IEEE P802.11
Wireless LANs

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| Proposed Spec Text for CCA section |
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Abstract

This document provides proposals for text spec related to CCA section.

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.***

1. **Proposed changes**

***TGax editor: Modify section 8.3.5.10 by replacing the text by the one below:***

* PHY-CCARESET.request
* Function

(#7700)This primitive is a request by the MAC sublayer to the local PHY entity to reset the PHY to the state appropriate for the end of a received frame and to turn IPI reporting on and off by means of the IPI-STATE parameter.

* Semantics of the service primitive

The primitive provides the following parameter:

PHY-CCARESET.request(

IPI-STATE
)

The IPI-STATE parameter is present if dot11RadioMeasurementActivated is true. The IPI-STATE parameter can be one of two values: IPI-ON or IPI-OFF. The parameter value is IPI-ON when the MAC sublayer is requesting the PHY entity to report IPI values when the PHY is neither receiving nor transmitting an MPDU. IPI-ON turns on IPI reporting in the PHY entity. IPI-OFF turns off IPI reporting in the PHY entity.

* When generated

This primitive is generated by the MAC sublayer for the local PHY entity at the end of a NAV (#7491)and at a time indicated in 10.3.2.1 (CS mechanism) after each MAC slot boundary, which is described in 10.3.7 (DCF timing relations) and 10.22.2.4 (Obtaining an EDCA TXOP)(#40). This request can be used by some PHY implementations that may synchronize antenna diversity with slot timings.

This primitive is also generated by the MAC sublayer for the local PHY entity when the conditions are met to perform OBSS\_PD-based spatial reuse operation as defined in 25.9.2 (OBSS\_PD-based spatial reuse operation).

* Effect of receipt

(#7700)The effect of receipt of this primitive by the PHY entity is to reset the PHY(#61) to the state appropriate for the end of a received frame and to initiate a new CCA evaluation cycle(#40). If IPI-STATE parameter is IPI-ON, the PHY entity collects IPI values when it is not transmitting or receiving and provides those values to the MAC sublayer using the IPI-REPORT parameter.

* PHY-CCARESET.confirm
* Function

This primitive is issued by the PHY to the local MAC entity to confirm that the PHY has reset the CCA state machine and to provide observed IPI values when IPI reporting is turned on.

* Semantics of the service primitive

The primitive provides the following parameters:

PHY-CCARESET.confirm(

IPI-STATE,
IPI-REPORT
)

The IPI-STATE parameter is present if dot11RadioMeasurementActivated is true. The IPI-STATE parameter can be one of two values: IPI-ON or IPI-OFF. The IPI-STATE value shall be set to the value of IPI-STATE received by the PHY entity in the most recent PHY-CCARESET.request primitive.

The IPI-REPORT parameter is present if dot11RadioMeasurementActivated is true and if IPI reporting was turned on prior to the receipt of the latest PHY-CCARESET.request primitive. The IPI-REPORT parameter provides a set of IPI values for a time interval. The set of IPI values are recent values observed by the PHY entity since the generation of the most recent PHY-TXEND.confirm, PHY-RXEND.indication, PHY-CCARESET.confirm, or (#1601)PHY‑CCA.indication primitive, whichever occurred latest.

* When generated

This primitive is issued by the PHY to the MAC entity when the PHY has received a PHY-CCA-RESET.request primitive.

* Effect of receipt

The effect of receipt of this primitive by the MAC is unspecified.

***TGax editor: Modify section 8.3.5.12 by replacing the text by the one below:***

* PHY-CCA.indication
* Function

This primitive is an indication by the PHY to the local MAC entity of the current state of the medium and to provide observed IPI values when IPI reporting is turned on.

* Semantics of the service primitive

The primitive provides the following parameters:

PHY-CCA.indication(

STATE,
IPI-REPORT,
channel-list.

)

The STATE parameter can be one of two values: BUSY or IDLE. The parameter value is BUSY if the assessment of the channel(s) by the PHY determines that the channel(s) are not available. Otherwise, the value of the parameter is IDLE.

The IPI-REPORT parameter is present if dot11RadioMeasurementActivated is true and if IPI reporting has been turned on by the IPI-STATE parameter. The IPI-REPORT parameter provides a set of IPI values for a time interval. The set of IPI values may be used by the MAC sublayer for radio measurement(#3606) purposes. The set of IPI values are recent values observed by the PHY entity since the generation of the most recent PHY-TXEND.confirm, PHY-RXEND.indication, PHY-CCARESET.confirm, or (#1601)PHY‑CCA.indication primitive, whichever occurred latest.

When STATE is IDLE or when, for the type of PHY in operation, CCA is determined by a single channel, the channel-list parameter is absent. Otherwise, it carries a set indicating which channels are busy. The channel-list parameter in a PHY-CCA.indication primitive generated by a VHT STA contains at most a single element. Table 8-5 (The channel-list parameter elements) defines the members of this set.

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| * The channel-list parameter elements(11ac)
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| channel-list element | Meaning |
| primary | In(#5274) an HT STA that is not a VHT STA, indicates that the primary 20 MHz channel is busy.In(#5274) 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 an HE STA, indicates that the primary 20 MHz channel is busy according to the rules specified in 26.3.16.1.3 (CCA sensitivity for signals occupying the primary 20 MHz channel).(11af) |
| secondary | In(#5274) an HT STA that is not a VHT STA, indicates that the secondary channel is busy.In(#5274) 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 an HE STA, indicates that the secondary 20 MHz channel is busy according to the rules specified in 26.3.16.1.4 (CCA sensitivity for signals not occupying the primary 20MHz 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 an HE STA, indicates that the secondary 40 MHz channel is busy according to the rules specified in 26.3.16.1.4 (CCA sensitivity for signals not occupying the primary 20MHz 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 26.3.16.1.4 (CCA sensitivity for signals not occupying the primary 20MHz channel). |

   (11ac)

The relationship of the channel-list parameter elements to the 40 MHz, 80 MHz, and 160 MHz BSS operating channel is illustrated by example in Figure 8-1 (The channel-list parameter element for 40 MHz, 80 MHz, and 160 MHz channel width). The relationship of the channel-list parameter elements to the 80+80 MHz BSS operating channel is illustrated by example in Figure 8-2 (The channel-list parameter element for 80+80 MHz channel width).

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| * The channel-list parameter element for 40 MHz, 80 MHz, and 160 MHz channel width(11ac)
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|  |
| * The channel-list parameter element for 80+80 MHz channel width(11ac)
 |

* When generated

For Clause 15 (DSSS PHY specification for the 2.4 GHz band designated for ISM -applications) to(Ed) Clause 20 (Directional multi-gigabit (DMG) PHY specification) PHYs,(11ac) this primitive is generated within aCCATime of the occurrence of a change in the status of the primary channel(#54) from channel idle to channel busy or from channel busy to channel idle or when the elements of the channel-list parameter change. For Clause 21 (Very High Throughput (VHT) PHY specification), Clause 22 (Television Very High Throughput (TVHT) PHY specification) and Clause 26 (High Efficiency (HE) PHY specification) PHYS,(#3065) this primitive is generated when the status of the channel(s) changes from channel idle to channel busy or from channel busy to channel idle or when the elements of the channel-list parameter change.(11ac) This includes the period of time when the PHY is receiving data. The timing of (#6641)PHY-CCA.indication primitives related to transitions on secondary channel(s) is PHY specific.(#54) Refer to specific PHY clauses for details about CCA behavior for a given PHY.

NOTE—For the VHT PHY, the timing information is omitted here and is defined in 21.3.18.5 (CCA sensitivity).(11ac)

If the STA is an HT STA but not a VHT STA(11ac) and the operating channel width is 20 MHz, the PHY maintains the channel busy indication until the period indicated by the LENGTH field has expired, where the LENGTH field is

* In a valid SIG field if the format of the PPDU is NON\_HT
* In a valid HT-SIG field if the format of the PPDU is HT\_MF or HT\_GF

If the STA is an HT STA but not a VHT STA(11ac) and the operating channel width is 40 MHz, the PHY maintains the channel busy indication until the period indicated by the LENGTH field has expired, where the LENGTH field is

* In a valid SIG field if the format of the PPDU is NON\_HT and the PPDU is received in the primary channel
* In a valid HT-SIG field if the format of the PPDU is HT\_MF or HT\_GF provided that the PPDU is either a 20 MHz PPDU received in the primary channel or a 40 MHz PPDU
* Effect of receipt

The effect of receipt of this primitive by the MAC is unspecified.

***TGax editor: Create new section 26.3.16 Receiver specification***

**26.3.16 Receiver specification**

**26.3.16.1 CCA sensitivity**

**26.3.16.1.1 General**

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

**26.3.16.1.2 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 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).

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).

**26.3.16.1.3 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 21-27 (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 21-27 (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 25.9.

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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.

**26.3.16.1.4 CCA sensitivity for signals not occupying the primary 20 MHz channel**

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, NON SRG OBSS\_PD) with >90% probability within a period aCCAMidTime (see 26.4.3 (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, NON SRG OBSS\_PD) with >90% probability within a period aCCAMidTime (see 26.4.3 (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, NON SRG OBSS\_PD) 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, NON SRG OBSS\_PD) with >90% probability within a period aCCAMidTime (see 26.4.3 (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, NON SRG OBSS\_PD) 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, NON SRG OBSS\_PD) with >90% probability within a period aCCAMidTime.

**26.3.16.1.5 CCA sensitivity for signals not occupying the primary 20 MHz channel for preamble puncturing**

***TGax editor: Modify section 25.9.2.1 by replacing the text by the one below:***

* OBSS\_PD-based spatial reuse operation
* General

(#2386)If the PHY of a STA issues a PHY-CCA.indication with a value equal to BUSY followed by an RXSTART.indication due to a PPDU reception then the STA’s MAC sublayer may a) issue a PHY-CCARESET.request primitive and b) not update its NAV timers based on frames carried in the PPDU if all the following conditions are met:

* The received PPDU is an Inter-BSS PPDU (see 25.2.1 (Intra-BSS and inter-BSS frame detection))
* The RxVector parameter RSSI\_LEGACY in the PHY-RXSTART.indication primitive, which defines the received power level measured from the legacy portion of the PPDU, is below the OBSS\_PD level (defined in 25.9.2.2 (Adjustment of OBSS\_PD and transmit power))
* The PPDU is not one of the following:
* A non-HT PPDU that carries an individually addressed Public Action frame where the RA field is equal to the STA MAC address(#Ed)
* A non-HT PPDU that carries a group addressed Public Action frame(#Ed)

(#2664)If the inter-BSS frame is carried in an HE extended range SU PPDU (where power of the L-STF/L-LTF symbols is boosted 3 dB), the received power measured based on the legacy preamble and captured in the RxVector parameter RSSI\_LEGACY in the PHY-RXSTART.indication primitive shall be decreased by 3 dB to compensate for the power boost factor when compared to the OBSS PD level.

* Adjustment of OBSS\_PD and transmit power

*TXPWRref* = 21 dBm for non-AP STAs.

*TXPWRref* = 21 dBm for AP STAs with Highest NSS Supported M1 subfield in the Tx Rx HE MCS Support field of the HE Capabilities element field is equal or lower than 1.

*TXPWRref* = 25 dBm for AP STAs with Highest NSS Supported M1 subfield in the Tx Rx HE MCS Support field of the HE Capabilities element field is equal or higher than 2.

***TGax editor: Modify table 26.1 as shown below:***

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| * TXVECTOR and RXVECTOR parameters(#1780)
 |
| Parameter | Condition | Value | TXVECTOR | RXVECTOR |
| RSSI | FORMAT is HE\_SU or HE\_EXT\_SU or HE\_MU or HE\_TRIG.  | The allowed values for the RSSI parameter are in the range 0 to 255 inclusive. This parameter is a measure by the PHY of the power observed at the antennas used to receive the current PPDU measured during the reception of the HE-LTF field. RSSI is intended to be used in a relative manner, and it is a monotonically increasing function of the received power. | N | Y |
|  |  |  |  |
| Otherwise | See corresponding entry in Table 21-1 | N | Y |
| RSSI\_LEGACY | Any PPDU FORMAT | The allowed values for the RSSI\_LEGACY parameter are in the range 0 to 255 inclusive. This parameter is a measure by the PHY of the power observed at the antennas used to receive the current PPDU measured during the reception of PHY legacy preamble. RSSI\_LEGACY is intended to be used in a relative manner, and it is a monotonically increasing function of the received power. | N | Y |