IEEE P802.11
Wireless LANs

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| Comment resolutions for 27.7.4 |
| Date: 2018-11-01 |
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Abstract

This submission proposes resolutions for multiple comments related to TGax D3.0 with the following CIDs (9 CIDs):

* 15102, 15181, 15757, 15845, 16425, 16426, 16427, 16428, 16429

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: CID 15757 is deferred. Included changes proposed during the presentation and some changes to OPS operation sent by Laurent. Changes are highlighted in green.
* Rev 2: Add definition of unavailable and some minor editorials (in blue)

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** |
| 15102 | Abhishek Patil | 327.41 | When a broadcast TWT schedule needs to be suspended or resumed for every participating STA, the AP is required to send individual TWT Information frame addressed to each STA. This can be very inefficient when large number of STAs are involved. Spec should allow TWT Information frame to be broadcasted when the schedule change affect all participants. | As in comment | Revised –The spec allows the AP to send multiple TWT Information frames to different STAs as part of a DL MU PPDU. Proposed resolution is to add a note specifying that this is a possibility.TGax editor to make the changes shown in 11-18/1472r2 under all headings that include CID 15102. |
| 15181 | Alfred Asterjadhi | 327.50 | Can a TWT Information frame sent to suspend/resume a broadcast TWT be broadcast? | Please clarify | Rejected –The commenter is asking a question. The answer to which is: “TWT Information frames are of type Action, as such they cannot be broadcast.” |
| 15757 | Jarkko Kneckt | 326.20 | The TWT Information frame is a management frame which handling/reception/parsing the content in the receiving STA takes time. A STA may transmit a TWT Information frame to teminate an ongoing TWT SP. For the receiving device the processing time of the TWT Information frame may be too long for immediate TWT SP termination. The immediate SP termination would be better to do through EOSP or more data bits which handling time is much shorter. | Please change that EOSP (or PM) bit controls the termination of the currently ongoing TWT SP and the TWT Information frame controls the future TWT SPs, i.e. whether the STA be available at future TWT SP. Please allow a STA to terminate the ongoing SP without a transmission of the TWT Information frame. | Rejected –The comment fails to identify a technical issue and seems to be hinting into an implementation issue which is out of scope of the standard. The proposed change on the other hand suggests the addition of another option for providing an existing functionality. |
| 15845 | Laurent Cariou | 328.17 | "may go to doze state": this is not fully accurate as active STAs can also be unavailable. Modify the normative text to ensure that active mode STAs can be unavailable during that period. | Change "move to doze state" by "become unavailable" or make changes to active mode to also allow in very specific circunstances to go to doze state. | Revised –Agree in principle with the comment. Proposed resolution clarifies this aspect by specifying that the STA may be unavailable in alternative to the doze state. Additionally, the comment resolution fixes some backward compatibility issues that were introduced in 11.2.3.2 as part of the comment resolution of CID 15822 that was dealing with similar items in the baseline text.TGax editor to make the changes shown in 11-18/1472r2 under all headings that include CID 15845. |
| 16425 | Matthew Fischer | 327.25 | When the ALL TWT == 1 indication is signaled in a TWT Information frame with a Next TWT Field present for the resume TWT operation and if some of the TWT agreements have indicated Flexible vs not Flexible, what are the resumption times for the TWT SPs of each TWT agreement, most interestingly, the Flexible ones? It might appear that all of the Flexible ones will change their next TWT SP Start time to match the single Next TWT time value in the resume frame. | Change "except that the resumptions of the respective TWTs occur not earlier than the NextTWT value contained in the TWT Information frame." to "except that the resumptions of the respective TWTs occur not earlier than the NextTWT value contained in the TWT Information frame and always at the next scheduled TWT for the respective TWT agreement, even when the value of the Flexible TWT Schedule Support field of the HE Capabilities element transmitted by the TWT requesting STA is equal to 1." | Revised –Agree in principle. Proposed resolution accounts for the suggested change with minor editorial modifications for further clarity. Also added the All TWT field in the TWT Teardown frame so that the same applies to the tear down functionality for all TWTs.TGax editor to make the changes shown in 11-18/1472r2 under all headings that include CID 16425. |
| 16426 | Matthew Fischer | 327.64 | Just to clarify because the bit is not mentioned, the text should include a statement about the Flexible TWT condition | Change "shall resume all broadcast TWT sessions in their respective broadcastTWT schedules, which occur not earlier than from the value indicated in the next TWT valuecontained in the transmitted TWT Information frame" to "shall resume all broadcast TWT sessions at the next scheduled TWT for each respective broadcast TWT agreement, which occurs not earlier than the value indicated in the Next TWT field contained in the transmitted TWT Information frame, regardless of the values of Flexible TWT Schedule Support fields in the respective Broadcast TWT members' HE Capabilities elements" | Revised –Agree in principle. Proposed resolution accounts for the suggested change with minor editorial modifications for further clarity. Also please note that the TWT Information frame does not have a broadcast TWT ID which is necessary if we were to flexibly resume the TWT SPs of member STAs.TGax editor to make the changes shown in 11-18/1472r2 under all headings that include CID 16426. |
| 16427 | Matthew Fischer | 326.37 | The dependency of the value of the Next TWT field on the Flexible bit in the HE Cap element is fine for individual TWT agreements, but the text here mentions scheduling AP and for that case, the scheduling AP can only stray from the periodically scheduled TWT SP Start times for Broadcast TWTs if all of the particpating STAs have indicated Flexible in their HE Cap IEs. Note that there are group member BTWTs and the all STA BTWT, and those two cases are different. Need to fix the language to account for these BTWT differences. | Change the language here to ensure that the selection of the next TWT value must be from existing TWT values for the agreement when at least one of the member STAs of the agreement has Flexible == 0, or use the logical inverse, your choice | Revised –Agree in principle with the comment but not with the interpretation. Proposed resolution accounts for the suggested change. Also please note that the TWT Information frame does not have a broadcast TWT ID which is necessary if we were to flexibly resume the TWT SPs of member STAs. So the selection of the broadcast TWTs is from the existing schedules independently of the value of the Flexible TWT Support field.TGax editor to make the changes shown in 11-18/1472r2 under all headings that include CID 16427. |
| 16428 | Matthew Fischer | 328.19 | The language of the first sentence is very specific about indicating that the TWT information frame for this case may be transmitted at any time, but this qualifier is not contrasted by any alternative qualifier in other sections, nor do those sections include this qualifier. (i.e. "at any time (i.e. without participating in any TWT sessions)") - given the relative difference in the language of the sections, it feels like there is some implied restriction on when the TWT information frame may be sent within the other cases - i.e. see the first sentences of 27.7.4.2 and 27.7.4.3 TWT information for individual and broadcast TWT, respectively, where there is no qualifier present in the very similar first sentences - i.e. it appears that for those cases too, the TWT information frame may be sent to any party of the agreement at any time. So is there a missing restriction in those cases? If so, please make it explicit. If not, then the extra qualifier in this section should be removed so that the language of this section looks more like the language of the others and eliminates the appearance of an implied restriction. Honestly, I am not certain what the first paragraph is trying to say: haven't the previous two sections already given STAs the permission to transmit TWT information frames in all cases? Is this sentence here to describe the non-AP STA to non-AP STA case? If it is, is that case not already covered by the individual and broadcast TWT because even in that situation, one STA needs to be the requesting STA and the other the responding STA? Not certain what to do here. Note that the heading of the subclause is also confusing. | Modify the first paragraph of the subclause to provide meaningful behavioral rules for a clearly identified case which is distinct from the cases indicated in the previous two subclauses. | Revised –Agree in principle with the comment. The difference between this subclause and the previous subclauses is that in this case the STA needs not negotiate individiaul TWTs and needs not follow broadcast TWT schedules to send a TWT information frame. An additional aspect is that in this mode the STA preserves the PM mode it has when it switches to until it wakes again. Also, that the STA can be in unavailable state. Proposed resolution clarifies this aspect in the first paragraph of the subclause and in other subclauses of interest.TGax editor to make the changes shown in 11-18/1472r2 under all headings that include CID 16428. |
| 16429 | Matthew Fischer | 328.28 | This entire paragraph is talking about PS operation - maybe it should be moved to the next subclause, which is the PS operation within TWT description and rules. But I also see similar paragraphs in the individual and broadcast TWT information frame sections, so there is a parallel structure here - not certain what the best solution is, but at least, make this subclause somehow distinct. | Move the cited paragraph to appear somewhere in 27.7.4.5 Power Save operation during TWT SPs | Revised –Agree in principle with the comment. The paragraphs in the subclause related to the use of TWT Information frames provide details for the generation and interpretation of the TWT information frames in different conditions. Since there is overlap in certain cases between these subclauses and the subclause related to PS operation the proposed resolution is to add two declarative statements for both TWT requesting STA and TWT scheduled STA classifying the reception of TWT information frames as TWT SP termination events, avoiding any duplication.TGax editor to make the changes shown in 11-18/1472r2 under all headings that include CID 16429. |

**Discussion: *None.***

* Use of TWT Information frames
* General

**TGax Editor: *Insert the note below in this subclause as follows (#CID 15102):***

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.

NOTE—An HE AP might include multiple TWT Information frames, each addressed to a different peer STA, in a transmitted DL MU PPDU (see 27.5.1 HE DL MU operation).*(#15102)*

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 16427, 16428):***

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, 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 an individual TWT agreement if the Flexible TWT Schedule Support field in the HE Capabilities element received from the peer STA is 0 and shall be selected from existing TWT values for a broadcast TWT schedule regardless of the value of the Flexible TWT Schedule Support field received from the peer STA
* The Next TWT may contain any nonzero value if Flexible TWT Schedule Support field in the HE Capabilities element received from the peer STA is 1.
* The All TWT field is 1 if the resumption applies to all broadcast TWT schedules followed by the TWT scheduled STA and/or to all individual TWT agreements followed by the TWT responding STA*(#16427)*
* 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 earliest 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 in the HE Capabilities element received from the peer STA is 0.
* The All TWT field is 1 if the resumption applies to all broadcast TWT schedules followed by the TWT scheduled STA and to all individual TWT agreements followed by the TWT requesting STA*(#16427)*
* The Next TWT may contain any nonzero value if Flexible TWT Schedule Support field in the HE Capabilities element received from the peer STA is 1.
*(#16428)*
* 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 All TWT subfield is 1 if the suspension applies to all broadcast TWT schedules followed by the TWT scheduled STA and to all individual TWT agreements followed by the TWT requesting STA*(#16427)*

NOTE—Information exchanged with TWT Information frames does not modify the TWT parameters of any existing TWT session except when the TWT Information frame is sent under flexible TWT (see 27.7.4.4).*(#16426, 16427, 16425)*

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 16428):***

The use of TWT Information frames for suspending and/or resuming existing individual TWT sessions is described in 27.7.4.2 (TWT information for individual TWT). The use of TWT Information frames for suspending and/or resuming existing broadcast TWT sessions is described in 27.7.4.3 (TWT Information for broadcast TWT). The use of TWT Information frames for providing a flexible TWT that is independent of any existing TWT sessions is described in 27.7.4.4 (TWT information for flexible TWT).*(#16428)*

* TWT information for individual TWT

An HE STA that has an individual TWT agreement may transmit a TWT Information frame to the STA with which it has an agreement. The HE STA sets the fields of the TWT Information frame as defined in Table 27.7.4.1 (General).

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 transmitted 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.
* Contains a Next TWT field shall resume the corresponding TWT session, 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)).

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 16425):***

If the TWT Information frame contains an All TWT subfield equal to 1 then the above rules apply to all individual TWT sessions, except that the resumptions of the respective TWTs shall occur at the first TWT of the respective TWT session that occurs not earlier than the Next TWT value contained in the TWT Information frame, regardless of the value of the Flexible TWT Schedule Support field in the HE Capabilities element exchanged between the two STAs.*(#16425)*

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

* TWT information for broadcast TWT

An HE STA that is a TWT scheduling AP may transmit a TWT Information frame to any of the members of a broadcast TWT schedule. An HE STA that is a TWT scheduled STA may transmit a TWT Information frame to the TWT scheduling AP corresponding to a broadcast TWT schedule established by that STA. 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 an All TWT subfield equal to 1 follows the rules defined in 27.7.3.3 (Rules for TWT scheduled STA), except that the TWT scheduled STA shall consider all the broadcast TWTs as resumed in their respective broadcast TWTs, which occur not earlier than the Next TWT value contained in the received TWT Information frame.

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 16426):***

A TWT scheduled STA that receives an acknowledgment in response to a transmitted TWT Information frame that contains an All TWT 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 broadcast TWT sessions are resumed.
* Does contain a Next TWT field shall resume all broadcast TWT sessions at the first scheduled TWT for each respective broadcast TWT schedule, which occurs not earlier than the value indicated in the next TWT field contained in the transmitted TWT Information frame, regardless of the values of the Flexible TWT Schedule Support field in the HE Capabilities element exchanged between the two STAs.*(#16426)*

NOTE—TWT suspension and resumption as indicated by a TWT Information frame with the All TWT subfield equal to 1 applies to all broadcast TWT sessions of the TWT scheduling AP.

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

* TWT information for flexible TWT

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 16428):***

An HE STA may transmit a TWT Information frame that contains a flexible TWT to a peer STA if the peer STA has set the Flexible TWT Schedule Support field of the HE Capabilities it transmits.

A flexible TWT is a nonzero value indicated in the Next TWT field of a TWT Information frame with All TWT subfield equal to 0, which is independent from any existing TWT values of TWT sessions that the HE STA might be following (if any). The HE STA sets the fields of the transmitted TWT Information frame as defined in 27.7.4.1 (General).

HE STAs that successfully exchange a TWT Information frame with flexible TWT and that:

* Contains a TWT Flow Identifier that identifies an existing TWT agreement shall replace the next TWT SP start time for that TWT agreement with the value contained in the Next TWT Information frame
* Contains a TWT Flow Identifier that does not identify any existing TWT agreement shall preserve the PM mode from the time the TWT Information frame was sent to the time indicated in the Next TWT field of the TWT Information frame

NOTE—When the TWT Information frame has the All TWT field equal to 1 then the TWTs are resumed as described in 27.7.4.2 (TWT information for individual TWT) and 27.7.4.3 (TWT information for broadcast TWT).

A non-AP HE STA sa that contains a flexible TWT may go to doze state if it is in PS mode and may be unavailable if it is in active mode and shall it indicated in the Next TWT field of the TWT Information frame and shall be in the awake state if the STA is in PS mode and in the awake state if the STA is in active mode at the next TWT*(#16428)*

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 15845):***

A non-AP HE STA that transmits a TWT Information frame that contains a flexible TWT to a peer STA may go to doze state or be unavailable 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 that contains a flexible TWTfrom a peer STA may go to doze state or be unavailable after transmitting the acknowledgment and shall be in the awake state at the specified TWT indicated in the TWT Information frame.*(#15845)*

**9.4.1.60 TWT Information field**

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 16425):***

The All TWT subfield is set to 1 by an HE STA to indicate that the TWT Information frame reschedules all TWTs as defined in 27.7.4 (Use of TWT Information frames). Otherwise, it is set to 0.*(#16425)*

* TWT Teardown frame format

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 16425):***

The TWT Flow field contains the TWT Flow Identifier/Broadcast TWT ID field, Negotiation Type field, and ~~5~~ Teardown All TWT subfield as shown in Figure 9-740b~~:~~ if the Negotiation Type field is 0 or 1 and in if the Negotiation Type subfield is 3.

Change Figure 9-939 as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0                   B2 | B3          ~~B7~~ B4 | B5    B6 | B7 |
|  | TWT Flow Identifier | Reserved | Negotiation Type | Teardown All TWT |
| Bits: | 3 | ~~5~~ 2 | 2 | 1 |
| * TWT Flow field format if the Negotiation Type subfield is 0 or 1
 |

Insert a new figure as follows:

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0                    B4 | B5                      B6 | B7 |
|  | Broadcast TWT ID | Negotiation Type |  Teardown All TWT |
| Bits: | 5 | 2 | 1 |
| * TWT Flow field format if the Negotiation Type subfield is 3
 |

Change the last paragraph as follows (splitting it into two paragraphs and adding a third):

The TWT Flow Identifier/Broadcast TWT ID field contains the TWT Flow Identifier when the Negotiation Type field is 0 or 1 and contains the Broadcast TWT ID field when the Negotiation Type field is 3. The TWT Flow Identifier field and the Broadcast TWT ID field are ~~is~~ defined in 9.4.2.200 and are reserved if the Teardown All TWT field is 1.*(#16425)*

~~In a TWT Teardown frame, the~~ The TWT Flow Identifier field in a TWT Teardown frame is set to the value of the TWT Flow Identifier field of the TWT element in the frame that successfully concluded the setup of the TWT that is the subject of the teardown request. The Broadcast TWT ID field of a TWT Teardown frame is set to the value of the Broadcast TWT identifier of the broadcast TWT schedule that is subject of the teardown request.

The Negotiation Type field indicates the type of negotiation that is subject to the teardown request and is set as defined in Table 9-298a (Interpretation of Negotiation Type subfield, Target Wake Time, TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields). An S1G STA sets the Negotiation Type field to 0. The Negotiation Type field is reserved if the Teardown All TWT field is 1.*(#16425)*

The Teardown All TWT field is set to 1 by an HE STA to indicate that the TWT Teardown frame tears down all TWTs as defined in 27.7 (TWT operation). Otherwise, it is set to 0.*(#16425)*

**27.7.2 Individual TWT agreements**

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 16425):***

An HE STA may tear down an individual TWT agreement by sending a TWT Teardown frame with the Negotiation Type field set to 0. An HE STA may tear down all individual TWT agreements by sending a TWT Teardown frame with the Teardown All TWT field set to 1.*(#16425)*

**27.7.3.2 Rules for TWT scheduling AP**

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 16425):***

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 Per-sistence subfield to indicate the number of TBTTs that remain until the broadcast TWT schedule is termi-nated. 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. A TWT scheduling AP may terminate the membership of a TWT scheduled STA in all broadcast TWTs by transmitting a TWT Teardown frame with the Teardown All TWT field set to 1.*(#16425)*

**27.7.3.3 Rules for TWT scheduled STA**

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 16425):***

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 may terminate membership in all broadcast TWTs by transmitting a TWT Teardown frame with the Teardown All TWT field set to 1.*(#16425)*

* Power save operation during TWT SPs

The following rules apply to TWT SPs for both broadcast TWT schedules and individual TWT agreements where the TWT SP of a broadcast TWT is uniquely identified by the <broadcast TWT ID, MAC address of TWT scheduling AP> tuple and the TWT SP of an individual TWT is uniquely identified by the <TWT flow identifier, MAC address of TWT requesting STA, MAC address of TWT responding STA> triple.

A TWT requesting STA or a TWT scheduled STA that is not in PS mode and that transmits a frame with the Power Management subfield set to 1 during a TWT SP shall remain in the awake state until the AdjustedMinimumTWTWakeDuration time has elapsed from the TWT SP start time or until a TWT SP termination event is detected, whichever occurs first for that particular TWT SP.

A TWT requesting STA or a TWT scheduled STA in PS mode that is in the awake state for a TWT SP may transition to the doze state after AdjustedMinimumTWTWakeDuration time has elapsed from the TWT SP start time even if it has previously transmitted a PS-Poll frame or U-APSD trigger frame and has not yet received the expected frames from the AP in response.

When a TWT SP termination event is detected within a TWT SP by a STA in PS mode that is participating in the TWT SP, the STA may transition to the doze state without waiting for the expiration of the AdjustedMinimumTWTWakeDuration time as described in 10.43.1 (TWT Overview), even if it has previously transmitted a PS-Poll frame or U-APSD trigger frame and has not yet received the expected frames from the AP in response.

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 16429):***

A TWT requesting STA or a TWT scheduled STA shall classify any of the following events as a TWT SP termination event:

* *(#16429)*The transmission by the TWT requesting STA or TWT scheduled STA of an acknowledgment in response to an individually addressed QoS Data or QoS Null frame sent by the TWT responding STA or TWT scheduling AP, respectively, that had the EOSP subfield equal to 1.
* The transmission by the TWT requesting STA or TWT scheduled STA of an acknowledgment in response to an individually addressed frame that is neither a QoS Data frame nor a QoS Null frame, sent by the TWT responding STA or TWT scheduling AP, respectively, with the More Data field equal to 0.
* The reception of an individually addressed or broadcast QoS Data or QoS Null frame sent by the TWT responding STA or TWT scheduling AP, that does not solicit an immediate response and with the EOSP subfield equal to 1.
* The reception of an individually addressed frame that is neither a QoS Data frame nor a QoS Null frame, sent by the TWT responding STA or TWT scheduling AP, that does not solicit an immediate response and with the More Data field equal to 0.
* The reception of a Trigger frame sent by the TWT responding STA or TWT scheduling AP that has the More TF field equal to 0 and is not intended for the TWT requesting STA or TWT scheduled STA provided that the TWT requesting STA or TWT scheduled STA is either awake for an announced trigger-enabled TWT SP but did not transmit an indication that it is in the awake state to the TWT responding STA or TWT scheduling AP or is awake for an unannounced trigger-enabled TWT SP.

The classification of a More Data field equal to 0 in an Ack, BlockAck and Multi-STA BlockAck frame as an event that terminates a TWT SP is only possible 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 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 SP termination event causes all of the overlapping TWT SPs to terminate.

NOTE 2—A Trigger frame, sent by the TWT scheduling AP, is defined as intended for the TWT scheduled STA when the Trigger frame contains the AID of the STA in one of its Per User Info fields (see 27.5.3 (UL MU operation)), and can have in the TA field the MAC address of the AP or the transmitted BSSID under the conditions defined in 27.5.3.2.3 (Allowed settings of the Trigger frame fields and TRS Control subfield). Otherwise, the Trigger frame is not intended for the STA. If the Trigger frame contains one or more RA-RUs for which the STA can gain access according to 27.5.5 (UL OFDMA-based random access (UORA)) then the STA can follow the rules defined in 27.14.2 (Power save with UORA) to determine an early TWT SP termination event.

**TGax Editor: *Add the paragraphs below in this subclause as follows (#CID 16429):***

Additional TWT SP termination events for a TWT requesting STA occur after the successful exchange of a TWT Information frame with the TWT responding STA as defined in 27.7.4.2 (TWT information for individual TWT) and in 27.7.4.4 (TWT information for flexible TWT).

Additional TWT SP termination events for a TWT scheduled STA occur after the successful exchange of a TWT Information frame with the TWT scheduling AP as defined in 27.7.4.3 (TWT information for broadcast TWT) and in 27.7.4.4 (TWT information for flexible TWT).*(#16429)*

**11.2.3.2 Non-AP STA power management modes**

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 15845):***

A non-AP STA can be in one of two power management modes:

— Active mode: The STA receives and transmits frames at any time if the STA is in awake state. The non-HE STA remains in the awake state. The HE STA remains in the awake state except when the STA is unavailable. A STA that is unavailable is not capable of receiving PPDUs. A STA is permitted to be unavailable as described in 27.14.3 (Opportunistic power save), in 27.14.1 (Intra-PPDU power save for non-AP HE STAs), and 27.7.4.4 (TWT information for flexible TWT).*(#15845)*

— Power save (PS) mode: The STA enters the awake state to receive or transmit frames. The STA remains in the doze state otherwise.

**11.2.3.9 STAs operating in active mode**

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 15845):***

A STA operating in this mode shall have its receiver activated continuously, unless the STA is allowed to be temporarily unavailable with opportunistic power save procedure as defined in 27.14.3 (Opportunistic power save), or with intra-PPDU power save procedure as defined in 27.14.1 (Intra-PPDU power save for non-AP HE STAs), or in 27.7.4.4 (TWT information for flexible TWT); such STAs do not need to interpret the TIM elements in Beacon frames.*(#15845)*

**11.2.3.6 AP operation**

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 15845):***

An AP shall maintain for each currently associated STA a Power Management status that indicates in which power management mode the STA is currently operating. APs that implement and signal their support of APSD shall maintain for each currently associated STA an APSD and an access policy status that indicates whether the STA is presently using APSD and shall maintain the schedule (if any) for the STA. An AP shall, depending on the power management mode of the STA, temporarily buffer BUs destined to the STA. An AP implementing APSD shall, if a STA is using APSD and is in PS mode, temporarily buffer BUs destined to that STA. No BUs addressed directly to STAs operating in the active mode shall be buffered for power management reasons. An HE AP should not transmit to an HE STA when the STA might be unavailable, as defined in 27.7.4.4, 27.14.1, 27.14.3, unless the transmission is solicited by the STA.*(#15845)*

* Opportunistic power save
* General

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 15845):***

An OPS STA is a non-AP HE STA that sets the OPS Support subfield in the HE MAC Capabilities Information field of the HE Capabilities element to 1.

An OPS AP is an AP HE STA that sets the OPS Support subfield in the HE MAC Capabilities Information field in HE Capabilities element to 1.

Opportunistic power save mechanism has the objective to allow OPS STAs that are in active mode to be unavailable and to allow OPS STAs that are in PS mode to be in doze state to save power for a defined period. The opportunistic power save mechanism has two modes: unscheduled and scheduled.*(#15845)*

In the unscheduled mode, an OPS AP sends an OPS frame or a FILS discovery frame at any time to provide the scheduling information for all OPS STAs for the OPS period that follows the transmission of the OPS frame or FILS discovery frame. Based on this information, the OPS STAs that are in active mode may be unavailable(18/1497r2) during the OPS period and the OPS STAs that are in PS mode may be in doze state during the OPS period.

In the scheduled mode, an OPS AP splits a beacon interval into several periodic broadcast TWT SPs and provides, at the beginning of each SP, the scheduling information for all OPS STAs. Based on this information, the OPS STAs that are in active mode may be unavailable(18/1497r2) until the next TWT SP and the OPS STAs that are in PS mode may be in doze state until the next TWT SP.*(#15845)*

* STA operation for opportunistic power save

**TGax Editor: *Change the paragraph below of this subclause as follows (#CID 15845):***

With unscheduled opportunistic power save, if an OPS STA with AID *N* that is in the awake state receives a TIM element and an OPS element in an OPS frame or a FILS Discovery frame from the associated OPS AP, then the STA may be unavailable if the STA is in active mode or may be in doze state if the STA is in PS mode, until the end of the OPS period indicated in the OPS element, if the bit N in the traffic indication virtual bitmap carried in the Partial Virtual Bitmap field of the current TIM element is set to 0, unless other conditions not related to operation with the OPS AP require the STA to be in the awake state. At the end of the OPS period, the STA shall be in the awake state, unless determined otherwise by other power save protocols.*(#15845)*

With scheduled opportunistic power save, if an OPS STA with AID *N* that is in the awake state receives from the OPS AP with which it associated a TIM element with bit *N* of the traffic indication virtual bitmap field equal to 0 in a TIM frame or FILS Discovery frame within a broadcast TWT SP with the Broadcast TWT Recommendation field set to 3, then the STA may be unavailable if the STA is in active mode or may be in doze state if the STA is in PS mode during the TWT SP and until the next TWT SP with the Broadcast TWT Recommendation field set to 3, unless other conditions not related to operation with the OPS AP require the STA to be in the awake state.*(#15845)*

An OPS STA shall not operate with TIM broadcast procedure if its associated AP is an OPS AP.