IEEE P802.11
Wireless LANs

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| PDT for Low Latency Indication |
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Abstract

This document contains proposed resolutions to the following comments received on 802.11bn D0.1.

189, 190, 191, 270, 433, 434, 1396, 1397, 1448, 1449, 1450, 1485, 1493, 1496, 1598, 1725, 1726, 1727, 1728, 1893, 2373, 2375, 2387, 2389, 2390, 2404, 2506, 2518, 2544, 2623,2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2824, 2825, 3114, 3115, 3148, 3344, 3345, 3346, 3347, 3348, 3349, 3350, 3351, 3352, 3353, 3453, 3622, 3899, 3908

# Revision information

The following is a summary of the important changes that occurred within each revision of this document:

|  |  |
| --- | --- |
| **Revision** | **Major changes** |
| 0 | Initial revision |
| 1 | Updated date, email of authors, Updated CIDs #1893,#2825,#3622 to Revised, Harmonized with 11-25-0438r5 and updated the Multi-STA BA section, harmonized with 11-25-0437r6 |
| 2 | Updating the AMPDU section to harmonize with 11-25-0838r4, clean text |
| 3 | Updated the LLI enabled field name to LLI supported as per Binita’s request, removed section 9.7.3 as it is resolved by 0838r5  |
| 4 | Added edits and comments / comments replies from Binita  |
| 5 | Minor edits  |
| 6 | Added edits and comments / comments replies from Insun, Yonggang and Alfred |
| 7 | Added reference to 37.6a and 37.6 for rules for ICF/ICR and block ack ack. Also, updates related to comments from Yue, Alfred, Binita and Jinho |
| 8 | Removed edits and cleaned text, removed watermark added by mistake, applied some edits from Mark |
| 9 | Updated the rule for receiving BSRP NTB to follow the current rule for sending BSR NTB frame. Changed may to shall for aggregating M-STA BA and QoS null as a response to BSRP TB frame, few edits to avoid confusion. Changes to r8 are highlighted in green |
| 10 | Added new low latency indication and changed the encoding of the Low Latency Indication subfield. Changes to r9 are marked in light blue  |

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| --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Page** | **Comment** | **Proposed Change** | **Resolution** |
| Capability |
| 1397 | Insun Jang | 86 | LLT Indication support capability needs to be included in UHR MAC Capabilities, and whether the AP can always understand LLT indication from non-AP STA should be clarified | As in the comment | Revised, added text to include LLI support to the UHR MAC Capabilities element. TGbn editor: please apply text marked #1397 in the document  |
| 1725 | Gaius Wee | 86 | Field and element names are incorrect | Replace "Capability" with "Capabilities" for both field and element names | Accepted |
| 2404 | Yuki Fujimori | 86 | Low Latency Indication Support field of the UHR MAC Capability Information field doesn't exist in the Figure 9-aa5 --UHR MAC Capabilities Information field format. | Please add the field into the figure. | Revised.added text to include LLI support to the UHR MAC Capabilities element TGbn editor: please apply text marked #2404 in the document |
| 2626 | Yue Qi | 86 | "UHR MAC Capability Information field" and "UHR Capability element" have not been defined or decided yet. The signaling and naming details can be TBD at this phase. | change "of the UHR MAC Capabilities Information field of the UHR Capability element" to "of the UHR TBD field" and "UHR TBD element" correspondingly. | Rejected.The comment fails to identify a technical issue. Both these fields are already defined. |
| 2628 | Yue Qi | 86 | UHR Capability element have not been defined. The signaling details can be TBD at this phase. | change to "of the transmitted UHR TBD elements" | Rejected.The comment fails to identify a technical issue. The element has already been defined. |
| 2632 | Yue Qi | 86 | UHR Capability element is not defined or decided yet. | singular and plural form is not consistant in this section. Please change to UHR Capabilities TBD field. | Rejected.The comment fails to identify a technical issue. The element has already been defined. |
| 3115 | Mark RISON | 86 | "the Low Latency Indication Support field of the UHR MAC Capability Information" -- no such field | As it says in the comment | Revised.added text to include LLI support to the UHR MAC capabilities element TGbn Editor: please apply text marked #3115 in the document |
| 3345 | Mohamed Abouelseoud | 86 | low latency indication capability is not defined in the UHR capability element | add the low latency capability definition in the UHR capability element | Revised.added text to include LLI support to the UHR MAC capabilities element TGbn Editor: please apply text marked #3345 in the document |
| 434 | Shuang Fan | 86 | There is no 'Low Latency Indication Support' field defined in the UHR MAC Capabilities Information in clause 9.4.2.aa2.2, please add it. | as in comment | Revised.added text to include LLI support to the UHR MAC capabilities element TGbn Editor: please apply text marked #434 in the document |
| 3908 | Abhishek Patil | 86 | The Low Latency Indication Support field seems to be missing in UHR Capabilities element. | Add Low Latency Indication Support field to UHR MAC Capabilities field of the UHR Capabilities element | Revised.added text to include LLI support to the UHR MAC capabilities element TGbn Editor: please apply text marked #3908 in the document |
| LLI needs |
| 189 | Yonggang Fang | 85 | The definition of LLI is too restricted. It should consider a use case of LLI that a TXOP responder can inform the TXOP holder regarding its low latency needs for its P2P communications. Please revise the text to add "The low latency needs are related to pending buffered low latency traffic between the TXOP responder and the TXOP holder 'or between the TXOP responder and its peer STA' " | See the comment | Revised Added text to define the P2P needs of the TXOP responder.  TGbn Editor: please apply text marked [#189, #190, #2824, #2625, #1149] in the document."  |
| 190 | Yonggang Fang | 85 | It needs to specify the detail of "low latency needs" to align the "TXOP holder should consider the low latency indication in determining subsequent actions within the current TXOP or subsequent TXOPs." | Please add the detail of low latency needs, like size of bufferred LL data, target delivery time (e.g., within the TXOP), the target delivery STA (e.g, the AP or its P2P STA) | Revised Added text to define the P2P needs of the TXOP responder.  TGbn Editor: please apply text marked [#189, #190, #2824, #2625, #1149] in the document." |
| 1485 | Shinya Otsuki | 86 | In this subclause, while there is a phrase, "The low latency needs are related to pending buffered low latency traffic", other relavant parameter may be taken into account. | After this sentence, adding "(Other relevant parameters are TBD)". | Rejected.Unclear what are the other relevant parameters. Group has not agreed on extending the low latency indication to include information beyond the request for action from the AP related to the request  |
| 1496 | Kotaro NAGANO | 85 | The notification of LLI need not be limited to TXOP holders. | The description should be such that the party to notify of the presence of LL traffic is not limited. | Rejected.LLI indication is defined for now as an indication for low latency traffic buffered between the TXOP responder to the TXOP holder. Other cases are not yet agreed on by the other IEEE members |
| 3114 | Mark RISON | 85 | "The low latency needs are related to pending buffered low latency traffic between the TXOP responder and the TXOP holder." not clear: is this potentially also about pending buffered LL traffic from the responder to the holder? | As it says in the comment | Revised. The sentence is updated to specify the traffic from the TXOP responder to the TXOP holder.TGbn Editor: please apply changes marked #3114 in the document |
| AP reporting LLI |
| 191 | Yonggang Fang | 86 | Similar to LLI report from non-AP STA, it is also important for the AP to indicate LLI to the non-AP TXOP holder, which can allow the AP to indicate the needs and handle the low latency transmissions. Please add the text to resolve the TBD for an AP to inform LL report to the non-AP TXOP holder. | Please add the text for the AP to indicate LL needs. | Rejected.Group has not agreed on extending LLI to AP as a TXOP responder |
| 2390 | Ahmadreza Hedayat | 86 | Resolve the TBD in: "Whether a TXOP responder AP may indicate its low latency needs to a TXOP holder non-AP STA is TBD". | As in comment | Rejected.Group has not agreed on extending LLI to AP as a TXOP responder |
| 3348 | Mohamed Abouelseoud | 86 | "Whether a TXOP responder AP may indicate its low latency needs to a TXOP holder non-AP STA is TBD."The behavior and low latency needs for AP and non-AP STAs should be the same when it comes to using LLI. There should be no reason to limit this procedure to non-AP STAs | define the procedure to be applicable to AP and non-AP STA | Rejected.Group has not agreed on extending LLI to AP as a TXOP responder |
| 2506 | Laurent Cariou | 86 | Simulations show that need for a low latency indication is on the STA side, not the AP side, which already has higher priority to access the medium over STAs and suffers a lot less from channel access delays | as in comment | Revised,Removed the TBD for the AP to send LLI TGbn Editor: please apply text marked #2506 in the document |
| 2544 | Behnam Dezfouli | 85 | If the TXOP responder is an AP, it cannot notify the TXOP holder of its low-latency (LL) requirements, such as the need to send urgent downlink traffic to a non-AP STA. | Enable the AP, as a TXOP responder, to notify a non-AP STA of its low-latency (LL) traffic requirements while the non-AP STA holds the TXOP. | Rejected.Group has not agreed on extending LLI to AP as a TXOP responder |
| MIB |
| 433 | Shuang Fan | 86 | dot11LowLatencyIndicationActivated is not defined in Annex C.3,please add it | as in comment | Revised.added text to define MIB variable to indicate the LLI capability. TGbn Editor: please apply text marked #433 in the document |
| 3899 | Abhishek Patil | 86 | Add MIB to Annex C. | As in comment | Revised.added text to define MIB variable to indicate the LLI capability. TGbn Editor: please apply text marked #3899 in the document  |
| Subsequesnt action by TXOP holder |
| 1450 | Akira Kishida | 86 | Regarding the sentence, "The subsequent actions taken by the TXOP holderafter receiving the low latency indication are out of scope of the standard. " These subsequent actions should not be all left for the implementation. | Modify the sentence to "The subsequent actions taken by the TXOP holderafter receiving the low latency indication are TBD."The commenter will bring a contribution in need. | Rejected,The comment fails to identify a technical issue.  |
| 1493 | Kotaro NAGANO | 85 | The provision of "The subsequent actions taken by the TXOP holder after receiving the low latency indication are out of scope of the standard." is too broad of an option for the TXOP holder to take. | It should be specified that the actions the TXOP holder can take are limited to actions within the TXOP period. You should list explicit alternatives such as RD, preemption, or doing nothing. | Rejected,The draft is stating that the AP should consider the low latency indication in determining the actions. These actions will depend on the channel conditions, the AP schedule and implementation.  |
| 1893 | Sanghyun Kim | 85 | If the behavior of the AP upon receiving an LL traffic indication is not specified, performing the LL traffic indication may become meaningless. | Although the AP's behavior after receiving an LL traffic indication may remain optional, it is recommended to provide guidelines on the appropriate actions the AP should take. |  Revised,Added a text stating that the AP should consider the low latency indication in determining the subsequent scheduling decision to fulfill the non-AP low latency needs.TGbn Editor: please apply text marked [#1893,#2825,#3622] in the document |
| 3622 | James Yee | 87 | "subsequent actions taken by the TXOP holder after receiving the low latency indication" covers an indefinite time period and a wide range of actions. Declaring this to be 'out of scope of the standard' is too vague and not meaningful. | Clarify exactly what is out of scope or Remove the last sentence of the paragraph. | Revised,Added a text stating that the AP should consider the low latency indication in determining the subsequent scheduling decision to fulfill the non-AP low latency needs.TGbn Editor: please apply text marked [#1893,#2825,#3622] in the document |
| 2825 | Serhat Erkucuk | 86 | The draft spec indicates that the subsequent actions taken by the TXOP holder after receiving the low latency indication are out of scope of the standard. However, it is necessary to include in the spec how the TXOP holder will behave based on the low latency indication. | The draft spec should be revised to include how the TXOP holder will behave based on the low latency indication. | Revised,Added a text stating that the AP should consider the low latency indication in determining the subsequent scheduling decision to fulfill the non-AP low latency needs.TGbn Editor: please apply text marked [#1893,#2825,#3622] in the document |
| 2633 | Yue Qi | 86 | The subsequent actions may not always out of the scope of the standard. Some actions may still within the scope, for example, AP may choose using existing protocols. | Propose to change "some" to "the". | RejectedThere is no “some” in the draft text related to the mentioned sentence  |
| 1728 | Gaius Wee | 86 | The intention can be made clearer by adding that the actions are implementation specific | Insert "implementation specific and" before "out of scope of the standard" | Rejected,Out of scope of the standards and implementation specific have the same outcomes and are similar in meaning  |
| 2629 | Yue Qi | 86 | "the TXOP holder should consider...", but there is no way for the TXOP responder to know if the TXOP holder considers the indication or not. | As in the comment | RejectedThe LLI is an indication to the AP about buffered low latency traffic. The expectation is that AP should do its best to fulfill the request. If the AP managed to consider the request, it should use the tools available in the standards to serve the non-AP STA  |
| 2630 | Yue Qi | 86 | There is no way for the TXOP responder to know the actions from TXOP holder. | The TXOP holder may provide actions or information when receiving the LLI. | RejectedThe expectation of the LLI is that the AP should consider the request and fulfill the non-AP STA indication. It is unclear what actions, or information should be provided by the TXOP responder |
| 2631 | Yue Qi | 86 | There is no method to assure the TXOP responder's indication will be constantly protected or further considered in the subsequent TXOPs. | As in the comment | RejectedCommentor is not providing a specific method to provide the requested assurance or protection |
| More indications |
| 1598 | Yuchen Guo | 85 | the control response frame should be able to provide information on the amount of resource required to transmit the LL traffic | add other information, e.g., required medium time in the control response frame that supports LL indication | Rejected.Group has not agreed on extending the low latency indication to include information beyond the request for action from the AP related to the request  |
| 3453 | Liuming Lu | 85 | The STA needs to report the information for pending buffered low latency traffic, such as LL buffer status report that considers the expiration time of MSDUs in the buffer. | Suggest to specify a mechanism to report LL buffer status report. | Rejected.Group has not agreed on extending the low latency indication to include information beyond the request for action from the AP related to the request  |
| 2625 | Yue Qi | 85 | related to pending buffered low latency traffic between the TXOP responder and the TXOP holder may be too restrictive. If the responder is also indicating low latency needs for traffic involving a third party, would the responder also indicate it to TXOP holder? | Clarify whether LLI applies to traffic itself between the responder and holder, or it can also indicate the TXOP holder responder's low latency needs which not only for TXOP holder. Propose to change "between" to "involved". | Revised Added text to define the P2P needs of the TXOP responder.  TGbn Editor: please apply text marked [#189, #190, #2824, #2625, #1149] in the document." |
| 2824 | Serhat Erkucuk | 85 | The low latency needs have been defined only for pending buffered low latency traffic between the TXOP responder and the TXOP holder. However, pending buffered low latency traffic may also be between the TXOP responder and another STA (e.g., P2P if the TXOP responder is a non-AP STA). | Revise to include pending buffered low latency traffic between STAs for P2P communications. | Revised Added text to define the P2P needs of the TXOP responder.  TGbn Editor: please apply text marked [#189, #190, #2824, #2625, #1149] in the document." |
| 1449 | Akira Kishida | 85 | Information on low latency indication should be utilized for other STAs, and then there should be room for broadcasting the indication information in addition to the baseline. It should not be limited to between the TXOP responder and the TXOP holder. | Add the sentence to "This low latency needs can be referred to other STAs." | Revised Added text to define the P2P needs of the TXOP responder.  TGbn Editor: please apply text marked [#189, #190, #2824, #2625, #1149] in the document." |
| Control frame carrying LLI and signaling |
| 2627 | Yue Qi | 86 | The control response frame is TBD. | Add "TBD" before the "control response frame" | Revised,Defined M-STA BA as a container for the LLI and defined the condition for sending it TGbn Editor: please apply text marked by [#2627,#2389,#2373,#3346,#3352,#3353,#2375,#1396] in the document |
| 1396 | Insun Jang | 86 | A candidate of control frame can be Multi-STA BA frame and then we need to have a way to signal LLT indication | There would be some optioins: 1) simply indicating LLT presence in BA control field, 2) in Per-AID TIID Info field, it can be included, which enables to contain more informatiion (e.g., buffer status for LLT) | Revised,Defined M-STA BA as a container for the LLI and defined the condition for sending it TGbn Editor: please apply text marked by [#2627,#2389,#2373,#3346,#3352,#3353,#2375,#1396] in the document |
| 2389 | Ahmadreza Hedayat | 86 | Define the TBD control frame that carries the LL indication. | As in comment | Revised,Defined M-STA BA as a container for the LLI and defined the condition for sending it TGbn Editor: please apply text marked by [#2627,#2389,#2373,#3346,#3352,#3353,#2375,#1396] in the document |
| 2373 | Ahmadreza Hedayat | 35 | The LL indication of 37.16, is also carried in M-STA BA. Need to assign the relevent signaling here for the LL indication . | As in comment | Revised,Defined M-STA BA as a container for the LLI and defined the condition for sending it TGbn Editor: please apply text marked by [#2627,#2389,#2373,#3346,#3352,#3353,#2375,#1396] in the document |
| 3346 | Mohamed Abouelseoud | 86 | "A TXOP responder non-AP STA may indicate its low latency needs to the TXOP holder in a TBD controlresponse frame" the control frame carrying the LLI needs to be defined | define the control frame to carry the LLI | Revised,Defined M-STA BA as a container for the LLI and defined the condition for sending it TGbn Editor: please apply text marked by [#2627,#2389,#2373,#3346,#3352,#3353,#2375,#1396] in the document |
| 3352 | Mohamed Abouelseoud | 85 | it is unclear how to solicit the LLI from the TXOP holder to the TXOP initiator | please define the control frame carrying the LLI and the conditions of sending it and soliciting it | Revised,Defined M-STA BA as a container for the LLI and defined the condition for sending it TGbn Editor: please apply text marked by [#2627,#2389,#2373,#3346,#3352,#3353,#2375,#1396] in the document |
| 3353 | Mohamed Abouelseoud | 85 | Low latency indication is not defined | Please define what is the low latency indication and what it means to the TXOP holder | Revised,Defined M-STA BA as a container for the LLI and defined the condition for sending it TGbn Editor: please apply text marked by [#2627,#2389,#2373,#3346,#3352,#3353,#2375,#1396] in the document |
| 2375 | Ahmadreza Hedayat | 37 | Table 9-39. Need to assign the relevent signaling here for the LL indication. | As in comment | Revised,Defined M-STA BA as a container for the LLI and defined the condition for sending it TGbn Editor: please apply text marked by [#2627,#2389,#2373,#3346,#3352,#3353,#2375,#1396] in the document |
| Enablement procedure |
| 3347 | Mohamed Abouelseoud | 86 | Unclear how the TXOP holder and TXOP responder can enable this feature | please add an enablement procedure for the TXOP holder and responder to use LLI | Revised.Added text to define enablement procedure for LLI mode TGbn Editor: please apply text marked by #3347 in the document |
| 2518 | Inaki Val | 85 | Is there going to be an initial negotiation within the BSS to establish the low latency traffic category (TID, SCSID, etc), limiting its use to known traffic, allowing the AP to manage the requests | Consider including an initial set up procedure to establish which are the low latency services. | Revised.Added text to define enablement procedure for LLI mode TGbn Editor: please apply text marked by #2518 in the document |
| LL traffic definition |
| 3351 | Mohamed Abouelseoud | 85 | Low latency traffic is not defined for the low latency indication procedure. When STA sends the low latency indication, it is not clear to the TXOP holder which traffic flow/TID is in need to be prioritized | in the enablement procedure, enable the possibility of defining the low latency traffic | Revised.Added text to define low latency traffic through SCS procedure TGbn Editor: please apply text marked by #3351 in the document |
| 2624 | Yue Qi | 85 | low latency traffic is not clearly defined. | propose to add "definition of low latency traffic in UHR is TBD." | Revised.Added text to define low latency traffic through SCS procedure TGbn Editor: please apply text marked by #2624 in the document |
| 2387 | Ahmadreza Hedayat | 85 | Define the "low latecy needs" and remove the TBD. | As in comment | Revised.Added text to define low latency traffic through SCS procedure TGbn Editor: please apply text marked by #2387 in the document |
| 3344 | Mohamed Abouelseoud | 85 | low latency needs are unclear. Please define what is low latency needs | Add specific definition to the low latency needs and how it is indicated | Revised.Added text to define low latency traffic through SCS procedure TGbn Editor: please apply text marked by #3343 in the document |
| 2634 | Yue Qi | 86 | its low latency needs is unclear. The definition of the low latency needs of AP as TXOP responder is the same or not? Would AP's low latency needs only refer to the pending traffic to non-AP STA TXOP holder? Or it refers to AP's own low latency needs may be addressed to a third party. | Propose to define the "low latency needs" for TXOP responder AP. | Revised.Added text to define low latency traffic through SCS procedure TGbn Editor: please apply text marked by #2634 in the document |
| 270 | Zhanjing Bao | 85 | 'Low latency traffic' requires a clear definition to illustrate its traffic characteristics | Add a definition for 'low latency traffic' before using the terminology | Revised.Added text to define low latency traffic through SCS procedure TGbn Editor: please apply text marked by #270 in the document |
| LLI in ICR |
| 3349 | Mohamed Abouelseoud | 85 | A STA should be able to indicate it low latency needs at the beginning of the TXOP or in the middle of the TXOP to enable the TXOP holder to react to the needs on time | define the procedure to enable adding the low latency indication at the beginning of the TXOP when a trigger frame is used to solicit LLI or when the STA is sending an immediate control response acking MPDU | Revised.Added text to enable the non-Ap STA to respond to an ICF sent by the AP to solicit the LLITGbn Editor: please apply text marked #3349 in the document |
| Misc |
| 3350 | Mohamed Abouelseoud | 85 | A STA should be able to request to limit the non-low latency PPDU sent from TXOP holder to enable LLI to be sent in time. | Add a procedure to enable the STA to indicate the requested PPDU target duration when enabling the LL indication mode operation | Rejected.Group has not reached agreement on this topic yet  |
| 3148 | Jeongki Kim | 85 | In TGbn D0.1, TXOP responder can transmit a response frame indicating the low latency traffic. Can An TXOP initiator also transmit ICF indicating presence of the low latency traffic? Define the mechanism for TXOP initiator to transmit ICF indicating the low latency traffic. | as per comment | Rejected.Unclear what the advantage of the TXOP initiator indicating the presence of low latency traffic. The TXOP initiator can send the low latency traffic in the TXOP initiated without any help from the TXOP responder.  |
| 1726 | Gaius Wee | 86 | "A STA" should be specifically a UHR STA | Replace "A STA" with "A UHR STA" | Accepted. |
| 1727 | Gaius Wee | 86 | "TXOP responder non-AP STA" is not defined | Replace "TXOP responder non-AP STA" with "A non-AP UHR STA that is a TXOP responder" | Accepted. |
| 2623 | Yue Qi | 85 | Upper letter for the subClause. | change "Low Latency Indiction" to "Low latency indication" | Accepted.  |
| 1448 | Akira Kishida | 85 | Target low latency traffic for low latency indication should not be limited to "pending buffered low latency traffic." There should be room for expected low latency traffic, both periodic and sporadic. | Change the sentence to "pending buffered or expected low latency traffic." | Rejected.The objective of LLI is to the AP to consider assigning resources for traffic that is already available at the non-AP STA. Expected low latency traffic is not yet available to transmit at the non-AP STA and the AP would not know when to schedule the resources for the UL transmission  |

# Introduction

 The following edits address CC50 related to LLI and complies with the following passed motion #273 MAC:

**TGbn defines or improves an existing mechanism so that a non-AP STA that is a TXOP responder can indicate its buffered low latency traffic needs (for traffic from the TxOP responder to the TxOP Holder) in a control response frame. The TXOP holder should consider the indication in determining subsequent actions. Subsequent actions related to this indication are out of the scope of the standard.**

* + Note: whether an AP can Indicate its low latency needs is TBD

***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).***

# Text to be adopted begins here:

* UHR Capabilities element
* General
* UHR MAC Capabilities Information field

***TGbn editor: Please update UHR MAC Capabilities in 11bn D0.3 to add LLI Support field as below***

***[#1397, #1725, #2404, #3115, #3345, #434, #3908]***

The format of the UHR MAC Capabilities Information field is defined in Figure 9-aa5 (UHR MAC Capabilities Information field format).

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B4 | B5 | B6 | B7 | B8 | B9 | B10 Bx |
|  | DPS Support | DPS Assisting Support | Multi-Link Power Management | NPCA Supported | BSR Enhancement Support | DBE Support | P-EDCA Support | UL LLI Support | Peer-to-peer LLI Support | Reserved |
| Bits: | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | x-9 |

|  |
| --- |
| * Subfields of the UHR MAC Capabilities Information field (continued)
 |
| Subfield | Definition | Encoding |
| … | … | … |
| UL LLI Support | Indicates whether or not UL LLI is supported  | Set to 1 if dot11LLIOptionActivated is true and UL LLI is supported (see 37.16 (Low Latency Indication (LLI)).Set to 0 otherwise. |
| Peer-to-peer LLI Support | Indicates whether or not Peer-to-peer LLI is supported  | Set to 1 if dot11LLIOptionActivated is true and Peer-to-peer LLI is supported (see 37.16 (Low Latency Indication (LLI)).Set to 0 otherwise. |

**9.3.1.8 BlockAck frame format**

**9.3.1.8.6 Multi-STA BlockAck variant**

***TGbn editor: please add the following paragraph to the end of subclause 9.3.1.8.6 as follows***

**Low latency feedback**

If the Feedback Type subfield is 1, the feedback subfield has the format defined in Figure 9-xx (Feedback subfield format if the Feedback Type subfield is set to 1 for low latency feedback) and includes low latency feedback information. The size of the Feedback subfield is 32 bits for UHR STAs. The Low Latency Indication subfield is set to 1 to indicate the presence of buffered low latency traffic at the TXOP responder for delivery to the TXOP holder and is set to 0 to indicate that there is no buffered low latency traffic from the TXOP responder for delivery to the TXOP holder (see 37.16.1 General).

[#189, #190, #2824, #2625, #1149] The Peer-to-peer Low Latency Indication subfield is set to 1 to indicate the presence of buffered low latency traffic at the TXOP responder for delivery to a STA other than the TXOP holder and is set to 0 otherwise.

The TXOP Responder shall not set both Low Latency Indication and Peer-to-Peer Low latency indication subfield to 1.

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0  | B1 | B2 variable |
|  | Low Latency Indication | Peer-to-peer Low Latency Indication | Reserved |
| Bits: | 1 | 1 | variable |

**Figure 9-xx --Feedback subfield format if the Feedback Type subfield is set to 1 for low latency feedback**

***TGbn editor: please change subclause 9.4.2.326 in 802.11be as follows***

**9.4.2.326 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), 35.8 (Restricted TWT (R-TWT)) and 37.17 (Low latency indication (LLI)).

***TGbn editor: please change Figure 9.1074bd in 802.11be as follows***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 B1  | B2 B5 | B6 B8 | B9 B24 | B25 B28 | B29 | B30 B31 |
|  | Direction | TID | User Priority | Presence Bitmap of Additional Parameters | LinkID | LLI Requested | Reserved |
| Bits: | 2 | 4 | 3 | 16 | 4 | 1 | 2 |

**Figure 9-1074bd—Control Info field format**

***TGbn editor: please change the 4th paragraph in 9.4.2.326 802.11be as follows***

* The LinkID subfield contains the link identifier that corresponds to the link for which the direct link transmissions are going to occur. This field is reserved if the Direction subfield is equal to any value but 2 (Direct link).
* [#2624, #3351, #2634, #2387, #3343, #270] The LLI Requested subfield specifies if the use of the low latency indication (LLI) mode is being requested for the traffic of the SCS stream described by the QoS Characteristic element. The LLI Requested is set to 1 if the use of LLI mode is being requested for the traffic of the SCS stream described by the QoS Characteristic element and is set to 0 otherwise. The LLI Requested field is reserved if the QoS Characteristic element is sent by a non-UHR non-AP STA or a UHR non-AP STA that does not support LLI or if the Direction subfield is 1.

NOTE 1—The presence of the TID subfield is for any future expansion to enable carrying a TID value that is independent of the User Priority.

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 SPs that are allocated to the STA for UL frame exchanges and the value 0 is reserved unless the transmitting STA is a UHR STA that supports Uplink LLI and has set the LLI Requested subfield in the Control Info field to 1.
* 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 SPs 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 SPs that are allocated to the STA for direct link frame exchanges and the value 0 is reserved unless the transmitting STA is a UHR STA that supports peer to peer LLI and has set the LLI Requested subfield in the Control Info field to 1.

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 SPs that are allocated to the STA for UL frame exchanges and the value 0 is reserved unless the transmitting STA is a UHR STA that supports uplink LLI and has set the LLI Requested subfield in the Control Info field to 1.
* 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 SPs 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 SPs that are allocated to the STA for direct link frame exchanges and the value 0 is reserved unless the transmitting STA is a UHR STA that supports peer-to-peer LLI and has set the LLI Requested subfield in the Control Info field to 1.
* The value of this field is greater than or equal to the value of the Minimum Service Interval field.

NOTE 2—Periodic traffic can be indicated by setting the Minimum Service Interval field and Maximum Service Interval field to the same value.

If the LLI Requested subfield in the Control Info field is 1 and the Minimum Service Interval field and the Maximum Service Interval field are equal to 0, then the minimum interval and the maximum interval values are unspecified, and the QoS Characteristic element is used only for requesting the use of LLI mode for the traffic of the SCS stream described by this QoS Characteristic element (see 37.16 Low latency indication (LLI)).

NOTE 3 – A STA can use TID subfield to identify traffic of the SCS stream to be used for LLI.

If the LLI Requested subfield in the Control Info field is 1 and the Minimum Service Interval field and the Maximum Service Interval field are not equal to 0, then the QoS Characteristic element is used for requesting the use of LLI mode for the traffic of the SCS stream described by this QoS Characteristic element (see 37.16 Low latency indication (LLI)) in addition to defining the characteristics and QoS expectations of a traffic flow (see 11.25.2 SCS procedures).

***TGbn editor: Please update the 12th paragraph in subclause 35.17 EHT SCS Procedure in 802.11be as follows:***

**35.17 EHT SCS procedure**

The SCS Descriptor element that is included in an SCS Response frame shall not contain any Intra-Access Category Priority element, TCLAS Elements field or TCLAS Processing Element field. The Request Type field value in the corresponding SCS Descriptor element is reserved. The following fields in the QoS Characteristics element included in the corresponding SCS Descriptor element in the SCS Response frame may differ from the corresponding values in the requested SCS stream: Minimum Service Interval, Maximum Service Interval, Service Start Time, Medium Time and LLI Request.

***TGbn editor: Please update subclause 37.16 Low Latency Indication in the 802.11bn draft D0.3:***

37.16 Low latency indication (LLI)

37.16.1 General

Low latency indication (LLI) enables a TXOP responder to inform the TXOP holder regarding its low latency needs. The low latency needs are related to buffered low latency traffic [#3114]from the TXOP responder for uplink delivery to the TXOP holder or for peer-to-peer delivery to a STA other than the TXOP holder. [#2624, #3351, #2634, #2387, #3343, #270] The non-AP MLD to which the non-AP STA is affiliated shall use the SCS procedure to request the use the LLI mode for SCS stream(s) delivery of indication associated with low latency traffic. The LLI is used to feedback buffered traffic associated to these streams.

A UHR STA that supports low latency indication may set [#433, #3899]dot11LLIOptionActivated to true and shall set the UL LLI Support field of the UHR MAC Capabilities Information field of the UHR Capabilities element to 1 if the STA supports reporting buffered low latency traffic for delivery to the TXOP holder, and shall set the Peer-to-peer LLI Support field of the UHR MAC capabilities information field of the UHR Capabilities element to 1 if the STA supports reporting buffered low latency for delivery to a STA other than the TXOP holder. A UHR STA with dot11LLIOptionActivated equal to true is called a LLI STA.

A non-AP LLI STA that is a TXOP responder may indicate its low latency needs to the LLI TXOP holder STA in a [#2627,#2389,#2373,#3346,#3352,#3353,#2375,#1396] Multi-STA BlockAck frame sent to the TXOP holder if the TXOP holder has LLI mode is enabled.

[#2506 ]

* + 1. **Low latency indication (LLI) mode**

[#2518, #3347] For a non-AP LLI STA, to enable the LLI mode the corresponding non-AP MLD to which the non-AP STA is affiliated shall have at least one SCS stream established with its associated AP MLD that supports LLI mode where the LLI Requested subfield in the QoS Characteristic element is set to 1 (see (9.4.2.326 QoS Characteristics element)). The LLI mode is considered disabled if all SCS streams where the LLI Requested subfield in the QoS Characteristic element is set to 1 are terminated by either the non-AP LLI STA or the LLI AP STA. A non-AP LLI STA and that intends to enable or disable the LLI mode shall follow the procedure defined in 37.X (Procedure for operating mode and parameter updates).

A non-AP LLI MLD STA shall not establish SCS streams with its associated AP LLI MLD STA where the LLI Request subfield in the QoS Characteristic element is equal to 1 and the Direction subfield in the QoS Characteristic element is equal to UL and direct link NOTE—The Direction field of all SCS request frames sent by a non-AP LLI MLD that have the LLI Requested subfield equal to 1 will have the Direction field in the QoS Characteristics element set to the same value (0 or 2).

When a non-AP LLI STA is operating with the LLI mode enabled:

* The non-AP LLI STA shall use Multi-STA BlockAck frame, **which may include** low latency feedback information, if the preceding PPDU includes MPDU(s) that solicit an immediate response (e.g., Ack or BlockAck) and shall follow the rules in 37.6 (UHR Acknowledgement Procedure).
* [#3349] The AP that initiates frame exchanges with the non-AP STA that consists of neither group addressed Data nor group addressed Management frames with the non-AP STA may initiate the frame exchanges by transmitting to the non-AP STA an ICF that allows to carry the LLI feedback in the **initial** response frame **(see 37.6a (Rules for initial control and initial response frames)**.
* The ICF is either an individually addressed BSRP NTB Trigger frame, **if the BSRP NTB Trigger frame is** allowed to be sent to the non-AP STA, or an individual or group addressed BSRP Trigger frame as defined in 37.6a (Rules for initial control and initial response frames).
* The ICR frame used to indicate the low latency feedback shall be a Multi-STA BlockAck frame and shall follow the rules in 37.6a (Rules for initial control and initial response frames).

A non-AP UHR STA that is operating in the LLI mode that receives a BSRP Trigger frame from its associated AP and that addresses the non-AP STA in a User Info field of the BSRP Trigger frame shall respond with a TB PPDU following the rules defined in 26.5.5 (Buffer status report operation), except that the non-AP STA shall also aggregate a Multi-STA BlockAck frame, that may contain the low latency feedback, along with the one or more QoS Null frames that are required according to 37.6a (Rules for initial control and initial response frames).

A non-AP STA that is operating in the LLI mode and that receives, from its associated AP, a BSRP NTB Trigger frame that addresses the non-AP STA in a User Info field of the BSRP NTB Trigger frame shall respond subject to the rules defined in 26.5.2.5 UL MU CS mechanism, and the response shall be a Multi-STA BlockAck frame that may contain the low latency feedback and that is sent in non-HT PPDU or non-HT duplicate PPDU format (see 37.6a (Rules for initial control and initial response frames).

A non-AP STA that is operating in the LLI mode and that is a TXOP responder may indicate, in a Multi-STA BlockAck frame, whether the non-AP STA has pending buffered UL low latency traffic related to one or more SCS streams that have been established with LLI Requested subfield set to 1 and Direction subfield set to 0,by including a Per-AID TID Info field that has the Feedback Type subfield in the Starting Sequence Control subfield set to 1 and by setting the Low Latency Indication subfield to 1 or 0 in the Feedback subfield (see 9.3.1.8.6 (Multi-STA BlockAck variant)).

[#189, #190, #2824, #2625, #1149] A non-AP STA that is operating in the LLI mode and that is a TXOP responder may indicate, in a Multi-STA BlockAck frame, whether the non-AP STA has pending buffered low latency traffic to a STA other than the TXOP holder related to one or more SCS streams that have been established with LLI Requested subfield set to 1 and Direction subfield set to 2,by including a Per-AID TID Info field that has the Feedback Type subfield in the Starting Sequence Control subfield set to 1 and by setting the Peer-to-peer Low Latency Indication subfield to 1 or 0 in the Feedback subfield (see 9.3.1.8.6 (Multi-STA BlockAck variant)).

[#1893, #2825, #3622] Upon receiving the low latency indication in the Multi-STA BlockAck frame, the TXOP holder should consider the low latency indication in determining subsequent actions within the current TXOP or subsequent TXOPs. The subsequent actions taken by the TXOP holder after receiving the low latency indication are out of scope of the standard.

**Annex C**

**C.3 MIB Detail**

***TGbn editor: Please add the following new MIB variable***

[#433, #3899]

Dot11UHRStationConfigEntry ::=

SEQUENCE {

dot11CoRTWTOptionImplemented TruthValue,

dot11NPCAOptionImplemented TruthValue,

dot11DUOOptionImplemented TruthValue,

dot11UHRBSROptionImplemented TruthValue,

dot11LLIOptionActivated TruthValue,

}

dot11LLIOptionActivated 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 station implementation is capable of supporting LLI mode. The capability is disabled, otherwise”

::= { dot11UHRStationConfigEntry <ana> }

# Text to be adopted ends here.