IEEE P802.11  
Wireless LANs

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| --- | --- | --- | --- | --- |
| LB266 CR on Measurement Report for Low-latency Traffic | | | | |
| Date: 2022.12.28 | | | | |
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Abstract

This submission contains proposed comment resolutions to comments on P802.11be D2.0. The following CIDs are resolved:

10480

Revisions:

- Rev 0: Initial version of the document.

- Rev 1: Revised based on received comments

- Rev 2: Rewording the text based on received comments

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Page.**  **Line** | **Comment** | **Proposed Change** | **Resolution** |
| 10480 | Yonggang Fang | 35 | 399.5 | In ML operation, QoS traffic profile is applied to a MLD. Therefore it requires to measure traffic QoS on each enabled link and at MLD as well. This is missing in 802.11be D2.0, but it is required by SFD. | Please define ML QoS measurement report and specify corresponding rules. | Revised  Agreed in principle. The current Transmit Stream/Category Measurement Request/Report is modified to define a ML QoS measurement Report.  Instructions to the editor:  Please make the changes to the spec as shown in 11/22-2177r2 |

**Discussion:**

We have agreed that the SCS mechanism is used by a STA to inform the AP of the QoS requirement of a low-latency traffic flow. For a low-latency traffic, one important QoS parameter is the MSDU delivery ratio given the delay bound.

In 5G cellular network, 3GPP also has defined a measurement report to monitor this KPI for the low-latency traffic. In order to help the AP or AP MLD know whether the QoS requirement is met or not, a corresponding measurement report shall be defined. Thus the AP or AP MLD can take further actions (e.g. rTWT, TID-to-link mapping negotiation, load balancing and so on) to improve the QoS according to the received measurement report until the QoS requirement is not met. For simplicity, we try to reuse the current Transmit Stream/Category Measurement Request/Report to realize it.

***TGbe editor: modify the following subclause after 9.4.2.20.11 of Draft REVme 1.0 as:***

9.4.2.20.11 Transmit Stream/Category Measurement Request

The Transmit Stream/Category Measurement applies to TIDs for traffic streams associated with TSPECs, to TIDs for traffic categories for QoS traffic without TSPECs or with QoS Characteristics elements. The Measurement Request field corresponding to a Transmit Stream/Category Measurement request is shown in Figure 9-252 (Measurement Request field format for Transmit Stream/Category Measurement Request).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Randomization Interval | Measurement Duration | Peer STA Address | Traffic Identifier | Bin 0 Range | Optional Subelements |
| Octets: | 8 | 2 | 6 | 1 | 1 | variable |
| **Figure 9-252—Measurement Request field format for Transmit Stream/Category Measurement Request** | | | | | | |

The Randomization Interval field is set to the maximum random delay in the measurement start time, in units of TUs. The use of the Randomization Interval field is described in 11.10.3 (Measurement start time). When requesting a triggered Transmit Stream/Category Measurement, the randomization interval is not used and the Randomization Interval field is reserved. See 11.10.9.8 (Transmit Stream/Category Measurement report).

The Measurement Duration is set to the duration of the requested measurement, in units of TUs except when setting up a triggered QoS measurement, when it is not used and is set to 0.

The Peer STA Address field contains a MAC address indicating the RA for the measured frames if the peer STA is not affiliated with a MLD. Otherwise, it is set to the MLD MAC Address.

The Traffic Identifier field contains the TID subfield as shown in Figure 9-253 (Traffic Identifier field format).

|  |  |  |
| --- | --- | --- |
|  | B0 B3 | B4 B7 |
|  | Reserved | TID |
| Bits: | 4 | 4 |

**Figure 9-253 Traffic Identifier field format**

The TID subfield indicates the TC or TS for which traffic is to be measured.

Bin 0 Range indicates the delay range of the first bin (Bin 0) of the Transmit Delay Histogram, in units of TUs. The Bin 0 Range value is used to calculate the delay ranges of the other 5 bins making up the histogram. The delay range for each bin increases in a binary exponential fashion as described in 9.4.2.21.11 (Transmit Stream/Category Measurement report).

The Optional Subelements field contains zero or more subelements. The subelement format and ordering of subelements are defined in 9.4.3 (Subelements).

The Subelement ID field values for the defined subelements are shown in Table 9-148 (Optional subelement IDs for Transmit Stream/Category Measurement Request).

**Table 9-148—Optional subelement IDs for Transmit Stream/Category**

**Measurement Request**

|  |  |  |
| --- | --- | --- |
| * Optional subelement IDs for Transmit Stream/Category  Measurement Request | | |
| Subelement ID | Name | Extensible |
| 0 | Reserved |  |
| 1 | Triggered Reporting | Yes |
| 2–220 | Reserved |  |
| 221 | Vendor Specific | Vendor defined |
| 222–255 | Reserved |  |

The Subelement ID field is defined in Table 9-148 (Optional subelement IDs for Transmit Stream/Category Measurement Request).

The Triggered Reporting subelement is used to specify measurement trigger thresholds. It is present only if requesting triggered transmit stream/category measurement reporting. The Triggered Reporting subelement format is shown in Figure 9-254 (Triggered Reporting subelement format).

|  |  |  |  |
| --- | --- | --- | --- |
|  | Subelement ID | Length | Triggered Reporting |
| Octets: | 1 | 1 | 6 |
| * Triggered Reporting subelement format | | | |

The Subelement ID field is defined in Table 9-148 (Optional subelement IDs for Transmit Stream/Category Measurement Request).

The Length field is defined in 9.4.3 (Subelements).

The Triggered Reporting field is as shown in Figure 9-255 (Triggered Reporting field format).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Trigger  Conditions | Average Error Threshold | Consecutive Error  Threshold | Delay  Threshold | Measurement Count | Trigger  Timeout |
| Octets: | 1 | 1 | 1 | 1 | 1 | 1 |
| * Triggered Reporting field format | | | | | | |

Trigger Conditions is a bit-field that specifies reporting triggers when requesting a triggered transmit stream/category measurement. The format of the Trigger Conditions bit-field is shown in Figure 9-256 (Trigger Conditions bit-field format).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B3 | B4 B7 |
|  | Average | Consecutive | Delay | MSDU Delivery Ratio | Reserved |
| Bits: | 1 | 1 | 1 | 1 | 4 |

**Figure 9-256 Trigger Condition bit-field format**

* The Average subfield is set to 1 to request that a Transmit Stream/Category Measurement report be generated when the number of MSDUs for the TC or TS given by the TID that are discarded out of the number of preceding MSDUs specified in Measurement Count is greater than or equal to the value given in Average Error Threshold. MSDUs discarded due to the number of transmit attempts exceeding dot11ShortRetryLimit, or due to the MSDU lifetime having been reached, are counted.
* The Consecutive subfield is set to 1 to request that a Transmit Stream/Category Measurement report be generated when the number of MSDUs for the TC or TS given by the TID that are discarded in succession is greater than or equal to the value given in Consecutive Error Threshold. MSDUs discarded due to the number of transmit attempts exceeding dot11ShortRetryLimit, or due to the MSDU lifetime having been reached, are counted.
* The Delay subfield is set to 1 to request that a Transmit Stream/Category Measurement report be generated when the number of consecutive MSDUs for the TC or TS given by the TID that experience a transmit delay greater than or equal to the value specified in the Delay Threshold subfield is greater than or equal to the value given in Delayed MSDU Count. Delay is measured from the time the MSDU is passed to the MAC until the point at which the entire MSDU has been successfully transmitted, including receipt of the final Ack frame from the peer STA or MLD if the QoSAck service class is being used.
* The MSDU Delivery Ratio subfield is set to 1 to request that a Transmit Stream/Category Measurement report be generated when the resulting MSDU delivery ratio for the TC, given by the TID, is lower than the value specified in the MSDU Delivery Ratio field in the relevant QoS Characteristics element.

The Average Error Threshold field contains a value representing the number of discarded MSDUs to be used as the threshold value for the average trigger condition(#291). The field is reserved if the Average Error Threshold subfield of the Trigger Conditions (#291)subfield is 0.

The Consecutive Error Threshold field contains a value representing the number of discarded MSDUs to be used as the threshold value for the consecutive trigger condition. The field is reserved if the Consecutive Error Threshold subfield of the Trigger Conditions (#291)subfield is 0.

The Delay Threshold field contains two subfields as shown in Figure 9-257 (Delay Threshold subfield format). The Delay Threshold field is reserved if the Delay Threshold subfield of the Trigger Conditions (#291)subfield is 0.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B7 |
|  | Delayed MSDU Range | | Delayed MSDU Count | |
| Bits: | 2 | | 6 | |
| * Delay Threshold subfield format | | | | |

The Delayed MSDU Range field contains a value representing the MSDU transmit delay at or above which an MSDU is counted toward the Delayed MSDU Count threshold. The Delayed MSDU Range field is encoded as a value representing the lower bound of a bin in the Transmit Delay Histogram as shown in Table 9-149 (Delayed MSDU Range Definitions). The Transmit Delay Histogram is defined in 9.4.2.21.11 (Transmit Stream/Category Measurement report).

|  |  |
| --- | --- |
| * Delayed MSDU Range Definitions | |
| Delayed MSDU Range | Condition |
| 0 | Transmit Delay = Lower Bound of Bin 2 |
| 1 | Transmit Delay = Lower Bound of Bin 3 |
| 2 | Transmit Delay = Lower Bound of Bin 4 |
| 3 | Transmit Delay = Lower Bound of Bin 5 |

The Delayed MSDU Count field contains a value representing the number of MSDUs to be used as the threshold value for the delay trigger condition.

The Measurement Count field contains a number of MSDUs. This value is used to calculate an average discard count for the average trigger condition and the MSDU delivery ratio trigger condition. It is also used in place of measurement duration in determining the scope of the reported results when a report is triggered; see 11.10.9.8 (Transmit Stream/Category Measurement report).

The Trigger Timeout field contains a value, in units of 100 TU, during which a measuring STA does not generate further triggered transmit stream/category measurement reports after a trigger condition has been met. See 11.10.9.8 (Transmit Stream/Category Measurement report).

The Vendor Specific subelement has the same format as the Vendor Specific element (see 9.4.2.25 (Vendor Specific element)). Zero or more Vendor Specific subelements are included in the list of optional subelements.

***TGbe editor: modify subclause 9.4.2.21.11 of Draft REVme 1.1 as:***

9.4.2.21.11 Transmit Stream/Category Measurement Report

The Transmit Stream/Category Measurement report applies to TIDs for Traffic Streams associated with TSPECs, to TIDs for Traffic Categories for QoS traffic without TSPECs or with QoS Characteristics elements. The format of the Measurement Report field corresponding to a Transmit Stream/Category Measurement report is shown in Figure 9-310 (Measurement Report field format for Transmit Stream/Category Measurement report).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Actual Measurement Start Time | Measurement Duration | Peer STA Address | Traffic Identifier | Reporting Reason | Transmitted MSDU Count |
| Octets: | 8 | 2 | 6 | 1 | 1 | 4 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | MSDU Discarded Count | MSDU Failed Count | MSDU Multiple Retry Count | QoS CF-Polls Lost Count | Average Queue Delay | Average Transmit Delay |
| Octets: | 4 | 4 | 4 | 4 | 4 | 4 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Bin 0 Range | Bin 0 | Bin 1 | Bin 2 | Bin 3 | Bin 4 | Bin 5 | Optional Subelements |
| Octets: | 1 | 4 | 4 | 4 | 4 | 4 | 4 | variable |

**Figure 9-257 Measurement Report field format for Transmit Stream/Category Measurement report**

The Actual Measurement Start Time field is set to the TSF at the time at which the measurement started, or for a triggered Transmit Stream/Category Measurement report, the TSF value at the reporting QoS STA when the trigger condition was met. For MLO, it is in reference to the TSF time of the link indicated by the MLO Link Information subelement.

The Measurement Duration field is set to the duration over which the Transmit Stream/Category Measurement report was measured, in units of TUs. In a triggered Transmit Stream/Category Measurement report, metrics are reported over a number of transmitted MSDUs rather than a duration; hence Measurement Duration is set to 0; see 11.10.9.8 (Transmit Stream/Category Measurement report).

The Peer STA Address field contains a MAC address indicating the RA for the measured frames if the peer STA is not affiliated with a MLD. Otherwise, it is set to the MLD MAC Address.

The Traffic Identifier field contains the TID subfield as shown in Figure 9-204 (Measurement Request field format for Transmit Stream/Category Measurement Request). The TID subfield indicates the TC or TS for which traffic was measured.

The Reporting Reason field is a bitmap indicating the reason that the measuring QoS STA or MLD sent the transmit stream/category measurement report. The Reporting Reason field is shown in Figure 9-258 (Reporting Reason field format).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B3 | B4 B7 |
|  | Average Trigger | Consecutive Trigger | Delay Trigger | MSDU Delivery Ratio Trigger | Reserved |
| Bits: | 1 | 1 | 1 | 1 | 4 |

**Figure 9-311 Reporting Reason field format**

* The Average Trigger subfield set to 1 indicates that the Transmit Stream/Category Measurement report was generated as a triggered report due to the average error trigger.
* The Consecutive Trigger subfield set to 1 indicates that the Transmit Stream/Category Measurement report was generated as a triggered report due to the consecutive error trigger.
* The Delay Trigger subfield set to 1 indicates that the Transmit Stream/Category Measurement report was generated as a triggered report due to the delay exceeding the delay threshold.
* The MSDU Delivery Ratio Trigger subfield set to 1 indicates that the Transmit Stream/Category Measurement report was generated as a triggered report due to the MSDU delivery ratio for the TC, given by the TID, being lower than the value specified in the MSDU Delivery Ratio field in the relevant QoS Characteristics element.

When a Transmit Stream/Category Measurement report is sent as a direct response to a Transmit Stream/Category Measurement request and not as a triggered Transmit Stream/Category Measurement report, all subfields in the Reporting Reason field are set to 0. This is termed a requested Transmit Stream/Category Measurement report. Within a triggered Transmit Stream/Category Measurement report, more than one subfield in the Reporting Reason field might be set to 1 if more than one trigger condition was met.

The Transmitted MSDU Count, MSDU Failed Count, MSDU Discarded Count, MSDU Multiple Retry Count, QoS CF-Polls Lost Count, Average Queue Delay, Average Transmit Delay, and delay histogram fields relate to transmissions to the QoS STA or MLD given in the Peer STA Address field. Metrics are reported over the Measurement Duration, or for triggered transmit stream/category measurements, over the Measurement Count. Any counter that increments to a value of terminates the measurement.

The Transmitted MSDU Count field contains the number of MSDUs for the TC or the TS specified by the TID that were successfully transmitted. For the TC with a QoS Characteristics element, the Transmitted MSDU Count field contains the number of MSDUs, specified by the TID, that were successfully transmitted within the delay bound specified in the Delay Bound field in the relevant QoS Characteristics element.

The MSDU Discarded Count field contains the number of MSDUs for the TC or the TS, specified by the TID, that were discarded due either to the number of transmit attempts exceeding dot11ShortRetryLimit, or due to the MSDU lifetime having been reached. For the TC with a QoS Characteristics element, the MSDU Discarded Count field contains the number of MSDUs, specified by the TID, that were discarded due to the number of transmit attempts exceeding dot11ShortRetryLimit, or due to the delay bound or the MSDU lifetime having been reached, respectively specified in the Delay Bound and the MSDU Lifetime fields in the relevant QoS Characteristics element.

The MSDU Failed Count field contains the number of MSDUs for the TC or the TS specified by the TID that were discarded due to the number of transmit attempts exceeding dot11ShortRetryLimit.

The MSDU Multiple Retry Count field contains the number of MSDUs for the TC or the TS specified by the TID that were successfully transmitted after more than one retransmission attempt.

The QoS CF-Polls Lost Count field contains the number of QoS (+)CF-Poll frames that were transmitted where there was no response from the QoS STA. QoS CF-Polls Lost Count are returned only if the reporting QoS STA is contained within an AP and the TID is for a TS. This field is set to 0 when QoS CF-Polls Lost Count is not returned.

The Average Queue Delay field is the average queuing delay of the frames (MSDUs) that are passed to the MAC for the indicated peer STA address and the indicated traffic identifier. Queue Delay is expressed in TUs and is measured from the time the MSDU is passed to the MAC until the point at which the first or only corresponding MPDU begins transmission.

The Average Transmit Delay field is the average delay of the frames (MSDUs) that are successfully transmitted for the indicated Peer STA Address and TID. Average Transmit Delay is measured from the time the MSDU is passed to the MAC until the point at which the entire MSDU has been successfully transmitted, including receipt of the final Ack frame from the peer STA if the QoSAck service class is being used. Average Transmit delay is expressed in units of TUs.

The Bin 0 Range field value indicates the delay range of the first bin (Bin 0) of the Transmit Delay Histogram, in units of TUs. It is also used to calculate the delay ranges of the other five bins making up the histogram. The delay range for each bin increases in a binary exponential fashion as follows:



For example, if the Bin 0 Range field value is 10 TUs, the bin delay ranges are as defined in Table 9-171 (Delay definitions for a Transmit Stream/Category Measurement report for a Bin 0 Range field value of 10 TU).

|  |  |
| --- | --- |
| * Delay definitions for a Transmit Stream/Category Measurement report  for a Bin 0 Range field value of 10 TU | |
| Bin | Measured MSDU Transmit Delay (TUs) |
| 0 | Delay < 10 |
| 1 | 10  Delay < 20 |
| 2 | 20  Delay < 40 |
| 3 | 40  Delay < 80 |
| 4 | 80  Delay < 160 |
| 5 | 160  Delay |

To compute the value reported in Bin *i* (i.e., *Bi* for *i* = 0, 1...5 of the Transmit Delay Histogram), the STA initializes all bin values to 0. For each MSDU successfully transmitted, the measured MSDU Transmit Delay determines the bin to be incremented. If the measured delay has a duration *t* within Bin *i*, then Bin *i* is increased by one. MSDU Transmit Delay is measured from the time the MSDU is passed to the MAC until the point at which the entire MSDU has been successfully transmitted, including receipt of the final Ack frame from the peer STA if the QoSAck service class is being used. The sum of the values in all six bins is equal to the value reported in the Transmitted MSDU Count.

The Optional Subelements field contains zero or more subelements. The subelement format and ordering of subelements are defined in 9.4.3 (Subelements).

The Subelement ID field values for the defined subelements are shown in Table 9-172 (Optional subelement IDs for Transmit Stream/Category Measurement report).

|  |  |  |
| --- | --- | --- |
| * Optional subelement IDs for Transmit Stream/Category Measurement report | | |
| Subelement ID | Name | Extensible |
| 0 | Reserved |  |
| 1 | MLO Link Information | NO |
| 2-220 | Reserved |  |
| 221 | Vendor Specific | Vendor defined |
| 222–255 | Reserved |  |

The MLO Link Information subelement is the same as the MLO Link Information element defined in 9.4.2.317 (MLO Link Information element).For MLO, the MLO Link Information subelement is included within the Transmit Stream/Category Measurement report to indicate the link whose TSF is used as the reference. Only one bit in the Link ID Bitmap subfield of the MLO Link Information element shall be set to 1.

The Vendor Specific subelements have the same format as their corresponding elements (see 9.4.2.25 (Vendor Specific element)). Zero or more Vendor Specific subelements are included in the list of optional subelements.

**11.10.9.8 Transmit Stream/Category Measurement report**

***TGbe editor: modify the first paragraph in subclause 11.10.9.8 of Draft REVme 1.1 as:***

The Transmit Stream/Category Measurement applies to TIDs for Traffic Streams associated with TSPECs and also to TIDs for Traffic Categories for QoS traffic without TSPECs or with QoS Characteristics elements.

**9.4.2.313.2 EHT MAC Capabilities Information field**

***TGbe editor: modify the following figure in subclause 9.4.2.313.2 as:***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B3 | B4 | B5 |
|  | EPCS Priority Access Supported | EHT OM Control Support | Triggered TXOP Sharing Mode 1 Support | Triggered TXOP Sharing Mode 2 Support | Restricted TWT Support | SCS Traffic Description Support |
| Bits: | 1 | 1 | 1 | 1 | 1 | 1 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B6 B7 | B8 | B9 | B10 | B11 | B12 B15 |
|  | Maximum  MPDU Length | Maximum  A-MPDU Length Exponent Extension | EHT TRS Support | TXOP Return Support In TXOP Sharing Mode 2 | Traffic Stream/Category Measurement Report Support | Reserved |
| Bits: | 1 | 1 | 1 | 1 | 1 | 4 |

**Figure 9-1002af—EHT MAC Capabilities Information field format**

***TGbe editor: insert the following row after “SCS Traffic Description Support” in Table 9-401j as:***

**Table 9-401j—Subfields of the EHT MAC Capabilities Information field**

|  |  |  |
| --- | --- | --- |
| Subfield | Definition | Encoding |
| Traffic Stream/Category Measurement Report Support | Indicates support for transmission of Radio Measurement Request/Report frames containing a Transmit Stream/Category Measurement Request/Report element. | Set to 1 by an EHT STA that supports transmission of Radio Measurement Request/Report frames containing a Transmit Stream/Category Measurement Request/Report element.  Set to 0 otherwise. |

**35.3.22 Multi-link SCS procedure**

***TGbe editor: Add the following paragraph in the end of subclause 35.3.22:***

The traffic stream/category measurement report allows a non-AP EHT STA to provide the experienced QoS info to the EHT AP. If the QoS requirement is not met, then the AP can take actions to improve it until it is met. An EHT STA that supports traffic stream/category measurement has dot11EHTTrafficStreamCategotyMeasurementReportOptionImplemented set to true and shall set the Traffic Stream/Category Measurement Report Support subfield in the EHT Capability element it transmits to 1.

***TGbe editor:Add the following MIB Variables in Annex C***

Dot11EHTStationConfigEntry ::=  
SEQUENCE {

|  |  |
| --- | --- |
| dot11EHTPPEThresholdsRequired  dot11TIDtoLinkMappingActivated  dot11EHTEPCSPriorityAccessActivated  dot11MSDTimerDuration  dot11MSDTXOPMAX | TruthValue, TruthValue, TruthValue, Unsigned32, Unsigned32, |
| dot11EHTTrafficStreamCategotyMeasurementReportOptionImplemented | TruthValue} |

dot11EHTTrafficStreamCategotyMeasurementReportOptionImplemented OBJECT-TYPE  
SYNTAX TruthValue  
MAX-ACCESS read-only  
STATUS current  
DESCRIPTION  
"This is a capability variable. Its value is determined by device  
capabilities.  
This attribute, when true, indicates that the STA implementation is  
capable of providing traffic stream/Category measurement report. The capability is disabled otherwise."  
DEFVAL { false }  
::= { dot11EHTStationConfigEntry 6 }