**IEEE P802.11
Wireless LANs**

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| LB271 CR for R-TWT - Part 4 |
| **Date**: July 5, 2023 |
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 **Abstract**

This submission proposes resolutions for the following CIDs received for TGbe LB271:

**CID Set 1**

16286, 17095, 16341, 18220, 15239, 15738, 15673, 16291, 16406, 16407, 16459, 16460, 16300, 18230, 16418,

**CID Set 2**

15802, 15805

**Revisions:**

* Rev 0: Initial version of the document.
* Rev 1: Added resolution to related CID 15805

***TGbe editor: The baseline for this document is P802.11beD3.2***

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.***

**CID Set 1**

|  |  |  |  |  |  |
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| **CID** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 17095 | 35.8.6 | 621.24 | "When scheduling the transmission of Trigger frames, the R-TWT scheduling AP shall first triggermember R-TWT scheduled STAs to facilitate them to first deliver their QoS Data frames of R-TWTUL TID(s), if any." poor wording | Change to "When scheduling the transmission of Trigger frames, the R-TWT scheduling AP shall triggermember R-TWT scheduled STAs first, to allow them to deliver QoS Data frames of R-TWTUL TID(s), if any, first." | **Revised**Agree with commenter and revised.**TGbe editor, please make the changes tagged by CID #17095 in 23/1120r1.** |
| 16286 | 35.8.6 | 621.39 | Sentence "the AP should follow the rules specified in 35.17 (EHT SCS procedure) for scheduling of downlink or uplink QoS Data frames when scheduling QoS Data frames for that R-TWT TID in corresponding R-TWT SPs" is not clear (for scheduling...when scheduling) .In addition, an AP does not "schedule Data frames", but allocates transmission opportunities. | Please clarify. | **Revised**Agree in principle. The sentence is revised.**TGbe editor, please make the changes tagged by CID #16286 in 23/1120r1.** |
| 16341 | 35.8 | 0.00 | No mention of clear rules for when R-TWT SPs are duplicated. | Should prohibit APs from setting up multiple duplicate R-TWT SPs or add a rule for STAs in such cases | **Rejected**The comment is not clear what constitutes duplicate R-TWT SPs or how they could be set up, and any resulting problem that require additional rules. R-TWT schedules are distinct within a BSS, identified by unique Broadcast TWT IDs, as defined in baseline 802.11ax 26.8.3. |
| 18220 | 35.8.1 | 617.44 | A restricted TWT schedule is set up in a per-TID based. For trigger-enabled restricted TWT (r-TWT), AP should have the mechanism to trigger a member r-TWT scheduled STA based on the TID corresponding to its latency-sensitive traffic(which TID the AP wants to trigger at a particular time during r-TWT SP can based on AP's scheduling decision). However, this mechanism to only trigger uplink PPDU corresponding to Latency-sensitive traffic, which would be critical for trigger-enabled r-TWT operation, is currently missing in the specification. | Please provide mechanisms, frameworks, and rules for enabling per-TID based triggering for R-TWT operation. | **Rejected**A mechanism to enable per TID based Triggering operation was discussed in 22/1828r1 and SP failed to get majority support (18Y/38N/11A). There is no consensus in the group at this point to pursue this direction. |
| 15239 | 35.8.2.2 | 618.57 | The following rule should be considered in addition to the text indicated in 35.8.2.2."Any other R-TWT scheduling APs except the R-TWT scheduling AP designated above may use those parameters in QoS Characteristics element(s) as guidance for their R-TWT schedule setup in order to avoid overlap with the R-TWT SP of the R-TWT scheduling AP." | As in the comment. | **Rejected**SCS negotiations and QoS Characteristics IE apply at MLD level, and hence may be used by any APs affiliated with the AP MLD for guidance for scheduling as defined in 35.17 (EHT SCS procedure). |
| 15738 | 35.8.2.2 | 618.57 | "If an R-TWT scheduling AP has received QoS Characteristics element(s) from an R-TWT scheduled STA whose TID and Direction fields match an R-TWT TID and its specified direction for an R-TWT schedule setup, the R-TWT scheduling AP may use those parameters in QoS Characteristics element(s) as guidance for R-TWT schedule setup."The parameters in QoS Characteristics element(s) may be useful as guidance for other R-TWT scheduling APs to adjust R-TWT schedule. | Please add the following language."Other R-TWT scheduling APs may use those parameters in order to adjust their R-TWT schedules as well." | **Rejected**SCS negotiations and QoS Characteristics IE apply at MLD level, and hence may be used by any APs affiliated with the AP MLD for guidance for scheduling as defined in 35.17 (EHT SCS procedure). |
| 15673 | 35.8.2.2 | 618.36 | The sentence, "to identify the TID(s) that carry latency sensitive traffic in DL and UL for theR-TWT membership being set up" implies that TIDs are used for different reason than they are being used in the baseline where TID 0-7 are used for access category and EDCA, and TID 8-15 are used as stream ID. How is thise new use of TID compatible with legacy STA? | As in comment | **Rejected**The context of R-TWT TIDs, indicated in the membership setup, is limited to R-TWT SPs only and follow additional traffic prioritization rules as defined in 35.8.5. This does not affect operation outside the R-TWT SPs, and hence compatibility with legacy STAs is not a concern. Further, indication of a TID as R-TWT TID does not change its access category, baseline rules apply. |
| 16291 | 35.8.2.2 | 618.25 | "An R-TWT scheduling AP should set the Trigger field to 1 in the Restricted TWT Parameter Set field(s) ittransmits". It seems all scenarios envisage such indication. Therefore, it shall be a 'shall' not a "should". Otherwise, there is a lack of description of STA behavior for medium access within an R-TWT SP. | Replace should by shall.Or describe medium access behavior for EHT STAs when R-TWT SP starts. | **Rejected**The option of “should” vs “shall” for this rule was discussed in 22/1470 and the group reached consensus to make this a recommendation and not a requirement. This statement is a recommendation for AP to indicate R-TWT schedules as Trigger-enabled. However, non-Trigger enabled R-TWT SP operation is possible (follows baseline bTWT operation with additional rules defined in 35.8.4 Channel access rules for R-TWT SPs). |
| 16406 | 35.8.6 Traffic delivery | 621.29 | "first include QoS Data frames" seems to be incorrect. | Suggest to modify "first include QoS Data frames" as "first aggregate QoS Data frames in ... the A-MPDU" | **Rejected**The context of MPDU aggregation is clear from the preceding phrase and usage of inclusion of QoS Data frames is correct in this context. No further changes are needed.  |
| 16407 | 35.8.6 Traffic delivery | 621.29 | The descritption "except that the STA shall first include QoS Data frames (if any) of TID(s) in the R-TWT UL TID(s)" seems to be confusing. How to follow the rules if R-TWT UL TID(s) correspond to different ACs? | Please clarify how to follow the rules if if R-TWT UL TID(s) correspond to different ACs | **Rejected**The MPDU aggregation rules for Multi-TID A-MPDUs are TID based rather than AC based, so there is no issue if they belong to different ACs. The prioritization rule discussed here applies to R-TWT UL TID(s) and should be applied per TID basis.  |
| 16459 | 9.4.2.199 | 242.57 | Inter-BSSs scheduled their R-TWT independently may have their R-TWT SPs overlapped in time. QoS Data frames from R-TWT member STAs and R-TWT scheduling APs may suffer delay due to OBSS interference during the overlapped inter-BSS R-TWTs.It's better to enable cooperative R-TWT schedule for inter-BSSs that allocates different channel for the overlapped R-TWT schedules to avoid inter-BSS interference. | In Restricted TWT Parameter Set field, add new subfield(s) to signal allocated channel information for inter-BSS cooperative R-TWT negotiation and intra-BSS R-TWT negotiation | **Rejected**Indication and announcement of OBSS schedules in R-TWT was discussed in 22/1827 but the group reached consensus to leave it out of the scope of 802.11be and discuss this in the next revision of the spec. |
| 16460 | 9.4.2.199 | 244.54 | Inter-BSSs scheduled their R-TWT independently may have their R-TWT SPs overlapped in time. QoS Data frames from R-TWT member STAs and R-TWT scheduling APs may suffer delay due to OBSS interference during the overlapped inter-BSS R-TWTs.It's better to enable cooperative R-TWT schedule for inter-BSSs that allocates different channel for the overlapped R-TWT schedules to avoid inter-BSS interference. | Add one more bit to the Restricted TWT schedule Info subfield of the Broadcast TWT Info subfield, and use the new field value 4 to indicate the R-TWT scheduling AP is likely to cooperate with another R-TWT scheduling AP from OBSS for inter-BSS cooperative R-TWT schedule. | **Rejected**Indication of OBSS schedules in R-TWT announcements was discussed in 22/1827 but the group reached consensus to leave it out of the scope of 802.11be and discuss this in the next revision of the spec.For the proposed resolution, Restricted TWT Schedule Info subfield is 2 bits, and all values 0-3 are defined. A new value 4 is not possible to be defined. |
| 16300 | 35.8.2.2 | 618.10 | R-TWT is a feature for transmitting latency-sensitive traffic. However, if a member STA is constantly interfered by OBSS during the R-TWT SP, delay may occur (e.g., if the SPs of the OBSS overlap with the current BSS's SPs). To address this issue, procedures are required in which the R-TWT member STA reports information on the interference situation and the AP MLD re-assigns or moves the SP based on this information. | As in comment. | **Rejected**Within R-TWT membership setup framework, a STA may renegotiate its R-TWT schedule parameters, or teardown a membership and setup a new schedule to mitigate the scenarios indicated in the comment. Therefore, amendment or renegotiation of R-TWT schedules is already possible in current spec. |
| 18230 | 35.8.1 | 617.44 | For Restricted TWT (rTWT) operation, if an STA is done with transmitting latency-sensitive packets in uplink before the end of restricted TWT service period (SP) and there is no packet waiting for that STA in downlink for remainder of the SP, then it causes channel under-utilization for that STA if the STA is prohibited to transmit latency-tolerant traffic for remainder of the SP. Channel under-utilization due to under-utilized restricted TWT SP can be reduced by allowing latency-tolerant traffic in addition to latency-sensitive traffic for transmission during rTWT SP. Once the scheduled STA is done transmitting latency-sensitive traffic during rTWT SP, and if there is still time remaining in the SP, the scheduled STA can choose to transmit its latency-tolerant packets (if any) during remaining of the SP. This will improve the channel utilization for the STA . However, it creates fairness issue. Regarding contention among the scheduled STAs, if one scheduled STA starts transmitting latency-tolerant traffic during the restricted TWT SP, it is not fair for other scheduled STAs that are still transmitting latency-sensitive traffic during the SP. Also, an STA with ill intention may abuse this functionality by setting up TWT parameters such that there is always additional time left in the restricted TWT SP after transmitting latency-sensitive packets. How to handle these situation is not clear. | The spec needs to provide mechanisms and procedures to handle the r-TWT fairness issue as described in the comment. | **Rejected**Member STAs of an R-TWT SP are not prohibited from transmitting their non-R-TWT TID traffic during the SP, so the under-utilization issue raised by the commenter does not apply.Further, for Trigger-enabled R-TWT SPs, which is the recommended mode of operation, AP still prioritizes R-TWT TID traffic of member STAs and avoid fairness issues. Traffic delivery rules have been discussed extensively in the group and the group reached consensus to prioritize R-TWT TID traffic for member STAs during SP, and not create restrictions for non-member STAs (please refer to discussions in 21/462 and discussions on 35.8.5). There is no consensus in the group to add further restrictions for member STAs’ EDCA, since no restrictions are imposed on non-member STAs or STAs not supporting R-TWT operation. |
| 16418 | 35.8.6 | 621.23 | R-TWT is designed for supporting latency sensitive traffic. According to current draft, TGB e D3.0, in a trigger-enabled R-TWT SP a non-member R-TWT scheduled STA (e.g., legacy STA or other EHT STA) may transmit a frame using EDCA while a member STA does not transmit a frame using EDCA if the member STA follows the existing recommendation rule for the existing Trigger-enabled TWT. This will decrease the peformance of the member STA or the entire R-TWT SP. Furthermore, as described in 22/2153, if the member STA does not follow the existing recommendation rule for Trigger-enabled TWT, each member STA might transmit a frame using EDCA based on its implemenation rule while the other member STA does not transmit a frame using EDCA by following the existing recommendation rule. It may result in the fairness issue or lower performance of R-TWT SP. Please define a mechanism to manage the allocated R-TWT SP efficiently from the freely medium access. | Define a method for controling a transmisison using EDCA in a trigger-enabled R-TWT | **Rejected**During a Trigger enabled TWT SP, member STAs are recommended not to do EDCA as per TWT baseline spec, and in case of R-TWT, the AP prioritizes member STA’s R-TWT TID traffic. Member STAs doing EDCA in this case may have the disadvantage of increased contention and reduced efficiency.The method proposed in 22/1253 was discussed in the group and it failed to reach consensus. The group’s consensus at this point is to use baseline bTWT EDCA rules for R-TWT as well. |

**35.8.5 Traffic delivery**

***TGbe editor: Please modify 35.8.5 in P802.11beD3.2 as follows:***

An R-TWT scheduling AP or a member R-TWT scheduled STA that has initiated or participated in a frame exchange during an R-TWT SP shall ensure that QoS Data frames of the R-TWT TID(s) are delivered first during the R-TWT SP.

In a trigger-enabled R-TWT SP, the following apply:

-- (#17095)When scheduling the transmission of Trigger frames, the R-TWT scheduling AP shall ~~first~~ trigger member R-TWT scheduled STAs first, to facilitate them to ~~first~~ deliver their QoS Data frames of R-TWT UL TID(s), if any, first.

-- The triggered member STA follows the rules specified in 26.6.3 (Multi-TID A-MPDU and ack-enabled single-TID A-MPDU) to aggregate MPDUs except that the STA shall first include QoS Data frames (if any) of TID(s) in the R-TWT UL TID(s).

NOTE—The R-TWT scheduling AP might still include the 12 LSB of the AID of a STA that is not a member of this R-TWT SP in Trigger frame(s) transmitted in trigger-enabled (#17170)R-TWT SPs.

If an R-TWT scheduling AP has established SCS stream(s) described by QoS Characteristics element(s) with an R-TWT scheduled STA whose TID and Direction fields match an R-TWT TID and its specified direction for an R-TWT schedule established with the R-TWT scheduled STA, the AP should follow the rules specified in 35.17 (EHT SCS procedure) for scheduling of downlink (#16286)QoS Data frames or enabling the transmission of uplink QoS Data frames for that R-TWT TID in corresponding R-TWT SPs, in addition to the traffic delivery rules specified in this clause.

**CID Set 2**

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| **CID** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
|  |  |  |  |  |  |
| 15802 | 9.3.3.6 | 0.00 | The notes on TWT element for inclusion in (Re)Association Response frames should be amended to clarify that "One or two TWT elements may be present". One element may be present for negotiation of membership, if also present in (Re)Association Request frame, while other may be present for R-TWT schedule announcements | as in comment | **Revised**The text is revised based on suggestion.**TGbe editor, please make the changes tagged by CID #15802 in 23/1120r1.** |
| 15805 | 9.4.2.199 | 245.57 | The baseline states that TWT Recommendation field is reserved when transmitted by a TWT scheduled STA. This should be amended for R-TWT as a STA, when negotiating schedules, needs to indicate whether the request is for bTWT or R-TWT | as in comment | **Revised**35.8.2 (R-TWT membership setup) defines that R-TWT membership is setup by transmitting TWT element carrying one or more Restricted TWT Parameter Set fields, which have Broadcast TWT Recommendation value=4. However, it is good to align this in the baseline, as pointed out in the comment.**TGbe editor, please make the changes tagged by CID #15805 in 23/1120r1.** |

***TGbe editor: Please modify Table 9-63 in P802.11beD3.2 as follows:***

**Table 9-63—Association Response frame body**

|  |  |  |
| --- | --- | --- |
| Order | Information | Notes |
| … |  |  |
| 40 | TWT | (#15802)One or two TWT elements are optionally present.The TWT element is present if dot11TWTOptionActivated is true and the TWT element is present in the Association Request frame that elicited this Association Response frame.The TWT element is optionally present if dot11TWTOptionActi­vated is true, dot11HEOptionImplemented is true, and the TWT Requester Support field in the HE Capabilities element in the Association Request frame that elicited this Association Response frame is 1.The TWT element (#15802)with Negotiation Type equal to 2 is present if dot11RestrictedTWTOptionImple­mented is true and the soliciting Association Request frame is sent by an EHT STA that has the Restricted TWT Support subfield in transmitted EHT Capabilities elements set to 1, and the AP has at least one R-TWT schedule as described in 35.8.3 (R-TWT announcement(#16064)).Otherwise, the TWT element is not present.If the TWT element is present in the Association Request frame that solicits the Association Response frame but the TWT element is not present in the Association Response frame, then the STA can transmit another TWT request frame after association. |

***TGbe editor: Please modify Table 9-65 in P802.11beD3.2 as follows:***

**Table 9-65—ReAssociation Response frame body**

|  |  |  |
| --- | --- | --- |
| Order | Information | Notes |
| … |  |  |
| 43 | TWT | (#15802)One or two TWT elements are optionally present.The TWT element is present if dot11TWTOptionActivated is true and the TWT element is present in the Association Request frame that elicited this Association Response frame.The TWT element is optionally present if dot11TWTOptionActi­vated is true, dot11HEOptionImplemented is true, and the TWT Requester Support field in the HE Capabilities element in the Reassociation Request frame that elicited this Reassociation Response frame is 1.The TWT element (#15802)with Negotiation Type equal to 2 is present if dot11RestrictedTWTOptionImple­mented is true and the soliciting Reassociation Request frame is sent by an EHT STA that has the Restricted TWT Support subfield in transmitted EHT Capabilities elements set to 1, and the AP has at least one R-TWT schedule as described in 35.8.3 (R-TWT announcement(#16064)).Otherwise, the TWT element is not present.If the TWT element is present in the Reassociation Request frame that solicits the Reassociation Response frame but the TWT element is not present in the Reassociation Response frame, then the STA can transmit another TWT request frame after association. |

**9. Frame formats**

**9.4.2.198. TWT element**

***TGbe editor: modify 20th paragraph of 9.4.2.198 (last paragraph on Page 1287 of REVmeD3.0) (﻿The TWT Flow Identifier…) as follows:***

﻿The TWT Flow Identifier subfield contains a 3-bit value that identifies the specific information for this TWT request uniquely from other requests made between the same TWT requesting STA and TWT responding STA pair. The Broadcast TWT Recommendation subfield contains a value that indicates recommendations on the types of frames that are transmitted by TWT scheduled STAs and scheduling AP during the broadcast TWT SP, encoded according to the Broadcast TWT Recommendation field for a broadcast TWT element as ﻿defined in Table 9-332 (Broadcast TWT Recommendation field for a broadcast TWT element(11ax)). The Broadcast TWT Recommendation is reserved if transmitted by a TWT scheduled STA(#15805), except when the STA is also an R-TWT scheduled STA, in which case it sets the Broadcast TWT Recommendation field to 0 or 4.