IEEE P802.11
Wireless LANs

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| Proposed Text Changes for OBSS\_PD-based SR parameters |
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Abstract

This document provides proposals for spec changes for OBSS\_PD-based SR mode.

1. **Revision notes**

R6: slight modifications to the optionally present fields of the SRP element, i.e. rewording for readability without technical change

 Change “ESS” to “ESS ” in a few places (i.e. just a spacing issue) (later changed all ESS to SRG)

 Expanded the description of how to determine if a PPDU is inter-ESS – i.e. used language that discusses the use of the bitmap, as opposed to just saying “use the bitmap”

 Changed OBSSPD to OBSS\_PD everywhere, since that seems to be the term that has more momentum in the TGax community

R7: update the “not received at all” language to reflect updated language fom 11-16-1223r6

 Removed default value statements for TXPwr\_ref and OBSS\_PD MIN and OBSS\_PD MAX because these are duplicates of changes that appear already in 11-16-1223r6 which should precede the changes in this document

R8: add a note to the editing instructions to point out that subclause 25.9.3 becomes 25.9.2.1 after the application of changes found in 11-16-1223r6

R9:

In 25.9.2:

Merged condition for ESS OBSS PD use of ESS Info present = 1 and PPDU is an intra-ESS PPDU

Merged condition for ESS OBSS PD use of ESS Info present = 1 and PPDU is an inter-ESS PPDU

(Note that the R10 revision changes ESS to SRG)

R10:

Because the AP might be selective about which colors to include, the set of colors and/or partial BSSID values might not be the same as the ESS which the STA belongs to – so ESS is replacaed with SRG = Spatial Reuse Group

Added a definition of the term SRG

Changed ESS to SRG

R11:

Changed occurrences of addSRG to address

R12:

Changed occurrences of wirelSRG to wireless

In 25.9.2 changed the first paragraph, which used to be the only paragraph in the draft descsribing how to discard an OBSS PPDU, and was using only inter-BSS identification – in earlier revisions, this paragraph included a new condition such that the OBSS PPDU discard could only be performed if no SRG parameters were received – that condition has now been removed, effectively making the use of the SRG list optional by a receiver – i.e. if a non-AP STA receives an SR P IE with SRG present, then it may decide to continue to only apply an inter-BSS test based on the associated BSS color

Added NDPA to 25.11a list of PPDUs that have SRP disallowed set in the HE PHY SRP field

25.9.2 – added NDPA to the list of non-HT PPDUs to which SR cannot be applied

R13:

25.9.3 SRG OBSS PD MIN offset and SRG OBSS PD MAX offset values transmitted by the AP in SR info elements language updated to fix errors, i.e. offset vs absolute value

Fixed a couple more places where SRG should be “ess”, e.g. within the title page in the word “wireless” and within the R10 revision notes, where a couple of instances of SRG should remain as ESS, and within R6 and R9 revision notes, which reference an earlier version of the document that did not yet contain the term SRG

R14:

Global:

Changed name of OBSS\_PD parameter to NON SRG OBSS PD

3.2 definitions:

Added OBSS PD SR PPDU – as the PPDU that is transmitted by an SR transmitter

9.4.2.x Spatial reuse parameter set element

Removed NON SRG OBSS PD MIN OFFSET

25.2.1

Added a description of an SRG.

Modified wording so that if SRG information is present, a STA identifies intr-SRG PPDUs instead of identifying inter-SRG PPDUs.

25.9.2

Added a restriction against SRP use when the STA receives an SR Set element from its AP with SRP Disallowed = 1.

Removed the third case, since it is redundant to the first case, provided that the SRG PD is always >= NON SRG PD, which is an enforced condition under the rules of setting the SRG offset values that are added.

25.9.3

Added more conditions to be met for setting the thresholds, common sense values.

Added two tables to show how to determine MIN and MAX values for NON SRG and SRG OBSS PD thresholds.

Fixed default language – instead of “Default OBSS\_PD” and SRG OBSS\_PD, the equivalent terms are NON SRG OBSS\_PD and SRG OBSS\_PD

Added at the very end, text to allow CTS2SELF to be transmitted in order to allow a transmitter of a PPDU to prevent a third party recipient from invoking OBSS\_PD on the PPDU that follows the CTS2SELF:

Provided that other conditions are fulfilled to allow the transmission of an OBSS PD SR PPDU, a STA may transmit the PPDU only if one of the following conditions is met:

1. the medium was idle for PIFS preceding the received OBSS PPDU
2. a PHY-CCA.indication transition from BUSY to IDLE occurred within the PIFS time immediately preceding the received OBSS PPDU and the transition corresponded to the end of a PPDU that did not contain a CTS
3. a PHY-CCA.indication transition from BUSY to IDLE occurred within the PIFS time immediately preceding the received OBSS PPDU and the transition corresponded to the end of a PPDU that contained 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 a PPDU that contained an RTS
4. An existing SRP transmit power restriction is not exceeded

Adjusted behavioural language to account for the new bits, in particular, noting the default values to be used for various bit combinations

25.11a

Corrected field names

R15:

Removed extra copy of R14 revision notes

9.4.2.x Spatial Reuse Parameter Set element

Removed NON SRG OFFSET MAX and its present bit in the SR control field

25.9.3

Removed NON SRG OBSS PD MAX OFFSET references and associated language

At the very end, fixed the conditions for transmission to separate the last one from the others to make it an or of the first three and an and of the fourth condition

Added SRP transmit power to the set of conditions

R16:

Removed SRP PPDU definition – the term is not used in this document

25.9.2

Added definition of SRO\_PPDU as a PPDU discarded based on OBSS\_PD

25.9.2.2

Added allowance for TX power to revert to full power at end of last SRO\_PPDU

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. **Explanation of the proposed changes**
	1. **OBSS\_PD-based SR parameters**

The spec defines a spatial reuse mode that we call OBSS\_PD-based SR, and which is defined in 25.9.2 and 25.9.3.

In the SFD, we agreed that the TxPower and OBSS\_PD can be adjusted based on a proportional rule.

An 11ax STA regards a valid OBSS PPDU 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 if the RXPWR of the received PPDU is below the OBSS\_PD threshold and TBD conditions are met, noting that the OBSS\_PD threshold is accompanied by a TXPWR value following adjustment rules:



[SR Motion 4, September 17, 2015, see [137], modified with SR Motion 7, March 2016, see 16/414r0]

This document proposes to fill TBDs in the spec:

* Default parameters for this proportional rule
* how to set/adjust the different values in this proportional rule.

**Default parameters:**

This document proposes default parameters that are conservative:

* + OBSS\_PD MIN\_default = -82dBm for 20MHz
	+ OBSS\_PD MAX\_default = -62dBm for 20MHz
	+ PWRref = 21dBm for non-AP STAs or AP STAs with 1 and 2 SSs, 25dBm for AP STAs of 3 SSs or more

**how to set/adjust the different values in this proportional rule.**

An SRG may provide SRG OBSS PD MIN and OBSS\_PD MAX values that apply to intra-SRG PPDUs

* OBSS\_PD MIN\_default <= OBSS\_PD MIN <= ED threshold
* OBSS\_PD MIN <= OBSS\_PD MAX

NON SRG OBSS\_PD MIN and NON SRG OBSS\_PD MAX values apply to inter-BSS PPDUs that are not intra-SRG PPDUs

* 1. **Allowing/disallowing SR modes:**

In the specification framework 11-15-0132-17-00ax, we have the following sentence:

Include the “SR\_allowed” signaling in HE-SIGA to indicate whether SR operation is allowed or not.

* use a value of Spatial Reuse field to indicate SR is disallowed
* The conditions to disallow SR are TBD

[SR Motion 6, March 2016, see 16/382r0]

We have 2 spatial reuse modes currently defined in the SFD:

* OBSS\_PD-based SR: which uses OBSS\_PD levels as defined in 25.9.2 and 25.9.3, and which don’t use information in SIG-A.
* SRP-based SR: defined in the SFD and which uses information in SIG-A SR field.

We propose:

* that the “SR disallowed” entry set in SR field in HE-SIGA only disallows SRP-based SR

We propose also that:

– non-AP STAs set “SR disallowed” entry in Spatial Reuse field when AP requests.

– non-AP STAs set “SR disallowed” entry in Spatial Reuse field in frame with NDP or FTM.

1. **Proposed changes**

3. Definitions, acronyms, and abbreviations

**3.2 Definitions specific to IEEE 802.11**

**TGax Editor: *Add the following definitions in the appropriate location within subclause 3.2 Definitions specific to IEEE 802.11:***

**SR PPDU:** a PPDU that is transmitted during a spatial reuse opportunity

**OBSS PD SR PPDU:** a PPDU that is transmitted during a spatial reuse opportunity that was determined using the OBSS\_PD threshold

3.4 Abbreviations and acronyms

**TGax Editor: *Add the following in the appropriate location within subclause 3.4 Abbreviations and acronyms:***

SR Spatial Reuse

SRG Spatial Reuse Group

***TGax editor: Add the following row to the frame format descriptions for the following frames, Beacon, Probe Response, (Re)Association Response (header row shown for reference only):***

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| <ANA> | Spatial Reuse Parameter Set | The Spatial Reuse Parameter Set element is optionally present if dot11HighEfficiencyOptionImplemented is true |

***TGax editor: Add a new line for spatial reuse parameter set element in Table 9-76—Element IDs.***

***TGax editor: Insert a new subclause (Spatial reuse parameter set element) in 9.4.2***

**9.4.2.x Spatial reuse parameter set element**

The Spatial Reuse Parameter Set element provides information needed by STAs for proper operation when operating with OBSS\_PD-based spatial reuse as defined in section 25.9.2. The format of the Spatial Reuse Parameter Set element is defined in Figure 9-ax6b (Spatial Reuse Parameter Set element).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Element ID Extension  | SR Control | SRG OBSS PD MIN OFFSET | SRG OBSS PD MAX OFFSET | SRG BSS Color Bitmap | SRG Partial BSSID Bitmap |
| Octets: | 1 | 1 | 1 | 1 | 0 or 1 | 0 or 1 | 0 or 8 | 0 or 8 |

 **Figure 9-ax6b- Spatial Reuse parameter set element**

The Element ID, Element ID extension and Length fields are defined in 9.4.2.1 (General).

The SR Control field is defined in Figure 9-ax6c (SR Control field format).

|  |  |  |  |
| --- | --- | --- | --- |
|  | SRP Disallowed | SRG Information Present | Reserved |
| Bits: | 1 | 1 | 6 |

**Figure 9-ax6c SR Control field format**

The SRP disallowed subfield in the SR Control field indicates whether SRP-based SR is allowed or not at non-AP STAs that are associated with the AP that transmitted this element. SRP-based SR is disallowed when the SRP Disallowed subfield has the value 1. SRP-based SR is allowed when the SRP Disallowed subfield has the value 0.

The SRG Information Present subfield indicates whether the SRG OBSS PD MIN Offset, SRG OBSS PD MAX Offset, SRG BSS Color Bitmap and SRG Partial BSSID Bitmap subfields are present. When this bit is set to 1, the SRG OBSS PD MIN Offset, SRG OBSS PD MAX Offset, SRG BSS Color Bitmap and SRG Partial BSSID Bitmap subfields are present. When this bit is set to 0, the SRG OBSS PD MIN Offset, SRG OBSS PD MAX Offset, SRG BSS Color Bitmap and SRG Partial BSSID Bitmap subfields are not present.

The SRG OBSS PD MIN Offset subfield is present when the value of the SRG Information Present subfield is equal to 1; Otherwise, the SRG OBSS PD MIN Offset subfield is not present. The SRG OBSS PD MIN Offset field contains an unsigned integer which is added to the value -82 dBm to generate the value of the SRG OBSS PD MIN parameter.

The SRG OBSS PD MAX Offset subfield is present when the value of the SRG Information Present subfield is equal to 1; Otherwise the SRG OBSS PD MAX Offset subfield is not present. The SRG OBSS PD MAX Offset field contains an unsigned integer which is added to the value -82 dBm to generate the value of the SRG OBSS PD MAX parameter.

The SRG BSS Color Bitmap subfield is present when the value of the SRG Information Present subfield is equal to 1; Otherwise the SRG BSS Color Bitmap subfield is not present. The SRG BSS Color Bitmap subfield is a bitmap that indicates which BSS Color values are used by members of the SRG of which the transmitting STA is a member. Each bit of the bitmap corresponds to one of the 63 available BSS Colors, where the lowest numbered bit corresponds to BSS Color value 0 and the highest numbered bit corresponds to BSS Color value 63. A BSS Color value is used by at least one BSS that is a member of the same SRG of the transmitting STA if the corresponding bit of the bitmap is set to 1. If a bit in the bitmap is set to 0, then no BSS in the same SRG of the transmitting STA uses the corresponding BSS Color value.

The SRG Partial BSSID Bitmap subfield is present when the value of the SRG Information Present subfield is equal to 1; Otherwise the SRG Partial BSSID Bitmap subfield is not present. The SRG Partial BSSID Bitmap subfield is a bitmap that indicates which Partial BSSID values are used by members of the SRG of which the transmitting STA is a member. Each bit of the bitmap corresponds to one of the 2^6 possible values of BSSID[39:44], where the lowest numbered bit corresponds to Partial BSSID value 0 and the highest numbered bit corresponds to Partial BSSID value 63. A Partial BSSID value is used by at least one BSS that is a member of the same SRG of the transmitting STA if the corresponding bit of the bitmap is set to 1. If a bit in the bitmap is set to 0, then no BSS in the same SRG of the transmitting STA uses the corresponding Partial BSSID value.

***TGax editor: Add the following text to section 25.2.1***

A Spatial Reuse Group is a set of BSSs that are identified as potentially benefiting from OBSS PD SR operation due to the parameters of their interactions on the medium. For example, the associated STAs of each BSS of an SRG are expected, due to channel planning and geographical planning, to have much higher intra-BSS receive powers than inter-BSS received powers. OBSS PD is expected to provide significant total system throughput gains within such a system. An HE STA that has received a Spatial Reuse Parameter Set element from its associated AP with a value of 1 in the SRG Information Present subfield shall use information provided in the Spatial Reuse Parameter Set element to identify BSSs that are members of the STA’s SRG to determine whether or not a received inter-BSS PPDU is an intra-SRG PPDU. If BSS Color information is present in a PPDU, the PPDU is determined to be an intra-SRG PPDU if the bit corresponding to the BSS Color of the PPDU in the SRG BSS Color Bitmap is 1. If Partial BSSID information is present in a PPDU, the PPDU is determined to be an intra-SRG PPDU if the bit corresponding to the SRG Partial BSSID Bitmap is 1. Otherwise, the PPDU is not determined to be intra-SRG. An HE STA that has not received a Spatial Reuse Parameter Set element from its associated AP with a value of 1 in the SRG Information Present subfield shall not classify any received PPDUs as intra-SRG.

***TGax editor: Add the underlined text to section 25.9.2***

**25.9.2 Color code based CCA rules**

If the RXVECTOR parameter SPATIAL\_REUSE is set to SR disallowed entry, then SRP-based SR is disallowed.

If an HE STA has received a Spatial Reuse Parameter Set element from its AP and the SRP Disallowed bit of the SR Control field is equal to 1, then SRP-based SR is disallowed.

***TGax editor: Modify the text as shown within 25.9.2***

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)
* The received power level measured from the legacy portion of the PPDU is below the NON SRG OBSS\_PD level (defined in 25.9.2.1)
* The PPDU is other than:
	+ a non-HT PPDU that carries a public action frame where the frame is individually addressed and the frame’s RA matches the receiving STA’s MAC address
	+ a non-HT PPDU that carries a public action frame where the frame is group addressed
	+ a non-HT PPDU that carries an NDPA

***TGax editor: Add the following text to 25.9.2***

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 of the following conditions are met:

* The received PPDU is an Inter-BSS PPDU (see 25.2.1)
* The STA received a Spatial Reuse Parameters information element from its associated AP with the SRG Information Present subfield equal to 1 and the received PPDU is an Intra-SRG PPDU (see 25.2.1)
* The received power level measured from the legacy portion of the PPDU is below the SRG OBSS\_PD level (defined in 25.9.2.1)
* The PPDU is other than:
	+ a non-HT PPDU that carries a public action frame where the frame is individually addressed and the frame’s RA matches the receiving STA’s MAC address
	+ a non-HT PPDU that carries a public action frame where the frame is group addressed
	+ a non-HT PPDU that carries an NDPA

A PPDU that has been discarded as described above is an SRO\_PPDU (Spatial Reuse OBSS\_PD PPDU).

***TGax editor: Modify the last paragraph of 25.9.2.2 Adjustment o OBSS\_PD and transmit power as shown:***

**25.9.2.2 Adjustment of OBSS\_PD and transmit power**

If a STA regards an inter-BSS PPDU as not having been received at all using a specific *OBSS\_PDlevel*, the STA’s power as measured at the output of the antenna connector, shall be equal or lower than the *TXPWRmax*, calculated with this specific *OBSS\_PDlevel* with Equation (25-1), for the transmissions of any PPDU (including UL TB PPDU) until at least, the earlier of:

1. the end of the TXOP that the STA gains once its backoff reaches zero
2. the latest end time of all correctly received DUR fields and LSIG length values and SIGA TXOP field values of all SRO\_PPDUs

The STA may increase the *OBSS\_PDlevel* 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 *TXPWRmax* shall be calculated with *OBSS\_PDlevel* equal to the received signal strength of the inter-BSS PPDU, with Equation (25-1).

**25.9.3 Adaptive CCA and transmit power control**

***TGax editor: Add the following to section 25.9.3 (renumbered to 25.9.2.1 after application of 11-16-1223r6 the proposed changes of which the editor should apply first)***

An AP may define SRG OBSS PD MIN Offset and SRG OBSS PD MAX Offset values that are used by its associated STAs to derive an SRG OBSS\_PD level for determining reception behaviour for inter-BSS PPDUs that are determined to be intra-SRG PPDUs. The values of SRG OBSS PD MIN Offset and SRG OBSS PD MAX Offset are transmitted to associated STAs within the Spatial Reuse Parameter Set element.

An AP transmitting a Spatial Reuse Parameter Set element shall respect the following constraints:

* OBSS\_PDmin\_default <= -82 + SRG OBSS PD MIN Offset dBm <= -62dBm
* SRG OBSS PD MIN Offset <= SRG OBSS PD MAX Offset
* SRG OBSS PD MAX Offset + -82 dBm <= -62 dBm

HE STAs shall maintain a NON SRG OBSS\_PD level, with its value calculated according to the Allowable OBSS\_PD level equation above but with OBSS\_PDmin\_default and OBSS\_PDmax\_default in place of OBSS\_PDmin and OBSS\_PDmax, respectively.

HE STAs shall maintain a SRG OBSS\_PD level, with its value calculated according to the Allowable OBSS\_PD level equation above but with SRG OBSS PD MIN and SRG OBSS PD MAX in place of OBSS\_PDmin and OBSS\_PDmax, respectively, where SRG OBSS PD MIN and SRG OBSS PD MAX are determined according to Table 25-yyz

**Table 25-yyz Determining SRG OBSS\_PD\_MIN and SRG OBSS\_PD\_MAX values**

|  |  |  |
| --- | --- | --- |
| **SRG Information Present** | **Value of SRG OBSS\_PD\_MIN** | **Value of SRG OBSS\_PD\_MAX** |
| Spatial Reuse Parameter Set element not received | N/A\* | N/A\* |
| 0 | N/A\* | N/A\* |
| 1 | -82 + SRG OBSS PD MIN Offset | -82 + SRG OBSS PD MAX Offset |
| \*Note: When SRG Information is not present, a STA cannot determine if a PPDU is intra-SRG and so will not use SRG OBSS\_PD\_MIN or SRG OBSS\_PD\_MAX values. |

The Spatial Reuse Parameter Set element is optionally present in Beacons, Probe Responses and (Re)Association responses.

Provided that the conditions specified in 25.9.2 (Color code based CCA rules) are fulfilled to allow the transmission of an OBSS PD SR PPDU, a STA may transmit the PPDU if each of the following four conditions are met:

1. at least one of the following conditions is met:
	1. The medium was idle (i.e. based on physical and virtual carrier sense) for PIFS preceding the received OBSS PPDU
	2. A PHY-CCA.indication transition from BUSY to IDLE occurred within the PIFS time immediately preceding the received OBSS PPDU and the transition corresponded to the end of a PPDU that did not contain a CTS
	3. A PHY-CCA.indication transition from BUSY to IDLE occurred within the PIFS time immediately preceding the received OBSS PPDU and the transition corresponded to the end of a PPDU that contained 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 a PPDU that contained an RTS
2. The SR transmit power restrictions specified in 25.9.2.2 (Adjustment of OBSS\_PD and Transmit power) are not exceeded for each PPDU of all OBSS PPDUs that contribute to this SR Opportunity
3. Any applicable SRP transmit power restrictions are not exceeded
4. The normal backoff procedure has reached zero for the applicable AC

***TGax Editor: Insert the following subclause, 25.11a, after 25.11***

**25.11a TXVECTOR parameters SPATIAL\_REUSE for** **an HE PPDU**

A STA shall set the TXVECTOR parameter SPATIAL\_REUSE to “SR disallowed” entry if one of the following conditions is met:

* An NDPA, NDP or FTM frame is carried in the HE PPDU.
* The STA is a HE non-AP STA that received a Spatial reuse parameter set element from its associated AP, and the “SRP disallowed” subfield in the “SR Control” field of the Spatial Reuse parameter set element is set to 1