IEEE P802.11
Wireless LANs

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| CRs on Rx specification |
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This document provides PHY resolutions for the following CIDs on Clause 28.3.17 Receiver specification. The baseline for this comment resolution document is 802.11ax Draft 1.1.

* CIDs: 5284, 10315, 8329, 8330, 9032, 7833, 9033, 8330, 4873, 5878, 7834, 10307, 5875, 5876, 5877, 9035, 9036, 10308, 10309, 10310, 5875, 5876, 5877, 9035, 9036, 10309, 10310

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.***

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| **CID** | **Clause** | **P** | **L** | **Comment** | **Proposed Change** | **Resolution** |
| 5284 | 28.3.17.2 | 345 | 26 | Why is the minimum sensitivity for BPSK w/ DCM no better than without? If DCM doesn't improve sensitivity, then delete the feature. | as in comment | RejectedCCA preamble detection level of -82dBm is widely used. Setting the sensitivity level below -82dm may cause sometimes the recipient of a packet may ignore the packet.  |
| 10315 | 28.3.17.2 | 345 | 5 | It will be good to specify sensitivity for the STA with large power boost between two adjacent RU. With power boost mode, the minimum power delta is 6dB and the largest is 12dB. It will be meaningful to specify the sensitivity with large power boost | add STA sensitivity requirement with 6dB or up to 12dB power boost MU DL signal. | RejectedSensitivity is tested for only HE SU PPDU for which there is no RU boosting. |
| 8329 | 28.3.17.3 | 345 | 55 | As the frequency bands are shared, receiver performance where the interfering signal is not our own modulation should be specified. Receiver selectivity with AWGN should be specified. | The interfering signal should not be the same signal as is used in 28.3.17.2 receiver sensitivity. Specify with AWGN interfering signal of bandwidth W MHz. | RejectedHE signal is chosen as the interference signal for testing since HE signal has less guard bandwith comparing to HT and VHT signal of the same bandwith thus more chanllenging for testing.  |
| 8330 | 28.3.17.4 | 347 | 6 | As the frequency bands are shared, receiver performance where the interfering signal is not our own modulation should be specified. Receiver selectivity with AWGN should be specified. | The interfering signal should not be the same signal as is used in 28.3.17.2 receiver sensitivity. Specify with AWGN interfering signal of bandwidth W MHz. | RejectedDuplicated CID as 8329. |
| 9032 | 28.3.17.3 | 345 | 64 | Unknown reference: Table xx-a | Replace with correct reference | Revised. Agree with comment. TGax editor: please make the changes shown in 11-17/0317r1 for CID 9032. |
| 7833 | 28.3.17.3 | 346 | 63 | Use proper normative verbs | Change sentence to, "If the regulatory domain permits a 160 MHz band plan, then the STA shall be measured for adjacent channel rejection for 160 MHz operation, otherwise such measurement is optional." Similarly for nonadjacent channel, at P347L47. | RejectedThe same text is used for the VHT receiver specification. Keep the same text for consistency |
| 9033 | 28.3.17.3 | 346 | 2 | "of the frequency segment lower in the frequency of the desired signal." is not clear. Replace with "of the frequency segment of the desired signal that is lowest in frequency" | See comment | RejectedThe text is clear. The same text is also to describe the VHT adjacent channel rejection testing procedure.  |
| 8330 | 28.3.17.4 | 347 | 6 | As the frequency bands are shared, receiver performance where the interfering signal is not our own modulation should be specified. Receiver selectivity with AWGN should be specified. | The interfering signal should not be the same signal as is used in 28.3.17.2 receiver sensitivity. Specify with AWGN interfering signal of bandwidth W MHz. | RejectedHE signal is chosen as the interference signal for testing since HE signal has less guard bandwith comparing to HT and VHT signal of the same bandwith thus more chanllenging for testing.  |

 ***To TGax editor: Please make the following changes to 28.3.17.3 (#CID 9032)***

Adjacent channel rejection for 80+80 MHz channels shall be measured by setting the desired signal's strength 3 dB above the rate-dependent sensitivity specified in Table 28-41 (Receiver minimum input level sensitivity).

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| **CID** | **Clause** | **P** | **L** | **Comment** | **Proposed Change** | **Resolution** |
| 4873 | 28.3.17.6.2 | 348 | 17 | Should update the note. Change all the references on clause 21 VHT to the caluse 28 HE receiver | as in comment | RevisedTGax editor: please make the changes shown in 11-17/0317r1 for CID 4873. |
| 5878 | 28.3.17.6.3 | 348 | 37 | Table 28-43 requires that a STA transmits 40MHz, or 80MHz, 160MHz bandwidth to satisfy the lowest CCA level of -82 dBm. The transmit power density of 40, 80, or 160MHz is proportionally lower by 3, 6, 9 dB relative to that of the 20MHz transmit bandwidth. The lowest power spectral density does not reach as far as 20MHz transmit bandwidth. For STA transmitting higher bandwidth, a higher CCA level than Table28-43 by 3, 6, 9 dB depending on transmit bandwidth is 40, 80, or 160MHz should be allowed to use. If the dynamic secondary channel bandwidth detects secondary channel CCA busy, and the transmit bandwidth is reduced, the same power density as he wider intended bandwidth should be used. | Modify Table 28-43 based on intended transmit bandwidth as commented. | Rejected.Wtth the introduction of OBSS\_PD and SRP based Spatial reuse, current CCA/reuse rules are already very complicated. Dynamic CCA level based on transmission bandwidth is yet another new concept and may add to the complexity. There are also potential issues like fairness issue to legacy devices which need to be thoroughly examined.  |
| 7834 | 28.3.17.6.2 | 348 | 3 | Sentence is out of place ("also", in addition to what?), and redundant with the following text. | Delete the first setence of 28.3.17.6.2. | Revised.Word “also” is removedTGax editor: please make the changes shown in 11-17/0317r1 for CID 7834 |
| 10307 | 28.3.17.6.2 | 348 | 1 | CCA-ED is given in Table D-2 as written in this section.In this Table 2-5, encoding=1 is assigned to CCA-EDBehavior saying that"CCA shall also detect a medium busy condition when CCAEnergyDetectdetects a channel busy condition."Also in the following sentence in this section says;"The operating classes requiring the corresponding CCA-ED behavior class are given in E.1 (Country information and operating classes)."Please note that 11ax D1.0 doesn't include amendment to Annex-E in 11mc so I refer tables in 11mc.If you refer Table E-1 for US, only operating class=13, 14 & 15 requires "CCA-EDBehavior" and these operating channels are 3GHz band.In Table E-2 for EU and E-3 for Japan don't include "CCA-EDBehavior".If you refer Table E-4 for Global, only operating class=94, 95 & 96 requires "CCA-EDBehavior" and these operating channels are 3GHz band.If you read section 28.1.1, it is clear that clause 28 PHY is for 2.4GHz and 5GHz.On the other hand, section 8.1 for item 5b in PAR says:"The focus of this amendment is on WLAN indoor and outdoor operation in the 2.4 GHz and the 5 GHz frequency bands. Additional bands between 1 GHz and 6 GHz may be added as they become available."So, adding specification for 3GHz band can be within a scope of PAR. | EitherRemove section 28.3.17.6.2 entirely,orAdd specifications for 3GHz operation to clause 28. | Rejected. 11ax, although most discussions are focused on 2.4 and 5Ghz band, is not excluded operation in other band. It clearly states “this amendment defines modifications to both the IEEE 802.11 physical layer (PHY) and the medium access control (MAC) sublayer for high efficiency operation in frequency bands between 1 GHz and 6 GHz.”. It is better to keep this subcluse in case other bands are opened for 11ax operation in the future. Please note the samilar subclause also exists for VHT. |
| 5875 | 28.3.17.6.4 | 349 | 21 | expression max(-72dBm, OBSS\_PD) should be max(-72 dBm, OBSS\_PDlevel) | as indicated in comment | RevisedAgreed in principle of the comment. TGax editor: please make the changes shown in 11-17/0317r1 for CID 5875. |
| 5876 | 28.3.17.6.4 | 349 | 36 | expression max(-72 dBm, OBSS\_PD) should be max(-72dBm, OBSS\_PDlevel (40MHz)). | as indicated. | RevisedAgreed in principle of the comment. TGax editor: please make the changes shown in 11-17/0317r1 for CID 5876. |
| 5877 | 28.3.17.6.4 | 349 | 51 | expression max(-69dBm, OBSS\_PD) should be changed to max(-72dBm, OBSS\_PDlevel (80MHz)) | as indicated in comment | RevisedAgreed in principle of the comment. TGax editor: please make the changes shown in 11-17/0317r1 for CID 5877. |
| 9035 | 28.3.17.6.4 | 349 | 21 | Where is OBSS\_PD used in this formula defined? Provide reference. | See comment | RevisedTGax editor: please make the changes shown in 11-17/0317r1 for CID 9035. |
| 9036 | 28.3.17.6.4 | 349 | 36 | Does detection in the seconday 40 use the same OBSS\_PD as detection in a 20 MHz subchannel of the secondary 40 (see lines 36 and 40)? Shouldn't the levels be different. | Clarify | RevisedTGax editor: please make the changes shown in 11-17/0317r1 for CID 9036. |
| 10309 | 28.3.17.6.4 | 349 | 36 | The threshold value -72dBm during aCCAMidTime is applied for 40MHz band but the value of the OBSS\_PD is defined for 20MHz band. Compensate the OBSS\_PD by -3dB considering the bandwidth. | Replace "max( -72 dBm, OBSS\_PD)" with "max( -72 dBm, OBSS\_PD - 3dB)" | RevisedAgreed in principle of the comment. TGax editor: please make the changes shown in 11-17/0317r1 for CID 10309. |
| 10310 | 28.3.17.6.4 | 349 | 51 | The threshold value -69dBm during aCCAMidTime is applied for 80MHz band but the value of the OBSS\_PD is defined for 20MHz band. Compensate the OBSS\_PD by -6dB considering the bandwidth. | Replace "max( -69 dBm, OBSS\_PD)" with "max( -69 dBm, OBSS\_PD - 6dB)" | RevisedAgreed in principle of the comment. TGax editor: please make the changes shown in 11-17/0317r1 for CID 10310. |
| 10308 | 28.3.17.6.4 | 349 | 21 | OBSS\_PD is only available if the PPDU can be identified as an inter-PPDU. On the other hand the secondary 20MHz channel sensing threshold during aCCAMidTime can be applied for any IEEE Std 802.11 transmission. What is the reason to use OBSS\_PD level during aCCAMidTime for any PPDUs without identification of inter-BSS frames? Same comments on secondary 40 MHz channel and 80 MHz channel cases. | Add technical description to explain the reason to apply OBSS\_PD to the secondary 20MHz channel sensing threshold during aCCAMidTime. If not, remove OBSS\_PD. | Rejected.Secondary channel checking is performed only afer the primary 20MHz is idle. For Intra-BSS PPDU, it should be detected in in the primary 20MHz, so any power detected on the secondary channel checking with idle primary channel should come from OBSS or other technology.  |

 ***To TGax editor: Please make the following changes to 28.3.17.6.2 in D1.1 (CID 4873, 7834)***

* CCA sensitivity for operating classes requiring CCA-ED

For the operating classes requiring CCA-Energy Detect (CCA-ED), the PHY shall 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.

NOTE—The requirement to detect a channel busy condition as stated in 28.3.17.6.3 CCA sensitivity for the primary 20 MHz channel and 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 is a mandatory energy detect requirement on all Clause 28 High Efficient (HE) 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).

***To TGax editor: Please make the following changes in D1.1 (#CID 5875, 5876, 5877, 9035, 9036, 10309, 10310)***

* 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\_PDlevel* (#6125)) 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\_PDlevel(40MHz)*(#6125)) 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 level* (#6125)) 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\_PDlevel(80MHz))* 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\_PDlevel(40MHz)*(#6125)) 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\_PDlevel*(#6125)) with >90% probability within a period aCCAMidTime.

*OBSS\_PDlevel*, *OBSS\_PDlevel(40MHz)* and *OBSS\_PDlevel*(80MHz) are defined in 27.9.2.2 Adjustment of OBSS\_PD and transmit power.

* 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, {per20MHzbitmap}) 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 subchannel 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 subchannel of secondary 20 MHz, secondary 40 MHz or secondary 80 MHz at or above max(–72 dBm, *OBSS\_PDlevel*) with >90% probability within a period aCCAMidTime (see 28.4.3 (HE PHY)).