IEEE P802.11
Wireless LANs

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| Proposal for TWT Wide Range Parameters |
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Abstract

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: constraint applicable to STA side as well
* Rev 2: editorials, clarification that constraints applies to individual and broadcast TWT, extension of 2 TWT concept to TWT response in case of dictate and alternate
* Rev 3: editorials
* Rev 4: Plus some other amendments based on received feeedback.

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

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

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

### Providing range of TWT parameters within TWT Setup

***Discussion Item:*** *Current a TWT request can provide only a value for each TWT parameter. Seems to be desirable to specify that the TWT request can also provide a range of values from which the peer STA can chose to select the TWT parameters.*

**TG Editor: *change section 9.3.3.3 as follows***

9.3.3.3 Beacon frame format

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| --- |
| * Beacon frame body
 |
| **Order** | **Information** | **Notes** |
| 19 | EDCA Parameter Set | The EDCA Parameter Set element is present if dot11QosOptionImplemented is true, ~~and~~ dot11MeshActivated is false, and the QoS Capability element is not present; otherwise it is not present. |
| 20 | QoS Capability | The QoS Capability element is present if dot11QosOptionImplemented is true, ~~and~~ dot11MeshActivated is false, and neither the EDCA Parameter Set element nor the MU EDCA Parameter Set element are ~~is not~~ present; otherwise it is not present. |
| 57 | VHT Operation | The VHT Operation element is present when dot11VHTOptionImplemented is true and is optionally present if dot11HEOptionImplemented is true; otherwise, it is not present. |
| 63 | Reduced Neighbor Report | The Reduced Neighbor Report element is optionally present ifdot11TVHTOptionImplemented or dot11FILSActivated(11ai) or dot11ColocatedRNRImplemented(#20668) istrue; otherwise not present.(11ai) |
| 73 | Multiple BSSID Configuration | The Multiple BSSID Configuration element is optionally present if dot11MultiBSSIDImplemented is true.(M125) |
| 76 | HE Capabilities | The HE Capabilities element is present if dot11HEOptionImplemented is true; otherwise it is not present. |
| 77 | HE Operation | The HE Operation element is present if dot11HEOptionImplemented is true; otherwise it is not present. |
| 78 | TWT | The TWT element is optionally present if dot11TWTOptionActivated is true; otherwise it is not present. |
| 79 | UORA Parameter Set | The UORA Parameter Set element is optionally present if dot11OFDMARandomAccessOptionImplemented is true; otherwise it is not present. |
| 80 | BSS Color Change Announcement | The BSS Color Change Announcement element is optionally present if dot11HEOptionImplemented is true; otherwise it is not present. |
| 81 | Spatial Reuse Parameter Set | The Spatial Reuse Parameter Set element is optionally present if dot11HEOptionImplemented is true; otherwise it is not present. |
| 82 | MU EDCA Parameter Set | The MU EDCA Parameter Set element is optionally present if dot11HEOptionImplemented is true and dot11MUEDCAParametersActivated is true; otherwise, it is not present.(#20603) |
| 83 | ESS Report | The ESS Report element is optionally present.(#20638) |
| 84 | NDP Feedback Report Parameter Set | The NDP Feedback Report Parameter Set element is optionally present if dot11HEOptionImplemented is true; otherwise, it is not present. |
| 85 | HE BSS Load | The HE BSS Load element is optionally present if dot11QBSSLoadImplemented and dot11HEOptionImplemented are true. |
| 86 | HE 6 GHz Band Capabilities(#21158) | The HE 6 GHz Band Capabilities element is present if dot11HEOptionImplemented and dot11HE6GOptionImplemented(#20458) are true. |
| <ANA> | TWT Constraint Parameters | The TWT Constraint Parameters element is optionally present if dot11TWTOptionActivated is true; otherwise it is not present. |

**TG Editor: *Insert in the tables of sections 9.3.3.7 (only this insertion is shown) and 9.3.3.8 the row below***

9.3.3.7 Association Response frame format

|  |
| --- |
| * Association Response frame body
 |
| **Order** | **Information** | **Notes** |
| 6 | EDCA Parameter Set | The EDCA Parameter Set element(#2479) is optionally(#20624) present ifdot11QosOptionImplemented is true; otherwise not present. |
| 29 | VHT Operation | The VHT Operation element is present when dot11VHTOptionImplemented is true and is optionally present if dot11HEOptionImplemented is true; otherwise, it is not present. |
| 39 | TWT | The TWT element is present if dot11TWTOptionActivated is true and the TWT element is present in the Association Request frame that elicited the Association Response frame.The TWT element is optionally present if dot11TWTOptionActivated is true, dot11HEOptionImplemented is true, and the TWT Requester Support field in the HE Capabilities element in the Association Request frame that elicited this Association Response frame is 1.Otherwise, the TWT element is not present.If the TWT element is present in the Association Request frame that solicits the Association Response frame but the TWT element is not present in the Association Response frame then the STA can transmit another TWT request frame after association. |
| 54 | HE Capabilities | The HE Capabilities element is present if dot11HEOptionImplemented is true; otherwise it is not present. |
| 55 | HE Operation | The HE Operation element is present if dot11HEOptionImplemented is true; otherwise it is not present. |
| 56 | BSS Color Change Announcement | The BSS Color Change Announcement element is optionally present if dot11HEOptionImplemented is true; otherwise it is not present. |
| 57 | Spatial Reuse Parameter Set | The Spatial Reuse Parameter Set element is optionally present if dot11HEOptionImplemented is true; otherwise it is not present. |
| 58 | MU EDCA Parameter Set | The MU EDCA Parameter Set element is present if dot11HEOptionImplemented is true and dot11MUEDCAParametersActivated is true; otherwise, it is not present.(#20603) |
| 59 | UORA Parameter Set | The UORA Parameter Set element is optionally present if dot11HEOptionImplemented is true; otherwise, it is not present. |
| 60 | ESS Report | The ESS Report element is optionally present.(#20638) |
| 61 | NDP Feedback Report Parameter Set | The NDP Feedback Report Parameter Set element is optionally present if dot11HEOptionImplemented is true; otherwise, it is not present. |
| 62 | HE 6 GHz Band Capabilities(#21158) | The HE 6 GHz Band Capabilities element is present if dot11HEOptionImplemented and dot11HE6GOptionImplemented(#20458) are true. |
| <ANA> | TWT Constraint Parameters | The TWT Constraint Parameters element is optionally present if dot11TWTOptionActivated is true; otherwise it is not present. |

**TG Editor: *change section 9.3.3.11 as follows***

9.3.3.11 Probe Response frame format

|  |
| --- |
| * Probe Response frame body
 |
| **Order** | Information | Notes |
| 18 | EDCA Parameter Set | The EDCA Parameter Set element is optionally present ifdot11QosOptionImplemented is true and dot11MeshActivated isfalse.(#20624) |
| 59 | VHT Operation | The VHT Operation element is present when dot11VHTOptionImplemented is true and is optionally present if dot11HEOptionImplemented is true; otherwise, it is not present. |
| 65 | Reduced Neighbor Report  | The Reduced Neighbor Report element is optionally present ifdot11TVHTOptionImplemented (11ai)or dot11FILSActivated or dot11ColocatedRNRImplemented(#20668) istrue; otherwise not present. (11ai) |
| 92 | Multiple BSSID Configuration | The Multiple BSSID Configuration element is optionally present if dot11MultiBSSIDImplemented is true.(M125) |
| 93 | HE Capabilities | The HE Capabilities element is present if dot11HEOptionImplemented is true; otherwise it is not present. |
| 94 | HE Operation | The HE Operation element is present if dot11HEOptionImplemented is true; otherwise it is not present. |
| 95 | TWT | The TWT element is optionally present within broadcast Probe Response frames if dot11TWTOptionActivated, dot11HEOptionImplemented and dot11FILSOmitReplicateProbeResponses are true; otherwise it is not present. If the TWT element is present, then the Negotiation Type subfield(#20589) of the TWT element is 2. |
| 96 | UORA Parameter Set | The UORA Parameter Set element is optionally present if dot11OFDMARandomAccessOptionImplemented is true; otherwise it is not present. |
| 97 | BSS Color Change Announcement | The BSS Color Change Announcement element is optionally present if dot11HEOptionImplemented is true; otherwise it is not present. |
| 98 | Spatial Reuse Parameter Set | The Spatial Reuse Parameter Set element is optionally present if dot11HEOptionImplemented is true; otherwise it is not present. |
| 99 | MU EDCA Parameter Set | The MU EDCA Parameter Set element is present if dot11HEOptionImplemented is true and dot11MUEDCAParametersActivated is true; otherwise, it is not present.(#20603) |
| 100 | ESS Report | The ESS Report element is optionally present.(#20638) |
| 101 | NDP Feedback Report Parameter Set | The NDP Feedback Report Parameter Set element is optionally present if dot11HEOptionImplemented is true; otherwise, it is not present. |
| 102 | HE BSS Load | The HE BSS Load element is optionally present if dot11QBSSLoadImplemented and dot11HEOptionImplemented are true. |
| 103 | HE 6 GHz Band Capabilities(#21158) | The HE 6 GHz Band Capabilities element is present if dot11HEOptionImplemented and dot11HE6GOptionImplemented(#20458) are true. |
| <ANA> | TWT Constraint Parameters | The TWT Constraint Parameters element is optionally present if dot11TWTOptionActivated is true; otherwise it is not present. |

**TG Editor: *Insert in the tables of sections 9.3.3.5 (only this insertion is shown) and 9.3.3.6 the row below:***

* + - 1. Association Request frame format

|  |
| --- |
| Table 9-36 - Association Request frame body  |
| **Order** | Information | Notes |
| <ANA> | TWT Constraint Parameters | The TWT Constraint Parameters element is optionally present if dot11TWTOptionActivated is true; otherwise it is not present. |

**TG Editor: *Insert the following row in the table of section 9.3.3.9***

* + - 1. Probe Request frame format

|  |
| --- |
| Table 9-40 - Probe Request frame body  |
| **Order** | Information | Notes |
| <ANA> | TWT Constraint Parameters | The TWT Constraint Parameters element is optionally present if dot11TWTOptionActivated is true; otherwise it is not present. |

**TG Editor: *Insert the following subclause after 9.4.2.257***

9.4.2.xxx TWT Constraint Parameters element

The TWT Constraint Parameters element provides TWT constraint parameters that can be used during the establishment of individual TWT agreements and/or broadcast TWT schedules. The format of the TWT Constraint Parameters element is shown in Figure 9-xxx (TWT Constraint Parameters element format).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  | Element ID | Length | Element ID Extension | TWT Constraint Parameter Set |
| Octets:  | 1 | 1 | 1 | 3 |
|  | Figure 9-xxx TWT Constraint Parameters element format |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  | Starting Target Wake Time Alignment | Number Of TWT Sessions/Schedules |
| Octets:  | 2 | 1 |
|  |  |  |

Figure 9-xxx TWT Constraint Parameter Set field format

The Starting Target Wake Time Alignment field contains a positive integer *n* that indicates a recommended time for the start of the first TWT SP of a TWT agreement. A value of *n* indicates that the first start time is recommended to be an integer multiple of *n*+1 TUs (i.e. (Target Wake Time) mod (*n*+1) = 0).

The Number Of TWT Sessions field contains the maximum number of TWT sessions that a STA is capable of establishing with a peer STA.

**TG Editor: *Insert a new capability bit in the Extended Capabilities element named “TWT Parameters Range Support” defined as follows:***

TWT Parameters Range Support Set to 1 to indicate support for reception of a TWT Setup frame that contains two TWT elements (see 10.48.9 (Multiple choice TWT parameters); otherwise set to 0.

* TWT Setup frame format

The TWT Setup frame is an Action frame of category Unprotected S1G. It is sent by a STA to request the setup of a TWT SP and it is sent by a responding STA to indicate the status of a requested TWT SP. The Action field of the TWT Setup frame contains the information shown in Table 9-500 (TWT Setup frame Action field format(11ah)).

**TG Editor: *Change the table below as follows:***

|  |
| --- |
| * TWT Setup frame Action field format
 |
| Order | Information |
| 1 | Category  |
| 2 | Unprotected S1G Action |
| 3 | Dialog Token |
| 4 | One or two TWT elements (9.4.2.199 (TWT element(11ah))) |

The Category field is defined in 9.4.1.11 (Action field).

The Unprotected S1G Action field is defined in 9.6.24.1 (Unprotected S1G Action field).

In a TWT Setup frame with a TWT Request field that is set to 1, the Dialog Token field is set to a nonzero value chosen by the transmitting STA to identify the request/response transaction. In a TWT Setup frame with a TWT Request field set to 0 that is sent in response to a TWT Setup frame with a TWT Request field set to 1, the Dialog Token field is set to the value copied from the corresponding received TWT Setup frame with a TWT Request field equal to 1. In a TWT Setup frame with a TWT Request field set to 0 that is not sent in response to a TWT Setup frame with a TWT Request field equal to 1, the Dialog Token field is set to 0.

**TG Editor: *Insert a new paragraph as follows:***

A TWT Setup frame contains only one TWT element except when used for the establishment of a TWT agreement with a range of TWT parameter values (see 10.48.9 (Multiple choice TWT parameters), in which case an additional TWT element is present.

**TG Editor: *Insert two new paragraphs as follows:***

**10.48.1 TWT overview**

If a STA has received a TWT Constraint Parameters element from another STA, it should not initiate a new TWT agreement with that STA if the total number of TWT sessions/schedules between the two STAs would exceed the value of the Number Of TWT Sessions/Schedules field in the TWT Constraint Parameters element.

If a STA has received a TWT Constraint Parameters element from another STA, and includes the Target Wake Time field in a TWT element transmitted to initiate a new TWT agreement with that STA, it should set the Target Wake Time field to an integer multiple of *n*+1 TUs (i.e. (Target Wake Time) mod (*n*+1) = 0) where *n* is the value from the Starting Target Wake Time Alignment field of the most recent TWT Constraint Parameters element received from that STA.

**TG Editor: *Insert a new subclause as follows:***

**10.48.9 TWT parameter ranges**

A STA that supports receiving two TWT elements in a TWT Setup frame sets the TWT Parameters Range Support field to 1 in the Extended Capabilities elements that it transmits.

A TWT requesting STA may send a TWT request that contains two TWT elements to a TWT responding STA if it has received an Extended Capabilities element from the responding STA with the TWT Parameters Range Support field equal to 1. The TWT requesting STA shall either set the TWT Setup Command fields of the two TWT elements to Suggest TWT or set the TWT Setup Command fields of the two TWT elements to Demand TWT.

A TWT responding STA may send a TWT response that contains two TWT elements to a TWT requesting STA if the TWT Setup Command fields of the two TWT elements in the TWT response are either Alternate TWT or Dictate TWT and if it has received an Extended Capabilities element from the requesting STA with the TWT Parameters Range Support field equal to 1.

If a STA sends a TWT request or a TWT response with two TWT elements:

* It shall set the TWT Flow Identifier field or the Broadcast TWT ID field of the two TWT elements to the same value.
* For a TWT parameter of the proposed TWT agreement that is carried in the Target Wake Time field, Nominal Minimum TWT Wake Duration field, and for the TWT wake interval parameter, the STA may indicate either a single value or a range of values. For other TWT parameters, the STA shall indicate a single value. To indicate a single value for a parameter, the STA sets the value of that parameter to be the same in each TWT element. To indicate a range of values for a parameter, the STA sets the value of that parameter differently in each TWT element. The range indicated for a parameter is the range that starts with the lower value and includes all values up to the higher value, irrespective of their order in the TWT elements, except for the TWT Wake Interval Mantissa and the TWT Wake Interval Exponent fields. The range indicated for the TWT wake interval begins with the lower value of the two TWT wake interval values and ends with the higher value of the two TWT wake interval values, where the TWT wake interval is determined from the TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields as specified in 9.4.2.199 (TWT element).

If a TWT requesting STA sent a TWT request that contains two TWT elements to a TWT responding STA, the TWT responding STA shall set each TWT parameter of the TWT response to a value selected from the range of values provided in the TWT request, if the TWT Setup Command field of the TWT response is Accept TWT and the parameter included a range in the corresponding TWT request.

If a TWT responding STA sent a TWT response that contains two TWT elements to a TWT requesting STA with a TWT Setup Command field value of Dictate TWT, it implies that a TWT agreement is likely to be accepted only if the requesting STA transmits a new TWT request with the TWT parameters set to a value selected from the range of values provided in the TWT response. If a TWT responding STA sent a TWT response that contains two TWT elements to a TWT requesting STA with a TWT Setup Command field value of Alternate TWT, it implies a counter-offer of TWT parameters by the TWT responding STA, which can be indicated in the form of a range of values (although alternative TWT parameters might be accepted as well).

**26.8.3.2 Rules for TWT scheduling AP**

**TG Editor: *Change the sentence below as follows:***

The TWT scheduling AP shall set the Target Wake Time field to the TSF timer [10: 25] that 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.

**TG Editor: *Replace “TWT field” with “Target Wake Time field” in 10.47.1 (ensuring that this is done only for TWT field, e.g., not for Next TWT field***