IEEE P802.11
Wireless LANs

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| --- |
| LB 266 - CR for ML Reconfiguration Add/Delete Link procedure |
| Date: September 20, 2022 |
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Abstract

This submission proposes resolutions for following 24 CIDs received for TGbe LB266:

10385, 10436, 10486, 10632, 10722, 10771, 10772, 11102, 11428, 11742,

12163, 12164, 12168, 12169, 12377, 12378, 12481, 12906, 13092, 13277,

12165, 10717, 11658, 13066

**Revisions:**

* Rev 0: Initial version of the document.
* Rev 1: Updates based on offline feedback from members
* Rev 2: Text updates in 35.3.6.3 based on further offline feedback + editorial updates

***TGbe editor: The baseline for this document is 11be D2.2 + CR doc 22/1487r7 + CR doc 22/1460r3.***

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.***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***CID*** | ***Commenter*** | ***Clause*** | ***Page*** | ***Comment*** | ***Proposed Change*** | ***Resolution*** |
| 10385 | GEORGE CHERIAN | 35.3.6.2.1 | 0.00 | The procedure for a non-AP MLD to add a link when the AP MLD adds APs to its set is missing. Without the procedure, the non-AP MLD will be forced to perform the ML-re-setup procedure, which disrupts the ongoing IP traffic. | Add the procedure for a non-AP MLD can add a link without going through a new ML Setup procedure. | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to add or delete links to the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 10436 | Liuming Lu | 35.3.6 Multi-Link reconfiguration | 425.38 | Suppose a use case : if a non-AP MLD has set up links with an AP MLD and later AP MLD adds an AP, non-AP needs to have more links for data transmission and wants to add the new link corresponding to the added AP. In current specification, in order to have more setup links the non-AP MLD has to be firstly disassociated with the AP MLD and then (re)setup the links, which would cause the service interruption. Therefore Multi-Link reconfiguration needs to include the addition or deletion of one or more links between a non-AP MLD and AP MLD on the condition that the non-AP MLD has setup more than one link. | The mechanism to add or delete one ore more links between a non-AP MLD and AP MLD on the condition that the non-AP MLD has set up more than one link and is associated with the AP MLD needs to be specified. | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to add or delete links to the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 10486 | Eldad Perahia | 35.3.6.2.1 | 425.52 | "An AP MLD may add new affiliated APs anytime. A new affiliated APs shall be announced through the Basic Multi-Link element (by changing the Maximum Number Of Simultaneous Links field of the MLD Capabilities and Operations field), and through the Reduced Neighbor Report element (by including a TBTT Information field for the new AP) in the Beacon and Probe Response frames." This requires non-AP STAs to reassociate to use the new link. In order for 802.11be to support Enterprise use cases, it is required to have a mechanism for the AP to add a link without having all the non-AP STAs reassociate. | as in comment | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to add or delete links to the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 10632 | Abhishek Patil | 35.3.6.2.1 | 425.50 | The spec needs to provide guidance on how a non-AP MLD that has performed ML setup with an AP MLD can include an AP, that was recently added as an affiliated AP to the AP MLD, to its existing ML setup | As in comment | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to add or delete links to the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 10722 | Xiandong Dong | 35.3.6.2.1 | 425.53 | need to define a mechnism how does the Non-AP MLD that has already associated with the AP MLD make multilink setup with the new added links. | as in the comment | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to add or delete links from the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 10771 | Chien-Fang Hsu | 35.3.6.2.1 | 425.53 | Since An AP MLD may add new affiliated APs anytime, the capability to add new APs shall be announced in the beacon or probe response so that during the association, the non-AP MLD may allocate certain resources accordingly in advance. Such signaling may improve the link adding process on the non-AP MLD side to avoid reassociation. | Add the signaling in the beacon or probe response that the MLD AP is capable of adding another affiliated AP in the future so that the non-AP MLD can pre-allocate certain resources for the new AP to avoid reassociation. The signaling should contain the number of the AP to be added and optional new AP information. | RevisedNew ML reconfiguration action frame messaging is defined to add or delete links from the ML setup of a non-AP MLD without requiring reassociation. This addresses the issue of adding links without reassociation**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 10772 | Chien-Fang Hsu | 35.3.6.2.1 | 425.53 | If AP MLD is capable of adding new AP in the future, on the client side, it is helpful to know if the non-AP MLD is also capable of setting up new links when AP MLD adds a new link. It may prevent non-AP MLD's reassociation process. | Add signaling of non-AP MLD is capable of adding new link, including the number of links capable of being added. This is different from "the Maximum Number Of Simultaneous Links field". For example, an MLSR device sets up "the Maximum Number Of Simultaneous Links field=0 ", but it is capable of adding a new link while AP MLD adds a link. The Maximum Number Of Simultaneous Links field remains the same after link's addtition, but the proposed signaling should minus 1 | New ML reconfiguration action frame messaging is defined to add or delete links from the ML setup of a non-AP MLD without requiring reassociation. This addresses the issue of adding links without reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 11102 | Brian Hart | 35.3.6.2.1 | 425.53 | AP add is unnecessarily disruptive. After an AP is removed then re-added from an AP MLD, a non-AP STA must (re)assoc (losing its BA and TWT agreements on the surviving links) to add the new AP to its MLD setup. | At assoc time, allow a new capability bit that allows a non-AP MLD to indicate if the non-AP MLD wants to auto add any newly added affiliated APs to its setup (and start in power save mode in that new link). | RevisedAgree with the issue identified. New ML reconfiguration action frame messaging is defined to add or delete links from the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 11428 | Gaurang Naik | 35.3.6.2.1 | 425.56 | The text that allows non-AP MLD to add the newly added AP to its existing ML setup with the AP MLD is missing. | Please add rules for how a non-AP MLD can add the newly added AP to its existing ML setup with the AP MLD without requiring reassociation. | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to add or delete links from the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 11742 | Gaurav Patwardhan | 35.3.6.2.1 | 425.56 | On adding an AP to the existing AP MLD all the following processes happen: the BA agreement gets extended to that link, non-default TID-to-Link mapping may take place, a new GTK corresponding to the new link is conveyed to the non-AP MLD. Add normative text for all these cases. | as in comment | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to add or delete links from the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 12163 | Hirohiko Inohiza | 35.3.6.1 | 425.44 | Multi-Link reconfiguration only considers link adding of AP side. There is a case that non-AP side wants to add a link after detecting that AP side is adding a link. Link adding of non-AP side should also be considered. | Add link adding procedure of Non-AP side in 35.3.6 Multi-Link reconfiguration. | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to add or delete links from the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 12164 | Hirohiko Inohiza | 35.3.6.1 | 425.44 | Multi-Link reconfiguration only considers link removing of AP side. There is a case that non-AP side wants to remove part of links according to the non-AP conditions such as communication quality becoming poor for a particular link, remaining battery capacity becoming low and so on. Link removing of non-AP side should also be considered. | Add link removing procedure of Non-AP side in 35.3.6 Multi-Link reconfiguration. | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to add or delete links from the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 12168 | Masatomo Ouchi | 35.3.6 | 427.04 | When an AP add new affiliated APs,it is not clear that non-AP STA MLD may use reassociation request. | Add a subclause for adding links. | RevisedAgree in principle. Added ML reconfiguration procedure for non-AP MLD to add links and added text to specify that the non-AP MLD could make use of the new ML reconfiguration procedure defined, for adding links with the added AP to its ML setup. **TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 12169 | Masatomo Ouchi | 35.3.6 | 427.04 | It is not clear that non-AP STA MLD may use reassociation request for moving links from current link set. | Add a subclause for removing links. | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to delete links from the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 12377 | Rojan Chitrakar | 35.3.6.2.1 | 425.53 | Once an associated AP MLD adds new affiliated APs, it is natural that some of its associated non-AP MLDs would also setup new links with the newly added APs; the addition of the new links should be made possible without having to tear down the existing ML Setup. | Expand the ML reconfiguration procedure to also allow non-AP MLDs to add new links to its existing ML setup (i.e., without having to tear down the existing ML Setup and re-performing a new ML Setup including the links with the newly added APs). | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to add or delete links from the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 12378 | Rojan Chitrakar | 35.3.6.2.2 | 426.03 | Similar to the removal of affiliated APs by an AP MLD, a non-AP MLD should also be able to remove its one or more affiliated non-APs without having to tear down the existing ML Setup. One reason for it (e.g., compared to disabling a link through TID-link-mapping, or PS mechanisms) could be simpler link management etc. | Expand the ML reconfiguration procedure to also allow non-AP MLDs to remove affiliated non-AP STAs (i.e., without having to tear down the existing ML Setup and re-performing a new ML Setup excluding the links). | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to delete links from the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 12481 | stephane baron | 35.3.6.2.1 | 425.50 | The procedure for a non AP MLD already associated to an AP MLD to use a newly added AP is not defined | Please define the procedure for a non-AP STA to associate to a newly added AP when the non-AP MLD is already associated to the AP MLD using existing links. | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to add or delete links from the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 12906 | Payam Torab Jahromi | 35.3.6 | 425.38 | Since affiliated APs can be added and removed, it is possible for an associated client to detect new affiliated APs in its associated AP MLD that the client is capable of, and intends to take advnatge of. A simple signaling such as a protected action frame exchange can add a new link to the client MLD, without having to disassociate and reassociate fron the AP MLD. This is not a matter of speed or efficiency alone, but seamless addition of adding new resources to existing ones. There is no guarantee for the client to have access to the airtime (TWTs), channels (links) and other resources (e.g., Block Ack window size) it had before disassociation. Simple, disassociating and re-associating is not an option as there is no guarantee to get the same links back. Adding links, by any logic is a post association operation. Another common sense case is when client is denied a link during association (no affilated AP added/removed) -- client must be able to simply try adding a link at a later time without disrupting and risking losing established resources through reassociation. | Add a mechanism to add a link to an existing association | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to add or delete links from the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 13092 | Chittabrata Ghosh | 35.3.6 | 425.38 | Since affiliated APs can be added and removed, it is possible for an associated client to detect new affiliated APs in its associated AP MLD that the client is capable of, and intends to take advnatge of. A simple signaling such as a protected action frame exchange can add a new link to the client MLD, without having to disassociate and reassociate fron the AP MLD. This is not a matter of speed or efficiency alone, but seamless addition of adding new resources to existing ones. There is no guarantee for the client to have access to the airtime (TWTs), channels (links) and other resources (e.g., Block Ack window size) it had before disassociation. Simple, disassociating and re-associating is not an option as there is no guarantee to get the same links back. Adding links, by any logic is a post association operation. Another common sense case is when client is denied a link during association (no affilated AP added/removed) -- client must be able to simply try adding a link at a later time without disrupting and risking losing established resources through reassociation. | Add a mechanism to add a link to an existing association | RevisedAgree in principle. New ML reconfiguration action frame messaging is defined to add or delete links from the ML setup of a non-AP MLD without requiring reassociation.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 13277 | Binita Gupta | 35.3.6.2.1 | 425.57 | This clause is missing behavior for the non-AP STA/MLD when a new affiliated AP is added. Add text describing non-AP STA/MLD behavior. | As in comment | RevisedAgree in principle. Added ML reconfiguration procedure for non-AP MLD to add links and added text to specify that the non-AP MLD could make use of the new ML reconfiguration procedure defined, for adding links with the added AP to its ML setup.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 12165 | Hirohiko Inohiza | 35.3.5.2 | 423.43 | There is a case that non-AP side wants to add a link after detecting that AP side is adding a link. Link adding of non-AP side should also be considered. There is no description how GTK/IGTK/BIGTK is delivered when a link is added by non-AP side. If they are delivered through 4-way handshake, it requires disassociation and starting from association again which leads to disconnection of the already setup links. | Add a description how GTK/IGTK/BIGTK is delivered when a link is added by non-AP side. | RevisedThe new ML reconfiguration action frame messaging defined to add links to ML setup of non-AP MLDs carries the MLO KDEs for GTK/IGTK/BIGTK.**TGbe editor, please make the changes tagged by CID #10385 in 22/1709r2.** |
| 10717 | Xiandong Dong | 35.3.6.2.1 | 425.52 | should the TIDs be mapped to the added links, please clarify | as in the comment | RevisedText has been added to specify that all TIDs are mapped on the newly added links.**TGbe editor, please make the changes tagged by CID #10717 in 22/1709r2.** |
| 11658 | Morteza Mehrnoush | 35.3.6.2.1 | 425.53 | What is the behavior after adding a new affiliated AP? Is the link enable (all TID to link mapping) or link is disabled? Please define the TID-to-link mapping of the new link, and also the power state of the STA affiliated with non-AP MLD after adding new affiliated AP. | as in comment | RevisedWhen an affiliated AP is added, it is not part of ML setup of any non-AP MLD. A non-AP MLD can add that AP to its ML setup using the ML reconfiguration procedure for adding links. After link is added, text has been added to specify that all TIDs are mapped on the newly added links and the power state of the non-AP STA for the new link is in power save mode.**TGbe editor, please make the changes tagged by CID #11658 in 22/1709r2.** |
| 13066 | Chittabrata Ghosh | 35.3.6.2.1 | 425.53 | What is the behavior after adding a new affiliated AP? Is the link enable (all TID to link mapping) or link is disabled? Please define the TID-to-link mapping of the new link, and also the power state of the STA affiliated with non-AP MLD after adding new affiliated AP. | as in comment | RevisedWhen an affiliated AP is added, it is not part of ML setup of any non-AP MLD. A non-AP MLD can add that AP to its ML setup using the ML reconfiguration procedure for adding links. After link is added, text has been added to specify that all TIDs are mapped on the newly added links and the power state of the non-AP STA for the new link is in power save mode.**TGbe editor, please make the changes tagged by CID #11658 in 22/1709r2.** |

**Discussion:**

The CIDs listed in this document ask to define a procedure for the non-AP MLD to add links when one or more affiliated APs are added to its associated AP MLD, without requiring to reassociate (i.e., perform multi-link (re)setup) with the AP MLD. Such procedures will maintain the exiting association, security and BA context between the AP MLD and the non-AP MLD. Similar procedure can be defined for the non-AP MLD to delete links dynamically from its ML setup without disrupting the context for other setup links.

This CR doc proposes following:

* Defines new protected EHT action frames for ML reconfiguration request/response messages to support adding links dynamically to the multi-link setup of a non-AP MLD (e.g. after the AP MLD has added an affiliated AP) or deleting links dynamically from the current ML setup of a non-AP MLD without requiring (Re)association between the peer MLDs.
* The addition and deletion of links to the multi-link setup of a non-AP MLD is only initiated by that non-AP MLD.
* A single ML reconfiguration request supports indicating both addition and deletion of links to the ML setup. The AP MLD may accept the request partially or fully and it indicates the status accordingly in the response frame.
* The ML reconfiguration response provides GTK/IGTK/BIGTK (as applicable) for any newly added links to the ML setup. The MLO KDEs for GTK/IGTK/BIGTK are sent in the response frame. This proposal ensures that no additional message exchanges are needed to establish group keys for the newly added links.
* The ML Reconfiguration Request/Response exchange are done as protected action frame to deliver the group keys encrypted. Support for protected management frame is only required for EHT AP in current 11be draft text. For this feature, it is proposed to mandate the support for protected management frame for the EHT STAs as well.

Proposals in this CR doc uses design elements from earlier CR doc 11-21/0534r5.

***TGbe editor: Please update this subclause as shown below:***

* + - 1. **.4 Reconfiguration Multi-Link element** (#10385)

The Reconfiguration Multi-Link element is used to announce an ML reconfiguration operation by the AP MLD (see 35.3.6.2 (Adding or removing affiliated APs)) and is used to initiate multi-link reconfiguration operation for adding or deleting links to existing ML setup by the non-AP MLD (see 35.3.6.3 (Multi-link reconfiguration for adding or deleting links)).

The format of the Presence Bitmap subfield of the Reconfiguration Multi-Link element is defined in [Figure 9-1002u (Presence Bitmap subfield of the Reconfiguration Multi-Link element format)](#bookmark165).

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 | B1 | B2 B11 |
|  | LD MAC Address Present | MLD Capabilities and Operations Present | Reserved |
| Bits | 1 | 1 | 10 |

**Figure 9-1002u—Presence Bitmap subfield of the Reconfiguration Multi-Link element format**

The MLD MAC Address Present subfield is set to 1 if the MLD MAC Address field is present in the Common Info field. Otherwise, the subfield is set to 0.The MLD Capabilities and Operations Present subfield is set to 1 if the MLD Capabilities and Operations
subfield is present in the Common Info field. Otherwise, the MLD Capabilities and Operations Present subfield is set to 0.

The format of the Common Info field of the Reconfiguration Multi-Link element is defined in [Figure 9-](#bookmark166) [1002v (Common Info field of the Reconfiguration Multi-Link element format (#13478))](#bookmark166).

|  |  |  |  |
| --- | --- | --- | --- |
|  | Common Info Length | MLD MAC Address | MLD Capabilities and Operations |
| Octets | 1 | 0 or 6 | 0 or 2 |

**Figure 9-1002v—Common Info field of the Reconfiguration Multi-Link element format**

(#13478)The Common Info Length subfield indicates the number of octets in the Common Info field, including one octet for the Common Info Length subfield.

The MLD MAC Address subfield specifies the MAC Address of the MLD with which the STA transmitting the Reconfiguration Multi-Link element is affiliated.

The MLD Capabilities and Operations subfield has the same definition as the MLD Capabilities and Operations subfield of the Common Info field of the Basic Multi-Link element (see Figure 9-1002l—MLD Capabilities and Operations subfield format).One or more Per-STA Profile subelements are included in the list of subelements in the Link Info field (see [Table 9-401d (Optional subelement IDs for Link Info field of the Multi-Link element)](#bookmark141)).

Each Per-STA Profile subelement starts with a STA Control field, followed by a variable number of fields and elements, as defined in [Figure 9-1002w (Per-STA Profile subelement for](#bookmark167) [the Reconfiguration Multi-Link element(#13478))](#bookmark167).

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

 Octets: 1 1 2 variable variable

**Figure 9-1002w—Per-STA Profile subelement for the Reconfiguration Multi-Link element**

The format of the STA Control field is defined in [Figure 9-1002x (STA Control field format for the Recon-figuration Multi-Link element)](#bookmark168).

B0 B3 B4 B5 B6 B7 B8 B9 B10 B11 B15

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Link ID | Complete Profile | MACAddress Present | Delete Timer Present | Reconfiguration Operation Type | NSTR Link Pair Present | NSTR Bitmap Size | Reserved |

Bits: 4 1 1 1 2 1 1 5

**Figure 9-1002x—STA Control field format for the Reconfiguration Multi-Link element**

The Link ID subfield specifies a value that uniquely identifies the link that the reported AP is operating on or the link which is indicated for addition or deletion to the existing multi-link setup of a non-AP MLD.

The Complete Profile subfield is set to 1 when the corresponding Per-STA Profile subelement of the Reconfiguration Multi-Link element carries the complete profile as defined in 35.3.6.3 (Multi-link reconfiguration for adding or deleting links), otherwise the subfield is set to 0.

The MAC Address Present subfield indicates the presence of the STA MAC Address subfield in the STA Info field and is set to 1 if the STA MAC Address subfield is present in the STA Info field; otherwise set to 0(#10568).The Delete Timer Present subfield is set to 1 to indicate the presence of the Delete Timer subfield in the STA Info field, and that the AP corresponding to the Per-STA Profile subelement will be removed at the time indicated by the Delete Timer subfield; it is set to 0 otherwise.

The Reconfiguration Operation Type subfield is set to indicate the type of multi-link reconfiguration operation in the ML reconfiguration Request frame for the link indicated by the Link ID subfield as per Table 9-401j.

Table 9-401j - Reconfiguration Operation Type

|  |  |
| --- | --- |
| **Value** | **Name** |
| 0 | Delete Link |
| 1 | Add Link |
| 2 - 3 | Reserved |

The NSTR Link Pair Present subfield is set to 1 if an NSTR Indication Bitmap is included in the STA Info field, otherwise this subfield is set to 0. The NSTR Bitmap Size subfield is set to indicate the size of the NSTR Indication Bitmap in the STA Info field as defined for the Basic Multi-Link element in 9.4.2.312.2.4 (Link Info field of the Basic Multi-Link element).

The STA Info field consists of (#10568)fields whose presence is indicated by the subfields of the STA Control field. The subfields in the STA Info field appear in the same order as their corresponding presence sub- field in the STA Control field.

(#10568)The format of the STA Info field is defined in [Figure 9-1002y (STA Info field format for the](#bookmark169) [Reconfiguration Multi-Link element(#10568))](#bookmark169).

|  |  |  |  |
| --- | --- | --- | --- |
| STA Info Length | STA MAC Address | Delete Timer | NSTR Indication Bitmap |

 Octets: 1 0 or 6 0 or 2 0 or 1 or 2

**Figure 9-1002y—STA Info field format for the Reconfiguration Multi-Link element**

(#10568)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 AP or non-AP STA that operates or can operate on the link identified by the Link ID subfield and is affiliated with the same MLD as the STA that transmitted the Reconfiguration Multi-Link element.

(#10568)The Delete Timer subfield indicates the number of TBTTs of the AP corresponding to the Per-STA Profile subelement until the AP is removed.

The NSTR Indication Bitmap subfield indicates updated NSTR link pair for the non-AP MLD. Each bit B*j* (*j* != *i*) in the NSTR Indication Bitmap subfield included in the Per-STA Profile subelement with Link ID subfield equals to *i* (where 0<= *i* <=15) is set to 1 if the link pair corresponding to Link IDs equal to <*i*, *j>* is an NSTR link pair and the non-AP MLD has the link with Link ID *j* either already established as part of its multi-link setup or the Reconfiguration Multi-Link element contains a Per-STA Profile subelement with Link ID value equal to *j* and the Reconfiguration Operation Type subfield equal to 1.

If the Complete Profile subfield is set to 1, the STA Profile field includes the complete profile for the STA identified by the STA MAC Address and consists of all the elements and fields that would be included in a (Re)Association Request frame sent by that EHT STA. If the Complete Profile subfield is set to 0, the STA Profile field is not included.

The Vendor Specific subelements have the same format as their corresponding elements (see 9.4.2.25 (Vendor Specific element)). Zero or more Vendor Specific subelements are included in the list of optional subelements in the Link Info field.

* + 1. **Protected EHT Action frame details**
			1. **Protected EHT Action field** (#10385)

***TGbe editor: Please add the following rows to the end of Table 9-623c and change the reserved range:***

**Table 9-623c—Protected EHT Action field values**

|  |  |  |
| --- | --- | --- |
| **Value** | **Meaning** | **Time priority** |
| 8 | ML Reconfiguration Request | No |
| 9 | ML Reconfiguration Response | No |
| 10-255 | Reserved |  |

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

9.6.35.10 ML Reconfiguration Request frame format (#10385)

The ML Reconfiguration Request frame is used by a non-AP MLD to request addition or deletion of links to its multi-link setup.

The ML Reconfiguration Request frame is an Action frame of category Protected EHT. The Action field of an ML Reconfiguration Request frame contains the information shown in Table 9-623l (ML Reconfiguration Request frame Action field format).

|  |
| --- |
| Table 9-623l—ML Reconfiguration Request frame Action field format |
| Order | Information |
| 1 | Category  |
| 2 | Protected EHT Action |
| 3 | Dialog Token |
| 4 | Reconfiguration Multi-Link element (see 9.4.2.312.4 (Reconfiguration Multi-Link element)) |
| 5 | OCI element (see 9.4.2.236 (OCI element))(optional) |

The Category field is defined in Table 9-79 (Category values) and is set to Protected EHT.

The Protected EHT Action field is defined in 9.6.35.1 (Protected EHT Action field).

The Dialog Token field is set to a nonzero value chosen by the non-AP MLD sending the ML Reconfiguration Request frame.

One Reconfiguration Multi-Link element is included as defined in 9.4.2.312.4 (Reconfiguration Multi-Link element).

One OCI element field is optionally present and contains an OCI element as defined in 9.4.2.236 (OCI element).

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

9.6.35.11 ML Reconfiguration Response frame format (#10385)

The ML Reconfiguration Response frame is sent by an AP MLD in response to an ML Reconfiguration Request frame received from a non-AP MLD to accept or reject request for adding and/or deleting links to the multi-link setup of the non-AP MLD.

The ML Reconfiguration Response frame is an Action frame of category Protected EHT. The Action field of an ML Reconfiguration Response frame contains the information shown in Table 9-623m (ML Reconfiguration Response frame Action field format).

|  |
| --- |
| Table 9-623m—ML Reconfiguration Response frame Action field format |
| Order | Information |
| 1 | Category  |
| 2 | Protected EHT Action |
| 3 | Dialog Token |
| 4 | Count  |
| 5 | Reconfiguration Status List |
| 6 | Group Key Data (optional) |
| 7 | OCI element (see 9.4.2.236 (OCI element)) (optional) |
| 8 | Basic Multi-Link element (see 9.4.2.312.2 Basic Multi-Link element) (optional)  |

The Category field is defined in Table 9-79 (Category values) and is set to Protected EHT.

The Protected EHT Action field is defined in 9.6.35.1 (Protected EHT Action field).

When the ML Reconfiguration Response frame is transmitted as a response to an ML Reconfiguration Request frame, the Dialog Token field is set to the value of the Dialog Token field from the corresponding ML Reconfiguration Request frame.

The Count subfield is set to the number of Reconfiguration Status duple in the Reconfiguration Status List subfield.

The Reconfiguration Status List subfield contains one or more Reconfiguration Status duple as shown in Figure 9-1205.

|  |  |
| --- | --- |
| Link ID Info | Status |

 Octets: 1 2

 Figure 9-1205 - Reconfiguration Status duple format

The format of the Link ID Info subfield is defined in Figure 9-1002i (Link ID Info subfield format). The Link ID subfield of the Link ID Info subfield indicates the link identifier of the AP which is indicated for addition or deletion to existing multi-link setup in the corresponding ML Reconfiguration Request frame.

The Status subfield indicates the status of the reconfiguration operation for the link corresponding to the Link ID subfield, as indicated in Table 9-78 (Status codes) and following the rules defined in 35.3.6.3 (Multi-link reconfiguration for adding or deleting links).

The Group Key Data subfield is optionally present and contains group keys for the links successfully added (Status value equal to SUCCESS) to the multi-link setup. It is formatted as per Figure 9-1206. This subfield is not included if no link addition requested in the corresponding ML Reconfiguration Request frame is indicated as SUCCESS in the ML Reconfiguration Response frame.

|  |  |
| --- | --- |
| Key Data Length | Key Data |

Octets: 2 variable

Figure 9-1206 - Group Key Data subfield format

The Key Data Length subfield is the length of the Key Data subfield.

The Key Data subfield contains one or more MLO KDEs for group keys corresponding to added links. For each added link, an MLO GTK KDE is included as defined in Figure 12-36a (MLO GTK KDE format), an MLO IGTK KDE is included as defined in Figure 12-42a (MLO IGTK KDE) and an MLO BIGTK KDE is included as defined in Figure 12-48a (MLO BIGTK KDE).

Note: The MLO KDE format is link specific and includes Link ID.

One OCI element subfield is optionally present if the Group Key Data subfield is included and contains an OCI element as defined in 9.4.2.236 (OCI element).

One Basic Multi-Link element is included to provide Per-STA Profile information for one or more APs corresponding to the successfully added links to the ML setup of the non-AP MLD, if at least one link addition was accepted by the AP MLD. Otherwise, Basic Multi-Link element is not included.

**35.3.6 Multi-Link reconfiguration**

**35.3.6.1 General**

*Multi-link reconfiguration* (ML reconfiguration, or reconfiguration for short) refers to a set of procedures
through which an AP MLD can add one or more affiliated APs to the AP MLD, or remove one or more
affiliated APs from the AP MLD.

***TGbe editor: Please add following paragraph at the end of this subclause:***

(#10385)The ML reconfiguration also defines procedure for adding links dynamically to the multi-link setup of a non-AP MLD (e.g. after the AP MLD has added new affiliated AP) or deleting links dynamically from the current multi-link setup of a non-AP MLD without requiring (Re)association between the peer MLDs.

**35.3.6.2 Adding or removing affiliated APs**

**35.3.6.2.1 Adding new affiliated APs**

***TGbe editor: Please add following paragraph at the end of this subclause:***

(#10385) When a non-AP MLD detects that an affiliated AP has been added to its associated AP MLD through Basic Multi-Link element or through Reduced Neighbor Report element contained in the Beacon or Probe Response frames transmitted by any of the APs affiliated with the AP MLD, the non-AP MLD may use the multi-link reconfiguration procedure as per 35.3.6.3 (Multi-link reconfiguration for adding or deleting links) to add a new link with the added affiliated AP to its multi-link setup.

**35.3.6.2.2 Removing affiliated APs**

***TGbe editor: Please modify 3rd paragraph of this subclause as shown below:***

(#10385)For each affiliated AP that the AP MLD intends to remove, the Reconfiguration Multi-Link element shall
include a Per-STA Profile subelement with the subfields of the STA Control field set as following: The
Link ID subfield shall identify the AP to be removed, the Complete Profile subfield shall be set to 0, the Delete Timer
Present subfield shall be set to 1, the Reconfiguration Operation Type subfield shall be set to 0 and the NSTR Link Pair Present subfield shall be set to 0. The Delete Timer subfield in the STA Info field shall be set to the number of TBTTs of that
affiliated AP before it is removed (#14015)(#13901)or for NSTR mobile AP MLD the Delete Timer subfield
shall be set to the number of the TBTTs of the AP operating on the primary link. The initial value of the
Delete Timer subfield (#12082)should point to a TBTT value that provides sufficiently large enough time to
announce the removal of affiliated AP such that all associated non-AP MLDs including the ones in power
save mode have the opportunity to receive Reconfiguration Multi-Link element at least once before the AP
is removed. The Per-STA Profile subelement shall not include a STA Profile field.

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

**35.3.6.3 Multi-link reconfiguration for adding or deleting links (#10385)**

A non-AP MLD in the associated state may request modification of its multi-link setup by sending an ML Reconfiguration Request frame from an affiliated non-AP STA to the corresponding AP affiliated with the AP MLD that it is associated with. The ML Reconfiguration Request frame shall contain a Reconfiguration Multi-Link element that includes a Per-STA Profile subelement for each STA that the non-AP MLD is requesting to add or delete to its multi-link setup. The Reconfiguration Multi-Link element shall not include any other Per-STA Profile subelements.

The following rules apply for each Per-STA Profile subelement corresponding to a non-AP STA included in the ML Reconfiguration Request frame:

* If the non-AP MLD is indicating to add a link, it shall set the fields in the Per-STA Profile subelement as follows:
	+ The Link ID subfield is set to the link identifier of the AP affiliated with the associated AP MLD that is operating on the link that the non-AP MLD is requesting to add. The Complete Profile subfield and the MAC Address Present subfield are set to 1. The Delete Timer Present subfield is set to 0. The Reconfiguration Operation Type subfield is set to 1.
	+ The NSTR Link Pair Present subfield is set to 1 if an NSTR Indication Bitmap is included in the STA Info field. The NSTR Bitmap Size subfield is set to indicate the size of the NSTR Indication Bitmap, as defined in 9.4.2.312.2.4 (Link Info field of the Basic Multi-Link element).
	+ The STA MAC Address subfield in the STA Info field is set to the STA MAC address of the non-AP STA which would operate on the added link with the AP indicated by the Link ID.
	+ The STA Profile field includes the complete profile for the non-AP STA and consists of all the elements and fields that would be included in the STA Profile field for that non-AP STA in an Association Request frame that includes the corresponding non-AP STA as a reported STA.
* If the non-AP MLD is indicating to delete an existing link, it shall set the fields in the Per-STA Profile subelement as follows:
	+ The Link ID subfield is set to the link identifier of the AP affiliated with the AP MLD that is being requested to be removed from the ML setup. The Complete Profile subfield is set to 0. The MAC Address Present subfield is set to 1. The Delete Timer Present subfield is set to 0. The Reconfiguration Operation Type subfield is set to 0.
	+ The NSTR Link Pair Present subfield is set to 0.
	+ The STA MAC Address subfield in the STA Info field is set to the STA MAC address of the non-AP STA operating on the link to be deleted indicated by the Link ID.
	+ Note: The STA Profile field is not included for delete link

If the non-AP MLD is indicating to add one or more links, it shall include an OCI element subfield in the ML Reconfiguration Request frame to provide operating channel information for the current channel where the ML Reconfiguration Request frame is being transmitted if all the following conditions are met:

* the dot11RSNAOperatingChannelValidationActivated is true for the non-AP MLD,
* the RSNE in last (Re)Association Request frame transmitted to the AP MLD indicated OCV capability, and
* the RSNE in the Beacon of the AP corresponding to the current link indicates OCV capability.

After receiving an ML Reconfiguration Request frame indicating request for adding one or more links from a non-AP STA affiliated with a non-AP MLD which indicated OCV capability in its RSNE, and if the RSNE for the affiliated AP also indicates OCV capability, the AP MLD shall validate the OCI element received in the request by ensuring that all the following are true:

* OCI element is present,
* Channel information in the OCI element matches current operating channel parameters (see 12.2.9 (Requirements for Operating Channel Validation)).

Otherwise, the AP MLD shall reject the request by discarding the ML Reconfiguration Request frame.

After receiving an ML Reconfiguration Request frame from a non-AP MLD, the AP MLD shall respond with an ML Reconfiguration Response frame when no OCI element validation is required, or when OCI element validation is required and the validation is successful.

In the ML Reconfiguration Response frame, the AP MLD shall include a Reconfiguration Status duple subfield for each Link ID indicated in the Per-STA Profile subelements of the corresponding ML Reconfiguration Request frame. If the AP MLD accepts an add link request for a Link ID, the corresponding Status subfield shall be set to SUCCESS in the Reconfiguration Status duple subfield.

The AP MLD shall accept a delete link request for a Link ID and shall set the corresponding Status subfield to SUCCESS in the Reconfiguration Status duple subfield, except if it is an NSTR mobile AP MLD and the delete link request is for deleting the primary link of the NSTR mobile AP MLD in which case the AP MLD shall reject the delete link request and set the corresponding Status subfield to REQUEST\_DECLINED.

If the AP MLD accepts link addition for one or more links, the AP MLD shall include Group Key Data subfield in the ML Reconfiguration Response frame when using RSN. For each added link, the AP MLD shall include an MLO GTK KDE, an MLO IGTK KDE and an MLO BIGTK KDE in the Group Key Data subfield.

If the AP MLD accepts link addition for one or more links, the AP MLD shall include an OCI element subfield in the ML Reconfiguration Response frame to provide operating channel information for the current channel where the ML Reconfiguration Response frame is being transmitted if all the following conditions are met:

* the dot11RSNAOperatingChannelValidationActivated is true for the AP MLD,
* the RSNE in last (Re)Association Request frame received from the non-AP MLD indicated OCV capability, and
* the RSNE in the Beacon of the AP corresponding to the current link indicates OCV capability

If the AP MLD accepts any add link request, it shall include in the response frame a Basic Multi-Link element that includes Per-STA Profile subelements corresponding to each AP that is operating on the link that is added to the ML setup of the non-AP MLD as a result of the ML reconfiguration. The Basic Multi-Link element shall not include any other Per-STA Profile subelements. For each Per-STA Profile subelement included in the Basic Multi-Link element, the Complete Profile subfield in the STA Control field shall be set to 1, and the STA Profile field corresponding to that AP shall be complete and consists of all the elements and fields that would be included in the STA Profile field for that AP in an Association Response frame that includes the corresponding AP as a reported AP.

If the AP MLD rejects the indicated add link request for a Link ID, it shall set the corresponding Status subfield in the Reconfiguration Status duple subfield to indicate an appropriate rejection status code as per Table 9-78 (Status codes).

After receiving an ML Reconfiguration Response frame which includes Group Key Data subfield, if the AP indicated OCV capability in its RSNE and the receiving EHT STA RSNE also indicates OCV capability, the non-AP MLD shall validate the OCI element received in the response by ensuring that all of the following conditions are true:

* OCI element is present,
* Channel information in the OCI element matches current operating channel parameters (see 12.2.9 (Requirements for Operating Channel Validation)).

Otherwise, the non-AP MLD shall discard the ML Reconfiguration Response frame.

A non-AP MLD shall send an ML Reconfiguration Request frame on an existing enabled link that is not indicated for deletion in that ML Reconfiguration Request frame. An AP MLD shall send the ML Reconfiguration Response frame on the same link where the corresponding ML Reconfiguration Request frame was received.

(#11658) (#10717)If a multi-link reconfiguration results in one or more links being added to the ML setup of a non-AP MLD, the non-AP MLD and the AP MLD shall operate with all the TIDs mapped to the newly added links. The power management mode of the affiliated non-AP STA corresponding to the added link is the power save mode immediately after the acknowledgement of the ML Reconfiguration Response frame, and its power state is in the doze state.

If a multi-link reconfiguration deletes one or more links from the ML setup of a non-AP MLD that results in one or more TIDs not being mapped to existing enabled links, then the non-AP MLD and the AP MLD shall operate with all the TIDs mapped to all the remaining enabled links for that non-AP MLD, otherwise both the AP MLD and the non-AP MLD shall operate based on the currently established TID-to-Link mapping on the existing enabled links.

**35.3.3.5 Processing of Per-STA Profile subelement of Multi-Link element(#10600)**

***TGbe editor: Please modify first paragraph in this subclause as shown below:***

(#13979)A non-AP STA (STA 1) affiliated with a non-AP MLD shall follow the procedures (if any) that are applicable to a field carried (#13257)(directly or within an element) in a Management frame received on another link(#13259), from an AP (AP 2), as if it (STA 1) had received that field in the corresponding frame transmitted by a reported AP (AP 1) operating on the same link as the non-AP STA (STA 1), if all of the following conditions are satisfied:

* The transmitting AP (AP 2) is affiliated with the same AP MLD as the reported AP (AP 1).
* The field is carried within the STA Info field or STA Profile field of a Per-STA Profile subelement of a Multi-Link element, corresponding to the reported AP (AP 1).
* The corresponding frame is received by another non-AP STA (STA 2) that is affiliated with the same non-AP MLD as the non-AP STA (STA 1).
* One of the conditions is true:
	+ (#10385)The Management frame is a Beacon frame, a Probe Response frame, a (Re)Association Response frame or an ML Reconfiguration Response frame and the transmitting AP (AP 2) does not belong to a multiple BSSID set or is the transmitted BSSID in the multiple BSSID set
	+ (#10385)The Management frame is a (Re)Association Response frame or an ML Reconfiguration Response frame, and the transmitting AP (AP 2) corresponds to a nontransmitted BSSID in a multiple BSSID set.

***TGbe editor: Please modify last paragraph in this subclause as shown below:***

(#13600)(#13601)An AP (AP 1) affiliated with an AP MLD shall follow the procedures (if any) that are applicable to a field carried (directly or within an element) in a (Re)Association Request frame (#10385)or ML Reconfiguration Request frame received on another link, from a non-AP STA (STA 2), as if it (#13259)(AP 1) had received that field in the corresponding frame transmitted by a reported non-AP STA (#13259)(STA 1) operating on the same link as the AP (AP 1), if all of the following conditions are satisfied:

* The transmitting non-AP STA (STA 2) is affiliated with the same non-AP MLD as the reported non- AP STA (STA 1).
* The corresponding frame is received by another AP (AP 2) affiliated with the same AP MLD as the AP (AP 1).
* The field is carried within the STA Info field or STA Profile field of a Per-STA Profile subelement of a Multi-Link element, corresponding to the reported non-AP STA (STA 1).

**35.3.14 Multi-link device individually addressed Management frame delivery**

**35.3.14.1 General**

 ***TGbe editor: Please modify paragraph in this subclause as shown below:***

Between an AP MLD and a non-AP MLD associated with the AP MLD, the following individually addressed
MMPDUs shall be intended for an MLD:
— Authentication frame that includes a Basic Multi-Link element
— (Re)Association Request/Response frame that includes a Basic Multi-Link element
— Deauthentication frame
— Disassociation frame
— Block Ack Action frame
— SA Query Action frame
— (#11318)Multi-link probe request/response
— WNM Sleep Mode Request/Response frame
— TID-To-Link Mapping Request/Response/Teardown frame
— EPCS Priority Access Enable Request/Enable Response/Teardown frame
— EML Operating Mode Notification frame
— SCS Request/Response frame
— MSCS Request/Response frame

— (#10385)ML Reconfiguration Request/Response frame

**12.12 Constraints on allowed security parameters**

**12.12.3 Security constraints for EHT(#11039)**

***TGbe editor: Please modify paragraph in this subclause as shown below:***

(#10385)Management frame protection and beacon protection are required for an EHT BSS when using RSN. An EHT STA shall set dot11RSNAProtectedManagementFramesActivated to true when using RSN. An EHT AP shall have dot11BeaconProtectionEnabled set to true when using RSN. (#13533, #11039)