IEEE P802.11
Wireless LANs

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| CC50 CR for CID 1872, 1879, 1880 – NPCA operation |
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This document proposes resolution to the following CC50 CIDs (changes relative to draft 0.3):

1872, 1879, 1880

Revisions:

* Rev0: Initial version of the document.
* Rev1: Some proposed changes in the Doc. [11-25/0936r7](https://mentor.ieee.org/802.11/dcn/25/11-25-0936-07-00bn-pdt-cr-mac-npca-cc50.docx) related to the CID 1872 have been applied with modifications. The reason for the modifications has been added to the discussion section.

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| **CID** | **Page** | **Line** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| 1872 | 79 | 43 | 37.10 | An NPCA AP may receive a frame transmitted by a STA(e.g., legacy STA) that is operating on the BSS primary channel. It makes no sense if the NPCA AP respond with a response frame to the received frame on the NPCA primary channel. This is because the STA operating on the BSS primary channel cannot receive the response frame.  | Please add responding rules for the NPCA AP.Adding an indication to the NPCA ICF (transmitted by both an NPCA AP and a non-AP NPCA STA) could be considered for letting the AP can make decision for responding based on the indication. | **Revised**Agree with the commenter.As the NPCA Primary Indication is introduced in D0.3, the AP can determine whether a received frame was transmitted over the NPCA primary channel or not. By limiting the AP’s response to the frame transmitted on the NPCA primary channel only, the AP is prevented from responding to the frame transmitted through the BSS primary channel.Corresponding rule was added.**TGbn editor: please implement changes as shown in this document tagged CID1872.** |
| 1879 | 80 | 22 | 37.10 | It is unclear how a STA that has completed backoff procedure defer its Tx initiation considering the NPCA switching delay of a recipient STA. | Please provide a channel access mechanism for a NPCA STAs to defer Tx initiation considering the NPCA switching delay. | **Revised**Agree with the commenter.Channel access mechanism for deferring start of the transmission on the NPCA primary channel was added.**TGbn editor: please implement changes as shown in this document tagged CID1879.** |
| 1880 | 80 | 22 | 37.10 | When an AP intends to transmit an MU PPDU, it must defer its transmission start time until the non-AP STA with the longest switching delay among the intended recipient STAs has completed switching. If a non-AP STA initiates UL PPDU transmission while the AP is still deferring its transmission start, the non-AP STA may acquire the TXOP despite the AP having already completed its backoff procedure. | Please define a mechanism to ensure that the non-AP NPCA STAs do not initiate UL PPDU transmission while the NPCA AP is deferring its transmission start. | **Revised**Agree with the commenter.The “UL TXOP Restricted Duration**”** field is added to the NPCA Operation Information field, and the corresponding channel access rule for the NPCA non-AP STA is defined.This field is used to indicate the duration during which untriggered UL transmissions are restricted, and whether such untriggered transmissions are allowed on the NPCA primary channel.In addition, NOTE 2 has been added to clarify the behavior of an NPCA AP transmitting the NPCA ICF to the multiple NPCA non-AP STAs.**TGbn editor: please implement changes as shown in this document tagged CID1880.** |

**Discussion:**

1. **Mechanism for deferring TX initiation considering NPCA switching delay**

In the NPCA primary channel, an NPCA STA is required to defer its transmission until the NPCA switching delay of the intended recipient STA expires. However, D0.3 does not specify mechanism for achieving this transmission deferral.

Two types of deferral mechanisms commonly used in the baseline are as follows:

1. **Re-generating a random backoff counter when the backoff counter reaches zero**

**e.g. Quiet interval, R-TWT, etc.**

1. **Freezing the backoff counter at zero until the transmission condition is met**

**e.g. EDCAF with no queueing packet, Start time sync PPDUs medium access, etc.**

If method ii) is used, NPCA STAs that consider the same NPCA switching delay may attempt to initiate transmissions at the same time. For example, multiple STAs attempting to transmit to the NPCA AP would all start uplink transmissions simultaneously when the AP's NPCA switching delay expires, resulting in collisions.

Therefore, it is preferable for NPCA STAs to defer their transmission start time following the mechanism i) in order to reduce the likelihood of simultaneous transmissions and collisions.

1. **Untriggered UL Transmission Restricted Duration**

When an NPCA AP intends to transmit a DL MU PPDU, it should adjust the transmission start time by considering the capability of the intended recipient non-AP STA that has the largest NPCA switching delay. The problem here is that another NPCA STA may initiate NPCA ICF transmission while the NPCA AP deferring its transmission.

To address the issue, we propose to introduce Untriggered UL Transmission Restricted Duration.

The restricted durationrefers to the time period during which uplink transmissions from NPCA non-AP STAs are restricted, and it is designated by the NPCA AP. The NPCA AP may determine the restricted duration based on the NPCA switching delays of the associated NPCA STAs.
Once the restricted duration is indicated by the NPCA AP, the NPCA non-AP STAs shall not initiate uplink transmissions on the NPCA primary channel until the restricted duration expires, even if the NPCA switching delay of the AP has already elapsed.

An NPCA non-AP STA that defers its transmission due to the untriggered UL transmission restriction duration uses the same mechanism as used when deferring transmission based on the NPCA switching delay, i.e., by re-generating the backoff counter.

More details on the proposed resolutions can be found in [11-25/0864r1](https://mentor.ieee.org/802.11/dcn/25/11-25-0864-01-00bn-channel-access-mechanisms-for-the-npca-operation.pptx).

1. **Response rules on the NPCA primary channel**

It is meaningless for an NPCA AP to respond to a frame transmitted by a non-AP STA operating on the BSS primary channel, as the response frame is unlikely to be received by the non-AP STA.

However, in the case of an NPCA non-AP STA, if the received frame allocates an RU that the NPCA non-AP STA can respond on, the STA may still participate in the frame exchange sequence by responding to the received frame — even if the received frame was transmitted on the BSS primary channel. Therefore, such responses need not be restricted.

**Proposed resolution:**

**9.4.2.aa1 UHR Operation Element**

***TGbn Editor: Please modify the NPCA Operation Information field format in 11bn D0.3 as follows:***

The format of the NPCA Operation Information field is defined in Figure 9-aa3 (NPCA Operation Information field format),

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B0 B7 | B8 B11 | B12 B17 | B18 B23 | B24 B31 |
|  | **NPCA Primary Chanel** | **NPCA Minimum Duration Threshold** | **NPCA Switching Delay** | **NPCA Switch Back Delay** | **UL TXOP Restricted Duration**(#1880) |
| Bits: | 8 | 4 | 6 | 6 | 8 |

The NPCA Primary Channel field indicates the channel number of a channel within the BSS bandwidth that corresponds to the channel that the NPCA AP and its associated NPCA non-AP STAs switch to in order to perform NPCA operation, as described in 37.11 (Non-primary channel access (NPCA)).

The NPCA Minimum Duration Threshold field indicates the minimum duration of inter-BSS activity (inter-BSS PPDU or inter-BSS TXOP) that is required to have been indicated on the primary channel of the BSS as a necessary condition to permit an NPCA STA to switch to the NPCA primary channel to perform NPCA operation. The NPCA Minimum Duration Threshold field is set as defined in Table 9-xxx (Encoding of the NPCA Minimum Duration Threshold field).

The NPCA Switching Delay field indicates the time needed by an NPCA STA to switch from the BSS primary channel to the NPCA primary channel in units of 4 μs.

The NPCA Switch Back Delay field indicates the time needed by an NPCA STA to switch from the NPCA primary channel to the BSS primary channel in units of 4 μs.

The UL TXOP Restricted Duration field indicates the duration, in units of 9 μs, during which untriggered UL transmissions are restricted after switching to the NPCA primary channel. The field is reserved when transmitted by a non-AP STA.(#1880)

The value 0 indicates that untriggered UL transmissions are not restricted by this field. The value 255 indicates that untriggered UL transmissions are not allowed on the NPCA primary channel.(#1880)

***TGbn editor: Please modify subclause 37.11 Non-primary channel access (NPCA) as follows:***

**37.11 Non-primary channel access (NPCA)**

A STA that supports NPCA operation is called an NPCA STA. An AP that supports NPCA operation is called an NPCA AP. A non-AP NPCA STA shall set the NPCA Supported field of the UHR MAC Capabilities Information field of the UHR Capabilities element to 1. A non-AP NPCA STA may enable the NPCA mode only if it is associated with an NPCA AP. It is TBD how the non-AP STA enables NPCA mode.

An NPCA AP that has an operating bandwidth less than TBD (but either 80 or 160 MHz) shall not enable NPCA operation. An AP of a multiple BSSID set which enables NPCA operation shall indicate the same NPCA primary channel as all of the other APs of the same multiple BSSID set which have enabled NPCA operation.

An NPCA AP that has enabled NPCA operation shall include the NPCA Operation Information field in its UHR Operation element and indicate its NPCA switching delay and NPCA switch back delay and UL TXOP restricted duration respectively in the NPCA Switching Delay field, NPCA Switch Back Delay and UL TXOP Restricted Duration field of the TBD frames. (#1880)

A non-AP STA that supports NPCA operation shall announce its NPCA switching delay and NPCA switch back delay respectively in the NPCA Switching Delay field and NPCA Switch Back Delay fields of the TBD frames.

An NPCA AP may enable a mode of operation in which untriggered UL transmissions on the NPCA primary channel by NPCA non-AP STAs are not permitted by setting the UL TXOP Restricted Duration field it transmits to 255. Whether the mode is for all associated non-APs or per non-AP is TBD. Whether MU EDCA parameters mechanism is used for this or not is TBD. (#1880)

A non-AP 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 field from its associated AP is equal to 0. An NPCA AP shall not switch to the NPCA primary channel for NPCA operation if the value of its most recently transmitted NPCA Operation Information Present field 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 or transmitted NPCA Operation Information Present field corresponding to the BSS of which it is a member is equal to 1 and either condition 1) or 2) is met:

1. the STA received a PPDU and/or received a PHY-RXSTART.indication primitive for an HE/ EHT/UHR PPDU on the BSS primary channel and all of the following conditions are true:
	1. the 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 PPDU, (determined by the MAC in a manner TBD, but necessarily involving some of the parameters of the RXVECTOR associated with the received PPDU) or the duration of the PPDU plus the value of the RXVECTOR parameter TXOP\_DURATION of the PPDU, is greater than the value indicated in the most recently received or transmitted NPCA Minimum Duration Threshold field corresponding to the BSS of which it is a member
		1. whether the RXVECTOR parameter TXOP\_DURATION of the PPDU is considered for this comparison and whether it is indicated by the AP is TBD
	3. the 20/40/80/160 MHz channel occupied by the 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 PPDU does not overlap with the NPCA primary channel
	4. TBD conditions
2. 2) the STA received a PPDU containing a Control frame and a PPDU containing an 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 from the Duration field of the received frame(s), is greater than the value indicated in the most recently received or transmitted NPCA Minimum Duration Threshold field corresponding to its BSS
		1. Whether the RXVECTOR parameter TXOP\_DURATION of the received PPDU(s) are considered for this comparison is TBD
	3. the 20/40/80/160 MHz channel occupied by the received PPDU(s), identified by the STA based on the channel allocations in the corresponding band and the PPDU bandwidth that is signaled in the received PPDU(s) or obtained from the RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT of the received PPDU(s), 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 meeting condition 1) above, the STA shall initiate the switch at the NPCA HE switch time and it shall be ready to transmit and receive frames (subject to its capabilities and operating mode) on the NPCA primary channel no later than the value of its most recently indicated NPCA switching delay after the NPCA HE switch time, where NPCA HE switch time is defined as follows:

a. TBD

1. If the STA switches from the BSS primary channel to the NPCA primary channel based on meeting condition 2) above, 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 switching delay after the NPCA NHT switch time, where NPCA NHT switch time is defined as follows:

a. TBD

1. 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.
2. 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: M126
	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 for that STA, then the STA shall not initiate a TXOP on the NPCA primary channel.

NOTE 1—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.(#1880)

1. The STA shall not initiate a transmission on the NPCA primary channel to another STA until that STA's NPCA switching delay time has elapsed since the NPCA HE switch time if switching due to condition 1) above or NPCA NHT switch time if switching due to condition 2) above.

NOTE 2— When an NPCA AP initiates a transmission to multiple NPCA non-AP STAs, it needs to take into account the maximum NPCA switching delay among the switching delays indicated by all the NPCA non-AP STAs.(#1880)

1. An NPCA non-AP STA shall not initiate a transmission on the NPCA primary channel to the NPCA AP until the time duration indicated by the UL TXOP Restricted Duration field transmitted by the NPCA AP has elapsed since the NPCA HE switch time if switching due to condition 1) above or NPCA NHT switch time if switching due to condition 2) above. (#1880)
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. (#1872)
4. An NPCA STA that transmits a Trigger frame on the NPCA primary channel shall set the NPCA Primary Indication field to 1 in the Special User Info field. (#1872)
5. The 20 MHz channels occupied by PPDUs transmitted by the STA shall meet all of the following conditions:
	1. include at least the NPCA primary channel
	2. all be within the BSS bandwidth
	3. not include any of the channels occupied by the inter-BSS traffic that caused the STA to switch from the BSS primary channel to the NPCA primary channel
	4. not include channels that are indicated as punctured in the Disabled Subchannel Bitmap field 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 field of the EHT Operation element.
6. An NPCA AP shall not respond to a received frame if the frame is not a BSRP NTB Trigger frame with a value of 1 in the NPCA Primary Indication field of the Special User Info field. (#1872)

NOTE 3—An NPCA non-AP STA may transmit a response frame based on the CS mechanism, regardless of the presence or value of the NPCA Primary Indication field, as long as the frame received from its associated AP allocates RU(s) on which the STA can transmit the response. (#1872)

The NPCA STA that defers its TXOP initiation following 5) or 6) above shall select a random backoff counter using the present CW[AC] when it gains the right to initiate transmission. In such a case, CW\_NPCA[AC] and QSRC\_NPCA[AC] shall be left unchanged. (#1879)