IEEE P802.11
Wireless LANs

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| --- |
| LB271 CR for subclause 35.3.24-aligned TWT |
| Date: 2023-03-01 |
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Abstract

This submission proposes resolutions of comments received from TGbe comment collection LB271 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: update based on the discussion with Alfred, Laurent and Yongho

***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** | **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 or multiple TWT elements. 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 or multiple TWT elements. 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 or multiple TWT elements. 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 or multiple TWT elements. 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 or multiple TWT elements. 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 or multiple TWT elements. 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 or multiple TWT elements. 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 or multiple TWT elements. 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: Change Figure 9-1001ah (EHT MAC Capabilities Information field format) as follows: (#16419):***

**9.4.2.312.2.3 Common Info field of the Basic Multi-Link element**

**…**

The format of the MLD Capabilities And Operations subfield is defined in Figure 9-1001k (MLD Capabilities And Operations subfield format

B0 B3 B4 B5 B6 B7 B11 B12

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Maximum Number Of Simultaneous Links | SRS Support | TID-To-Link Mapping Negotiation Support | Frequency Separation For STR/AP MLD Type Indication | AAR Support |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Bits: | 4 |  | 1 |  | 2 | 5 | 1 |
|  | B13 |   | B14 |  B15 |  |  |

|  |  |  |
| --- | --- | --- |
| Link Reconfiguration Operation Support | Aligned TWT Support | Reserved |

Bits: 1 1 1

**Figure 9-1001k—MLD Capabilities And Operations subfield format**

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

**Table 9-404i—Subfields of the MLD Capabilities And Operations subfield**

|  |  |  |
| --- | --- | --- |
| **Subfield** | **Definition** | **Encoding** |
| ... | … | … |
|

|  |
| --- |
| Link Recon­figuration Operation Support |

 |

|  |
| --- |
| Indicates support for ML reconfigura­tion operations for adding a link and deleting a link to the ML setup of a non-AP MLD and support for recom­mendation for ML reconfiguration to the ML setup of a non-AP MLD. |

 |

|  |
| --- |
| Set to 1 if dot11EHTLinkReconfigurationOp­erationActivated equal to true Set to 0 otherwise.See 35.3.6.4 (ML reconfiguration to the ML setup(#15985)). |

 |
| Aligned TWT Support  | Indicates support for an alignment or nonalignment of the TWTs across more than one link | For an MLD  Set to 1 to indicate that an MLD with which the STA is affiliated is capable of receiving a TWT setup frame that requests an alignment or nonalignment of the TWTs across more than one link. Set to 0 otherwise. |

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 the link that is requested for setting up the TWT agreement in the Link ID Bitmap subfield, if present, of a TWT element in the TWT request. Only one bit in the Link ID Bitmap subfielf of the TWT element shall be set to 1.
* 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 in the TWT element carried in the TWT responseshall 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 peerMLD 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. Only one bit in the Link ID Bitmap subfield of the TWT element shall be set to 1.

35.3.26.2.1 Alignment of TWT agreements across multiple links

A STA affiliated an MLD with dot11AlignedTWTOptionImplemented equal to true that supports reception of a TWT setup frame that requests an alignment or nonalignment of the TWTs across multiple links shall set the Aligned TWT Support subfield in the Common Info field of the Basic Multi-Link element it transmits to 1; otherwise, the STA shall set it to 0.

A TWT requesting STA may transmit a TWT request containing TWT element(s) that request an alignment or nonalignement of the TWTs across mutliple links to a TWT responding STA that set the Aligned TWT Support subfield in the Common Info field of the Basic Multi-Link element it transmits to 1.

If 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 parameters on these links, and includes only one TWT element for these links in the TWTrequest, then the TWT element shall carry the Aligned TWT Bitmap subfield that indicates the link(s) that have been requested to have TWTs that are aligned with the TWTs of the link indicated in the Link ID Bitmap subfield. The bit corresponding to the link indicated in the Link ID Bitmap subfield shall be set to 0 in the Aligned TWT Bitmap subfield.

The TWT responding STA that receives a TWT request that contains the Aligned TWT Bitmap subfield shall respond with a TWT response frame that contains an Aligned TWT Bitmap subfield that has the same value as the Aligned TWT Bitmap subfield of the TWT request.

A TWT requesting STA that sends a TWT request containing multiple TWT elements for multiple links may request an alignment and overlap of the TWTs SPs across the links by setting the TWT fields of each of the TWT elements that correspond to each of these links to the TSF times, of the respective links, at which the corresponding STAs affiliated with the MLD request to wake. The TWT requesting STA shall ensure that the TWT wake intervals obtained from these TWT elements are multiples of the same common denominator. A TWT responding STA that receives the TWT request and that accepts the alignment and overlap of TWTs across these set of links shall ensure that the TWT fields of the TWT elements that correspond to these links are set to the TSF times, of the respective links, but point to start times that are aligned across these links and that the TWT wake intervals indicated in the TWT elements are multiples of the same common denominator.

A TWT requesting STA that sends a TWT request containing multiple TWT elements for multiple links may request a nonalignment of TWTs SPs across the links by setting the TWT field of the TWT elements that correspond to each of these links to the TSF times, of the respective links, at which the corresponding STAs affiliated with the MLD request to wake. The TWT requesting STA shall ensure that the TWT wake intervals obtained from these TWT elements are multiples of the same common denominator and that none of the requested TWTs occur during the requested TWT SPs of any of the other links. A TWT responding STA that receives the TWT request and that accepts the nonalignment TWT SPs across the set of links shall ensure that the TWT fields of the TWT elements that correspond to these links are set to the TSF times, of the respective links, but point to start times that do not overlap with TWT SPs of accepted TWT agreements of any other links and that the TWT wake intervals indicated in the TWT elements are multiples of the same common denominator.

NOTE 1—If the TWT wake intervals of any two links that are included in a TWT request are multiples of the same common denominator and the TWTs of these two links point to aligned start times, then aligned TWT SPs are being negotiated. If the TWT wake intervals of any two links that are included in a TWT request are multiples of the same common denominator and the TWTs of these two links do not point point to aligned start times, then non-aligned TWT SPs are being negotiated.

NOTE 2-The TWT request and the TWT response are sent after (re)association.

* **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.

***TGbe Editor: Change the paragraph below as follows:***

If transmitted by a TWT requesting STA or a TWT scheduled STA and the TWT Setup Command subfield contains a value corresponding to the command “Suggest TWT” or “Demand TWT”, the Target Wake Time field contains a positive an unsigned integer corresponding to a TSF time at which the STA requests to wake. 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 except when TWT alignment across links is requested in which case the Target Wake Time field contains a positive unsigned integer corresponding to a TSF time at which the STA requests to wake (see 35.3.26). The Target Wake Time field is 8 octets if the Broadcast field is 0; otherwise, it is 2 octets with the lowest bit of the 2 octets corresponding to bit 10 of the relevant TSF value. If a TWT responding STA with dot11TWTGroupingSupport equal to 0 transmits a TWT element to the TWT requesting STA, the TWT element contains a value in the Target Wake Time field corresponding to a TSF time at which the TWT responding STA requests the TWT requesting STA to wake for the corresponding TWT SP and it does not contain the TWT Group Assignment field.

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 parameters 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. 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.

**C.3 MIB Detail**

***Change Dot11StationConfigEntry as follows (not all lines shown):***

-- \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

-- \* dot11StationConfig TABLE

-- \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Dot11StationConfigEntry ::= SEQUENCE

{

dot11StationIDMacAddress,

…

dot11BSSMaxIdlePeriodIndicationByNonAPSTA,TruthValue

,

dot11EHTOptionImplemented,TruthValue,

dot11EHTTXOPSharingTFOptionImplementedTruthValue,

dot11EHTNSTRMobileAPMLDImplementedTruthValue,

dot11RestrictedTWTOptionImplementedTruthValue,

dot11TwoBQRsOptionImplementedTruthValue,

dot11AlignedTWTOptionImplementedTruthValue,

}

***Insert the following after the dot11BSSMaxIdlePeriodIndicationByNonAPSTA OBJECT-TYPE in the dot11StationConfig TABLE:***

dot11AlignedTWTOptionImplemented OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

This attribute, when true, indicates the ability of the MLD to support the Aligned TWT operation. If the attribute is false, the MLD does not support the Aligned TWT operation."

::= { dot11StationConfigEntry <ANA> }