IEEE P802.11
Wireless LANs

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| LB271 CR for subclause 35.3.24-aligned TWT |
| Date: 2023-03-01 |
| 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 D3.1.

15708 16197 16198 17845 17954 17287 15711 17356 (8 CIDs)

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Minor update

***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.***

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| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Resolution** |
| 15708 | 35.3.24.2 | 585.20 | 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 and clarification on TSF part. This procedure can achieve aligned TWT SP on mutliple links, which is not only important for eMLSR/eMLMR, but also import for NSTR.Apply the changes marked as #15708 in this document |
| 16197 | 35.3.24.2 | 585.20 | 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. Add a procedure for negotiating multiple TWT agreements using a single TWT element and clarification on TSF part. This procedure can achieve aligned TWT SP on mutliple links, which is not only important for eMLSR/eMLMR, but also import for NSTR.Apply the changes marked as #16197 in this documentple links-aligned SP |
| 16198 | 35.3.24.2 | 585.20 | What about the case of multiple links indicated in the Link ID Bitmap subfield of the TWT element? Please call out this case as well if such case is valid (since only one TWT field is present in the TWT element then this can be possible only if TSF timers accross links are having the same values, hence clairfy this part too). Also TWT reference rule in the response is missing. Either make the respective sentence as an independent bullet or add the same sentence as a subbullet of the next item as well. | 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. This procedure can achieve aligned TWT SP on mutliple links, which is not only important for eMLSR/eMLMR, but also import for NSTR.Apply the changes marked as #16198 in this documentple links-aligned SP |
| 17845 | 35.3.24.2 | 585.20 | 802.11be should define a TWT flow that can be operated in multiple links and is optimized for EMLSR access. EMLSR transmits data in a single links at a time. AP should consider that EMSLR STA is avaiable on all links, or if AP early terminates SPs, both SPs are terminated at the same time.When the STA operates EMLSR mode both links should be triggered at the same and early terminated at the same time. | Please, define ML TWT operation rules for EMSLR access mode that allow EMLSR operation on both links, i.e. STA is available at all links and early termination terminates all links. | 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. This procedure can achieve aligned TWT SP on mutliple links, which is not only important for eMLSR/eMLMR, but also import for NSTR.Apply the changes marked as #17845 in this documentple links-aligned SP |
| 17954 | 35.3.24.2 | 585.20 | 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 and clarification on TSF part. This procedure can achieve aligned TWT SP on mutliple links, which is not only important for eMLSR/eMLMR, but also import for NSTR.Apply the changes marked as #17954 in this documentple links-aligned SP |
| 17287 | 35.3.24.2 | 585.22 | It is not clear how to set Target Wake Time field of the TWT element when the Link ID Bitmap indicates more than one link. | If more than one link is not possible, then we should specify it clearly. | 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. This procedure can achieve aligned TWT SP on mutliple links, which is not only important for eMLSR/eMLMR, but also import for NSTR.Apply the changes marked as #17287 in this documentple links-aligned SP |
| 15711 | 35.3.24.2 | 586.23 | Multi-link operation for TWT Information frames 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 and clarification on TSF part. This procedure can achieve aligned TWT SP on mutliple links, which is not only important for eMLSR/eMLMR, but also import for NSTR.Apply the changes marked as #15711 in this documentple links-aligned SP |
| 17356 | 35.3.24.2 | 585.20 | This bullet seems to imply that there might be a case that there might be a case where more than one link can be indicated. If that is the case please provide reference to the subclause that specifies that case, otherwise rephrase to make it clear. | 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. This procedure can achieve aligned TWT SP on mutliple links, which is not only important for eMLSR/eMLMR, but also import for NSTR.Apply the changes marked as #17357 in this documentple links-aligned SP |

***TGbe Editor: please modify the following paragraphs as follows: (#***15708 16197 16198 17845 17954 17287 15711 17356***)***

 35.3.26 TWT operation

35.3.26.1 **General**

 35.3.26.2 Individual TWT agreements

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 except the following:

* A TWT requesting STA affiliated with the MLD may indicate a link that is requested for setting up TWT agreement in the Link ID Bitmap subfield, if present, of a TWT element in the TWT request.
* A single TWT agreement is requested for the STA affiliated with the same MLD which 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.

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.

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 a TWT agreement on that link.

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).



Figure 35-32 – Example of TWT agreements negotiation across multiple links

In this example, an AP MLD has three affiliated APs: AP 1 operates in the 2.4 GHz band, AP 2 operates in the 5 GHz band, and AP 3 operates in the 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 have different TWT parameters, such as target wake up time, and all are with a value of Demand 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 link 3 is in reference to the TSF time of link 3.

* **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  |
| 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 field indicates whether 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 is requested or confirmed. The Aligned TWT Link Bitmap subfield is present if the Aligned TWT 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 if the Link ID Bitmap Subfield is present; otherwise the Aligned TWT Link Bitmap subfield indicates the link(s) which has the aligned TWT SPs with the link in which the TWT element is transmitted. 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 or the link in which the TWT element is transmitted. 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 or the link in which the TWT element is transmitted. 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.