IEEE P802.11
Wireless LANs

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| Resolution for comments related to Multi-Link TDLS |
| Date: November 08, 2022 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Abhishek Patil | Qualcomm Inc. |  |  | appatil@qti.qualcomm.com |
| Abdel Karim |  |  |  |
| George Cherian |  |  |  |
| Gaurang Naik |  |  |  |
| Alfred Asterjadhi |  |  |  |
| Duncan Ho |  |  |  |
| Yanjun Sun |  |  |  |

 Abstract

This submission proposes resolutions for the following 10 comments received for TGbe LB266:

10062 10366 12393 12707 12765 12785 12786 13085 13667 13820

Revisions:

* Rev 0: Initial version of the document.

***TGbe editor: Please note baseline is 802.11be D2.2***

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

***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** | **Commenter** | **Section** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 10062 | Morteza Mehrnoush | 35.3.21.2 | 471.09 | Current spec only defines the TDLS direct link over a single link. Please add the TDLS discovery/setup/frame-exchange procedure over multiple links. | as in comment | **Revised**Proposed changes add a new subclause describing multi-link TDLS discovery and setup procedure. In addition, subclause on TDLS Multi-Link element is extended to carry per-STA profile subelement of the links intended for multi-link TDLS discovery or setup.**TGbe editor, please make changes as proposed in 11-22/1796r0 tagged 10062** |
| 10366 | Tomoko Adachi | 35.3.21 | 0.00 | A non-AP MLD that has dot11EHTBaseLineFeaturesImplementedOnly set to false, which means a non-AP MLD capable of Release 2 features, should be able to negotiate TDLS over multiple links. | Add a mechanism for non-AP MLDs that have dot11EHTBaseLineFeaturesImplementedOnly set to false to be able to perform direct link communication on multiple links with each other. Direct link transmission at non-AP MLDs having an NSTR link pair may have similar constraints as the transmission at a non-AP MLD with an NSTR mobile AP MLD, setting a primary link in one of the multiple links. | **Revised**Same resolution as 10062**TGbe editor, please make changes as proposed in 11-22/1796r0 tagged 10062** |
| 12393 | Rojan Chitrakar | 35.3.21.2 | 471.09 | Between two MLDs, TDLS direct link setup and transmissions should be supported on multiple links. | Expand the TDLS direct link setup and transmissions to multiple links between two MLDs. | **Revised**Same resolution as 10062**TGbe editor, please make changes as proposed in 11-22/1796r0 tagged 10062** |
| 12707 | Pascal VIGER | 35.3.21.1 | 470.58 | TDLS procedure in multi-link operation is not defined. TDLS is important as it offloads traffic for AP, so AP MLD can benefit of this also. | Please define the specification for multiple link TDLS. | **Revised**Same resolution as 10062**TGbe editor, please make changes as proposed in 11-22/1796r0 tagged 10062** |
| 12765 | Patrice Nezou | 35.3.21.1 | 470.62 | A TDLS direct link procedure over a single link has been specified in a multi link environment. Why is it limited to a single link P2P ? | Define a procedure to setup Multiple link P2P connection. | **Revised**Same resolution as 10062**TGbe editor, please make changes as proposed in 11-22/1796r0 tagged 10062** |
| 12785 | Romain GUIGNARD | 35.3.21 | 470.56 | Current draft does not define Multi-Link TDLS. It should be define so as to non-AP MLDs take benefit of MLO for P2P communication. | Please consider a Multi-link solution for TDLS not only limited to the usage of a single link | **Revised**Same resolution as 10062**TGbe editor, please make changes as proposed in 11-22/1796r0 tagged 10062** |
| 12786 | Romain GUIGNARD | 35.3.21 | 470.61 | The standard states: "the AP does not need to be directlink capable, nor does it have to support the same set of capabilities that are used on the direct link between the two TDLS peer STAs." However, it seems to envision limiting the ML usage for TDLS to the scope of the non-AP MLD (associated with AP MLD). Should not we consider Multi radio capable devices associated with legacy AP and hence define TDLS rules to support ML TDLS out of the AP MLD scope? | Could we consider ML TDLS without MLD association with an AP MLD? | **Revised**Same resolution as 10062**TGbe editor, please make changes as proposed in 11-22/1796r0 tagged 10062** |
| 13085 | Chittabrata Ghosh | 35.3.21.2 | 471.09 | Current spec only defines the TDLS direct link over a single link. Please add the TDLS discovery/setup/frame-exchange procedure over multiple links. | as in comment | **Revised**Same resolution as 10062**TGbe editor, please make changes as proposed in 11-22/1796r0 tagged 10062** |
| 13667 | Rubayet Shafin | 35.3.21 | 470.55 | Two non-AP MLDs should be able to establish multiple TDLS links between them to reap the MLO benefits for P2P communication. However, an MLD-level procedure for setting up multiple TDLS links between two non-AP MLDs is currently missing in the spec. | Please describe the mechanism for setting up multiple TDLS direct links between two non-AP MLDs. | **Revised**Same resolution as 10062**TGbe editor, please make changes as proposed in 11-22/1796r0 tagged 10062** |
| 13820 | Yuchen Guo | 35.3.21 | 470.56 | Multi-Link TDLS beween two MLDs is missing | Please define Multi-Link TDLS beween two MLDs | **Revised**Same resolution as 10062**TGbe editor, please make changes as proposed in 11-22/1796r0 tagged 10062** |

**35.3.21.1 General**

***TGbe editor: Please update the following paragraph as shown below:***

A non-AP MLD that intends to establish a single link TDLS direct link with a peer STA on one of its links follows the procedures defined in 11.20 (Tunneled direct-link setup), with additional rules as defined in 35.3.21.2 (TDLS direct link over a single link). A non-AP MLD that intends to establish a multi-link link TDLS direct link with a peer non-AP MLD follows the procedures defined in 11.20 (Tunneled direct-link setup), with additional rules as defined in 35.3.21.2a (TDLS direct link over multiple links).

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NOTE – As an alternative to transmitting a TDLS Discovery Request frame, a non-AP MLD can discover a TDLS peer by sending an unsolicited TDLS Discovery Response frame or a TDLS Setup Request frame without exchanging TDLS discovery frames (see 11.20.3 (TDLS discovery)).

**35.3.21.2 TDLS direct link over a single link**

***TGbe editor: Please update the following paragraph as shown below:***

Frames that traverse the intermediate AP (MLD) are sent or received by a STA affiliated with a non-AP MLD. Frames sent over the direct link are sent or received by a TDLS non-AP STA affiliated with the non-AP MLD. The TDLS direct link, when successfully established, is between the TDLS non-AP STA affiliated with the non-AP MLD and a TDLS peer STA at the other end of the direct link.

***TGbe editor: Please add the following new subclause after 35.3.21.2 as shown below:***

**35.3.21.2a TDLS direct link over multiple links**

A non-AP MLD that intends to establish a TDLS direct link over multiple links shall follow the discovery procedure (including setting of the Address 1 (RA) and Address 2 (TA) fields) as described in 35.3.21.2 (TDLS direct link over single link) with the exception that the TDLS Multi-Link element carries a Per-STA Profile subelement for each link that the non-AP MLD proposes to be part of the multi-link TDLS setup.

NOTE – During the time of TDLS discovery (solicited or unsolicited), the non-AP MLD is unaware of the capabilities of the peer STA (which could be a non-MLO non-AP STA or a non-AP MLD that supports only single TDLS). Therefore, the Address 2 (TA) field of the TDLS discovery and setup frames is set to the MLD MAC address of the non-AP MLD.

A recipient non-AP MLD that supports establishing TDLS direct link over multiple links shall include, in its response frame, a TDLS Multi-Link element carrying a Per-STA Profile subelement for each link, amongst the set proposed by the initiating non-AP MLD, that it has accepted to be part of the TDLS setup.

NOTE – A non-EHT non-AP STA does not include TDLS Multi-Link element in its response frame. The TDLS Multi-Link element carried in a response frame transmitted by a non-AP MLD that supports only single link TDLS direct link does not include Link Info field (i.e., does not include Per-STA Profile subelement(s)).

NOTE – A recipient non-AP MLD can accept a proposed link to be part of a multi-link TDLS setup if the link ID matches one of the links on which the non-AP MLD is operating on and the capabilities and operational parameters of the peer non-AP STA operating on that link are found to be suitable.

A non-AP MLD that supports establishing multi-link TDLS direct link shall setup a single link TDLS by following the procedures described in 35.3.21.2 (TDLS direct link over single link) if the TDLS discovery or TDLS setup frame from the TDLS peer does not include TDLS Multi-link element or the TDLS Multi-Link element included in the frame does not contain Link Info field.

A non-AP MLD that has successfully setup a multi-link TDLS direct link shall set:

* the value of the Address 2 (TA) field (if present) in the MAC header of the frame to the MAC address of the transmitting non-AP STA that is affiliated with it and is operating on that link.
* the value of the Address 1 (RA) field in the MAC header of the frame to the MAC address of the receiving non-AP STA that is affiliated with the receiving non-AP MLD and is operating on that link.

NOTE – A non-AP MLD determines the MAC address of the non-AP STA affiliated with the TDLS peer non-AP MLD based on the STA MAC address subfield contained in the Per-STA Profile subelement carried in the TDLS Multi-Link element.

When two non-AP MLDs successfully establish multi-link TDLS between them, the TDLS TPK generation shall include the AP MLD MAC address in addition to the MAC address of each affiliated AP that is operating on the link on which the TDLS direct link is being established, as defined in Equation (12-3).

**12.7.8.2 TPK handshake**

***TGbe editor: Please update the following paragraph as shown below:***

***Insert the following paragraph after the eighth paragraph (“The TPK shall be derived as ...” ):***

The TPK shall be derived as follows when the frames transmitted during the TPK handshake by both peers include a TDLS Multi-Link element and the setup is for a single link TDLS (see 35.3.21.2 (TDLS direct link over a single link)):

TPK-Key-Input = Hash(min (SNonce, ANonce) || max (SNonce, ANonce))

TPK = KDF-Hash-Length(TPK-Key-Input, “TDLS PMK”, min (MAC\_I, MAC\_R) || max (MAC\_I, MAC\_R) ||

BSSID || AP MLD MAC) (12-2)

where

Hash, KDF-Hash-Length, Length, TK\_bits, MAC\_I, MAC\_R, SNonce, ANonce and BSSID are as defined above.

AP MLD MAC is the MLD MAC address of the AP MLD with which the initiating non-AP MLD has performed multi-link setup

The TPK shall be derived as follows when the frames transmitted during the TPK handshake by both peers include a TDLS Multi-Link element and the setup is for a multi-link TDLS (see 35.3.21.2a (TDLS direct link over multiple links)):

TPK-Key-Input = Hash(min (SNonce, ANonce) || max (SNonce, ANonce))

TPK = KDF-Hash-Length(TPK-Key-Input, “TDLS PMK”, min (MAC\_I, MAC\_R) || max (MAC\_I, MAC\_R) ||

BSSID1 || BSSID2 || … || AP MLD MAC) (12-3)

where

Hash, KDF-Hash-Length, Length, TK\_bits, MAC\_I, MAC\_R, SNonce and ANonce are as defined above.

BSSID1, BSSID2, … are the BSSIDs of the APs affiliated with the AP MLD with which the initiating non-AP MLD is affiliated with and the APs operate on the links that are accepted as part of the multi-link setup.

AP MLD MAC is the MLD MAC address of the AP MLD with which the initiating non-AP MLD has performed multi-link setup

* + - * 1. **TDLS Multi-Link element**

***TGbe editor: Please update the 2nd paragraph in this subclause as shown below:***

The Presence Bitmap subfield of the Multi-Link Control field is reserved in a TDLS Multi-Link element.

***TGbe editor: Please add the following paragraphs and figures after the 6th paragraph as shown below:***

If the Link Info field is present, it consists of one or more Per-STA Profile subelements along with other optional elements in [Table 9-401c (Optional subelement IDs for Link Info field of the Multi-Link element)](file:///C%3A%5CUsers%5Cappatil%5CAppData%5CLocal%5CTemp%5CTemp1_Draft%20P802.11be_D2.2%20-%20Word.zip%5CDraft%20P802.11be_D2.2%20-%20Word%5CTGbe_Cl_09.doc#bookmark142).

The format of a Per-STA Profile subelement is defined in [Figure 9-1002xx (Per-STA Profile subelement format)](file:///C%3A%5CUsers%5Cappatil%5CAppData%5CLocal%5CTemp%5CTemp1_Draft%20P802.11be_D2.2%20-%20Word.zip%5CDraft%20P802.11be_D2.2%20-%20Word%5CTGbe_Cl_09.doc#bookmark159).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Subelement ID | Length | STA Control | STA Info | STA Profile |

Octets: 1 1 2 variable variable

**Figure 9-1002xx—Per-STA Profile subelement format**

The format of the STA Control field is defined in [Figure 9-1002xx (STA Control field of the TDLS](file:///C%3A%5CUsers%5Cappatil%5CAppData%5CLocal%5CTemp%5CTemp1_Draft%20P802.11be_D2.2%20-%20Word.zip%5CDraft%20P802.11be_D2.2%20-%20Word%5CTGbe_Cl_09.doc#bookmark167) [Multi-Link element format)](file:///C%3A%5CUsers%5Cappatil%5CAppData%5CLocal%5CTemp%5CTemp1_Draft%20P802.11be_D2.2%20-%20Word.zip%5CDraft%20P802.11be_D2.2%20-%20Word%5CTGbe_Cl_09.doc#bookmark167).

B0 B3 B4 B5 B15

Bits: 4 1 11

|  |  |  |
| --- | --- | --- |
| Link ID | Complete Profile | Reserved |

**Figure 9-1002xx —STA Control field of the TDLS Multi-Link element format**

The Link ID subfield identifies the link where the reported STA is operating on (see 35.3.3.2 (Link ID)).

The Complete Profile subfield is set to 1 when the Per-STA Profile subelement of the TDLS Multi-Link element carries the complete profile as defined in 35.3.3.3 (Advertisement of complete or partial per-link information). Otherwise, the subfield is set to 0.

The format of the STA Info field is defined in [Figure 9-1002xx (Format of STA Info field of TDLS Multi-Link element)](file:///C%3A%5CUsers%5Cappatil%5CAppData%5CLocal%5CTemp%5CTemp1_Draft%20P802.11be_D2.2%20-%20Word.zip%5CDraft%20P802.11be_D2.2%20-%20Word%5CTGbe_Cl_09.doc#bookmark161).

|  |  |
| --- | --- |
| STA Info Length | STA MAC Address |

Octets: 1 6

**Figure 9-1002xx— Format of STA Info field of TDLS Multi-Link element**

The STA Info Length subfield indicates the number of octets in the STA Info field, including one octet for the STA Info Length subfield.

The STA MAC Address subfield of the STA Info field carries the MAC address of the non-AP STA that operates on the link identified by the Link ID subfield and is affiliated with the same MLD as the non-AP STA that transmitted the TDLS Multi-Link element.

The contents of the STA Profile field are defined in

* 9.6.12 (TDLS Action field formats) if the frame carrying TDLS Multi-Link element is not TDLS Discovery Response frame.
* 9.6.7.16 (TDLS Discovery Response frame format) if the frame carrying TDLS Multi-Link element is TDLS Discovery Response frame.

with inheritance applied with respect to the link where the frame is transmitted (as described in 35.3.3.6.1).