IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| LB266 CR for subclause 35.8.2 | | | | |
| Date: 2022-09-01 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Ming Gan | Huawei |  |  | ming.gan@huawei.com |
| Jason Yuchen Guo | Huawei |  |  |  |
| Yunbo Li | Huawei |  |  |  |
| Guogang Huang | Huawei |  |  |  |
| Yiqing Li | Huawei |  |  |  |
| Mengyao Ma | Huawei |  |  |  |
| Hongjia Su | Huawei |  |  |  |
| Lan Peng | Huawei |  |  |  |
| Zhenguo Du | Huawei |  |  |  |
| Qi Wang | Huawei |  |  |  |

Abstract

This submission proposes resolutions of comments received from TGbe comment collection LB266 based on TGbe D2.0.

12820 11877 13837 13870 11878 12821 13442 13871 13834 10050 13223 10395 13299 11881 13826 10051 (16 CIDs)

Revisions:

* Rev 0: Initial version of the document.
* Rev 2-3: Update the resolutions of CID 10050 12821 13442 13834 13871
* Rev 5: mark the change for CID 10050 with green color

***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.***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Submission** |
| 12820 | Laurent Cariou | 35.8.2 | 509.48 | It seems that these changes on TWT operation belong to Multi-link operation. As such, this subclause should be moved to subclause 35.3 and probably to the Multi-link Power management subclause 35.3.12 | Move the subclause to 35.3.12.x | Revised-  Agree with the comment in principle. Move this subclause to subclause 35.3 Multi-link operation. Apply the changes marked as #12820 in this document |
| 11877 | Alfred Asterjadhi | 35.8.2 | 509.49 | This subclause seems to be exclusively applicable to MLDs. Either remove this subclause to be under MLD operation or simply add "between STAs affiliated with an MLD" at the end of the title. | As in comment. | Revised-  Agree with the comment in principle. Move this subclause to subclause 35.3 Multi-link operation. Apply the changes marked as #11877 in this document |
| 13837 | Sanghyun Kim | 35.8.2 | 509.48 | The TWT negotiation procedure should be considered as an MLD-level operation, it is because a non-AP STA operating on a link cannot make judgment(accept, reject, etc.) on behalf of the another STA. | Please define the negotiation procedure for the individually TWT agreements between the MLDs as MLD-level operation, and provide a way identifying each individual TWT agreement established between the MLDs. | Revised-  Agree with the comment in principle. Move this subclause to subclause 35.3 Multi-link operation. Apply the changes marked as #13837 in this document |
| 13870 | Ming Gan | 35.8.2 | 509.61 | TWT negotiation for MLD should be MLD level, please update the the text | please update the text | Revised-  Agree with the comment in principle. Move this subclause to subclause 35.3 Multi-link operation. Apply the changes marked as #13837 in this document |
| 11878 | Alfred Asterjadhi | 35.8.2 | 509.52 | baseline negotiation applies to the same link. So add "operating on the same link" after "with another MLD. | As in comment. | Revised-  Agree with the comment in principle. Apply the changes marked as #11878 in this document |
| 12821 | Laurent Cariou | 35.8.2 | 509.63 | As we've defined a may to negotiate a TWT agreement on one link A through frame exchanges on another link B, we should also allow the joint negotiation of TWT agreements with overlapping SPs on mutliple links (particularly useful for eMLSR non-AP MLDs or dual radio non-AP MLDs) and allow the negotiation of TWT agreements with non-overlapping SPs on multiple links (particularly useful for single radio non-AP MLDs that have the constraint of not being able to operate at the same time on both links). | Define such joint TWT negotiation. Note that we need to be careful on the reference link of the timing parameters for the TWT elements when there are multiple links that are being negotiated | Revised-  Agree with the comment in principle. Aligned TWT SP on mutliple links is not only important for eMLSR/eMLMR, but also import for NSTR. Add a procedure for negotiating multiple TWT agreements using a single TWT element. Apply the changes marked as #12821 in this document |
| 13442 | Liwen Chu | 35.8.2 | 509.48 | the subclause allows the TWT agreement establishing for "link(s)" through one TWT Request. The TWT Wake Start Time should be clarified since differernt link(s) may have different TSF time values. Otherwise please change "link(s)" to "link" through the subcaluse and also do the related change in management frame transmission subclause since that subclause assumes that the TWT agreement of multiple links can be done through single TWT negotiation . | As in comment. | Revised-  Agree with the comment in principle. Add a procedure for negotiating multiple TWT agreements using a single TWT element and clarification on TSF part. Apply the changes marked as #13834 in this document |
| 13871 | Ming Gan | 35.8.2 | 509.61 | The case of multi-link indicated by one TWT element is missing | please complete the missing case | Revised-  Agree with the comment in principle. Add a procedure for negotiating multiple TWT agreements using a single TWT element. Apply the changes marked as #13871 in this document |
| 13834 | Sanghyun Kim | 35.8.2 | 509.48 | It is missing how an MLD negotiate the TWT agreement for the multiple links using a single TWT element. | Please define a procedure negotiating multiple TWT agreements using a single TWT element. | Revised-  Agree with the comment in principle. Add a procedure for negotiating multiple TWT agreements using a single TWT element. Apply the changes marked as #13834 in this document |
| 10050 | Morteza Mehrnoush | 35.8.2 | 509.59 | Add "s" to STA in "... behalf of the STAs affiliated with the same MLD ..." | as in comment | Revised-  Change “on behalf of” to “for”, change “and that” to “which” based on offline discussion.  Apply the changes marked as #10050 with green color in this document |
| 13223 | Binita Gupta | 35.8.2 | 510.09 | Text "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." needs to clarify that the TWT parameters from each TWT element is applied to setup TWT agreement on that link. | Modify the said sentence to "The TWT parameters provided by each TWT element shall be applied in reference to the respective link indicated by the Link ID Bitmap in that TWT element to setup TWT agreement on that link." | Accepted- |
| 10395 | Mengshi Hu | 35.8.2 | 510.24 | To be consistent, "link3" should be "link 3". A space is needed there. | Change "link3" into "link 3" | Accepted- |
| 13299 | Binita Gupta | 35.8.2 | 510.35 | Sentence reads incoherent. Modify current text "These three TWT elements indicate the links of AP 1, AP 2, and AP 3 requesting three links to be setup TWT agreements, respectively, " to new text "These three TWT elements indicate the links of AP 1, AP 2, and AP 3 respectively, requesting three TWT agreements to be setup on three links," | As in comment | Revised-  Agree with the comment in principle. Apply the changes marked as #13299 in this document |
| 11881 | Alfred Asterjadhi | 35.8.2 | 510.37 | I think TWT field is present in a twt request only in demand and suggest twt (not request twt). Double check if this is the case and amend accordingly (chose demand or suggest rather than request for the example). | As in comment. | Revised-  Agree with the comment in principle. In the spec, it says "If transmitted by a TWT requesting STA or a TWT scheduled STA and the TWT Setup Command subfield contains the value corresponding to the command “Request TWT”, the Target Wake Time field contains the value 0". Apply the changes marked as #11881 in this document |
| 13826 | Yuchen Guo | 35.8.2 | 510.42 | "SPs" should be "Agreements" | Replace "SPs" with "Agreements". | Rejected-  it is TWT SPs with different parameters, such as their starting time. |
| 10051 | Morteza Mehrnoush | 35.8.2 | 510.48 | Add "indicates" to this part "element that indicates Link 3 ..." | as in comment | Accepted- |

***TGbe Editor: please modify the following paragraphs in subcClause 35.8 as follows:***

35.3.26 TWT operation (#12820, 11877,13837, 13870)

35.3.26.1 **General (#12820,** 11877,**13837, 13870)**

35.3.26.2 Individual TWT agreements (#12820, 11877,13837, 13870)

An MLD may negotiate individual TWT agreements with a peer MLD as defined in 10.47.1 (TWT overview) and 26.8.2 (Individual TWT agreements) via an enabled link (#11878) except the following: (#12820, 11877, 13837, 13870)

* A TWT requesting STA affiliated with the MLD may indicate a link that is requested for setting up TWT agreement(s) in the Link ID Bitmap subfield, if present, of a TWT element in the TWT request.(#12820, 13837, 13870)
* A single TWT agreement is requested for the STA affiliated with the same MLD which (#10050) 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 TWT responding 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 indicates the link in the Link ID Bitmap field of a TWT element. The link, if present, in the TWT element carried in the TWT response, shall be the same as the link indicated in the TWT element of the soliciting TWT request. (#12820, 11877, 13837, 13870)

NOTE-The individual TWT agreement is negotiated between the STAs affiliated with the MLDs that are operating on an enabled link and is not negotiated between two MLDs. (#12820, 11877, 13837, 13870)

During the negotiation of individual TWT agreements, a TWT requesting STA affiliated with an MLD and a TWT responding STA affiliated with a peer MLD may include multiple TWT elements where each of the Link ID Bitmap subfields in each TWT element indicates different link in the same TWT Setup frame. The TWT parameters provided by each TWT element shall be applied in reference to the respective link that is indicated by the Link ID Bitmap in that TWT element to setup TWT agreement on that link. (#13223)

If the TWT element sent by the TWT requesting STA carries the Link ID Bitmap subfield and the TWT requesting STA intends to request an alignment of the TWTs across the setup links that point to start times that are aligned across these links and have the same TWT wake intervals on these links, then the TWT element shall carry the Aligned TWT Bitmap subfield that indicates the link(s) has been requested to have TWT SPs that are aligned with the link indicated by the Link ID Bitmap Subfield.

If the TWT element sent by the TWT requesting STA does not carry the Link ID Bitmap subfield and the TWT requesting STA intends to request an alignment of the TWTs across the setup links that point to start times that are aligned across these links and have the same TWT wake intervals on these links, then the TWT element shall carry the Aligned TWT Bitmap subfield that indicates the link(s) has been requested to have TWT SPs that are aligned with the link in which the TWT elemenet is sent.

If the TWT responding STA received a TWT request that contains the Aligned TWT Bitmap subfield, then the TWT responding STA shall respond with a TWT response with the Aligned TWT Bitmap subfield with same value.

An example of TWT agreements negotiated for multiple links is shown in Figure 35-32 (Example of TWT agreements negotiation across multiple links).



(#10395)

Figure 35-32 – 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. the Link ID Bitmap subfields of these three TWT elements indicate the links of AP 1, AP 2, and AP 3 respectively, requesting three TWT agreements to be setup on three links, and they (#13299) have different TWT parameters, such as target wake up time, and all are with a value of Demand (#11881) TWT in the TWT Setup Command field. AP 1 sends three TWT elements in a TWT response to non-AP STA 1 and these three TWT elements indicate 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), respectively. 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 indicates (#10051) link 3 is in reference to the TSF time of link 3.

In another example with the same configuration, non-AP STA 1 affiliated with the non-AP MLD sends a TWT element in a TWT request to AP 1 affiliated with the AP MLD. The Link ID Bitmap subfield in the TWT element indicates the link of AP 2, and the Aligned TWT Bitmap subfield in the TWT element indicates the link of AP 3, requesting two links on which to setup TWT agreements (link 2 between AP 2 and non-AP STA 2, and link 3 between AP 3 and non-AP STA 3) and aligned TWT SPs between these two links, and carries a value of Suggest TWT in the TWT Setup Command field. Moreover, the TWT element indicates a Target Wake Time value of T1 and Nominal Minimum TWT Wake Duration of T. AP 1 sends a TWT element in a TWT response to non-AP STA 1 and the TWT element sent by AP 1 confirms the links of AP 2, and AP 3 with a value of Accept TWT in the TWT Setup Command field. After successful TWT agrements setup on two links, two sets of TWT SPs with same TWT parameters exist on these two links (link 2 between AP 2 and non-AP STA 2, and link 3 between AP 3 and non-AP STA 3), respectively. For these two TWT agreements, the Target Wake Time field of the TWT element that indicates link 2 is in reference to the TSF time of link 2; the target wake time of link 3 indicated in the Aligned TWT Bitmap subfield is derived from the Target Wake Time field of the TWT element as follows: TWT\_3 = TWT\_t3 + TSF\_offset, where TWT\_t3 obtained from the the Target Wake Time field of the TWT element is in reference to the TSF time of link 3, TSF\_offset = (TSF\_2 - TSF\_3) and TSF\_2 is the TSF time of the link 2 and the TSF\_3 is the TSF time of the link 3. As per subclause 35.3.1 (General), an AP MLD or an NSTR mobile AP MLD shall correct the clock drift to be within ±30 μs between TSF timers of any two APs affiliated with the AP MLD. In this case, the start times of two TWT SPs on two links are almost same. An example of how these TWT SPs on the two links occur in time is shown in Figure 35-x (Example of negotiated TWT SPs in the time domain). (#12821, 13442, 13871, 13834)



Figure 35-x – Example of negotiated TWT SPs in the time domain

(#12821, 13442, 13871, 13834)

***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 | B B7 |
|  | NDP Paging Indicator | | Responder PM Mode | Negotiation Type | TWT Information Frame Disabled | Wake Duration Unit(#20352) | Link ID Bitmap Present | Aligned TWT Request |
| Bits: | 1 | | 1 | 2 | 1 | 1 | 1 | 21 |
|  | | * **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 subfield is present if the Link ID Bitmap Present field is equal to 1; otherwise, The Link ID Bitmap field is not present.

The Aligned TWT Link Bitmap subfield is present if the Aligned TWT Request field is equal to 1; otherwise, the Aligned TWT Bitmap subfield 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).

|  |  |  |  |
| --- | --- | --- | --- |
| * **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 | Aligned TWT Link Bitmap |
| Octets: | 2 | 0 or 8 | 0, 3 or 9 | 1 | 2 | 1 | 0 or 4 | 0 or 2 | 0 or 2 |
| * **Individual TWT Parameter Set field format** | | | | | | | |  |  |

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

The Aligned TWT Link Bitmap subfield indicates the link(s) which has the aligned TWT SPs with the link indicated by the Link ID Bitmap Subfield in the TWT element. A value of 1 in bit position *i* of the Aligned TWT Link Bitmap subfield means that the link associated with the link ID *i* is the link which has the aligned TWT SPs with the link indicated by the the Link ID Bitmap Subfield. A value of 0 in bit position *i* of the Aligned TWT Link Bitmap subfield means that the link associated with the link ID *i* is the link which does not have the aligned TWT SPs with the link indicated by the Link ID Bitmap Subfield. The bit in the Aligned TWT Link Bitmap subfield, which corresponds to the link indicated by the Link ID Bitmap subfield, is set to 0.