**IEEE P802.11
Wireless LANs**

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| **LB266: CR for CIDs related to TWT Information frame** |
| **Date:** 2022-09-08 |
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**Abstract**

This submission proposes resolutions for the following CIDs (10) for TGbe LB266:

13311, 13738, 10733, 12074, 13015, 13057, 13312, 13240, 13657, 13658, ~~13661, 13659~~

Revisions:

* Rev 0: Initial version of the document
* Rev 1: Changes based on offline discussion, updated discussion section and added related CID #13659
* Rev 2: Updated on draft 11be D2.2. Added indication of presence of optional field based on offline feedback. Deferred #13659
* Rev 3: Minor changes based on offline discussion, updated discussion
* Rev 4: Excluded CID 13661 from SP, revision 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 D2.2 and P802.11meD1.3***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 13311 | Muhammad Kumail Haider | 35.9.5 | 510.50 | Currently TWT Information field lacks fields to identify specific bTWT schedules, only All TWT field is there. As we expand usage to r-TWT operation, it will be useful to add signaling capability to indicate a particular r-TWT schedule the TWT Information field applies to. | as in comment | **Revised**Agree in principle. The gaps in signaling for usage of TWT Information frame for R-TWT is addressed in this document **TGbe editor, please make change as shown in 22/1545r4 tagged by #13311** |
| 13738 | Yunbo Li | 35.9 | 510.50 | When the All TWT subfield in TWT Information field of TWT Information frame is set to 1, all broadcast TWTs will be suspended. Since rTWT is designed base on broadcast TWT, my understanding is that All TWT will also suspend rTWT. But the use case of rTWT is quite different from other broadcast TWT. So the STA may only intend to suspend all broadcast TWT except rTWT. The spec should allow this flexibility. | The spec should allow rTWT not be included in the suspended broadcast TWTs when All TWT subfield set to 1. | **Revised**Agree in principle. The gaps in signaling for usage of All TWT subfield is addressed in this document and a new All R-TWT subfield is defined.**TGbe editor, please make change as shown in 22/1545r4 tagged by #13738** |
| 10733 | Insun Jang | 35.9.1 | 511.56 | The use of TWT Information frame for rTWT is missing It would enable suspend or resume rTWT SPs similar to broadcast TWT | As in the comment, we need to handle how to use TWT information frame for rTWT | **Revised**Since R-TWT schedules are broadcast TWT schedules, baseline rules for TWT Information frame usage apply. The gaps in signaling for usage of TWT Information frame for R-TWT is addressed in this document **TGbe editor, please make change as shown in 22/1545r4 tagged by #13311 and #13738** |
| 12074 | SunHee Baek | 35.9.2.2 | 511.17 | In the current spec, the TWT Information frame can only represent broadcast/individual TWT schedules. The restricted TWT schedules also need to be included in an existing frame, or a new designed frame. | As the comment | **Revised**Since R-TWT schedules are broadcast TWT schedules, baseline rules for TWT Information frame usage apply. The gaps in signaling for usage of TWT Information frame for R-TWT is addressed in this document **TGbe editor, please make change as shown in 22/1545r4 tagged by #13311 and #13738** |
| 13015 | Chunyu Hu | 35.9.4.1 | 511.51 | Suspending/resuming each individual r-TWT schedule is necessary as different non-AP STAs/applications are operating independently. Current TWT Information frame format only has All TWT field applicable to bTWT. | Add necessary design and/or procedure. | **Revised** Agree in principle. The gaps in signaling for usage of TWT Information frame for R-TWT is addressed in this document **TGbe editor, please make change as shown in 22/1545r4 tagged by #13311 and #13738** |
| 13057 | Chittabrata Ghosh | 35.9.4.1 | 512.46 | Define a r-TWT termination mechanism that terminates the existing r-TWT agreement setup (not existing other b-TWT sessions) | Define a mechanism either by reusing TWT Information frame where absence of Next TWT subfield is an indication of r-TWT setup suspension or another mechanism | **Revised**Since R-TWT schedules are broadcast TWT schedules, baseline rules for TWT Information frame usage apply. The gaps in signaling for usage of TWT Information frame for R-TWT is addressed in this document **TGbe editor, please make change as shown in 22/1545r4 tagged by #13311 and #13738** |
| 13312 | Muhammad Kumail Haider | 35.9.5 | 510.50 | Please clarify if according to current spec, a particular r-TWT schedule may be suspended/resumed. Make signaling/spec changes as needed to enable this functionality | as in comment | **Revised**Agree in principle. The gaps in signaling for usage of TWT Information frame for R-TWT is addressed in this document **TGbe editor, please make change as shown in 22/1545r4 tagged by #13311 and #13738** |
| 13240 | Binita Gupta | 9.4.1.60 | 0.00 | The TWT information frame can be used to suspend/resume specific rTWT SPs. Currently TWT Information field format does not support specifying broadcast TWT ID, hence can't be used to request or deliver information about specific rTWT SPs. The TWT Information field format should be enhanced to support broadcast TWT ID, to enable use of this frame for rTWT SPs e.g. to suspend/resume rTWT SPs. | Enhance TWT Information field to specify a broadcast TWT ID to be able to indicate an rTWT SP in the TWT information frame. | **Revised**Agree in principle. The gaps in signaling for usage of TWT Information frame for R-TWT is addressed in this document **TGbe editor, please make change as shown in 22/1545r4 tagged by #13311 and #13738** |
| 13657 | Rubayet Shafin | 35.8 | 509.39 | According to current 802.11 specification, while the TWT Information frame can be used for suspending and resuming all the broadcast TWT schedules followed by a broadcast TWT scheduled STA, the TWT Information frame cannot be used for suspending or resuming broadcast TWT SPs on a per-schedule basis. In 802.11be, with the inclusion of restricted TWT schedule, which is a variant of broadcast TWT schedule, it would be important to better manage the broadcast TWT schedules/restricted TWT schedules and hence, a mechanism is needed to suspend and resume particular broadcast/restricted TWT schedules while maintaining the others. | Please add procedures and mechanisms to enable suspension/resumption of TWT schedules on a per-schedule basis. | **Revised**Agree in principle. The gaps in signaling for usage of TWT Information frame for R-TWT is addressed in this document **TGbe editor, please make change as shown in 22/1545r4 tagged by #13311 and #13738** |
| 13658 | Rubayet Shafin | 35.8 | 509.39 | Currently, when All TWT subfield in the TWT Information frame is set to 1 in the TWT Information field in a TWT Information frame, all individual TWT agreements or broadcast TWT schedules are intended by the TWT Information field of the TWT Information frame. All individual TWT agreements or broadcast TWT schedules are meant to be suspended or resumed by the TWT Information frame. There is no way to exclude any particular TWT agreements or schedules from the group of schedules or agreements that are being suspended or resumed. This is not very conducive for restricted TWT operation, e.g., an r-TWT scheduled STA can have multiple broadcast/individual TWT schedules/agreements and restricted TWT schedules. For some purpose (e.g. power saving), the scheduled STA may want to suspend the broadcast TWT schedules while still maintain the r-TWT schedules for low latency purposes. | Please provide mechanism and framework for selective schedule exclusion from All TWT suspension/resumption procedure. | **Revised**Agree in principle. The gaps in signaling for usage of TWT Information frame for R-TWT is addressed in this document **TGbe editor, please make change as shown in 22/1545r4 tagged by #13311 and #13738** |
| 13661 | Rubayet Shafin | 35.3.6.2.2 | 426.01 | If a link of an AP MLD is about to be deleted or unavailable, the AP MLD may need to suspend all the existing TWT schedules on that link. Currently there is not an efficient way for the AP MLD to notify the scheduled STAs about this TWT suspension on that link | Please provide a mechanism to notify the STAs that are member of bTWT/rTWT schedules about impending suspension of the schedule. This can be equivalent to extension of the use of TWT Information frame. | **Revised**Agree in principle. The gaps in signaling for usage of TWT Information frame for R-TWT is addressed in this document **TGbe editor, please make change as shown in 22/1545r4 tagged by #13311 and #13738** |
| 13659 | Rubayet Shafin | 35.8 | 509.39 | For r-TWT operation, the r-TWT scheduled STA should have the flexibility to set the Next TWT value in the TWT Information frame as needed. It may be any positive value; not necessarily from the available set of TWT values. This would help any change in the traffic pattern without negotiating a new r-TWT schedule with the r-TWT scheduling AP. | Please provide text to enable Flexible r-TWT as illustrated in the comment. | **Rejected**The scenario raised in the comment is already allowed in baseline broadcast TWT operation and hence R-TWT No further changes are needed.﻿26.8.4 (﻿Use of TWT Information frames): “﻿A Next TWT subfield that is present if the frame is transmitted by a TWT requesting STA, by aTWT scheduled STA, or by any HE STA to a peer STA that has set the Flexible TWT Schedule Support field to 1 in the HE Capabilities element it transmits.-- ﻿The Next TWT subfield may contain any nonzero value if Flexible TWT Schedule Supportfield in the HE Capabilities element received from the peer STA is 1” |

**Discussion:**

TWT Information frame may be used to suspend and/or resume individual TWT or broadcast TWT schedules.

**26.8.4:**

﻿An HE STA may transmit a TWT Information frame to its peer STA during an individual TWT agreement, during broadcast TWT schedule, or at any time as defined in 26.8.4.2 (TWT Information frame exchange for individual TWT), 26.8.4.3 (TWT Information frame exchange for broadcast TWT), and 26.8.4.4 (TWT Information frame exchange for flexible wake time), respectively.

NOTE 1—An HE AP might include multiple TWT Information frames, each addressed to a different peer STA, in an HE MU PPDU (see 26.5.1 (HE DL MU operation)).

TWT Information field, carried in the TWT Information frame, doesn’t include a broadcast TWT ID field.



Existing text for broadcast TWT operation in 11ax (﻿26.8.4.3 TWT Information frame exchange for broadcast TWT):

﻿A TWT scheduled STA that is in PS mode and that transmits a TWT Information frame to a TWT scheduling AP shall suspend the corresponding broadcast TWT schedule and may transition to doze state after receiving the acknowledgment, even if it has previously transmitted a PS-Poll or U-APSD trigger frame and has not yet received the expected frames from the TWT scheduling AP in response. The STA shall resume TWT operation for the corresponding broadcast TWT schedule at the specified TWT indicated (if any) in the TWT Information frame.

Issues:

1. STA needs to be in PS mode, schedule will not be suspended if STA in Active mode
2. STA needs to send a TWT Information frame during on-going SP of the corresponding schedule. R-TWT scheduled STA cannot suspend/resume a schedule if outside the SP and/or in Active Mode

To address (1), we add text in 35.9 to remove the condition to be in PS mode for R-TWT scheduled STA in R-TWT SP.

To address (2), we propose to add an optional field to TWT Information frame to indicate bTWT ID.

**Discussion post r1 presentation in group**

Some members pointed out that we should include a presence indicator for the new field since it is optionally present. Since there are no reserved bits in TWT Information field, we propose that we repurpose Response Requested subfield, which is always set to 0 as per baseline (see below), to indicate presence of the Extended TWT Info field.

**26.8.4 Use of TWT Information frames**

**26.8.4.1 General**

An HE STA may transmit a TWT Information frame to its peer STA during an individual TWT agreement, during broadcast TWT schedule, or at any time as defined in 26.8.4.2 (TWT Information frame exchange for individual TWT), 26.8.4.3 (TWT Information frame exchange for broadcast TWT), and 26.8.4.4 (TWT Information frame exchange for flexible wake time), respectively.

NOTE 1—An HE AP might include multiple TWT Information frames, each addressed to a different peer STA, in an HE MU PPDU (see 26.5.1 (HE DL MU operation)).

The TWT Information frame shall have the Response Requested subfield equal to 0, the Next TWT Request

subfield equal to 0, and one of the following:

— The Next TWT subfield that is equal to a nonzero value if the frame is transmitted by a TWT responding STA, by a TWT scheduling AP, or by any HE STA to a peer STA that has set the Flexible TWT Schedule Support field to 1 in the HE Capabilities element it transmits.

— The value of the Next TWT subfield shall be selected from existing TWT values for an individual TWT agreement if the Flexible TWT Schedule Support field in the HE Capabilities element received from the peer STA is 0 and shall be selected from existing TWT values for a broadcast TWT schedule regardless of the value of the Flexible TWT Schedule Support field received from the peer STA.

— The Next TWT subfield may contain any nonzero value if the Flexible TWT Schedule Support field in the HE Capabilities element received from the peer STA is 1.

— The All TWT subfield is 1 if the resumption applies to all broadcast TWT schedules followed by the TWT scheduled STA and/or to all individual TWT agreements followed by the TWT responding STA.

Following table is included from offline discussion to clarify the setting of All TWT and All R-TWT subfields in various scenarios.

|  |  |  |  |
| --- | --- | --- | --- |
| **Intention/Scenario** | **All TWT** | **All R-TWT** | **Extended TWT Info field** |
| Suspend a specific schedule  | 0 | 0 | optionally present (if present, Broadcast TWT ID subfield specifies the schedule) |
| Suspend all R-TWT schedules only | 0 | 1 | Present |
| Suspend all non R-TWT schedules | 1 | 0 | Present |
| Suspend all TWT schedules | 1 | N/A | Not present |

**9.4.1.60 TWT Information field**

**﻿ *TGbe editor: please modify Figure 9-189 as follows:***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 B2 | B3 |  B4  | B5 B6 |  B7 | B8 Bn |
|  | TWT Flow Identifier | Response Requested/ Extended TWT Info Present | Next TWT Request  | Next TWT Subfield Size | All TWT | Next TWT |
| Bits**:** | 3 | 1 | 1 | 2 | 1 | 0, 32, 48 or 64 |

 ﻿ **Figure 9-189—TWT Information field format**

**﻿ *TGbe editor: please modify third paragraph (The TWT Flow Identifier…) as follows:***

﻿The TWT Flow Identifier subfield contains the TWT flow identifier for which TWT information is requested or being provided. The TWT Flow Identifier subfield is reserved if the All TWT subfield is 1(#13311), or if the Extended TWT Information field is present in the TWT Information frame.

***TGbe editor: please insert a new paragraph after the 4th paragraph (The Response Requested subfield…) as follows:***

When the TWT Information field is sent from an EHT STA to another EHT STA, B3 is defined as the Extended TWT Info Present subfield and the Response Requested subfield is not present.

When Extended TWT Info Present subfield is set to 1, it indicates that the Extended TWT Information field is present in the TWT Information frame (see 9.4.24.12 TWT Information frame format); otherwise, it is set to 0.

***TGbe editor: please modify 9.6.24.12 (TWT Information frame format) as follows:***

**9.6.24.12. TWT Information frame format**

﻿The TWT Information frame is sent by a STA to request or deliver information about a TWT and is transmitted by either STA of an existing TWT agreement or is transmitted by a STA to a peer STA that has indicated support of its reception. The Action field of the TWT Information frame contains the information shown in Table 9-593 (TWT Information frame Action field format).

**Table 9-593—TWT Information frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 1 | Category |
| 2 | Unprotected S1G Action |
| 3 | TWT Information (9.4.1.60 (TWT Information)) |
| (#13311)4 | Extended TWT Information (optional) |

﻿The Category field is defined in 9.4.1.11 (Action field).

The Unprotected S1G Action field is defined in 9.6.24.1 (Unprotected S1G Action field).

(#13311)The Extended TWT Information is optionally present when the TWT Information frame is transmitted by an EHT STA to another EHT STA and the Extended TWT Info Present subfield in the TWT Information field is set to 1, and has the format shown in Figure 9-144j:

***(#13311, 13738) TGbe editor: please insert a new figure as follows (labelled 9-144j or next available number):***

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B4 | B5 | B6 B7 |
|  | Broadcast TWT ID | All R-TWT | Reserved  |
| Bits**:** | 5 | 1 | 2 |

 ﻿ **Figure 9-144j—Extended TWT Information field format**

(#13311)The Broadcast TWT ID subfield is defined in 9.4.2.199 (TWT element) and identifies the broadcast TWT schedule for which the TWT information is being requested or provided. The Broadcast TWT ID subfield is reserved if the All R-TWT subfield is set to 1, or if the All TWT subfield in the TWT Information field is set to 1.

﻿(#13738)The All R-TWT subfield is set to 1 by an EHT STA with dot11RestrictedTWTOptionImplemented equal to true to indicate that the TWT Information frame reschedules all R-TWT schedules as defined in 26.8.4 (Use of TWT Information frames). Otherwise, it is set to 0.

﻿(#13738)If the All TWT subfield in the TWT Information field (9.4.1.60 (TWT Information)) is set to 1 and the Extended TWT Information field is present and has the All R-TWT subfield set to 0, then ﻿the TWT Information frame reschedules all TWT schedules except all R-TWT schedules, as defined in 26.8.4 (Use of TWT Information frames).

**26.8.4 Use of TWT Information frames**

**26.8.4 Use of TWT Information frames**

***TGbe editor: please modify the first sentence of third paragraph (The TWT Information frame…) as follows:***

The TWT Information frame shall have the Response Requested subfield equal to 0 (if present), the Next TWT Request subfield equal to 0, and one of the following:

— The Next TWT subfield that is equal to a nonzero value if the frame is transmitted by a TWT responding STA, by a TWT scheduling AP, or by any HE STA to a peer STA that has set the Flexible TWT Schedule Support field to 1 in the HE Capabilities element it transmits.

***TGbe editor: rest of text is omitted, no further change is needed***

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

***TGbe editor: please add the following new subclause after 35.9.5:***

**(#13311)35.8.6. R-TWT schedule suspension and resumption**

An R-TWT scheduled STA that receives a TWT Information frame or receives an acknowledgment to a TWT Information frame sent by the STA shall follow the rules defined in 26.8.4 (Use of TWT Information frames), except that if the TWT Information frame includes a Broadcast TWT ID subfield, the suspension and/or resumption applies to the schedule identified by the indicated ID, or if the TWT Information frame indicates All R-TWT, the suspension and/or resumption applies to all R-TWT schedules.

If the TWT Information frame carries the Extended TWT Information field, the recipient STA shall suspend or resume the R-TWT schedule as soon as practical after sending an acknowledgment in response to that frame.