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 |
| 3 | Fix a few editorial issues in the motionsThe r2 version of this document was mostly a consolidation of various text suggestions without a thorough editorial review. The r3 version includes a much more careful examination of the text with the aim of correcting editorial issues. The summary of those corrections is listed here, NOTE THAT a few TECHINCAL CHANGES occurred in the update to r3:Make figure numbers 9-XX different from each otherRemove duplicate reference to Figure NPCA Op Info field format9.4.2.x UHR Operation element- NPCA Primary Channel subfield, editorial clarifications- NPCA Minimum Duration Threshold subfield, editorial clarifications- NPCA Operation Information Present subfield, editorial clarifications- NPCA Switching Delay subfield, editorial clarifications – TECHNICAL change = max value is 252 usec, not 256 usec- NPCA Switch Back Delay subfield, editorial clarifications – TECHNICAL change = max value is 252 usec, not 256 usec, make format diagram subfield name match description name37.x Non-primary channel access (NPCA)- added editorial clarification, more precise text regarding enabling NPCA operation within a BSS- various minor editorial changes, e.g. add missing articles, NPCA mode vs NPCA operation, capitalization consistency- added a paragraph to restrict NPCA operation by an NPCA STA to the times when the AP has indicated that NPCA operation is enabled in the BSS- Added terms NPCA HE switch time and NPCA NHT switch time to better differentiate the two distinct parameters identified in the NPCA STA switching rules section |
|  |  |
|  |  |

# 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 Non-Primary Channel Access (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 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 NPCA operation is supported by the STA transmitting this subfield. A value of 1 in this subfield indicates that NPCA operation is supported. A value of 0 in this subfield indicates that NPCA operation is not 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-X3—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-X4—** **UHR Operation Parameters field format**

The NPCA Operation Information Present subfield indicates whether NPCA operation is enabled at the AP transmitting this field and whether the NPCA Operation Information subfield is present in the UHR Operation Information field contained in the UHR Operation element that contains this subfield. The NPCA Operation Information Present subfield is set to 1 to indicate that NPCA operation is enabled by the AP and that the NPCA Operation Information subfield is present in the UHR Operation Informaiton field. The NPCA Operation Information Present subfield is set to 0 to indicate that NPCA operation is not enabled by the AP and that the NPCA Operation Information subfield is not present in the 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 Switch Back Delay |
| Bits: | 8 | TBD | 6? | 6? |

**Figure 9-X5—** **NPCA Operation Information field format**

The NPCA Primary Channel subfield indicates the channel number of a secondary channel within the BSS bandwidth that corresponds to the channel that the NPCA AP and its associated NPCA non-AP STAs switch to to perform NPCA operation when the primary channel is determined to be busy because of OBSS frame exchanges or an OBSS PPDU, as described in 37.x (Non-primary channel access (NPCA)).

The NPCA Minimum Duration Threshold subfield indicates the minimum duration of OBSS activity (OBSS PPDU or OBSS TXOP) that is required to be indicated on the primary channel of the BSS before an NPCA STA switches to the NPCA primary channel to perform NPCA operation. The encoding and the maximum value of this subfield are TBD.

The NPCA Switching Delay subfield indicates the time needed by an AP to switch from the BSS primary channel to the NPCA primary channel. The NPCA Switching Delay subfield is an unsigned integer in units of 4 usec.

The NPCA Switch Back Delay subfield indicates the time needed by an AP to switch from the NPCA primary channel to the BSS primary channel. The NPCA Switch Back Delay subfield is an unsigned integer in units 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 supports NPCA operation is called an NPCA AP.

An AP that has an operating bandwidth greater than 40 MHz and that supports NPCA operation may enable NPCA operation for the BSS by setting the NPCA Operation Information Present subfield to 1. An AP that has an operating bandwidth of 40 MHz or less shall set the NPCA Operation Information Present subfield to 0 to indicate that NPCA operation is disabled 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 AP that enables NPCA operation in its BSS shall set the value of the NPCA Primary Channel subfield to conform with these restrictions.

An NPCA AP shall include the NPCA Operation Information subfield in its UHR Operation element and indicate its NPCA Switching Delay and NPCA Switch Back Delay respectively in the NPCA Switching Delay subfield and NPCA Switch Back Delay subfields of the TBD frames that it transmits.

A non-AP STA that supports NPCA operation shall announce its NPCA Switching Delay and NPCA Switch Back Delay in TBD frames.

An NPCA STA shall not switch to the NPCA primary channel for NPCA operation if the value of the most recently received NPCA Operation Information Present subfield from its associated AP is equal to 0.

An NPCA STA may switch to the NPCA primary channel for NPCA operation if the value of the most recently received NPCA Operation Information Present subfield from its associated AP is equal to 1 if either condition a) or b) is met:

1. the STA received a PPDU that is an HE/EHT/UHR PPDU on the BSS primary channel and all of the following conditions are true:
	1. 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).
	2. 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 NPCA Minimum Duration Threshold advertised by its associated AP
	3. the 20/40/80/160MHz channel occupied by the received PPDU is identified by the STA, based on the Bandwidth field in the PHY preamble of the PPDU and the channel allocations in the corresponding band, and the channel occupied by the received PPDU does not overlap with the NPCA primary channel
	4. TBD conditions
2. the STA received a PPDU containing a control frame and/or a PPDU containing a initial response frame of a control frame exchange on the BSS primary channel and all of the following conditions apply:
	1. the received PPDU(s) are classified by the STA as inter-BSS PPDU(s) following the procedure defined in 26.2.2 (Intra-BSS and inter-BSS PPDU classification)
	2. the TXOP duration, determined by the Duration field of the received frame(s), is larger than the NPCA 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
	3. the 20/40/80/160MHz channel occupied by the received PPDU is identified by the STA, based on the channel allocations in the corresponding band and the PPDU bandwidth that is signaled in the received frame or obtained with the RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT 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. identification of the channel occupied by a received CTS frame in a non-HT (duplicate) PPDU is determined by examining the RTS frame or the MU-RTS frame that elicited the CTS response
	4. TBD conditions

When an NPCA STA switches to the NPCA primary channel for NPCA operation, then the following rules apply:

1. 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 BSS primary channel, the STA shall initiate the switch at the NPCA HE switch time and it 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 the value of its most recently indicated NPCA Switch Delay after the NPCA HE switch time, where NPCA HE switch time is defined as follows:
	1. TBD
2. 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, the STA shall initiate the switch at the NPCA NHT switch time and it 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 the value of its most recently indicated NPCA Switch Delay after the NPCA NHT switch time, where NPCA NHT switch time is defined as follows:
	1. TBD
3. The STA shall use the same EDCA Parameter Set, MU EDCA Parameter Set, and EPCS EDCA Parameter Set values for operation on the NPCA primary channel as it uses on the BSS primary channel.
4. 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. Each time that the STA switches to the NPCA Primary channel, it shall initialize CW\_NPCA[AC] to TBD value and randomly choose a new initial value between 0 and CW\_NPCA[AC] for the backoff counter (BO\_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 and or some other mechanism is used to disable untriggered UL transmissions on the NPCA Primary channel.

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

1. The STA shall not initiate a transmission on the NPCA primary channel to another STA until that STA’s NPCA Switch Delay time has elapsed since the NPCA HE switch time or NPCA NHT switch time, whichever is relevant
2. The STA shall begin all frame exchanges on the NPCA primary channel with an NPCA initial Control frame using 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. An NPCA AP that transmits a Trigger frame on the NPCA Primary channel shall indicate RU index values that use the NPCA Primary channel as the reference primary channel. The Trigger frame shall include an explicit indication that it is being transmitted on the NPCA Primary channel. Signaling details TBD.
4. The 20MHz channels occupied by PPDUs transmitted by the STA while performing NPCA operation on the NPCA primary channel shall meet all of the following conditions:
	1. include at least the NPCA primary channel
	2. all be within the AP’s BSS bandwidth
	3. not include any of the channels occupied by the OBSS traffic that caused the STA to switch from the BSS primary channel to the NPCA primary channel
	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.)