IEEE P802.11
Wireless LANs

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| Proposed Draft Text for TWT for MLD |
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Abstract

This submission proposes draft text for TWT for MLD

Revisions:

* Rev 0: Initial version of the document.
* Rev 4: Some change according to the offline discussion with Abhi, Laurent, Young Hoon and so on, thanks
* Rev 5: Some change according to the offline discussion with Chunyu and Kumail,thanks
* Rev 8: clean version

**The texts are based on the following motion**

Individual TWT agreement(s) could be set up on a setup link for more than one setup link.

[Motion 115, #SP60, [16] and [231]]

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

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

***Discussion for the motion***

A TWT requesting STA affiliated with a TWT requesting MLD may negotiate individual TWT agreements with a TWT responding STA affiliated with a TWT responding MLD

* STA1 of STA MLD and AP1 of AP MLD operating on link 1 can exchange TWT setup frames (in a single negotiation) to negotiate
	+ A TWT agreement on link1 between STA1 and AP1

* + A TWT agreement on link2 between STA2 and AP2

* + 2 TWT agreements, one on link1 between STA1 and AP1, one on link1 between STA2 and AP2
		- These agreements can have same start time and end time, same parameters
		- These agreements can also have different ones as well (specifically ensure no overlap for instance)

***TGbe Editor: please insert Clause 35.5 as follows:***

35. Extremely High Throughput (EHT) MAC specification

35.5 TWT operation

35.5.1 Individual TWT agreements

A STA affliated with an MLD may negotiate individual TWT agreements with another STA affiliated with another MLD as defined in 10.47.1 (TWT overview) and 26.8.2 (Individual TWT agreements) except the following:

* The STA affiliated with the MLD may indicate the link(s) that are requested for setting up TWT agreement(s) in the Link ID Bitmap subfield, if present, of a TWT element in the TWT request.
	+ - If only one link is indicated in the Link ID Bitmap subfield of the TWT element, then a single TWT agreement is requested on behalf of the STA affiliated with the same MLD and that is operating on the indicated link. The Target Wake Time field of the TWT element shall be in reference to the TSF time of the link indicated by the TWT element.
* A STA affiliated with a peer MLD that receives a TWT request that contains a Link ID Bitmap subfield in a TWT element shall respond with a TWT response that may indicate the link(s) in the Link ID Bitmap field of a TWT element. The link(s), if present, in the TWT element in the TWT response, shall be the same as the link(s) indicated in the TWT element of the soliciting TWT request.

During the negotiation of TWT agreements, a TWT requesting STA affiliated with an MLD and a TWT responding STA affiliated with another MLD may include multiple TWT elements where each of the Link ID Bitmap subfields indicate different link(s) with respect to the Link ID Bitmap subfields of the other TWT elements contained in the same TWT Setup frame. The TWT parameters provided by each TWT element shall be applied and be in reference to the respective link that is indicated in the TWT element.

An example of TWT agreements negotiated for multiple links is shown in Figure 35-x-a (Example of TWT agreements negotiation across multiple links).

Figure 35-x-a – Example of TWT agreements negotiation across multiple links

In this example, an AP MLD has three affiliated APs: AP 1 operates on 2.4 GHz band, AP 2 operates on 5 GHz band, and AP 3 operates on 6 GHz band. Non-AP STA 1 affiliated with the non-AP MLD sends three TWT elements in a TWT request to AP 1 affiliated with the AP MLD. These three TWT elements indicate the links of AP 1, AP 2, and AP 3 requesting three links to be setup TWT agreements, respectively, have different parameters, such as target wake up time, and all are with a value of Request TWT in the TWT Set Command field. AP 1 sends three TWT elements in a TWT response to non-AP STA 1 and these three TWT elements confirm the links of AP 1, AP 2, and AP 3 respectively; and they are all with a value of Accept TWT in the TWT Setup Command field. After successful TWT agreements setup on the three links, three TWT SPs with different TWT parameters exist on these three links (link 1 between AP 1 and non-AP STA 1, link 2 between AP 2 and non-AP STA 2, and link 3 between AP 3 and non-AP STA 3). For these three TWT agreements, the Target Wake Time field of the TWT element that indicates link 1 is in reference to the TSF time of link 1, the Target Wake Time field of the TWT element that indicates link 2 is in reference to the TSF time of link 2 and the Target Wake Time field of the TWT element that link 3 is in reference to the TSF time of link 3.

***TGbe Editor: please modify Clause 9.4.2.199 of 802.11ax D8.0 as follows:***

* **TWT element**

***Replace Figure 9-686 (TWT element format) with the following:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | Element ID | Length | Control | TWT Parameter Information |
| Octets:  | 1 | 1 | 1 | variable |
| * **TWT element format**
 |

***Change Figure 9-687 (Control field format) as follows.***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2           B3 | B4 | B5 | B6 |  B7 |
|  | NDP Paging Indicator | Responder PM Mode | Negotiation Type | TWT Information Frame Disabled | Wake Duration Unit(#20352) | Link ID Bitmap Present | Reserved |
| Bits: | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
|  | * **Control field format**
 |

***Insert the following (including table) after the 5th paragraph (“The Responder PM Mode subfield...”):***

The Negotiation Type subfield indicates whether the information included in the TWT element is for the negotiation of parameters of broadcast or individual TWT(s) or a Wake TBTT interval. The MSB of the Negotiation Type subfield is the Broadcast field.

The TWT Information Frame Disabled subfield is set to 1 to indicate that the reception of TWT Information frames is disabled by the STA; otherwise, it is set to 0.

The Wake Duration Unit subfield indicates the unit of the Nominal Minimum TWT Wake Duration field. The Wake Duration Unit subfield is set to 0 if the unit is 256 us and is set to 1 if the unit is a TU. A non-HE STA sets the Wake Duration Unit subfield to 0.

The Link ID Bitmap field is present if the Link ID Bitmap Present field is equal to 1; otherwise, The Link ID Bitmap field is not present. (#20352)

If the Broadcast field of the Negotiation Type subfield is 1, then one or more broadcast TWT parameter sets are contained in the TWT element (see Figure 9-687b (Broadcast TWT Parameter Set field format)). If the Broadcast field of the Negotiation Type subfield is 0, then only one Individual TWT parameter set is contained in the TWT element (see Figure 9-687a (Individual TWT Parameter Set field format)). An S1G STA sets the Negotiation Type subfield to 0.

A TWT element that has the Broadcast field in the Control field set to 1 is referred to as broadcast TWT element.

The Negotiation Type subfield determines the interpretation of the Target Wake Time, TWT Wake Interval Mantissa and TWT Wake Interval Exponent subfields of the TWT element as defined in Table 9-296a (Interpretation of Negotiation Type subfield, Target Wake Time, TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields).

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| --- |
| * **Interpretation of Negotiation Type subfield, Target Wake Time, TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields**
 |
| **Negotiation Type subfield** | **Target Wake Time field** | **TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields** | **Description** |
| 0 | A future Individual TWT SP start time | Interval between individual TWT SPs | Individual TWT negotiation between TWT requesting STA and TWT responding STA or individual TWT announcement by TWT responder. See 10.48 (Target wake time (TWT)), and 26.8.2 (Individual TWT agreements).The TWT element contains one individual TWT parameter set. |
| 1 | Next Wake TBTT time | Interval between wake TBTTs | Wake TBTT and wake interval negotiation between TWT scheduled STA and TWT scheduling AP. See 26.8.6 (Negotiation of wake TBTT and wake interval).The TWT element contains one individual TWT parameter set. |
| 2 | A future Broadcast TWT SP start time | Interval between broadcast TWT SPs | Provide broadcast TWT schedules to TWT scheduled STAs by including the TWT element in broadcast Management frames sent by TWT scheduling AP. See 26.8.3.2 (Rules for TWT scheduling AP).The TWT element contains one or more broadcast TWT parameter sets. |
| 3 | A future Broadcast TWT SP start time | Interval between broadcast TWT SPs | Manage memberships in broadcast TWT schedules by including the TWT element in individually addressed Management frames sent by either a TWT scheduled STA or a TWT scheduling AP. See 26.8.3 (Broadcast TWT operation).The TWT element contains one or more broadcast TWT parameter sets. |

The TWT Parameter Information field contains a single Individual TWT Parameter Set field with format defined in Figure 9-687a (Individual TWT Parameter Set field format) if the Broadcast subfield in the Control field is 0 and contains one or more Broadcast TWT Parameter Set fields with format defined in Figure 9-687b (Broadcast TWT Parameter Set field format) if the Broadcast subfield of the Control field is 1. The number of Broadcast TWT Parameter Set fields present is determined by the values of the Last Broadcast Parameter Set subfields(#20112) of the Request Type fields.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |
|  | Request Type | Target Wake Time | TWT Group Assignment | Nominal Minimum TWT Wake Duration | TWT Wake Interval Mantissa | TWT Channel | NDP Paging (optional) | Link ID Bitmap |
| Octets:  | 2 | 0 or 8 | 0, 3 or 9 | 1 | 2 | 1 | 0 or 4 | 0 or 2 |
| * **Individual TWT Parameter Set field format**
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***TGbe Editor:Insert the following paragraphs and figure after paragraph 21 (“The TWT Wake Interval Mantissa…”):***

The Link ID Bitmap subfield indicates the links to which the TWT element negotiated by a STA affiliated with an MLD applies. A value of 1 in bit position *i* of the Link Bitmap subfield means that the link associated with the link ID *i* is the link to which the TWT element negotiated by a STA is applied. A value of 0 in bit position *i* of the Link Bitmap subfield means that the link associated with the link ID *i* is not the link to which the TWT element negotiated by a STA applies.