IEEE P802.11
Wireless LANs

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| CR for OBSS\_PD-based spatial reuse – 25.9.2 |
| Date: 2016-09-09 |
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Abstract

This submission proposes resolutions for multiple comments related to TGax D0.1 with the following CIDs (**24 CIDs**):

* 2386, 1232, 63, 463, 2663, 67, 641, 2913, 65, 462, 2742, 2743, 777, 255, 2665, 449, 2719, 68, 706, 1018, 2723, 1017, 1582, 2667

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** | **Commenter** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 2386 | Yonggang Fang | 50.11 | It needs to clarify what transmit power control to be used. | As in comment. | Revised – Agree in principle with the comment. The adjustment rule in this document clarifies this. |
| 1232 | Mark Hamilton | 63.32 | BSS Color of zero means the BSS has "no color", per 9.4.2.214. So, a color of zero should be treated as a BSS that is not participating in color-specific BSS CCA rules. | Add "or the BSS Color is zero in the detected PPDU" to end of the first bullet. | Revised – Agree in principle with the comment. The first paragraph of 25.9.2 in the proposed text in this document illustrates the conditions where spatial reuse is not possible. |
| 63 | Ahmadreza Hedayat | 63.41 | "If the detected frame is an inter-BSS frame, under TBD condition, uses TBD OBSS PD level that is greater than the minimum receives sensitivity level." The rules for setting or obtaining OBSS PD are not specfied. | Specify the behavior/rules of an AP that sets/annonces the value of OBSS PD. Specify how a HE STA obtains the OBSS PD value. | Revised – Agree in principle with the comment. The adjustment rule in this document clarifies this. |
| 463 | Deqwon Lee | 63.41 | Too many TBD in text "If the detected frame is an inter-BSS frame, under TBD condition, uses TBD OBSS PD level that is greater than the minimum receives sensitivity level." The text does not imply anything since anything is possible. Furthermore, the sentence is imcomplete because it only describes the conditions and does not describe the operation that needs to occur when conditions are met. | Clarify the TBD conditions and TBD OBSS PD level or delete the text. | Revised – Agree in principle with the comment. The adjustment rule in this document clarifies this. |
| 2663 | Young Hoon Kwon | 63.41 | The sentence is not complete. Need rewriting | Rewrite the sentence or delete the sentence. | Revised – Agree in principle with the comment. The adjustment rule in this document clarifies this. |
| 67 | Ahmadreza Hedayat | 63.41 | The content of this clause is not stated in the best way and needs to be rewritten: "If the detected frame is an inter-BSS frame, under TBD condition, uses TBD OBSS PD level that is greater than the minimum receives sensitivity level. A STA should regard an inter-BSS PPDU with a valid PHY header and that has receiving power/RSSI below the OBSS PD level used by the receiving STA and that meets additional TBD conditions, as not having been received at all (e.g., should not update its NAV), except that the medium condition shall indicate BUSY during the period of time that is taken by the receiving STA to validate that the PPDU is from an inter-BSS, but not longer than the time indicated as the length of the PPDU payload." | As in the comment | Revised – Agree in principle with the comment. The Sentence is revised in this document. |
| 641 | Geonjung Ko | 63.41 | Need to define the duration for which OBSS PD level is applied. | The duration should not exceed the time indicated as the length of the detected PPDU payload. | Rejected – The OBSS\_PD level leads to a TxPower constraint. This power constraint should be applied until the STA acquires a TxOP and for all transmission until the end of this TxOP. |
| 2913 | Guido Hiertz | 63.41 | OBSS PD is not specified | OBSS PD level is one or more following prameters, CCA ED level, 802.11 signal detect CCA or TXPWR threshold values. | Revised – Agree in principle with the comment. The adjustment rule in this document clarifies this. |
| 65 | Ahmadreza Hedayat | 63.44 | This TBD condition is crutial and should be specified: "A STA should regard an inter-BSS PPDU with a valid PHY header and that has receiving power/RSSI below the OBSS PD level used by the receiving STA and that meets additional TBD conditions, as not having been received at all" | As in the comment. | Revised – Agree in principle with the comment. The conditions are specified in this document. |
| 462 | Deawon Lee | 63.41 | Need to clarify what "received signal/RSSI" refers to. Currently there is no definition for received signl/RSSI. | Clarify define what received signal/RSSI is and put the correct references for the definition. | Revised – Agree in principle with the comment. Change the text with “a received power measured based on the legacy preamble” as in this document. |
| 2742 | yujin noh | 63.45 | RSSI can be measured in L-LTF and/or HE-LTF. Measurement results based on L-LTF and HE-LTF can be radically different. For consistent behavior among STAs, draft needs to clarify futher whtat "receiving power/RSSI" refers to. | clarify "receiving power/RSSI" | Revised – Agree in principle with the comment. Change the text with “a received power measured based on the legacy preamble” as in this document. |
| 2743 | yujin noh | 63.45 | SR operation for wider bandwidths (i.e. 40MHz or larger) is not clearly specified. It is not clear whether it will have identical channel access rules as non-SR operation. | clarify SR operations for 40/80/160 MHz transmissions and how STAs can access the channel under SR rules. | Revised – Agree in principle with the comment. The adjustment rule is defined for higher bandwidth in this document. |
| 777 | Jarkko Kneckt | 63.47 | Define the NAV update rule more precisely. Does the NAV rule follow the normal EDCA rule, so the channel is sensed busy and after AIFS the channel is considered Idle again and the backoff calculation continues | Define the NAV rules for the transmission scheme | Revised – Agree in principle with the comment. The proposed text below clarifies that a STA may not update its NAV if it is an inter-BSS PPDU. |
| 255 | Anton Kiryanov | 63.47 | We may have two NAVs | Replace "NAV" with "NAVs" | Revised – Agree in principle with the comment. Change NAV into NAVs in the proposed text in this document. |
| 2665 | Young Hoon Kwon | 63.47 | How to adjust backoff counter during the period of time that is taken by the receiving STA to validate the PPDU is not clear. | Clarify how to adjust backoff counter during the period of time that is taken by the receiving STA to validate the PPDU. | Revsed –Agree in principle with the comment. The sentence is clarified in this document. As during that period, the medium conditions indicate busy, the backoff counter is not decremented.  |
| 449 | Brian Hart | 63.49 | "but not longer than the time indicated as the length of the PPDU payload" has several problems. PPDU payload is PSDU. But really we mean the end of the PPDU. So just say so | but not longer than the end of the PPDU | Revised – Agree in principle with the comment. This document clarifies the sentence and change the text to mention the end of the PPDU. |
| 2719 | Yuichi Morioka | 63.51 | Behavior after the BUSY state needs to be defined. Backoff should continue as if the OBSS PPDU was "not received at all". | Add text; "After the BUSY medium condition is released, the STA should resume its backoff procedure as the PPDU was not received at all (in insertion of IFS)." | Revised – Agree in principle with the comment. This document clarifies the sentence by mentioning that the STA should resume its backoff procedure. |
| 68 | Ahmadreza Hedayat | 63.57 | There should be an upper limit on OBSS-PD and particularly referenced in this clause: "When the color code based CCA rule is used, as described in Error! Reference source not found., an HE STA is allowed to adjust the OBSS\_PD threshold in conjunction with transmit power control to improve the system level performance and the utilization of the spectrum resources." | As in the comment. | Revised – Agree in principle with the comment. This document defines an upper limit for OBSS\_PD. |
| 706 | James June Wang | 63.57 | "an HE STA is allowed to adjust the OBSS\_PD threshold in conjunction with transmit power control" should be modified based on the SFD DCN132-16 P37L35 "adjustment rules formula | Please update the adjustment rules for OBSS\_PD trhehsold and transmit power as stated. | Revised – Agree in principle with the comment. This document includes the description of the adjustment rule from the SFD. |
| 1018 | Kazuyuki Sakoda | 63.57 | 802.11 devices should use Transmit power control (TPC) more efficiently to reduce interference. Most of the current 802.11 implementation transmit signal with a fixed power which is excessive in certain circumstances, i.e., mobile AP communicates with another device in very close range. More rules to encourage HE STAs to reduce transmission power shall be defined as a part of 802.11ax. | Please define a rule to reduce transmission power when a STA relaxes its CCA channel busy criteria. | Revised – Agree in principle with the comment. This document includes the description of the adjustment rule from the SFD. |
| 2723 | Yuichi Morioka | 63.57 | The text is talking about color code based CCA, hence should be moved to subclause 25.92. | as commented. | Revised – Agree in principle with the comment. This document clarifies the section by removing section 25.9.3 and including a new section 25.9.2.1 |
| 1017 | Kazuyuki Sakoda | 63.57 | Transmit power control (TPC) works well to reduce OBSS interference, i.e., minimize interfere from an HE STA to others. However, there will be no incentive for the HE STA to reduce its transmission power if the rule is not properly defined. The TPC rule for spatial reuse shall enable HE STAs to enjoy clear performance gain in dense scenario. The rule for spatial reuse TPC is lacking in the spec at the moment. | Spell out the spatial reuse TPC rule following the spirit of linking CCA threshold and transmission power as proposed in 11-16/414r1. | Revised – Agree in principle with the comment. This document includes the description of the adjustment rule from the SFD, which links transmit power adjustments with OBSS\_PD modification to create incentive for STAs. |
| 1582 | Mark RISON | 63.58 | "the OBSS\_PD threshold" -- what is this? | Clarify | Revised – Agree in principle with the comment. This document defines OBSS\_PD. |
| 2667 | Young Hoon Kwon |  | It is possible that a STA obtains TXOP by reducing the transmission power (and raising the OBSS\_PD threshold) for initial frame transmission. But, if the STA increases the transmission power for following frame transmission during the TXOP which does not require any further CCA, it defeats the purpose of adjusting the OBSS\_PD threshold. Therefore, once a STA obtains the channel with reducing the transmission power, the STA shall not use higher transmission power than the level that is used for color code based CCA. | Add the following sentence at the end of the first paragraph: "If an HE STA assesses wireless channel as idle by reducing transmit power and initiates TXOP, the HE STA shall not increase the transmit power during the TXOP.". | Revised – Agree in principle with the comment. This document defines the rule that the STA needs to respect the Transmit power constraints for any transmissions until the end of the TxOP that the STA gains once its backoff reaches zero. |
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***Rename 25.9.2 OBSS\_PD-based spatial reuse operation***

***Modify text as follows:***

~~(#62)If the detected frame is inter-BSS(#1575), under TBD condition, uses TBD OBSS PD level that is greater than the minimum receiver(#2334) sensitivity level.~~

~~An HE STA(#2331) should regard an inter-BSS PPDU with a valid PHY header and that has receiving power/RSSI below the OBSS PD level used by the receiving STA and that meets additional TBD conditions, as not having been received at all (e.g., should not update its NAV), except that the medium condition shall indicate BUSY during the period of time that is taken by the receiving STA to validate that the PPDU is inter-BSS(#1580), but not longer than the time indicated as the length of the PPDU payload.~~

~~An HE STA(#2331) should revise the NAV depending on TBD conditions at the recipient of the ongoing inter-BSS frame(#2720).~~

If OBSS\_PD-based SR is allowed, the STA may regard an inter-BSS PPDU with a valid PHY header and with a received power measured based on the legacy preamble below the OBSS\_PD level (defined in 25.9.2.1), as not having been received at all, which means that:

* When receiving the inter-BSS PPDU, the medium condition shall indicate BUSY during the period of time that is taken by the receiving STA to validate that the PPDU is from an inter-BSS. After this period of time and until the end of the PPDU, the medium condition may indicate IDLE. The STA resumes its backoff procedure when medium condition become IDLE.
* The STA should not update its NAVs timers.

*Note: If the inter-BSS PPDU carries a CF-End, the STA should update its regular NAV timer.*

OBSS\_PD-based Spatial Reuse is allowed for a STA as described in the previous paragraph if none of the following conditions apply:

* BSS Color field in the HE-SIG-A of the received inter-BSS PPDU is set to 0
* If the received inter-BSS PPDU is a public action frame carried in non-HT PPDU and is individually addressed and its RA matches the receiving STA’s MAC address
* If the received inter-BSS PPDU is a public action frame carried in non-HT PPDU and is group addressed.

***Modify section 25.9.3 into sub-section 25.9.2.1 Adjustment of OBSS\_PD and transmit power***

***Modify text as follows***

~~When the color code based CCA rule is used, as described in 25.9.2 (Color code based CCA rules)(#2721), an HE STA is allowed to adjust the OBSS PD(#2333) threshold in conjunction with transmit power control to improve the system level performance and the utilization of the spectrum resources.~~

Adjusting OBSS\_PD level and transmit power can improve the system level performance and the utilization of the spectrum. When using OBSS\_PD-based spatial reuse, an HE STA is allowed to adjust the OBSS\_PD level in conjunction with its transmit power based on the following adjustment rules:



Figure xxx: Illustration of the adjustment rules for OBSS\_PD and TX\_PWR.

The OBSS\_PDlevel is applicable to the start of a 20MHz PPDU received on the primary 20MHz. The OBSS\_PDlevel(40MHz) which is applicable to the start of a a 40MHz PPDU received on the primary 40MHz, the OBSS\_PDlevel(80MHz) which is applicable to the start of a a 80MHz PPDU received on the primary 80MHz and the OBSS\_PDlevel(160MHz or 80+80MHz) which is applicable to the start of a 160 or 80+80MHz PPDU received on the primary 160 or 80+80MHz, can be derived by the following equations:

TX\_PWRref = 21dBm for non-AP STAs or for AP STAs with 1 and 2 spatial streams, 25dBm for AP STAs of 3 spatial streams or more.

OBSS\_PDmin\_default=-82dBm, and OBSS\_PDmax\_default=-62dBm.

TX\_PWR is the STA’s transmission power in dBm.

A STA can select an OBSS\_PD level during its operation under SR mode. This level can be dynamically adjusted or can be static.

If a STA chooses a specific OBSS\_PDlevel during its operation under SR mode, the allowable SR\_maximum\_transmit\_power shall be calculated based on the equation (25-xxx) below:

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| * If OBSS\_PDlevel equals OBSS\_PDmin, there are no additional constraints on the\_STA’s SR\_maximum\_transmit\_power.
* If OBSS\_PDmax ≥OBSS\_PDlevel > OBSS\_PDmin, the SR\_maximum\_transmit\_power is equal to

SR Maximum transmit power =TX\_PWRref –(OBSS\_PDlevel – OBSS\_PDmin) |  (25-xxx) |

If a STA regards an inter-BSS PPDU as not having been received at all using a specific OBSS\_PD value, the STA’s power as measured at the output of the antenna port, shall be equal or lower than the SR\_maximum\_transmit\_power, calculated with this specific OBSS\_PDlevel with equation xxx, for the transmissions of any PPDU (including UL TB PPDU) until the end of the TXOP that the STA gains once its backoff reaches zero. STA may increase the OBSS\_PDlevel value during the backoff procedure, its maximum transmit power being adjusted as defined above. The minimum OBSS\_PDlevel used by the STA shall be above the received signal strength of the inter-BSS PPDU, which means that the maximum SR\_maximum\_transmit\_power shall be calculated with OBSS\_PDlevel equal to the received signal strength of the inter-BSS PPDU, with equation (25-xxx).