**IEEE P802.11
Wireless LANs**

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| **LB 271 CR for R-TWT-Part 2** |
| **Date:** 2023-05-05 |
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**Abstract**

This submission proposes resolutions for the following CIDs (**15**) for TGbe LB271:

Group 1 (SP Termination): 15836

Group 2 (misc): 15641, 15905, 17578, 15421, 16668, 15238, 15737, 15652, 15653, 16169, 16405, 16148, 17170, 15835

Revisions:

* Rev 0: Initial version of the document
* Rev 1: Editorial changes and completed resolution of 15421
* Rev 2: Changes to resolution of #15836 based on offline feedback.
* Rev 3: Further changes to resolution of #15836 based on offline feedback

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 P802.11be D3.1 and P802.11meD3.0***

**Group 1: CIDs related to SP Early Termination**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 15836 | Muhammad Kumail Haider | 35.8 | 617.00 | Baseline rules for TWT SP termination do not provide STA with a method to indicate its state of termination; whether it is requesting termination or it is ready for it. Currently it's only a notification from AP side. | TWT SP termination signaling should be revised for an explicit indication from the STA about its state/readiness for SP termination | **Revised**Agree in principle. Additional signaling for TWT SP termination is defined in this document to address the issues raised by commenter.**TGbe editor, please make change as shown in 23/0754r3 tagged by #15836** |

**Discussion**

TWT SP early termination rules are defined in 26.8.5, and R-TWT STAs may follow the baseline procedures to early terminate an on-going SP.

As discussed in detail in 22/0304, a key issue with baseline rules is that an AP may early terminate the SP without checking with the STA if it is ready to terminate the SP. That is, the early termination procedure is not a handshake but rather a single notification from the AP (e.g., using EOSP=1). Conversely, there is no explicit signaling for a STA to request an early termination of the SP e.g., if it is done transmitting its traffic for the SP, or if the STA needs to go into doze state for power saving.

One possibility in existing spec is to use buffer status report by the STA to indicate to the AP its end of pending traffic. However, there are a few gaps in this implicit approach (please refer to 22/0304 for detailed discussion):

* The AP is not required/recommended to wait for or inquire the buffer status of the STA before terminating the SP
* For R-TWT, traffic intended for delivery during SPs is tied to R-TWT TIDs. This requires delivering BSR for possibly multiple TIDs instead of a simple, explicit indication.
* In trigger-enabled TWT, or if the non-AP STA supports UL MU, then AP can inquire buffer status using BSRP. However:
* **Problem 1**: BSR A-control reports buffer status for AC, not TID
* **Problem 2**: QoS-Control reports status per TID, but Queue Size is for one TID. Note: STA *could* aggregate up to 8 QoS Control in Qos Null to report buffer of all desired TIDs (which needs Multi-TID BA to respond): added overhead and onerous effort.
* **Problem 3:** Queue Size for both BSR Control and QoS Control has to **include buffer** for any DATA in carrying frames, and the report may not be precise due to scaling factor-based encoding (see slide 17 in 22/0304r0). Cannot always clearly convey that DATA included in carrying frame is the only remaining buffer

As highlighted by above discussion and comments raised in LB271 stated above, there is a need for an explicit indication from the STA side that it is ready to terminate the on-going SP after end of traffic at its end. And the AP is recommended to wait to receive this indication from the STA before terminating the SP.

Therefore, as a resolution to above CIDs, we propose to redefine bit 7 of the QoS Control subfield of QoS Null frames sent by non-AP STAs as the EOTSP (End of Traffic for SP) indication.

**9.2.4.5 QoS Control field**

**9.2.4.5.1 QoS Control field structure**

***TGbe editor: Please modify row 6 of Table 9-10 (QoS Control field) as follows:***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Applicable frame (sub)types** | **Bits 0-3** | **Bit 4** | **Bits 5-6** | **Bit 7** | **Bits 8** | **Bit 9** | **Bit 10** | **Bit 11-15** |
| … | … | … | … | … | … |
| QoS Data and QoS Data+CF-Ack frames sent in a nonmesh BSS by non-AP STAs that are not a TPU buffer STA or a TPU sleep STA | TID | 0 | Ack Policy Indicator | AMSDU Present | TXOP Duration Requested |
| TID | 1 | Ack Policy Indicator | AMSDU Present | Queue Size |
| QoS Null frames sent in a nonmesh BSS by non-AP STAs that are not a TPU buffer STA or a TPU sleep STA | TID | 0 | Ack Policy Indicator | Reserved | TXOP Duration Requested |
| TID | 1 | Ack Policy Indicator | (#15836)~~Reserved~~EOTSP | Queue Size |
| … | … | … | … | … | … | … | … | … |

***TGbe editor: Please add a new subclause in 9.2.4.5 as follows:***

(#15836)**9.2.4.5.xxx EOTSP subfield**

﻿The End of Traffic for SP (EOTSP) subfield indicates if there is no further pending traffic from the transmitting non-AP STA during the current TWT service period. The EOTSP subfield is set to 1 if the transmitting non-AP STA does not have any more pending traffic to be delivered during the current TWT service period, and it is set to 0 if the transmitting non-AP STA either has more pending traffic to be delivered or does not know whether there is more pending traffic during the current TWT service period.

***TGbe editor: Please insert the following paragraphs at the end of 35.3.24.1 in P802.11beD3.1:***

**35.3.24 TWT operation**

**35.3.24.1 General**

﻿(#15836)A TWT requesting STA or a TWT scheduled STA may set the EOTSP subfield to 1 in a QoS Null frame it transmits to a TWT responding STA or a TWT scheduling AP during an on-going TWT SP to indicate that the STA does not have any pending traffic for the remainder of the current TWT SP.

(#15836)A TWT responding STA or a TWT scheduling AP, which receives a QoS Null frame with the EOTSP subfield equal to 1 from a TWT requesting STA or a TWT scheduled STA during a TWT SP, may terminate the TWT SP for that STA as described in 26.8.5 (Power save operation during TWT SPs).

**Group 2: Misc CIDs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 15641 | Takuhiro Sato | 4.5.6 | 69.08 | "stringent requirements in terms of latency and its jitter ..." is vague. These kinds of requrements may be defined in higher layers, application layer, etc. Please make it clear. | as in comment | **Rejected** It’s not clear what’s the technical issue here with the understanding as follows: ‘stringent’ is a general description without extending efforts that will likely go beyond Layer-1/2 to define it quantitively. |
| 15905 | Xiaofei Wang | 9.4.2.25 | 229.07 | The sentence "The value of 0 is reserved for a non-EHT AP and an EHT AP." is unnecessarily complex. It can be simplified as "The value of 0 is reserved for an AP." | as in comment | **Accepted.** |
| 17578 | Brian Hart | 9.4.2.199 | 243.51 | Conceptual disconnect. "TWT Parameters" is a set of parameters. TID(s) then should be additional members of the set (described using intiial caps for consistency with baseline). Also missing articles x2. | Try along the lines of "The TWT Parameters for an EHT STA further include the TID(s) indicated in \*the\* Restricted TWT Traffic Info field, when included in a Restricted TWT Parameter Set field in the TWT element". ALSO, further rewrite to clarify if "when included" modifies "the TID(s)" or the " Restricted TWT Traffic Info field" by inserting one of these nouns/equivalent before "included" | **Revised**Agree in principle. The sentence is revised to address the issue raised by the commenter. **TGbe editor, please make change as shown in 23/0754r1 tagged by #17578** |
| 15421 | John Wullert | 35.8.2.2 | 618.16 | The text refers to the AP having dot11TWTOptionActivated equal to true but does not mention dot11RestrictedTWTOptionImplemented. It also says the AP sets the Restricted TWT Support subfield to 1, which based on the text above implies dot11RestrictedTWTOptionImplemented is equal to true. The reference to dot11TWTOptionActivated raises the question of how these two MIB variables interact - must an AP with dot11RestrictedTWTOptionImplemented equal to true also have dot11TWTOptionActivated equal to true? | Clarify the relationship between dot11TWTOptionActivated and dot11RestrictedTWTOptionImplemented for devices supporting R-TWT. | **Revised**dot11TWTOptionActivated is tied to basic TWT operation and as such an AP with dot11RestrictedTWTOptionImplemented equal to true also has dot11TWTOptionActivated equal to true. (26.8.3.1) “A TWT scheduling AP is an HE AP with dot11TWTOptionActivated equal to true that sets the Broadcast TWT Support field in the HE Capabilities element it transmits to 1”The sentence is revised to update the MIB variable to clarify. **TGbe editor, please make change as shown in 23/0754r2 tagged by #17578** |
| 16668 | Liwen Chu | 35.8.2.2 | 618.33 | Change "should" to "shall" in the sentence since this sentence is mandatory requirement. | As in comment | **Accepted** |
| 15238 | Akira Kishida | 35.8.5.6 | 621.18 | The rule described in 35.8.6 Traffic delivery should be applied to the aligned schedule indicated in 35.8.3 Broadcast TWT operation. In other words, triggered-enabled R-TWT SP should be allowed among multiple links. | As in the comment. | **Rejected**The comment fails to identify a specific gap in current spec.Trigger-enabled R-TWT SPs are already allowed among multiple links. Aligned schedules are distinct schedules setup on respective links with aligned start time (within 1TU). As such, Traffic delivery rules in 35.8.6 apply to any aligned R-TWT schedules.  |
| 15737 | KENGO NAGATA | 35.8.5.6 | 621.18 | "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."If an aligned schedule is available across multiple links, this rule should be applied to the aligned schedule, and QoS Data frames of the R-TWT TID(s) are delivered first during a trigger-enabled R-TWT SP as well. | Please add the following language."Note- Trigger-enabled R-TWT SPs may be aligned across multiple links. In this case, QoS Data frames of the R-TWT TID(s) are delivered first during the aligned trigger-enabled R-TWT SPs." | **Rejected**Aligned schedules are distinct schedules setup on respective links with aligned start time (within 1TU). As such, Traffic delivery rules in 35.8.6 apply to any aligned R-TWT schedules on respective links. No further changes are needed. |
| 15652 | Patrice Nezou | 35.8.6 | 620.26 | Replace "member R-TWT scheduled STAs" by "registered R-TWT scheduled STA" | As in comment | **Rejected**“membership” is the correct terminology as a membership is established in an R-TWT schedule, and not registration. Please refer to 35.8.2 (R-TWT membership setup) |
| 15653 | Patrice Nezou | 35.8.6 | 620.28 | Replace "triggered member STAs" by "A registered R-TWT scheduled STA that is triggered" | As in comment | **Rejected**“membership” is the correct terminology as a membership is established in an R-TWT schedule, and not registration. Please refer to 35.8.2 (R-TWT membership setup) |
| 16169 | Charlie Pettersson | 35.8.6 | 621.18 | What is a "member R-TWT scheduled STA"? Only 3 mentions in the amendment and no description. Furthermore, does not scheduled implicitly mean that it is a member? | Add some description of what the member R-TWT scheduled STA is and perhaps think about shortening the name. | **Rejected**The term “member TWT scheduled STA” is used in baseline broadcast TWT spec (please refer to 25.8.3) and hence is used in a similar context for R-TWT operation. R-TWT membership setup is specified in 35.8.2. It follows that STAs that perform this setup become members of the corresponding schedule. |
| 16405 | Liuming Lu | 35.8.6 | 621.24 | "When scheduling the transmission of Trigger frames" seems not to be correct. | Suggest to modify "When scheduling the transmission of Trigger frames" as "When scheduling the uplink transmission by Trigger frames" | **Rejected**The text here specifically refers to the scheduling of Trigger frames and not the uplink frames that they may solicit and hence is correct.  |
| 16148 | SunHee Baek | 35.8.6 | 621.32 | The NOTE could make misunderstanding that non-member STA, receiving the Trigger frame transmitted in trigger-enabled SPs, can get an opportunity to access the R-TWT SP. | Please clarify the sentence. | **Rejected**That is in-fact the intention of the NOTE. The NOTE clarifies, while complying to the traffic prioritization rule, it's still possible for AP to trigger non-member STAs. An example: when there are resources (time/freq/spatial) left over after addressing member STA’s requirements in the Trigger frame, then AP may trigger non-member STA as well to improve efficiency. |
| 17170 | Dana Ciochina | 35.8.6 | 621.32 | "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 SPs." The part "transmitted in trigger enabled SPs " is too vague. It would be better to be "transmitted in the triggered enabled R-TWT SP". The sentence should be further completed to clarify that this can happen after the traffic of the member R TWT STA has finished. | as in comment | **Revised**Text is revised to specify “R-TWT SP”.For the second part of the comment, the normative above the NOTE clearly states that member STA traffic is prioritized. So, no further changes are needed for that part. **TGbe editor, please make change as shown in 23/0754r1 tagged by #17170** |
| 15835 | Muhammad Kumail Haider | 35.8.6 | 621.39 | "when scheduling QoS Data frames" is redundant here and should be omitted for brevity | Suggest to remove "when scheduling QoS Data frames" | **Revised**Agree in principle. The text is amended to clarify the context of schedules.**TGbe editor, please make change as shown in 23/0754r1 tagged by #15835** |

**9.4.2.199 TWT element**

***TGbe editor: Please modify Table 9-338 in P802.11beD3.1 as follows:***

**Table 9-338—TWT Setup Command field values**

|  |  |  |
| --- | --- | --- |
| **TWT Setup Command field value** | **Command name** | **Description** |
| … | … | … |
| NOTE—TWT Parameters are TWT, Nominal Minimum TWT Wake Duration, TWT Wake Interval, and TWT Channel subfield values indicated in the TWT element. The Trigger subfield value indicated in the TWT element is also a TWT parameter for an HE STA. (#17578)When the Restricted TWT Traffic Info field is included in a Restricted TWT Parameter Set field in the TWT element, TID(s) indicated in the Restricted TWT Traffic Info field are also TWT parameters for an EHT STA. |

**35.8 Restricted TWT (R-TWT)**

**35.8.1 General**

An R-TWT scheduling AP is an EHT AP with (#15421)dot11RestrictedTWTOptionImplemented equal to true that sets the Restricted TWT Support subfield in the transmitted EHT Capabilities element to 1.

**35.8.2 R-TWT membership setup**

***TGbe editor: Please modify 4th paragraph in 35.8.2 in P802.11beD3.1 as follows:***

The R-TWT scheduling AP and the R-TWT scheduled STA (#16668)shall set the Restricted TWT Traffic Info field (see 9.4.2.199 (TWT element)) to identify the TID(s) that carry latency sensitive traffic in DL and UL for the R-TWT membership being set up. The TID(s) indicated as latency sensitive traffic in DL and UL in the Restricted TWT Traffic Info field shall be within the set of TIDs that are mapped in DL and UL, respectively, to the link on which the R-TWT membership is being setup (see 35.3.7.1 (TID-to-link mapping)).

**35.8.5 Traffic delivery**

***TGbe editor: Please modify the NOTE and paragraph below it in 35.8.5 on page 627 in P802.11beD3.1 as follows:***

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 or uplink QoS Data frames (#15835)~~when scheduling QoS Data frames~~ for that R-TWT TID in corresponding R-TWT SPs, in addition to the traffic delivery rules specified in this clause.