IEEE P802.11
Wireless LANs

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| CR 27.9 Spatial Reuse Updates |
| Date: 2017-04-26 |
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Abstract

In the March 2017 meeting, 11-16-1476r21 was adopted to resolve many spatial reuse related comments.

There were a few errors in that document which need to be resolved.

This submission proposes to reopen and reresolve CIDs:

5941, 5873

5941 is chosen because it asks for clarification of SR\_DELAY

5873 is chosen because it asks for clarification of the general concept of SRP, indicating that there is little description in D1.0

The proposed changes on this document are based on TGax Draft 1.2.

**REVISION NOTES:**

**R0**:

initial

**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**

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| 5941 | James Yee | 274.12 | 28.3.10.7.2 | It is not clear what exactly the behavior of "SR\_Delay" is and more information should be provided in 27.9.2.1 and 27.11a. | Please clarify. | Revise – generally agree with comment, TGax editor shall incorporate changes in 11-16-1476r21 and 11-17-0633r0 |
| 5873 | James June Wang | 192.27 | 27.9 | Missing description of SRP-based SR Operation (27.9.3) | Add description of SRP-based SR operation (27.9.3) | Revise – generally agree with comment, TGax editor shall incorporate changes in 11-16-1476r21 and 11-17-0633r0 |
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**Discussion:**

The updates in this document are effectively changes to the previously adopted 11-16-1476r21 which, in addition to a few other changes, added the text of the complete definition of the SRP feature. The updates are summarized as follows:

1. 27.9.3 - A reference to the added SR Responder bit in the HE PHY Cap Info field used an incorrect field name
2. 27.9.3.3 – the value of TXPWRAP was only described for the case of 20 MHz – it needs to also be described for 40, 80 and 160 MHz operation
3. 27.9.3.4 – the description of the restriction on what is allowed to be transmitted during an SRP opportunity (i.e. all included MPDUs that elicit a response must include A-control with SR PPDU indication set to 1) is reworded for clarity in response to a request for a rewording after a review by some readers of the adopted text in the context of the new D1.2
4. 27.9.2.1 – this is OBSS\_PD related text discussing behaviour of an OBSS PD receiver when the RXVECTOR SPATIAL\_REUSE parameter value is SR\_DELAY or SR\_RESTRICTED – this text was deleted by 1476r21 as per the early revisions of that document, but after discussion with other SR experts around revision 8, it was determined that the text should not have been deleted, but the *undeletion* was never implemented in any revision of 1476 after those discussions took place and no one noticed – the undeletion is being performed now, in the form of an insertion to D1.2 to restore the deleted text
5. 27.11.6 – description of how the MAC assigns a value to the TXVECTOR SPATIAL\_REUSE parameter – revisions of 1476 before r21 included more than one case of SRP, and the correct assignment of the TXVECTOR SPATIAL\_REUSE parameter was described for all of those cases. When, at 1476r21 (and maybe a few revisions before that), all but one of the SRP cases were deleted, some of the language for the TXVECTOR SPATIAL\_REUSE parameter assignment was not correctly updated to reflect the fact that only one case remained – the change here deals with the one instance remaining that covered those now deleted additional cases

**Proposed Changes to Draft Text of TGax D1.2:**

***TGax editor: modify subclause 27.9.3 SRP-based spatial reuse operation as follows:***

**27.9.3 SRP-based spatial reuse operation**

**(#5873)**

SRP-based SR Opportunities are identified from the value of the RXVECTOR parameter SPATIAL\_REUSE and/or the contents of a Trigger MPDU. An HE STA is allowed to initiate an SR transmission during an SRP-based SR Opportunity using an adjusted transmit power level for the duration of an ongoing PPDU when certain conditions, designed to avoid interfering with the reception of the ongoing PPDU at the recipient are met. When the RXVECTOR parameter SPATIAL\_REUSE of the ongoing PPDU has the value SR\_DISALLOW, no SRP-based SR transmission is allowed for the duration of that PPDU.

An HE-STA supporting SRP-based SR operation indicates support for SRP-based SR operation by setting the SR Responder subfield to 1 in the HE PHY Capabilities Information field of the HE Capabilities element (Table 9-262aa).

An AP sending a trigger frame may set the SR field in the Common Info field of the trigger frame to SR\_DISALLOW to forbid OBSS STAs from performing SRP-based SR transmission during the ensuing uplink SRP\_PPDU duration. An AP sending a trigger frame shall not set the SR field in the Common Info field of the trigger frame to SR\_DELAY.

***TGax editor: modify the text of subclause 27.9.3.3 Spatial Reuse field of Trigger frame as follows:***

**27.9.3.3 Spatial Reuse field of Trigger frame**

An AP with dot11HESRPOptionImplemented set to true that transmits a trigger frame may determine the value of the Spatial Reuse field value of the Common Info field of the trigger frame in each 20MHz bandwidth for 20MHz, 40MHz, 80 MHz PPDU or in each 40MHz bandwidth for 80+80 or 160 MHz PPDU by selecting the row in Table 28-19 (Spatial Reuse subfield encoding) that has a numerical value in the column labeled “Meaning” that is the highest value that is equal to or below the value of the computed MAC parameter SRP\_INPUT as follows:

* SRP\_INPUT = TXPWRAP + Acceptable Receiver Interference LevelAP
* where
	+ The TXPWRAP is the transmit power in dBm at the output of the antenna connector of the AP sending the trigger frame normalized to 20MHz bandwidth (i.e., transmit power in dBm minus transmit bandwidth divided by 20MHz bandwidth in dB) for each 20MHz transmit bandwidth for 20MHz, 40MHz, and 80MHz PPDU or in each of the 40MHz transmit bandwidths for an 80+80MHz or 160 MHz PPDU. **(#5873)**
	+ Acceptable Receiver Interference LevelAP is a value in dBm normalized to a 20MHz bandwidth (i.e., minus transmit bandwidth divided by 20MHz bandwidth in dB) for each 20MHz transmit bandwidth for 20MHz, 40MHz, and 80MHz PPDU or in each of the 40MHz transmit bandwidths for an 80+80MHz or 160 MHz PPDU and should be set to the ambient noise plus interference power level observed at the AP immediately prior to the transmission of the trigger frame plus the SNR margin value which yields a 10% PER for all of the intended MCS(s) in the ensuing uplink HE trigger-based PPDU, minus a safety margin value not to exceed 5 dB as determined by the AP.

An AP with dot11HESRPOptionImplemented set to true that transmits a trigger frame may set the value of the Spatial Reuse field value of the Common Info field of the trigger frame in each 20MHz bandwidth for 20MHz, 40MHz, 80 MHz PPDU or in each 40MHz bandwidth for 80+80 or 160 MHz PPDU to SR\_DISALLOW.

An AP with dot11HESRPOptionImplemented set to false that transmits a trigger frame shall set the value of the Spatial Reuse field value of the Common Info field of the trigger frame in each 20MHz bandwidth for 20MHz, 40MHz, 80 MHz PPDU or in each 40MHz bandwidth for 80+80 or 160 MHz PPDU to SR\_DISALLOW.

***TGax editor: modify the text of subclause 27.9.3.4 SR\_PPDU transmission requirements as follows:***

**27.9.3.4 SR\_PPDU transmission requirements**

An HE STA that identifies an SRP Opportunity shall not transmit a PPDU during the SRP Opportunity that elicits a response transmission from a STA from which it has not received an HE Capabilities element with the SR Responder field equal to 1. An HE STA that identifies an SRP Opportunity shall not transmit an MPDU that elicits a response transmission during that SRP Opportunity that does not include an A-control field with the SR\_PPDU Indication subfield value set to 1. **(#5873)**

***TGax Editor: In TGa D1.2, insert the following text at the end of subclause 27.9.2.1 General as shown:***

**27.9.2.1 General**

**(#5941)**The PHYCCARESET.request primitive shall be issued at the end of the PPDU if the PPDU is HE SU PPDU or HE extended range SU PPDU and the RXVECTOR parameter SPATIAL\_REUSE indicates SR\_ DELAY.

If the PHYCCARESET.request primitive is issued before the end of the PPDU, and a TXOP is initiated within the duration of the PPDU, then the TXOP shall be limited to the duration of the PPDU if the PPDU is HE MU PPDU and the RXVECTOR parameter SPATIAL\_REUSE indicates SR\_RESTRICTED.

***TGax Editor: In TGa D1.2, modify subclause 27.11.6 SPATIAL\_REUSE as shown:***

**27.11.6 SPATIAL\_REUSE**

The contents of the Spatial Reuse field are carried in the TXVECTOR parameter SPATIAL\_REUSE for an HE PPDU indicating spatial reuse information (See 27.9.3 SRP-based spatial reuse operation). **(#5941)**

For a PPDU with a value of HE\_TRIG for the TXVECTOR parameter FORMAT, the SPATIAL\_REUSE parameter contains an array of four values. The first value in the array is the SPATIAL\_REUSE parameter that applies to the lowest frequency 20 MHz subband, the second value in the array applies to the second lowest frequency 20 MHz subband, the third value in the array applies to the third lowest frequency 20 MHz subband and the fourth value in the array applies to the highest frequency 20 MHz subband when the CH\_BANDWIDTH parameter has the value of CBW20, CBW40 or CBW80. The first value in the array applies to the lowest frequency 40 MHz subband, the second value in the array applies to the second lowest frequency 40 MHz subband, the third value in the array applies to the third lowest frequency 40 MHz subband and the fourth value in the array applies to the highest frequency 40 MHz subband when the CH\_BANDWIDTH parameter has the value of CBW160 or CBW80+80. When the SPATIAL\_REUSE parameter is an array, each value in the array shall individually conform to the rules in this subclause.

An AP with dot11HESRPOptionImplemented set to true that transmits an HE ER PPDU should set the TXVECTOR parameter SPATIAL\_REUSE to SR\_DISALLOW.

A non-AP STA with dot11HESRPOptionImplemented set to true that transmits an HE SU PPDU, HE ER PPDU or HE MU PPDU shall set the TXVECTOR parameter SPATIAL\_REUSE to SR\_DISALLOW.

An HE STA that transmits an HE Trigger-based PPDU determines the value of the TXVECTOR parameter SPATIAL\_REUSE according to 27.5.2.3 (STA behavior).

An HE AP with dot11HESRPOptionImplemented set to true may set the TXVECTOR parameter SPATIAL\_REUSE of an MSDU, A-MPDU or MMPDU to the value SR\_DISALLOW to forbid OBSS STAs from performing SRP-based SR transmission during the duration of the corresponding HE SU, HE ER, or HE MU PPDU.

An HE STA shall set the TXVECTOR parameter SPATIAL\_REUSE to SR\_DISALLOW for an NDP PPDU.

An HE STA shall set the TXVECTOR parameter SPATIAL\_REUSE to SR\_DISALLOW for a PPDU containing an FTM or NDPA.

An HE STA that transmits an HE SU PPDU or an HE extended range SU PPDU that contains a Trigger MPDU should set the TXVECTOR parameter SPATIAL\_REUSE to SR\_DELAY or SR\_RESTRICTED.

An HE STA that transmits a PPDU that does not contain a Trigger MPDU shall not set the TXVECTOR parameter SPATIAL\_REUSE to SR\_DELAY or SR\_RESTRICTED.

An HE STA with dot11HESRPOptionImplemented set to false may set the TXVECTOR parameter SPATIAL\_REUSE to SR\_DISALLOW for any PPDU that is not an an HE Trigger-based PPDU or an NDP PPDU or a PPDU containing an FTM or NDPA.

An HE STA with dot11HESRPOptionImplemented set to true that transmits an HE PPDU and that has not set the value of the TXVECTOR parameter SPATIAL\_REUSE according to the rules listed above may determine the value of the SPATIAL\_REUSE parameter in each 20MHz bandwidth for 20MHz, 40MHz, 80 MHz PPDU or in each 40MHz bandwidth for 80+80 or 160 MHz PPDU by selecting the row in Table 28-19 (Spatial Reuse subfield encoding) that has a numerical value in the column labeled “Meaning” that is the highest value that is equal to or below the value of the computed MAC parameter SRP\_VALUE as follows:

* SRP\_VALUE = TXPWRTX\_STA + Acceptable Target Interference Level
* where
	+ TX\_STA = STA transmitting the HE PPDU
	+ RX\_STA = STA that is the intended recipient of the HE PPDU
	+ TXPWRTX\_STA is the transmit power in dBm at the output of the antenna connector normalized to 20MHz bandwidth (i.e., transmit power in dBm minus transmit bandwidth divided by 20MHz bandwidth in dB) of TX\_STA, which is the STA sending the frame.
	+ Acceptable Target Interference Level is a value in dBm normalized to a 20MHz bandwidth (i.e., minus transmit bandwidth divided by 20MHz bandwidth in dB) for each 20MHz transmit bandwidth for 20MHz, 40MHz, and 80MHz PPDU or in each of the 40MHz transmit bandwidths for an 80+80MHz or 160 MHz PPDU and should be set to the RSSIRX\_STA\_at\_TX\_STA plus the relative constellation error value from table 28-45 (Allowed relative constellation error versus constellation size and coding rate) which corresponds to the modulation and coding of the HE PPDU, minus a safety margin value not to exceed 5 dB
	+ RSSIRX\_STA\_at\_TX\_STA is the received power measured by TX\_STA of the most recently received PPDU that was transmitted by RX\_STA

Figure 27-6a (SR Illustration) provides an example to show the relationships between TX\_STA, RX\_STA, and SR Initiator and an SR Responder.

TX\_STA

RX\_STA

STA3 (SR initiator)

on-going frame

Transmission

STA4 (SR responder)

RSSI

Space Loss

**Figure 27-11 SR Illustration**

**End of proposed changes.**