IEEE P802.11  
Wireless LANs

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | CR 24235 24236 PSR 20 MHz Normalization | | | | | | Date: 2020-04-30 | | | | | | Author(s): | | | | | | Name | Affiliation | Address | Phone | email | | Matthew Fischer | Broadcom |  |  | [Matthew.fischer@broadcom.com](mailto:Matthew.fischer@broadcom.com) | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |

Abstract

Proposed language to address TGaxD6.0 WG LB247 CIDs on PSR 20 MHz normalization description for CIDs 24235 and 24236.

Proposed changes are referenced to TGax D6.0.

**REVISION NOTES:**

**R0**:

initial

**R1**:

Added a definition for log (x), made use consistent

Add exception for OBSS\_PD operation to not include DSSS and CCK PSDUs

Change PPDU\_BW to PSDU\_BW

Several and various editorial changes, e.g. spaces around “/” symbol, insert a comma, less than or equal to phrasing, etc.

Updated doc references

**R2**:

Simplified the spatial reuse exlusion list addition to simply DATARATE is one of 1, 2, 5.5, 11 – note that this had not been done earlier because clause 16 does not actually explicitly call out these values, while 15 calls out only 1 and 2, but a reread of 16 seems to allow any value as appropriate, hence 5.5 and 11 are implicit.

Change PSDU\_BW to PPDU\_BW and generally fix other PSDU v PPDU stuff. Note that the use of PSDU instead of PPDU was an R1 change that was prompted by the suggestion that the thing transferred between MAC and PHY must be a PSDU, and therefore, any behaviour of the MAC that depends on receipt of something from the PHY should be referencing a PSDU, but this is not exactly true in this case, as the thing that is being used by the MAC is the RXVECTOR which is sent from the PHY in response to the PHY’s receipt of a PPDU, and whose parameters correspond to that PPDU and not to a PSDU and therefore, the “receive” operations in these locations is an implicit reference to the PHY reception of that PPDU as inferred by the MAC receipt of the RXVECTOR within the PHY-RXSTART.indication and not a reference to the receipt by the MAC of a PSDU thereby confirming that PPDU is the correct term.

Added punctured BW values in the PPDU\_BW value determination table. (see 60 MHz and 140 MHz values)

Updated doc references

**R3**:

To the DISCUSSION section, added an explanation of what it takes to successfully perform OBSS PD SR with received DSSS and/or CCK frames.

Removed changes to the spatial reuse exlusion list to allow OBSS PD SR to operate when the received frame is DSSS or CCK.

Add RSSI determination for DSSS and CCK received frames to allow OBSS PD SR to operate when the received frame is DSSS or CCK.

Add DSSS and CCK to the PPDU\_BW table to allow OBSS PD SR to operate when the received frame is DSSS or CCK.

Updated doc references

**R4**:

Change log() to log10()

26.10.2.4 – move the BW based adjustment of OBSS\_PDlevel from a separate pagragraph into equation (26-5)

Add a new TGax editor instruction to move figure 26-11 and its introductory paragraph to the end of the list of definitions of the terms of equation (26-5) within 26.10.2.4 – this is to ensure that the list of definitions of equation terms are not interrupted by text/figures

Removed the quotes from around the label for the column referenced in the text of 26.10.3.4

Updated doc references

**R5**:

Change to log10() to log10()

Changed equation symbols <=, +, - to symbol font equivalents

Updated doc references

**END OF REVISION NOTES**

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.***

**CIDs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Resolution (Proposed)** |
| 24235 | Wilhelmsson, Leif | 26.10.3.2 | 426.10 | The description of how things are normalized to 20 MHz becomes nicer if the formula is spelled out as on p. 420 l.35 | Rephrase how the normalization is done in the same was as on p. 420, l. 35 | Revise – Tgax editor to make the changes marked with CID 24235 in 11-20-0529r5 which generally agree with the commenter’s suggestion to rewrite the description of the calculation of the spatial reuse value and in consequence, affecting the description of the calculation of the OBSS\_PDLevel value. |
| 24236 | Wilhelmsson, Leif | 26.10.3.4 | 427.39 | The description of how things are normalized to 20 MHz becomes nicer if the formula is spelled out as on p. 420 l.35 | Rephrase how the normalization is done in the same was as on p. 420, l. 35 | Revise – Tgax editor to make the changes marked with CID 24236 in 11-20-0529r5 which generally agree with the commenter’s suggestion to rewrite the description of the calculation of the spatial reuse value. |

**Discussion:**

Note that the cases for when OBSS PD SR will work on DSSS and CCK frames is somewhat limited, but as long as there are no technical problems with doing it, there is no reason to not allow it.

An explanation of what is meant by “somewhat limited”:

Examining the conditions in 26.10.2.2 General operation with non-SRG OBSS PD level

We find:

The received signal strength level, which is measured from the L-STF or L-LTF fields of the PPDU and which is used to determine PHY-CCA.indication, is below the non-SRG OBSS PD level.

Because DSSS and CCK frames have no L-STF or L-LTF, we cannot determine an RSSI, so no OBSS PD SR possible.

But maybe this is an oversight.

Assuming that it is, and that we make a slight modification to the text to fix it, then we have some other conditions to examine:

The received PPDU is an inter-BSS PPDU (see 26.2.2 (Intra-BSS and inter-BSS PPDU classification)) and the received PPDU is not a non-HT PPDU carrying a response frame (Ack, BlockAck or CTS frame), or the received PPDU contains a CTS and a PHY-CCA.indication transition from BUSY to IDLE occurred within the PIFS time immediately preceding the received CTS and that transition corresponded to the end of an inter-BSS PPDU that contained an RTS that was ignored following this procedure.

Now, the first condition "inter-BSS PPDU" cannot possibly be met for a DSSS or CCK PPDU carrying a normal DATA MPDU because the determination of inter-BSS-ness is only possible after the complete MPDU has been received and because DSSS and CCK PPDUs do not accommodate aggregation, this only happens when the entire PPDU has been received and then it is too late to do OBSS PD SR.

So - for a general DATA-bearing DSSS/CCK MPDU, it is impossible to do OBSS PD SR.

HOWEVER, there is another path, which is the RTS-CTS path:

One could have the following situation:

DSSS/CCK RTS received (again, assume a fix for L-STF, L-LTF RSSI problem is in place)

RTS is identified as inter-BSS through RA or TA identification

RTS RSSI is below OBSS PD Level, so even though the frame discard occurs after the receipt of the RTS, the OBSS PD rules allow the NAV to be ignored

Next, the CTS NAV is also possibly ignored because:

a. CTS is identified as inter-BSS through RA (identifying the frame as inter-BSS is required)

For a non-AP STA, inter-BSS identification of CTS is practically only possible when RA == OBSS AP. It can determine this by receiving OBSS Beacons and identifying the TA and storing it and then running a match against the RA of the CTS. For a STA to do anything more, the STA would have to have a list of all associated STAs in its own BSS and there is no way to have such a list within the rules of the standard.

In the case of an AP receiving the CTS, the RA test for inter-BSS is possible, as the AP does have a list of all associated STAs in its own BSS.

b. CTS is below RSSI

At this point, an OBSS PD SR capable STA is potentially able to discard the NAV from both the RTS and the CTS if the OBSS PD Level test is satisfied

Now comes the DATA PPDU

Note that the conditions above require that the RTS at least caused a BUSY condition.

This means that the RTS was likely decodeable, or at least, the preamble and SIG were hearable and this means that the DATA PPDU should also have a receivable preamble and SIG (i.e. same transmitter as the RTS).

Assume that the DATA PPDU RSSI is below OBSS PD Level

Now, at this point, there are at least three choices:

a. The DATA PPDU is not DSSS/CCK, in which case, we might have a possible OBSS PD opportunity because the NAV of the RTS and CTS were both discarded and the DATA PPDU is below OBSS PD SR. But this is only possible if we are able to identify that the DATA PPDU is inter-BSS

If the DATA PPDU is HE or VHT, then maybe we can identify the COLOR in the PHY header.

If the DATA PPDU is not HE or VHT, then we have to decode the MAC portion to determine inter-BSS-ness – depending on the PPDU FORMAT, this might take us to the end of the PPDU, in which case, we missed the opportunity, but if the FORMAT allows aggregation, we can determine inter-BSS before the end of the PPDU and perform some OBSS PD.

b. DATA PPDU is DSSS/CCK, PHY header decode fails

Recall that RST and CTS NAVs were discarded. In this case, after the DATA PPDU PHY header decode failure, we have a valid OBSS PD opportunity – but of course, because we were able to decode the PHY header of the RTS, we are likely to be able to decode this one as well. So this is not a very likely outcome.

c. DATA PPDU is DSSS/CCK, PHY header decode passes

If the PHY header decode passes, then we are stuck without an OBSS PD opportunity, because we are back to the condition that one cannot identify this PPDU as inter-BSS until the PPDU is done.

So - there is a narrow set of conditions that might allow an OBSS PD operation with DSSS and CCK frames.

**Proposed Changes to TGax D6.0:**

**CID 24235, 24236:**

***TGax editor: in an appropriate location within TGax D6.0, add the following new text and editing instructions:***

**1.5 Terminology for mathematical, logical, and bit operations**

***Insert the following mathematical operation before the operation log2 (x):***

log10 (*x*) is the logarithm of *x* to the base 10. For example, log10 (100) is 2. **(#24236)**

***TGax editor: within subclause 26.10.2.2 General operation with non-SRG OBSS PD level within TGax D6.0, change the text as shown:***

**26.10.2.2 General operation with non-SRG OBSS PD level**

— The received signal strength level, which is measured from the L-STF or L-LTF fields of the PPDU or the PHY SYNC field or shortSYNC field or Long PHY SYNC field, whichever exists and which is used to determine PHY-CCA.indication, is below the non-SRG OBSS PD level. The non-SRG OBSS PD level is defined in 26.10.2.4 (Adjustment of OBSS PD and transmit power). If the STA has dot11HEPSROptionImplemented set to true, it also follows the rules defined in 26.10.4 (Interaction of OBSS PD and PSR-based spatial reuse) to determine non-SRG OBSS PD level.

***TGax editor: within subclause 26.10.2.3 General operation with SRG OBSS PD level within TGax D6.0, change the text as shown:***

**26.10.2.3 General operation with SRG OBSS PD level**

— The received signal strength level, which is measured from the L-STF or L-LTF fields of the PPDU or the PHY SYNC field or shortSYNC field or Long PHY SYNC field, whichever exists and which is used to determine PHY-CCA.indication, is below the SRG OBSS PD level. The SRG OBSS PD level is defined in 26.10.2.4 (Adjustment of OBSS PD and transmit power). If the STA has dot11HEPSROptionImplemented set to true, it also follows the rules defined in 26.10.4 (Interaction of OBSS PD and PSR-based spatial reuse) to determine SRG OBSS PD level.

***TGax editor: within TGax D6.0, in subclause in 26.10.2.4 Adjustment of OBSS PD and transmit power, change the text as shown and insert a new table as shown:***

**26.10.2.4 Adjustment of OBSS PD and transmit power**

If using OBSS PD-based spatial reuse, an HE STA shall maintain an OBSS PD level and may adjust this OBSS PD level in conjunction with its transmit power and the bandwidth of the received PPDU and this adjustment shall be made in accordance with Equation (26-5).

*OBSS\_PDlevel*  *max(OBSS\_PDmin, min(OBSS\_PDmax, OBSS\_PDmin* *(TX\_PWRref*  *TX\_PWR)))*  10 log10(PPDU\_BW / 20 MHz)(26-5)

where PPDU\_BW is determined from Table 26-xxyy (PPDU\_BW value determination) using the RXVECTOR parameter CH\_BANDWIDTH of the received PPDU, if present or CH\_BANDWIDTH\_IN\_NON\_HT if CH\_BANDWIDTH is not present or DATARATE if neither CH\_BANDWIDTH nor CH\_BANDWIDTH\_IN\_NON\_HT is present. **(#24235)(#24236)**

**Table 26-xxyy PPDU\_BW value determination (#24235)(#24236)**

|  |  |  |
| --- | --- | --- |
| **DATARATE** | **CH\_BANDWIDTH or CH\_BANDWIDTH\_IN\_NON\_HT** | **PPDU\_BW** |
| ANY | CBW20, HT\_CBW20, NON\_HT\_CBW20 | 20 MHz |
| ANY | CBW40, HT\_CBW40, NON\_HT\_CBW40 | 40 MHz |
| ANY | HE-CBW-PUNC80-PRI, HE-CBW-PUNC80-SEC | 60 MHz |
| ANY | CBW80 | 80 MHz |
| ANY | HE-CBW-PUNC160-PRI20, HE-CBW-PUNC80+80-PRI20, HE-CBW-PUNC160-SEC40, HE-CBW-PUNC80+80-SEC40 | 140 MHz |
| ANY | CBW80+80, CBW160 | 160 MHz |
| 1, 2, 5.5 or 11 | ANY or not present | 20 MHz |

***TGax editor: within TGax D6.0, in subclause in 26.10.2. 4 Adjustment of OBSS PD and transmit power, move figure 26-11 (Illustration of the adjustment rules for OBSS PD and TX\_PWR) and the paragraph that precedes it and references it to appear immediately before the paragraph in the same subclause which begins with the text “An AP may define”:***

***TGax editor: within TGax D6.0, in subclause in 26.10.3.2 PSR-based spatial reuse initiation, change the text as shown:***

**26.10.3.2 PSR-based spatial reuse initiation**

2) A PSRT PPDU is queued for transmission and the intended transmit power of the PSRT PPDU in dBm minus log10(PPDU\_BW / 20 MHz) dB is below the value of PSR - RPL, where PPDU\_BW is determined from Table 26-xxyy (PPDU\_BW value determination) using the TXVECTOR parameter CH\_BANDWIDTH or CH\_BANDWDITH\_IN\_NON\_HT of the PSRT PPDU, whichever is present, and PSR is the value obtained from Table 27-23 (Spatial Reuse field encoding for an HE TB PPDU) based on at least one of: **(#24235)**

***TGax editor: within TGax D6.0, in subclause in 26.10.3.4 UL Spatial Reuse subfield of Trigger frame, change the header and text as shown:***

**26.10.3.4 UL Spatial Reuse subfield of Trigger frames**

An AP with dot11HEPSROptionImplemented set to true that transmits a Trigger frame may determine the value of the UL Spatial Reuse subfield of the Common Info field of the Trigger frame for each 20 MHz subchannel for a 20 MHz, 40 MHz, or 80 MHz PPDU or for each 40 MHz subchannel for an 80+80 MHz or 160 MHz PPDU by selecting the row in Table 27-23 (Spatial Reuse field encoding for an HE TB PPDU) that has a numerical value in the Meaning column that is the highest value that is less than or equal to the value of the computed MAC parameter PSR\_INPUT as follows: **(#24236)**

PSR\_INPUT = *TX\_PWRAP* + Acceptable Receiver Interference LevelAP (26-7)

where

*TX\_PWRAP* is the total power at the antenna connector, in dBm, for that 20 MHz subchannel, over all antennas used to transmit the PSRR PPDU containing the Trigger frame for each 20 MHz subchannel for a 20 MHz, 40 MHz, or 80 MHz PPDU or in each of the 40 MHz subchannels for an 80+80 MHz or 160 MHz PPDU. **(#24236)**

Acceptable Receiver Interference LevelAP is a value in dBm for that 20 MHz subchannel for a 20 MHz, 40 MHz, or 80 MHz PPDU or for each of the 40 MHz subchannels for an 80+80 MHz or 160 MHz PPDU and should be set to value of the UL target RSSI indicated in the Trigger frame minus the minimum SNR value that yields ≤ 10% PER for the highest HE-MCS of the ensuing uplink HE TB PPDU, minus a safety margin value not to exceed 5 dB as determined by the AP. **(#24236)**

**End of proposed changes.**