IEEE P802.11
Wireless LANs

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| CR TWT Operation |
| Date: 2017-08-17 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Matthew Fischer | Broadcom |  |  | Matthew.fischer@broadcom.com |
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Abstract

Comment resolution with proposed changes to TGax D1.3 for CIDs relating to TWT operation. Note that some of the proposed changes within this document will modify resolutions that have already been approved by TGax.

The CID list is:

4846 4767

4777 4778 4779 5061 5062 5064 5777 5778 5970

6105 6547 6548 6549 6902

7209 7210 7211 7212 7213 7214 7215

8084 8129 8423 8425

9435 9867 9972

The proposed changes on this document are based on TGax Draft 1.3.

**REVISION NOTES:**

**R0**:

initial

**R1**:

Add CID 4767 and make appropriate changes by splitting the TWT command table in 10.43 into

**R2**:

Add language regarding broadcast TWT persistence

27.7.3.2 Rules for TWT Scheduling AP – added table for unilateral broadcast TWT setup announcements including alternate and reject - and added required behaviour for TWT Flow ID == 4, that is at least one NDP Feedback Report Poll Trigger frame shall be sent during the bTWT.

27.7.3.3 Rules for TWT Scheduled STA – modified table for broadcast TWT exchanges slightly

Add CIDs:

4777 4778 4779 5061 5062 5064 5777 5778 5970

6105 6547 6548 6549 6902

7209 7210 7211 7212 7213 7214 7215

8084 8129 8423 8425

9435 9867 9972

And their associated proposed changes – although most of the CIDs that are added are addressed by proposed changes that were already in R1 of the document. Very few minor additional text changes are added to R2 to accommodate that additional CIDs.

**END OF REVISION NOTES**

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 TGax Draft. This introduction is not part of the adopted material.

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

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

**CIDs**

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| 4846 | Alfred Asterjadhi | 183.60 | 27.7.3.2 | PLease list the possible values of this fields (Wake TBTT and broadcast, and their interpretation) when they are part of the TWT setup prceudre | As in comment. For both these paragraphs. | REVISED (MAC: 2017-05-20 00:33:37Z)Revised –Agree in principle with the comment. Proposed resolution fixes these inconsistencis.TGax editor to make the changes shown in 11-17/0687r0 under all headings that include CID 4846 followed by all changes under heading that include CID 4846 within 11-17/1138r2. |
| 4767 | Alfred Asterjadhi | 70.21 | 9.4.2.200 | Couple or more things: There is another table that performs a similar function in 10.43.smth. Maybe just keep that one and undo the changes to this table. This table also contains some inconsistencies (compared to (27.7.3.4 Negotiation of wake TBTT and listen interval) some values are not right), compared to 10.43.1 (TWT overview) it does not contain the listing in dependency of the broadcast field values.) | As in comment (my preference is to have one Table, and that contains all possible combos in one place). | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 4767 |
| 4777 | Alfred Asterjadhi | 137.43 | 10.43.1 | The Reject TWT case is missing in the description. Please add for completeness. Also it would be beneficial to provide a list of what types of individual TWTs, and broadcast TWTs can be negotiated, depending on the setting of the Broadcast, Wake TBTT Interval Negotiation, since they govern TWT Setup for Individual TWTs, Broadcast TWTs, and TBTTs. | As in comment. | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 4777, which are in general agreement with the commenter, who should note that the set of types of TWTs that can be negotiated is located in a subclause 27.x instead of 10.43.1 because 10.43.1 is the location of the legacy TWT text. |
| 4778 | Alfred Asterjadhi | 138.7 | 10.43.1 | Broadcast field value is missing in some of these entries. Need to be added and clarify in the third column the dependency of the Wake TBTT, Bcast fields settings and the type fo TWT agreement that is setup. Also instead of using "Don't care" use "Any". Actually since the broadcast TWT cases are valid for HE STAs only I suggest this table only covers the case of individual TWT (with Wake TBTT = 0 and Broadcast = 0) and then another table is added in clause 27 that covers the other combinations (citing as much as possible from the basic table). | As in comment. And editorial: this table is a new insertion so no need for underlines and strikesthoughs. | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 4778, which are in general agreement with the commenter, who should note that much of the clarifying text is located in a subclause 27.x instead of 10.43.1 because 10.43.1 is the location of the legacy TWT text. |
| 4779 | Alfred Asterjadhi | 138.18 | 10.43.1 | Instead of putting the combinations that are not allowed, it would be best to put those that are allowed and specify in the last row: other combinations are not allowed. Also some of these rows are not correct (e.g., page 139L52, there is unsolicited TWT responses that are allowed). | As in comment. | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 4779, which are in general agreement with the commenter, who should note that much of the clarifying text is located in a subclause 27.x instead of 10.43.1 because 10.43.1 is the location of the legacy TWT text. |
| 5061 | Dengyu Qiao | 138.7 | 10.43.1 | Please clarify the meaning of "Wake TBTT Negotiation subfield = don't care" | as in comment | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 5061 |
| 5062 | Dengyu Qiao | 138.9 | 10.43.1 | Some rows are missing. For example, there is no description for the case that Initiating frame is Request TWT with Wake TBTT Negotiation subfield =1, and Response frame is Accept TWT with Wake TBTT Negotiation subfield =1 and Broadcast subfield =1 | Even if it is not allowed, it still should be included | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 5062, which are in general agreement with the commenter, who should note that much of the clarifying text is located in a subclause 27.x instead of 10.43.1 because 10.43.1 is the location of the legacy TWT text. |
| 5064 | Dengyu Qiao | 139 | 10.43.1 | Broadcast TWT ID is introduced. For Broadcast TWT, TWT scheduled STA cannot provide any resource requirement in TWT element during negotiation of wake TBTT. How does TWT scheduling STA determine to accept or reject the TWT request from TWT scheduled STA. | please clarify | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 5064, noting that the Broadcast TWT discussion is removed from this legacy subclause to 27.x, and noting that the determination of necessary resources is made dynamically by the AP for broadcast TWT. If the AP wants to control the use of the broadcast TWT SPs it can offer a triggered broadcast TWT, in which case the AP is then in control of UL TX during the bTWT SPs |
| 5777 | Hanseul Hong | 138.47 | 10.43.1 | When the Broadcast subfield is 1, what is the value of Wake TBTT Negotiation subfield? | Clarify | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 5777 |
| 5778 | Hanseul Hong | 139.53 | 10.43.1 | The 'Accept TWT with Wake TBTTNegotiation subfield = 1 0 andBroadcast subfield = 1' case is included in 'Accept TWT or Alternate TWTor Dictate TWT or Reject TWTwith Wake TBTT Negotiationsubfield = 0'. One is indication of broadcast TWT parameter, and the other is not allowed setting | Exclude the former case from the latter case | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 5778 |
| 5970 | Jarkko Kneckt | 137.56 | 10.43.1 | Table 9-262k in p.71, line 19 defines operation TWT Grouping. The TWT grouping response frame is not included to the Table 10-19a. Please add guidance for handling TWT Grouping response frame to the table 10-19a. | Please clarify how TWT Grouping Response frame is interpretted by the HE STAs. Alternatively, please define that the TWT Grouping Response frame is not used in 802.11ax. |  |
| 6105 | Jian Yu | 137.42 | 10.43.1 | TWT Setup/Teardown frames are S1G category action frame and should be clarified that 802.11ax uses the same frames or some other frames. | As in comment | Reject – while the name of a group of action frames might imply some restriction against their use, the name is not the determinant, but instead, the behavioral subclauses are where restrictions are placed on their use. No prohibition against the use of the S1G Action category exists, so no text needs to be changed. |
| 6547 | John Coffey | 137.48 | 10.43.1 | Inconsistent use of defined term: here we have "accept TWT", whereas elsewhere we have "Accept TWT". | Change "accept TWT" to "Accept TWT". | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 6547 |
| 6548 | John Coffey | 137.49 | 10.43.1 | Inconsistent use of defined term: here we have "alternate TWT", whereas elsewhere we have "Alternate TWT". | Change "alternate TWT" to "Aternate TWT". | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 6548 |
| 6549 | John Coffey | 137.50 | 10.43.1 | Inconsistent use of defined term: here we have "dictate TWT", whereas elsewhere we have "Dictate TWT". |  | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 6549 |
| 6902 | Jonathan Segev | 137.60 | 10.43.1 | Table 10-19a TWT operation uses in alternating "first STA" "second STA" however 10.43.1 uses the terminology TWT Requesting STA and TWT Responding STA. | Replace first and second STA with TWT Requesting and TWT Responding STAs respectively. | Reject – commenter to note that in the case of Reject TWT, the frame can be initiated by either requesting or responding STA. |
| 7209 | kaiying Lv | 139.37 | 10.43.1 | The description of TWT conditions after the completion of the exchange in Table 10-19a is conflict. "An active broadcast TWT agreement is either created ...The responding STA will not create any new broadcast TWT agreement with the requester at this time" | Suggest to change to "An active broadcast TWT agreement has already exists and is using the TWT parameters identified in the response frame, including a broadcast TWT ID.The responding STA will not create any new broadcast TWT agreement with the requester at this time" | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 7209 |
| 7210 | kaiying Lv | 139.9 | 10.43.1 | The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by ascheduling STA. In Table 10-19a, the response frame transmitted by the scheduling STA or responding STA should set Wake 139.22TBTT Negotiation subfield to 0 | Suggest to change to "Accept TWT with Wake TBTT Negotiation subfield= 0 and Broadcast subfield = 1" | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 7210, commenter to note that table is split into multiple tables located in several subclauses. |
| 7211 | kaiying Lv | 139.15 | 10.43.1 | The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by ascheduling STA. | suggest to change to "Accept TWT with Wake TBTT Negotiation subfield= 0 and Broadcast subfield = 1" | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 7211, commenter to note that table is split into multiple tables located in several subclauses. |
| 7212 | kaiying Lv | 139.22 | 10.43.1 | The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by ascheduling STA. In table 10-19a, change the setting of the above field in TWT elements sent by scheduling or responding STA. | suggest to change to "Alternate TWT Wake TBTT Negotiation subfield= 0 and Broadcast subfield = 1" | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 7212, commenter to note that table is split into multiple tables located in several subclauses. |
| 7213 | kaiying Lv | 140.14 | 10.43.1 | The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by ascheduling STA. In table 10-19a, change the setting of the above field in TWT elements sent by scheduling or responding STA. | suggest to change to "Reject TWT with Wake TBTT Negotiation subfield = 1 andBroadcast subfield = 1" | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 7213, commenter to note that table is split into multiple tables located in several subclauses. |
| 7214 | kaiying Lv | 140.23 | 10.43.1 | The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by ascheduling STA. In table 10-19a, the Wake TBTT Negotiation subfield in reject TWT sent by scheduling STA should be set to 0. | suggest to change to "Reject TWT with Wake TBTT Negotiation subfield = 0 andBroadcast subfield = 1" | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 7214, commenter to note that table is split into multiple tables located in several subclauses. |
| 7215 | kaiying Lv | 140.6 | 10.43.1 | change "TWT flow ID" to "broadcast TWT ID" | As in comment | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 7215, commenter to note that table is split into multiple tables located in several subclauses. |
| 8084 | Matthew Fischer | 139.9 | 10.43.1 | It feels like the TWT request command could appear in the initiating box as well for this row | Change "Demand TWT" to "Request or Demand TWT" | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 8084, commenter to note that table is split into multiple tables located in several subclauses. |
| 8129 | Matthew Fischer | 137.56 | 10.43.1 | Table 10-19a does not include any case where the scheduled STA includes Broadcast=1, so is it disallowed, and if so, shouldn't there be an explicit statement somewhere, instead of this implicit one | Clarify and add explicit language with the answer | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 8129, commenter to note that table is split into multiple tables located in several subclauses. |
| 8423 | Robert Stacey | 138.6 | 10.43.1 | "= don't care": if it's a don't care why mention the the field? | Change to "Request TWT, Suggest TWT or Demand TWT" | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 8423, commenter to note that table is split into multiple tables located in several subclauses. |
| 8425 | Robert Stacey | 137.59 | 10.43.1 | The first row after the heading row in Table 10-19a appears to be part of the heading. However, the relationship between the first heading row and this row is not clear. | Clarify menaing of first body row in table | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 8425, commenter to note that table is split into multiple tables located in several subclauses. |
| 9435 | Xiaofei Wang | 137.57 | 10.43.1 | The TWT Setup exchange comment interpretation shown in Table 10-19a seems to be overly complicated and should be simplified. Otherwise, it can lead to very complicated implementation. | simplify the TWT setup exchange procedure to ensure it is simple, straightforward. | Revise – TGax editor to make changes as shown in 11-17/1138r2 that are marked with CID 9435, commenter to note that table is split into multiple tables located in several subclauses. |
| 9867 | Young Hoon Kwon | 137.42 | 10.43.1 | Currently TWT setup frame is defined under S1G Action frame. However, as TWT is going to be used not only for S1G STA but also for HE STA, it's better to categorize TWT setup frame in other way. | As in the comment. | Reject – while the name of a group of action frames might imply some restriction against their use, the name is not the determinant, but instead, the behavioral subclauses are where restrictions are placed on their use. No prohibition against the use of the S1G Action category exists, so no text needs to be changed. |
| 9972 | Yuchen Guo | 137.33 | 10.43.1 | The explicit TWT related expressions should be deleted since the implicit subfield shall be set to 1 during the TWT setup procedure | As per comment | Reject – this is the legacy TWT subclause, where explicit is still allowed. This subclause needs changes as per the use of TWT by HE. The prohibition against explicit TWT for an HE STA is found elsewhere and is not in contradiction with this subclause. |

**Discussion:**

The following is a summary of the features proposed to be modified, added or updated by this document:

The TWT command interpretation table in 10.43 is modified to include the case of unsolicited TWT membership. I.e. the case when an AP unilaterally decides TWT agreement membership by transmitting a TWT IE with TWT Command ACCEPT to an associated STA. The table is split into three tables, with the broadcast TWT and Wake TBTT negotiation exchanges moved to different tables in 27.x subclauses to avoid confusion with baseline TWT operation and to have the tables nearer to the behavioural language that describes each of the associated interactions. It also simplifies the parsing of the tables.

Individual TWT agreements – removed a line that is redundant to existing 10.43 text regarding announced and unannounced agreements and prohibited the use of RAW for protection within the context of TGax. Moved the unsolicited TWT paragraph to the general section because it applies to both individual and broadcast TWT. Other minor corrections and clarifications.

Moved the TWT SP PS STA operation to a new, single common subclause, because the language for the broadcast TWT case is nearly identical, i.e. the operation of PS within TWT SP is virtually identical between broadcast and individual. As part of this move, the language is modified a little bit to clarify the rules and to cover a few cases that were not adequately described by the D1.3 language.

Broadcast TWT agreements – added a line to note that a TWT IE can be transmitted within an association response. As in the individual TWT agreement language, moved the PS STA operation to a single common subclause. Added language for the unsolicited broadcast TWT join operation. Added language in the AP section to describe deletion of broadcast TWT membership by a TWT scheduled STA. Added language in the non-AP STA section to describe unsolicited join of a broadcast TWT.

The TWT teardown cannot be used to delete a wake TBTT agreement because the wake TBTT agreement is not associated with an individual TWT agreement, which is currently the only entity that can be identified by the TWT Teardown frame. So the D1.3 language which says that the TWT Teardown can be used to delete a wake TBTT agreement is deleted and replaced with a description of the use of the TWT Setup frame to delete the wake TBTT agreement.

Added language to describe behaviour allowed for the broadcast membership join and terminate operations.

Note that subclause 10.43 mentions the new bits in the TWT IE, e.g. the Broadcast bit and the Wake TBTT Negotiation bit, which you might at first think is strange because 10.x is the legacy subclause and the new functionality for TGax is appearing in 27.x, but the elements and other frame formats back in 9 are not split between legacy and TGax, so it is still fair to talk about Broadcast and Wake TBTT Negotiation within 10.43 because of that connection to 9.x.

**Proposed Changes to Draft Text of TGax D1.3:**

**CID 4846, 4767, 4777, 4778, 4779, 5061, 5062, 5064, 5777, 5778, 6547, 6548, 6549, 7209, 7210, 7211, 7212, 7213, 7214, 7215, 8084, 8129, 8423, 8425, 9435**

***TGax editor: modify TGax D1.3 subclause 10.43 Target wake time (TWT) as follows:***

* Target wake time (TWT)
* TWT overview

Change the 2nd paragraph as follows:

A TWT requesting STA communicates wake scheduling information to its TWT responding STA and the TWT responding STA devises a schedule and delivers TWT values to the TWT requesting STA when a TWT agreement has been established between them. When explicit TWT is employed, a TWT requesting STA wakes and performs a frame exchange and receives the next TWT information in a response from the TWT responding STA as described in 10.43.2.2 (Explicit TWT operation). When implicit TWT is used, the TWT requesting STA calculates the Next TWT by adding a fixed value to the current TWT value as described in 10.43.3 (Implicit TWT operation).

Insert a new paragraph and table after the 9th paragraph:

The result of an exchange of TWT Setup frames between a TWT requesting STA and a TWT responding STA is defined in Table 10-19a. In general, the meaning of Request TWT is that the transmitting STA does not provide a set of TWT parameters for a TWT agreement, leaving the choice of parameters to the responding STA, Suggest TWT indicates that the transmitting STA offers a set of preferred TWT parameters for a TWT agreement but might accept alternative TWT parameters that the responding STA indicates and Demand TWT indicates that the transmitting STA will currently accept only the indicated TWT parameters for a TWT agreeement. Reject TWT transmitted by a requesting STA or a responding STA with an existing TWT agreement is used to terminate that agreement. Reject TWT transmitted by a responding STA as part of a negotiation for a new TWT agreement is used to indicate that the negotiation has ended in failure to create a new TWT agreement.**(#4777)** When transmitted by a responding STA, Accept TWT**(#6547)** indicates that the responding STA has initiated a TWT agreement with the given parameters, Alternate TWT**(#6548)** indicates a counter-offer of TWT parameters without the creation of a TWT agreement and Dictate TWT**(#6549)** indicates that no TWT agreement is created, but one is likely to be created using the indicated TWT parameters if the requesting STA transmits a new TWT setup request with those parameters.**(#4767)(#4846) (#7210) (#7211) (#7212) (#7213) (#7214) (#7215) (#8129) (#8423) (#9435)**

A TWT requesting STA shall set the Broadcast subfield to 0 and the Wake TBTT Negotiation subfield to 0 in the TWT element of transmitted TWT Setup request frames. **(#4767)(#4846)(#4779)(#5062)(#5064) (#5777) (#5778) (#7209) (#7211) (#7212) (#7213) (#7214) (#7215)**

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| --- |
| * TWT setup exchange command interpretation
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| Initiating frame, with Wake TBTT Negotiation is set to 0(#4767)(#4846) (#5061)(#5777) (#5778) | Response frame, with Wake TBTT Negotiation set to 0(#5061)(#5777) (#5778) |  |
| **TWT Setup Command field value within a TWT Setup frame transmitted from a first STA to a second STA** | **TWT Setup Command field value within a TWT Setup frame transmitted from the second STA to the first STA** | **TWT condition after the completion of the exchange(#8425) (#9435)** |
| Request TWT or Suggest TWT or Demand TWT  | No frame transmitted | No new active individual TWT agreement exists with the TWT Flow ID corresponding to the Flow ID in the initiating frame. No new active Broadcast or individual TWT agreement exists. |
| Suggest TWT or Demand TWT  | Accept TWT with Broadcast subfield = 0 | An individual TWT agreement is now active and is using the TWT parameters identified in the initiating frame. The TWT parameters in the response frame match the TWT parameters of the initiating frame. |
| Request TWT  | Accept TWT with Broadcast subfield = 0 | An individual TWT agreement is now active and is using the TWT parameters identified in the ~~responding~~ response frame. |
| Request TWT or Suggest TWT or Demand TWT  | Accept TWT with Broadcast subfield = 1 | This response is not allowed. |
| Demand TWT  | Alternate TWT or Dictate TWT with Broadcast subfield = 0 | No active individual TWT agreement exists with the associated TWT Flow ID. The responder is offering an alternative set of parameters vs. those indicated in the initiating frame. The requesting STA can send a new request with any set of TWT parameters and the responder might create an individual TWT agreement using those parameters. |
| Suggest TWT  | Alternate TWT with Broadcast subfield = 0 | No active individual TWT agreement exists with the associated TWT Flow ID. The responder is offering an alternative set of parameters vs. those indicated in the initiating frame, as a means of negotiating TWT parameters with the requester. The requesting STA can send a new request with any set of TWT parameters and the responder might entertain the creation of an individual TWT agreement using those parameters. |
| Suggest TWT  | Dictate TWT with Broadcast subfield = 0 | No active individual TWT agreement exists with the associated TWT Flow ID. The responder offers an alternative set of parameters vs. those indicated in the TWT request. By selecting “Dictate TWT”, the responder indicates that it is not willing to accept any other TWT parameters for the requesting STA at this time. The requesting STA can send a new request, but will only receive an Accept TWT if it uses the dictated TWT parameters. |
| Request TWT | Dictate TWT with Broadcast subfield = 1 | No active individual TWT agreement exists with the associated TWT Flow ID. A broadcast TWT agreement is now active and is using the TWT parameters identified in the ~~responding frame~~ response frame including a Broadcast TWT ID subfield. The broadcast TWT agreement is not necessarily a newly created broadcast TWT agreement. The responding STA will not create any new individual TWT agreement with the requester at this time. The STA transmitting the initiating frame is not a member of the broadcast TWT. |
| Request TWT or Suggest TWT or Demand TWT  | Reject TWT with Broadcast subfield = 0 | No active individual TWT agreement exists with the associated TWT Flow ID. The responding STA will not create any new individual TWT agreement with the requester at this time. |
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| Accept TWT with Broadcast subfield set to 0 and with an individual address in the RA field of the MPDU. | No frame transmitted | The STA receiving this frame is a member of the individual TWT identified by the initiating frame. . |
| Accept TWT with Broadcast subfield set to 1 and with an individual address in the RA field of the MPDU. | No frame transmitted | Only an HE AP is permitted to transmit this sequence. The STA receiving this frame is a member of the broadcast TWT identified by the initiating frame. |
|  |  | **(#7209)** |
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| Alternate TWT or Dictate TWT with Wake TBTT Negotiation subfield = 0 | No frame transmitted | The STA receiving this frame is not a member of the TWT identified by the initiating frame but can use the information provided to create a request to join a TWT in a subsequent initiating frame that it transmits. |
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| Reject TWT | No frame transmitted | The individual TWT agreement identified by the TA, RA pair of the transmitted frame and with the corresponding TWT Flow ID is terminated. |
| NOTE 1—Initiating frames ~~are all required to~~ not explicitly indicating broadcast have Broadcast subfield value of 0.NOTE 2—Request frame settings not listed in the table are not allowed. |

NOTE – TWT Setup frame exchanges between TWT Scheduled STAs and TWT Scheduling STAs are described in 27.x.y.z (TWT Setup Exchanges Between TWT Scheduling STAs and TWT Scheduled STAs) **(#4767)(#4846)**

***TGax editor: modify TGax D1.3 subclause 27.7 TWT Operation as follows:***

* TWT operation
* General

Target wake times (TWTs) allow STAs to manage activity in the BSS by scheduling STAs to operate at different times in order to minimize contention between STAs and to reduce the required amount of time that a STA in PS mode needs to be awake.

An HE STA can negotiate individual TWT agreements, as defined in 10.43 (Target wake time (TWT)), subject to the additional rules and restrictions that are defined in 27.7.2 (Individual TWT agreements). An HE STA can negotiate broadcast TWT agreements, as defined in 27.7.3 (Broadcast TWT operation), which can be used as defined in 27.7.3.3 (Rules for TWT scheduled STA), 27.14.2 (Power save with UORA), and 27.14.3 (Opportunistic power save(#6041))(#7618, #7400). An HE AP can deliver broadcast TWT parameter set(s) to non-AP HE STAs(#6256), without requiring that an individual TWT agreement has been established between them, as described in 27.7.3 (Broadcast TWT operation). **(#4767)(#4846)**

A STA does need not to be aware of the values of TWT parameters of the TWT agreements of other STAs in the BSS of the STA or of TWT agreements of STAs in other BSSs. A STA does not need to be aware that a TWT service period (SP) can be used to exchange frames with other STAs(#7619, #5963). Frames transmitted during a TWT SP can be carried in any PPDU format supported by the pair of STAs that have established the TWT agreement corresponding to that TWT SP, including HE MU PPDU, HE TB PPDU, etc. **(#4767)(#4846)**

An HE STA with dot11TWTOptionActivated equal to true shall set:

* The TWT Requester Support subfield to 1 in the HE Capabilities element that it transmits if it supports operating in the role of a TWT requesting STA(#9978); otherwise set to 0.
* The TWT Responder Support subfield to 1 in the HE Capabilities elements that it transmits if it supports operating in the role of a TWT responding STA; otherwise set to 0.
* The Broadcast TWT Support subfield to 1 in the HE Capabilities element that it transmits if it supports operating in the role of a TWT scheduled STA or in the role of a TWT scheduling AP(#6919); otherwise set to 0.

An HE AP shall set the TWT Responder Support subfields of the Extended Capabilities element and HE Capabilities element to 1.

An HE AP may set the TWT Required subfield to 1 in HE Operation elements it transmits to request TWT participation by all HE STAs that are associated to it and that have declared support for TWT. A STA that supports TWT and is associated with an HE AP(#10277) from which it receives an HE Operation element whose TWT Required subfield is 1 shall either negotiate individual TWT agreements, as defined in 27.7.2 (Individual TWT agreements), or participate in broadcast TWT operation, as defined in 27.7.3 (Broadcast TWT operation).

NOTE—The AP sets the TWT Required subfield to 1 when it is unavailable outside of TWT SPs (see 27.7.2 (Individual TWT agreements) and 10.43.7 (TWT Sleep Setup)).(#7396)

An HE AP may send an unsolicited TWT initiating frame to an associated non-AP HE STA(#6256) that has set the TWT Requester Support subfield to 1 in the HE Capabilities elements that it transmitted to the AP. The unsolicited TWT initiating frame may have the value 0 or 1 in the Broadcast subfield of the TWT IE. The unsolicited TWT initiating frame shall have one of the values: Accept TWT, Alternate TWT or Dictate TWT in the TWT Command field. Unsolicted TWT initiating frames with TWT Command values of Alternate and Dictate are advisory notifications, indicating to the recipient a TWT parameter value set that is likely to be accepted by the transmitting AP if the recipient transmits a subsequent TWT setup request including those TWT parameters to the AP. Receipt of an unsolicited TWT initiating frame with the TWT Command value of Accept TWT creates a TWT agreement between the transmitting and receiving STAs. A STA that received an unsolicited TWT initiating frame with the TWT Command value of Accept might transmit a TWT Teardown frame to delete its membership in the unsolicited TWT agreement. **(#4767)(#4846)**

* Individual TWT agreements

An HE STA may negotiate individual TWT agreements with another HE STA as defined in 10.43.1 (TWT overview), except that the STA:

* May set the Responder PM Mode subfield to 1 if it is a TWT responding STA that intends to go to doze state outside of TWT SPs.
* If the TWT responding STA is an AP then it may set the Responder PM Mode subfield to 1 only if all non-AP STAs that are associated to it indicate support of TWT in the role of a TWT requester and the AP has set the TWT Required subfield to 1 in the HE Operation element it transmits(#7620); otherwise it shall set the Responder PM Mode subfield to 0.
* An AP that sets the Responder PM Mode subfield to 1 follows the rules defined in 10.43.7 (TWT Sleep Setup).
* Shall set the Implicit subfield to 1 and the NDP Paging Indicator subfield to 0 in all TWT elements that it transmits during the TWT setup
* May set the Trigger subfield to 1 in the TWT element it transmits during the TWT setup to negotiate a trigger-enabled TWT
* A successful TWT agreement whose Trigger subfield in the TWT response sent by an AP is 1 is a trigger-enabled TWT; otherwise it is not a trigger-enabled TWT(#5657, #7118)
* Shall set the TWT Channel subfield in the TWT element it transmits to 0(#7621, #5966).
* May set the TWT Protection field to 1 to indicate that TXOPs within the TWT SPs shall be initiated with a NAV protection mechanism, such as (MU) RTS/CTS, or CTS-to-self frame; otherwise it shall set it to 0.
* An HE STA shall not use the RAW mechanism for protection of TWT SPs**(#4767)(#4846)**

An HE STA that successfully sets up a TWT agreement with another HE STA shall follow the rules defined in 10.43.1 (TWT overview) and 10.43.4 (Implicit TWT operation), except that all the additional rules defined in this subclause supersede all the respective rules(#6741, #5907) defined in 10.43.1 (TWT overview) and 10.43.4 (Implicit TWT operation). A TWT or TWT SP that is set up(#6742) under an implicit TWT agreement is an implicit TWT or implicit TWT SP, respectively (see 10.43.1 (TWT overview))(#6744). A TWT or TWT SP that is set up(#6743) under a trigger-enabled TWT agreement is a trigger-enabled TWT or trigger-enabled TWT SP, respectively.

An HE STA that successfully sets up an individual TWT agreement and operates in PS mode may listen to Beacon frames, but is exempt from the requirements for receiving Beacon frames as defined in 11.2.2.1 (General).(#7820) **(#4767)(#4846)**

An HE STA shall not transmit BAT, TACK, or STACK frames.

A TWT requesting STA should not transmit frames(#8285) to the TWT responding STA outside of negotiated TWT SPs (#5657, #7188, #7623)for that TWT agreement and should not transmit frames(#8285) that are not contained within HE TB PPDUs to the TWT responding STA within trigger-enabled TWT SPs for that TWT agreement. **(#4767)(#4846)**

NOTE—The non-AP STA decides what frames to transmit within or outside TWT SPs and while it is recommended that the STA not to transmit it is still permitted to do so(#5033).

The TWT responding STA of a trigger-enabled TWT agreement shall schedule for transmission a Trigger frame for the TWT requesting STA, as described in 27.5.2 (UL MU operation), within each TWT SP for that TWT agreement. The TWT responding STA that intends to transmit additional Trigger frames during a trigger-enabled TWT SP shall set the Cascade Indication field of the Trigger frame to 1 to indicate that it will transmit another Trigger frame within the same TWT SP. The TWT responding STA shall set the Cascade Indication field to 0 when the Trigger frame is the last Trigger frame of the TWT SP or when the Trigger frame is sent outside of a TWT SP.

NOTE 1—The TWT responding STA might not(#7821) schedule for transmission a Trigger frame for the TWT requesting STA when the TWT agreement is not a trigger-enabled TWT agreement or when the TWT requesting STA has sent an OM Control field(#4727) that has the UL MU disable bit equal to 1 (see 27.8 (Operating mode indication).

NOTE 2— The Trigger frame can also be an UMRS Control field(#Ed) contained in an MPDU carried in a DL MU PPDU, provided that the AP allocates enough resources in the HE TB PPDU for the STA to at least deliver its BSRs in response to the soliciting DL MU PPDU(#4839).

A TWT requesting STA transmits an HE TB PPDU(#4839) as a response to a Trigger frame that is intended for it and is sent during a trigger-enabled TWT SP (see 27.5.2 (UL MU operation)). A TWT requesting STA that is in PS mode and is awake shall include a PS-Poll frame or an APSD trigger frame in the HE TB PPDU if the TWT is an announced TWT unless the STA has already transmitted the PS-Poll or APSD trigger frame within that TWT SP. The STA may include other frames in the HE TB PPDU when other rules do not prohibit their inclusion, see 27.7.3.3 (Rules for TWT scheduled STA). **(#4767)(#4846)**

NOTE–A Trigger frame is intended for a TWT requesting STA if it is sent by the AP to which the STA is associated and the frame contains the 12 LSBs of the(#7817) STA’s AID in any of its User Info fields. The Trigger frame can have multiple recipients, each of which is identified by the presence of the 12 LSBs of the(#7817) recipient’s AID in any of its User Info fields (see 27.5.2 (UL MU operation)), and can have in the TA field the MAC address of the transmitted BSSID under the conditions defined in 27.5.2.2.2 (Allowed settings of the Trigger frame fields and UMRS Control field(#Ed))(#7171).

A TWT responding STA that receives a PS-Poll frame or an APSD trigger frame from a TWT requesting STA during an announced TWT SP shall follow the rules defined in 11.2.3.6 (AP operation during the CP)(#5890) to deliver buffered BUs to the STA except that it may deliver multiple buffered BUs as defined here. A TWT responding STA that sends frames to a TWT requesting STA during an unannounced TWT SP shall follow the rules defined in 11.2.3.6 (AP operation during the CP) to deliver buffered BUs to the STA except that it may deliver multiple buffered BUs as defined here.(#5660) A TWT responding STA may deliver multiple buffered BUs to the TWT requesting STAs during:

* An announced TWT SP, without following the rules in 11.2.3.6 (AP operation during the CP)(#5890) as long as the BU delivery does not exceed the duration of the TWT SP and the TWT requesting STA has indicated to be awake for that TWT SP(#4840).
* An unannounced TWT SP, without following the rules in 11.2.3.6 (AP operation during the CP)(#5890) if(#4840) the BU delivery does not exceed the duration of the TWT SP.

NOTE—The TWT responding STA can deliver the buffered BUs in an A-MPDU under a block ack agreement if the TWT is an announced TWT and the TWT requesting STA is awake for that TWT SP(#4840), or if the TWT is an unannounced TWT. The TWT responding STA can exceed the duration of the TWT SP if the TWT requesting STA is in Active mode.(#4840, #4851)

* **(#4767)(#4846)**Broadcast TWT operation
* General

A TWT scheduling AP(#6919) is an HE AP with dot11TWTOptionActivated equal to true that sets the Broadcast TWT Support field of the HE Capabilities element it transmits to 1 and that follows the rules in 27.7.3.2 (Rules for TWT scheduling AP(#6919)), 27.14.2 (Power save with UORA), and 27.14.3 (Opportunistic power save(#6041)).

A TWT scheduling AP may include a broadcast TWT element in the Beacon frame.(#7627, #7401) The TWT scheduling AP(#6919) may also include the broadcast TWT element in broadcast Probe Response frames that are sent when the STA's dot11FILSOmitReplicateProbeResponses is equal to true(#9659). A TWT scheduling AP may include a broadcast TWT element in an Association Response frame to create an unsolicited TWT agreement, which is a TWT agreement created without a preceding request for such an agreement. **(#4767)(#4846)**

A TWT scheduled STA is an non-AP HE STA that sets the Broadcast TWT Support field of the HE Capabilities element it transmits to 1 and receives a broadcast TWT element transmitted by an HE AP that is a TWT scheduling AP(#6919).(#5662, #7628, #8143)

A TWT scheduled STA follows the schedule provided by the TWT scheduling AP(#6919) as described in 27.7.3.3 (Rules for TWT scheduled STA), 27.14.2 (Power save with UORA), and 27.14.3 (Opportunistic power save(#6041))(#4843). A TWT scheduled STA can negotiate the wake TBTT and wake interval(#8154) for Beacon frames it intends to receive as described in 27.7.3.3 (Rules for TWT scheduled STA) or join a particular broadcast TWT as described below(#4843).

An example of broadcast TWT operation is shown in Figure 27-8 (Example of broadcast TWT operation(#8225)), where the AP is the TWT scheduling AP(#6919) and STA 1 and STA 2 are the TWT scheduled STAs.

|  |
| --- |
|  |
| * Example of broadcast TWT operation(#8225)
 |

The TWT scheduling AP includes a broadcast TWT element in the Beacon frame that indicates a broadcast TWT at or after which the AP intends to send Trigger frames, or DL BUs to the TWT scheduled STAs. STA 1 and STA 2 wake to receive the Beacon determine the broadcast TWT. During the trigger-enabled TWT SP the AP sends a Trigger frame to which STA 1 and STA 2 indicate that they are awake during the TWT SP. STA 1 indicates that it is awake by sending a PS-Poll and STA 2 indicates that it is awake by sending a QoS Null frame in response to the Trigger frame STA 1 and STA 2 receive their DL BUs in a subsequent exchange with the AP and go to doze state outside of this TWT SP.(#8153)

Each broadcast TWT is uniquely identified by the <broadcast TWT ID, MAC address> tuple, where the broadcast TWT ID is the value of the Broadcast TWT ID subfieldand is greater than 0,(17/296r1) and the MAC address is the address of the TWT scheduling AP.

Broadcast TWT agreements are advertised by TWT scheduling STAs in frames that carry TWT elements with the Broadcast subfield equal to 1 and the Wake TBTT Negotiation subfield equal to 0 as described in 27.7.3.2 (Rules for TWT scheduling AP(#6919)).(#8145, #4846, #8130). **(#4767)(#4846)**

Negotiations to join a Broadcast TWT are performed with an exchange frames that carry TWT elements with the Broadcast subfield equal to 1 and the Wake TBTT Negotiation subfield equal to 1 as described in 27.7.3.3 (Rules for TWT scheduled STA). **(#4767)(#4846)**

* Rules for TWT scheduling AP(#6919)

A TWT scheduling AP(#6919) may transmit a broadcast TWT advertisement by including a broadcast TWT element in a Beacon frame that is scheduled at a TBTT (see 11.1.3.2 (Beacon generation in non-DMG infrastructure networks)). The TWT scheduling AP(#6919) shall include one or more TWT parameter sets in the TWT element, and each TWT parameter set may indicate a periodic occurrence of TWTs. The TWT scheduling AP(#6919) shall set the NDP Paging Indicator subfield to 0, the Broadcast subfield to 1, the Implicit subfield to 1, the Wake TBTT Negotiation subfield to 0(#4845) and the Responder PM Mode subfield to 0 in the TWT element (see 10.43.7 (TWT Sleep Setup)). Each TWT parameter set specifies the TWT parameters of a specific broadcast TWT that are valid within a broadcast TWT SP. Each specific broadcast TWT is identified as indicated in 27.7.3.1 (General). Individual STAs may have membership in broadcast TWTs as the result of negotiation with a TWT scheduling AP as described in 27.7.3.1 (General).(#4845) **(#4767)(#4846)**

(#8145, #8130, #9576)The TWT scheduling AP(#6919) sets the TWT parameters of each TWT parameter set as described below.

The TWT scheduling AP(#6919) shall set the TWT Request subfield to 0 and the TWT Setup Command subfield to Accept TWT, except that it may set the TWT Setup Command subfield to:

* Reject TWT when the periodic TWT is being terminated or,
* Alternate TWT when the periodic TWT is being modified

The TWT scheduling AP(#6919) shall set the Trigger field to 1 to indicate a trigger-enabled TWT. Otherwise, it shall set the Trigger field to 0 to indicate an implicit TWT.

The TWT scheduling AP(#6919) shall schedule for transmission a Trigger frame addressed to one or more TWT scheduled STAs during a trigger-enabled TWT SP. A TWT scheduling AP(#6919) should not include the 12 LSBs of the(#7817) STA's AID in a User Info field of a Trigger frame transmitted within a broadcast TWT SP unless the STA is in the awake state, has established membership in the broadcast TWT with that Broadcast TWT ID, or has indicated to receive the Beacon, as defined in 27.7.3.4 (Negotiation of wake TBTT and wake(#8154) interval), preceding the beacon interval that contains this TWT SP(#7398, #6044, #7635, #4847).

The TWT scheduling AP(#6919) that intends to transmit additional Trigger frames during a trigger-enabled TWT SP shall set the Cascade Indication field of the Trigger frame to 1 to indicate that it will transmit another Trigger frame within the same TWT SP. The TWT scheduling AP(#6919) shall set the Cascade Indication field to 0 when the Trigger frame is the last Trigger frame of the TWT SP or when the Trigger frame is sent outside of a trigger-enabled TWT SP(#4848).

NOTE 1—The TWT scheduling AP(#6919) might not(#7821) schedule for transmission a Trigger frame for the TWT scheduled STA when the broadcast TWT is not a trigger-enabled TWT or when the TWT scheduled STA has sent an OM Control field(#4727) that has the UL MU disable bit equal to 1 (see 27.8 (Operating mode indication)).

NOTE 2—The Trigger frame can also be an UMRS Control field(#Ed) contained in an MPDU carried in a DL MU PPDU, provided that the AP allocates enough resources in the HE TB PPDU for the STA to at least deliver its BSRs in response to the soliciting DL MU PPDU(#4849).

The TWT scheduling AP(#6919) shall set the Flow Type field to 1 to indicate an unannounced TWT. Otherwise, it shall set the Flow Type field to 0 to indicate an announced TWT.

The TWT scheduling AP(#6919) should schedule delivery of DL BUs during unannounced TWT SPs.

The TWT scheduling AP(#6919) shall set the TWT Flow Identifier field according to Table 9.262kl (TWT Flow Identifier field for a broadcast TWT element)(#8132).

(#7631)A Trigger frame transmitted during a broadcast TWT SP whose TWT parameter set has the TWT Flow Identifier subfield equal to 0 or 3(#7632) may contain zero or more random access RU(17/646r4) (see 27.5.4 (UL OFDMA-based random access (UORA))). A Trigger frame transmitted during a broadcast TWT SP whose TWT parameter set has the TWT Flow Identifier subfield equal to 1 shall contain no random access RU(17/646r4) (see 27.5.4 (UL OFDMA-based random access (UORA))). A Trigger frame transmitted during a broadcast TWT SP whose TWT parameter set has the TWT Flow Identifier subfield equal to 2 shall contain at least one random access RU(17/646r4) (see 27.5.4 (UL OFDMA-based random access (UORA))). The TWT scheduling AP sends a TIM frame or FILS Discovery frame at the start of a broadcast TWT SP whose TWT parameter set has the TWT Flow Identifier subfield equal to 3 (see 27.14.3 (Opportunistic power save(#6041))).(#7399) The TWT scheduling AP sends at least one NDP Feedback Report Poll Trigger frame during a Broadcast TWT whose TWT parameter set has the TWT Flow Identifier subfield equal to 4.

The TWT scheduling AP(#6919) shall set the TWT field to the TSF timer [4: 19] at which the first TWT is scheduled for this TWT parameter set.

The TWT scheduling AP(#6919) shall include a nonzero value for the TWT wake interval in the TWT Wake Interval Exponent and TWT Wake Interval Mantissa fields for a periodic TWT and a zero value for an aperiodic TWT.

The TWT parameters are valid for each successive TWT of the periodic TWT or for the only TWT of the aperiodic TWT.

The TWT scheduling AP may include a value in the Broadcast TWT Persistence subfield for each Broadcast TWT to indicate the number of Beacon Intervals for which the Broadcast TWT is in existence. The AP may change the value of the Broadcast TWT Persistence subfield for any Broadcast TWT within any transmitted TWT element.

The TWT scheduling AP shall include a unique value in the Broadcast TWT ID subfield for each Broadcast TWT to allow identification of each Broadcast TWT.

The TWT scheduling AP(#6919) may set the TWT Protection field to 1 to indicate that TXOPs within the TWT SP shall be initiated with a NAV protection mechanism defined in 10.3.2.4 (Setting and resetting the NAV), 27.2.4 (MU-RTS/CTS procedure(#9274)), or CTS-to-self as described in 10.3.2.13 (NAV distribution); otherwise it shall set it to 0.

A TWT scheduling AP(#6919) that receives a PS-Poll or an APSD trigger frame from a TWT scheduled STA during an announced TWT SP shall follow the rules defined in 11.2.3.6 (AP operation during the CP)(#5084) to deliver buffered BUs to the STA except that it may deliver multiple buffered BUs as defined here(#5665). A TWT scheduling AP that sends frames to a TWT scheduled STA during an unannounced TWT SP shall follow the rules defined in 11.2.3.6 (AP operation during the CP) to deliver buffered BUs to the STA except that it may deliver multiple buffered BUs as defined here.(#5660) A TWT scheduling AP(#6919) may deliver multiple buffered BUs to the TWT scheduled STA during:

* An announced TWT SP, without following the rules in 11.2.3.6 (AP operation during the CP)(#5084) as long as the BU delivery does not exceed the duration of the TWT SP and the TWT scheduled STA has indicated to be awake for that TWT SP(#4840).
* An unannounced TWT SP, without following the rules in 11.2.3.6 (AP operation during the CP)(#5084) as long as the BU delivery does not exceed the duration of the TWT SP.(#9313, #5664, #4851)

NOTE—The TWT scheduling AP(#6919) can deliver the buffered BUs in an A-MPDU under a BlockAck agreement if the TWT is an announced TWT and the TWT scheduled STA is awake for that TWT SP, or if the TWT is an unannounced TWT(#4840). The TWT scheduling AP can exceed the duration of the TWT SP if the TWT scheduled STA is in Active mode.(#9313, #5664)

A TWT scheduling AP(#6919) should indicate Alternate TWT or Reject TWT in the TWT Command Setup field of the broadcast TWT element for as many DTIM periods as needed to exceed the longest interval any STA is expected to not receive Beacon frames either when:

* The TWT parameters of a periodic TWT have changed, or
* The periodic TWT specified by that TWT parameter set is terminated.

A change in the TWT parameter set occurs in a subsequent DTIM Beacon frame.

A TWT scheduling AP that receives a TWT IE with the TWT Request field equal to 1, the Broadcast field equal to 1, the Wake TBTT Negotiation field set to 1 and the TWT Command field set to Suggest or Demand may respond with a frame containing a TWT IE as shown in Table 27aa (Broadcast TWT Membership exchanges). **(#4767)(#4846)(#4777)(#4778) (#4779) (#5777) (#5778) (#7210) (#7211) (#7212) (#7213) (#7214) (#7215) (#8423)**

A TWT scheduling AP that receives a TWT IE with the TWT Request field equal to 1, the Broadcast field equal to 1, the Wake TBTT Negotiation field set to 1 and the TWT Command field set to Reject shall delete the membership of the STA corresponding to the TA of the MMPDU that contained the TWT IE from the broadcast TWT agreement that has the Broadcast TWT ID value that is equal to the value of the Broadcast TWT ID field of the TWT IE. **(#4767) (#4846) (#4777) (#4778) (#4779)**

A TWT STA shall not transmit a TWT Setup frame with the Broadcast subfield set to 0 and the Wake TBTT Negotiation subfield set to 1. **(#4779) (#5062) (#5777)**

Valid broadcast TWT announcements are described in Table 27mm – Valid Broadcast TWT Announcements. **(#7210) (#7211) (#7212) (#7213) (#7214) (#7215)**

Table 27mm – Valid Broadcast TWT Announcements

|  |  |  |
| --- | --- | --- |
| Initiating frame**(#4767)(#4846)** | Response frame |  |
| TWT Setup Command field value within a TWT Setup frame transmitted from a first STA to a second STA, with Broadcast set to 1 and Wake TBTT Negotiation set to 1 | TWT Setup Command field value within a TWT Setup frame transmitted from the second STA to the first STA with Broadcast set to 1 and Wake TBTT Negotiation set to 1 | Condition after the completion of the exchange**(#8425)** |
| Accept TWT |  No frame transmitted | When transmited by a scheduling STA, an active broadcast TWT agreement is either created or already exists and is using the TWT parameters identified in the initiating frame, including a broadcast TWT ID. The broadcast TWT agreement is identified by the broadcast TWT ID and the TA of the initiating frame. |
| Alternate TWT | No frame transmitted | When transmitted by a scheduling STA, some of the parameters of the broadcast TWT agreement identified by the broadcast TWT ID and the TA of the initiating frame frame will change in the future. The new parameters will be present in the next frame transmitted by the scheduling STA that has a broadcast TWT with the same TWT ID and same TA, but with the TWT command value set to Accept TWT. |
| Reject TWT | No frame transmitted | When transmitted by a scheduling STA, the broadcast TWT agreement identified by the broadcast TWT ID and the TA of the initiating frame frame will be terminated in the future. The termination occurs when a Beacon is transmitted by the scheduling STA that does not include a broadcast TWT with the same TWT ID and same TA as the initiating frame. |

* Rules for TWT scheduled STA

A TWT element with the Broadcast field equal to 1 is referred to as broadcast TWT element.(#8229) A TWT scheduled STA that receives a broadcast TWT element in a Beacon frame shall follow the rules defined in this subclause to interact with the TWT scheduling AP(#6919).

A TWT scheduled STA should not transmit frames(#8285) to the TWT scheduling AP(#6919) outside of broadcast TWT SPs and within trigger-enabled TWT SPs.

A TWT scheduled STA may request to become a member of a broadcast TWT by transmitting a frame to its associated AP that contains a TWT element with the Broadcast subfield set to 1 and the Wake TBTT Negotiation set to 1 and the TWT command field set to Suggest TWT or Demand TWT. The TWT Parameter set indicates the Broadcast TWT ID of the broadcast TWT that the STA is requesting to join.(#8145, #4846, #8130) See Table 27aa (Broadcast TWT Membership exchanges). **(#4767)(#4846) (#7210) (#7211) (#7212) (#7213) (#7214) (#7215) (#8084) (#8423)**

A TWT scheduled STA may terminate membership in a broadcast TWT by transmitting a frame to its associated AP that contains a TWT element with the Broadcast subfield set to 1 and the Wake TBTT Negotiation set to 1 and the TWT command field set to Reject TWT. **(#4767)(#4846)**

A TWT scheduled STA that receives a TWT IE with the TWT Request field equal to 0, the Broadcast field equal to 1,the Wake TBTT Negotiation field equal to 1 and the TWT Command field equal to Accept is a member of the broadcast TWT identified by the <broadcast TWT ID, MAC address> tuple, where the broadcast TWT ID is the value of the Broadcast TWT ID subfield in the TWT IE and the MAC address which is the TA of the MMPDU that contained the TWT IE is equal to the MAC address of the AP with which the STA is associated, regardless of whether the TWT scheduled STA had previously transmitted a corresponding TWT IE to the AP with the value Suggest TWT or Demand TWT in the TWT Command field.**(#4767)(#4846)**

Valid broadcast TWT membership exchanges are described in Table 27aa – Valid Broadcast TWT Membership Exchanges.

Table 27aa – Broadcast TWT Membership Exchanges

|  |  |  |
| --- | --- | --- |
| Initiating frame**(#4767)(#4846)** | Response frame |  |
| TWT Setup Command field value within a TWT Setup frame transmitted from a first STA to a second STA, with Broadcast set to 1 and Wake TBTT Negotiation set to 1 | TWT Setup Command field value within a TWT Setup frame transmitted from the second STA to the first STA with Broadcast set to 1 and Wake TBTT Negotiation set to 1 | Condition after the completion of the exchange**(#8425)** |
| Demand TWT | Accept TWT | An active broadcast TWT agreement exists or has been created with the TWT parameters indicated in the initiating frame and repeated in the responding frame. The STA transmitting the initiating frame is a member of the Broadcast TWT identified by the Broadcast TWT ID and the TA of the response frame. |
| Suggest TWT | Accept TWT | An active broadcast TWT agreement exists or has been created with the TWT parameters indicated in the response frame. The STA transmitting the initiating frame is a member of the broadcast TWT identified by the broadcast TWT ID and the TA of the response frame. |
| Suggest TWT | Alternate TWT | No new broadcast TWT agreement has been created with the TWT parameters indicated in the initiating frame. The responder is offering an alternative set of parameters vs. those indicated in the initiating frame, as a means of negotiating TWT parameters with the requester. The requesting STA can send a new request with any set of TWT parameters and the responder might entertain the creation of a new broadcast TWT agreement using the parameters indicated in the responding frame. |
| Request TWT or Demand TWT | Alternate TWT | This response is not allowed. |
| Suggest TWT or Demand TWT | Dictate TWT | An active broadcast TWT agreement is either created or already exists and is using the TWT parameters identified in the response frame, including a broadcast TWT ID. The responding STA will not create any new broadcast TWT agreement with the requester at this time. The STA transmitting the initiating frame is not a member of the broadcast TWT identified by the broadcast TWT ID and the TA of the response frame. |
| Suggest TWT or Demand TWT | Reject TWT | The STA transmitting the initiating frame is a not a member of a broadcast TWT identified by the broadcast TWT ID and the TA of the response frame, if such a broadcast TWT exists. |
| Accept TWT |  No frame transmitted | Not permitted to be transmitted by a scheduled STA. |
| Alternate TWT | No frame transmitted | Not permitted to be transmitted by a scheduled STA. |
| Reject TWT | No frame transmitted | When transmitted by a scheduled STA, the transmitting STA’s membership in the broadcast TWT agreement identified by the broadcast TWT ID and the RA of the initiating frame frame is terminated. |

1the Broadcast subfield set to 1 and the

A TWT scheduled STA that is in PS mode may enter the doze state after receiving the Beacon frame and shall be in the awake state at the broadcast TWT start times which the STA has indicated it will be awake by either establishing a membership for the broadcast TWT with that Broadcast TWT ID, or by negotiating a wake TBTT and wake interval between Beacon frames that the STA receives, as defined in 27.7.3.4 (Negotiation of wake TBTT and wake(#8154) interval), or has sent a PS-Poll or UPSD trigger frame during that beacon interval (#7634, #8086). **(#4767)(#4846)**

A TWT scheduled STA transmits an HE TB PPDU as a response to a Trigger frame that is intended for it and is sent during a trigger-enabled TWT SP (see 27.5.2 (UL MU operation)). A TWT scheduled STA(#6750) that is in PS mode and is awake shall include a PS-Poll frame or an APSD trigger frame in the HE TB PPDU if it intends to solicit buffered BUs from the TWT scheduling AP(#6919) (see 11.2.2.8 (Receive operation for STAs in PS mode during the CP)) unless the STA has already transmitted a PS-Poll(#6752) or APSD trigger frame within that announced TWT SP or the TWT SP is an unannounced TWT SP(#5670).(#5065)

NOTE 2 —A TWT scheduling AP(#6919) sets the bit in the TIM element of the Beacon frame that corresponds to the AID of the TWT scheduled STA to 1 to indicate that it expects the TWT scheduled STA to solicit available buffered BUs (see 11.2.2.8 (Receive operation for STAs in PS mode during the CP)).

A TWT scheduled STA should only send frames that satisfy the TWT flow identifier recommendations defined in Table 9.248l1 (TWT Flow Identifier field for a broadcast TWT element) during the corresponding TWT SP(s). Frames sent as a response to a Trigger frame are subject to further restrictions as defined in 27.5.2 (UL MU operation).

A TWT scheduled STA may continue participation in Broadcast TWT SPs corresponding to a Broadcast TWT identified by the value in the Broadcast TWT ID subfield of a received Beacon from the AP with which it is associated, for *n* Beacon Intervals beyond the Beacon reception regardless of whether any additional Beacons are received during those *n* Beacon Intervals, where *n* is equal to one plus the value of the Broadcast TWT Persistence subfield of the corresponding Broadcast TWT, except that *n* is infinite when the value of the subfield is 7. The value of the Broadcast TWT Persistence subfield is dynamic.

* Negotiation of wake TBTT and wake(#8154) interval

A TWT scheduled STA that intends to operate in power save mode (see 11.2.2.2 (STA Power Management modes)) may transmit a TWT request frame to the TWT scheduling AP(#6919) that identifies the wake TBTT of the first Beacon frame and the wake interval between subsequent Beacon frames it intends to receive. The TWT request frame shall contain:

* The Wake TBTT Negotiation subfield equal to 1 and the TWT Command field to Suggest TWT or Demand TWT, the Broadcast subfield equal to 0(#5671, #8126), and
* The requested first wake TBTT in the Target Wake Time field(#8125),
* The requested wake interval(#8154) between consecutive TBTTs in the TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields.
* All other fields in the TWT element are reserved.

A TWT scheduling AP(#6919) that receives a TWT request frame from a STA whose value of the Wake TBTT Negotiation subfield is 1 and Broadcast subfield is 0(#5671) shall respond with a TWT response frame that contains either Accept TWT or Reject TWT in the TWT Command field and, in the case of an Accept TWT, it shall also contain:

* The Wake TBTT Negotiation subfield equal to 1, the Broadcast subfield equal to 0(#5672, #8126), and
* The allocated first wake TBTT in the Target Wake Time field, and
* The allocated wake interval(#8154) between consecutive TBTTs in the TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields.
* All other fields in the TWT element are reserved.

After successfully completing the negotiation, the TWT scheduled STA may go to doze state until its TSF matches the next negotiated wake TBTT provided that the STA is in power save mode, and no other condition requires the STA to remain awake. The TWT scheduled STA shall be in the awake state to listen to Beacon frames transmitted at negotiated wake TBTTs and shall operate as described in 27.7.3.3 (Rules for TWT scheduled STA).

After receiving the Beacon frame at or after TBTT, the TWT scheduled STA may go to doze state until the next wake TBTT if no other condition requires the STA to remain awake. The TWT scheduled STA may go to doze state after AdjustedMinimumTWTWakeDuration time has elapsed from the TBTT start time if no Beacon frame is received.(#3076)

A TWT scheduling AP may delete a wake TBTT agreement by transmitting a TWT request frame to a TWT scheduled STA with:

* The TWT Request field set to 0
* The TWT Command field set to Reject
* The Wake TBTT Negotation subfield set to 1
* The Broadcast subfield set to 0
* The Target Wake Time field set to 0
* The TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields set to 0
* All other fields in the TWT element are reserved.

A TWT scheduled STA may delete a wake TBTT agreement by transmitting a TWT request frame to a TWT scheduling AP with:

* The TWT Request field set to 1
* The TWT Command field set to Reject
* The Wake TBTT Negotation subfield set to 1
* The Broadcast subfield set to 0
* The Target Wake Time field set to 0
* The TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields set to 0
* All other fields in the TWT element are reserved.

Table 27ab (Wake TBTT Negotiation Exchanges) summarizes the interacations between devices that negotiate a Wake TBTT agreement. **(#4767)(#4846)**

Table 27ab – Wake TBTT Negotiation Exchanges

|  |  |  |
| --- | --- | --- |
| Initiating frame**(#4767)(#4846)** | Response frame |  |
| TWT Setup Command field value within a TWT Setup frame transmitted from a first STA to a second STA, with Broadcast set to 0 and Wake TBTT Negotiation set to 1 | TWT Setup Command field value within a TWT Setup frame transmitted from the second STA to the first STA with Broadcast set to 0 and Wake TBTT Negotiation set to 1 | Condition after the completion of the exchange |
| Request TWT | Accept TWT or Alternate TWT or Dictate TWT or Reject TWT or no response | This exchange is not allowed. |
| Demand TWT or Suggest TWT | Accept TWT | A Wake TBTT agreement has been created with the Wake TBTT parameters indicated in the initiating frame. |
| Demand TWT or Suggest TWT | Reject TWT | No Wake TBTT agreement has been created. |
| Reject TWT | None | An existing Wake TBTT agreement between the iniator and the responder has been terminated. |

* Use of TWT Information frames
* General

An HE STA may transmit a TWT Information frame to its peer STA during an individual TWT session, broadcast TWT session, or at any time as defined in 27.7.4.2 (TWT information for individual TWT), 27.7.4.3 (TWT information for broadcast TWT) and 27.7.4.4 (TWT information for flexible TWT), respectively.(#8109, #7403)

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:

* A nonzero value in the Next TWT subfield when the frame is transmitted by a TWT responding STA, a TWT scheduling AP(#6919), or by any HE STA to a peer STA that supports TWT
* The value of the Next TWT shall be selected from existing TWT values for a TWT session if the Flexible TWT Schedule Support field of the peer STA is 0
* The Next TWT may contain any nonzero value if Flexible TWT Schedule Support field of the peer STA is 1
* A Next TWT subfield that is present when the frame is transmitted by a TWT requesting STA, a TWT scheduled STA, or any HE STA to a peer STA that supports TWT
* The Next TWT indicates the TWT at which the TWT session is resumed and shall be selected from existing TWT values for that TWT session if the Flexible TWT Schedule Support field of the peer STA is 0
* The Next TWT may contain any nonzero value if Flexible TWT Schedule Support field of the peer STA is 1
NOTE—In such case, the TWT requesting STA or TWT scheduled STA or peer STA that transmitted the TWT Information frame preserves the PM mode from the time it sent the TWT Information frame to the time it is expected to wake-up.
* A Next TWT subfield that is not present when the frame is transmitted by a TWT requesting STA or a TWT scheduled STA to indicate suspension of the TWT session

The TWT Information frame may have the Broadcast Reschedule subfield set to 1 to indicate reschedule of all broadcast TWT sessions and a flexible TWT as defined below.(#8109, #7403)

* TWT information for individual TWT

An HE STA may transmit a TWT Information frame to its peer STA during an individual TWT session. The HE STA sets the fields of the TWT Information frame as defined in Table 27.7.4.1 (General).(#8109, #7403)

A TWT requesting STA that receives a TWT Information frame follows the rules defined in 10.43.4 (Implicit TWT operation).

A TWT requesting STA that receives an acknowledgment in response to a TWT Information frame that:

* Does not contain a Next TWT field shall consider that TWT session suspended, and can follow other individual TWT sessions, the procedure in 27.7.3 (Broadcast TWT operation), or the default PS procedure defined in 11.2 (Power management) until the TWT session is resumed.(#8109, #7403)
* Contains a Next TWT field shall consider the corresponding TWT session resumed, starting from the value indicated in the Next TWT field of the transmitted TWT Information frame.

NOTE—The TWT Flow Identifier, together with the MAC addresses of the TWT requesting STA and TWT Responding STA identifies the TWT agreement for which the TWT Information frame is sent (see 10.43.1 (TWT overview)).

A TWT requesting STA that transmits a TWT Information frame to a peer STA may transition to doze state after receiving the acknowledgment and shall be in the awake state at the specified TWT indicated in the TWT Information frame. A TWT requesting STA that receives a TWT Information frame from a peer STA may transition to doze state after transmitting the acknowledgment and shall be in the awake state at the specified TWT indicated in the TWT Information frame.(#8109, #7403)

* TWT information for broadcast TWT

An HE STA may transmit a TWT Information frame to its peer STA during a broadcast TWT session. The HE STA sets the fields of the TWT Information frame as defined in 27.7.4.1 (General).

A TWT scheduled STA that receives a TWT Information frame that contains a Broadcast Reschedule subfield equal to 1 follows the rules defined in 27.7.3.3 (Rules for TWT scheduled STA), except that it shall use the Next TWT value contained in the received TWT Information frame.

A TWT scheduled STA that receives an acknowledgment in response to a TWT Information frame that contains a Broadcast Reschedule subfield equal to 1 and:

* Does not contain a Next TWT field shall consider all broadcast TWT sessions suspended, and can follow the default PS procedure defined in 11.2 (Power management) until the TWT session is resumed.
* does contain a Next TWT field shall consider all broadcast TWT sessions resumed, starting from the value indicated in the Next TWT field of the transmitted TWT Information frame.

NOTE—TWT suspension and resumption as indicated by a TWT information frame with the Broadcast Reschedule subfield equal to 1 applies to all broadcast TWT sessions of the TWT scheduling STA.(#8109, #7403) **(#4767)(#4846)**

* TWT information for flexible TWT

An HE STA may transmit a TWT Information frame to its peer STA at any time (i.e., without participating in any TWT sessions) if the peer STA has set the Flexible TWT Schedule Support field of the HE Capabilities it transmits. An HE STA may transmit a TWT Information frame to a TWT scheduling AP. The HE STA sets the fields of the TWT Information frame as defined in 27.7.4.1 (General).

A non-AP HE STA(#6256) that transmits a TWT Information frame with Broadcast Reschedule subfield equal to 1 to a peer STA may go to doze state after receiving the acknowledgment and shall be in the awake state at the specified TWT indicated in the TWT Information frame. A non-AP HE STA that receives a TWT Information frame with Broadcast Reschedule subfield equal to 1 from a peer STA may go to doze state after transmitting the acknowledgment and shall be in the awake state at the specified TWT indicated in the TWT Information frame.(#8109, #7403)

27.7.5 PS operation during TWT SPs(#4767)(#4846)

The following rules apply to TWT SPs for both broadcast TWT agreements and individual TWT agreements.

A TWT requesting STA in PS mode that is awake for a TWT SP may transition to the doze state after AdjustedMinimumTWTWakeDuration time has elapsed from the scheduled TWT SP start time if no frame addressed to the TWT requesting STA, including control response frames, was received from the responding STA since the scheduled TWT SP start time.

If any frame transmitted by a TWT responding STA or TWT scheduling STA that is addressed to a TWT requesting STA or TWT scheduled STA, respectively, that is in PS mode and is received by the STA since the scheduled start time of a TWT SP, then the receiving STA shall remain awake until it receives a TWT SP termination event. If a TWT SP termination event is contained within the first frame received from the TWT responding STA or TWT scheduling STA within a TWT SP, then the receiving may tranisition to the doze state immediately after transmitting any required immediate response to that frame, or immediately after receipt of the frame if no response is required. When a TWT SP termination event occurs within a TWT SP at a STA in PS mode that is participating in the TWT SP, the STA may transition to the doze state without waiting for the completion of the AdjustedMinimumTWTWakeDuration time.

 A TWT SP termination event is any of the following:

* The reception of a Trigger frame sent by the TWT responding STA or TWT scheduling STA with the Cascade Indication field equal to 0 that is intended for the TWT requesting STA or TWT scheduled STA, respectively(#5658, #4841)
* The transmission by the TWT requesting STA or TWT scheduled STA of an acknowledgement in response to a frame (#4842, #5660) sent by the TWT responding STA or TWT scheduling STA, respectively, that had either the EOSP subfield equal to 1 or the More Data field equal to 0 when the frame does not contain an EOSP subfield
* The reception of a frame sent by the TWT responding STA or TWT scheduling STA that does not solicit an immediate response and that (#4842, #5660) had either an EOSP subfield present with a value equal to 1 or had no EOSP subfield present but had the More Data field equal to 0

The classification of a More Data field equal to 0 in an Ack, BlockAck and Multi-STA BlockAck frame as a TWT SP termination event can occur only when both STAs have indicated support of transmitting or receiving the frame with a nonzero More Data subfield, which is indicated in the More Data Ack subfield of the QoS Info field of frames they transmit (see 11.2.2 (Power management in a non-DMG infrastructure network)).

NOTE 1—A Trigger frame, sent by the TWT scheduling AP(#6919) or TWT responding STA, is defined as intended for the TWT scheduled STA or TWT requesting STA, respectively, when the Trigger frame contains the AID of the STA in one of its Per User Info fields (see 27.5.2 (UL MU operation)), and can have in the TA field the MAC address of the transmitted BSSID under the conditions defined in 27.5.2.2.2 (Allowed settings of the Trigger frame fields and UMRS Control field(#Ed))(#7171). Otherwise, the Trigger frame is not intended for the STA. If the Trigger frame contains one or more random access RUs(17/646r4) for which the STA can gain access according to 27.5.4 (UL OFDMA-based random access (UORA)) then the STA can follow the rules defined in 27.14.2 (Power save with UORA) to determine a TWT SP termination event.

NOTE 2—A STA participating in multiple TWT SPs which overlap in time stays in the awake state until the latest AdjustedMinimumTWTWakeDuration time of all of the TWT SPs expires, except that a TWT termination event causes all of the overlapping TWT SPs to terminate.(#8090) **(#4767)(#4846)**

**End of proposed changes.**