IEEE P802.11
Wireless LANs

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|

|  |
| --- |
| TWT Capability Support Signaling |
| Date: 2019-01-01 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Matthew Fischer | Broadcom |  |  | Matthew.fischer@broadcom.com |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

 |

Abstract

Proposed language to modify TWT capability as exists within the Extended Capability IE.

The proposed changes are not directly related to a CID.

Changes are referenced to TGax D3.3.

**REVISION NOTES:**

**R0**:

initial

**R1**:

10.48.1 - Add allowance for HE STA to be a TWT requester or TWT responder STA based on HE Cap IE

10.48.1 - Add allowance for a non-HE nonS1G STA to be a TWT requester or TWT responder based on Ext Cap IE

**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**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |

**Discussion:**

Existing Extended Capability IE bits, TWT Requester Support and TWT Responder Support are redundant to the TWT Requester Support and TWT Responder Support support bits in the HE Cap IE.

In particular, the Extended Capability IE bits are only allowed to be set to “support” if the dot11HEOptionImplemented is true.

**Proposed Changes to TGax D3.3:**

***TGax editor: within TGax D3.3, modify the text as shown within 9.4.2.26 Extended Capabilities element:***

**9.4.2.26 Extended Capabilities element**

***Insert the following rows into Table 9-154 (Extended Capabilities element) (header row shown for convenience):* (#15056)**

**Table 9-154—Extended Capabilities field**

|  |  |  |
| --- | --- | --- |
| **Bit** | **Information** | **Notes** |
| 77 | TWT Requester Support | A STA sets the TWT Requester Support field to 1 when dot11TWTOptionActivated is true and TWT requester functionality is supported. Otherwise, the STA sets the TWT Requester Support field to 0. See 10.48 (Target wake time (TWT)). |
| 78 | TWT Responder Support | A STA sets the TWT Responder Support field to 1 when dot11TWTOptionActivated is true and TWT responder functionality is supported. Otherwise, the STA sets the TWT Responder Support field to 0. See 10.48 (Target wake time (TWT)). |
| 79 | OBSS Narrow Bandwidth RU In OFDMA Tolerance Support | An AP STA sets the OBSS Narrow Bandwidth RU In OFDMA Toler-ance Support field to 1 if dot11OBSSNarrowBWRUinOFDMAToler-ated is true, and sets it to 0 otherwise.A non-AP STA sets the OBSS Narrow Bandwidth RU In OFDMA Tolerance Support field to 0. |
| <ANA> | Enhanced Multi- BSSID Advertisement Support | This field is reserved for a non-AP STA or when the AP has dot11MultiBSSIDActivated set to false.Set to 1 to indicate that the AP supports enhancements related to discovery and advertisement of nontransmitted BSSIDs. Set to 0, otherwise.Also see 11.1.3.8 (Multiple BSSID procedure). **(#15056)** |

***TGax editor: within TGax D3.3, modify the text as shown within 10.48.1 TWT overview:***

**10.48.1 TWT overview**

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 and to reduce the required amount of time that a STA utilizing a power management mode needs to be awake.

STAs that request a TWT agreement are called TWT requesting STAs and the STAs that respond to their requests are TWT responding STAs. A TWT requesting STA is assigned specific times to wake and exchange frames with the TWT responding STA. 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. When implicit TWT is used, the TWT requesting STA calculates the Next TWT by adding a fixed value to the current TWT value. STAs need not be made aware of the TWT values of other STAs.

The maximum number of active TWT agreements between any pair of STAs cannot exceed 8, since the TWT Flow Identifier field of the TWT element comprises 3 bits. TWT responding STAs may protect TWT times with protection mechanisms including, but not limited to NAV-setting frame exchanges.

TWT responding STAs that are APs may additionally protect TWT times using RAW scheduling. TWT requesting STAs may wake at times other than TWT. An AP that is a TWT requesting STA shall not be in Doze state for a duration that exceeds the value of the dot11MaxAwayDuration during a beacon interval or short beacon interval, as defined in 11.2.3.18 (AP Power Management(11ah)).

An S1G STA with dot11TWTOptionActivated equal to true and that operates in the role of TWT requesting STA shall set the TWT Requester Support subfield to 1 in all S1G Capabilities elements that it transmits. An S1G STA with dot11TWTOptionActivated equal to true and that operates in the role of TWT responding STA shall set the TWT Responder Support subfield to 1 in all S1G Capabilities elements that it transmits.

An HE STA with dot11TWTOptionActivated equal to true and that operates in the role of TWT requesting STA shall set the TWT Requester Support subfield to 1 in all HE Capabilities elements that it transmits. An HE STA with dot11TWTOptionActivated equal to true and that operates in the role of TWT responding STA shall set the TWT Responder Support subfield to 1 in all HE Capabilities elements that it transmits.

A STA that is not an S1G STA and is not an HE STA and with dot11TWTOptionActivated equal to true and that operates in the role of TWT requesting STA shall set the TWT Requester Support subfield to 1 in all Extended Capabilities elements that it transmits. An STA that is not an S1G STA and is not an HE STA and with dot11TWTOptionActivated equal to true and that operates in the role of TWT responding STA shall set the TWT Responder Support subfield to 1 in all Extetnded Capabilities elements that it transmits.

If the TWT Responder Support subfield of the S1G Capabilities element or HE Capabilties element or Extended Capabilities element received from its associated AP is equal to 1, a non-AP STA with dot11TWTOptionActivated equal to true may transmit a TWT element to the AP with a value of Request TWT, Suggest TWT or Demand TWT in the TWT Command field and with the TWT Request field equal to 1

An AP with dot11TWTOptionActivated equal to true shall transmit a TWT element to a STA that is associated to the AP and from which it received a frame containing a TWT element that contained a value of Request TWT, Suggest TWT or Demand TWT in the TWT Command field and with the TWT Request field equal to 1. The transmitted TWT element shall be included in the frame that is the appropriate response frame to the received frame. The AP shall include a value of Accept TWT, Alternate TWT, Dictate TWT or Reject TWT in the TWT Command field of the response and shall set the TWT Request field to 0. If the AP response’s TWT Command field includes anything other than Accept TWT or Reject TWT, the STA should send a new request for a TWT value by sending another frame that contains a TWT element, modifying the parameters of the request to indicate, for example, an acceptance of a proposed alternate TWT or dictated TWT value. If the STA receives a TWT response to a TWT request with the TWT Command value of Accept TWT, then the STA has successfully completed a TWT setup with that STA for the TWT Flow Identifier indicated in the TWT response and the STA becomes a TWT requesting STA and the STA may enter the Doze state until the TSF matches the next TWT value of the STA, provided that the STA has indicated that it is in a power save mode and no other condition requires the STA to remain awake. The AP becomes a TWT responding STA of the TWT requesting STA.

The receipt of a TWT command value of Suggest TWT implies that the STA sending the command will consider accepting a proposed TWT that differs from the value found in the TWT field of the element. The receipt of a TWT command value of Demand TWT implies that the STA sending the command will not consider accepting a proposed TWT that differs from the value found in the TWT field of the element. The receipt of a TWT command value of Alternate TWT implies that the STA sending the command will consider accepting a proposed TWT that differs from the value found in the TWT field of the element. The receipt of a TWT command value of Dictate TWT implies that the STA sending the command will not consider accepting a proposed TWT that differs from the value found in the TWT field of the element.

The MAC addresses of the TWT requesting STA and the TWT responding STA and the TWT Flow Identifier indicated in the TWT Response of a successful TWT setup between those two STAs uniquely identifies a TWT agreement. A MAC variable AdjustedMinimumTWTWakeDuration is defined for each TWT of each TWT agreement and has a value equal to Nominal Minimum TWT Wake Duration minus the elapsed time from the scheduled start of the TWT SP to the actual start of the SP, where the scheduled and actual start times of the TWT SP are determined after any necessary TSF adjustment. Because the value of the AdjustedMinimumTWTWakeDuration depends on the actual TWT SP start time, it is computed for each TWT SP once the TWT SP begins.

The TWT Wake Interval of a TWT agreement is the value calculated as shown in 9.4.2.199 (TWT element(11ah)) from the TWT Wake Interval Mantissa and TWT Wake Interval Exponent of the TWT response that successfully completed the TWT agreement.

An AP may transmit a TWT element in an individually addressed TWT Setup frame with a value of Request TWT, Suggest TWT or Demand TWT in the TWT Command field and with the TWT Request field equal to 1 to an associated non-AP STA if the TWT Responder Support subfield in the S1G Capabilities element received from the STA is equal to 1. An AP may transmit TWT Setup frames to more than one of its associated non-AP STAs.

A non-AP STA with dot11TWTOptionActivated equal to true shall transmit a frame containing a TWT element to the AP with which it is associated and from which it received an individually addressed frame containing a TWT element that contained a value of Request TWT, Suggest TWT or Demand TWT in the TWT Command field and with the TWT Request field equal to 1. The transmitted TWT element shall be included in the frame that is the appropriate response frame to the received frame. The non-AP STA shall include a value of Accept TWT, Alternate TWT, Dictate TWT or Reject TWT in the TWT Command field of the response and shall set the TWT Request field to 0. If the non-AP STA response’s TWT Command field includes anything other than Accept TWT or Reject TWT, the AP should send a new request for a TWT value by sending another frame that contains a TWT element, modifying the parameters of the request to indicate, for example an acceptance of a proposed alternate TWT or dictated TWT value. If the AP receives a TWT response to a TWT request with the TWT Command value of Accept TWT from an associated non-AP STA, then the AP has successfully completed a TWT setup with that STA for the TWT Flow Identifier indicated in the TWT response and the AP becomes a TWT requesting STA with respect to that STA.

A non-AP STA shall not transmit a frame containing a TWT element as a response to a group addressed frame with the TWT Request field equal to 1 that is transmitted by its associated AP.

If the NDP Paging field was not present in the TWT response corresponding to a TWT agreement, the TWT requesting STA shall be in the awake state following each TWT start time associated with each TWT agreement for the duration of the AdjustedMinimumTWTWakeDuration time associated with that TWT agreement even if no PS-Poll frame, NDP PS-Poll frame, or U-APSD trigger frame has been transmitted by the STA or until it has received an EOSP field equal to 1 from the TWT responding STA, whichever occurs first. If the NDP Paging field was present in the TWT response, the TWT requesting STA shall follow the operational rules defined in 10.48.6 (NDP Paging Setup).

If the Implicit bit is equal to 1 in the TWT response for a TWT agreement, the TWT associated with that TWT agreement is an implicit TWT and the TWT SP associated with that TWT is an implicit TWT SP. A TWT SP that is not an implicit TWT is an explicit TWT SP.

A TWT requesting STA that is a non-AP STA should transmit frames only within TWT SPs.

A TWT requesting STA that transmits a frame during a TWT SP is not granted any special medium access privileges, nor is there any guarantee that the TWT responding STA assigned the TWT SP to only one TWT requesting STA.

A single pair of STAs can create multiple TWT agreements. Each unique TWT agreement is identified by a TWT Flow Identifier and the MAC addresses of the TWT requesting STA and TWT responding STA. Because the TWT Flow Identifier field is 3 bits in length, the maximum number of TWTs per STA pair is 8. There are no explicit restrictions on the class of traffic (i.e., EDCA Access Category) that can be transmitted within any specific TWT SP when multiple TWT agreements have been set up by a single TWT requesting

STA.

A TWT requesting STA that is a non-AP STA may wake to receive Beacons that are transmitted outside of a TWT SP. A TWT requesting STA that is an AP generates S1G Beacon frames as described in 11.1.3 (Maintaining synchronization) and operates in power save mode as described in 11.2.3.18 (AP Power Management(11ah)).

A TWT responding STA should include a Pentapartial Timestamp field or a Tetrapartial Timestamp field or a Timestamp field in at least one frame transmitted to a TWT requesting STA during a TWT SP for that STA.

NOTE—When dot11TWTOptionActivated is true, a TWT responding STA might use the TWT Wake Interval in determining the lifetime of frames that it buffers for an TWT requesting STA.

The Flow Type field in the TWT response that successfully set up a TWT agreement indicates the type of interaction between the TWT requesting STA and the TWT responding STA within each TWT SP for that TWT agreement. Flow Type field equal to 0 indicates an announced TWT. The TWT responding STA of an announced TWT agreement shall not transmit a frame to the TWT requesting STA within a TWT SP until it has successfully received a PS-Poll frame or APSD trigger frame (see (M18)11.2.3.5 (Power management with APSD)) from the TWT requesting STA. Flow Type field equal to 1 indicates an unannounced TWT. The TWT responding STA of an unannounced TWT agreement may transmit a frame to the TWT requesting STA within a TWT SP before it has successfully received a frame from the TWT requesting STA.

NOTE—A TWT requesting STA that is an AP does not send PS-Poll frames, but it can send APSD trigger frames.

A TWT requesting STA indicates which single channel it desires to use as a temporary primary channel during a TWT SP by setting a single bit to 1 within the TWT Channel field of the TWT element, according to the mapping described for that field. A TWT responding STA indicates which single channel the TWT requesting STA is permitted to use as a temporary primary channel during a TWT SP by setting a single bit to 1 within the TWT Channel field of the TWT element, according to the mapping described for that field. During a TWT SP, access to a channel that is not the primary channel of the BSS shall be performed according to the procedure described in 10.53 (Subchannel selective transmission (SST)(#1071)(11ah)).

**End of proposed changes.**