IEEE P802.11  
Wireless LANs

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| Detailed Text Proposal on coexistence mechanisms for TGbn and related ICF-ICR | | | | |
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Introduction

The authors prepared this document to describe in more details the coexistence feature, as well as on ICF-ICR design, on the basis of the agreed motions.

The authors look forward to working with all interested participants to prepare an official proposal for specification text on the topic of coexistence.

This document is based on the following SFD agreements related to coexistence mechanisms topic:

* 11bn defines a mechanism for a non-AP STA to report unavailability at TXOP level and define or reuse/update existing mechanism for a non-AP STA to report long term (periodic) unavailability.
* A non-AP STA that is a TXOP responder can indicate in a response frame 1) for how long it will be available, if known and/or 2) whether it will be unavailable after a specific point in time and, if known, for how long
  + the response frame is a multi-STA BlockAck frame sent by the non-AP STA in response to the initial control frame or to MPDUs that solicit an immediate response
* Define a mechanism so that a non-AP STA as a TXOP holder can indicate in a BSRP as the ICF frame 1) for how long it will be available, if known and/or 2) whether it will be unavailable after a specific point in time and, if known, for how long
  + There are conditions under which such a BSRP can be sent, and those conditions are TBD.
* TGbn defines a mechanism that allows a STA to provide an update to its peer STA of specific operational Tx/Rx parameters using management frame exchanges (which parameters is TBD, focusing generally on local constraints (for example, coexistence constraints))
* The parameter update mechanism, done using management frame exchanges, allows a non-AP STA to transition in/out of a limited operation/capability mode
  + A STA in limited operation/capability mode changes one or more of the following TX/RX parameters: Maximum PPDU duration, Maximum MCS, use of LDPC, use of HT-immediate BlockAck, Disabled Subchannel bitmap, etc.
  + Optional/mandatory TBD
* TGbn uses Multi-STA BA for Initial Control Response frame (ICR) for DL and UL, at least when carrying the unavailability information
* TGbn uses BSRP Trigger frame as a UHR Initial Control frame (ICF) sent:
  + From an AP for soliciting response in TB PPDU format from one or more scheduled STAs to allow a Multi-STA BA frame to be included in the TB PPDU sent by the UHR scheduled STAs in response, when carrying unavailability information
    - BSRP Trigger frame follows baseline rules for the solicited TB PPDU
* TGbn defines the following fields for unavailability indication in M-STA BA frames:
  + an Unavailability Target Start Time field defined as the TSF time at which the STA becomes unavailable (range and resolution TBD, expectation is to use a portion of the TSF)
  + an Unavailability Duration field defined as the time during which the STA is unavailable (field may be not present or set to an unknown value)
* TGbn defines a special Feedback Per AID TID Info field (name TBD) that carries control feedback in the Multi-STA BA frame
  + The control feedback (i.e., unavailability indication) is carried instead of the BlockAck Bitmap in that Feedback Per AID TID Info field
  + The Ack Type subfield of the Per AID TID Info field is set to 0 and the TID subfield of the Per AID TID Info field is set to a reserved value
  + The AID11 subfield of this Per AID TID Info field is set to a reserved TBD value if the control feedback is addressed to all STAs or to the AID11 that identifies the intended recipient STA
  + The Starting Sequence Number field of this Per AID TID Info field is reserved
* TGbn defines the following:
  + Unavailability Target Start Time is indicated using 9 bits with a granularity of 64us
  + Unavailability Duration is indicated using 9 bits with a granularity of 64us
* The AP maintains up to one dynamic unavailability report per STA
  + And the most recent dynamic unavailability report is the valid one
* 11bn allows Multi-STA BA to carry one or more feedback (e.g. unavailability) information
  + How to include feedback information is TBD.
* An individually addressed BSRP Trigger, used as an ICF, can indicate whether the responding PPDU is a non-HT (duplicate) PPDU and contains a multi-STA BA?
  + The indication (TBD whether reserved value or a reserved bit) is carried in the Common Info field of the BSRP Trigger frame
* A non-AP STA can request its associated AP to initiate TXOPs/frame exchanges with the STA with an initial control frame that enables the non-AP STA to include unavailability feedback in the initial response frame.
* Periodic unavailability announcements from a non-AP STA are performed in UHR by enhancing the P2P TWT mechanism.
* Scheduled periodic power save on AP side is performed in UHR using Broadcast TWT with TWT ID=0 with Responder PM=1 as described in 26.8.3.2 Rules for TWT scheduling AP
* TGbn defines or reuses/updates existing mechanism for a UHR AP to report long term (periodic) unavailability
  + Applies when non-AP STA(s) support the mechanism

Some relevant IEEE contributions:

<https://mentor.ieee.org/802.11/dcn/23/11-23-2002-02-00bn-in-device-coexistence-and-interference-follow-up.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-0094-00-00bn-probe-before-talk-and-unsolicited-unavailability-announcement-for-co-ex-management.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-1226-00-00bn-icf-icr-design.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-1227-01-00bn-some-usage-of-intermediate-fcs.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-1887-00-00bn-bsrp-tf-response-rules-changes-for-m-ba.pptx>

<https://mentor.ieee.org/802.11/dcn/23/11-23-1934-00-00bn-in-device-interference-mitigation-follow-up.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-0857-01-00bn-icr-consideration.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-1562-02-00bn-in-device-coexistence-follow-up.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-1221-03-00bn-icf-icr-follow-up.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-1558-02-00bn-in-device-coexistence-follow-up.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-0543-01-00bn-coexistence-protocols-for-uhr-follow-up.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-1559-01-00bn-in-device-coexistence-next-steps.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-1550-01-00bn-in-device-coexistence-follow-up.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-1247-00-00bn-icf-icr-design-for-coex.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-1460-00-00bn-extension-of-txop-level-idc-to-mlo.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-1170-00-00bn-further-considerations-on-in-device-coexistence.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-0834-01-00bn-some-details-on-in-device-coexistence.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-1490-01-00bn-more-consideration-of-icr-crf-for-in-device-coexistence.pptx>

<https://mentor.ieee.org/802.11/dcn/24/11-24-0831-02-00bn-periodic-idc-use-cases-and-considerations-for-signaling.pptx>

**9.3.1.8 BlockAck frame format**

**9.3.1.8.6 Multi-STA BlockAck variant**

***change subclause 9.3.1.8.6 as follows***

……

The AID11 subfield carries the 11 LSBs of the AID of the non-AP STA for which the Per AID TID Info subfield is intended. The format of the Per AID TID Info subfield depends on the value of the AID11 subfield. If the Multi-STA BlockAck frame is sent to an AP, the AID11 subfield is set to 0. A value of 2045 in the AID11 subfield is used as an identifier for any unassociated STA. If the AID11 subfield is set to 2045, then the Ack Type subfield and TID subfield are set to 0 and 15, respectively. A value of 2008 in the AID11 subfield is used as the identifier for carrying the feedback (i.e. unavailablity information) that applies to all receiving UHR STAs.

NOTE 1—More than one Per AID TID Info subfield with the same value in the AID11 subfield but different values in the TID subfield can be present in the Multi-STA BlockAck frame.

If the AID11 subfield of the AID TID Info subfield is not 2045, then the Per AID TID Info subfield has the format shown in Figure 9-60 (Per AID TID Info subfield format if the AID11 subfield is not 2045(11ax)).

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  | AID TID Info | Block Ack Starting Sequence Control | Block Ack Bitmap |
| Octets: | 2 | 0 or 2 | 0, 4, 8, 16 or 32 |
| Figure 9-60 Per AID TID Info subfield format if the AID11 subfield is not 2045 | | | |

If the AID11 subfield is not 2045, then the context and the presence of each optional subfield in a Per AID TID Info subfield in a Multi-STA BlockAck frame is defined in Table 9-39 (Context of the Per AID TID Info subfield and presence of optional subfields if the AID11 subfield is not 2045(11ax)).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| * Context of the Per AID TID Info subfield and presence of optional subfields if the AID11 subfield is not 2045(11ax) | | | | |
| Ack Type subfield values | | TID subfield values | Presence of Block Ack Starting Sequence Control subfield Block Ack Bitmap subfields | Context of a Per AID TID Info subfield in a  Multi-STA BlockAck frame |
| 0 | | 0–7 | Present | Block acknowledgment context:  Sent as an acknowledgment to QoS Data frames that solicit a BlockAck frame response or to a BlockAckReq frame. |
| 1 | | 0–7 | Not present | Acknowledgment context:  Sent as an acknowledgment to a QoS Data or QoS Null frame that solicits an Ack frame response. |
| 1 | | 13 | N/A | Reserved |
| 0 or 1 | | 8–1~~3~~2 | N/A | Reserved |
| 0 | | 13 | Present | Feedback context:  Sent as a feedback of unavailability |
| 0 | | 14 | N/A | Reserved |
| 1 | | 14 | Not present | All ack context:  Sent as an acknowledgment to an A-MPDU that contains an MPDU that solicits an immediate response and all MPDUs contained in the A-MPDU are received successfully. |
| 0 | | 15 | N/A | Reserved |
| 1 | | 15 | Not present | Management/PS-Poll frame acknowledgment context:  Sent as an acknowledgment to a Management or PS-Poll frame. |
| NOTE 1—Additional rules for acknowledgment, block acknowledgment and the all ack context are defined in 26.4.2 (Acknowledgment context in a Multi-STA BlockAck frame) for a multi-TID A-MPDU.  NOTE 2—As HE STAs do not use HCCA (see 10.23.1 (General)), TID values from 8 to 15 are not used in QoS Data frames. | | | | |

If the Ack Type subfield is 0, the Fragment Number subfield encoding indicates the length of the BlockAck bitmap subfield and the Feedback subfield as defined in Table 9-40 (Fragment Number subfield encoding for the Multi-STA BlockAck variant (11ax)).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| * Fragment Number subfield encoding for the  Multi-STA BlockAck variant (11ax) | | | | | |
| Fragment Number subfield | | | Fragmentation level 3  (ON/OFF) | Block Ack Bitmap and Feedback subfield length  (octets) | Maximum number of MSDUs/A-MSDUs that can be acknowledged |
| B3 | B2–B1 | B0 |
| 0 | 0 | 0 | OFF | 8 | 64 |
| 0 | 1 | 0 | 16 | 128 |
| 0 | 2 | 0 | 32 | 256 |
| 0 | 3 | 0 | 4 | 32 |
| 0 | 0 | 1 | ON | 8 | 16 |
| 0 | 1 | 1 | 16 | 32 |
| 0 | 2 | 1 | 32 | 64 |
| 0 | 3 | 1 | 4 | 8 |
| 1 | Any | Any |  | Reserved | Reserved |
| NOTE—A Multi-STA BlockAck frame with B0 of the Fragment Number subfield set to 1 cannot be sent to an HE STA, unless the HE Capabilities element received from the HE STA has the Dynamic Fragmentation Support subfield equal to 3 (see 26.3 (Fragmentation and defragmentation)). | | | | | |

If a Per AID TID Info field that has the Ack Type subfield set to 0 and the TID subfield equal to 13 then:

* It includes Feedback information instead of Acknowledgement status (see Table 9-39 (Context of the Per AID TID Info subfield and presence of optional subfields if the AID11 subfield is not 2045)
* The AID11 subfield of the AID TID Info subfield is set to the AID of a UHR STA that is the intended receiver of the feedback information or to 2008 if the feedback information is intended to all receiving UHR STAs.
* The Block Ack Bitmap subfield is a Feedback subfield that has the same length as the Block Ack Bitmap subfield and that has the format defined in Figure 9-xx (Feedback subfield format). The Unavailability Target Start Time subfield indicates the start time in TSF[15:7] when the STA transmitting the Multi-STA BA becomes unavailable. The Unavailablity Duration subfield indicates the duration in unit of 64 us when the STA transmitting the Multi-STA BA is not available. The Unavailablity Duration subfield with value TBD indicates the unknown unavailable duration.

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B8 | B9 B17 | B18 B31 |
|  | Unavailability Target Start Time | Unavailability Duration | Reserved |
| bits: | 9 | 9 | 14 (variable) |
| Figure 9-xx----Feedback subfield format | | | |

***change subclause 9.7.3 as follows***

**9.7.3 A-MPDU contents**

|  |  |  |
| --- | --- | --- |
| **Table 9-660—A-MPDU contexts** | | |
| **Name of Context** | **Definition of Context** | **Table defining**  **permitted contents** |
| Control Response | The A-MPDU is transmitted by a STA that is neither a TXOP  holder nor an RD responder, (11ax) or the A-MPDU is  transmitted by an HE AP in response to an HE TB PPDU, and the transmitter also needs to transmit one of the following  immediate response frames:  — Ack frame  — BlockAck frame with a TID for which an HT-immediate  block ack agreement exists  — Multi-STA BlockAck frame for acknowledging multi-TID A-MPDU(11ax) or reporting unavailability feedback | Table 9-663 (A-MPDU contents in the control response context) |

|  |  |  |
| --- | --- | --- |
| **Table****9-663 — A-MPDU contents in the control response context** | | |
| **MPDU** | **Conditions** | |
| Ack | Ack frame transmitted in response to an MPDU that requires an Ack frame. | (11ax)One of Ack and compressed BlockAck frame is present at the start of the A-MPDU between two STAs that are not both HE STAs; these are not present other than at the start of the A-MPDU.  (11ax)One of Ack, Compressed BlockAck, and Multi-STA BlockAck frame is present at the start of the A-MPDU between two HE STAs; these are not present other than at the start of the A-MPDU. |
| BlockAck | (11ax)Compressed BlockAck frame with a TID that corresponds to an HT-immediate block ack agreement. See NOTE. (11ay)  (11ax)Multi-STA BlockAck frame if the preceding PPDU is ~~either~~ an HE TB PPDU that solicits an immediate response (see 26.4.4.5 (Responding to an HE TB PPDU with an SU PPDU)) or an HE PPDU that carries a multi-TID A-MPDU or ack-enabled multi-TID A-MPDU (see 26.6.3 (Multi-TID A-MPDU and ack-enabled single-TID A-MPDU))~~.~~, or if the preceding PPDU carries an individually addressed BSRP Trigger frame with the GI And HE/EHT/UHR-LTF Type subfieldset to 3(see 9.3.1.22.2 Common Info field) |
| EDMG Multi-TID BlockAck (11ay) | If the preceding PPDU that carried a multi-TID A-MPDU contains an implicit or explicit block ack requests for multiple TIDs for which an HT-immediate block ack agreement exists, one or several copies of the same EDMG Multi-TID BlockAck frame. (11ay) |
| Action No Ack | (11ax)In an A-MPDU between two STAs that are not both HE STAs:  BRP +HTC frames.  Action No Ack +HTC frames containing an explicit feedback response.  Action No Ack frames that are Flow Suspension frames or Flow Resumption frames.  (11ax)In an A-MPDU between two HE STAs: Action No Ack frames. |  |
| (11ax)QoS Null frame with No Ack ack policy | If sent to an HE STA. QoS Null frames with No Ack ack policy.  If solicited by an UHR AP’s BSRP as ICF that allows inclusion of unavailability feedback then an additional Multi-STA BlockAck frame is allowed. |  |
| NOTE—This condition is applicable for BlockAck variants established by block ack agreements and is not applicable for the EDMG Multi-TID BlockAck where the condition depends on a preceding PPDU. (11ay) |  |  |

**9.3.1.22 Trigger frame format**

**9.3.1.22.1 General**

**9.3.1.22.2 Common Info field**

***add the following text at the end of subclause 9.3.1.22.2***

The UHR variant Common Info field is defined in [Figure 9-xx (UHR variant Common Info field](#_bookmark63) [format)](#_bookmark63).

B0 B3 B4 B15 B16 B17 B18 B19 B20 B21 B22 B23 B25

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Trigger Type | UL  Length | More TF | CS  Required | UL BW | GI And HE/ EHT-LTF/UHR-LTF Type/ TXS Mode | Reserved | Number Of HE/ EHT-LTF/UHR-LTF  Symbols |

Bits: 4 12 1 1 2 2 1 3

B26 B27 B28 B33 B34 B35 B36 B37 B52 B53 B54

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reserved | LDPC Extra Symbol Segment | AP Tx  Power | Pre-FEC  Padding Factor | PE  Disambiguity | UL Spatial Reuse | Reserved | HE/EHT P160 |

Bits: 1 1 6 2 1 16 1 1

B55 B56 B59 B60 B61 B62 B63

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Special User Info Field Flag | UHR Reserved | IFCS Present | TF Protection | Key ID | Reserved | Trigger Dependent Common Info |

Bits: 1 4 1 1 1 1 Variable

**Figure 9-xx—UHR variant Common Info field format**

***add the following text***

**Table 9-xx—GI And HE/EHT/UHR-LTF Type subfield encoding**

|  |  |
| --- | --- |
| **GI And HE/EHT/UHR-LTF Type subfield value** | Description |
| 0 | 1Χ HE/EHT/UHR-LTF + 1.6 μs GI |
| 1 | 2Χ HE/EHT/UHR-LTF + 1.6 μs GI |
| 2 | 4Χ HE/EHT/UHR-LTF + 1.6 μs GI |
| 3 | The responding PPDU format is non-HT (Dup) PPDU format |

If the GI And HE/EHT/UHR-TLF Type subfield is set to 3 in a BSRP Trigger frame, then the PPDU send in response to the BSRP Trigger frame is using non-HT (duplicate) PPDU format. If the GI And HE/EHT/UHR-TLF Type subfield is set to a value different than 3 in a BSRP Trigger frame, then the PPDU send in response to the BSRP Trigger frame is using TB PPDU format.

* + - * 1. **Reconfiguration Multi-Link element (or a new element (TBD))**

***Modify figure 9-1001x STA Control field format for the Reconfiguration Multi-Link element (if we decide to use Reconfiguration Multi-Link element for the 11bn Coex parameter update mechanism TBD)***

B0 B3 B4 B5 B6 B7 B10

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Link ID | Complete Profile | STA MAC  Address Present | AP Removal Timer Present | Reconfiguration Operation Type |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Bits: | 4 | 1 | 1 |  | 1 |  | 4 |
|  | B11 | B12 | B13 |  | B14 | ~~B15~~ | B15 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Operation Parameters Present | NSTR Bitmap Size | NSTR Indication Bitmap Present | ~~Reserved~~ Limited Operation Parameters Present | Reserved |

Bits: 1 1 1 ~~2~~1 1

**Figure 9-1001x—STA Control field format for the Reconfiguration Multi-Link element**

***Modify Table 9-404l—Reconfiguration Operation Type subfield encoding (if we decide to use Reconfiguration Multi-Link element for the 11bn Coex parameter update mechanism TBD)***

**Table 9-404l—Reconfiguration Operation Type subfield encoding**

|  |  |
| --- | --- |
| **Value** | **Name** |
| 0 | AP Removal |
| 1 | Operation Parameter Update |
| 2 | Add Link |
| 3 | Delete Link |
| 4 | NSTR Status Update |
| 5 | Limited Operation parameters |
| ~~5~~6–15 | Reserved |

***Insert the following paragraph after the paragraph starting with “The NSTR Indication Bitmap Present subfield” (if we decide to use Reconfiguration Multi-Link element for the 11bn Coex parameter update mechanism TBD)***

The NSTR Indication Bitmap Present subfield in the STA Control field is set to 1 if at least one NSTR link pair is present for the non-AP MLD that contains the link corresponding to the Link ID, otherwise, this sub- field is set to 0.

The Limited Operation Paremeter Present subfield is set to 1 if the Limited Operation Parameters subfield is present in the STA Info field; and otherwise, it is set to 0.

***Modify Figure 9-1001y—STA Info field format for the Reconfiguration Multi-Link element (if we decide to use Reconfiguration Multi-Link element for the 11bn Coex parameter update mechanism)***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| STA Info Length | STA MAC Address | AP Removal Timer | Operation Parameters | NSTR Indication Bitmap | Limited Operation Parameters |

Octets: 1 0 or 6 0 or 2 0 or 3 0 or 1 or 2 0 or 8

**F****igure 9-1001y—STA Info field format for the Reconfiguration Multi-Link element**

***Insert the following paragraphs after the paragraph starting with “The NSTR Indication Bitmap subfield indicates NSTR link pairs” (if we decide to use Reconfiguration Multi-Link element for the 11bn Coex parameter update mechanism TBD)***

The NSTR Indication Bitmap subfield indicates NSTR link pairs for the non-AP MLD. Each bit B*j* (*j* ≠ *i*) in the NSTR Indication Bitmap subfield included in the Per-STA Profile subelement with Link ID subfield equal to *i* (where 0 ≤ *i* < 15) is set to 1 if the link pair corresponding to link IDs equal to <*i*, *j*> is an NSTR link pair; otherwise, bit B*j* is set to 0. Bit B*i* in the NSTR Indication Bitmap subfield included in the Per- STA Profile subelement with Link ID subfield value equal to *i* is reserved. The NSTR Indication Bitmap subfield is not included in the Reconfiguration Multi-Link element transmitted by an AP MLD.

The Limited Operation Parameters subfield provides limited operation (LO) parameters, and has a format that is shown in [Figure 9-1001ax (Limited Operation Parameters subfield format)](#_bookmark227).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Maximum PPDU Duration | Maximum  MCS | LDPC Mode | HT-Immediate BA Mode | Disabled Subchannel Bitmap | Reserved |

Bits: TBD TBD TBD TBD 16 16

**Figure 9-1001ab—Limited Operation Parameters subfield format**

The Maximum PPDU Duration subfield indicates the maximum PPDU duration, in microseconds, that is supported by the STA in transmit and/or receive when the non-AP STA is in LO mode.

The Maximum MCS subfield indicates the maximum MCS that is supported by the STA in transmit and/or receive when the non-AP STA is in LO mode.

The LDPC Mode subfield indicates whether LDPC is supported by the STA in transmit and/or receive when the non-AP STA is in LO mode.

The HT-Immediate BA Mode subfield indicates whether all HT-immediate BA agreements are active or suspended when the non-AP STA is in LO mode.

The Disabled Subchannel Bitmap subfield indicates whether one or more of the 20 MHz subchannels that lie within the BSS bandwidth are enabled or disabled when the non-AP STA is in LO Mode. The Disabled Subchannel Bitmap subfield is a 16-bit bitmap where the lowest numbered bit corresponds to the 20 MHz subchannel that lies within the BSS bandwidth and is the lowest in frequency of the set of all 20 MHz subchannels within the BSS bandwidth. Each successive bit in the bitmap corresponds to the next higher frequency 20 MHz subchannel. A bit in the bitmap that lies within the BSS bandwidth is set to 1 to indicate that the corresponding 20 MHz subchannel is punctured and is set to 0 to indicate that the corresponding 20 MHz subchannel is not punctured. A bit in the bitmap that falls outside of the BSS bandwidth is reserved.

**9.3.1.22.10 BSRP Trigger frame format**

***Add the following text at the end of subclause 9.3.1.22.10***

When an UHR variant [TBD] BSRP Trigger frame is individually addressed to a single STA:

The Number Of HE/ EHT-LTF/UHR-LTF field, the LDPC Extra Symbol Segment, the AP TxPower, the Pre-FEC Padding Factor field, the PE Disambiguity UL Spatial Reuse field, the HE/EHT P160 field of the Common Info field are reserved

the User Info field with the AID12 field set to the STA’s AID and all the other fields of this User Info field are reserved.

***add the following subclause 9.6.39 UHR Action frame details***

**9.6.39 UHR Action frame details**

**9.6..39.1 UHR Action field**

* + 1. **Protected UHR Action frame details**
       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-xxx (Protected UHR Action field values)](#_bookmark328).

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

|  |  |  |
| --- | --- | --- |
| **Value** | **Meaning** | **Time priority** |
| 0 | UHR Mode Enablement Notification | No |
| 3–255 |  |  |

* + - 1. **UHR Mode Enablement Notification frame details**

The UHR Mode Enablement Notification frame is used to indicate that a non-AP STA is enabling or disabling a UHR mode and is used by its associated AP as a response to the received UHR Mode Enablement Notification frame from the soliciting STA.

The Action field of the UHR Mode Enablement Notification frame contains the information shown in [Table 9-](#_bookmark335)xxx [(Protected UHR Mode Enablement Notification frame Action field format)](#_bookmark335).

**Table 9-xxx—Protected UHR Mode Enablement Notification frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 1 | Category |
| 2 | Protected UHR Action |
| 3 | Dialog Token |
| 4 | UHR Control (see [9.4.1.xx (UHR Control field)](#_bookmark126)) |

The Category field is defined in [9.4.1.11 (Action field)](#_bookmark114).

The Protected UHR Action field is defined in [9.6.40.1 (Protected UHR Action field)](#_bookmark327).

The Dialog Token field is set by a non-AP STA to a nonzero value chosen by the STA for sending a request and is set by an AP to the value copied from the corresponding received UHR Mode Enablement Notification frame for sending a response.

The UHR Control field is defined in [9.4.1.xx (UHR Control field)](#_bookmark126).

***Add the following subclause 9.4.1.xx UHR Control field***

**9.4.1.xx UHR Control field**

The UHR Control field is defined in [Figure 9-xxx (UHR Control field format)](#_bookmark127).

B0 B1 B2-B7

Bits: 1 1 6

|  |  |  |
| --- | --- | --- |
| **DUO Mode** | **DPS mode** | **Reserved** |

**Figure 9-206b—UHR Control field format**

**Table xxx—DUO Mode subfield**

|  |  |
| --- | --- |
| **Subfield** | **Description** |
| DUO Mode | For a non-AP STA:  Set to 0 to indicate that the DUO mode is disabled for the non-AP STA.  Set to 1 to indicate that the DUO mode is enabled for the non-AP STA.  See 37.x.2 (Dynamic Unavailability Operation (DUO) mode)  For an AP:  Reserved |

***add the following subclause 37.x Coexistence mechanisms in 802.11bn D0.1:***

37.x Unavailability reporting and coexistence mechanisms

37.x.1 General

The Unavailability reporting mechanisms subclause describes a set of mechanisms that allows a STA to inform its peer STA of its unavailabilities. Subclause 37.x.2 (Dynamic unavailability operation mode) describes the mechanism for a non-AP STA to indicate unavailability in certain control frames, where the unavailability may overlap with the ongoing TxOP. Subclause 37.x.3 (Periodic unavailability indication) describes how a non-AP STA can inform its associated AP about (periodic) service period(s) where it will be unavailable. Subclause 37.x.4 (Periodic AP power save) describes how and under which conditions an AP can operate its BSS with (periodic) service period(s) during which it will be unavailable. Finally, subclause 37.x.5 describes a parameter update mechanism based on management level signaling that allows a non-AP STA to limit its operation capabilities when experiencing in-device coexistence issues.

37.x.2 Dynamic Unavailability Operation (DUO) mode

A STA that has dot11DUOActivated equal to 1 supports DUO operation, is called a DUO STA and shall set the DUO Supported field of the UHR MAC Capabilities Information field of the UHR Capabilities element to 1.

When a DUO non-AP STA intends to enable the DUO mode with its associated DUO AP:

— the non-AP STA shall transmit an UHR Mode Enablement Notification frame with the DUO Mode subfield of the UHR Control field of the frame set to 1 to the AP

— The AP shall transmit an UHR Mode Enablement Notification frame, after the AP is ready to serve the non-AP STA in the DUO operation, as a response to the received UHR Mode Enablement Notification frame, to the non-AP STA.

It is TBD whether the AP can reject the request to enable the DUO mode at the STA side. It is TBD whether the AP can disable the DUO mode for its BSS.

When a DUO non-AP STA intends to disable the DUO mode, then:

— the non-AP STA shall transmit an UHR Mode Enablement Notification frame with the DUO Mode subfield of the UHR Control field of the frame set to 0 to its associated AP.

— the associated AP shall transmit an UHR Mode Enablement Notification frame, after the AP is no longer serving the non-AP STA in the DUO operation, as a response to the received UHR Mode Enablement Notification frame, to the non-AP STA.

When a DUO non-AP STA is operating in the DUO mode with its associated AP, then:

* the associated AP that initiates frame exchanges that are neither group addressed Data nor group addressed Management frames with the non-AP STA shall begin the frame exchanges by transmitting a DUO initial Control frame (ICF) to the non-AP STA.
* The DUO ICF shall be a BSRP Trigger frame that is either:
  + With a User Info field with the AID12 field set to the AID of the STA, and with the GI And HE/EHT/UHR-LTF Type field set to 3 to solicit a non-HT (Dup) PPDU response
  + With a User Info field with the AID12 field set to the AID of the STA, and with the GI And HE/EHT/UHR-LTF Type field not set to 3 to solicit a TB PPDU.
* The DUO ICF shall have the UL Length field set to a value that is sufficiently large to allow the STA to include in the PPDU that is sent in response a DUO Initial Control Response frame (ICR) that can include the unavailability information.
* The DUO ICR frame that includes the Unavailability information shall be a Multi-STA BlockAck frame.

NOTE - The frame exchange includes individually addressed frame exchanges and group addressed control frames (e.g., Trigger frames, NDP Announcement frames etc.).

A DUO non-AP STA operating in the DUO mode and that receives a BSRP Trigger frame from its associated DUO AP that contains the 12 LSBs of the non-AP STA’s AID in any of the User Info fields and that solicits a response in TB PPDU format shall follow the rules defined in 26.5.5 (Buffer status report operation), except that it may also do the following:

* include in the HE TB PPDU one or more QoS Null frames as described in 26.5.5 (Buffer status report operation) aggregated with a Multi-STA BlockAck frame

A DUO non-AP STA operating in the DUO mode and that receives a BSRP Trigger frame from its associated DUO AP that is individually addressed to the STA and that solicits a response in non-HT (duplicate) PPDU format shall respond in non-HT (duplicate) PPDU format subject to the rules defined in 26.5.2.5 UL MU CS mechanism and shall include a Multi-STA BlockAck frame.

A DUO non-AP STA operating in the DUO mode and that is a TxOP responder may indicate in a response Multi-STA BlockAck frame whether it will be unavailable after a specific point in time, and, if known, for how long. In order to describe the period of unavailability, the Multi-STA BlockAck frame shall include the Unavailability Target Start Time field subfield and the Unavailability Duration subfield as described in 9.3.1.8.6 (Multi-STA BlockAck variant).

A DUO non-AP STA operating in the DUO mode and that is a TxOP holder may indicate in a BSRP Trigger frame whether it will be unavailable after a specific point in time, and, if know, for how long, only if certain TBD conditions are true. In order to describe the period of unavailability, the BSRP Trigger frame shall include the Unavailability Target Start Time field subfield and the Unavailability Duration subfield as described in 9.3.1.22 (Trigger frame format). The response frame to such a BSRP Trigger frame is TBD.

When a DUO AP receives from a DUO STA operating in the DUO mode a Multi-STA BlockAck frame addressed to it that includes an Unavailability Target Start Time field, then the UHR AP shall consider the STA as being unavailable:

* at and after the target time indicated in the Unavailability Target Start Time field,
* and until the time indicated in the Unavailability Target Start time field + the duration indicated in the Unavailability Duration field, if the Unavailability Duration field is not set to TBD (for unknown duration), and other TBD condition to become available, whichever comes first.

A DUO AP shall maintain up to one unavailability report per DUO STA, and that unavailability report corresponds to the most recently received unavailability report (if any).

When an AP considers a STA as being unavailable during a service period after having received unavailability information in a control frame as described in this subclause, then the AP should not schedule for transmission PPDUs addressed to a STA that overlaps with its unavailability service period and if it still transmits, the STA is not expected to receive the PPDUs

NOTE 1 - If the AP transmits PPDUs addressed to the STA during the STA’s unavailability service period, then the expectation is that the AP does not take into account the failed reception of the frames contained in the PPDUs for its rate selection algorithm nor for its EDCA function for the AC used to transmit these frames, unless required by regulatory rules.

37.x.3 Non-AP STA Periodic unavailability Operation mode

Periodic Unavailability Operation allows a non-AP STA to indicate to its associated AP that it will be unavailable during (periodic) service periods.

A UHR AP that supports Periodic Unavailability Operation is called a P2P TWT AP and shall have dot11ChannelUsageActivated equal to true and shall set to 1 the Peer-to-peer TWT Support field in the Extended Capabilities elements that it transmits.

A UHR STA that supports Periodic Unavailability is called a P2P TWT STA and shall support channel usage procedure in 11.21.15 (Channel Usage Procedures) and have the TWT Requester Support subfield set to 1 in the HE Capabilities element that it transmits.

A P2P TWT STA that intends to be unavailable during specific service periods shall follow the rules defined in 11.21.15 (Channel Usage Procedures) to report its periodic unavailability to its associated P2P TWT AP. A P2P TWT AP that intends to exchange frames with the P2P TWT STA shall follow the rules defined in 11.21.15 (Channel Usage Procedures) related to P2P TWT procedure.

Enhancements to the P2P TWT procedure are TBD.

When an AP considers a STA as being unavailable during a service period after having received long term periodic unavailability indication through P2P TWT as described in this subclause, then the AP should not schedule for transmission PPDUs addressed to a STA that overlaps with its unavailability service period and if it still transmits, the STA is not expected to receive the PPDUs

NOTE 1 - If the AP transmits PPDUs addressed to the STA during the STA’s unavailability service period, then the expectation is that the AP does not take into account the failed reception of the frames contained in the PPDUs for its rate selection algorithm nor for its EDCA function for the AC used to transmit these frames, unless required by regulatory rules.

37.x.4 **AP Periodic Unavailability Operation mode (scheduled AP power save)**

AP Periodic Unavailability Operation modeoperation allows a UHR AP to manage activity in the BSS by scheduling STAs to operate during specific service periods, and to either save power or use internal resources elsewhere by allowing the UHR AP to be unavailable to all associated STAs outside of these service periods. An UHR AP supporting Scheduled Periodic AP Power Save operation is called a PPS AP and shall set TBD field in the TBD Capabilities element it transmits to 1. A UHR STA supporting operation with a PPS AP is called a PPS STA and shall set the TBD field of the TBD Capabilities element that it transmits to 1.

A PPS AP that intends to be unavailable outside of broadcast TWT SPs shall ensure that all associated STAs are PPS STAs and shall follow the rules defined in 26.8.3.2 (Rules for TWT scheduling AP) by advertising a TWT element that carries one or more Broadcast TWT Parameter Set fields with a Broadcast TWT ID subfield equal to 0, a Responder PM Mode subfield equal to 1 and an NDP Paging Indicator/Unavailability Mode subfield that is set to either 0 or 1. An UHR non-AP STA that intends to exchange frames with the UHR AP shall follow the rules defined in 26.8.3.3 (Rules for TWT scheduled STA).

37.x.5 Non-AP STA Parameter Update mechanism

An MLD that has dot11LOModeImplemented equal to true shall set the Limited Operation Mode Support subfield in the MAC Capabilities subfield of the UHR Capabilities element that is transmitted by its affiliated STA(s) to 1. The MLD shall set the Limited Operation Mode Support subfield to 0 if it has dot11LOModeImplemented equal to false. A UHR STA may set the dot11LOModeImplemented to true.

A non-AP STA affiliated with an MLD in which dot11LOModeImplemented is true is referred to as a LO requesting STA. An AP affiliated with an MLD in which dot11LOModeImplemented is true is referred to as a LO responding STA.

A LO requesting STA may notify a LO responding STA of a change in its LO Mode and/or LO parameters by transmitting a TBD Request frame (below we use the Multi-Link Operation Update Request frame including a Reconfiguration Multi-Link element with Reconfiguration Operation Type subfield set to 5) if at least one of the LO parameters have changed.

In the Reconfiguration Multi-Link element of a Multi-Link Operation Update Request frame with Reconfiguration Operation Type subfield set to 5 transmitted by the LO requesting STA:

—All subfields in the Presence Bitmap subfield of the Multi-Link Control field in the Reconfiguration Multi-Link element shall be set to 0

—All subfields of the STA Control field in the Reconfiguration Multi-Link element, except for the Link ID and the Limited Operation Parameters Present subfields, shall be set to 0

* The Link ID subfield shall be set to the identifier of the link to which the limited operation parameters apply
* The Limited Operation Parameters Present subfield shall be set to 1

—The Limited Operation Parameters subfield shall indicate the updated limited operation parameters (as applicable) for the link identified by the value of the Link ID subfield.

NOTE --An AP affiliated with an AP MLD does not transmit a Multi-Link Operation Update Request frame (see 35.3.6.6 Non-AP MLD operation parameter update).

An LO responding AP that received a Multi-Link Operation Update Request frame including a Reconfiguration Multi-Link element with Reconfiguration Operation Type subfield equal to 5 shall respond with a TBD Response (below we use the Multi-Link Operation Update Response frame). The Status Code subfield of the Multi-Link Operation Update Response frame shall be set to 0 (SUCCESS). Whether the LO responding AP may set the Status Code subfield to141 (DENIED\_OPERATION\_PARAMETER\_UPDATE) is TBD.

Before receiving the Multi-Link Operation Update Response frame, the LO requesting STA shall not apply the limited operation parameters indicated in the Reconfiguration Multi-Link element of the corresponding Multi-Link Operation Update Request frame. Before successfully transmitting the Multi-Link Operation Update Response frame, the LO responding AP shall not apply the limited operation parameters indicated in the Reconfiguration Multi-Link element of the corresponding Multi-Link Operation Update Request frame.

After receiving the Multi-Link Operation Update Response frame in which the Status Code field is equal to the value 0 (SUCCESS), the LO requesting STA affiliated with the non-AP MLD shall apply the limited operation parameters indicated in the Limited Operation Parameters subfield in the Reconfiguration Multi-Link element of the corresponding Multi-Link Operation Update Request frame. After successfully transmitting the Multi-Link Operation Update Response frame in which the Status Code field is equal to the value 0 (SUCCESS), the LO requesting STA affiliated with the non-AP MLD shall apply the limited operation parameters indicated in the Limited Operation Parameters subfield in the Reconfiguration Multi-Link element of the corresponding Multi-Link Operation Update Request frame.

A limited operation parameter update is successful if the LO responding STA successfully transmits an Multi-Link Operation Update Response frame with the Status Code field equal to the value 0 (SUCCESS).