IEEE P802.11
Wireless LANs

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| Restricted TWT Spec TextRestricted TWT Announcement |
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Abstract

This submission proposes resolutions for the following CIDs for TGbe CC36:

4156, 4433, 4783, 5938, 6412, 6414, 6746, 7858

Revisions:

* Rev 0: Initial version of the document
* Rev 1: Remove three CIDs (6415, 7429, 5273) to be addressed later, added discussion, fixed “agreement” (use membership or schedule), addressed some feedback.
* Rev 2: address comments raised by Brian and Gaurav.

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGbe Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGbe Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGbe Editor: Editing instructions preceded by “TGbe Editor” are instructions to the TGbe editor to modify existing material in the TGbe draft. As a result of adopting the changes, the TGbe editor will execute the instructions rather than copy them to the TGbe Draft.***

***TGbe editor: The baseline for this document is 11be D1.1.***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 4156 | Alfred Asterjadhi | 35.6.3 | 298.32 | The correct term is membership rather than agreement. Replace please, and specify what is actually modified in the B-TWT IE in this subclause rather than saying that it is a modified B-TWT IE. Also is the AP required to have a membership already setup before starting to announce these schedules? Can't the AP start advertising and the STAs join them? | As in comment. | **Agreed and revised.**The original text has been replaced by the new text in which “membership” or “schedule” is used instead of “agreement.”AP can advertise the r-TWT schedule even without any membership setup as described by the 35.7.2 (Restricted TWT setup), but will use a new IE to announce the SPs that have any membership setup as the new text proposed in this draft.**TGbe editor, please make change as shown in this doc 11-21/1147 tagged by 4156.** |
| 4433 | Arik Klein | 35.6.3 | 298.34 | the sentence refers to "the modified broadcast TWT element " - please clarify what is the format of this element? It is not specified in section 9.4.2.X... | As in comment | **Revised.****TGbe editor, please make change as shown in this doc 11-21/1147 tagged by 4156.** |
| 4783 | Chunyu Hu | 35.6.3 | 298.30 | The TBDs in this subclause per D0.4 was fixed with some brief description as temporary solution in order to move onto D1.0. There is a draft text pending to fix TBDs to solve a few problems: advertise the rTWT schedule only if there are agreement setup, share with the rTWT supporting STAs a consolidated view of rTWT SP schedule so they don't need to parse each rTWT schedule contained in each rTWT parameter set. | Will bring in contribution to solve the original TBDs in D0.4 | **Revised.****TGbe editor, please make change as shown in this doc 11-21/1147 tagged by 4156.** |
| 5938 | Li-Hsiang Sun | 35.6.3 | 298.34 | No definition of the "modified broadcast TWT element" | add definition | **Revised.****TGbe editor, please make change as shown in this doc 11-21/1147 tagged by 4156.** |
| 6412 | M. Kumail Haider | 35.6.3 | 298.30 | A PDT and motion(#2920) was passed to make changes to TWT element to accommodate restricted TWT schedule announcements and negotiations. Part of proposed changes is to introduce an r-TWT traffic info field to indicate latency sensitive TIDs. However, it is not specified whether such a field may be included in TWT announcements in broadcast frames | Traffic TID specification is part of r-TWT schedule negotiation between AP and STA and it should be allowed for the same r-SP to carry traffic for different TIDs for different member STAs, depending on their own negotiations. As such, traffic Info field should not be included in schedule announcements and the text should specify that TWT schedule announcements in broadcast frames shall not carry traffic info field. | **Revised.**Agree with commenter. In the proposed announcement IE design, no traffic info (TID specifically as commenter requested) is included.**TGbe editor, please make change as shown in this doc 11-21/1147 tagged by 4156.** |
| 6414 | M. Kumail Haider | 35.6.3 | 298.30 | The text specifies that modified version of broadcast TWT element shall be used for restricted TWT schedule announcements in Management frames as specified in 26.8.3 (Broadcast TWT operation). A PDT and motion(#2920) was also passed to make changes to TWT element to accommodate restricted TWT announcements. However, broadcast TWT element does not convey occupancy information of SPs. For example, AP may announce r-SP schedule to invite membership but no STAs have established membership in such a schedule. In that case, EHT STAs supporting r-TWT operation should not have to end their TXOPs prior to such unoccupied SPs. Moreover, r-SP announcement via b-TWT element does not present a consolidated timeline view of future occurrence of r-SPs and r-SP start boundaries to be used by EHT STAs supporting r-TWT operation to end their TXOPs. | Additional signaling should be introduced to indicate r-SP occupancy information and present a consolidated channel-time view of r-SP occurrence and start boundaries | **Revised.****TGbe editor, please make change as shown in this doc 11-21/1147 tagged by 4156.** |
| 6746 | Rojan Chitrakar | 35.6.3 | 298.33 | It is not clear what is the "modified broadcast TWT element" referred in this sentence is; 26.8.3 does not specify "modified broadcast TWT element". | Provide a proper reference for "modified broadcast TWT element" | **Revised.****TGbe editor, please make change as shown in this doc 11-21/1147 tagged by 4156.** |
| 7858 | Yonggang Fang | 35.6.3 | 298.34 | Suggest to delete "modified" broadcast TWT ... | See the comment | **Revised.****TGbe editor, please make change as shown in this doc 11-21/1147 tagged by 4156.** |

**Discussion:**

* As per Broadcast TWT operation defined in baseline, broadcast TWT element is advertised in the following broadcast frames and carries broadcast and/or restricted TWT parameter set field(s) with Negotiation Type 2:
	1. Beacon frames
	2. Broadcast Probe Response frames
	3. FILS Discovery frames

It doesn’t seem necessary to repeat this text/rule in this section.

Based on several comments in CC36, this document presents a new Restricted TWT SP Announcement element to present a consolidated view of restricted SPs in time domain and convey additional information about SPs such as whether there is membership established by any non-AP STAs, which is not carried in bTWT element.

# 9. Frame formats

## 9.3.3 Management frames

***TGbe editor: insert a new row to Table 9-32 (Beacon frame body)***

**Table 9-32—Beacon frame body (#4156)**

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| <Last assigned + 1> | Restricted TWT SP Announcement | (#4156)The Restricted TWT SP Announcement element is optional present if dot11RestrictedTWTOptionImplemented is true. |

***TGbe editor: insert a new row to Table 9-39 (Probe Response frame body)***

**Table 9-39—Probe Response frame body (#4156)**

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| <Last assigned + 1> | Restricted TWT SP Announcement | (#4156)The Restricted TWT SP Announcement element is optional present if dot11RestrictedTWTOptionImplemented is true. |

## 9.4.2 Elements

TGbe editor: insert the following subclause as follows. Note: the subclause number 295d can be changed to applicable number in subclause (9.4.2 Element) and the figure numbers can be changed accordingly as well.

### 9.4.2.295d Restricted TWT SP Announcement element (4156, 4433, 4783, 5938, 6412, 6414, 6746, 7858)

The Restricted TWT SP Announcement element describes a consolidated view of the restricted TWT SPs schedule information. The format of the restricted TWT SP Announcement element is shown in Figure 9-xxx-a (Restricted TWT SP Announcement element format).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |
|  | Element ID | Length | Element ID Extension | SP Bitmap Control | Start Time | Interval | Persistence | SP Status Bitmap | SP Info Bitmap(optional) |
| Octets: | 1 | 1 | 1 | 3 | 8 | 2 | 1 | Variable | variable |
| Figure 9-xxx-a −− Restricted TWT SP Announcement element format |

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

The format of the SP Bitmap Control field is shown in Figure 9-xxx-b (SP Bitmap Control field format).

|  |  |  |  |
| --- | --- | --- | --- |
| B0 B9 | B10 B17 | B18 | B19 B23 |
| Time Slice Count | Time Slice Duration | SP Info Bitmap Present | Reserved |
| 10 | 8 | 1 | 5 |

**Figure 9-xxx-b – SP Bitmap Control field format**

The Time Slice Count subfield specifies the number of time slices contained by the time duration that the SP Status Bitmap field describes.

The Time Slice Duration subfield specifies the time duration of each time slice. The time duration is calculated by (1+ x) \* 256 microseconds, where x is the value contained in the subfield.

The SP Info Bitmap Present subfield indicates if the SP Info Bitmap field is present. When this subfield is set to 1, the SP Info Bitmap field is present; and set to 0 otherwise.

The Start Time field specifies the TSF at the start time of the first time slice.

The Interval field is set to the value of the periodicity of the schedule in unit of time slice.

The Persistence field specifies the number of intervals during which the restricted TWT SPs corresponding to this restricted SP announcement are present. The number of intervals during which the restricted TWT SPs are present is equal to the value in the Persistence field plus 1 except that the value 255 indicates that the restricted TWT SPs are present until explicitly terminated. The interval value is equal to (Interval x Time Slice Duration x 256) microseconds.

The SP Status Bitmap field contains a bitmap with a bit in position *i* set to 1 to indicate the corresponding time slice is occupied by a restricted TWT SP that has at least one non-AP STA set up the membership of a restricted TWT shedule and is active, and set to 0 otherwise. The length of this field in octets is calculated as Ceil (N/8), where N is the value in the Time Slice Count subfield described in Figure 9-xxx-b (SP Bitmap Control field format). The first N bits in this field correspond to time slices described by the Restricted TWT SP Announcement element, and the remaining bits, if any, are padding bits and set to 0. Bit 0 of the first octet of the SP Status Bitmap field represents the first time slice.

The SP Info Bitmap field contains *N* number of SP Slice Information subfields as described in Figure 9-xxx-c (SP Slice Information subfield), where *N* is the value in the Time Slice Count field. Bit *k,* …, *k+3* in the SP Slice Information subfield describe the information for time slice *k/4*. The length in octets of the SP Info Bitmap field is calculated as Ceil (*N/2*). The first *4\*N* bits in this field correspond to time slices described by the Restricted TWT SP Announcement element, and the remaining bits, if any, are padding bits and are set to 0. Bits 0-3 of the first octet of the SP Info Bitmap describes the first time slice’s information.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Bk | Bk+1 | Bk+2 | Bk+3 |
|  | Boundary | OBSS | Full | Reserved |
| Bits:  | 1 | 1 | 1 | 1 |
| Figure 9-xxx-c. SP Slice Information subfield format |

The Boundary subfield is set to 0 if the corresponding time slice belongs to the same restricted TWT SP as the previous time slice; and set to 1 if the corresponding time slice belongs to a different restricted TWT SP from the previous time slice, or the previous time slice doesn’t belong to any restricted TWT SP that has at least one non-AP EHT STA as member of a restricted TWT schedule.

The OBSS subfield is set to 1 to indicate the corresponding restricted TWT SP is setup by EHT STAs in a neighboring BSS; and set to 0 otherwise.

The Full subfield is set to 1 if the r-TWT scheduling AP no longer accepts new ETH STAs to setup a new or revised restricted TWT schedule with any SP overlapping with this time slice; otherwise, it is set to 0.

# 35. Extremely High Throughput (EHT) MAC specification

# 35.7 Restricted TWT

***TGbe editor: replace the following part shown in grey-highlighted text in Subclause 35.7.3 (Restricted TWT Service Periods announcement) with the text marked as NEW TEXT:***

## ~~35.7.3 Restricted TWT service periods announcement~~

~~If there is any restricted TWT agreement set up, the EHT AP shall announce the restricted TWT service period schedule information in the modified broadcast TWT element contained in transmitted Management frames, which are specified in 26.8.3 (Broadcast TWT operation).~~

 ***TGbe editor: NEW TEXT as follows:***

## 35.7.3 Restricted TWT service periods announcement (4156, 4433, 4783, 5938, 6412, 6414, 6746, 7858)

The Restricted TWT SP Announcement element as described in 9.4.2.295d (Restricted TWT SP Announcement element) provides a consolidated view in time domain of the restricted SPs that have at least one restricted TWT membership setup and that is not currently suspended. If there is any restricted TWT membership setup and not currently suspended, the r-TWT scheduling AP shall advertise the restricted TWT SP occupancy information by including a Restricted TWT SP Announcement element in the following transmitted frames:

* Beacon frames
* Broadcast Probe Response frames
* FILS Discovery frames
* Individual Probe Response frames addressed to a non-AP EHT STA supporting the restricted TWT feature

The r-TWT scheduling AP may also include a Restricted TWT SP Announcement element in frames that carry TWT elements with the Negotiation Type set to 3 and the TWT Setup Command subfield set to Accept TWT, Alternate TWT, or Reject TWT.

The restricted TWT SPs schedule advertised by the Restricted SP Announcement element starts from a time offset specified by the fields: Start Time Alignment in the SP Bitmap Control field and Start Time; and lasts for a duration specified by the fields: Interval, Persistence and Time Slice Duration subfield in the SP Bitmap Control field of the Restricted TWT SP Announcement element (see 9.4.2.295d Restricted TWT SP Announcement element).

The r-TWT scheduling AP may set a value of 0 in the Time Slice Count subfield in the SP Bitmap Control field of the Restricted TWT SP Announcement element to announce the termination of all previously scheduled restricted TWT SPs. When the value is 0 in the Time Slice Count subfield, the r-TWT scheduling AP shall set a value of 0 in the SP Info Bitmap Present subfield and the SP Status Bitmap is zero-byte length. The r-TWT scheduling AP may use this value to indicate that all existing retricted TWT memberships setup with non-AP STAs have been terminated at the time of this announcement.

The r-TWT scheduling AP shall set a value of 1 in the Boundary subfield in SP Slice Information subfield for the time slice in a restricted TWT SP belonging to a restricted TWT membership that is different from the previous time slice, or the previous time slice doesn’t have any restricted TWT SP setup; and otherwise, set the value to 0.

The r-TWT scheduling AP may set a value of 1 in the OBSS subfield in the SP Slice Information subfield for the time slice in a restricted TWT SP based on the Beacon frames the rTWT scheduling AP received from other neighboring APs operating on any overlapping channels.

An example of the Restricted TWT SP Announcement element setting is shown in Figure 35-23 (Example of restricted TWT SP Announcement element).



**Figure 35-23 – Example of Restricted TWT SP Announcement element**

In this example, the r-TWT scheduling AP included a Restricted TWT SP Announcement element in a Beacon frame transmitted at time T0. Included in the element, the SP Bitmap Control field has value 0 in the Start Time Alignment subfield, and the Start Time field has the lower 32 bits of T1 as the value. In the SP Bitmap Control field, the value 16 in the Time Slice Duration subfield specifies that each time slice has duration of 4 TUs, the value of 17 in the Time Slice Count subfield indicates there are in total 16 time slices reported, covering a total duration of 64 TUs. The figure shows four different r-TWT SPs: SP1-4, from the start time T1 belonging to four different restricted TWT schedules. Three of them are active with various STAs as members, while the fourth SP corresponds to a suspended schedule. SP1, SP2 and SP3 have duration of 8, 12 and 20 TUs, respectively, and they are sperated by 4 and 0 TUs, respectively. The resulted SP Status Bitmap field has value 0x07FD. SP4 is suspended and hence the corresponding bits in the SP Status Bitmap have value 0’s.

The element includes an SP Info Bitmap field in this example indicated by the value 1 in the SP Info Bitmap Present subfield. Bits 0-3 in the SP Info bitmap field correspond to SP1’s first time: it has the Boundary subfield set to 1 and remaining bits set to 0’s, indicating the start of a restricted TWT SP. Further, the Full subfield has value 0, indicating that the r-TWT scheduling AP may accept request from more STAs to join the membership of this schedule. Similarly, the Boundary subfields of SP Info Bitmaps corresponding to time slice 3 (first time slice of SP 2) and time slice 6 (first slice of SP 3) are also set to 1. Further, the Full subfields of all SP Info Bitmap subfields corresponding to SP 3 are set to 1, indicating that the r-TWT scheduling AP will not accept any new members to this schedule due to resource constraint. Finally, SP 4 belongs to a suspended restricted TWT schedule. As such, all the bits in the SP Status Bitmap field corresponding to this SP are set to 0’s. This is an example where a restricted TWT membership is setup but currently is suspended – the corresponding bits in the SP Status Bitmap subfield are set to 0 and as result, the restricted TWT supporting STAs don’t have to end their TXOPs to avoid overlapping the start of such service periods.