IEEE P802.11
Wireless LANs

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| PDT MAC NPCA |
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Abstract

This document contains Proposed Draft Text (PDT) for the Non Primary Channel Access (NPCA) feature of the proposed TGbn (UHR, Ultra High Reliability) amendment to the 802.11 standard.

# Revision information

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

|  |  |
| --- | --- |
| **Revision** | **Major changes** |
| 0 | Initial revision |
| 1 | Author list adjustments |
| 2 | Text offered by TTT members to address motions that were passed during the NOV 2024 802.11 meeting session, with accompanying new motion text added to the motion section |
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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 TGbe 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 TGbe 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 passing motions:

* TGbn defines a mode of operation that enables a STA to access the secondary channel while the primary channel is known to be busy due to OBSS traffic or other TBD conditions.
	+ The mode of operation shall not assume that the STA is capable to detect or decode a frame and obtain NAV information of the secondary channel concurrently with the primary channel.
	+ A BSS shall only have a single NPCA primary channel (name TBD) on which the STA contends while the primary channel of the BSS is known to be busy due to OBSS traffic or other TBD conditions.
* [Motion #11, [1]]
* TGbn defines a mode of operation in NPCA where the NPCA non-AP does not use untriggered UL transmissions on the NPCA primary channel
	+ This mode can be enabled/disabled by the AP
	+ Whether the mode is for all associated non-APs or per non-AP is TBD
	+ TBD whether MU EDCA parameters mechanism is used for this or not

[Motion #129, [1]]

* An NPCA STA shall indicate the following to its peer NPCA STA
	+ NPCA switching delay
		- time it needs to switch from the BSS Primary channel to the NPCA Primary channel
	+ NPCA switch back delay
		- time it needs to switch from the NPCA Primary channel to the BSS Primary channel
	+ Delay values range between 0 and 256 us with a 4 us resolution

[Motion #124, [1]]

* An AP that is capable of NPCA announces at most one NPCA Primary channel
	+ NPCA Primary channel is in AP's BSS operating channel width
	+ NPCA Primary channel is not a punctured 20 MHz subchannel (as indicated in EHT Operation element)
	+ Details on signaling is TBD

[Motion #130, [1]]

* All the APs in a multiple BSSID set that enable NPCA announce the same NPCA primary channel

[Motion #131, [1] and [205]]

* An NPCA STA shall initiate frame exchange on the NPCA Primary channel with an NPCA Initial Control Frame (ICF) in the non-HT PPDU or non-HT duplicate PPDU format using a rate of 6 Mb/s, 12 Mb/s, or 24 Mb/s
	+ Details on NPCA ICF are TBD

[Motion #125, [1]]

* The event that triggers switching to the NPCA primary channel shall be
	+ OBSS Control frame exchange (e.g., (MU-)RTS/CTS) or
	+ OBSS HE/EHT/UHR PPDU
	+ Note: Other conditions TBD

[Motion #144, [1]]

* The NPCA operation shall use the same EDCA parameters ((MU) EDCA Parameter Set, EPCS EDCA Parameters), on both the BSS primary channel and the NPCA primary channel.

[Motion #145, [1]]

* An NPCA STA shall initiate a TXOP on the NPCA Primary channel following the rules defined in 10.23.2.2 (EDCA backoff procedure) and 10.23.2.4 (Obtaining an EDCA TXOP) with the following exception:
	+ Every time the STA switches to the NPCA Primary channel, it shall initialize CW\_NPCA[AC] to TBD value and pick a new backoff counter (BO\_NPCA) randomly between 0 and CW\_NPCA[AC]. QSRC\_NPCA[AC] shall be set to 0.
	+ NOTE – Baseline EDCA procedure is followed on the BSS Primary channel. The values of CW\_NPCA and BO\_NPCA are discarded by the NPCA STA when it switches back to the BSS Primary channel.

[Motion #126, [1]]

* After an NPCA STA has gained the right to initiate a TXOP on the NPCA Primary channel, it can transmit on a set of channels that:
	+ Includes the NPCA Primary channel, and
	+ are within the AP’s BSS bandwidth, and
	+ do not include the channels in the bandwidth occupied by the OBSS traffic that caused the NPCA STA to switch from the BSS primary channel to the NPCA primary channel, and
	+ do not include the channels that are indicated as punctured in the Disabled Subchannel Bitmap subfield in the EHT Operation element,
	+ It is TBD whether a frame that does not solicit TB PPDUs can puncture 20 MHz subchannels not indicated as punctured in the Disabled Subchannel Bitmap subfield of the EHT Operation element

[Motion #127, [1]]

* When transmitting a Trigger frame on the NPCA Primary channel, the NPCA AP shall signal the RU index considering the NPCA Primary channel as the reference primary channel
	+ The Trigger frame shall explicitly indicate that it is transmitted via the NPCA Primary channel (details TBD)

[Motion #128, [1]]

* When an NPCA STA switches to the NPCA Primary channel, it shall not initiate a transmission to its peer NPCA STA until the peer STA’s switching delay has elapsed since TBD switch start time

[Motion #132, [1]]

* An AP that enables NPCA announces the minimum duration threshold of the BSS primary channel busyness because of OBSS activity for switching to NPCA primary channel
	+ If the duration of the OBSS activity that makes the primary channel busy is smaller than the duration threshold, the NPCA STAs (AP and non-AP) do not switch to the NPCA primary channel.

[Motion #133, [1]]

* An AP shall not allow the use of NPCA within its BSS if the BSS operating bandwidth is less than or equal to TBD MHz, where TBD = 40 MHz or 80 MHz

[Motion #134, [1]]

* If an NPCA STA receives an OBSS RTS frame in a non-HT duplicate PPDU that does not include the bandwidth signaling TA, the NPCA STA shall not switch to the NPCA Primary channel,
* If an NPCA STA receives an OBSS RTS frame in a non-HT duplicate PPDU that includes the bandwidth signaling TA and the signaled PPDU bandwidth is 320 MHz, the NPCA STA shall not switch to the NPCA Primary channel,
* If an NPCA STA receives a CTS frame in a non-HT duplicate PPDU without receiving the soliciting OBSS RTS or MU-RTS frame, the NPCA STA shall not switch to the NPCA Primary channel
* [Motion #164, [1]]

# Text to be adopted begins here:

***TGbn editor: Please make the following changes to the 802.11bn draft D0.1:***

**9.3.3.5. Association Request frame format**

***TGbn editor: Please insert a new row as follows:***

**Table 9-64—Association Request frame body**

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| … |  |  |
| <Last assigned + 1> |  UHR Capabilities | The UHR Capabilities element is present if dot11UHROptionImple- mented is true; otherwise, it is not present. |

**9.3.3.6. Association Response frame format**

***TGbn editor: Please insert a new row as follows:***

**Table 9-63—Association Response frame body**

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| … |  |  |
| <Last assigned + 1> |  UHR Capabilities | The UHR Capabilities element is present if dot11UHROptionImple- mented is true; otherwise, it is not present. |
| <Last assigned + 2> |  UHR Operation | The UHR Operation element is present if dot11UHROptionImple- mented is true; otherwise, it is not present. |

**9.3.3.7. Reassociation Request frame format**

***TGbn editor: Please insert a new row as follows:***

**Table 9-66—Association Request frame body**

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| … |  |  |
| <Last assigned + 1> |  UHR Capabilities | The UHR Capabilities element is present if dot11UHROptionImplemented is true; otherwise, it is not present. |

* + - 1. **Reassociation Response frame format**

***TGbn editor: Please insert a new row as follows:***

**Table 9-65—Reassociation Response frame body**

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| … |  |  |
| <Last assigned + 1> |  UHR Capabilities | The UHR Capabilities element is present if dot11UHROptionImple- mented is true; otherwise, it is not present. |
| <Last assigned + 2> |  UHR Operation | The UHR Operation element is present if dot11UHROptionImple- mented is true; otherwise, it is not present. |

* + - 1. **Probe Request frame format**

***TGbn editor: Please insert a new row as follows:***

**Table 9-68—Probe Request frame body**

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| … |  |  |
| <Last assigned + 1> |  UHR Capabilities | The UHR Capabilities element is present if dot11UHROptionImplemented is true; otherwise, it is not present. |

* + - 1. **Probe Response frame format (TBD)**

***TGbn editor: Please insert a new row as follows:***

**Table 9-67—Probe Response frame body**

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| … |  |  |
| <Last assigned + 1> |  UHR Capabilities | The UHR Capabilities element is present if dot11UHROptionImple- mented is true; otherwise, it is not present. |
| <Last assigned + 2> |  UHR Operation | The UHR Operation element is present if dot11UHROptionImple- mented is true; otherwise, it is not present. |

* + 1. **Elements**
			1. **General**

***TGbn editor: Please insert a new row as follows:***

**Table 9-128—Element IDs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Element** | **Element ID** | **Element ID Extension** | **Extensible** | **Fragmentable** |
| … |  |  |  |  |
| UHR Capabilities (see [9.4.2.x (UHR](#_bookmark180)  [Capabilities element)](#_bookmark180)) | 255 | <ANA> | Yes | No |
| UHR Operation (see [9.4.2.x (UHR](#_bookmark180)  [Capabilities element)](#_bookmark180)) | 255 | <ANA> | Yes | No |

***TGbn editor: Please insert a new subclause as follows:***

**9.4.2.x UHR Capabilities element**

The format of the UHR Capabilities element is shown in [Figure 9-X1 (UHR Capabilities element format)](#_bookmark181).

|  |  |  |  |
| --- | --- | --- | --- |
| Element ID | Length | Element ID Extension | UHR MAC Capabilities Information |

Octets: 1 1 1 TBD

**Figure 9-X1—UHR Capabilities element format**

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

The format of the UHR MAC Capabilities Information field is defined in Figure 9-X2 (UHR MAC

Capabilities Information field format).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 | B1 – TBD |  |  |
|  | NPCA Supported | Reserved |  |  |
| Bits: | 1 | TBD |  |  |

**Figure 9-X2—** **UHR MAC Capabilities Information field format**

The NPCA Supported subfield indicates whether or not NPCA is supported.

**9.4.2.x UHR Operation element**

The format of the UHR Operation element is shown in [Figure 9-X1 (UHR Operation element format)](#_bookmark181).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Element ID | Length | Element ID Extension | UHR Operation Parameters | Basic UHR MCS And Nss Set  | UHR Operation Information |

Octets: 1 1 1 TBD TBD TBD

**Figure 9-XX—UHR Operation element format**

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

The format of the UHR Operation Parameters field is defined in Figure 9-XX (UHR Operation Parameters field format).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 | B1 - TBD |  |  |
|  | NPCA Operation Information Present | Reserved |  |  |
| Bits: | 1 | TBD |  |  |

**Figure 9-XX—** **UHR Operation Parameters field format**

The NPCA Operation Information Present subfield equal to 1 indicates that the NPCA operation is enabled by the AP and the NPCA Operation Information subfield is present in UHR Operation Informaiton field.

The format of the NPCA Operation Information subfield is defined in Figure 9-XX (NPCA Operation Information field format).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 - B7 | B8 - TBD |  TBD - TBD | TBD |
|  | NPCA Primary Channel | NPCA Minimum Duration Threshold | NPCA Switching Delay | NPCA Switching Back Delay |
| Bits: | 8 | TBD | 6? | 6? |

**Figure 9-XX—** **NPCA Operation Information field format**

The format of the NPCA Operation Information subfield is defined in Figure 9-XX (NPCA Operation Information field format).

The NPCA Primary Channel subfield indicates the channel number of the secondary channel within the BSS bandwidth and corresponds to the common channel of operation that the NPCA AP and its NPCA non-AP STAs switch to when the primary channel is determined to be busy because of OBSS frame exchanges or OBSS PPDU, following the procedure defined in xxx.

The NPCA Minimum Duration Threshold indicates the duration where if the detected OBSS activity (OBSS PPDU or OBSS TXOP) is longer than the value in the NPCA Minimum Duration Threshold subfield an NPCA STA detecting such activity can switch to NPCA primary channel for the frame exchanges. The unit and maximal value of NPCA Minimum Duration Threshold are TBD.

The NPCA Switching Delay subfield indicates time used by an AP to switch from primary channel to NPCA primary channel. The NPCA Switching Delay subfield value ranges between 0 and 256 usec and has a granularity of 4 usec.

The NPCA Switch Back Delay subfield indicates time used by an AP to switch from NPCA primary channel to primary channel. The NPCA Switch Back Delay subfield value ranges between 0 and 256 usec and has a granularity of 4 usec.

***TGbn editor: Please add the following subclause 37.x Non-primary channel access (NPCA) in 802.11bn D0.1:***

37.x Non-primary channel access (NPCA)

A STA that supports NPCA operation is called an NPCA STA and shall set the NPCA Supported field of the UHR MAC Capabilities Information field of the UHR Capabilities element to 1.

An AP that has an operating bandwidth of 40 MHz shall not enable the NPCA mode within its BSS.

In a 320 MHz BSS, the NPCA Primary channel shall be one of the 20MHz channels within the Secondary 160 MHz channel of the BSS. In a 160 MHz BSS, the NPCA Primary channel shall be one of the 20 MHz channels within the Secondary 80 MHz channel. In a 80 MHz BSS, the NPCA Primary channel shall be one of the 20 MHz channels within the Secondary 40 MHz channel of the BSS.

An NPCA AP shall carry the **NPCA Operation Information field in its UHR Operation element and** announce its NPCA Switching delay and NPCA Switch back delay respectively in the NPCA Switching Delay subfield and NPCA Switching Back Delay subfield of the ~~TBD~~ TBD frames that it transmits.

A non-AP STA that supports the NPCA mode shall announce its NPCA Switching delay and NPCA Switch back delay in TBD frames

When a STA is operating in the NPCA mode, the following applies:

1. the STA may switch from the BSS primary channel to the NPCA primary channel based on an HE/EHT/UHR PPDU reception on the BSS primary channel if all of the following conditions apply:
	1. the STA received on the BSS primary channel a PPDU that is an HE/EHT/UHR PPDU
	2. the received PPDU is classified by the STA as an inter-BSS PPDU following the procedure defined in (26.2.2 Intra-BSS and inter-BSS PPDU classification)
	3. the duration of the received PPDU, determined by the Length and Rate fields of the L-SIG field of the PPDU, plus the TXOP duration, indicated in the TXOP field of the HE-SIG-A/U-SIG field, is greater than the minimum duration threshold advertised by its associated NPCA AP
	4. the 20/40/80/160MHz channel occupied by the received PPDU is identified by the STA, thanks to the Bandwidth field in the PHY preamble of the PPDU and to the channel allocations in the corresponding band, and the channel occupied by the received PPDU does not overlap with the NPCA primary channel
	5. TBD conditions
2. the STA may switch from the BSS primary channel to the NPCA primary channel based on the reception of all or part of an OBSS control frame exchange on the primary channel if all of the following conditions apply:
	1. the STA received on the BSS primary channel a PPDU containing a control frame and/or a PPDU containing a initial response frame of a control frame exchange
		1. Which initial control frame and initial response frame are permissible for NPCA switching are TBD
	2. the received PPDU is classified by the STA as an inter-BSS PPDU following the procedure defined in (26.2.2 Intra-BSS and inter-BSS PPDU classification)
	3. the TxOP duration, determined by the Duration field of the received frame, is larger than the minimum duration threshold advertised by its associated NPCA AP
		1. Whether the duration indicated in the TXOP field of the HE-SIG-A/U-SIG field is considered for this comparison is TBD
	4. the 20/40/80/160MHz channel occupied by the received PPDU is identified by the STA, thanks to the channel allocations in the corresponding band and the PPDU bandwidth that is signaled in the received frame or obtained with the CH\_BANDWIDTH\_IN\_NON\_HT RxVector of the received PPDU and the channel occupied by the received PPDU does not overlap with the NPCA primary channel
		1. if the Control frame is an RTS frame in a non-HT (duplicate) PPDU, then it includes a bandwidth signaling TA and the signaled PPDU bandwidth is 20 MHz, 40 MHz, 80 MHz, or 160 MHz
		2. identifying the channel occupied by a received CTS frame in a non-HT (duplicate) PPDU may only be achieved when the soliciting RTS frame or the MU-RTS frame is also received
	5. TBD conditions
3. If the STA switches from the BSS primary channel to the NPCA primary channel based on an OBSS HE/EHT/UHR PPDU reception on the primary channel, it shall initiate the switch at the NPCA switch time (TBD) and the STA shall be ready to transmit and receive frames addressed to it (subject to its capabilities and operating mode) on the NPCA primary channel no later than NPCA switching delay after the NPCA switch time, using the NPCA switching delay most recently indicated by the STA, where NPCA switch time is defined as follows:
	1. TBD
4. If the STA switches from the BSS primary channel to the NPCA primary channel based on an OBSS control frame exchange reception on the primary channel, it shall initiate the switch at the NPCA switch time (TBD) and the STA shall be ready to transmit and receive frames addressed to it (subject to its capabilities and operating mode) on the NPCA primary channel no later than NPCA switching delay after the NPCA switch time, using the NPCA switching delay most recently indicated by the STA, where NPCA switch time is defined as follows:
	1. TBD
5. The STA shall apply the same EDCA Parameter Set, MU EDCA Parameter Set, and EPCS EDCA Parameter Set on the BSS Primary channel and NPCA Primary channel.
6. Once the STA becomes ready to transmit on the NPCA primary channel, the STA may initiate a TXOP on the NPCA primary channel by following the rules defined in 10.23.2.2 (EDCA backoff procedure) and 10.23.2.4 (Obtaining an EDCA TXOP) with the following exceptions:
	1. Every time the STA switches to the NPCA Primary channel, it shall initialize CW\_NPCA[AC] to TBD value and pick a new backoff counter (BO\_NPCA) randomly between 0 and CW\_NPCA[AC].
	2. QSRC\_NPCA[AC] shall be set to 0.
	3. If the STA is a non-AP STA and the associated AP has disabled the use of untriggered UL transmissions on the NPCA Primary channel, then the non-AP STA shall not initiate a TXOP on the NPCA primary channel.
		1. TBD whether MU EDCA parameters mechanism is used to disable untriggered UL transmissions on the NPCA Primary channel or not.

NOTE – Baseline EDCA procedure is followed on the BSS Primary channel. The values of CW\_NPCA and BO\_NPCA are discarded by the NPCA STA when it switches back to the BSS Primary channel.

1. The STA shall not initiate a transmission to its peer NPCA STA on the NPCA primary channel until the peer STA’s switching delay has elapsed since the NPCA switch time
2. The STA shall initiate frame exchange on the NPCA Primary channel with an NPCA initial Control frame in the non-HT PPDU or non-HT duplicate PPDU format using a rate of 6 Mb/s, 12 Mb/s, or 24 Mb/s.
	1. Details on the NPCA ICF are TBD
3. If the STA is an AP and transmits a Trigger frame on the NPCA Primary channel, the STA shall signal the RU index considering the NPCA Primary channel as the reference primary channel. The Trigger frame shall include an explicit indication that it is transmitted on the NPCA Primary channel. Signaling details TBD.
4. The 20MHz channels occupied by PPDUs sent by the STA after having switched to the NPCA primary channel and gaining the right to initiate a TXOP shall:
	1. Contain at least the NPCA primary channel
	2. Be within the AP’s BSS bandwidth
	3. not include the channels in the bandwidth occupied by the OBSS traffic that caused the NPCA STA to switch from the BSS primary channel to the NPCA primary channel, and
	4. not include the channels that are indicated as punctured in the Disabled Subchannel Bitmap subfield in the EHT Operation element,
	5. It is TBD whether a frame that solicits a response other than TB PPDUs can puncture 20 MHz subchannels not indicated as punctured in the Disabled Subchannel Bitmap subfield of the EHT Operation element.

# Text to be adopted ends here.

**References:**

1. [11-24-0171r21](https://mentor.ieee.org/802.11/dcn/24/11-24-0171-21-00bn-tgbn-motions-list-part-1.pptx): 11-24-0171-21-00bn-tgbn-motions-list-part-1, Alfred Asterjadhi (Qualcomm Inc.)