IEEE P802.11
Wireless LANs

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| Comment Resolution on CCA for Preamble Puncturing |
| Date: 2017-01-17 |
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Abstract

This submission proposes resolutions of comments received from TGax comment collection (TGax Draft 1.0).

* CIDs: 6125, 6193, 7037, 7248, 8538, 9418, 10162 and 10178 (8 CIDs)
1. **Introduction**

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. The introduction and the explanation of the proposed changes are not part of the adopted material.

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

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

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| CID | Page Number | Line Number | Comment | Proposed Change | Resolution |
| 6125 | 349 | 7 | add the CCA rule for preamble puncturing | add the CCA rule for preamble puncturing | Revised.Add subclause to describe the rules for preamble puncturingTGax editor to make the changes shown in 11-17/0060r3 under all headings that include CID 6125. |
| 6193 | 349 | 7 | The current PHY-CCA.indication primitive only provides CCA results of primary, secondary, secondary40, and secondary80. In order to support BW options of current preamble puncturing mode, additional PHY-CCA.indication primitives should be defined. | As in comment. | Revised.Add subclause to describe the rules for preamble puncturingTGax editor to make the changes shown in 11-17/0060r3 under all headings that include CID 6193. |
| 7037 | 349 | 7 | The currrent PHY-CCA.indication primitive only provides CCA results of primary, secondary, secondary40, and secondary80. In order to support BW options of current preamble puncturing mode, additional PHY-CCA.indication primitives should be defined. | Please specify the additional PHY-CCA.indication primitives for preamble puncturing. | Revised.Add subclause to describe the rules for preamble puncturingTGax editor to make the changes shown in 11-17/0060r3 under all headings that include CID 7037. |
| 10178 | 348 | 58 | The CCA for preamble puncturing is missed in this subclause. | Add a subclause to decripte the CCA for preamble puncturing. | Revised.Add subclause to describe the rules for preamble puncturingTGax editor to make the changes shown in 11-17/0060r3 under all headings that include CID 10178. |
| 7248  | 148 | 1 | For UL MU transmission, CCA-ED should be conducted not only for the primary 20MHz channel and secondary 20MHz/40MHz/80MHz channel but also for the non-primary 20MHz channel. | Add the following text:21.3.18.5.2 CCA sensitivity for operating classes requiring CCA-EDChange as follows:CCA-ED shall detect a channel busy condition when the received signal strength exceeds the CCA-ED threshold as given by dot11OFDMEDThreshold for the primary 20 MHz channel, dot11OFDMEDThreshold for the secondary 20 MHz channel (if present), dot11OFDMEDThreshold + 3 dB for the secondary 40 MHz channel (if present), and dot11OFDMEDThreshold + 6 dB for the secondary 80 MHz channel (if present). The CCA-ED thresholds for the operating classes requiring CCA-ED are subject to the criteria in D.2.5.For UL MU transmission in response to a Trigger frame, CCA-ED shall detect a channel busy condition when the received signal strength exceeds the CCA-ED threshold as given by dot11OFDMEDThreshold for the primary 20 MHz channel and dot11OFDMEDThreshold for the non-primary 20MHz channel (if present). | Revised.Per 20MHz CCA-ED is applied for HE trigger-based PPDU transmission for 20MHz sub-channels that require CCATGax editor to make the changes shown in 11-17/0060r3 under all headings that include CID 7248. |
| 8538 | 16 | 20 | The PHY-CCA.indication(BUSY, {primary}) primitive is issued by the PHY as long as a valid PPDU is detected at a sufficient signal strength over the primary 20 MHz channel. However, just based on this indication, it is not possible for the MAC to understand which of the 20 MHz channels other than the primary 20 MHz are actually busy. To facilitate better spectrum re-use during DL/UL OFDMA transmissions, it would be beneficial for the MAC to be aware of the busy/idle state of the rest of the 20 MHz channels even when the primary 20 MHz channel is busy. | In order to enable the MAC to understand which of the 20 MHz channels other than the primary 20 MHz are actually busy, add three more channel-list elements for HE STAs:primary20: In an HE STA, indicates that the primary 20 MHz channel is busy but the rest of the 20 MHz channels within the operating channel width are idle.primary40: In an HE STA, indicates that the primary 40 MHz channel is busy but the rest of the 20 MHz channels within the operating channel width are idle.primary80: In an HE STA, indicates that the primary 80 MHz channel is busy but the rest of the 20 MHz channels within the operating channel width are idle. | Revised.Per 20MHz CCA-ED is applied for HE trigger-based PPDU transmission for 20MHz sub-channels that require CCATGax editor to make the changes shown in 11-17/0060r3 under all headings that include CID 8538. |
| 9418  | 349 | 7 | In order to support BQR bitmap of 20MHz units, more granular PHY-CCA.indication primitives are necessary | Define more PHY-CCA.indication primitives | Revised.Per 20MHz CCA-ED is applied for BQR transmissionTGax editor to make the changes shown in 11-17/0060r3 under all headings that include CID 9418. |
| 10162 | 43 | 1 | The CS Required subfield is set to 1, ED-based CCA follows the same procedure as defined in VHT receiver specification. The rules describes the STA behaviors such that the STA shall start sensing the primary 20MHz channel first and then if present, additional secondary 20MHz channel, secondary 40MHz and secondary 80MHz channel(s) are measured to compare with the pre-determined CCA-ED threshold(s) depending on the operating channel.However when receiving the Trigger frame in 11ax, there might be a STA which is assigned to use the RU whose 20MHz channel(s) does not contain the primary 20MHz channel.ED-based CCA needs to be modified to sense either a single 20 MHz channel or multiple of 20 MHz channels which does not contain the primary 20MHz channel. | As in the comment. | Revised.Per 20MHz CCA-ED is applied for HE trigger-based PPDU transmission for 20MHz sub-channels that require CCATGax editor to make the changes shown in 11-17/0060r3 under all headings that include CID 10162. |

1. **Proposed changes**

***TGax editor: Modify section 8.3.5.12.2 by replacing the text by the one below:***

* Semantics of the service primitive

*Change Table 8-5(The channel-list parameter elements) as follows:*

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| * The channel-list parameter elements(11ac)
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| channel-list element | Meaning |
| primary | In an HT STA that is not a VHT STA, indicates that the primary 20 MHz channel is busy. In a VHT STA, indicates that the primary 20 MHz channel is busy according to the rules specified in 21.3.18.5.3 (CCA sensitivity for signals occupying the primary 20 MHz channel). In a TVHT STA, indicates that the primary channel is busy according to the rules specified in 22.3.18.6.3 (CCA sensitivity for signals occupying the primary channel). In an HE STA, indicates that the primary 20 MHz channel is busy according to the rules specified in 28.3.17.6.3 (CCA sensitivity for signals occupying the primary 20 MHz channel).(11af) |
| secondary | In an HT STA that is not a VHT STA, indicates that the secondary channel is busy. In a VHT STA, indicates that the secondary 20 MHz channel is busy according to the rules specified in 21.3.18.5.4 (CCA sensitivity for signals not occupying the primary 20 MHz channel). In a TVHT STA, indicates that the secondary channel is busy according to the rules specified in 22.3.18.6.4 (CCA sensitivity for signals not occupying the primary channel). In an HE STA, indicates that the secondary 20 MHz channel is busy according to the rules specified in 28.3.17.6.4 (CCA sensitivity for signals not occupying the primary 20 MHz channel). (11af) |
| secondary40 | Indicates that the secondary 40 MHz channel is busy according to the rules specified in 21.3.18.5.4 (CCA sensitivity for signals not occupying the primary 20 MHz channel). In a TVHT STA, indicates that the secondary TVHT\_2W channel is busy according to the rules specified in 22.3.18.6.4 (CCA sensitivity for signals not occupying the primary channel). In an HE STA, indicates that the secondary 40 MHz channel is busy according to the rules specified in 28.3.17.6.4 (CCA sensitivity for signals not occupying the primary 20 MHz channel). (11af) |
| secondary80 | Indicates that the secondary 80 MHz channel is busy according to the rules specified in 21.3.18.5.4 (CCA sensitivity for signals not occupying the primary 20 MHz channel). In an HE STA, indicates that the secondary 80 MHz channel is busy according to the rules specified in 28.3.17.6.4 (CCA sensitivity for signals not occupying the primary 20 MHz channel). |
| per20MHz bitmap | Indicates the busy/idle status of each 20 MHz sub-channel in 80 MHz or 160 MHz (80+80 MHz) according to the rules specified in 28.3.16.1.2 (CCA sensitivity for operating classes requiring CCA-ED) and 28.3.17.6.5 (CCA sensitivity for signals not occupying the primary 20 MHz channel for a STA attemping a preamble puncturing transmission). Valid only for the 20 MHz sub-channels that require CCA operation for the preamble puncturing transmission, HE trigger-based PPDU transmission and BQR operation. |

   (11ac)

***TGax editor: Modify section 27.5.2.4 by replacing the text by the one below:***

**27.5.2.4 UL MU CS mechanism**

The ED-based CCA and virtual CS functions are used to determine the state of the medium if CS is required before responding to a received Trigger frame. ED-based CCA is described in 28.3.16.1.2 (#7248, 8538, 9418, 10162) (CCA sensitivity for operating classes requiring CCA-ED) and virtual CS is defined in 10.3.2.1 (CS mechanism).

***TGax editor: Modify section 28.3.17.6 by replacing the text by the one below:***

**28.3.17.6 CCA sensitivity**

**28.3.17.6.1 General**

The thresholds in this subclause are compared with the signal level at each receiving antenna.

**28.3.16.1.2 CCA sensitivity for operating classes requiring CCA-ED**

For the operating classes requiring CCA-Energy Detect (CCA-ED), the PHY shall also indicate a medium

busy condition when CCA-ED detects a channel busy condition. For improved spectrum sharing, CCA-ED is required in some bands. The behavior class indicating CCA-ED is given in Table D-2 (Behavior limits). The operating classes requiring the corresponding CCA-ED behavior class are given in E.1 (Country information and operating classes). The PHY of a STA that is operating within an operating class that requires CCA-ED shall operate with CCA-ED.

CCA-ED for a STA that is attempting a non-preamble puncturing transmission (#6125, 6193, 7037, 10178) shall detect a channel busy condition when the received signal strength exceeds the CCA-ED threshold as given by dot11OFDMEDThreshold for the primary 20 MHz channel, dot11OFDMEDThreshold for the secondary 20 MHz channel (if present), dot11OFDMEDThreshold + 3 dB for the secondary 40 MHz channel (if present), and dot11OFDMEDThreshold + 6 dB for the secondary 80 MHz channel (if present). The CCA-ED thresholds for the operating classes requiring CCA-ED are subject to the criteria in D.2.5 (CCA-ED threshold).

CCA-ED for a STA that is attempting a preamble puncturing transmission shall detect a channel busy condition when the received signal strength exceeds the CCA-ED threshold as given by dot11OFDMEDThreshold for the primary 20 MHz channel and dot11OFDMEDThreshold for each non-primary 20 MHz sub-channel. The CCA-ED thresholds for the operating classes requiring CCA-ED are subject to the criteria in D.2.5 (CCA-ED threshold). (#6125, 6193, 7037, 10178)

For the HE trigger-based PPDU transmission, for each of 20 MHz sub-channels that require CCA, CCA-ED shall detect a channel busy condition when the received signal strength exceeds the CCA-ED threshold as given by dot11OFDMEDThreshold. The CCA-ED thresholds for the operating classes requiring CCA-ED are subject to the criteria in D.2.5 (CCA-ED threshold). (#7248, 8538, 10162)

For the BQR transmission, CCA-ED shall detect a channel busy condition when the received signal strength exceeds the CCA-ED threshold as given by dot11OFDMEDThreshold for primary 20 MHz channel and dot11OFDMEDThreshold for the non-primary 20 MHz channel (if present). The CCA-ED thresholds for the operating classes requiring CCA-ED are subject to the criteria in D.2.5 (CCA-ED threshold). (#9418)

NOTE—The requirement to detect a channel busy condition as stated in 21.3.18.5.3 (CCA sensitivity for signals occupying the primary 20 MHz channel) and 21.3.18.5.4 (CCA sensitivity for signals not occupying the primary 20 MHz channel) is a mandatory energy detect requirement on all Clause 21 (Very High Throughput (VHT) PHY specification) receivers. Support for CCA-ED is an additional requirement that relates specifically to the sensitivities described in D.2.5 (CCA-ED threshold).

**28.3.17.6.3 CCA sensitivity for signals occupying the primary 20 MHz channel**

The PHY shall issue a PHY-CCA.indication(BUSY, {primary}) primitive if one of the conditions listed in Table 28-43 (Conditions for CCA BUSY on the primary 20 MHz) is met in an otherwise idle 20 MHz, 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz operating channel width. With >90% probability, the PHY shall detect the start of a PPDU that occupies at least the primary 20 MHz channel under the conditions listed in Table 28-43 (Conditions for CCA BUSY on the primary 20 MHz) within a period of aCCATime (see 21.4.4 (VHT PHY)) and hold the CCA signal busy (PHY-CCA.indication(BUSY, channel-list) primitive) for the duration of the PPDU, unless it receives a CCARESET.request primitive before the end of the PPDU for instance during spatial reuse operation as described in 27.9 (Spatial reuse operation).

**Table 28-43—Conditions for CCA BUSY on the primary 20 MHz**

|  |  |
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| Operating channel width | Conditions |
| 20 MHz, 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz | The start of a 20 MHz NON\_HT PPDU in the primary 20 MHz channel as defined in 17.3.10.6 (CCA requirements).The start of an HT PPDU under the conditions defined in 19.3.19.5 (CCA sensitivity).The start of a 20 MHz VHT PPDU in the primary 20 MHz channel at or above –82 dBm.The start of a 20 MHz HE PPDU in the primary 20 MHz channel at or above –82 dBm. |
| 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz | The start of a 40 MHz non-HT duplicate, VHT PPDU or HE PPDU in the primary 40 MHz channel at or above –79 dBm.The start of an HT PPDU under the conditions defined in 19.3.19.5 (CCA sensitivity). |
| 80 MHz, 160 MHz, or 80+80 MHz | The start of an 80 MHz non-HT duplicate, VHT PPDU or HE PPDU in the primary 80 MHz channel at or above –76 dBm. |
| 160 MHz or 80+80 MHz | The start of a 160 MHz or 80+80 MHz non-HT duplicate, VHT PPDU or HE PPDU at or above –73 dBm. |

The receiver shall issue a PHY-CCA.indication(BUSY, {primary}) primitive for any signal that exceeds a threshold equal to 20 dB above the minimum modulation and coding rate sensitivity (–82 + 20 = –62 dBm) in the primary 20 MHz channel within a period of aCCATime after the signal arrives at the receiver’s antenna(s); then the receiver shall not issue a PHY-CCA.indication(BUSY,{secondary}), PHYCCA.indication(BUSY,{secondary40}), PHY-CCA.indication(BUSY,{secondary80}), or PHYCCA.indication(IDLE) primitive while the threshold continues to be exceeded.

**28.3.17.6.4 CCA sensitivity for signals not occupying the primary 20 MHz channel for a STA attempting a non-preamble puncturing transmission**(#6125, 6193, 7037, 10178)

The PHY shall issue a PHY-CCA.indication(BUSY, {secondary}) primitive if the conditions for issuing PHY-CCA.indication(BUSY, {primary}) primitive are not present and one of the following conditions are present in an otherwise idle 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz operating channel width:

— Any signal within the secondary 20 MHz channel at or above a threshold of –62 dBm within a period of aCCATime after the signal arrives at the receiver’s antenna(s); then the PHY shall not issue a PHY-CCA.indication(BUSY,{secondary40}), PHY-CCA.indication(BUSY,{secondary80}), or PHY-CCA.indication(IDLE) primitive while the threshold continues to be exceeded.

— A 20 MHz NON\_HT, HT\_MF, HT\_GF, VHT PPDU or HE PPDU detected in the secondary 20 MHz channel at or above max(–72 dBm, OBSS\_PD\_20MHz) with >90% probability within a period aCCAMidTime (see 28.4.3 (HE PHY)).

The PHY shall issue a PHY-CCA.indication(BUSY, {secondary40}) primitive if the conditions for issuing a PHY-CCA.indication(BUSY, {primary}) and PHY-CCA.indication(BUSY, {secondary}) primitive are not present and one of the following conditions are present in an otherwise idle 80 MHz, 160 MHz, or 80+80 MHz operating channel width:

— Any signal within the secondary 40 MHz channel at or above a threshold of –59 dBm within a period of aCCATime after the signal arrives at the receiver’s antenna(s); then the PHY shall not issue a PHY-CCA.indication(BUSY, {secondary80}) primitive or PHY-CCA.indication(IDLE) primitive while the threshold continues to be exceeded.

— A 40 MHz non-HT duplicate, HT\_MF, HT\_GF, VHT PPDU or HE PPDU detected in the secondary 40 MHz channel at or above max( –72 dBm, OBSS\_PD\_20MHz) with >90% probability within a period aCCAMidTime (see 28.4.3 (HE PHY)).

— A 20 MHz non-HT, HT\_MF, HT\_GF, VHT PPDU or HE PPDU detected in any 20 MHz sub-channel of the secondary 40 MHz channel at or above max( –72 dBm, OBSS\_PD\_20MHz) with >90% probability within a period aCCAMidTime.

The PHY shall issue a PHY-CCA.indication(BUSY, {secondary80}) primitive if the conditions for PHYCCA.indication(BUSY, {primary}), PHY-CCA.indication(BUSY, {secondary}), and PHYCCA.indication(BUSY, {secondary40}) primitive are not present and one of the following conditions are present in an otherwise idle 160 MHz or 80+80 MHz operating channel width:

— Any signal within the secondary 80 MHz channel at or above –56 dBm.

— An 80 MHz non-HT duplicate, VHT PPDU or HE PPDU detected in the secondary 80 MHz channel at or above max(–69 dBm, OBSS\_PD\_20MHz) with >90% probability within a period aCCAMidTime (see 28.4.3 (HE PHY)).

— A 40 MHz non-HT duplicate, HT\_MF, HT\_GF, VHT or HE PPDU detected in any 40 MHz sub-channel of the secondary 80 MHz channel at or above max(–72 dBm, OBSS\_PD\_20MHz) with >90% probability within a period aCCAMidTime.

— A 20 MHz NON\_HT, HT\_MF, HT\_GF, VHT or HE PPDU detected in any 20 MHz sub-channel of the secondary 80 MHz channel at or above max(–72 dBm, OBSS\_PD\_20MHz) with >90% probability within a period aCCAMidTime.

**28.3.17.6.5 CCA sensitivity for signals not occupying the primary 20 MHz channel for a STA attempting a preamble puncturing transmission**(#6125, 6193, 7037, 10178)

The PHY shall issue a PHY-CCA.indication(BUSY, {per20MHz bitmap}) primitive if the conditions for issuing PHY-CCA.indication(BUSY, {primary}) primitive are not present and one of the following conditions are present in an otherwise idle 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz operating channel width:

* Any signal within the any 20 MHz sub-channel of secondary 20 MHz, secondary 40 MHz or secondary 80 MHz at or above a threshold of –62 dBm within a period of aCCATime after the signal arrives at the receiver’s antenna(s); then the PHY shall not issue PHY-CCA.indication(IDLE) primitive while the threshold continues to be exceeded.
* A 20 MHz NON\_HT, HT\_MF, HT\_GF, VHT, or HE PPDU detected in the any 20 MHz sub-channel of secondary 20 MHz, secondary 40 MHz or secondary 80 MHz at or above max( –72 dBm, OBSS\_PD\_20MHz) with >90% probability within a period aCCAMidTime (see 28.4.3 (HE PHY)).

The per20MHz bitmap is 8 bits in length. For 160 MHz or 80+80 MHz operation, the first bit to the 8th bit correspond to the 20 MHz sub-channel with the lowest frequency to the 20 MHz sub-channel with the highest frequency respectively. When a 20 MHz sub-channel is BUSY, the corresponding bit is set to 1, otherwise it is set to 0. The bit corresponding to the primary 20 MHz is set to 0.

For 80 MHz operation, the first bit to the 4th bit corresponds to the 20 MHz sub-channel with the lowest frequency to the 20 MHz sub-channel with the highest frequency respectively. When a 20 MHz sub-channel is BUSY, the corresponding bit is set to 1, otherwise it is set to 0. The bit corresponding to the primary 20 MHz is set to 0, and the last 4 bits are reserved and set to 1s. (#6125, 6193, 7037, 10178)