IEEE P802.11
Wireless LANs

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| LB266 CR for 35.9.2.1 Latency sensitive traffic differentiation |
| Date: 2022-07-10 |
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Abstract

This submission proposes resolutions for the following CIDs for TGbe LB266:

14072

Revisions:

* Rev 0: Initial version of the document
* Rev 1: Make some changes for the proposed element
* Rev 2,3,4: Update the document based on the offline discussion

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 TGbe 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.***

***TGbe editor: The baseline for this document is 11be D2.3.***

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| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 14072 | 35.9.2.1 Latency sensitive traffic differentiation | 511.12 | According to current specification it is difficult to differentiate the latency sensitive traffic especilly for the traffic identified with QoS Characteristics element. Because the latency Sensitive Traffic can be transferred during Restricted TWT periods for strict protection, some traffic with less-stringent requirements in terms of latency is treated as latency-sensitive traffic in advance and occupies the R-TWT periods, which is unfair for other EHT STAs which need to deliver the latency sensitive traffic latter. | The Latency Sensitive Traffic Criterion or differentiation is suggested to be specified. | RevisedR-TWT SPs are expected to be allocated by priority - e.g. by SCS delay bound, TID, etc - and can be allocated such that they are not shared with other STA - if the R-TWT slots are shared then AC-based access (triggered UL or EDCA) is used to differentiate.As the AP can know the CURRENT achievable KPIs (latency, MSDU Delivery Ratio, etc) it’s more useful to advertise the current KPIs and let the STA decide whether it should associate OR issue SCS and optionally use R-TWT SPs.Based on the above analyses a Latency Sensitive Traffic KPI element is proposed to be defined and used to identify latency sensitive traffic as the currently supported and non-supported latency sensitive traffic.**Instruction to the editor**, ***please insert the paragraphs in 4.5.6.3 Support for predictable latency, and insert the new subclause at the end of subclause 9.4.2 Elements, as shown in this document (doc.: IEEE 802.11-22/1036r5).*** |
|  |  |  |  |  |  |

**Discussion:**

This document proposes a mechanism for identifying currently supported or non-suported latency sensitive traffic with the KPIs of an advertised Latency Sensitive Traffic KPI element including the Delay KPI and KPI for MSDU Delivery Ratio.

The reasons for specifying the mechanism is described as follows:

1. 11be has currently specified latency sensitive traffic which has stringent requirements in terms of latency and its jitter along with certain reliability constraints, and latency bound and the reliability as the key KPIs of latency sensitive traffic. And the QoS Characteristics element includes a set of parameters to define the characteristics and QoS expectations of a traffic, among of which latency bound and MSDU Delivery Ratio correspond to the two key KPIs respectively.
2. The duration of r-TWT SPs or SCS SIs and the occurrence frequency of r-TWT SPs or SCS SIs should be controlled for the efficiency of the transmission of both LL traffic and non-LL traffic. The usage of the currently supported KPIs provides a tool for AP and STA to plan the resource allocation including r-TWT SPs, SCS SIs and balance the protected delivery of LL traffic in UL TB PPDUs, r-TWT SPs and the unprotected transmission of other traffic outside of scheduled traffic.
3. AP determines the KPIs based on the current network conditions and BSS load, the resource occupied by current r-TWT SPs and the remaining resource which can be allocated for pending r-TWT SPs, and the transmission status and performance statistics of current low-latency traffic.
4. The KPIs are helpful for the STA to decide whether it should associate OR issue SCS and optionally use R-TWT SPs on the BSS. Especially for MLO, non-AP MLD can use the KPIs to decide which link is suitable for the delivery of latency sensitive traffic according to its QoS requirement. For example, non-AP MLD can decide to which link(s) the TID for low-latency traffic is suitable for being mapped, and negotiate the TID-to-link mapping with the AP MLD. And how to use the KPIs for non-AP STA mainly depends on the implementation.
5. The AP can support multiple combinations of delay bound + delivery ratio for a given scenario/network conditions.  For example: 1 msec @ 99.9%, 2 msec @ 99.99%, 3 msec @ 99.999%, and so on.

Q & A:

Q1: Are these advertised KPIs a commitment from the AP e.g., if a non-AP MLD requests SCS with QoS that can be supported by the AP MLD according to these KPI thresholds, the AP shall not reject these SCS Request and the AP has to deliver the requested QoS?

A1: KPIs are advertised by AC/TID , which is interpreted as “don’t expect to get better than x” post-association. Certainly, if the current latency is much higher than the required SLA for voice/video/etc the STA may want to consider other BSSIDs (e.g. 6GHz would be expected to be better than 5Ghz even if the RSSI is ~same). On SCS specifically, there’s never a “contractual” guarantee so a reject may still occur even if the SCS requested  delay is > the current advertised latency for it would be due to other resource constraints.

Q2: Does the KPI for MSDU Delivery Ratio the only metric to determine a latency sensitive traffic? Is it a reference information or strict requirement?

A2: The KPI is not the only metric to determine a latency sensitive traffic, and it is used to identify latency sensitive traffic as the currently supported and non-supported latency sensitive traffic from AP’s perspective. It is a reference information advertised to non-AP STAs.

Q3: How are these KPIs estimated by the AP MLD given that in MLO, a client may have diff number of links so I would expect the QoS that the AP MLD can deliver to the client will highly dependent on which link(s) are used and the channel condition/load on those links. How do these KPI options capture the diff combinations of links a client may request and diff channel/load conditions using a single per-MLD value?

A3: The KPIs are per BSSID/AP based on AP metrics (DL) and STA metrics (UL as part of proposed BSR extension) so that’s per-link not per MLD per-se. Pre-association, the AP doesn’t know which links the STA will request nor the links that will be active and under all MLO modes there is uncertainty as to which link will be dominant post-assoc. A simplistic strategy for a STA might be to take the min of delay (link 1,2,3) and if that’s good enough ensure that good link is requested.

Q4: If the channel condition of BSS load changes, will the AP change the value of KPI? Which value of the Delay KPI field should be set based on the current traffic load?

A4: The AP may change the value of KPI If the channel condition of BSS load changes. The current traffic load is a factor for impacting the value of the Delay KPI field, but is not the only factor for the determination of the value. The KPIs are per BSSID/AP based on AP metrics (DL) and STA metrics. How to determine the values of the KPIs depends on the implementation. For example, DL can be estimated accurately by the AP per TID/AC. For the UL the extended BSR can be considered, for example, the latency reports/indications can be carried in BSR.

 Q5: The QoS that can be served to a STA will highly dependent on the capability of the STA and the radio condition between the STA and the AP

A5: The KPI is gained from AP’s perspective, and how to determine the KPI is depend on the algorithm implemented by AP, such as AP can take the optimal KPI per TID/AC estimated as the advertised KPI. And it is a reference information advertised to non-AP STAs. The capability of the STA and the radio condition between the STA and the AP is a factor for impacting the KPI for the STA. The STA can gain more precise KPI suitable for itself by the further estimation of communication between itself and AP.

**Proposed Text Change:**

**1. Proposed Text Change for “3.4 Abbreviations and acronyms”**

**TGbe editor**: ***please insert the following acronym definition:***

KPI Key Performance Indicator

**2. Proposed Text Change for “4.5.6.3 Support for predictable latency”**

**TGbe editor**: ***please*** insert the following ***pa***ragra***phs in 4.5.6.3 Support for predictable latency*** (CID 14072)

An EHT AP that has dot11ExtendedEstimatedServiceParametersImplemented equal to true may announce current support for latency sensitive traffic by containing a Latency Sensitive Traffic KPI element in transmitted Beacon frames, Probe Response frames, and (Re)Association Response frames, and other management frames. A non-AP EHT STA identifies the support of its associated AP for latency sensitive traffic according to the thresholds indicated in the most recently received Latency Sensitive Traffic KPI element. A traffic stream with a stringent requirement for predictable latency is identified as a supported latency sensitive traffic if the following conditions are met for any Latency Sensitive Traffic KPI subfield of the Latency Sensitive Traffic KPI List field in the Latency Sensitive Traffic KPI element:

* The direction for the traffic stream is the same as the direction indicated in the Direction subfield of the Latency Sensitive Traffic KPI Control field of Latency Sensitive Traffic KPI element.
* The MSDU delivery ratio for the traffic stream is more than or equal to 95% and less than or equal to the KPI for MSDU delivery ratio indicated in the valid value for the KPI for MSDU Delivery Ratio subfield of the Latency Sensitive Traffic KPI subfield if present.
* The delay threshold for the traffic stream is more than or equal to the delay KPI indicated in the Delay KPI subfield of the Latency Sensitive Traffic KPI subfield and less than or equal to the maximum valid value of the Delay KPI subfield of the Latency Sensitive Traffic KPI subfield.

Otherwise it is not identified as a supported latency sensitive traffic.

**3. Proposed Text Change for “9.4.2 Elements”**

**TGbe editor**: ***please insert the following new subclause at the end of subclause 9.4.2 Elements*** (CID 14072)***:***

The format of the Latency Sensitive Traffic KPI element is defined in [Figure 9-xxx (Latency Sensitive Traffic KPI element format)](#bookmark93). The frames carrying this element and usage of this element are described in 4.5.6.3 Support for predictable latency.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Element ID | Length | Element ID Extension | Latency Sensitive Traffic KPI Control | Latency Sensitive Traffic KPI List |

Octets: 1 1 1 1 variable

**Figure 9-xxx—Latency Sensitive Traffic KPI element format**

The Element ID, Length, and Element ID Extension fields are defined in [9.4.2.1 (General)](#bookmark71).

The format of the Latency Sensitive Traffic KPI Control field is defined in [Figure 9-xxx (Latency Sensitive Traffic KPI Control field format )](#bookmark131).

B0 B1 B2 B4 B5 B6 B7

|  |  |  |  |
| --- | --- | --- | --- |
| Direction | Number of Latency Sensitive Traffic KPIs | KPI for MSDU Delivery Ratio Presence Indicator | Reserved |

Bits: 2 3 1 2

**Figure 9-xxx—Latency Sensitive Traffic KPI Control field format**

The Direction subfield is defined in 9.4.2.316 (QoS Characteristics element).

The Number of Latency Sensitive Traffic KPIs subfield indicates the number of the Latency Sensitive Traffic KPI subfields in the Latency Sensitive Traffic KPI List field. The subfield is encoded to n, where (n+1) is the number of the Latency Sensitive Traffic KPI subfields.

The KPI for MSDU Delivery Ratio Presence Indicator subfield indicates whether the KPI for MSDU Delivery Ratio field is present in the Latency Sensitive Traffic KPI subfield of the Latency Sensitive Traffic KPI List field. A value of 1 in the KPI for MSDU Delivery Ratio Presence Indicator subfield indicates that the KPI for MSDU Delivery Ratio field is present in the Latency Sensitive Traffic KPI subfield of the Latency Sensitive Traffic KPI List field. Otherwise, the KPI for MSDU Delivery Ratio field is not present in the Latency Sensitive Traffic KPI subfield of the Latency Sensitive Traffic KPI List field . If the number of the Latency Sensitive Traffic KPI subfields are more than 1 the value of the KPI for MSDU Delivery Ratio Presence Indicator subfield shall be equal to 1.

The Latency Sensitive Traffic KPI List field is defined in Figure 9-xxx (Latency Sensitive Traffic KPI List field format). The Latency Sensitive Traffic KPI List field contains m Latency Sensitive Traffic KPI subfields, where m is the number of Latency Sensitive Traffic KPI subfields.

|  |  |  |
| --- | --- | --- |
| Latency Sensitive Traffic KPI 1 | … | Latency Sensitive Traffic KPI m |

Octets: 5 5

**Figure 9-xxx—Latency Sensitive Traffic KPI List field format**

|  |  |
| --- | --- |
| Delay KPI | KPI for MSDU Delivery Ratio |

Octets: 4 0 or 1

**Figure 9-xxx—Latency Sensitive Traffic KPI subfield format**

The Latency Sensitive Traffic KPI subfield is defined in Figure 9-xxx (Latency Sensitive Traffic KPI subfield format).

The Delay KPI subfield is 3 octets long and contains an unsigned integer that specifies the KPI for delay, 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 suc-cessful transmission or retransmission of the MSDU or A-MSDU to the destination.

The KPI for MSDU Delivery Ratio subfield indicates the KPI for the percentage of MSDUs that are expected to be delivered within the delay KPI specified in the Delay KPI subfield and its encoding is defined in Table 9-xxx. The KPI for MSDU Delivery Ratio subfield is optional.

Table 9-xxx: KPI for 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 |

**4. Proposed Text Change for “****Annex C”**

**TGbe editor**: ***please insert dot11ExtendedEstimatedServiceParametersImplemented in the Dot11StationConfigEntry as follows:***

Dot11StationConfigEntry ::= SEQUENCE

{

…

(CID 14072) dot11ExtendedEstimatedServiceParametersImplemented TruthValue

 }

**TGbe editor**: ***please insert the following at the end of the dot11StationConfig TABLE:***

(CID 14072) dot11ExtendedEstimatedServiceParametersImplemented 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 the ability of the EHT STA to support the extended estimated service Parameters. If the attribute is false, the EHT STA does not support the extended estimated service Parameters."

::= { StationConfigEntry <Last assigned + 1> }