IEEE P802.11
Wireless LANs

|  |
| --- |
| PDT: Channel access for Triggered TXOP Sharing  |
| Date: 2021-03-17 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Dibakar Das | Intel |  |  | Dibakar.das@intel.com |
| Laurent Cariou |  |  |  |
| Dmitry Akhmetov |  |  |  |
| Dan Bravo |  |  |  |
| Danny Alexander |  |  |  |
| Matthew Fischer | Broadcom |  |  |  |
| Stephane Baron | Canon |  |  |  |
| Alfred Asterjadhi | Qualcomm |  |  |  |
| Yunbo Li | Huawei |  |  |  |

Abstract

This submission proposes channel access rules to the **Triggered TXOP sharing procedure** in 0087r6 and resolve the following TBD:

“After a non-AP STA receives an MU-RTS TXS Trigger frame from its associated AP and addressed to it, the STA shall transmit one or more non-TB PPDUs within the time allocation signaled in the TBD field of the MU-RTS TXS Trigger frame.”

Rev0: initial version

Rev4: removed case of STA exceeding its allocation.

**Discussion:**

1. We propose the signaling and the channel access procedure for the Triggered TXOP sharing procedure.
2. We propose that the time allocation information is carried in the UL Length field of the MU-RTS TX Trigger frame to signal upto ~16ms. However, there can be two options on the signaling format. As such we may want to run a SP.

 **SP 1**

 Which option do you support for the encoding in the UL Length field in an MU-RTS TX Trigger frame to indicate the time allocated to a non-AP STA:

 Option 1: Bits B0-B6 of the UL Length field are used and with unit of 128us

 Option 2: Bits B0-B11 of the UL Length field in units of 4us ?

 This PDT assumes if UL length field is majority opinion, then option 2 is preferred based on SP results.

SP 2

 Which option do you support to indicate the time allocated to a non-AP STA in an MU-RTS TX Trigger frame:

 Option 1: 7 reserved bits in the User Info are used and with unit of 128us

 Option 2: Bits B0-B11 of the UL Length field in units of 4us ?

**Option 1** will allow an easy extension in R2 in case we want to extend this signaling for other purposes such as Multi-user TXOP Sharing or C-TDMA.

**Option 2**  keeps it aligned with baseline design of the TF wrt usage of UL Length field. However, it makes it more convoluted to extend the signaling for any multi-user cases in future because (a) It changes the signaling location for same functionality (i.e., allocated time) based on whether its for SU or MU and (b) The number of available reserved bits in User Info is much smaller than one in Common Info which could result in different granularity of time allocation in the SU and MU variants.

I prefer Option 1 because of forward-compatibility. Check page 4 (with track change enabled) for spec changes corresponding to each option.

**9.3.1.22 Trigger frame format**

**9.3.1.22.1 General**

***TGbe editor: Modify Figure 9-64b in P45L53 of 11ax draft 8.0 as follows***

 **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-LTF Type/TXOP Sharing Mode | MU-MIMO HE-LTF Mode | Number of HE-LTF Symbols And Midamble Periodicity |

Bits: 4 12 1 1 2 2 1 3

 **B26 B27 B28 B33 B34 B35 B36 B37 B52 B53 B54 B62**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL STBC | LDPCExtraSymbolSegment | AP TxPower | Pre-FECPaddingFactor | PEDisambiguity | UL SpatialReuse | Doppler | ULHE-SIG-A2Reserved |

Bits: 1 1 6 2 1 16 1 9

 **B63**

|  |  |
| --- | --- |
| Reserved | Trigger Dependent Common Info |

 Bits: 1 variable

 **Figure 9-64b—Common Info field format**

***TGbe editor: Insert the following text in P128L48 of 11ax draft 8.0 as follows:***

The GI And HE-LTF Type subfield of the Common Info field indicates the GI and HE-LTF type of the HE TB PPDU response. The GI And HE-LTF Type subfield is present in a Trigger frame that solicits a TB PPDU response and its encoding is defined in Table 9-29e (GI And HE-LTF Type subfield encoding). The TXOP Sharing Mode subfield indicates the TXOP sharing mode. The TXOP sharing Mode subfield is present in an MU RTS Trigger frame and is defined in 9.3.1.22.5.

**9.3.1.22.5 MU-RTS Trigger frame format**

***[Option 1 starts]***

***TGbe editor: Modify the following text in P129L43 of 11ax draft 8.0 as follows:***

The MU-MIMO HE-LTF Mode, Number Of HE-LTF Symbols And Midamble Periodicity, UL STBC, LDPC Extra Symbol Segment, AP Tx Power, Pre-FEC Padding Factor, PE Disambiguity, UL Spatial Reuse, Doppler and UL HE-SIG-A2 Reserved subfields in the Common Info field are reserved.

***TGbe editor: Modify the following text in P95L12 of 11be draft 0.4 as follows:***

The UL Length subfield in the Common Info field of the MU-RTS TXS Trigger frame indicates the time duration allocated to the non-AP STA within the TXOP obtained by the AP in units of 4 µs.

The UL Length subfield is reserved in an MU-RTS Trigger frame that is not a MU-RTS TXS Trigger frame.

***[Option 1 ends]***

***[Option 2 starts]***

***TGbe editor: Revise the text in P125L32 of 11ax draft 8.0 as follows***

The User Info field is defined in Figure 9-64d (User Info field format) for all Trigger frame variants except the NFRP Trigger frame and the MU-RTS Trigger frame, which is defined in 9.3.1.22.9 (NFRP Trigger frame format) and 9.3.1.22.5 (MU-RTS Trigger frame format) respectively.

***TGbe editor: Add the following text in P131L49 of 11ax draft 8.0 as follows***

The User Info field for MU-RTS Trigger frame is defined in Figure 9-64xx (User Info field format in the MU-RTS Trigger frame). The UL HE-MCS, UL FEC Coding Type and UL Target Receive Power fields in the User Info field are reserved.

B0 B11 B12 B19 B20 B21 B24 B25 B31 B32 B38 B39

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| AID12 | RU Allocation | UL FEC Coding Type | UL HE-MCS | Time Allocation | UL Target Receive Power | Reserved | Trigger Dependent User Info |

Bits: 12 8 1 4 7 7 1 variable

 **Figure 9-64xx—User Info field format in the MU-RTS Trigger frame**

***TGbe editor: Modify the following text in P95L12 of 11be draft 0.4 as follows:***

The Time Allocation subfield in the User Info field of the MU-RTS TXS Trigger frame indicates the time duration allocated to the non-AP STA within the TXOP obtained by the AP, in units of 128 µs.

The Time Allocation subfield is reserved in an MU-RTS Trigger frame that is not a MU-RTS TXS Trigger frame.

***[Option 2 ends]***

***TGbe editor: Modify the following text in P95L1 of draft 0.4 as follows:***

The TxOP Sharing Mode subfield in the Common Info field is set to a nonzero value if theMU-RTS Trigger frame is sent by an EHT AP that intends to allocate time within an obtained TXOP to an EHT non-APSTA for transmitting one or more non-TB PPDUs sequentially (see 35.2.1.3 (Triggered TXOP sharing procedure)); otherwise it is set to 0. The encoding of the TXOP Sharing Mode subfield is defined in Table 9-31xxx (TXOP Sharing Mode subfield encoding).

 **Table 9-31xxx TXOP Sharing Mode subfield encoding**

|  |  |
| --- | --- |
| **TxOP Sharing Mode subfield value** | **Description** |
| 0 | MU-RTS that does not initiate MU-RTS TXOP Sharing procedure  |
| 1 | MU-RTS that initiates MU-RTS TXOP Sharing procedure wherein a scheduled STA can only transmit PPDU(s)addressed to its associated AP  |
| 2 | MU-RTS that initiates MU-RTS TXOP Sharing procedure wherein a scheduled STA can transmit PPDU(s) addressed to its associated AP or addressed to another STA  |
| 3  | Reserved |

An MU-RTS Trigger frame that has the TXOP Sharing Mode subfield set to a nonzero value is called an MU-RTS TXOP Sharing (TXS) Trigger frame for the remainder of this subclause and throughout Clause 35 (Extremely high throughput (EHT) MAC specification).

***TGbe editor: Modify the following text in P189L58 of draft 0.4 as follows:***

**35.2.1.3 Triggered TXOP sharing procedure**

 **35.2.1.3.1 General**

The Triggered TXOP sharing procedure allows an AP to allocate a portion of the time within an obtained TXOP to only one non-AP STA for transmitting one or more non-TB PPDUs.
An EHT STA with dot11EHTTXOPSharingTFOptionImplemented equals to true shall set the Triggered TXOP Sharing Support subfield in EHT Capabilities element to 1; otherwise, it shall set the subfield to 0.

An EHT STA with dot11EHTTXOPSharingTFOptionImplemented equal to 1 shall follow the rules defined in 26.2.6 (MU-RTS Trigger/CTS frame exchange procedure) when transmitting or responding to a MU-RTS TXS Trigger frame and the additional rules defined in 35.2.1.3.2 (AP behavior) and in 35.2.1.3.3 (Non-AP STA behavior).

An EHT STA that uses information from an MU-RTS TXS Trigger frame as the most recent basis to

update its NAV should not reset the NAV that is updated by this frame unless it receives a CF-End frame that satisfies the conditions in 26.2.5 (Truncation of TXOP).

**35.2.1.3.2 AP behavior**

An EHT AP may allocate time within an obtained TXOP to a non-AP STA by transmitting an MU- RTS TXS Trigger frame as defined in 9.3.1.22.5 (MU-RTS Trigger frame format) parametrized as follows:
— The Trigger frame has one User Info field that is addressed to the non-AP STA.

An EHT AP shall not send a MU-RTS TXS Trigger frame with the User Info field that is addressed to an associated non-AP STA from which it has not received an EHT Capabilities element with the Triggered TXOP Sharing Support subfield set to 1.

If the EHT AP receives a CTS frame in response to its transmitted MU RTS TXS Trigger frame to a non-AP STA with the TXOP Sharing Mode subfield equal to 1 then the AP shall not transmit any PPDU within the allocated time specified in the MU RTS TXS Trigger frame unless:

* The PPDU is solicited by a non-AP STA that requires an immediate response.
* The CS mechanism indicates that the medium is idle at the TxPIFS slot boundary after the end of either the transmission of the last immediate response frame sent to that STA or the reception of the last frame from that STA that did not require an immediate response.

If the EHT AP receives a CTS frame in response to its transmitted MU RTS TXS Trigger frame with the TXOP Sharing Mode subfield equal to 2 then the AP shall not initiate any PPDU transmission within the allocated time specified in the MU RTS TXS Trigger frame unless the PPDU is solicited by a non-AP STA that requires an immediate response.

NOTE- The EHT AP that transmits an MU-RTS TXS Trigger frame does not initiate transmission of any PPDU without performing a new backoff if the TXNAV timer has expired.

If in response to a transmitted MU RTS TXS Trigger frame the EHT AP receives a CTS frame

from the non-AP STA that was allocated time in that Trigger frame then the AP may transmit a PPDU after the end of the allocated time and before its TXNAV timer has expired if any of the following conditions are satisfied:

* The medium is determined to be idle by the CS mechanism at the end of the allocated time in which case it may transmit PIFS after the end of the allocated time.
* The last PPDU transmission by the AP ended less than aSIFSTime before the end of the allocated time in which case it may transmit SIFS after the end of the last PPDU transmission.
* The medium is determined to be busy by the CS mechanism at the end of the allocated time in which case it may transmit after the CS mechanism (see 10.3.2.1 (CS mechanism)) indicates that the medium is idle at the TxPIFS slot boundary.

If in response to a transmitted MU RTS TXS Trigger frame the EHT AP receives a CTS frame

from the non-AP STA that was allocated time in that Trigger frame, the CS mechanism indicates that the medium is busy at the end of the allocated time, then the AP might transmit at TxPIFS slot boundary as described above or invoke the backoff procedure described in 10.23.2.2 (EDCA backoff procedure) or wait for the TXNAV timer to expire and invoke the backoff procedure.

Figure 35-xx (Example of MU-RTS TXS Trigger frame with TXOP Sharing Mode value equal to 1 soliciting UL PPDU) shows an example of the exchange of MU-RTS TXS Trigger frame with TXOP Sharing Mode value equal to 1 and transmission of UL non-TB PPDUs by a scheduled STA within the allocated time.

**Figure 35-xx Example of MU-RTS TXS Trigger frame with TXOP Sharing Mode value equal to 1 soliciting UL PPDU.**

Figure 35-xy (Example of MU-RTS TXS Trigger frame with TXOP Sharing Mode value equal to 2) shows an example of the exchange of MU-RTS TXS Trigger frame with TXOP Sharing Mode value equal to 2 and transmission of PPDUs by a scheduled STA to another STA within the allocated time.

**Figure 35-xy Example of MU-RTS TXS Trigger frame with TXOP Sharing Mode value equal to 2.**

**35.2.1.3.3 Non-AP STA behavior**

After a non-AP STA receives an MU-RTS TXS Trigger frame from its associated AP that contains a User Info field that is addressed to it, the STA shall transmit one or more non-TB PPDUs within the time allocation signalled in the MU-RTS TXS Trigger frame. The first PPDU of the exchange shall be a CTS frame transmitted per the rules defined in 26.2.6.3 (CTS frame response to an MU-RTS Trigger frame).

.

The time allocation shall start when the PHY-RXEND.indication primitive of the PPDU that contains the MU-RTS TXS Trigger frame has occured.

During this allocated time, the non-AP STA may transmit non-TB P­­­PDUs to its associated AP or another STA if the TXOP Sharing Mode subfield value is 2 and only to its associated AP if the TXOP Sharing Mode subfield value is 1.
NOTE—For example, the other STA can be a peer STA of a peer-to-peer link.

A non-AP STA addressed by a User Info field in the MU-RTS TX Trigger frame shall ensure that its PPDU transmission(s) and any expected responses fit entirely within the allocated time.

­­