IEEE P802.11
Wireless LANs

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| PDT MAC and CR Coordinated Spatial Reuse Protocol |
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 Abstract

This document contains Proposed Draft Text (PDT) for the coordinated spatial reuse protocol of the TGbn (UHR, Ultra High Reliability) amendment to the 802.11 standard.

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: add PDT for more motions
* Rev 2: make changes based on offline comments
* Rev 3: change the definitions and resolve a TBD in Clause 38
* **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 TGbn Draft. The abstract, revision information, introduction, explanation of the proposed changes and references sections are not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGbn Draft (i.e., they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

**Explanation of the proposed changes:**

The proposed changes to the 802.11 TGbn draft within this document are based on the following motions adopted by the TGbn task group:

**Relevant passed motions:**

**[Motion #29]**

**TGbn defines a multi-AP Coordinated Spatial Reuse (Co-SR) at TXOP-level with power control.**

**[Motion #135]**

**The sharing AP, that transmits a Trigger frame as part of a transmission sequence in a Multi-AP coordinated transmission scheme, identifies the shared AP via an AP ID carried in the AID12 field of the User Info field of the frame**

* **Note: the name of "sharing AP" and "shared AP" are TBD**
* **Note: Multi-AP coordinated transmission schemes are Co-SR, Co-BF and Co-TDMA**

**[Motion #252]**

**11bn defines the following modes for co-SR transmission:**

* **Mode 1: trigger + same L-SIG contents, could be different U-SIG contents.**
	+ **For UHR+EHT, or EHT+UHR or EHT+EHT co-SR transmission.**
	+ **Provided no changes to non-UHR EHT non-AP STAs are needed.**
* **Mode 2: Tigger + same L-SIG contents + same U-SIG contents**
	+ **For UHR+UHR co-SR transmission.**
* **For all modes, the two PPDUs will start and end at the same time.**
* **UHR PPDU for co-SR transmission will be used for either mode 1 or mode 2 when UHR transmission exists.**
	+ **There exists an indication in U-SIG field to indicate the UHR PPDU is a UHR PPDU for co-SR transmission.**

 **[Motion #253]**

**In Coordinated Spatial Reuse:**

* **A sharing AP that intends to initiate a Coordinated Spatial Reuse transmission shall transmit a Trigger frame to initiate concurrent Co-SR transmissions with one (whether to allow more is TBD) other AP within its obtained TXOP BW;**
* **When all addressed non-AP STAs are UHR STAs, the concurrent Co-SR transmission starts SIFS after the Trigger frame**
* **Which trigger frame is TBD**

**[Motion #254]**

**In Coordinated Spatial Reuse, the following information shall be carried in the Trigger frame that initiates concurrent CSR transmissions of the 2 APs**

* **The duration of the data PPDU transmitted by the sharing AP and of the data PPDU transmitted by the shared AP, which are the same, after the Trigger frame**
* **Other parameters TBD**

**[Motion #429]**

**In Coordinated Spatial Reuse, the following information shall be carried in the Trigger frame that initiates concurrent CSR transmissions:**

* **The transmit power limit of the shared AP**
	+ **The shared AP Tx power limitation indicated by the sharing AP should not be lower than the minimum TX power indicated by the shared AP in its request.**
* **The transmit power of the sharing AP**

**Relevant CIDs (Part I):**

**416 747 1477 1478 1479 1480 1791 1792 2203 2672**

**3579 3784**

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| --- | --- | --- | --- | --- | --- | --- |
| CID | Commenter | Clause | Page | Comment | Proposed Change | Resolution |
| 416 | Shuang Fan | 37.8.2.2 | 72.27 | The passed Motion #252 has the text 'For all modes, the two PPDUs will start and end at the same time', this limits the number of APs participating in Co-SR transmission to 2. So, please add the number of participating APs in a Co-SR transmission to 2 in the draft | add the number of participating APs in a Co-SR transmission to 2 in this clause | Revised – Agree in principle with the commenter.TGbn Editor:Please implement the changes in this document tagged as #416 |
| 747 | Junbin Chen | 37.8.2.2.1 | 72.35 | In the sentence "The sharing AP transmits a Trigger frame to the shared AP identified by the AP ID ......", the "shared AP" shall be "coordinated AP". | as commented | Revised – Agree in principle with the commenter.TGbn Editor:Please implement the changes in this document tagged as #747 |
| 1477 | Akira Kishida | 37.8.2.2.1 | 72.34 | Information required to establish Co-SR for a sharing AP should be clarified. | As in the comment. | Revised – Agree in principle with the commenter.TGbn Editor:Please implement the changes in this document tagged as #1477 |
| 1478 | Akira Kishida | 37.8.2.2.1 | 72.35 | In the sentence regarding "The sharing AP transmits a Trigger frame to the shared AP," Co-SR does not limit the number of participating APs to two, unlike Co-BF. | Modify the sentence as follows; "The sharing AP transmits a Trigger frame to the shared AP"-> "The sharing AP transmits a Trigger frame to shared APs" | Rejected – According to Motion#252, the number of participating APs in a Co-SR transmission shall be 2. |
| 1479 | Akira Kishida | 37.8.2.2.1 | 72.35 | Regarding establishing Co-SR, the shared AP may respond to the agreement by "accept" or "reject." Please clarify that. | As in the comment. | Revised – Agree in principle with the commenter. In the resolution to CID 1477, subclause 37.8.1.3 (MAPC agreement negotiation) is referred, where it is described that the MAPC responding AP may respond to the agreement by "accept" or "reject."TGbn Editor:Please implement the changes in this document tagged as #1477 |
| 1480 | Akira Kishida | 37.8.2.2.1 | 72.35 | Regarding the establishment of Co-SR, the procedure for removal of the agreement should be clarified. | Please consider to clarify. | Revised – Agree in principle with the commenter. In the resolution to CID 1477, subclause 37.8.1.3 (MAPC agreement negotiation) is referred, where it is described that either AP can tear down the agreement for Co-SR.TGbn Editor:Please implement the changes in this document tagged as #1477 |
| 1791 | Junichi Iwatani | 37.8.2.2.1 | 72.35 | "to the shared AP" should be "to the shared AP(s)" on the assumption that two or more shared APs are possible. | As in comment. | Rejected – According to Motion#252, the number of participating APs in a Co-SR transmission shall be 2. |
| 1792 | Junichi Iwatani | 37.8.2.2.1 | 72.35 | When a shared AP receives a trigger frame from a sharing AP for Co-SR agreement, the shared AP can select "accept" or "reject" as a response. In addition, the agreement of Co-SR may be canceled. | The procedures should be described for accept, reject, and cancel. | Revised – Agree in principle with the commenter. In the resolution to CID 1477, subclause 37.8.1.3 (MAPC agreement negotiation) is referred, where it is described that the MAPC responding AP may respond to the agreement by "accept" or "reject." Besides, either AP can tear down the agreement for Co-SR.TGbn Editor:Please implement the changes in this document tagged as #1477 |
| 2203 | Brian Hart | 37.8.2.2.1 | 72.36 | "to the shared AP" is very limiting and limits this feature such that it can only deliver relatively weak benefits Greater gains, in terms of higher MCS and better QoS/determinism, will happen if the sharing AP is also allowed to share a portion of its TXOP with two other APs at the same time: a) if they are say on the left and right of the sharing AP, they will enjoy greater pathloss separation and higher MCSs, and b) the two other APs may both have very urgent traffic, and each really need/deserve a portion of the TXOP. | Define signaling to allow Co-SR between two coordinated APs. Since knowledge of pathloss (or SIR, RSSI etc) between the two coordinated BSSs is needed at the sharing AP in order to determine when Co-TDMA or Co-SR is warranted, and transmitting this pathloss/SIR/RSSI information over the air is likely to appreciably diminish the net benefit of the feature, it is sufficient to assume MLME + out-of-band transfer of this information. | Rejected – According to Motion#252, the number of participating APs in a Co-SR transmission shall be 2. |
| 2672 | Xiaofei Wang | 37.8.2.2.1 | 72.35 | "shared AP" is not a good term and causes confusions and should be changed. | change to "coordinated AP" | Revised – Agree in principle with the commenter.TGbn Editor:Please implement the changes in this document tagged as #747 |
| 3579 | Malcolm Smith | 37.8.2.2.1 | 72.36 | Only allowing ONE shared AP per CoSR TXOP for the entire PPDU limits the value of this feature to low AP density use cases and has little value in high-density networks (e.g. 4-8 160MHz co-channel APs) especially those with a wide variation in PPDU lengths avaiilable at the time of CoSR scheduling.. Public domain research indicates combining CoTDMA and CoSR for multiple APs per TXOP delivers the best benefits for these scenariios. | CoSR should support CoTDMA with mulltiple APs per TXOP to share spatial and time resources simultaneously. An extension of e.g. CoTDMA with multiple time-aligned sequences of multiple APs or simialr is recommended. | Rejected – According to Motion#252, the number of participating APs in a Co-SR transmission shall be 2. |
| 3784 | Yongho Seok | 37.8.2.2.1 | 72.35 | "The sharing AP transmits a Trigger frame to the shared AP identified by the AP ID carried in the AID12 field of the User Info field of the Trigger frame to initiate the Co-SR transmission."The AP ID is commonly used across all multi-AP schemes. Since this is not specific to Co-SR, please move this section to the part that defines the common protocol among multi-AP features. | As in the comment | Revised – This sentence will be needed in the Trigger frame setting for initiating Co-SR transmission, so it is moved to subclause 37.8.2.2.4 (Co-SR transmission phase)TGbn Editor:Please implement the changes in this document tagged as #3784 |

# Text to be adopted begins here:

**3.2 Definitions specific to IEEE Std 802.11**

**(#747) coordinated spatial reuse coordinating AP:** [Co-SR coordinating AP] A coordinating AP that initiates Co-SR transmission with other APs.

**(#747) coordinated spatial reuse coordinated AP:** [Co-SR coordinated AP] A coordinated AP that participates in Co-SR transmission initiated by the Co-SR coordinating AP.

**37.13 Multi-AP coordination framework**

**37.13.2 Procedures for specific Multi-AP coordination schemes**

**37.13.2.2 Coordinated spatial reuse**

**37.13.2.2.1 General**

The objective of coordinated spatial reuse (Co-SR) is to allow more efficient medium usage by concurrent transmissions (#Editorial)from multiple APs using transmit power control. (#416) The number of participating APs in a Co-SR transmission shall be 2. (#747) (#3784)

(#747) A Co-SR coordinating AP is an AP with dot11CoSROptionImplemented equal to true that obtains a TXOP and initiates Co-SR transmission with another AP. A Co-SR coordinated AP is an AP with dot11CoSROptionImplemented equal to true that participates in Co-SR transmission initiated by the Co-SR coordinating AP. The Co-SR transmission shall be initiated by the Co-SR coordinating AP.

(#1477) An AP shall not initiate Co-SR transmission with another AP unless the two APs have established a MAPC agreement for Co-SR according to the procedure defined in 37.8.2.2.2 (Co-SR negotiation) or by other means outside of the scope of this standard.

(#1477) **37.13.2.2.2 Co-SR negotiation**

A MAPC requesting AP that follows the rules defined in 37.8.1.3 (MAPC agreement negotiation) to establish, update, or tear down a Co-SR agreement with a MAPC responding AP shall additionally follow the rules defined in this subclause. A MAPC responding AP that responds to a MAPC requesting AP in a MAPC agreement negotiation for Co-SR agreement that follows the rules defined in 37.8.1.3 (MAPC agreement negotiation) shall additionally follow the rules defined in this subclause.

In the MAPC Negotiation Request frame and the MAPC Negotiation Response frame, the Co-SR profile shall include one MAPC Scheme Request field that includes the following information:

* (M#429)The minimum transmit power in Co-SR transmission as Co-SR coordinated AP.

**(M#253) 37.13.2.2.3 Co-SR transmission**

(M#253)The Co-SR coordinating AP shall transmit a Co-SR Trigger frame to the Co-SR coordinated AP prior to the two data PPDUs transmitted simultaneously by the Co-SR coordinating and Co-SR coordinated APs. The Co-SR Trigger frame shall include the following information:

* (M#254)The duration of the data PPDU transmitted by the Co-SR coordinating AP and the duration of the data PPDU transmitted by the Co-SR coordinated AP, which shall be the same.
* (M#429)The transmit power limit of the Co-SR coordinated AP. The value of the transmit power limit shall not be lower than the value indicated by the Co-SR coordinated AP in the MAPC Negotiation Request frame or MAPC Negotiation Response frame during the MAPC agreement establishment procedure as defined in 37.8.2.2.2 (Co-SR negotiation).
* (M#429)The transmit power of the Co-SR coordinating AP.

(M#135)(#3784)The Co-SR Trigger frame shall include one User Info field that corresponds to the Co-SR coordinated AP. The User Info field shall be set as follows:

* The AID12 field shall be set to the AP ID of the Co-SR coordinated AP, which is assigned by the Co-SR coordinating AP during the MAPC agreement establishment procedure as defined in 37.8.2.2.2 (Co-SR negotiation).

(M#254)After transmitting the Co-SR Trigger frame, the Co-SR coordinating AP shall transmit a data PPDU where the TXVECTOR parameters shall be set as follows:

* The L\_LENGTH parameter is set to the value indicated in the Co-SR Trigger frame

(M#254)After receiving the Co-SR Trigger frame, the Co-SR coordinated AP shall transmit a data PPDU where the TXVECTOR parameters shall be set as follows:

* The L\_LENGTH parameter is set to the value indicated in the Co-SR Trigger frame
* The TXPWR\_LEVEL\_INDEX parameter is set to a value that leads to a transmit power less than or equal to the transmit power indicated in the Co-SR Trigger frame

**38.3.22 Coordinated spatial reuse38.3.22.1 General**

Co-SR is a technique where multiple APs transmit simultaneously DL MU PPDUs using the mechanism of transmit power control as defined in 37.13.2.2 (Coordinated spatial reuse).

**9.4.2.1 General**

**9.4.2.aa3 MAPC element**

**9.4.2.aa3.2.3 Co-SR profile**

The MAPC Scheme Type field is set to the value for Co-SR as indicated in Table 9-349f (MAPC Scheme Type field values).

The MAPC Info field and the Last MAPC Request field are reserved.

The MAPC Scheme Parameter Set field of the Co-SR profile is defined in Figure 9-aaY.

|  |  |  |
| --- | --- | --- |
|  | B0     B5 | B6     B7 |
|   | Minimum Transmit Power | Reserved |
| Bits:  | 6 | 2 |

Figure 9-aaY— MAPC Scheme Parameter Set field of the Co-SR profile format

The Minimum Transmit Power field indicates the minimum acceptable transmit power of the AP in Co-SR transmission as Co-SR coordinated AP.