IEEE P802.11  
Wireless LANs

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| Comment resolutions for 27.7.3 | | | | |
| Date: 2018-11-01 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Alfred Asterjadhi | Qualcomm Inc. | 5775 Morehouse Dr, San Diego, CA 92109 | +1-858-658-5302 | aasterja@qti.qualcomm.com |
| Abhishek Patil | Qualcomm Inc. |  |  |  |
| George Cherian | Qualcomm Inc. |  |  |  |

Abstract

This submission proposes resolutions for multiple comments related to TGax D3.0 with the following CIDs (19 CIDs):

* 15096, 15097, 15099, 15100, 15101, 15164, 15165, 15182, 15731, 15732,
* 15733, 15840, 15841, 15842, 15843, 15844, 16423, 16452, 16463

Revisions:

* Rev 0: Initial version of the document.

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.***

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| **CID** | **Commenter** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 15096 | Abhishek Patil | 317.01 | Replace all occurances of TWT Flow Identifier field with Broadcast TWT Recommendation field. TWT Flow Identifier applies to Individual TWT. The corresponding bits are repurposed for Broadcast TWT and have a different meaning as per Table 9-262k1 | As in comment | Revised –  Agree in principle with the comment. Incoporated the suggestec changes throughout the subclause.  TGax editor to make the changes shown in 11-18/1697r0 under all headings that include CID 15096. |
| 15097 | Abhishek Patil | 317.25 | FD frames or broadcast probe response frames are meant for unassociated STAs. Unassociated STAs are only interested in TWT SPs where a TF carrying RA-RUs is sent. Therefore, the TWT element included in such frames need not carry other TWT parameter sets. Such rules will help prevent bloating of the frame. | Clarify that the TWT element carries only the Broadcast TWT Parameter set(s) that corresponds to TWT SPs where TF with RA-RUs for unassociated STAs is expected. | Revised –  Agree with the comment. Proposed resolution clarifies this aspect by indicating that only B TWT PSs can be included that provide RA RU info. Also stated that the Broadcast TWT ID field in these cases is equal to 0.  TGax editor to make the changes shown in 11-18/1697r0 under all headings that include CID 15097. |
| 15099 | Abhishek Patil | 319.55 | When a new STA receives a TWT element with two parameter sets having the same value of Broadcast TWT ID and both the parameter sets have the command 'Alternate', how can it identify the active profile versus the one that would take effect after the specified time has passed? | Clarify that the first one of the two is the active profile. | Revised –  Agree in principle with the comment. Proposed resolution adds a sentence to specify accordingly.  TGax editor to make the changes shown in 11-18/1697r0 under all headings that include CID 15099. |
| 15100 | Abhishek Patil | 321.02 | The TWT field of Broadcast TWT Parameter Set is 2-octets long. The 16 bits take on the value of TSF timer [10:25] while lower bits [0:9] of TSF timer are assumed to be 0. | Delete the sentence: "The TWT scheduling AP shall set Bits 0 to 9 of the TWT field to 0." and add a note "Bits [0:9] of TSF timer are assumed to be 0 when computing the time of the first TWT." | Revised –  Agree in principle with the comment. Proposed resolution clarifies this aspect not only for bits 0 to 9 but also for bits 26 to 63.  TGax editor to make the changes shown in 11-18/1697r0 under all headings that include CID 15100. |
| 15101 | Abhishek Patil | 322.60 | The terms broadcast TWT element is frequently used in the spec and most of the occurances are before the sentence that defines what it means. | Move this sentence to section 9.4.2.200 after the term Broadcast field is defined (i.e., P140L47). | Accepted |
| 15164 | Alfred Asterjadhi | 321.02 | Super bug: The bits 0 to 9 shall not be set to 0. What you want to say is that the bits that are not transmitted (bits 0 to 9) are assumed to be 0 by both the transmitter and receiver. | As in comment. | Revised –  Agree in principle with the comment. Proposed resolution clarifies this aspect not only for bits 0 to 9 but also for bits 26 to 63.  TGax editor to make the changes shown in 11-18/1697r0 under all headings that include CID 15164. |
| 15165 | Alfred Asterjadhi | 321.02 | This counter counts down by one unit every beacon, so it cannot be represented as a mantissa and an exponent. Fix is needed. | As in comment. | Revised –  This issue was solved by the resolution of CIDs 15030 and 16445 in 11-18/1465r1 which was motioned in September F2F. Proposed resolution is the same as the resolution for those CIDs.  *Note to TGax editor: These changes are already present in D3.2 as such no further changes are needed.*  TGax editor to make the changes shown in 11-18/1465r1 under all headings that include CID 15030 and 16445. |
| 15182 | Alfred Asterjadhi | 320.61 | In order to clarify what the possible combinations are for the broadcast TWT ID value of 0 it is better to put them in a table. This way the list is complete and we don't miss anything that might be unclear. | As in comment. | Revised –  Agree in principle. Proposed resolution provides the list of possible choices in a bulleted list.  TGax editor to make the changes shown in 11-18/1465r1 under all headings that include CID 15030 and 15182. |
| 15731 | Jarkko Kneckt | 325.41 | The broadcast TWT is designed to operate in a BSS with large number of associated STAs. In this BSS, the AP is able to transmit to one STA only few percents of the total time. The power of consumption of a non-AP STA that uses broadcast TWT will be high, because if a STA indicates that it is active during a Beacon Period, then the STA needs to wake up for every Broadcast TWT SP on that beacon period. This likely causes many unnecessary waking ups.Especially unannounced TWT SPs increase STA power consumption, because AP can send traffic directly to the STA during the whole SP without any indication from the STA. The number of wake ups that BC TWT causes to the STA needs to be reduced in order to reduce STA power consumption and to make STA availability with BC TWT reasonable with the level of transmission resources the AP may share to a STA. | Specify broadcast TWT rules that allow AP to indicate more precisely during which BC TWT SPs the STA is expected to be available. Allow AP and STA to indicate during which BC TWT SPs the non-AP STA is available. Allow STA to deny to be available during unannounced TWT SPs and/or during TWT SPs that are targetted for small packets transmissions for the remainder of the beacon period. | Revised –  The STA is free to join or not join a particular broadcast TWT schedule. In addition the STA can also suggest to the AP the broadcast TWT schedule that it deems more appropriate for its type of traffic and activity. In addition the STA can send TWT Information frames to suspend and/or resume a certain broadcast TWT schedule if it does not want to wake anymore for the remainder of the beacon period. The proposed resolution is to add to the note following this paragraph that the STA indicates that it will not be awake in certain broadcast TWTs by sending a TWT information frame and added reference to the respective subclause.  TGax editor to make the changes shown in 11-18/1465r1 under all headings that include CID 15030 and 15731. |
| 15732 | Jarkko Kneckt | 325.41 | A STA should not be mandated to be available for all BC TWTs in a beacon period, if it has created a membership in a BC TWT. The STA should only wake up during the BC TWT SP in which it is a member. Alternatively please add signaling for a STA to enable the STA to indicate in BC TWT membership signaling whether the STA desires to be available at all TWT SPs in the beacon period or during the TWT SPs that occur after the BC TWT SP to which the STA is member. | Please add a signaling to allow the STA to control during which BC TWT SPs it will be available or clarify that if a STA has created a membership with a BC TWT, the STA needs to be available only during the broadcast TWT SPs in which it is a member. | Revised –  The STA can send a TWT Information frame if it does not want to wake for certain TWT SPs during a beacon period. Similarly, the AP can send a TWT information frame to the STA to tell the STA to not wake anymore during that beacon interval. Please note that in general the AP will try to serve the STAs as soon as possible as it is not in its interest either to keep the STA awake. The proposed resolution is to add to the note following this paragraph that the STA indicates that it will not be awake in certain broadcast TWTs by sending a TWT information frame and added reference to the respective subclause. Similarly for the AP side.  TGax editor to make the changes shown in 11-18/1465r1 under all headings that include CID 15030 and 15732. |
| 15733 | Jarkko Kneckt | 320.37 | In mass events, like in formula 1 rally or in soccer world cup, the BC TWT should have means to transmit real time multicast data, so that devices could get instant repetitions and updated statistics updated continuosly and efficiently. | Add a posibility to transmit selected multicast frames only throgh a broadcast TWT SPs and use FMS-like signaling to signal the traffic that is being transmitted. | Rejected –  The comment fails to identify a technical issue. It is unclear the relationship between FMS and broadcast TWT. Currently the AP uses the broadcast TWT ID value 0 to indicate that there is group addressed BU delivery for the corresponding BSSID available at the AP. If the AP were to use FMS then the delivery is in multiple of DTIMs, which would still be applicable in this case. |
| 15840 | Laurent Cariou | 317.10 | Opportunistic power save does not require the AP to be TWT scheduling AP. Clarify this in this sentence. | As in comment | Revised –  Agree in principle with the comment. Proposed resolution clarifies that this applies to the scheduled OPS.  TGax editor to make the changes shown in 11-18/1697r0 under all headings that include CID 15840. |
| 15841 | Laurent Cariou | 317.55 | Opportunistic power save does not require the STA to be TWT scheduled STA. Clarify this in this sentence. | As in comment | Revised –  Agree in principle with the comment. Proposed resolution clarifies that this applies to the scheduled OPS.  TGax editor to make the changes shown in 11-18/1697r0 under all headings that include CID 15841. |
| 15842 | Laurent Cariou | 321.23 | "or any indication that the STA ... is in the awake state". In other places in the TWT spec, there is a note that indicate that a response to NFRP is such an indication. This note should also be present here or a reference to it should be added. | As in comment | Revised –  Agree in principle. Added as suggested.  TGax editor to make the changes shown in 11-18/1697r0 under all headings that include CID 15842. |
| 15843 | Laurent Cariou | 325.49 | Broadcast TWT with TWT ID=0 have very specific behavior and most of the rules defined in 27.7.3 don't apply for TWT ID=0, and is mostly used to inform the STAs about when a AP will transmit specific frames (UORA TF...). It would be much clearer if we had a specific subclause for broadcast TWT with TWT ID=0. | As in comment | Revised –  Proposed resolution provides the list of possible choices in a bulleted list, regarding the trigger field, TWT recommendation field, and expected behavior. Please note that the subclause contains a lot of spec that applies to this particular case as well. Hence, to avoid duplications the language is kept in the same subclause.  TGax editor to make the changes shown in 11-18/1465r1 under all headings that include CID 15030 and 15843. |
| 15844 | Laurent Cariou | 326.08 | "or any indication that the STA ... is in the awake state". In other places in the TWT spec, there is a note that indicate that a response to NFRP is such an indication. This note should also be present here or a reference to it should be added. | As in comment | Revised –  Agree in principle. Added as suggested.  TGax editor to make the changes shown in 11-18/1697r0 under all headings that include CID 15844. |
| 16423 | Matthew Fischer | 321.33 | The language here is a bit misleading, in that it mentions only that the BU count rules are not to be followed, but really, the wake determination rules are also modified | change "An announced TWT SP, without following the rules regarding the number of buffered BUs to be delivered in 11.2.3.6 (AP operation during the CP) 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 and as long as the TWT scheduled STA has not entered the doze state" to "An announced TWT SP, without waiting for an explicit indication that the STA is in the AWAKE state, and disregarding the limits of the number of buffered BUs to be delivered in 11.2.3.6 (AP operation during the CP) as long as the BU delivery does not exceed the duration of the TWT SP and the TWT scheduled STA has indicated that it is awake for that TWT SP and as long as the TWT scheduled STA has not entered the doze state" | Revised –  Agree in principle with the comment. Proposed resolution is to separate the two cases (announced and unannounced) in separate sentences so that the rules that are exemptions are clear.  TGax editor to make the changes shown in 11-18/1697r0 under all headings that include CID 16423. |
| 16452 | Matthew Fischer | 323.01 | Nowhere does it say that a BTWT participant non-AP STA is allowed to use normal EDCA access within a BTWT SP, add it. Might need to add conditions, such as whether the SP is triggered or not, and announced or not. | Add statements indicating when it is ok to use normal EDCA vs MU EDCA during BTWT SPs. | Revised –  Ommitance in the rules indicates that normal contention is followed. To clarify this aspect a note is added that specifies that the TWT scheduled STA contends for accessing the medium as defined in 27.2.6.  TGax editor to make the changes shown in 11-18/1697r0 under all headings that include CID 16452. |
| 16463 | Ming Gan | 321.30 | It is not clear what will be followed when A TWT scheduling AP may deliver multiple buffered BUs to the TWT scheduled STA, the original bullets are vague, emphasis "without following" all the time. | The intention is to say A TWT scheduling AP ca deliver more than one BUs, not a BU as decribed in 11.2.3.6. Please reword these two bullets | Revised –  Agree in principle with the comment. Proposed resolution further clarifies this aspect to indicate the exemption rule from baseline and the intent to have the AP transmit as many BUs as possible to the STA subject to the respective rules provided in the bullets.  TGax editor to make the changes shown in 11-18/1697r0 under all headings that include CID 16463. |

**Discussion: *None.***

* Broadcast TWT operation
* General

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 15840):***

A TWT scheduling AP 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), 27.14.2 (Power save with UORA), and those for scheduled OPS defined in 27.14.3 (Opportunistic power save)*(#15840)*.

A TWT scheduling AP includes a broadcast TWT element in the Beacon frame as described in 27.7.3.2 (Rules for TWT scheduling AP).

A TWT scheduling AP may include a TWT element with the Negotiation Type subfield equal to 3 in an (Re)Association Response frame or in a TWT setup frame to assign the recipient STA to a broadcast TWT schedule without having received a request from the STA to become a member of the broadcast TWT schedule if that STA has set the Broadcast TWT Support field of HE Capabilities element it transmits to 1.

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 15096, 15097):***

The TWT scheduling AP may include a broadcast TWT element in FILS Discovery frames and in broadcast Probe Response frames to indicate the TWT SP(s) during which the AP intends to schedule for transmission Trigger frames with at least one RU with the AID12 subfield set to 2045. The broadcast TWT element shall carry only a broadcast TWT parameter set with the Broadcast TWT Recommendation subfield set to 2, the Trigger subfield set to 1 and the Broadcast TWT ID subfield set to 0. The AP transmits broadcast Probe Response frames if it has dot11FILSOmitReplicateProbeResponses equal to true.*(#15096, 15097)*

An HE BSS belonging to a Multiple BSSID set (see 11.11.14 (Multiple BSSID set)) may advertise TWT element carried in the Management frames transmitted by the transmitted BSSID. An HE AP may include the TWT element in a nontransmitted BSSID profile carried in the Multiple BSSID element (see 9.4.2.46 (Multiple BSSID element)) to provide different TWT parameter values for STAs associated with that nontransmitted BSSID.

A non-AP HE STA shall obtain TWT parameter values from the most recently received TWT element carried in the Management frames of its associated AP. A non-AP HE STA with dot11MultiBSSIDActivated set to true and associated with a nontransmitting BSSID shall inherit the TWT parameter values from the TWT element when advertised by the transmitted BSSID if the element is not carried in the nontransmitted BSSID profile for that BSSID.

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.

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 15841):***

A TWT scheduled STA follows the schedule provided by the TWT scheduling AP as described in 27.7.3.3 (Rules for TWT scheduled STA), 27.14.2 (Power save with UORA), and for scheduled OPS as described in 27.14.3 (Opportunistic power save). A TWT scheduled STA can negotiate the wake TBTT and wake interval for Beacon frames it intends to receive as described in 27.7.6 (Negotiation of wake TBTT and wake interval) or can join a particular broadcast TWT as described below.*(#15841)*

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

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| * Example of broadcast TWT operation with optional TBTT negotiation |

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.

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 subfield and is greater than 0 and the MAC address is the address of the TWT scheduling AP.

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 15182, 15843):***

Broadcast TWT schedules are advertised by the TWT scheduling AP in frames that carry TWT elements with the Negotiation Type subfield set to 2 as described in 27.7.3.2 (Rules for TWT scheduling AP). Broadcast TWT schedules that are intended for member TWT scheduled STAs are identified by a Broadcast TWT ID subfield that is greater than 0 and broadcast TWT schedules that are intended for all TWT scheduled STAs are identifier by a Broadcast TWT ID subfield equal to 0.*(#15182, 15843)*

Negotiations to join or leave a Broadcast TWT, identified by a Broadcast TWT ID subfield greater than 0, are performed with an exchange of frames that carry TWT elements with the Negotiation Type subfield set to 3 as described in 27.7.3.3 (Rules for TWT scheduled STA). *(#15182, 15843)*

The TWT scheduling AP may send an unsolicited TWT response with the Trigger subfield set to 1 to a non-AP HE STA that has set the Broadcast TWT Support subfield to 1 in the HE Capabilities elements that it transmits to the AP. The TWT response shall indicate one of the following values in the TWT Command field: Accept TWT, Alternate TWT, or Dictate TWT. An unsolicited TWT response with TWT Command field indicating Alternate TWT or Dictate TWT contains an advisory notification to the recipient of TWT parameters that are likely to be accepted by the AP if the recipient transmits a subsequent TWT request to the AP that includes those TWT parameters. An unsolicited TWT response with a TWT Command field that indicates Accept TWT allocates a broadcast TWT schedule to the receiving STA. A STA that receives an unsolicited TWT response with a TWT Command field that indicates Accept TWT may transmit a TWT Teardown frame or a TWT response with TWT Command field indicating Reject TWT to withdraw from the unsolicited broadcast TWT schedule.

* Rules for TWT scheduling AP

A TWT scheduling AP may include 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 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 shall set the Last Broadcast Parameter Set subfield to 0 in each TWT parameter set except for that the last (or only) TWT parameter set of the TWT element that shall have the Last Broadcast Parameter Set subfield set to 1. The TWT scheduling AP shall set the NDP Paging Indicator subfield to 0 and the Negotiation Type subfield to 2, and may set 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).

The TWT scheduling AP sets the TWT parameters of each TWT parameter set as described below.

The TWT scheduling AP shall set the TWT Request subfield to 0 and the TWT Setup Command subfield as defined in Table 27-6 (Broadcast TWT announcements) and shall include the broadcast TWT element in the Beacon frames for as long as there is at least one active broadcast TWT schedule.

The TWT scheduling AP shall include a nonzero value in the Broadcast TWT Persistence subfield for each Broadcast TWT to indicate the number of TBTTs for which the Broadcast TWT schedule will be in existence, counting forward from the current TBTT. The AP may change the value of the Broadcast TWT Persistence subfield for any Broadcast TWT within any transmitted TWT element. If the AP reduces the value of the subfield, it shall not reduce the value by more than one as compared to the value transmitted during the immediately preceding beacon interval. If the AP increases the value of the Broadcast TWT Persistence subfield, it may increase the value by any amount as compared to the value transmitted during the immediately preceding TBTT.

A TWT scheduling AP that sets the TWT Setup Command subfield to Reject TWT shall indicate the TBTT at which the periodic broadcast TWT will be terminated by setting the value of the Broadcast TWT Persistence subfield to indicate the number of TBTTs that remain until the broadcast TWT schedule is terminated. The broadcast TWT schedule terminates at the next TBTT that follows the TBTT at which the TWT scheduling AP transmits the broadcast TWT element with Broadcast TWT Persistence subfield for that broadcast TWT schedule equal to 0.

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 15099):***

A TWT scheduling AP that sets the TWT Setup Command subfield to Alternate TWT shall indicate the TBTT at which the periodic broadcast TWT parameter set will be modified by setting the Broadcast TWT Persistence subfield to indicate the number of TBTTs that remain until the broadcast TWT schedule is modified. The broadcast TWT schedule will be modified at the next TBTT, which follows the TBTT at which the TWT scheduling AP transmits the broadcast TWT element with Broadcast TWT Persistence subfield for that broadcast TWT schedule equal to 0. The AP shall include in the broadcast TWT element the future broadcast TWT parameter set that will take effect at that TBTT. The future broadcast TWT parameter set shall have the same values in the TWT Setup Command and Broadcast TWT ID subfields as the current broadcast TWT parameter set that is being modified and switch the TWT Setup Command subfield from Alternate TWT to Accept TWT at that TBTT. The future broadcast TWT parameter set shall be in a Broadcast TWT Parameter Set field that is located after the Broadcast TWT Parameter Set field with the current broadcast TWT parameter set.*(#15099)*

A TWT scheduling AP should indicate Alternate TWT or Reject TWT in the TWT Command Setup field of the broadcast TWT element for as many TBTTs 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 will change, or when the periodic TWT specified by that TWT parameter set will be terminated.

The TWT scheduling AP shall set the Trigger field to 1 to indicate a trigger-enabled TWT. Otherwise, it shall set the Trigger field to 0 (i.e., the TWT is not a trigger-enabled TWT). The AP is not expected to schedule for transmission Trigger frames during a non-trigger-enabled TWT SP and is expected to schedule Trigger frames during a trigger-enabled TWT SP as described below.

The TWT scheduling AP shall schedule for transmission of a Trigger frame addressed to one or more TWT scheduled STAs during a trigger-enabled TWT SP. A TWT scheduling AP should not include the 12 LSBs of the 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 preceding the beacon interval that contains this TWT SP (see 27.7.6 (Negotiation of wake TBTT and wake interval)).

The TWT scheduling AP that intends to transmit additional Trigger frames during a trigger-enabled TWT SP shall set the More TF subfield in the Common Info 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 shall set the More TF subfield 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. The TWT scheduling AP should poll as many STAs as possible among TWT scheduled STAs that are members of that nonzero Broadcast TWT ID so that the STAs can perform a frame exchange with the TWT scheduling AP during that TWT SP.

NOTE 1—The TWT scheduling AP does not intend to schedule for transmission of 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 subfield that has the UL MU disable bit equal to 1 (see 27.8 (Operating mode indication)).

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 16962):***

NOTE 2—The Trigger frame can also be an TRS Control subfield 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, and allocate enough resources in subsequent Trigger frames sent during the TWT SP so that the STA can send the amount of data reported in the BSR. The AP is not required to include the STA in subsequent Trigger frames if the STA reported no data in the BSR*(#16962)*.

The TWT scheduling AP 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.

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 15182, 15843):***

The TWT scheduling AP should schedule delivery of individually addressed DL BUs during unannounced TWT SPs with nonzero Broadcast TWT ID subfield. *(#15182, 15843)*

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 15096):***

The TWT scheduling AP shall set the Broadcast TWT Recommendation field according to Table 9.262kl (Broadcast TWT Recommendation field for a broadcast TWT element). The TWT scheduling AP shall set the Trigger field to 1 if the Broadcast TWT Recommendationfield is 1 or 2, and may set the Trigger field to any value if the Broadcast TWT Recommendation field is 0 or 3. *(#15096)*

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 15096):***

A Trigger frame transmitted during a broadcast TWT SP whose TWT parameter set has the Broadcast TWT Recommendation subfield equal to 0 or 3 may contain zero or more RA-RUs (see 27.5.5 (UL OFDMA-based random access (UORA))). A Trigger frame transmitted during a broadcast TWT SP whose TWT parameter set has the Broadcast TWT Recommendation subfield equal to 1 shall contain no RA-RU. *(#15096)*

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 15096, 15182, 15843):***

A TWT scheduling AP that has advertised a broadcast TWT with a Broadcast TWT ID equal to 0 shall schedule:

* The delivery of group addressed DL BUs during the broadcast TWT SP(s) located within the beacon interval that follows the DTIM Beacon frame if the TWT parameter set indicated non-trigger enabled unannounced TWT SP and had the Broadcast TWT Recommendation subfield equal to 0.
* The transmission of a Trigger frame that does not contain an RA-RU during the broadcast TWT SP(s) if the TWT parameter set indicated trigger-enabled announced TWT SP and had the Broadcast TWT Recommendation subfield equal to 1. The Trigger frame shall be addressed to TWT scheduled STAs whose TIM bit in the Beacon is set to 1 and are not members of any nonzero broadcast TWT during this beacon interval
* The transmission of a Trigger frame that contains at least one RA-RU during the broadcast TWT SP(s) if the TWT parameter set indicated trigger-enabled announced TWT SP and had the Broadcast TWT Recommendation subfield equal to 2see 27.14.2 (Power save with UORA)).
* The transmission of a TIM frame or FILS Discovery frame at the start of a broadcast TWT SP if the TWT parameter set indicated non-trigger enabled unannounced TWT SP and had the Broadcast TWT Recommendation subfield equal to 3. )(see 27.14.3.2 (AP operation for opportunistic power save)).*(#15096, 15182, 15843)*

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 15100, 15164):***

The TWT scheduling AP shall set the TWT field to the TSF timer [10: 25] , which corresponds to the next TWT that is scheduled for this TWT parameter set, when it queues for transmission the frame that contains the TWT element.. The TSF timer at which the next TWT is scheduled has bits 0 to 9 equal to 0 and bits 26 to 63 equal to the same value as the respective bits in the current TSF timer.*(#15100, 15164)*

The TWT scheduling AP 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 and for the only TWT of the aperiodic TWT.

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 15182, 15843):***

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 except when the TWT Command is Alternate TWT or when the value of the Broadcast TWT ID field is zero*(#15182, 15843)*.

The TWT scheduling AP 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), 27.2.5 (MU-RTS Trigger/CTS frame exchange(#15729) procedure), or CTS-to-self as described in 10.3.2.13 (NAV distribution); otherwise it shall set it to 0.

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 16423, 16463, 15842):***

A TWT scheduling AP that receives a PS-Poll or a U-APSD trigger frame or any other indication from a TWT scheduled STA that is in PS mode that the STA is in the awake state during, or prior to the start of an announced TWT SP shall follow the rules defined in 11.2.3.6 (AP operation during the CP) except that the AP should deliver to the TWT scheduled STA as many buffered BUs as available at the AP, provided that the BU delivery does not exceed the duration of the TWT SP, the TWT scheduled STA has indicated to be in the awake state for that TWT SP and as long as the TWT scheduled STA has not entered the doze state (see 27.7.4.3 (TWT information for broadcast TWT) and 27.7.5 (Power save operation during TWT SPs)).

NOTE—Other indications that the STA is in the awake state are the transmission of an HE TB NDP PPDU in response to an NFRP Trigger frame (see 27.5.6 (NDP feedback report procedure)) or the transmission of a frame that indicates that the STA is in active mode (see 11.2.3.2 (STA power management modes)).*(#15842)*

A TWT scheduling AP that sends frames to a TWT scheduled STA that is in PS mode during an unannounced TWT SP shall follow the rules defined in 11.2.3.6 (AP operation during the CP) except that the AP should deliver to the TWT scheduled STA as many buffered BUs as available at the AP, provided that the BU delivery does not exceed the duration of the TWT SP and as long as the TWT scheduled STA has not entered the doze state (see 27.7.4.2 (TWT information for broadcast TWT) and 27.7.5 (Power save operation during TWT SPs)).

* .
* .*(#16423, 16463)*

NOTE—The TWT scheduling AP 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 (at the start of which the TWT scheduled STA is assumed to already be awake). The TWT scheduling AP can exceed the duration of the TWT SP if the TWT scheduled STA is in Active mode.

A TWT scheduling AP may transmit to a TWT scheduled STA that is in Active mode at any time (see 11.2.3.2 (STA power management modes).

A TWT scheduling AP that receives a TWT element with the TWT Request field equal to 1, the Negotiation Type subfield equal to 3 and the TWT Command field set to Suggest or Demand may respond with a frame containing a TWT element as shown in Table 27-7 (Broadcast TWT membership exchanges).

A TWT scheduling AP that receives a TWT element with the TWT Request field equal to 1, the Negotiation Type subfield equal to 3 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 element from the broadcast TWT schedule that has the Broadcast TWT ID value that is equal to the value of the Broadcast TWT ID field of the TWT element.

Valid broadcast TWT announcements are described in Table 27-6 (Broadcast TWT announcements).

|  |  |  |
| --- | --- | --- |
| * Broadcast TWT announcements | | |
| TWT Setup Command field in an initiating frame | TWT Setup Command field in a response frame | Condition after the completion of the exchange |
| Accept TWT | No frame transmitted | Only an HE AP is permitted to transmit this sequence.  TWT scheduled STAs that receive this frame use the provided TWT parameters to determine the broadcast TWT schedule.  The broadcast TWT schedule is identified by the broadcast TWT ID and the TA of the initiating frame. |
| Alternate TWT | No frame transmitted | When transmitted by a TWT scheduling AP, some of the parameters of the broadcast TWT schedule identified by the broadcast TWT ID and the TA of the initiating frame will change at the TBTT that occurs after the Broadcast TWT Persistence Mantissa field of that broadcast TWT parameter set reaches 0. The new parameters will be present in the first Beacon frame transmitted by the TWT scheduling AP at the TBTT, which has a broadcast TWT parameter set with the same broadcast TWT ID and same TA, but with the TWT command value set to Accept TWT. |
| Reject TWT | No frame transmitted | When transmitted by a TWT scheduling AP, the broadcast TWT schedule identified by the broadcast TWT ID and the TA of the initiating frame will be terminated at the TBTT that occurs after the Broadcast TWT Persistence Mantissa field of that broadcast TWT parameter reaches 0. The termination occurs at the TBTT at which a Beacon is transmitted by the TWT scheduling AP that does not include a broadcast TWT parameter set with the same broadcast TWT ID and same TA as the initiating frame. |
| NOTE 1—The Negotiation Type field of the TWT element contained in these frames is 2.  NOTE 2—The initiating frame and response frame settings not listed in the tables in 10.43 (Target wake time (TWT)) or 27.7 (TWT operation) are not allowed. The initiating frame is a TWT response.  NOTE 3—MMPDUs that contain a broadcast TWT element generated by a TWT scheduling AP can be broadcast Probe Response, FILS Discovery, and Beacon frames. The TWT element has the TWT Request field equal to 0 and the Negotiation Type subfield equal to 2. The TWT scheduling AP can include a TWT parameter set with Broadcast TWT ID value 0 to indicate a TWT allocated for all STAs, and Broadcast TWT ID greater than 0 to indicate a TWT intended to TWT scheduled STAs that are members of that broadcast TWT. | | |

* Rules for TWT scheduled STA

A TWT element with the Broadcast field equal to 1 is referred to as broadcast TWT element. 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.

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 16452):***

A TWT scheduled STA should not transmit frames to the TWT scheduling AP outside of broadcast TWT SPs and within trigger-enabled broadcast TWT SPs, except that the STA can transmit frames within negotiated individual TWT SPs as defined in 27.7.2 (Individual TWT agreements).

NOTE—The TWT scheduled 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. If the STA decides to transmit then the STA might contend for accessing the medium as defined in 27.2.6 (EDCA operation using MU EDCA parameters).*(#16452)*

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 Negotiation Type subfield set to 3 and the TWT command field set to Request TWT or 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. See Table 27-7 (Broadcast TWT membership exchanges).

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 Negotiation Type field set to 3 and the TWT Command field set to Reject TWT or by transmitting a TWT Teardown frame that has the Negotiation Type set to 3.

A TWT scheduled STA that receives a TWT element with the TWT Request field equal to 0, the Negotiation Type subfield equal to 3 and the TWT Command field indicating Accept TWT 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 element and the MAC address which is the TA of the MMPDU that contained the TWT element 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 element to the AP with the TWT Command field indicating Request TWT, Suggest TWT or Demand TWT.

Valid broadcast TWT membership exchanges are described in Table 27-7 (Broadcast TWT membership exchanges).

|  |  |  |
| --- | --- | --- |
| * Broadcast TWT membership exchanges | | |
| TWT Setup Command field in an initiating frame | TWT Setup Command field in a response frame | Condition after the completion of the exchange |
| Demand TWT | Accept TWT | A broadcast TWT schedule exists or has been created with the TWT parameters indicated in the initiating frame and repeated in the responding frame.  The TWT scheduled STA transmitting the initiating frame is a member of the Broadcast TWT schedule identified by the Broadcast TWT ID and the TA of the response frame. |
| Request TWT or Suggest TWT | Accept TWT | A broadcast TWT schedule exists or has been created with the TWT parameters indicated in the response frame.  The TWT scheduled STA transmitting the initiating frame is a member of the broadcast TWT schedule identified by the broadcast TWT ID and the TA of the response frame. |
| Suggest TWT or Demand TWT | Alternate TWT | No new broadcast TWT schedule has been created with the TWT parameters indicated in the initiating frame.  The TWT scheduling AP is offering an alternative set of parameters vs. those indicated in the initiating frame, as a means of negotiating TWT parameters with the TWT scheduled STA.  The TWT scheduled STA can send a new request with any set of TWT parameters and the TWT scheduling AP might create a new broadcast TWT schedule using the parameters indicated in the responding frame. |
| Suggest TWT or Demand TWT | Dictate TWT | A broadcast TWT schedule is either created or already exists and is using the TWT parameters identified in the response frame, including a broadcast TWT ID.  The TWT scheduling AP will not create any new broadcast TWT schedule with the TWT scheduled STA at this time.  The TWT scheduled STA transmitting the initiating frame is not a member of the broadcast TWT schedule identified by the broadcast TWT ID and the TA of the response frame.  The TWT scheduled STA can send a new request, but will only receive an Accept TWT if it uses the dictated TWT parameters. |
| Request TWT or Suggest TWT or Demand TWT | Reject TWT | The TWT scheduled 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.  The TWT scheduling AP will not accept any new request from the TWT scheduled STA to join or create a broadcast TWT at this time. |
| Accept TWT | No frame transmitted | Not permitted to be transmitted by a TWT scheduled STA.  When transmitted by a TWT scheduling AP, the recipient STA's membership in the broadcast TWT schedule identified by the broadcast TWT ID and the TA of the initiating frame is established. |
| Alternate TWT or Dictate TWT | No frame transmitted | Not permitted to be transmitted by a TWT scheduled STA.  When transmitted by a TWT scheduling AP, the TWT scheduled STA receiving this frame is not, through the receipt of this frame, a member of the broadcast TWT identified by the initiating frame.  The TWT scheduled STA can use the information provided to create a request to join a TWT in a subsequent initiating frame that it transmits. |
| Reject TWT | No frame transmitted | When transmitted by a TWT scheduled STA, the transmitting STA's membership in the broadcast TWT schedule identified by the broadcast TWT ID and the RA of the initiating frame is terminated.  When transmitted by a TWT scheduling AP, the receiving STA's membership in the broadcast TWT schedule identified by the broadcast TWT ID and the TA of the initiating frame is terminated. |
| NOTE 1—The Negotiation Type field of the TWT element contained in these frames is 3.  NOTE 2—The initiating frame and response frame settings not listed in the tables in 10.43 (Target wake time (TWT)) or 27.7 (TWT operation) are not allowed. The initiating frame is a TWT request if the TWT element contained in the frame has the TWT Request field equal to 1 (see Table 9-262k (TWT Setup Command field values)); otherwise it is a TWT response. The response frame is a TWT response.  NOTE 3—In addition to these exchanges, the TWT scheduling AP might respond to an initiating frame that solicits membership in a broadcast TWT schedule with an indication or solicitation of the establishment of an individual TWT agreement.  NOTE 4—MMPDUs that contain a broadcast TWT element generated by a TWT scheduled STA can be (Re)Association Request, and TWT Setup frames with TWT Request field equal to 1. The TWT element has the Negotiation Type subfield equal to 3 and the Broadcast TWT ID(s) that the STA intends to join or withdraw. MMPDUs that contain a broadcast TWT element generated by a TWT scheduled AP can be (Re)Association Response, and TWT Setup frames with TWT Request field equal to 0. The TWT element has the Negotiation Type subfield equal to 3 and the Broadcast TWT ID(s) to which the STA is assigned or from which the STA is withdrawn. | | |

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 15731, 15732):***

A TWT scheduled STA that is in PS mode may enter the doze state after receiving a Beacon frame with a TWT element indicating the existence of a broadcast TWT and shall be in the awake state at the broadcast TWT start times for which the STA has indicated it will be awake by any of the following means:

* Establishing a membership for the unannounced broadcast TWT with those broadcast TWT IDs
* Negotiating a wake TBTT and wake interval between Beacon frames that the STA receives, as defined in 27.7.6 (Negotiation of wake TBTT and wake interval)
* Having sent a PS-Poll or U-APSD trigger frame during the beacon interval
* Having sent another indication that it is in the awake state during that beacon interval

NOTE 1—Other indications that the STA is in the awake state are the transmission of an HE TB NDP PPDU in response to an NFRP Trigger frame (see 27.5.6 (NDP feedback report procedure)) or the transmission of a frame that indicates that the STA is in active mode (see 11.2.3.2 (STA power management modes)).

NOTE 2—The STA might indicate that it will not be awake at certain broadcast TWT start times by sending a TWT Information frame. The AP might indicate to a STA that it need not be awake at certain broadcast TWT start times by sending a TWT information frame (see 27.7.4 (Use of TWT Information frames)). *(#15731, 15732)*

A TWT scheduled STA is not required to be in the awake state at broadcast TWT SP start times corresponding to the broadcast TWT that has the broadcast TWT ID value of 0.

A TWT scheduled STA that did not receive a Beacon frame at a TBTT shall act as if it had received the expected Beacon frame containing a TWT element for a broadcast TWT, if the missed beacon corresponds to a TBTT that is within the next *n* TBTTs beyond the most recently received Beacon frame that included a TWT element for that broadcast TWT, where *n* is equal to one plus the value obtained from the Broadcast TWT Persistence subfield of the corresponding Broadcast TWT, except that *n* is infinite when the Broadcast TWT Persistence subfield is 255.

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 15844):***

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 27.5.3 (UL MU operation)). A TWT scheduled STA that is in PS mode and is awake during an announced TWT SP shall include a PS-Poll frame or a U-APSD trigger frame in the HE TB PPDU if it intends to solicit buffered BUs from the TWT scheduling AP (see 11.2.2.8 (Receive operation for STAs in PS mode during the CP)) unless the STA has already transmitted within that TWT SP a PS-Poll or U-APSD trigger frame or has transmitted any other indication that the STA is in the awake state within that TWT SP, or has, previous to the TWT SP, otherwise indicated to the AP that it is currently in the awake state. A TWT scheduled STA that is in PS mode shall transition to the awake state at the start of an unannounced TWT SP of which it is a member. The STA may include other frames in the HE TB PPDU when other rules do not prohibit their inclusion (see 27.5.3 (UL MU operation))

NOTE 1—A TWT scheduling AP 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)).

NOTE 2—Other indications that the STA is in the awake state are the transmission of an HE TB NDP PPDU in response to an NFRP Trigger frame (see 27.5.6 (NDP feedback report procedure)) or the transmission of a frame that indicates that the STA is in active mode (see 11.2.3.2 (STA power management modes)).*(#15844)*

**TGax Editor: *Change the paragraph below in this subclause as follows (#CID 15096):***

A TWT scheduled STA should only send frames that satisfy the Broadcast TWT Recommendation recommendations defined in Table 9.248l1 (Broadcast TWT Recommendation 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 27.5.3 (UL MU operation).*(#15096)*