IEEE P802.11
Wireless LANs

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| Resolution for CC36 CID 4822 related to the QoS Characteristic element |
| Date: May, 2022 |
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 Abstract

This submission proposes a resolution for CID 4822 for TGbe (CC36).

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: minor clarification and editorials.
* Rev 2:
	+ Changed to resolve CID 4822 instead
	+ Corrected size of Medium Time field to 12 bits to cover up to ~1 second (also reserved values from 3,906 to 4,095 since those will indicate a duration that is greater than 1 second)
	+ Changed the “Number of Direct Links” field to 0-based (i.e., a value 0 means one direct link, 1 means two direct links and so on)
	+ Added in the Note “If the bandwidth assigned by the MU-RTS TXS is less than the bandwidth indicated in the Bandwidth field, the AP might assign a longer medium time than requested to compensate in the same MU-RTS TXS.”
* Rev 3:
	+ Fixed a sentence that implies the Delay bound field can be absent when in fact the field is always present
	+ Tie the MSDU Delivery Ratio field and MSDU Count Exponent filed together so they are either present together or absent together (since including only one of them does not make sense).

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. This introduction is 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).***

***TGbe Editor: Editing instructions preceded by “TGbe Editor” are instructions to the TGaxbe editor to modify existing material in the TGbe draft. As a result of adopting the changes, the TGbe editor will execute the instructions rather than copy them to the TGbe Draft.***

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| --- | --- | --- | --- | --- | --- |
| **CID** | **Section** | **Page.Line** | **Comment** | **Proposed Change** | **Resolution** |
| 4822 | 35.2.1.3.3 | 245.59 | Define a way for a STA to dynamically request air-time resource to an AP so that the AP can allocate the resources efficiently. | As in comment. | **Revised**Agree the spec needs a way for the STA to dynamically request air-time resource. For p2p case, the QoS characteristics element includes most of the info needed by the AP. One thing missing is the bandwidth info. The proposed resolution is to add the (LinkID, medium time, BW) tuple in the QoS Characteristics element to complete the p2p support.**TGbe editor, please make changes as shown in doc 11-22/0200r3** |

# Discussion

In D1.3, the CR 21/1407r3 was incorporated to address a lot of the low-latency support issues, especially the conveying of the QoS information from the non-AP MLD to the AP MLD (by introduction of the QoS Characteristics element). However, there was still some open discussion regarding the p2p case about how to interpret the medium time and how to indicate the bandwidth in the p2p case.

In this contribution we propose in the p2p case, add a list of tuple (LinkID, medium time, BW) in the QoS Characteristics element to convey the per-link medium time and the bandwidth requirements of each link that is between the two peers of the p2p. Such structure will support multiple links between the p2p peers. Assume a fixed p2p traffic demand between the p2p peers, each tuple indicates the medium time needed on the specified link if all the traffic was to route through that link only. In practice, the AP MLD may schedule p2p transmissions on multiple links between the p2p peers, in which case the AP MLD will keep track of each TXOP duration (and bandwidth) assigned on each link dynamically and ensure the aggregated resource is enough to serve the total p2p traffic between the peers.

In addition, the following editorial issues are also addressed:

1. Burst Size: need to clarify its definition => Clarified it’s measured over the time duration of Delay Bound
2. Usage of Burst Size? Any more text needed? =>With the above clarification, the peak rate (not included in the QoS Characteristics element) can be computed as peak rate = Burst Size/(Delay bound) so nothing further is needed in the spec
3. Clarify that EHT STAs are expected to use this new QoS Characteristics element to convey QoS info => Added a sentence saying EHT STA uses this QoS element and not the TSPEC element
4. Service Start Time: the service period may or may not start at that exact time. Suggest rephrasing to clarify this point. => Clarified this indicates the anticipated start time of the traffic flow
5. MSDU Delivery Ratio: clarify/add text to cover the case when Delay Bound is not specified (assume it would follow the default retransmission practice.) => Clarified if delay bound not included, this will just be indicating the typical PER (or 1 - PER)
6. MSDU/A-MSDU alignment on all parameters => Fixed
7. Clarify the TXS capability bitmap: clarify if the STA support TXS, either bit or both bits can be set to 1 => Fixed
8. Clarify the TSF specified in the Service Start Time is w.r.t the link for which the QoS Characteristics element is transmitted on => Fixed

Proposed Text Change

***TGbe editor: modify subclause 9.4.2.316 as follows:***

9.4.2.316 QoS Characteristics element

The QoS Characteristics element contains a set of parameters that define the characteristics and QoS expectations of a traffic flow, in the context of a particular non-AP EHT STA, for use by the EHT AP and the non-AP EHT STA in support of QoS traffic transfer using the procedures defined in 11.25.2 (SCS procedures) and 35.7 (Restricted TWT). A EHT STA uses the QoS Characteristics element (instead of the TSPEC element) to convey QoS information.

The element information format comprises the items as defined in this subclause, and the structure is defined in Figure 9-1002af (QoS Characteristics element format).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|    | Element ID | Length | Element ID extension | Control Info | Minimum Service Interval | Maximum Service Interval | Minimum Data Rate | Delay Bound |
| Octets: |  | 1 | 1 | 1 | 4 | 4 | 4 | 3 | 3 |
|  |  | Maximum MSDU Size | Service Start Time | Mean Data Rate | Burst Size | MSDU Lifetime | MSDU Delivery Ratio | MSDU Count Exponent |  | Direct Link Info |
| Octets: |  | 0 or 2 | 0 or 4 | 0 or 3 | 0 or 4 | 0 or 2 | 0 or 1 | 0 or 1 |  | 0 or 3 x (Number of Direct links + 1) |
| Figure 9-1002af – QoS Characteristics element format |  |

The structure of the Control Info field is defined in Figure 9-1002ag (Control Info field format).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 B1 | B2 B5 | B6 B8 | B9 B24 | B25 B28 | B29 B31 |
|  | Direction  | TID | User-Priority | Presence Bitmap of Additional Parameters | Number of Direct links | Reserved |
| Bits: | 2 | 4 | 3 | 16 | 4 | 3 |
|  | Figure 9-1002ag – Control Info field format |

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

The subfields of the Control Info field are defined as follows:

* The Direction subfield specifies the direction of data described by this element as defined in Table 9-401o (Direction subfield encoding).

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| Table 9-401o - Direction subfield encoding  |
| Bit 5 | Bit 6 | Usage |
| 0 | 0 | Uplink, defined as follows: * MSDUs or A‑MSDUs are sent from the non-AP STA to the AP.
 |
| 1 | 0 | Downlink, defined as follows: * MSDUs or A‑MSDUs are sent from the AP to the non-AP STA.
 |
| 0 | 1 | Direct link (MSDUs or A‑MSDUs are sent from the non-AP STA to another non-AP STA). |
| 1 | 1 | Reserved. |

* The TID subfield contains the TID value of the data frames that are described by this element. The TID subfield is set to the same value as the User Priority field. The values 8~15 are reserved.
* The User Priority subfield contains the user priority value (0~7) of the data frames that are described by this element. When the TCLAS element is present in the SCS Request frame containing this element, the User Priority subfield is set to the User Priority value specified in the TCLAS element.
* The Presence Bitmap of Additional Parameters subfield contains a bitmap where the ith entry of the bitmap is set to 1 if the ith field starting from the Maximum MSDU Size field is present in this element. For each field starting from the Maximum MSDU Size field, the value 0 is reserved.
* The Number of Direct Links subfield contains the number of Direct Link Info fields contained in this element minus one and this field is reserved if the Direction subfield is set to any value other than 2 (Direct link). The values 1 to 15 are reserved.

The structure of the Direct Link Info field is defined in Figure 9-zzz (Direct Link Info field format). This field is present only if the Number of Direct Links subfield is greater than zero.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 B3 | B4 B15 | B16 B19 | B20 B23 |
|  | LinkID | Medium Time | Bandwidth | Reserved |
| Bits: | 4 | 12 | 4 | 4 |
| Figure 9-zzz – Direct Link Info field format |

The subfields of the Direct Link Info field are defined as follows:

* The LinkID subfield specifies the link identifier of the link that corresponds to the direct link for which the medium time and bandwidth are requested.
* The Medium Time field contains an unsigned integer that specifies the medium time, in units of 256 microseconds, requested by the STA for direct link transmissions as the average medium time needed in each second, based on the bandwidth indicated in the Bandwidth field for direct link transmissions and based on the assumption that all the direct link transmissions associated with this TID were to take place only on this link specified in the LinkID field. The values from 3,906 to 4,095 are reserved.
* The Bandwidth field specifies the maximum bandwidth the STA can operate for direct link transmissions on the link specified in the LinkID field. This field is used to compute the medium time requested in the Medium Time field and this field is encoded as shown in Table 9-yyy.

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| Table 9-yyy Bandwidth values |
| Value | Bandwidth |
| 0 | 20MHz |
| 1 | 40MHz |
| 2 | 80MHz |
| 3 | 160MHz |
| 4 | 320MHz |
| 5 - 15 | Reserved |

The Minimum Service Interval field contains the following:

* If the Direction subfield is set to 0 (Uplink), the Minimum Service Interval field contains an unsigned integer that specifies the minimum interval, in microseconds, between the start of two consecutive service periods that are allocated to the STA for UL frame exchanges and the value 0 is reserved.
* If the Direction subfield is set to 1 (Downlink), the Minimum Service Interval field contains an unsigned integer that specifies the minimum interval, in microseconds, between the start of two consecutive service periods that are allocated for DL frame exchange sequences and the value 0 indicates that this parameter is unspecified.
* If the Direction subfield is set to 2 (Direct link) the Minimum Service Interval field contains an unsigned integer that specifies the minimum interval, in microseconds, between the start of two consecutive service periods that are allocated to the STA for direct link frame exchanges and the value 0 is reserved.

The Maximum Service Interval field contains the following:

* If the Direction subfield is set to 0 (Uplink), the Maximum Service Interval field contains an unsigned integer that specifies the maximum interval, in microseconds, between the start of two consecutive service periods that are allocated to the STA for UL frame exchanges and the value 0 is reserved.
* If the Direction subfield is set to 1 (Downlink), the Maximum Service Interval field contains an unsigned integer that specifies the maximum interval, in microseconds, between the start of two consecutive service periods that are allocated for DL frame exchange sequences and the value 0 indicates that this parameter is unspecified.
* If the Direction subfield is set to 2 (Direct link) the Maximum Service Interval field contains an unsigned integer that specifies the maximum interval, in microseconds, between the start of two consecutive service periods that are allocated to the STA for direct link frame exchanges and the value 0 is reserved.
* The value of this field is greater than or equal to the value of the Minimum Service Interval field.

The Minimum Data Rate field contains an unsigned integer that specifies the lowest data rate specified at the MAC SAP, in kbps, for transport of MSDUs or A-MSDUs belonging to the traffic flow described by this element.

* If the Direction subfield is set to 0 (Uplink) or 1 (Downlink), the value 0 is reserved.
* If the Direction subfield is set to 2 (Direct link), the value 0 indicates that this parameter is unspecified.

The Delay Bound field contains an unsigned integer that specifies the maximum amount of time, in microseconds, allowed to transport an MSDU or A-MSDU belonging to the traffic flow described by this element, measured between the time marking the arrival of the MSDU, or the first MSDU of the MSDUs constituting an A-MSDU, at the local MAC sublayer from the local MAC SAP and the time of completion of the successful transmission or retransmission of the MSDU or A-MSDU to the destination. The completion time of the MSDU or A-MSDU transmission includes the relevant acknowledgment frame transmission time, if present.

* If the Direction subfield is set to 0 (Uplink) or 2 (Direct link), the value 0 indicates that this parameter is unspecified.
* If the Direction subfield is set to 1 (Downlink), the value 0 is reserved.
* This field is nonzero if the Burst Size field is present.

The Maximum MSDU Size field contains an unsigned integer that specifies the maximum size, in octets, of MSDUs or A‑MSDUs belonging to the traffic flow described by this element.

The Service Start Time field contains an unsigned integer that specifies the anticipated time, in micro-seconds, when the traffic starts for the associated TID. The Service Start Time indicates to the AP the time when the STA expects to exchange frames corresponding to the TID specified in this element. The field represents the four lower order octets of the TSF timer associated with the STA for which this QoS Characteristics element is transmitted at the start of the anticipated service period.

The Mean Data Rate field indicates the average data rate specified at the MAC SAP, in kbps, for transport of MSDUs or A-MSDUs belonging to the traffic flow within the bounds of this element.

The Burst Size field is 4 octets long and contains an unsigned integer that specifies the maximum burst, in octets, of the MSDUs or A-MSDUs belonging to the traffic flow that arrive at the MAC SAP within a time duration specified in the Delay Bound field.

The MSDU Lifetime field contains an unsigned integer that specifies the maximum amount of time, in units of milliseconds, since the arrival of the MSDU at the MAC data service interface beyond which the MSDU is not useful and may be discarded at the MSDU transmitter. The amount of time specified in this field is larger than or equal to the amount of time specified in the Delay Bound field, if present.

The MSDU Delivery Ratio field specifies the MSDU loss requirement and is encoded as follows:

* The 4 LSBs of the MSDU Delivery Ratio field indicate the percentage of MSDUs or A-MSDUs that are expected to be delivered within the delay bound specified in the Delay Bound field and its encoding is defined in Table 9-401p. The 4 MSBs of the MSDU Delivery Ratio field are reserved. If the delay bound is not specified, then the MSDU Delivery Ratio indicates the percentage of MSDUs or A-MSDUs that are expected to be delivered successfully to the receiver.

This field is present only if the MSDU Count Exponent field is present.

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| Table 9-401p MSDU Delivery Ratio field values |
| Value | MSDU delivery ratio |
| 0 | Not specified |
| 1 | 95% |
| 2 | 96% |
| 3 | 97% |
| 4 | 98% |
| 5 | 99% |
| 6 | 99.9% |
| 7 | 99.99% |
| 8 | 99.999% |
| 9 | 99.9999% |
| 10 - 15 | Reserved |

The MSDU Count Exponent field contains an unsigned integer that specifies the exponent from which the number of incoming MSDUs used for computing the MSDU delivery ratio is obtained. The number of incoming MSDUs is equal to 10MSDU Count Exponent. This field is present only if the MSDU Delivery Ratio field is present.

**35.3.21 Multi-link SCS procedure**

***TGbe editor: modify this section as follows:***

A non-AP EHT STA with dot11EHTTXOPSharingTFOptionImplemented equal to true may send an SCS request that contains a QoS Characteristics element whose Direction field is set to 2 (Direct Link) only if the EHT AP sets the Triggered TXOP Sharing Mode 2 Support subfield in the EHT Capabilities element it transmits to 1.

The QoS Characteristics element is a reference for the EHT AP's scheduling. An EHT AP should schedule for transmission downlink frames such that the delay bound and minimum data rate requested are met for the downlink Data frames if the Direction subfield of the QoS Characteristics element indicates downlink. An EHT AP should enable the transmission of uplink frames from the EHT STA with a selected service interval that falls between the requested minimum and maximum service intervals and the AP should meet the minimum data rate requested if the Direction subfield of the QoS Characteristics element indicates uplink. An EHT AP should enable the transmission of direct link frames from the EHT STA to another STA on any link specified in the Direct Link Info fields included in the QoS Characteristics element with a selected service interval that falls between the requested minimum and maximum service intervals and the AP should allocate enough resource to the STA to meet the medium time and bandwidth requested by the STA if the Direction subfield of the QoS Characteristics element indicates direct link.

NOTE – the medium time and bandwidth on each link requested by the STA assume all the anticipated direct link traffic corresponding to the TID were to take place only on that link. If the bandwidth assigned by the MU-RTS TXS is less than the bandwidth indicated in the Bandwidth field, the AP might assign a longer medium time than requested to compensate in the same MU-RTS TXS. If the AP allocates MU RTS TXS frames to more than one link to serve the STA, the AP provides resources (medium time and bandwidth on each link) on the requested links such that the combined resource is enough to serve the same anticipated amount of the requested o2o traffic.

The transmission of uplink Data frames should be enabled by using Basic Trigger frames or alternatively by using MU RTS TXS Trigger frames if both EHT STAs have dot11EHTTXOPSharingTFOptionImplemented equal to true. The transmission of direct link frames should be enabled by using MU RTS TXS Trigger frames if both EHT STAs have set the Triggered TXOP Sharing Mode 2 Support field in their transmitted EHT Capabilities elements to 1.

If the EHT STA is a TWT scheduled STA or TWT requesting STA (see 26.8 TWT operation) and there are negotiated TWT SPs with the EHT AP, the EHT AP should ensure that the selected service interval aligns with negotiated TWT wake intervals.

If the EHT STA is an r-TWT scheduled STA (see 35.7 Restricted TWT) and it has an r-TWT schedule established carrying the TID indicated in the QoS Characteristics element in the same direction (UL or DL) as indicated by the Direction subfield in the QoS Characteristics element, the EHT AP should use the already established r-TWT SPs for transmission of traffic associated with the TID in the QoS Characteristics element.

If the EHT STA is an r-TWT scheduled STA (see 35.7 Restricted TWT) and it has negotiated r-TWT SPs for the TID specified in the QoS Characteristics element and the associated r-TWT schedule is a trigger-enabled r-TWTs, the EHT AP should ensure that the trigger frames are scheduled at the start of the associated r-TWT SPs.

The EHT AP may discard a DL data frame if the lifetime of the frame has exceeded the value specified by the MSDU Lifetime field.

***TGbe editor: modify this section as follows:***

**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 an associated non-AP EHT STA for transmitting one or more non-TB PPDUs.

An EHT STA with dot11EHTTXOPSharingTFOptionImplemented equal to true shall set either or both of the following two bits in the EHT Capabilities element to 1: the Triggered TXOP Sharing Mode 1 Support subfield or the Triggered TXOP Sharing Mode 2 Support subfield.

An EHT STA with dot11EHTTXOPSharingTFOptionImplemented equal to true shall follow the rules defined in 35.2.2 (MU-RTS trigger/CTS frame exchange procedure for EHT STAs) when transmitting or responding to an MU-RTS TXS Trigger frame and the additional rules defined in 35.2.1.3.2 (AP behavior) and 35.2.1.3.3 (Non-AP STA behavior).

An EHT STA that uses information from a received MU-RTS TXS Trigger frame as the most recent basis to update its NAV should not reset its NAV after the NAVTimeout has expired (see 10.3.2.4 (Setting and resetting the NAV)) unless the STA receives a CF-End frame that satisfies the conditions in 26.2.5 (Truncation of TXOP).

Do you agree to the resolution provided in doc 11-22/0200r3 for CID 4822?