 20 MHz HE PPDU (see Table 28-5 (Data and pilot(#8603) subcarrier indices for RUs in a 20 MHz HE PPDU)) in the 2.4 GHz and 5 GHz frequency bands.

A ~~20 MHz-only non-AP HE STA~~ 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 28-6 (Data and pilot(#8603) subcarrier indices for RUs in a 40 MHz HE PPDU)) in the 2.4 GHz and 5 GHz frequency bands, and for 80 MHz~~, 80+80 MHz and 160 MHz~~ HE PPDU (see Table 28-7 (Data and pilot(#8603) subcarrier indices for RUs in an 80 MHz HE PPDU)) in the 5 GHz frequency band with the exception of RUs which are restricted from operation as specified in 28.3.3.6 (RU restrictions for 20 MHz operation(#10375)).(#8813)

A 20 MHz operating non-AP HE STA indicates support of tone mapping of 26-tone RU, 52-tone RU, and 106-tone RU for 80+80 MHz and 160 MHz HE PPDU in the 20 MHz In 160 MHz HE PPDU subfield in the HE PHY Capabilities Information field in the HE Capabilities element (see 9.4.2.237.3 (HE PHY Capabilities Information field)).

A ~~20 MHz-only non-AP HE STA~~ 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 28-6 (Data and pilot(#8603) subcarrier indices for RUs in a 40 MHz HE PPDU)) in the 2.4 GHz and 5 GHz frequency bands, and 80 MHz, 80+80 MHz and 160 MHz HE ~~MU~~ PPDU (see Table 28-7 (Data and pilot(#8603) subcarrier indices for RUs in an 80 MHz HE PPDU)) in the 5 GHz frequency band.(#8813). This support is indicated in the Channel Width Set subfield in the HE PHY Capabilities Information field of the HE Capabilities element (see 9.4.2.237.3 (HE PHY Capabilities Information field)).

**28.3.3.6 RU restrictions for 20 MHz operation(#10375)**

~~A non-AP STA may operate with 20 MHz channel width(#10376), either because it is a 20 MHz-only non- AP HE STA(#9797) (see 28.3.3.5 (20 MHz-only non-AP HE STAs(#8809)(#9154)(#8615)(#9152))(#10089, #7506)), or because it reduces its operating channel width to 20 MHz using OMI (see 27.8 (Operating mode indication))(#7508, #9798, 9798).~~ When ~~a non-AP STA with 20 MHz operating channel width~~ a 20 MHz operating non-AP HE STA is the receiver of a 40 MHz, 80 MHz, 80+80 MHz or 160 MHz HE MU PPDU, or the transmitter of a 40 MHz, 80 MHz, 80+80 MHz or 160 MHz HE TB PPDU, then the RU tone mapping in 20 MHz is not aligned with the 40 MHz, 80 MHz, 80+80 MHz or 160 MHz RU tone mapping (see 28.3.3.2 (Resource unit, guard and DC subcarriers)).(#9799, #9800, #8798, #10378)

An AP shall not assign the following RUs to a ~~non-AP HE STA with 20 MHz operating channel width~~20 MHz operating non-AP HE STA:

— 26-tone RU 5 and 14 of a 40 MHz HE MU PPDU and HE TB PPDU(#9766, #8799, #9151, #10090)

— 26-tone RU 5, 10, 14, 19, 24, 28 and 33 of an 80 MHz HE MU PPDU and HE TB PPDU(#9766, #8800, #9151, #10091)

— 26-tone RU 5, 10, 14, 19, 24, 28 and 33 of the lower 80 MHz or upper 80 MHz of an 80+80 MHz and 160 MHz HE MU PPDU(#9766, #8801, #9151, #10092)

— 26-tone RU 5, 10, 14, 19, 24, 28 and 33 of the lower 80 MHz or upper 80 MHz of an 80+80 MHz and 160 MHz HE TB PPDU(#9766, #8801, #9151)

— 52-tone RU 5 and 12 of an 80 MHz HE MU PPDU or HE TB PPDU(#9766, #8802, #9151)

— 52-tone RU 5 and 12 of the lower 80 MHz or upper 80 MHz of an 80+80 MHz and 160 MHz HE MU PPDU(#9766, #8803, #9151)

— 106-tone RU 3 and 6 of an 80 MHz HE MU PPDU and HE TB PPDU(#9766, #8804, #9151)

— 106-tone RU 3 and 6 of the lower 80 MHz or upper 80 MHz of an 80+80 MHz and 160 MHz HE MU PPDU(#9766, #8805, #9151)

— 106-tone RU 3 and 6 of the lower 80 MHz or upper 80 MHz of an 80+80 MHz and 160 MHz HE TB PPDU(#9766, #8805, #9151)

The(#10379) center 26-tone RU in the primary 20 MHz channel shall not be assigned to a non-AP STA when 20 MHz operating non-AP HE STAs are ~~a non-AP STA when non-AP STAs with 20 MHz operating channel width are~~ recipients of a 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz HE MU PPDU.(#5250)

~~It is optional whether all 242-tone RUs of non-AP STAs with 20 MHz operating channel width to be supported in 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz HE MU PPDU(#4973), and it is indicated in the Channel Width Set subfield in the HE PHY Capabilities Information field of the HE Capabilities element (see 9.4.2.237.3 (HE PHY Capabilities Information field))(#8807). If supported, there is no restriction on 242-tone RUs. A 242-tone RU for a 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz HE TB PPDU shall not be allocated to a non-AP STA with 20 MHz operating channel width(#4973, #Ed~~). A 242-tone RU for a 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz HE TB PPDU shall not be allocated to a 20 MHz operating non-AP HE STA.

1. ***Clarification pariticpation in 160/80+80 MHz OFDMA by a 20 MHz-only non-AP HE STA and a non-AP HE STA with 20 MHz operating channel width.***

Discussion: In D1.3, it is mandatory for a 20 MHz-only non-AP HE STA to support tone mapping of 26/52/106-tone RU, for 160/80+80 MHz HE PPDUs (see Pg/ln: 318/45 in D1.3). It implies that a 20 MHz-only non-AP HE STA shall support participation in a 160/80+80 MHz OFDMA using 26/52/106-tone RUs. However, in D1.3, the 160/80+80 MHz channel width support is optional for an HE STA.

To this end, while the 20 MHz-only non-AP HE STA shall support tone mapping of 26/52/106-tone RU to interoperate with the mandatory 20/40/80 MHz channel widths, it should be optional for the 20 MHz-only non-AP HE STA to interoperate with optional 160/80+80 MHz channel width.

We propose to introduce a one bit HE PHY capability, namely, ‘20 MHz in 160 MHz HE PPDU’, to indicate whether a 20 MHz operating non-AP HE STA (see (1)) supports participation in 160 MHz OFDMA transmission.

This bit is set to 0 or 1 by a 20 MHz-only non-AP HE STA.

This bit is set to 0 or 1 by a non-AP HE STA that supports up to 80 MHz channel width and operates with 20 MHz channel width by reducing its operating channel width to 20 MHz using OMI.

This bit is always set to 1 by a ‘non-AP HE STA that supports up to 160 MHz channel width and operates with 20 MHz channel width by reducing its operating channel width to 20 MHz using OMI.

Resolution:

***TGax Editor: Define a new HE PHY capability of 1 bit length, namely, “20 MHz In 160 MHz HE PPDU”. In Fig. 9-589cl (HE PHY Capabilities Information field format), change bit B15 from “Reserved” to “20 MHz In 160 MHz HE PPDU”.***

***Edit the Table-262aa (Subfields of the HE PHY Capabilities Information field) as follows.***

|  |  |  |
| --- | --- | --- |
| ***Subfield*** | ***Definition*** | ***Encoding*** |
| ***HE SU PPDU With 1x HE-LTF And 3.2 us GI*** |  |  |
| 20 MHz in 160 MHz HE PPDU | Indicates support of 26/52/106-tone mapping for a 20 MHz operating non-AP HE STA that is the receiver of a 80+80 MHz or a 160 MHz HE MU PPDU, or the transmitter of a 80+80 MHz or 160 MHz HE TB PPDU.Reserved for an AP. | Set to 0 if not supported.Set to 1 if supported.Note: Set to 1 if B2 of Channel Width Set subfield is set to 1. |
| ***…*** | ***…*** | ***…*** |

1. ***Clarification on participation in 160/80+80 MHz OFDMA by a non-AP HE STA that is capable of up to 80 MHz channel width when operating with 80 MHz channel width.***

Discussion: In D1.3, we have the following HE PHY capabilities in the Channel Width Set subfield of HE PHY Capabilities:

* 20 MHz-only non-AP HE STA, i.e., the device is hardware restricted to operate only at 20 MHz channel width
* A non-AP HE STA capable of up to 80 MHz channel width, i.e., the device is hardware capable to operate at 20/40/80 MHz channel width
* A non-AP HE STA capable of up to 160 MHz channel width, i.e., the device is hardware capable to operate at 20/40/80/160 MHz channel width
* A non-AP HE STA capable of up to 160/80+80 MHz channel width, i.e., the device is hardware capable to operate at 20/40/80/160/80+80 MHz channel width

The participation of ‘20 MHz-only non-AP HE STA’ and ‘a non-AP HE STA that supports up to 80 MHz channel width and operates with 20 MHz channel width by reducing its operating channel width to 20 MHz using OMI’ in 160/80+80 MHz OFDMA is discussed above in (2).

The D1.3, is silent whether a non-AP HE STA capable of up to 80 MHz channel width and operating at 80 MHz channel width can participate in 160/80+80 MHz OFDMA? We propose, it should be optional for a non-AP HE STA capable of up to 80 MHz channel width and operating at 80 MHz channel width to participate in 160/80+80 MHz OFDMA since 160/80+80 MHz channel width support is optional.

To this end, we propose to add a one bit HE PHY capability, namely, ’80 MHz in 160 MHz HE PPDU’, to indicate whether a non-AP HE STA capable of up to 80 MHz channel width and operating at 80 MHz channel width can participate in 160/80+80 MHz OFDMA.

This bit is set to 0 or 1 by a non-AP HE STA capable of up to 80 MHz channel width and operates with 80 MHz channel width.

This bit is always set to 1 by a non-AP HE STA capable of up to 160 MHz channel width and operates with 80 MHz channel width.

This bit is always set to 1 by a non-AP HE STA capable of up to 160/80+80 MHz channel width and operates with 80 MHz channel width.

Resolution:

***TGax Editor: Define a new HE PHY capability of 1 bit length, namely, “80 MHz Operating In 160 MHz HE PPDU”. In Fig. 9-589cl (HE PHY Capabilities Information field format), change bit B16 from “Reserved” to “80 MHz Operating In 160 MHz HE PPDU”.***

***Edit the Table-262aa (Subfields of the HE PHY Capabilities Information field) as follows.***

|  |  |  |
| --- | --- | --- |
| ***Subfield*** | ***Definition*** | ***Encoding*** |
| 80 MHz in 160 MHz HE PPDU | Indicates supports of 160 MHz OFDMA for a non-AP HE STA that sets bit B1 of Channel Width Set to 1, and sets B2 and B3 of Channel Width Set each to 0, when operating with 80 MHz channel width. The capability bit is applicable while receiving a 80+80 MHz or a 160 MHz HE MU PPDU, or transmitting a 80+80 MHz or a 160 MHz HE TB PPDU. Reserved for an AP. | Set to 0 if not supported.Set to 1 if supported.NOTE: Set to 1 if B2 of Channel Width Set subfield is set to 1. |
| **NDP With 4x HE-LTF And 3.2 us GI** | ***…*** | ***…*** |

***TGax Editor: Create a new subsection with the following text***

**28.3.3.7 80 MHz operating non-AP HE STAs**

A non-AP HE STA capable of up to 80 MHz channel width, when operating with 80 MHz channel width, indicates support of reception of 160 MHz or 80+80 MHz HE MU PPDU, or the transmission of 160 MHz or 80+80 MHz HE TB PPDU in the 80 MHz In 160 MHz HE PPDU subfield in the HE PHY Capabilities Information field in the HE Capabilities element (See 9.4.2.237.3 (HE PHY Capabilities Information field)).

An HE AP STA shall not allocate RUs outside of the primary 80 MHz when allocating an RU in a 160 MHz or 80+80 MHz HE MU PPDU or HE TB PPPDU to a non-AP HE STA that sets the 80 MHz in 160 MHz HE PPDU subfield in the HE PHY Capabilities Information field in the HE Capabilities element to 1 and is operating in 80 MHz channel width mode.

***TGax Editor: Edit the clause 28.1.1as follows***

**28.1.1 Introduction to the HE PHY**

A non-AP HE STA shall support the following clause 28 (High Efficiency (HE) PHY specification) features:

-…..

- ……

- 40 MHz and 80 MHz channel widths and all RU sizes and locations applicable to the 40 MHz and 80 MHz channel widths in 5 GHz band (transmit and receive) except for a 20 MHz~~-only~~ operating non-AP STA in which case the 40 MHz and 80 MHz channel widths, 996-tone RU, and 484-tone RU sizes in 5 GHz band are not applicable

- A 20 MHz~~-only~~ operating non-AP STA shall support 26-, 52-, and 106-tone RU sizes and locations in 40 MHz channel width in the 2.4 GHz band and 40 MHz and 80 MHz channel width in 5 GHz band (transmit and receive)

- …

A non-AP HE STA may support the following:

-..

- 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. Note applicable to a 20 MHz~~-only~~ operating non-AP STA~~.~~

- For a 20 MHz~~-only~~ operating non-AP STA, 242-tone RU sizes and locations in a 40 MHz channel width in the 2.4 GHz band

- For a 20 MHz~~-only~~ operating non-AP STA, 242-tone RU sizes and locations in a 40 MHz and 80 MHz channel widths in the 5 GHz band

- For a 20 MHz operating non-AP STA, 26-, 52-, 106-, and 242-tone RU sizes and locations in 160 MHz and 80+80 MHz channel widths in 5 GHz band

~~- For a 20 MHz-only operating non-AP STA, 242-tone RU sizes and locations in a 160 MHz and 80+80 MHz channel widths in the 5 GHz band~~

- 160 MHz and 80+80 MHz channel width and 2x996-tone RU sizes applicable to the 160 MHz and 80+80 MHz channel widths in 5 GHz (transmit and receive). Not applicable to a 20 MHz~~-only~~ operating non-AP STA

- ….

- MU-MIMO transmission on an RU in an HE TB PPDU, where the RU does not span the entire PPDU bandwidth (UL MU-MIMO with OFDMA). If it is supported, then a total of up to 8 space-time streams are supported

- For a non-AP HE STA capable of up to 80 MHz channel width, when operating with 80 MHz channel width, the reception of 160 MHz or 80+80 MHz HE MU PPDU, or the transmission of 160 MHz or 80+80 MHz HE TB PPDU

**28.2.5.3 Support for HT format**

***TGax Editor: Replace “20 MHz-only” with “20 MHz operating” on Pg 307, Ln 9***

The 20 MHz~~-onlyo~~perating non-AP HE STA only supports HT transmission on 20 MHz channel width.

***TGax Editor: Replace “20 MHz-only” with “20 MHz operating” on Pg 307, Ln 31***

The 20 MHz~~-only~~operating non-AP HE STA only supports HT reception on 20 MHz channel width.

**28.2.5.4 Support for VHT format**

***TGax Editor: Replace “20 MHz-only” with “20 MHz operating” on Pg 307, Ln 51***

The 20 MHz~~-onlyo~~perating non-AP HE STA only supports VHT transmission on 20 MHz channel width.

***TGax Editor: Replace “20 MHz-only” with “20 MHz operating” on Pg 308, Ln 2***

The 20 MHz~~-onlyo~~perating non-AP HE STA only supports VHT reception on 20 MHz channel width.

1. ***Fix HE PHY Capability “HE SU PPDU With 1x HE-LTF And 0.8 us GI” to include HE ER SU PPDU.***

Discussion: 1x HE-LTF And 0.8 us GI is optional to use for HE ER SU PPDU as stated on Pg 389, Ln 50. However, the HE PHY Capability, “HE SU PPDU With 1x HE-LTF And 0.8 us GI” is only applicable to HE SU PPDU and does not cover HE ER SU PPDU.

To this end, the subfield name and description is updated as follows.

Resolution

***TGax Editor: In Fig. 9-589cl (HE PHY Capabilities Information field format) Replace B14 “HE SU PPDU With 1x HE-LTF And 0.8 us GI” with “HE SU PPDU And HE ER SU PPDU With 1x HE-LTF And 0.8 us GI”.***

***TGax Editor: In Table 9-262aa (Subfields of the HE PHY Capabilities Information field)***

|  |  |  |
| --- | --- | --- |
| Subfield | Definition | Encoding |
| HE SU PPDU And HE ER SU PPDU With 1x HE-LTF And 0.8 us GI | Indicates support of the reception of an HE SU PPDU and an HE ER SU PPDU with 1x LTF and 0.8 us guard interval duration. | Set to 0 if not supported.Set to 1 if supported. |

**References:**

1. **IEEE P802.11axTM/D1.3, June 2017.**