IEEE P802.11  
Wireless LANs

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| PDT on Peer-to-Peer Communications (P2P) | | | | |
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Abstract

This document contains Proposed Draft Text (PDT) for the Peer-to-Peer (P2P) communication features of the proposed TGbn (UHR, Ultra High Reliability) amendment to the 802.11 standard.

This version of PDT includes the motions passed in IEEE up to December 19, 2024.

# Revision information

The following is a summary of the important changes that occurred within each revision of this document:

|  |  |
| --- | --- |
| **Revision** | **Major changes** |
| 0 | Initial version: New text in addition to D0.1 |
| 1 | Added CIDs |

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# 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 #184, [1]]

* 11bn enhances existing mechanism(s) to improve latency for a non-AP STA communication with another non-AP STA on the base channel and off-channel, respectively, by
  + enhancing mechanism(s) to allow an AP to share a TXOP with multiple peer-to-peer (P2P) non-AP STAs(s)
  + enhancing the baseline Channel Usage procedure to provide better recommendation on channel selection for P2P by enabling coordination between APs that do not belong to the same ESS so that the channels recommended for P2P operation sent by those APs are the same.

**Note 1:** the coordinated channel recommendation is an optional feature. Also, the responding AP has an option to reject the request for such coordination.

**Note 2:**

* Base channel is the channel where the AP associated with the non-AP STA is operating.
* A channel outside its associated AP’s operating BW is an off-channel for the non-AP STA.

# CC50 Comments:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page.line** | **Comment** | **Proposed Change** | **Resolution** |
| 229 | 37.15.1 | 85.41 | An AP can share a TXOP to multiple P2P non-AP STAs by using one MU-RTS TXS Trigger frame with multiple User Info field, each User Info field corresponding to one non-AP STA. | Allow MU-RTS TXS Trigger frame carry multiple User Info fields, each User Info field correspongding to a (P2P) non-AP STA. The time allocated to each (P2P) non-AP STA indicated in User Info field should not be overlapped. | **Revised**  Agree that we need to define the mechanism to share the TXOP with multiple, i.e., a group of non-AP STAs. The suggested change to add multiple non-AP STAs’ allocation in the trigger frame in a cascading manner will be extremely demanding for the hardware implementation, as it requires very precise timing synchronization. There are also MAC-related challenges, such as handling the scenario where one or multiple non-AP STAs in the chain become non-responsive; aligning the scheduling of these allocations with the P2P traffic arrival, and so on. A more practical approach would be to allocate the TXOP to a group of P2P STAs and let the non-AP STAs in the group decide when they want to access the TXOP for their traffic (i.e., not micro-managing different portions of the same TXOP for the P2P STAs). This procedure is detailed in this document  **TGbn editor, please make changes as marked by CID 3129 proposed in this document 11-25/764r1.** |
| 230 | 37.15.1 | 85.41 | In P2P scenario, if the link quality between one of the P2P pair and AP is poor, or if the P2P non-AP STA is out of the coverage of AP, it may report its buffer status report to peer STA (with high link quality), and then the peer STA reports it to AP for more accurate TXOP sharing. | Define a procedure that allow a non-AP STA reports its BSR to its peer STA, and then the peer STA reports it to AP. | **Rejected**  Agree with the comment that a non-AP STA can share its BSR with its peer in the situation described in the comment. However, this STA-STA communication is implementation dependent and hence, outside the scope of this document. |
| 373 | 37.15 | 85.36 | If one STA fail uplink transmission to AP but still could receive the downlink transmission, this STA may recover the uplink tranmission (assigned to DRU channel with higher transmission power for instance) if this STA could transmit this information to AP in alternal way. | STA1 transmits uplink recover request though P2P to STA2 and STA2 transmits the request though uplink link to AP. After recieved the request, AP could assign STA1 to DRU channel and STA1 can recover the uplink transmision with higher transmission power. The commentor will bring a contribution to address this comment and provide more detialed solutions. |  |
| 849 | 3.2 | 21.24 | The definition of Co-CR should also cover the case when APs belong to the same ESS. Make it consistent with other MAPC schemes. Even though there is already a way to recommend channels within the same ESS using channel usage frames, this Co-CR concept should also cover such case and should be extended to enable giving recommendation of channels over the air. | Delete "that does not belong to the same ESS". | **Accepted**  **TGbn editor, please make changes as marked by CID 849 proposed in this document 11-25/764r1.** |
| 875 | 37.15 | 0.00 | I would like to see MLO in P2P communications. | As in comment. | **Rejected**  We define the procedures in a way that is applicable on a per-link basis and can be applicable to multiple links within an MLD. Any MLO-specific rules (e.g. cross-link signaling) is outside the scope of the current document. |
| 876 | 37.15.2 | 0.00 | Co-CR should also cover the case when APs belong to the same ESS. Make it consistent with other MAPC schemes. Even though there is already a way to recommend channels within the same ESS using channel usage frames, this Co-CR concept should also cover such case and should be extended to enable giving recommendation of channels over the air. | As in comment. | **Accepted**  Agree with the commenter.  **TGbn editor, please make changes as marked by CID 849 proposed in this document 11-25/764r1.** |
| 1671 | 37.15 | 0.00 | P2P communications should cover unavailability coordination between the BSS operation and the P2P operation of the non-AP STA. E.g. a mechanism to announce unavailability within the same TXOP, not just to the AP but also to P2P peers. This can be coordinated by the AP as the TXOP holder. | Enhance as per comment. |  |
| 1743 | 37.15 | 85.44 | It feels strange that only Co-CR is in a separate chapter. | Please move it to a part of the chapter on Multi-AP coordination. |  |
| 1769 | 3.2 | 21.22 | The name "Co-CR" easily cause confusion with "Co-SR", suggest to change to "Co-ChR". | Change to: Co-ChR |  |
| 1997 | 37.15 Peer-to-peer (P2P) communications | 85.36 | Suggest to define a mechanism for trigger-based or scheduled spatial reuse to increase throughput and improve efficient use of the medium in P2P communications | As in comment. | **Rejected**  Although it seems like a good idea, this is outside the scope of the current document. |
| 2078 | 37.15.2 | 85.45 | need to define a trigger frame for P2P Co-SR | same as comment | **Rejected**  Although it seems like a good idea, this is outside the scope of the current document. |
| 2167 | 37.15 | 85.35 | The procedure for P2P(TDLS) set across different BSS is not defined | Define a mechanism to set up P2P(TDLS) across different BSS | **Rejected**  Although it seems like a good idea, this is outside the scope of the current document. |
| 2521 | 37.15.1 | 85.41 | Even when a TXOP is shared among multiple non-AP P2P STAs, they must still undergo channel access contention to communicate. Furthermore, existing TXOP sharing methods do not support nested TXOP sharing, which could help alleviate this issue. These challenges lead to increased delays and inefficient use of channel time during P2P communication. | Allow a leader non-AP STA to manage communication with both the AP and other STAs in the P2P group. This STA may engage in bidirectional communication with the AP and multiple P2P STAs within a TXOP. Additionally, the support for nested TXOP sharing enables the leader to permit other non-AP STAs to perform bidirectional communication. | **Revised**  Agree in principle. A procedure to share a TXOP with a group of P2P STAs in a simplified manner is described.  **TGbn editor, please make changes as marked by CID 3129 proposed in this document 11-25/764r1.** |
| 2573 | 37.15.1 | 85.41 | When a TXOP is shared among multiple non-AP STAs for P2P communication, an efficient channel access method is needed to enable STAs to transmit their data frames or notify the leader of their need to send data. | Designate specific intervals during which STAs can compete for channel access to transmit data frames or report their buffer status. The channel access contention structure should be organized to consider traffic priority. These intervals may be periodic or announced by a leader STA. | **Revised**  Agree in principle. A procedure to share a TXOP with a group of P2P STAs in a simplified manner is described.  **TGbn editor, please make changes as marked by CID 3129 proposed in this document 11-25/764r1.** |
| 3113 | 37.15 | 85.35 | Some TBDs or something are missing from both subsubclauses | As it says in the comment | **Revised**  Agree in principle. A procedure to share a TXOP with a group of P2P STAs in a simplified manner is described.  **TGbn editor, please make changes as marked by CID 3129 and CID 3130 proposed in this document 11-25/764r1.** |
| 3129 | 37.15.1 | 85.38 | Clause 37.15.1 provides high-level objective of TXOP sharing for a set of P2P STAs, but missing the details. | Please provide details for procedures of TXOP sharing with multiple STAs. | **Revised**  Agree in principle. A procedure to share a TXOP with a group of P2P STAs is described in detail.  **TGbn editor, please make changes as marked by CID 3129 proposed in this document 11-25/764r1.** |
| 3130 | 37.15.2 | 85.45 | Clause 37.15.2 provides high-level objective of coordinated channel recommedation (C-CR), but missing the details. | Please provide details for coordinated channel recommendation procedure. | **Revised**  Agree in principle. The missing details are added.  **TGbn editor, please make changes as marked by CID 3130 proposed in this document 11-25/764r1.** |
| 3621 | 37.15.2 | 85.47 | The description of Co-CR is unclear. The goal seems to be providing "better recommendations" on channel selection, but better than what? Also why is converging on the same channel recommendation among the APs 'better' than other methods? | The use cases and goals need to be better described for this mechanism to justify further development of this feature. | **Revised**  “Better” than the baseline case where each BSS announces the P2P channels independently, without any harmonization, leading to a scenario where different APs provide conflicting “safe-heaven” channels for P2P operation. In this document, more clarification and the missing details are added.  **TGbn editor, please make changes as marked by CID 3130 proposed in this document 11-25/764r1.** |

# TXSPG PDT text flow illustration

# 

# Text to be adopted begins here:

### 3.2 Definitions specific to IEEE Std 802.11

**coordinated channel recommendation:** [Co-CR] A procedure that enables an access point (AP) to coordinate with another AP that does not belong to the same ESS to advertise the same channel for peer-to-peer (P2P) communication.

***TGbn editor: Please add the following definition in subclause 3.2 (Definitions specific to IEEE Std 802.11) as follows(#3129):***

Peer-to-peer (P2P) group: A collection of non-AP STAs within which a non-AP STA can communicate with another non-AP STA over a direct link.

37.16 **Peer-to-peer (P2P) communications**

**37.16.1 TXOP sharing for multiple P2P non-AP STAs**

**37.16.1.1 General**

This subclause describes a set of operations that enable an AP to share a TXOP with multiple P2P non-AP STAs.

***TGbn editor: Please add the following paragraphs at the end of subcluase 37.16.1.1 (General) (#3129):***

A non-AP STA that has dot11TXSPGOptionImplemented equal to 1 supports TXOP sharing with a group of P2P non-AP STAs (TXSPG), is called a TXSPG non-AP STA, and shall set the TXSPG Supported field of the UHR MAC Capabilities Information field of the UHR Capabilities element to 1. A UHR AP that has dot11TXSPGOptionImplemented equal to 1 supports TXOP sharing with a group of P2P non-AP STAs, is called a TXSPG AP, and shall set the TXSPG Supported field of the UHR MAC Capabilities Information field of the UHR Capabilities element to 1.

A TXSPG requesting STA is a TXSPG non-AP STA that requests that the associated AP share its TXOP(s) with the P2P group of which the non-AP STA is a member.

***TGbn editor: Please add the following subclauses under subclause 37.16.1 (TXOP sharing for multiple P2P non-AP STAs) as follows (#3129):***

**37.16.1.2 AP behavior**

A UHR AP may allocate time within an obtained TXOP to a P2P group by transmitting an MU-RTS TXS Trigger frame with the following field settings :

* The TXS Mode subfield of the Common Info field shall be set to 3.
* The MU-RTS TXS Trigger frame shall have only one User Info field that is not a Special User Info field.
* The User Info field shall be addressed to an associated TXSPG requesting STA (i.e., the AID12 subfield is set to a value in the range 1 to 2006) that requested TXOP sharing for the P2P group.
* The P2P Group ID subfield of the User Info field shall be set to the P2P group ID of the P2P group
* The time allocated to the P2P group is specified in the Allocation Duration subfield in the MU-RTS TXS Trigger frame.

A UHR AP shall not send an MU-RTS TXS Trigger frame with TXS Mode subfield equal to 3 and with the User Info field addressed to a non-AP STA from which it has not received a UHR Capabilities element with the TXSPG Support subfield equal to 1.

If the UHR AP determines that its transmission of an MU-RTS TXS Trigger frame with the TXS Mode subfield equal to 3 is successful, then the AP shall not transmit any PPDU within the allocated time specified in the MU-RTS TXS Trigger frame unless one of the following conditions are true:

The PPDU carries an immediate response that is solicited by an associated TXSPG non-AP STA that is a member of the P2P group that is identified in the MU-RTS TXS trigger frame.

The AP sets the TXOP Return Support In TXSPG subfield equal to 1 and receives a frame from a TXSPG requesting STA containing a CAS Control field with the RDG/More PPDU subfield equal to 0, in which case the AP may transmit a PPDU SIFS after the frame with a CAS Control field.

**37.16.1.3 Non-AP STA behavior**

If a TXSPG non-AP STA receives an MU-RTS TXS Trigger frame from its associated AP that contains all of the following:

* a Common Info field with the TXS Mode field equal to 3,
* a User Info field addressed to a TXSPG requesting STA of the P2P group in which the non-AP STA is a member,
* the P2P Group ID field of the User Info field set to the P2P group ID of the P2P group of which the non-AP STA is a member,

then the non-AP STA shall transmit a CTS frame a SIFS after the end of the received PPDU carrying the Trigger frame, and may initiate an EDCA backoff procedure with TBD EDCA parameters for the transmission of one or more non-TB PPDUs within the time allocation indicated in the MU-RTS TXS trigger frame. The non-TB PPDUs may be addressed to the AP or to another non-AP STA. The non-AP STA, after sending the CTS frame, shall ignore the intra-BSS NAV either until the end of the time allocation indicated in the MU-RTS TXS Trigger frame or until the allocated time is returned to the TXOP holder, whichever happens earlier.

A TXSPG requesting STA that received an MU-RTS TXS Trigger frame with TXOP Sharing Mode subfield equal to 3 may transmit, within an allocated time, a QoS Data or QoS Null frame that includes an HE variant HT Control field with a CAS Control subfield with the RDG/More PPDU subfield set to 0 to the associated AP from which it has received a UHR Capabilities element with the TXOP Return Support in TXSPG subfield equal to 1 in order to indicate the return of the TXOP back to the AP. Otherwise, the STA shall not transmit such frame to its associated AP within the allocated time.

A TXSPG STA in a P2P group identified by a MU-RTS TXS Trigger frame shall ensure that its PPDU transmission(s) and any expected responses fit entirely within the allocated time for the P2P group.

After sending the CTS solicited by the MU-RTS TXS (Mode-3) Trigger frame, the TXSPG STA in the P2P group addressed by the Trigger frame shall set the Duration/ID field of its following frames(s) to indicate a NAV end time that is no later than the ending time of the PPDU[+SigExt] carrying the MU-RTS TXS Trigger frame plus the allocated time duration in the Allocation Duration field of the soliciting MU-RTS TXS (Mode-3) Trigger frame. Within the time allocated by the MU-RTS TXS Trigger frame, the TXSPG STA in that P2P group may transmit QoS Data frames, Management frames, and frames that assist the transmission of QoS Data and Management frames, e.g., RTS/CTS frames, sounding frames.

**37.16.1.4 SCS Procedure for TXSPG:**

A non-AP STA with dot11TXSPGOptionImplemented equal to true may send an SCS Request frame that contains a QoS Characteristics element whose Direction field is set to 3 (P2P Group) only if both the non-AP STA and the associated UHR AP set the TXSPG Support subfield in the UHR Capabilities element that they transmit to 1. In the SCS Request frame, the non-AP STA may identify one or more other associated non-AP STA(s) that are members of the same P2P group for which the TXOP is requested by including the AID values of the other non-AP STA(s) in the P2P STA AID List field of the transmitted QoS Characteristics element. The AP, if it accepts the SCS request, should facilitate the transmission of P2P frames within the P2P group on the link specified in the LinkID subfield of the Control Info field of the QoS Characteristics element with an interval that falls between the requested minimum and maximum service intervals. Upon acceptance of the SCS request for TXSPG, the AP shall send a TXSPG Provisioning frame to a non-AP STA whose AID12 value is listed in the P2P STA AID List field of the QoS Characteristics element in the SCS Request frame received by the AP. The P2P group ID value indicated in the P2P Group ID field of the P2P element in the TXSPG Provisioning frame shall be set to the same value as the P2P Group ID field in the P2P Group Information field in the QoS Characteristics element in the SCS Response frame transmitted in response to the SCS Request frame. Upon receiving the TXSPG Provisioning frame, the recipient non-AP STA shall send a TXSPG Provisioning Response frame to the AP indicating acceptance or rejection of the TXSPG provisioning indicated by the AP.

**9.4.2.aa2.2 UHR MAC Capabilities Information field**

***TGbn editor: Please update Figure 9-aa5 (UHR MAC Capabilities Information field format) as follows (#3129):***

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 Bx |
|  | DPS Support | DPS Assisting Support | Multi-Link Power Management | NPCA Supported | BSR Enhancement Support | Additional Mapped TID Support | TXSPG Support | TXOP Return Support In TXSPG | Reserved |
| Bits: | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | x |

**Figure 9-aa5 --- UHR MAC Capabilities Information field format**

***TGbn editor: Please insert two new rows in Table 9-130a (Subfields of the UHR MAC Capabilities Information field (continued)) as follows (#3129):***

|  |  |  |
| --- | --- | --- |
| * Subfields of the UHR MAC Capabilities Information field (continued) | | |
| Subfield | Definition | Encoding |
| **…** | **…** | **…** |
| TXSPG | Indicates whether TXSPG operation is supported | Set to 1 to indicate that TXSPG operation is supported.  Set to 0 to indicate that TXSPG operation is not supported. |
| TXOP Return Support In TXSPG | Indicates whether the TXOP return procedure for TXSPG operation is supported | Set to 1 to indicate that TXOP return in TXSPG operation is supported.  Set to 0 to indicate that TXOP return in TXSPG operation is not supported. |

**9.3.1.22.9 MU-RTS Trigger frame format**

***TGbn editor: Please update Table 9-46n (TXS Mode subfield encoding) as follows (#3129):***

**Table 9-46n—TXS Mode subfield encoding**

|  |  |
| --- | --- |
| **TXS Mode subfield value** | **Description** |
| 0 | MU-RTS that does not initiate TXS procedure. |
| 1 | MU-RTS that initiates TXS procedure wherein a scheduled STA can only transmit MPDU(s) addressed to its associated AP. |
| 2 | MU-RTS that initiates TXS procedure wherein a scheduled STA can transmit MPDU(s) addressed to its associated AP or addressed to another STA. |
| 3 | MU-RTS that initiates TXS procedure for a scheduled P2P group identified by this Trigger frame, wherein a non-AP STA member of the identified P2P group can transmit one or more MPDUs to another STA. |

***TGbn editor: Please update Figure 9-98a (HE variant User Info field format in the MU-RTS TXS Trigger***

***frame) as follows (#3129):***



**Figure 9-98a—HE variant User Info field format in the MU-RTS TXS Trigger frame**

***TGbn editor: Please update Figure 9-98b (EHT variant User Info field format in the MU-RTS TXS Trigger frame) as follows (#3129):***



Figure 9-xx7—EHT variant User Info field of MU-RTS TXS Trigger frame

***TGbn editor: Please add the following paragraph at the end of the 9.3.1.22.9 (MU-RTS Trigger frame format) (#3129):***

The P2P Group ID subfield indicates the group ID of the P2P group to which the Trigger frame is addressed for TXOP allocation. The subfield is reserved if the TXOP Mode subfield value is not equal to 3.

**9.4.2.326 QoS Characteristics element**

***TGbn editor: Please update Figure 9-1074bc (QoS Characteristics element format) as follows (#3129):***



**Figure 9-1074bc—QoS Characteristics element format**

***TGbn editor: Please update Table 9-417w (Direction subfield encoding) as follows (#3129):***

**Table 9-417s—Direction subfield encoding**

|  |  |
| --- | --- |
| **Direction** | **Usage** |
| 0 | Uplink, defined as follows:  — MSDUs or A-MSDUs are sent from the non-AP STA to the AP. |
| 1 | Downlink, defined as follows:  — MSDUs or A-MSDUs are sent from the AP to the non-AP STA. |
| 2 | Direct link (MSDUs or A-MSDUs are sent over a peer-to-peer link). |
| 3 | P2P group   * MSDUs or A-MSDUs are sent over peer-to-peer links within the P2P group whose traffic characteristics are described by this element. |

***TGbn editor: Please add the following paragraphs, including the figure, at the end of clause 9.4.2.326 (QoS Characteristics element) (#3129):***

The P2P Group Information field is present if the Direction subfield is set to 3 (P2P group); otherwise, it is not present. The P2P Group Info field format is defined in Figure 9-xx1 (P2P Group Info field format).



Figure 9-xx1—P2P Group Information field format

* The P2P Group ID subfield identifies the P2P group for which the traffic characteristics are described by this element.
* The Number Of P2P STAs subfield indicates the number of the P2P STAs, excluding the STA that sends the QoS Characteristics element, that are members of the P2P group identified by the P2P Group ID subfield and for which traffic characteristics described by this element apply.

The P2P STA AID List field, if present, contains one or more AID12 subfields corresponding to the AID12 values of the STAs that are members of the P2P group and for which the traffic characteristics are described by this element.

* The AID12 subfield is encoded as defined in Table 9-46i (AID12 subfield encoding) and has a value between 1 and 2006.
* The number of AID12 subfields present in the P2P STA AID List field is identified by the Number of P2P STAs field in the P2P Group Info field.
* The remaining bits of the P2P STA AID List till the nearest octet value are reserved.

***TGbn editor: Please add the following subclauses under clause 9.6 (Action frame format details) (#3129):***

**9.6.xx Protected UHR Action frame details**

**9.6.xx.1 Protected UHR Action field**

A Protected UHR Action field, in the octet immediately after the Category field, differentiates the Protected UHR Action frame formats. The Protected UHR Action field values associated with each frame format within the UHR category are defined in Table 9-YYa (Protected UHR Action field values).

**Table 9-YYa—Protected UHR Action field values**

|  |  |  |
| --- | --- | --- |
| **Value** | **Meaning** | **Time priority** |
| 0 | TXSPG Provisioning | No |
| 1 | TXSPG Provisioning Response | No |
| 2–255 |  |  |

**9.6.xx.2 TXSPG Provisioning frame format**

The Action field of the TXSPG Provisioning frame contains the information shown in Table 9-YYb (TXSPG Provisioning frame Action field format).

**Table 9-YYb—TXSPG Provisioning frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 1 | Category |
| 2 | Protected UHR Action |
| 3 | Dialog Token |
| 4 | P2P Element (see [9.4.2.xx1 (P2P](#_bookmark265) [element)](#_bookmark265)) |
| 5 | QoS Characteristics Element (Optional) |

The Category field is defined in 9.4.1.11 (Action field).

The Protected UHR Action field is defined in 9.6.xx.1 (Protected UHR Action field).

The Dialog Token field is defined in 9.4.1.12 (Dialog Token field). The Dialog Token field is set to a nonzero value chosen by the AP sending the TXSPG Provisioning frame to identify the TXSPG Provisioning/TXSPG Provisioning Response frames transaction.

The P2P Element field contains a P2P element, and its format is defined in 9.4.2.xx1 (P2P element).

The QoS Characteristics Element field may contain a QoS Characteristics element, and its format is defined in 9.4.2.326 (QoS Characteristics element)

**9.6.xx.3 TXSPG Provisioning Response frame format**

The Action field of the TXSPG Provisioning Response frame contains the information shown in Table 9-YYc (TXSPG Provisioning Response frame Action field format).

**Table 9-YYc—TXSPG Provisioning Response frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 1 | Category |
| 2 | Protected UHR Action |
| 3 | Dialog Token |
| 4 | Status Code |

The Category field is defined in 9.4.1.11 (Action field).

The Protected UHR Action field is defined in 9.6.xx.1 (Protected UHR Action field).

The Dialog Token field is defined in 9.4.1.12 (Dialog Token field). The Dialog Token field is set to a nonzero value chosen by the non-AP STA sending the TXSPG Provisioning Response frame to identify the TXSPG Provisioning/TXSPG Provisioning Response frames transaction.

The Status Code field is defined in 9.4.1.9 (Status Code field) and is set to the value 0 (SUCCESS) or 143 (DENIED\_TXSPG\_PROVISIONING).

***TGbn editor: Please add the following subclause (9.4.2.xx1 (P2P element))*** ***under clause 9.4.2 (Elements) (#3129):***

**9.4.2.xx1 P2P element**

The format of the P2P element is shown in Figure 9-xx2 (P2P element format).



Figure 9-xx2—P2P element format

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

The format of the Control field is shown in Figure 9-xx3

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 | B1 | B2 B7 |
|  | Group Negotiating STA AID12 Present | Group Negotiating STA MAC Address Present | Reserved |
| Bits: | 1 | 1 | 6 |

Figure 9-xx3—Control field format

The Group Negotiating STA AID12 Present subfield indicates the presence of the Group Negotiating STA AID12 field. If the Group Negotiating STA AID12 Present subfield in the Control Info field is set to 1, then the Group Negotiating STA AID12 field is present in the P2P element; otherwise, this field is not present.

The Group Negotiating STA MAC Address Present subfield indicates the presence of the Group Negotiating STA MAC Address field. If the Group Negotiating STA MAC Address Present subfield in the Control Info field is set to 1, then the Group Negotiating STA MAC Address field is present in the P2P element; otherwise, this field is not present.

The P2P Group Info field format is shown in Figure 9-xx4



Figure 9-xx4—P2P Group Info field format

The P2P Group ID subfield indicates the P2P group ID assigned by the AP for the P2P group whose information is carried by the P2P element.

The Group Negotiating STA AID12 field, if present, indicates the AID12 value of the non-AP STA that performed the TXSPG negotiation with the AP for the P2P group identified by the P2P Group ID subfield.

The Group Negotiating STA MAC Address field, if present, indicates the MAC Address of the non-AP STA that performed the TXSPG negotiation with the AP for the P2P group identified by the P2P Group ID subfield.

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Coordinated Channel Recommendation (Co-CR)\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**37.16.2 Coordinated channel recommendation (Co-CR)**

**37.16.2.1 General**

This subclause describes a mechanism for better recommendations on channel selection for P2P communication by enabling coordination among APs (**#849**) so that the channels recommended for P2P operation sent by those APs are the same. The procedure is optional for an AP to support, and an AP that supports the procedure may reject a request from another AP to perform Co-CR.

***TGbn editor: Please add the following paragraphs under subclause 37.16.2.1 (General) as follows (#3130):***

A Co-CR requesting AP is an AP with dot11CoCROptionImplemented equal to true that requests another AP for coordination on channel recommendation to facilitate P2P communication.

A Co-CR coordinated AP is an AP with dot11CoCROptionImplemented equal to true that responds to the request for coordination from the Co-CR requesting AP.

The Co-CR negotiation(s) between two APs to establish Co-CR agreement(s) are performed by following the rules described in clause 37.8 (Multi-AP coordination framework) and clause 37.16.2.2 (Co-CR negotiations).

***TGbn editor: Please add the following subclause 37.16.2.2 (Co-CR negotiations) under clause 37.16.2 (Coordinated Channel Recommendation (Co-CR)) (#3130):***

**37.16.2.2 Co-CR negotiations**

The Co-CR requesting AP shall include a Co-CR subelement in the Negotiation Multi-AP element carried in a transmitted individually addressed Multi-AP Negotiation Request frame. The Co-CR subelement shall include one or more Co-CR Parameter Set fields, where each Co-CR parameter set describes a particular set of channel recommendation parameters.

A Co-CR requesting AP that requests to establish a new Co-CR agreement shall set the Co-CR Setup Command field value to 0 (Request Co-CR) in the corresponding Co-CR Parameter Set field and include the suggested Co-CR recommended parameters in the parameter set field.

A Co-CR responding AP that receives a Co-CR agreement setup request from a Co-CR requesting AP and intends to indicate acceptance of the request shall send a Negotiation Multi-AP element carried in a transmitted individually addressed Multi-AP Negotiation Response frame, where the Multi-AP element shall carry a Co-CR subelement containing a corresponding Co-CR parameter set field with the Co-CR Setup Command field value set to 3 (Accept Co-CR). After the successful transmission of the Multi-AP Negotiation Response frame, a Co-CR agreement corresponding to the Co-CR parameter set is established between the Co-CR requesting AP and the Co-CR coordinated AP.

A Co-CR responding AP that receives a Co-CR agreement setup request from a Co-CR requesting AP and intends to indicate rejection of the request shall send a Negotiation Multi-AP element carried in a transmitted individually addressed Multi-AP Negotiation Response frame, where the Multi-AP element shall carry a Co-CR subelement containing a corresponding Co-CR parameter set field with the Co-CR Setup Command field value set to 5 (Reject Co-CR).

A Co-CR responding AP that receives a Co-CR agreement setup request from a Co-CR requesting AP and suggests an alternative set of Co-CR parameters shall send a Negotiation Multi-AP element carried in a transmitted individually addressed Multi-AP Negotiation Request frame, where the Multi-AP element shall carry a Co-CR subelement containing a corresponding Co-CR parameter set field with the Co-CR Setup Command field value set to 4 (Alternate Co-CR).

A Co-CR requesting AP or a Co-CR responding AP that intends to terminate an existing Co-CR agreement shall send a Multi-AP Negotiation Request frame with a Negotiation Multi-AP element included in the Request frame. The Negotiation Multi-AP element shall include a Co-CR Parameter Set field with the Co-CR Agreement ID field identifying the Co-CR agreement that is to be terminated. The Co-CR Setup Command field of the Co-CR Parameter Set field shall be set to the value 2 (Teardown Co-CR). After the successful transmission of the Multi-AP Negotiation Request frame, the Co-CR agreement corresponding to the Co-CR Agreement ID is terminated.

In a Co-CR Parameter Set field that includes a Co-CR Setup Command field value 2 (Teardown Co-CR) or 5 (Reject Co-CR) or 3 (Accept Co-CR), the Operating Class and Channel field shall be reserved, and the Recommendation Periods Information field and the Recommendation Timeout field shall not be present in the Co-CR Parameter Set field.

A Co-CR requesting AP or a Co-CR responding AP that intends to modify an existing Co-CR agreement shall send a Multi-AP Negotiation Request frame with a Negotiation Multi-AP element included in the Request frame. The Negotiation Multi-AP element shall include a Co-CR Parameter Set field with the Co-CR Agreement ID field identifying the Co-CR agreement that is to be modified. The Co-CR Setup Command field of the Co-CR Parameter Set field shall be set to the value 1 (Modify Co-CR). The Operating Class and Channel field, Recommendation Periods Information field (if present), and the Recommendation Timeout field (if present) shall indicate the suggested new set of Co-CR parameters that would replace the existing Co-CR agreement. After the successful reception of the Multi-AP Negotiation Request frame, the recipient AP may respond by sending a Multi-AP Negotiation Response frame that includes a Negotiation Multi-AP element including a Co-CR subelement with the Co-CR Setup Command field value set to either 3 (Accept Co-CR), or 4 (Alternate Co-CR), or 5 (Reject Co-CR).

The Operating Class and Channel field in a Co-CR subelement indicate the suggested operating class and the channel that the transmitting AP recommends for P2P operation.

The Recommendation Periods Information field (if present) indicates a set of parameters that describe a series of time windows during which the channel recommendation indicated by the Operating Class and Channel field is valid. The absence of the Recommendation Periods Information field in the Co-CR Parameter Set field indicates that the corresponding Co-CR channel recommendation is valid at all time instances until the agreement is torn down.

The Recommendation Timeout field indicates the time until when the channel recommendation corresponding to Co-CR Parameter Set field is valid. The absence of this field in the Co-CR Parameter Set field indicates that the recommendation is valid until the agreement is torn down.

An AP can include an Extended Channel Usage Element in its Beacon, Probe Response, and (Re) Association Response frame in order to advertise different sets of channels that can be deemed as conducive for peer-to-peer communication. Each recommended channel information can be included in a Channel Usage Parameter Set field of the Extended Channel Usage element. In the corresponding Channel Usage Parameter Set field, the AP can also include a Recommendation Periods Information field indicating a series of time windows during which the channel recommendation identified by this channel usage parameter set is applicable. In the corresponding Channel Usage Parameter Set field, the AP may also contain a Recommendation Timeout Information field indicating the time when the channel recommendation identified by this parameter set field expires. If the Recommendation Periods Information field is not present in the channel usage parameter set, then it means that the channel recommendation identified by this parameter set is applicable at all time (until the recommendation is ended). If the Recommendation Timeout Information field is not present in the channel usage parameter set, then it means that the channel recommendation identified by the parameter set is valid until the recommendation is ended (e.g., until the time when that channel usage parameter set fields are no longer carried in the extended channel usage element)

***TGbn editor: Please change all instances of “MAPC” to “Multi-AP” in clause 9 (#3130).***

***TGbn editor: Please add the following paragraphs under subclause 9.4.2.aa3 (MAPC element) as follows (#3130)***

The format of the Multi-AP Capabilities field is shown in Figure 9-xx-E.

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B4 | B5 | B6 B7 |
|  | Reserved | Co-CR Supported | Reserved |
| Bits: | 5 | 1 | 2 |

**Figure 9-xx-E—Multi-AP Capabilities field format**

The Co-CR Supported subfield indicates whether or not the Co-CR operation is supported. If the subfield is set to 1, then the Co-CR operation is supported by the transmitting AP; otherwise, it is not supported.

The Scheme Info field in the Multi-AP element contains one or more multi-AP scheme-specific subelements. The encoding of the scheme-specific subelement is shown in Table 9-yyC.

**Table 9-yy-C—** **Subelement IDs of the Multi-AP Scheme subelement**

|  |  |  |
| --- | --- | --- |
| **Subelement ID** | **Name** | **Extensible** |
| 0-3 | Reserved | Yes |
| 4 | Co-CR | Yes |
| 5-255 | Reserved |  |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*

***TGbn editor: Please add the following subclause 9.4.2.xxA (Co-CR Subelement)under the clause 9.4.2 (MAPC element) (#3130)***

9.4.2.xxA (Co-CR Subelement)

The Co-CR subelement format of the Multi-AP element is shown in Figure 9-xx-F.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Subelement ID | Length | Co-CR Parameter Sets |
| Octets: | 1 | 1 | variable |

**Figure 9-xx-F—Co-CR subelement format of Multi-AP element**

The Subelement ID field is defined in Table 9-K2 (Subelement IDs of the Multi-AP Scheme subelement).

The CoCR Parameter Sets field may include one or more Co-CR Parameter Sets. The format of the Co-CR Parameter Set is shown in Figure 9-xx-G (Co-CR Parameter Set field format).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Control | Operating Class and Channel | Recommendation Periods Information | Recommendation Timeout |
| Octets: | 2 | 2 | 0 or 6 | 0 or 4 |

**Figure 9-xx-G—Co-CR Parameter Set field format**

The Control field format of the Co-CR Parameter Set field is shown in Figure 9-xx-H.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Co-CR Setup Command | Co-CR Agreement ID | Recommendation Periods Info Present | Recommendation Timeout Info Present | Reserved |
| Bits: | 3 | 5 | 1 | 1 | 6 |

**Figure 9-xx-H—Control field format of the Co-CR Parameter Set field**

The Co-CR Setup Command subfield values indicate the type of Co-CR negotiation command. The encoding of this subfield is shown in Table 9-yy-D (Co-CR Setup Command field encoding).

**Table 9-yy-D (Co-CR Setup Command field encoding)**

|  |  |  |
| --- | --- | --- |
| **Co-CR Setup Command field value** | **Co-CR Setup Command name** | **Description** |
| 0 | Request Co-CR | A Co-CR Requesting AP requests to establish a Co-CR agreement channel recommendation parameter included in the Co-CR parameter set field. |
| 1 | Modify Co-CR | A Co-CR Requesting AP or a Co-CR coordinated AP requests to update the parameters of an existing Co-CR agreement identified by the Co-CR Agreement ID field of the Co-CR Parameter Set field. |
| 2 | Teardown Co-CR | A Co-CR Requesting AP or a Co-CR coordinated AP tears down an existing Co-CR agreement identified by the Co-CR Agreement ID field of the Co-CR Parameter Set field. |
| 3 | Accept Co-CR | A Co-CR coordinated AP accepts the request from the Co-CR requesting AP to establish a Co-CR agreement between the two APs. |
| 4 | Alternate Co-CR | A Co-CR coordinated AP rejects the request from the Co-CR requesting AP to establish a Co-CR agreement and suggests an alternative set of Co-CR recommendation parameters. If the Co-CR requesting AP resends the Co-CR request with the suggested set of parameters, the request is likely to be accepted by the Co-CR coordinated AP. |
| 5 | Reject Co-CR | A Co-CR coordinated AP rejects the request from the Co-CR requesting AP to establish a Co-CR agreement. |
| 6-7 | Reserved |  |

The Co-CR Agreement ID field contains an integer identifying a specific Co-CR agreement. The values 0 and 31 of this field are reserved.

The Recommendation Periods Info Present subfield in the Control field indicates whether or not the Recommendation Periods Information field is present in the Co-CR Parameter Set field. If the subfield is set to 1, then the Recommendation Periods Information field is present in the Co-CR Parameter Set field; otherwise, it is not present.

The Recommendation Timeout Info Present subfield in the Control field indicates whether or not the Recommendation Timeout field is present in the Co-CR Parameter Set field. If the subfield is set to 1, then the Recommendation Periods Information field is present in the Co-CR Parameter Set field; otherwise, it is not present.

The Operating Class and Channel field is defined in 9.4.1.22 (Operating Class and Channel field).

The Recommendation Periods Information field describes a series of time windows during which the channel recommendation identified by this parameter set applies. The format of the Recommendation Periods Information field is shown in Figure 9-xx-I.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Recommendation Start Time | Recommendation SP Duration | Recommendation Interval Mantissa | Recommendation Interval Exponent |
| Octets: | 2 | 1 | 2 | 1 |

**Figure 9-xx-I—Recommendation Periods Info field format**

# The Recommendation Start Time field contains a positive unsigned integer corresponding to the TSF value of the Co-CR requesting AP indicating the start time of the first Co-CR recommendation service period (SP) in the series of SPs described by this Co-CR Parameter Set field. The lowest bit of the Recommendation Start Time field is set to bit 10 of the corresponding TSF value Co-CR requesting AP.

The Recommendation SP Duration field indicates the duration of time, in units of TU, during which the Co-CR channel recommendation applies.

The Recommendation Interval Mantissa subfield is set to the value of the mantissa of the Recommendation SP interval value in microsecond, base 2.

The Recommendation Interval Exponent subfield is set to the value of the exponent of the Recommendation SP interval value in microsecond, base 2.

The Recommendation Timeout field contains an unsigned 32-bit integer, indicating the lifetime of the channel recommendation, in units of TUs.

***TGbn editor: Please add the following subclause 9.4.2.xx-B (Extended Channel Usage element) under clause under clause 9.4.2 (Elements) (#3130):***

**9.4.2.xx-B Extended Channel Usage element:**

The format of the Extended Channel Usage element is shown in Figure 9-xx-J.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Element ID | Length | Element ID Extension | Channel Usage Parameter Sets |
| Octets: | 1 | 1 | 1 | variable |

**Figure 9-xx-J—Extended Channel Usage element format**

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

The Channel Usage Parameter Sets field in the Extended Channel Usage element may contain one or more Channel Usage Parameter Set field(s). The format of the Channel Usage Parameter Set field is shown in Figure 9-xx-K.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Usage Mode | Operating Class and Channel | Presence Indicator | Recommendation Periods Information | Recommendation Timeout |
| Octets: | 1 | 2 | 1 | 0 or 6 | 0 or 4 |

**Figure 9-xx-K—Channel Usage Parameter Set field format**

The encoding of the Usage Mode field in the Channel Usage Parameter Set field is shown in Table 9-yy-E.

|  |  |
| --- | --- |
| Table 9-yy-E—Usage Mode field encoding | |
| Value | Usage Mode |
| 0 | Channel-usage-aidable BSS |
| 1 | Off-channel TDLS direct link |
| 2 | Channel-usage-aidable BSS in which none of the channel-usage-aiding BSSs that belong to the same ESS operate on the channels identified by the Channel Entry field |
| 3 | Unavailability indication |
| 4 | Channel-usage-aidable BSS channel switch request |
| 5 | Capability notification |
| 6 | Channel-usage-aidable BSS that has coordinated with one or more neighboring BSS in providing the channel recommendation identified by the Operating Class and Channel field of the corresponding Channel Usage Parameter Set field. |
| 7–254 | Reserved |
| 255 | Unknown request |

The Operating Class and Channel field is defined in 9.4.1.22 (Operating Class and Channel field).

The Presence Indicator field format of the Channel Usage Parameter Set field is shown in Figure 9-xx-L.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Recommendation Periods Info Present | Recommendation Timeout Info Present | Reserved |
| Bits: | 1 | 1 | 6 |

**Figure 9-xx-L—Presence Indicator field**

The Recommendation Periods Info Present subfield in the Presence Indicator field indicates whether or not the Recommendation Periods Information field is present in the corresponding Channel Usage Parameter Set field. If the subfield is set to 1, then the Recommendation Periods Information field is present in the Channel Usage Parameter Set; otherwise, it is not present.

The Recommendation Timeout Info Present subfield indicates whether or not the Recommendation Timeout field is present in the Channel Usage Parameter Set field. If the subfield is set to 1, then the Recommendation Timeout field is present in the corresponding Channel Usage Parameter Set; otherwise, it is not present.

The Recommendation Periods Information field describes a series of time windows during which the channel recommendation identified by this parameter set applies. The format of the Recommendation Periods Information field is shown in Figure 9-xx-M.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Recommendation Start Time | Recommendation SP Duration | Recommendation Interval Mantissa | Recommendation Interval Exponent |
| Octets: | 2 | 1 | 2 | 1 |

**Figure 9-xx-M—Recommendation Periods Information field format**

# The Recommendation Start Time field contains a positive unsigned integer corresponding to the TSF value of the AP advertising this element indicating the start time of the first service period (SP) in the series of SPs described by this Extended Channel Usage element. The lowest bit of the Recommendation Start Time field is set to bit 10 of the corresponding TSF value of the advertising AP.

The Recommendation SP Duration field indicates the duration of time, in units of TU, during which the channel recommendation advertised by this channel usage parameter set applies.

The Recommendation Interval Mantissa subfield is set to the value of the mantissa of the Recommendation SP interval value in microsecond, base 2.

The Recommendation Interval Exponent subfield is set to the value of the exponent of the Recommendation SP interval value in microsecond, base 2.

The Recommendation Timeout field in the Channel Usage Parameter Set field contains an unsigned 32-bit integer, indicating the lifetime of the channel recommendation, in units of TUs.

# Text to be adopted ends here.

**References:**

1. [11-24/171r26](https://mentor.ieee.org/802.11/dcn/24/11-24-0171-26-00bn-tgbn-motions-list-part-1.pptx): 11-24-0171-21-00bn-tgbn-motions-list-part-1, Alfred Asterjadhi (Qualcomm Inc.)