IEEE P802.11  
Wireless LANs

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| PDT MAC Coexistence | | | | |
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Abstract

This document contains Proposed Draft Text (PDT) for the Coexistence topic of the proposed TGbn (UHR, Ultra High Reliability) amendment to the 802.11 standard.

**R1:**

* **Comments from Hongwon**
* **Comments from Yan (UHR Mode Enablement replaced by UHR Mode)**
* **Jay: with DUO mode, ICF is always BSRP TF**
* **Comments from Mark**

R2:

* Further resolutions to Mark’s comments

R3:

* Further resolutions to Mark’s comments
* Resolutions to Alfred’s comments
* Remove fields in Trigger frame not related to Coex
* Comments from Brian

R4:

* Additional TAGs added
* Comments from Binita

Introduction

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

* [M30]: 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.
* [M146] 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
* [M158] 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.
* [M136] 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))
* [M137] 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
* [M138] TGbn uses Multi-STA BA for Initial Control Response frame (ICR) for DL and UL, at least when carrying the unavailability information
* [M139] 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
* [M140] 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)
* [M141] 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
* [M142] 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
* [M143] The AP maintains up to one dynamic unavailability report per STA
  + And the most recent dynamic unavailability report is the valid one
* [M151] 11bn allows Multi-STA BA to carry one or more types of feedback (e.g. unavailability) information
  + How to include feedback information is TBD.
* [M152] 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
* [M153] 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.
* [M155] Periodic unavailability announcements from a non-AP STA are performed in UHR by enhancing the P2P TWT mechanism.
* [M161] 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
* [M150] 11bn 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>

<https://mentor.ieee.org/802.11/dcn/24/11-24-1974-03-00bn-detailed-text-proposal-on-coexistence.docx>

**9.3.1.8 BlockAck frame format**

**9.3.1.8.6 Multi-STA BlockAck variant**

***TGbn editor: please 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 to identify a Per AID TID Info field that carries feedback (see 37.x.2 Dynamic Unavailability Operation (DUO) mode) that applies to all receiving UHR STAs. *[#M141, 151]*

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, and if the combination of the Ack Type subfield and TID subfield is not equal to 0 and 13 respectively 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 and if the combination of the Ack Type subfield and TID subfield is not equal to 0 and 13 respectively | | | |

If the AID11 subfield of the AID TID Info subfield is not 2045, and if the Ack Type subfield is equal to 0 and the TID subfield is equal to 13 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 | Feedback [#M141, 151] |
| 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. |
|  | |  |  |  |
| 0 or 1 | | 8–1~~3~~2 | N/A | Reserved |
| 0 | | 13 | Present | Feedback context:  Sent as feedback (e.g. of unavailability[#M152] |
| 1 | | 13 | Not Present | Reserved |
| 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 or 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 or 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)). | | | | | |

*[#M141, 151]* If a Per AID TID Info field has the Ack Type subfield equal 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 for all receiving UHR STAs.
* A Feedback subfield is included in the Per AID TID Info field instead of a Block Ack Bitmap subfield and the Feedback subfield has a length defined in Table 9-40 (Fragment Number subfield encoding for the Multi-STA BlockAck variant), has the format defined in Figure 9-xx (Feedback subfield format) and 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)). [M140, 142] The Unavailability Target Start Time subfield indicates the value of TSF[15:7] at the time when the STA transmitting the Multi-STA BlockAck frame becomes unavailable (see 11.2.1 **(**General**)**). The Unavailablity Duration subfield indicates the duration in units of 64 µs over which the STA transmitting the Multi-STA BA is not available.

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B8 | B9 B17 | B18 Variable |
|  | Unavailability Target Start Time | Unavailability Duration | Reserved |
| bits: | 9 | 9 | variable |
| Figure 9-xx----Feedback subfield format  *[#M140, 142]* | | | |

***TGbn editor: please 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 any preceding PPDU in the TxOP carried a BSRP Trigger frame addressing a STA that is operating with the DUO mode (see 37.x.2 Dynamic Unavailability Operation (DUO) mode |
| 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 Trigger frame that allows inclusion of unavailability feedback (see 37.x.2 Dynamic Unavailability Operation (DUO) mode) 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**

***TGbn editor: please 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 | Reserved | Reserved | Reserved | Trigger Dependent Common Info |

Bits: 1 4 1 1 1 1 Variable

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

***TGbn editor: please TGbn editor: please add the following text***

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

|  |  |
| --- | --- |
| **GI And HE/EHT/UHR-LTF Type subfield** | Description |
| 0 | 1x HE/EHT/UHR-LTF + 1.6 μs GI |
| 1 | 2x HE/EHT/UHR-LTF + 1.6 μs GI |
| 2 | 4x HE/EHT/UHR-LTF + 1.6 μs GI |
| 3 | The responding PPDU format is non-HT (duplicate) PPDU format that contains a Multi-STA BlockAck [M152] |

If the GI And HE/EHT/UHR-TLF Type subfield is set to 3 in an individualy addressed BSRP Trigger frame, then the PPDU sent in response to the BSRP Trigger frame is a non-HT (duplicate) PPDU that contains a Multi-STA BlockAck frame [#M152]. 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.

**9.3.1.22.10 BSRP Trigger frame format**

***TGbn editor: please 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 field, the AP TxPower field, the Pre-FEC Padding Factor field, the PE Disambiguity UL Spatial Reuse field and 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.

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

37.x Unavailability reporting and parameter updates

37.x.1 General

The unavailability reporting and parameter updates subclause describes a set of mechanisms that allow a STA to inform a peer STA of its unavailabilities. Subclause 37.x.2 (Dynamic unavailability operation mode) describes how a non-AP STA can indicate unavailability in certain Control frames, where the unavailability might 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 periods where the STA will be unavailable. Subclause 37.x.4 (AP Periodic Unavailability Operation mode (scheduled AP power save)) describes how and under which conditions an AP can operate its BSS with (periodic) service period(s) during which the AP will be unavailable. Finally, Subclause 37.x.5 (Non-AP STA Parameter Update mechanism) describes a parameter update mechanism 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 [M30, M146, M158, M153]

A non-AP STA that has dot11DUOOptionImplemented equal to 1 supports dynamic unavailability operation (DUO), is called a DUO non-AP STA and shall set the DUO Supported field of the UHR MAC Capabilities Information field of the UHR Capabilities element to 1. An AP STA that has dot11DUOOptionImplemented equal to 1 supports dynamic unavailability operation (DUO), is called a DUO Supporting AP and shall set the DUO Supported field of the UHR MAC Capabilities Information field of the UHR Capabilities element to 1.

[M153] To enable DUO mode with its associated DUO Supporting AP:

— the DUO non-AP STA shall transmit to the AP an TBD Request frame (TBD) with the DUO Mode subfield in the frame set to 1

— The AP shall transmit an TBD Response frame, after the AP is ready to serve the non-AP STA in DUO operation, as a response to the received TBD Request 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.

[M153] To disable DUO mode with its associated DUO Supporting AP:

— the DUO non-AP STA shall transmit a TBD Request frame with the DUO Mode subfield in the frame set to 0 to the AP.

— the associated AP shall transmit a TBD Response frame, after the AP is no longer serving the non-AP STA in the DUO mode, as a response to the received TBD Request frame, to the non-AP STA.

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

* [M153] 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 an initial Control frame (ICF) allowed for DUO mode to the non-AP STA.
* [M139, 153]The ICF allowed for DUO shall be a BSRP Trigger frame that has either:
  + 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 (Duplicate) PPDU
  + 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
* [M153] The BSRP Trigger frame 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 an initial control response frame (ICR) that can include unavailability information.
* [M138]The ICR frame that is allowed for DUO to include the unavailability information is a Multi-STA BlockAck frame.

[M139] A DUO non-AP STA that is operating in the DUO mode that receives a BSRP Trigger frame from its associated DUO Supporting 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 respond following the rules defined in 26.5.5 (Buffer status report operation), except that the DUP non-AP STA may also aggregate a Multi-STA BlockAck frame along with the one or more QoS Null frames that are required according to 26.5.5 (Buffer status report operation).

[M152] A DUO non-AP STA that is operating in the DUO mode and that receives, from its associated DUO Supporting AP, a BSRP Trigger frame that is individually addressed to the STA and solicits a response in non-HT (duplicate) PPDU format shall respond subject to the rules defined in 26.5.2.5 UL MU CS mechanism, and the response shall be in non-HT (duplicate) PPDU format and shall include a Multi-STA BlockAck frame.

[M146] A DUO non-AP STA that is operating in the DUO mode and that is a TxOP responder may indicate, in a response Multi-STA BlockAck frame, whether the non-AP STA will be unavailable after a specific point in time and, if known, for how long, by including a Per-AID TID Info field that contains an Unavailability Target Start Time and Unavailability Duration (see 9.3.1.8.6)) (Multi-STA BlockAck variant).

[M158] A DUO non-AP STA that is operating in the DUO mode and that is a TxOP holder may indicate in a BSRP Trigger frame whether the non-AP STA will be unavailable after a specific point in time, and, if known, for how long, by including a TBD User Info field that contains an Unavailability Target Start Time and Unavailability Duration (see 9.3.1.22 (Trigger frame format)). The DUO non-AP STA may transmit this BSRP Trigger frame only if certain TBD conditions are true. The response frame to such a BSRP Trigger frame is a Multi-STA BlockAck frame in non-HT (duplicate) PPDU format.

[M140, 146, M158] When a DUO Supporting AP receives from a DUO non-AP STA operating in the DUO mode a Multi-STA BlockAck frame addressed to the AP, in reponse to a preceeding BSRP Trigger frame, that includes an Unavailability Target Start Time field, the UHR AP shall consider the STA as being unavailable:

* from the future target time indicated in the Unavailability Target Start Time field,
* for a duration indicated in the Unavailability Duration field, if the unavailability duration is known, and until TBD (referring to the conditions for the STA to become available again) if the unavailability duration is unknown.

[M143] A DUO Supporting 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).

[M146, 158] When an AP considers a non-AP STA as being unavailable during a period of time after having received unavailability information as described in this subclause, the AP should not schedule for transmission PPDUs containing frames addressed to the STA that overlap with its unavailability period of time and if the AP still transmits, the STA is not expected to receive the PPDUs.

NOTE - If the AP transmits PPDUs containing frames addressed to the STA during the STA’s unavailability period of time, then the expectation is that the AP does not take into account the failed reception of the frames contained in the PPDUs for the AP’s 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 (PUO) mode [M30]

Periodic unavailability operation (PUO) allows a non-AP STA to indicate, to its associated AP, that the STA will be unavailable during periodic service periods.

[M155] A UHR AP that supports Periodic Unavailability Operation is called a PUO Supporting AP and shall set to 1 the PUO Supporting AP field of the UHR MAC Capabilities Information field of the UHR Capabilities that it transmits. A PUO Supporting AP shall have dot11ChannelUsageActivated equal to true and shall set to 1 the Peer-to-peer TWT Support field in the Extended Capabilities elements that the AP transmits.

[M155] A UHR STA that supports periodic unavailability operation is called a PUO non-AP STA and shall set to 1 the PUO Support field of the UHR MAC Capabilities Information field of the UHR Capabilities element that it transmits. A PUO non-AP STA shall support the 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 the STA transmits.

[M155] To be unavailable during specific service periods, a PUO non-AP STA shall follow the rules defined in 11.21.15 (Channel Usage Procedures) to report its periodic unavailability to its associated PUO Supporting AP. A PUO Supporting AP that intends to exchange frames with the PUO non-AP STA shall follow the rules defined in 11.21.15 (Channel Usage Procedures) related to the P2P TWT procedure.

[M30] Enhancements to the P2P TWT procedure are TBD.

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

NOTE - If the PUO Supporting AP transmits PPDUs containing frames addressed to the PUO non-AP STA during the STA’s unavailability service period, then the expectation is that the PUO Supporting 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 [M150, M161]**

AP periodic unavailability operation modeallows a UHR AP to manage activity in the BSS, composed of STAs that support this feature, by defining service periods, and to either save power or use internal resources elsewhere by allowing the UHR AP to be unavailable to all associated UHR STAs outside of these service periods. An UHR AP supporting AP periodic unavailability operation mode 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 Supporting non-AP STA and shall set the TBD field of the TBD Capabilities element that the AP transmits to 1.

To be unavailable outside of broadcast TWT SPs, a PPS AP 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 field set 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. A PPS Supporting non-AP STA that intends to exchange frames with the PPS AP shall follow the rules defined in 26.8.3.3 (Rules for TWT scheduled STA).

NOTE - If the STA transmits PPDUs containing frames addressed to the AP during the AP’s unavailability period, then the expectation is that the STA 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.

EDITOR’s NOTE: The mechanism described in this subclause is both a periodic unavailability reporting mechanism on AP side and an AP periodic power save mechanism, so the subclause might be moved to a separate location in following draft revisions.

37.x.5 Non-AP STA Parameter Update mechanism [M136, 137]

A non-AP STA that has dot11LimitedOperationModeImplemented equal to true shall set the Limited Operation Mode Support subfield in the MAC Capabilities subfield of the UHR Capabilities element that it transmits to 1 and to 0 otherwise. It is TBD whether this capability is at the STA level or at the MLD level.

A non-AP STA with dot11LOModeImplemented equal to true is referred to as a LOM requesting non-AP STA. An AP with dot11LOModeImplemented equal to true is referred to as a LOM responding AP.

An LOM requesting non-AP STA may notify a LOM responding AP of a change in its LOM mode and/or LOM parameters by transmitting a TBD Request frame if at least one of the LOM parameters have changed.

The TBD Request frame includes fields for the parameters that may be changed and include at least the following fields:

* a Maximum PPDU Duration subfield that 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 LOM mode.
* a Maximum MCS subfield that indicates the maximum MCS that is supported by the STA in transmit and/or receive when the non-AP STA is in LOM mode.
* An LDPC Mode subfield that indicates whether LDPC is supported by the STA in transmit and/or receive when the non-AP STA is in LOM mode.
* An HT-Immediate BA Mode subfield that indicates whether all HT-immediate BA agreements are active or suspended when the non-AP STA is in LOM mode.
* A Disabled Subchannel Bitmap subfield that 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 LOM mode. The Disabled Subchannel Bitmap subfield is a 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 the BSS bandwidth is reserved.
* Whether there are other fields is TBD.

An LOM responding AP that receives a TBD Request frame and that is ready to operate with the updated parameters shall respond with a TBD Response frame.

Before receiving the TBD Response frame, the LOM requesting non-AP STA shall not apply the updated limited operation parameters indicated in the TBD Request frame. Before successfully transmitting the TBD Response frame, the LOM responding AP shall not apply the limited operation parameters indicated in the TBD Request frame.

After receiving the TBD Response frame, the LOM requesting non-AP STA shall apply the updated limited operation parameters indicated in the TBD Request frame. After successfully transmitting the TBD Response frame the LOM responding AP shall apply the limited operation parameters indicated in the TBD Request frame.