IEEE P802.11
Wireless LANs

|  |
| --- |
| CC36 Comment resolution for Enterprise-Grade TID Mapping |
| Date: 2022-05-11 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Pooya Monajemi | Cisco |  |  | pmonajem@cisco.com  |
| Brian Hart | Cisco |  | brianh@cisco.com |
| Laurent Cariou | Intel |  |  | laurent.cariou@intel.com |
| Arik Klein | Huawei |  |  | arik.klein@huawei.com  |
| Yong Liu | Apple |  |  | yongliu@apple.com |
| Jarkko Kneckt | Apple |  |  | jkneckt@apple.com |
| Abhishek Patil | Qualcomm |  |  | appatil@qti.qualcomm.com |
| George Cherian | Qualcomm |  |  | gcherian@qti.qualcomm.com |
| Eldad Perahia | HPE |  |  | eldad.perahia@hpe.com |
| Gaurav Patwardhan | HPE |  |  | gaurav.patwardhan@hpe.com |
| Matthew Fischer | Broadcom |  |  | matthew.fischer@broadcom.com |
| Zhou Lan | Broadcom |  |  | zhou.lan@broadcom.com |
| Liuming Lu | Oppo |  |  | luliuming@oppo.com |
| Lei Huang | Oppo |  |  | huang.lei1@oppo.com |

Abstract

Proposed draft text for enhancements to TID mapping.

The submission proposes text changes to resolve CIDs 6643, 5154, 4027, 5038, 5030, 5692, 5759, 5956, 5957, 6347, 6498, 6766, 6767, 6895, 7671, 8179 from CC36. All proposed changes are based on 802.11be Draft 1.6 and including changes in document 22/601r2.

Please see discussion notes below for a review of introduced changes.

# Revision History

|  |  |  |
| --- | --- | --- |
| **Date** | **Revision** | **Changes** |
| 2021-11-6 | 0 | Initial draft |
| 2022-01-18 | 1 | Added countdown timer and reason code |
| 2022-04-04 | 2 | Added signaling in RNR, MLME additions, new CIDs, clarifications |
| 2022-04-07 | 3 | CIDs 5956,5957, Added descriptions to 9.4.2.314 |
| 2022-05-08 | 4 | Updates to MLME, etc |
| 2022-05-10 | 5 | MLME updates to new primitives, reason code updates, reorgranization of AP enablement/disablement to new sections, EPCS considerations, changed Mapping Switch Count to Mapping Switch Time, MU-EDCA only applicable to enhanced TID to link mapping, renamed Duration to Expected Duration, other notes and clarifications |
| 2022-05-11 | 6 | Removed Mobile AP sower save reason code |

# CC36 Comments and discussion [against Draft 1.0]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **P.L** | **Clause** | **Comment** | **Proposed Change** | **Proposed Resolution** |
| 6643 | 258.8 | 35.3.6.1.1 | TID to link negotiation can be mandatory in certain cases, however not in all. AP needs to be able to signal that a negotiation is required. | Add signaling in operation element indicating the need to perform negotiation. | Resolution: Revised, please implement the changes as shown in this document marked #6643. |
| 5154 |  |  | The procedure, if an AP MLD chooses to disable a link (for any reason) is missing. Please specify. | Add signaling in operation element indicating the need to perform negotiation. | Resolution: Revised, please implement the changes as shown in this document marked #6643. |
| 5956 | 162.01 | 9.6.35.3 | Currently specified TID-To-Link Mapping Response frame contains a field of status code, which only includes DENIED\_TID\_TO\_LINK\_MAPPING and SUCCESS for the response to the request. If the response MLD rejects the TID-TO-LINK mapping request sended by the request MLD only the status code of DENIED\_TID\_TO\_LINK\_MAPPING can be used, and the request MLD is still unable to know what TID-to-link mapping can be potentially accepted by the response MLD. The limited types of TID-To-Link Mapping Response and status codes would reduce the efficiency of the TID-to-link mapping negotiation | Suggest to further specify the types of TID-to-link Mapping Response and extend the specification of the field of status codes to increase the efficiency of the TID-to-link mapping negotiation | Resolution: Revised, please implement the changes as shown in this document marked #5956. |
| 5957 | 161.10 | 9.6.35.2 | Currently specified TID-To-Link Mapping Request frame is too simple to be convenient for the TID-to-link mapping negotiation.For example, the request MLD wants to suggest TID-to-link mapping parameters in the request but it still can potentially accept other TID-to-link mapping parameters if the suggested TID-to-link mapping parameters are not satisfied, and currently specified TID-To-Link Mapping Request frame cannnot be used in this case. | Suggest to further specify the types of TID-to-link Mapping request to increase the efficiency of the TID-to-link mapping negotiation | Resolution: Revised, please implement the changes as shown in this document marked #5957. |
| 4027 | 183.01 | 11.8 | Clause 11.8 describes DFS operation. An AP is required to move its BSS to a different channel when radar is detected on the current channel. Before moving the BSS operation to a new channel, the AP needs to perform certain checks (required by regulatory) to ensure there is no radar operating on the new channel. Such checks can take time (some times up to 10 minutes or more depending on the region and selected channel). In addition, while performing such checks, the AP may detect radar on the selected (new) channel and therefore, may need to select another channel. Under such conditions an AP will be unavailable for a prolong period of time. | The spec needs to provide mechanisms for multi-link operations to continue uninterrupted while an AP of an AP MLD is unavailable for DFS reasons. Commenter will provide a contribution. | Resolution: Revised, please implement the changes as shown in this document marked #6643. |
| 5038 | 264.57 | 35.3.9.2 | If the target operating class/channel selected by an AP performing a channel switch is a DFS channel, there can be a scenario where the AP detects a radar on the new channel and must switch the channel again. This will make the channel announced in the Channel Switch Announcement element invalid. The spec must provide a method to notify the non-AP MLDs about the new channel switch. | Clarify that if an AP affiliated with an AP MLD performs a channel switch and announces the channel switch through a (Extended) Channel Switch Announcement element and (optionally) Max Channel Switch Time element, if a second channel switch occurs within the time indicated in the Switch Time field of the Max Channel Switch Time element, the AP must announce this channel switch on all other links in the Beacon and Probe Response frames by including another (Extended) Channel Switch Announcement element and an (optional) Max Channel Switch Time element. | Resolution: Revised, please implement the changes as shown in this document marked #6643. |
| 6766 | 9.4.2.295e | 154.15 | The text suggests that the recommendation for a link is only for default mapping mode. I do not understand why is it excluded negociated TID-link mapping which may have several links (not all links) for one TID | as in comment | Revised – Add an additional signaling that will apply to all modes and for both UL and DL. Apply the changes marked as #6766 in this document.  |
| 6767 | 35.3 | 246.15 | The link recommendation addressed in 35.3.10.4 is for the downlink traffic, it may be necessary to have a mechanism of link recommendation for uplink traffic. | Propose an equivalent mechanism of link recommendation for uplink traffic to help AP for the scheduling. For instance, add the link id information in the buffer status report | Revised – Add an additional signaling that will apply to all modes and for both UL and DL. Apply the changes marked as #6766 in this document. |
| 6895 | 35.3.10.4 | 267.17 | The sentence says "An AP MLD may recommend a non-AP MLD to use one or more enabled links to retrieve individually addressed buffered BU(s)". Through what signaling mechanism this recommendation is done? Is the recommendation made by using the Multi-Link Traffic element? Specifically, by using the Per-Link Traffic Indication Bitmap subfield in Multi-Link Traffic element? | The spec needs to provide clarification on how (signaling mechanism) the recommendation is made | Revised – Clarify the signaling and add an additional signaling that will apply to all modes and for both UL and DL. Apply the changes marked as #6766 in this document. |
| 7671 | 35.3.10.4 | 267.17 | It says "An AP MLD may recommend a non-AP MLD to use one or more enabled links to retrieve individually addressed buffered BU(s)" But how to recommend is missing. Please clarify. | See comment. | Revised – Clarify the signaling and add an additional signaling that will apply to all modes and for both UL and DL. Apply the changes marked as #6766 in this document. |
| 8179 | 35.3.10.4 | 267.17 | "An AP MLD may recommend a non-AP MLD to use one or more enabled links to retrieve individually addressed buffered BU(s)" It only happens under default mapping, please clarify. | as in comment | Revised – Provide clarification for this signaling and add an additional signaling that will apply to all modes and for both UL and DL. Apply the changes marked as #6766 in this document. |
| 5030 | 35.3.10.4 | 267.18 | It is not clear from the spec, how to recommend to use specific links to retrieve BUs between the beacons | Add a special control field | Revised – agree with the commenter. Reformulate to better capture how the recommendation is made. Apply the changes marked as #5030 in this document. |
| 5759 | 35.3.10.4 | 267.18 | "The AP's indication may be carried in a broadcast or a unicast frame". Current spec has specified the broadcast version, but we still miss the unicast version of it, which will be useful to recommend a link when the STA is awake/active or for UL. | define signaling for a link recommendation that would be sent in a unicast manner (A-ctrl, management frame, ...) | Revised – agree with the commenter. Define a new Link Recommendation frame that can include recommendation in a broader way for DL and UL and also for active STAs. Apply the changes marked as #5759 in this document. |
| 6347 | 35.3.10.4 | 267.18 | The detail of how an AP MLD recommends one or more enabled links to a non-AP MLD in an individually addressed frame is missing. | Define a signaling that an AP MLD can recommend one or more enabled links to a non-AP MLD. One way is to use the A-Control field of a frame from the AP MLD to include the recommended links. | Revised – agree with the commenter. Define a new Link Recommendation frame that can include recommendation in a broader way for DL and UL and also for active STAs. Apply the changes marked as #6347 in this document. |
| 6498 | 35.3.10.4 | 266.17 | The third sentence is unclear of what is the procedure and frames used for recommendation : "An AP MLD may recommend a non-AP MLD to use one or more enabled links to retrieve individually addressed buffered BU(s). The AP's indication may be carried in a broadcast or a unicast frame" | Specify the frames or procedure used for such recommendation (instead or saying the frames can be unicast or broadcast) | Revised – agree with the commenter. Apply the changes marked as #6766 in this document |
| 5692 | 35.3.10.4 | 267.17 | An AP MLD may recommend a non-AP MLD to use one or more enabled links to retrieve individually addressed buffered BU(s). The AP's indication may be carried in a broadcast or a unicast frame. Need to clarify that the indication is carried in a multi-link Traffic elemement. | As in comment |  Revised – agree with the commenter. Apply the changes marked as #6766 in this document |

**Discussion:**

This document addresses two general topics in two sections:

* TID to link mapping enhancements
* Link recommendation

**TID to Link Mapping Use Cases**

The first part of the document presents TID to link mapping enhancements. Please refer to contribution 802.11-21/1611 for more discussion on this topic.

The enhancements are meant to help non-AP STAs maintain maximum connectivity on the maximum number of links that are most preferred by the non-AP STA as the AP performs one of the operations below:

1. AP Unavailability: An AP MLD needs a notification-based mechanism that will allow it to temporarily prohibit frame exchange on one or more of the links it operates. The reasons for the unavailability may include operations or maintenance by the AP administrator, regulatory reasons, reducing AP power consumption.
2. Load balancing: To mitigate excess collisions in high scale environments with a large number of STAs contending, the AP must have a reliable mechanism to balance loads among its links. Consider a case in which a large majority of STAs enable power save on all links except one, where the one awake link is the same link among the non-AP STAs. The AP MLD needs to be able distribute the load in this situation while taking into account any limitations that a STA may have.
3. QoS traffic prioritization: One link may be considered the preferred link for latency-sensitive traffic. In order to achieve the latency targets, traffic belonging to non-latency-sensitive TIDs should then be managed on this link to avoid congestion. This goal is achieved by mandating MU-EDCA operation on these links for non-latency-sensitive TIDs.

**TID to Link Mapping Enhancements**

The proposed draft text makes the following enhancements:

* Introduces a priority level in TID-to-link mapping negotiations
* Defines TID-to-link-subset mapping requirements, and adds an “enhanced TID to link subset” mapping capability
* Introduces a method for both non-AP STAs and APs to identify reasons for TID mapping changes
* Adds scalable TID-to-link mapping mechanisms (broadcast advertisement and group-negotiation)
* Adds a countdown timer (required when a mandatory priority is set), in order to allow time for the recipient to change its mapping

For load balancing an approach is introduced where an AP MLD can send unicast or “multicast” (ie. broadcast with an AID bitmap) TID-to-Link mapping requests with a priority level. When the priority level is set to recommendation the recipient STA may or may not follow the request. To address cases where the collective responses to the recommendation does not meet the load balancing need then a mandatory option is included. Even when the priority is set to mandatory, during the countdown timer, the recipient is allowed to respond with alternate requests indicating link preference and limitations on its side which the AP should take into consideration before completing the TID-to-Link negotiation**.**

For temporary disablement of an AP a broadcast method is defined where an AP MLD announces that a link will be temporarily disabled for all STAs using a TID-to-link-mapping element included in a Beacon. For this scheme no responses are defined.

**Link Recommendation**

The second part of the document presents enhancements to the link recommendation scheme.

The text introduces an enhancement to the link recommendation mechanism that is available currently only for buffered traffic indication. A frame is added that allows the AP to recommend links for a number of STAs with using an AID bitmap.

This tool can be used for quick recommendation of links to a number of non-AP MLDs when a permanent and/or mandatory negotiation of TID to link mapping is not desired or not feasible.

TGbe editor: Add two new sections in 6.3 as follows (#6643):

6.3.134 Link Disable

6.3.134.1 Introduction

This mechanism supports the process of advertising that a link on which an AP affiliated with an AP MLD is operating is disabled for all associated non-AP MLDs that have an affiliated non-AP STA operating on that link. An affiliatd AP, while disabled, does not transmit or receive any frames.

6.3.134.2 MLME-BSS-DISABLE.request

6.3.134.2.1 Function

This primitive requests the MAC entity associated with an affiliatd AP to disable links for all association non-AP MLDs.

6.3.134.2.2 Semantics of the service primitive

The primitive parameter is as follows:

MLME-BSS-DISABLE.request(

 SSID,

 DisableTimer,

 ExpectedDuration,

 ReasonCode,

 DisassociateNonMLDSTAs

)

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid range | Description |
| SSID | Octet string | 0–32 octets | The SSID of the BSS to be disabled. |
| DisableTimer | Integer | 0–65 535 | Specifies the number of TBTTs until the AP is disabled. A value of 0 indicates AP will be disabled at its next TBTT. |
| ExpectedDuration | Integer | 0- 16,777,215 | Indicates the duration for which the requested disablement is expected to be effective  |
| ReasonCode | Integer | 0-15 | Specifies the reason for disablement, as described in Table **9-XX3** |
| DisassociateNonMLDSTAs | Boolean | true, false | Specifies whether associated STAs not affiliated with any MLDs need to be disasociated. |

6.3.134.2.3 When generated

This primitive is generated by the SME when it decides to disable an affiliated AP.

6.3.134.2.4 Effect of receipt

The primitive starts the affiliated AP disablement process in 35.3.7.1 (Affiliated AP disablement). All services provided by the AP to an infrastructure BSS, including Beacon and Probe Response frame transmissions and access to the DS, are stopped by the disablement. If DisassociateNonMLDSTAs is true, then all the associated non-MLD STAs in an infrastructure BSS are disassociated by the disablement.

6.3.134.3 MLME-BSS-DISABLE.confirm

6.3.134.3.1 Function

This primitive reports the results of an affiliated AP disablement procedure.

6.3.134.3.2 Semantics of the service primitive

The primitive parameter is as follows:

MLME-BSS-DISABLE.confirm(

 SSID

)

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid range | Description |
| SSID | Octet string | 0–32 octets | The SSID of the BSS that was disabled. |

6.3.134.3.3 When generated

This primitive is generated by the MLME as a result of an MLME-BSS-DISABLE.request primitive to disable an affiliated AP.

6.3.134.3.4 Effect of receipt

The SME is notified of the results of the affiliated AP disablement procedure.

6.3.134.4 MLME-BSS-DISABLE.indication

6.3.134.4.1 Function

This primitive reports that the peer MAC entity has disabled an affiliatd AP.

6.3.134.4.2 Semantics of the service primitive

The primitive parameter is as follows:

MLME-BSS-DISABLE.indication(

 PeerSTAAddress,

 DisableTimer,

 ExpectedDuration,

 ReasonCode,

)

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid range | Description |
| PeerSTAAddress | MAC address | Any valid individual MAC address | Specifies the address of the peer MAC entity that has disabled an affiliated AP |
| DisableTimer | Integer | 0–65 535 | Specifies the number of TBTTs until the AP is disabled. A value of 0 indicates AP will be disabled at its next TBTT. |
| ExpectedDuration | Integer | 0- 16,777,215 | Indicates the duration for which the requested disablement is expected to be effective  |
| ReasonCode | Integer | 0-15 | Specifies the reason for disablement, as described in Table **9-XX3** |

6.3.134.4.3 When generated

This primitive is generated by the MLME when a Beacon frame which includes advertising of a new TID-To-Link mapping which contains one or more disabled links is received by one or more non-AP STA affiliated with associated non-AP MLD.

6.3.134.3.4 Effect of receipt

The SME is notified of the upcoming disablement of a link upon which an AP affiliated with the AP MLD is operating.

6.3.134.2 MLME-SOLICIT-BSS-DISABLE.indication

6.3.134.2.1 Function

This primitive solicits the SME of an AP MLD to disable a link on which one of the affiliatd APs is operating.

6.3.134.2.2 Semantics of the service primitive

The primitive parameter is as follows:

MLME- SOLICIT-BSS-DISABLE.indication(

 SSID,

 DisableTimer,

 ExpectedDuration,

 ReasonCode,

 DisassociateNonMLDSTAs

)

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid range | Description |
| SSID | Octet string | 0–32 octets | The SSID of the BSS to be disabled. |
| DisableTimer | Integer | 0–65 535 | Specifies the number of TBTTs until the AP is disabled. A value of 0 indicates AP will be disabled at its next TBTT. |
| ExpectedDuration | Integer | 0- 16,777,215 | Indicates the duration for which the requested disablement is expected to be effective  |
| ReasonCode | Integer | 0-15 | Specifies the reason for disablement, as described in Table **9-XX3** |
| DisassociateNonMLDSTAs | Boolean | true, false | Specifies whether associated STAs not affiliated with any MLDs need to be disasociated. |

6.3.134.2.3 When generated

This primitive is generated by the MLME of an AP MLD to notify the SME that a link on which an AP affiliated with the AP MLD is operating needs to become disabled.

6.3.134.2.4 Effect of receipt

The primitive solicits the affiliated AP disablement process to be initiated by the SME. Once the SME receives this solicitation it can initiate the process by sending a MLME-BSS-DISABLE.request primitive to the MLME.

6.3.135 Link Enable

6.3.135.1 Introduction

This mechanism supports the process of enabling a link on which an AP affiliated with an associated AP MLD, i.e., allowing transmission and reception of frames in the BSS the affiliated AP was operating before it was disabled.

6.3.135.2 MLME-BSS-ENABLE.request

6.3.135.2.1 Function

This primitive requests the AP MLD to re-initiate the operation of the BSS corresponding to the affiliated AP operation on the link that becomes enabled and to indicate the enabling of the link.

6.3.135.2.2 Semantics of the service primitive

The primitive parameter is as follows:

MLME-BSS-ENABLE.request(

 SSID,

 EnableTimer

)

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid range | Description |
| SSID | Octet string | 0–32 octets | The SSID of the BSS to be enabled. |
| EnableTimer | Integer | 0–65 535 | Specifies the number of TBTTs until the AP is enabled. A value of 0 indicates AP will be enabled at its next TBTT. |

6.3.135.2.3 When generated

This primitive is generated by the SME when a current link disablement is to expire and the BSS corresponding to the AP affiliated with the AP MLD which is operating on the that link should be re-initialized.

6.3.135.2.4 Effect of receipt

The primitive starts the affiliated AP enablement process in 35.3.7.1 (Affiliated AP enablement). All services provided by the AP to an infrastructure BSS, including Beacon and Probe Response frame transmissions and access to the DS, are resumed.

6.3.135.3 MLME-BSS-ENABLE.confirm

6.3.135.3.1 Function

This primitive reports the results of an affiliated AP enablement procedure.

6.3.135.3.2 Semantics of the service primitive

The primitive parameter is as follows:

MLME-BSS-ENABLE.confirm(

 SSID

)

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid range | Description |
| SSID | Octet string | 0–32 octets | The SSID of the BSS that was enabled. |

6.3.135.3.3 When generated

This primitive is generated by the MLME as a result of an MLME-BSS-ENABLE.request primitive to enable an affiliated AP.

6.3.135.3.4 Effect of receipt

The SME is notified of the results of the affiliated AP enablement procedure.

6.3.135.4 MLME-BSS-ENABLE.indication

6.3.135.4.1 Function

This primitive reports that the peer MAC entity has enabled an affiliatd AP.

6.3.135.4.2 Semantics of the service primitive

The primitive parameter is as follows:

MLME-BSS-ENABLE.indication(

 PeerSTAAddress,

 EnableTimer,

)

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid range | Description |
| PeerSTAAddress | MAC address | Any valid individual MAC address | Specifies the address of the peer MAC entity that has enabled an affiliated AP |
| EnableTimer | Integer | 0–65 535 | Specifies the number of TBTTs until the AP is enabled. A value of 0 indicates AP will be enabled at its next TBTT. |

6.3.135.4.3 When generated

This primitive is generated by the MLME when a peer MAC entity indicates intent to enable an affiliated AP.

6.3.135.3.4 Effect of receipt

The SME is notified of the upcoming enablement of an affiliated AP on the peer MAC entity.

6.3.135.2 MLME-SOLICIT-BSS-ENABLE.indication

6.3.135.2.1 Function

This primitive solicits the SME to enable an affiliatd AP.

6.3.135.2.2 Semantics of the service primitive

The primitive parameter is as follows:

MLME- SOLICIT-BSS-ENABLE.indication(

 SSID,

 EnableTimer

)

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid range | Description |
| SSID | Octet string | 0–32 octets | The SSID of the BSS to be enabled. |
| DisableTimer | Integer | 0–65 535 | Specifies the number of TBTTs until the AP is enabled. A value of 0 indicates AP will be enabled at its next TBTT. |

6.3.135.2.3 When generated

This primitive is generated by the MLME to notify the SME that an affiliated AP can be enabled.

6.3.135.2.4 Effect of receipt

The primitive solicits the affiliated AP enablement process to be initiated by the SME. Once the SME receives this solicitation it can initiate the process by sending a MLME-BSS-ENABLE.request primitive to the MLME.

### 9.3.3.2 Beacon frame format

TGbe editor: Add two rows to table 9-32 as follows (#6643):

**Table 9-32—Beacon frame body(#1004)(#2246)(#3352) *(continued)***

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| <Last assigned + 1> | Multi-Link | (#3016)(#1005)(#1896)(#6700)(#8265)The Basic Multi-Link element is present if dot11MultiLinkActivated is true; otherwise it is not present |
| <Last assigned + 2> | EHT Capabilities | The EHT Capabilities element is present if dot11EHTOptionIm- plemented is true; otherwise it is not present. |
| <Last assigned + 3> | EHT Operation | The EHT Operation element is present if dot11EHTOptionImple- mented is true; otherwise it is not present. |
| <Last assigned + 4> | Multi-Link Traffic Indication | The Multi-Link Traffic Indication element is present ifdot11MultiLinkTIMActivated is true; otherwise it is not present |
| <Last assigned + 5> | TID-To-Link Map- ping | One or two TID-To-Link Map ping elements are optionally present if dot11MultiLinkActivated and dot11TIDtoLinkMappingActivated are true; otherwise, none are present. - If two TID-To-Link Mapping elements are present, the Mapping Switch Time subfield in one of the TID-To-Link Mapping elements is set to 0 and the Mapping Switch Time subfield in the other TID- To-Link Mapping element is set to a nonzero value. |
| <Last assigned + 6> | ML Load  | The ML Load element is optionally present if dot11MultiLinkActivated is true and dot11TIDtoLinkMappingActivated is true; otherwise it is not present.  |

### 9.3.3.10 Probe Response frame format

TGbe editor: Add two rows to table 9-39 as follows (#6643):

### Table 9-39—Probe Response frame body(#1004)(#2246)(#3359)

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| 11 | Quiet | The Quiet element is optionally present if dot11SpectrumManage- mentRequired is true or if dot11RadioMeasurementActivated is true or dot11RestrictedTWTOptionImplemented is true(#2215). |
| <Last assigned + 1> | Multi-Link | (#3016)(#1005)(#1896)(#1007)(#2861)(#1898)(#2860)(#1155)(# 1414)(#2581)(#3367)(#3359)(#2859)(#6700)The Basic Multi-Link element is present if the AP is affiliated with an AP MLD. Otherwise it is not present. |
| <Last assigned + 2> | EHT Capabilities | The EHT Capabilities element is present if dot11EHTOptionIm- plemented is true; otherwise it is not present. |
| <Last assigned + 3> | EHT Operation | The EHT Operation element is present if dot11EHTOptionImple- mented is true; otherwise it is not present. |
| <Last assigned + 4> | TID-To-Link Map- ping | The TID-To-Link Map ping element is optionally present if dot11MultiLinkActivated is true, and dot11TIDtoLinkMappingActivated is true; otherwise it is not present.- If two TID-To-Link Mapping elements are present, the Mapping Switch Time subfield in one of the TID-To-Link Mapping elements is set to 0 and the Mapping Switch Time subfield in the other TID- To-Link Mapping element is set to a nonzero value. |
| <Last assigned + 5> | ML Load  | The ML Load element is optionally present if dot11MultiLinkActivated is true and dot11TIDtoLinkMappingActivated is true; otherwise it is not present.  |

### **9.4.2 Elements**

### **9.4.2.1 General**

TGbe editor: ***Insert two new rows to*** [***Table 9-128 (Element IDs(#1009)(#1121))***](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark86)(#6643)***:***

**Table 9-128—Element IDs(#1009)(#1121)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Element** | **Element ID** | **Element ID Extension** | **Extensible** | **Fragmentable** |
| EHT Operation (see [9.4.2.311 (EHT](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark113) [Operation element)](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark113)) | 255 | 106 | Yes | No |
| Multi-Link (see [9.4.2.312 (Multi-Link](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark116) [element)](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark116)) | 255 | 107 | Yes | Yes |
| EHT Capabilities (see [9.4.2.313 (EHT](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark142) [Capabilities element(#4819))](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark142)) | 255 | 108 | Yes | No |
| TID-To-Link Mapping (see [9.4.2.314](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark159) [(TID-To-Link Mapping element)](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark159)) | 255 | 109 | Yes | Yes |
| Multi-Link Traffic (see [9.4.2.315 (Multi-](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark162) [Link Traffic element(#2341))](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark162)) | 255 | 110 |  |  |
| (#4918)QoS Characteristics (see [9.4.2.316](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark167) [(QoS Characteristics element(#4918))](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark167) | 255 | <ANA> | Yes | Yes |
| AID Bitmap element (see 9.4.2.317 AID Bitmap element) | 255 | <ANA> | Yes | Yes |
| ML-Load element (see 9.4.2.318 ML Load element) | 255 | <ANA> | Yes | Yes |

**9.4.2.27 BSS Load element**

***TGbe editor: Modify the following paragraph in section 9.4.2.27 as follows*** (#6643)***:***

The STA Count field is interpreted as an unsigned integer that indicates the sum of total number of STAs currently associated with this BSS that are not affiliated with an MLD, and STAs affiliated with an MLD that are currently operating in this BSS on an enabled link.

NOTE – A link might be disabled between a non-AP MLD and its associated AP MLD via TID-to-Link mapping operation (see 35.3.7). For such non-AP MLD(s), the corresponding STA affiliated with the non-AP MLD is not operating on that link and hence is not counted towards the value carried in the STA Count field.

**9.4.2.170 Reduced Neighbor Report element**

**9.4.2.170.2 Neighbor AP Information field**

***TGbe editor: Update the following Figure 9-709b (MLD Parameters subfield format) as follows:***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 B7 | B8 B11 | B12 B19 | B20 | B21 | B22 B23 |
|  | MLD ID | Link ID | BSS Parameters Change Count | All UpdatesIncluded | Disabled Link Indication | Reserved |
| Bits: | 8 | 4 | 8 | 1 | 1 | 3 |

**Figure 9-709b—MLD Parameters subfield format**

***TGbe editor: Add the following at the end of this subclause as follows:***

The Disabled Link Indication subfield is set to 1 if the reported AP is operating on a link that is advertised as disabled for all associated non-AP MLDs and the Co-Located AP bit of the BSS Parameters subfield of the TBTT Information field of the Neighbor AP Information field is set to 1. Otherwise, the Disabled Link Indication subfield is set to 0. Additional rules for associated and unassociated STAs when a link is advertised as disabled for all associated non-AP MLDs are defined in 35.3.7.1.5(Advertised TID-to-link mapping in Beacon and Probe Response frames).

* MU EDCA Parameter Set element(11ax)

***TGbe editor: Update the following paragraph in section 9.4.2.251 as follows*** (#6643)***:***

The MU EDCA Timer field indicates the duration of time, in units of 8 TUs, during which the HE STA uses the MU EDCA parameters for the corresponding AC, as defined in 26.2.7 (EDCA operation using MU EDCA parameters), with the following exceptions:

* the field is reserved when conditions described in 35.3.7.1.1 (General) are met
* the value 0 is reserver otherwise

### **9.4.2.312.2.2 Multi-Link Control field of the Basic Multi-Link element**

TGbe editor: Modify section 9.4.2.312.2.2 as shown below (#6643):

**Table 9-401h—Subfields of the MLD Capabilities field(#1078)(#1475)(#2981) *(continued)***

|  |  |  |
| --- | --- | --- |
| **Subfield** | **Definition** | **Encoding** |
| TID-To-Link Map- ping Negotiation Sup- ported | Indicates support for TID-to-link mapping negotiation. | Set to 0 if dot11TIDtoLinkMappingActivated is false (#4267)and TID-to-link mapping is not supported by the MLD.Set to 1 if dot11TIDtoLinkMappingActivated is true and the MLD (#4267)only supports the mapping of all TIDs to the same link set, both for DL and UL.Set to 2 if dot11TIDtoLinkMappingActivated is true and the MLD supports the mapping, for both UL and DL, of all TIDs to a subset of links while optionally mapping some TIDs to one additional link, with TIDs corresponding to the same AC mapped to the same set of links, for UL and DL in both cases.Set to 3 if dot11TIDtoLinkMappingActivated is true and the MLD supports the mapping of each TID to the same or different link set.See NOTE 1(See 35.3.7.1.3 (Negotiation of TID-to-link mapping)) |
| NOTE 1—Indicating support for TID-to-link mapping negotiation using any value also indicates support for negotiations applicable to all smaller values. |

TGbe editor: Modify section 9.4.2.314 as shown below (#6643, #5956, #5957):

### **9.4.2.314 TID-To-Link Mapping element**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Element ID | Length | Element ID Extension | TID-To-Link Mapping Control | Mapping Switch Time | Expected Duration | Link Mapping Of TID 0(Optional) | … | Link Mapping Of TID 7(Optional) | Link Reason Code List(Optional)) |

Octets: 1 1 1 2 0 or 2 0 or 3 0 or 2 0 or 2 Variable

**Figure 9-1002z—TID-To-Link Mapping element format**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 B1 | B2 | B3 | B4 | B5 | B6 B7 | B8 |  | B15 |
| Direction | Default Link Mapping |  Priority | Mapping Switch Time Present | Expected Duration Present | Reserved |  | Link Mapping Presence Indicator |
| Bits: | 2 | 1 | 1 | 1 | 1 | 2 |  | 8 |  |

**Figure 9-1002aa—TID-To-Link Control field format**

The Default Link Mapping subfield is set to 1 if the TID-To-Link Mapping element represents the default TID-to-link mapping. Otherwise, it is set to 0.

The Priority subfield indicates the priority level for the proposed Link Mapping according to Table 9-xx2 when the TID-To-Link Mapping element is sent in a TID-To-Link Mapping Response frame or a (Re)Association Response frame, and according to Table 9-xx1 otherwise.

**Table 9-xx1 —Priority subfield in a frame other than a TID-To-Link Mapping Response frame or an Association Response frame**

|  |  |  |  |
| --- | --- | --- | --- |
|  **Priority Subfield** | **Request by AP MLD** | **Request by non-AP MLD** | **Description** |
| 0 | Prefer to change | Prefer to change | This TID-To-Link Mapping element specifies a preferred TID-to-link mapping to be requested. |
| 1 | Mandatory | Strongly prefer to change | **Request by AP MLD:**this TID-To-Link Mapping element specifies a mandatory TID-to-link mapping to be requested. **Request by non-AP MLD:**this TID-To-Link Mapping element specifies a strongly preferred TID-to-link mapping to be requested. |

**Table 9-xx2 —Priority subfield in a TID-To-Link Mapping Response frame or a (Re)Association Response frame**

|  |  |  |  |
| --- | --- | --- | --- |
| **Priority Subfield** | **Link Mapping Presence Indicator subfield** | **Status Code** | **Response** |
| 0 | All 0 | 133 (DENIED\_TID\_TO\_LINK\_MAPPING) | Prefer not to change |
| 1 | All 0 | 133 (DENIED\_TID\_TO\_LINK\_MAPPING) | Cannot accept change |
| 0 | At least one 1 | 134 (PREFERRED\_TID\_TO\_LINK\_MAPPING\_SUGGESTED) | This TID-To-Link Mapping element specifies a preferred TID-to-link mapping to be suggested.  |
| 1 | At least one 1 | 134 (PREFERRED\_TID\_TO\_LINK\_MAPPING\_SUGGESTED) | This TID-To-Link Mapping element specifies a strongly preferred TID-to-link mapping to be suggested.  |

The Mapping Switch Time Present subfield is set to 1 if the Mapping Switch Time field is present and 0 otherwise.

The Expected Duration Present subfield is set to 1 if the Expected Duration field is present and 0 otherwise.

The Link Mapping Presence Indicator subfield indicates whether the Link Mapping Of TID n field is present in the TID-To-Link Mapping element (#4023)(i.e., it identifies the TID(s) for which the mapping is pro- vided in the element). A value of 1 in bit position n of the Link Mapping Presence Indicator subfield indicates that the Link Mapping Of TID n field is present in the TID-To-Link Mapping element. Otherwise, the Link Mapping Of TID n field is not present in the TID-To-Link Mapping element. When the Default Link Mapping subfield is set to 1, this subfield is (#7707)not present.

The Mapping Switch Time field is present when the TID-To-Link Mapping element is transmitted by an AP affiliated with an AP MLD and the Priority subfield of the TID-To-Link Control field is 1;otherwise it is not present. The Mapping Switch Time field is set to the remaining time in units of TUs until the AP sending the TID-To-Link Mapping element starts using the new mapping. The value 0 indicates that the switch has already occurred.

The Expected Duration field indicates the duration for which the proposed TID-to-link Mapping is expected to be effective in units of TUs when the Mapping Switch Time field is greater than zero and the remaining duration for which the proposed TID-to-link Mapping is expected to be effective in units of TUs when the Mapping Switch Time field is zero. The Expected Duration field is present if the frame carrying the TID-To-Link Mapping element is a Beacon or a Probe Response frame transmitted by an AP affiliated with an AP MLD and the Priority subfield of the TID-To-Link Control field is set to 1, and is not present otherwise.

NOTE 1—The established TID-to-link mapping does not change or revert automatically at the time indicated by the Expected Duration field, this field only provides an estimate.

The Link Mapping Of TID n field (where n= 0, 1… 7 ) indicates the link(s) on which frames belonging to the TID n are allowed to (#4024)be sent (i.e., carries a bitmap of the links to which the TID n is mapped to). A value of 1 in bit position i (#6668)(where i = 0, 1…14 ) of the Link Mapping Of TID n field indicates that TID n is mapped to the link associated with the link ID i for the direction as specified in the Direc- tion subfield. (#5134)A value of 0 in bit position i indicates that the TID n is not mapped to the link associated with the link ID i. When the Default Link Mapping subfield is set to 1, this field is not present.

The Link Reason Code List field indicates a Reason Code associated with a link in a TID-to-link mapping negotiation. This field is present in TID-To-Link Mappingelements transmitted by an AP affiliated with an AP MLD and in all TID-To-Link Mapping elements with Priority subfield set to1 transmitted by a STA affiliated with a non-AP MLD, except when the AP MLD or the non-AP MLD set the Default Link Mapping subfield of the TID-To-Link Control field to 1. The Link Reason Code List field may be present when transmitted by a STA affiliated with a non-AP MLD with Priority subfield set to 0 or with the Default Link Mapping subfield set to 0. The format of the Link Reason Code List field is defined in Figure 9-1002ab (Link Reason Code List field format).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Link Reason Code Presence Indicator | Link 1 Reason Code  | Link 2 Reason Code  | … | Link m Reason Code  | Padding |
| Bits: | 16 | 4 | 4 |  | 4 | 0 or 4 |

**Figure 9-1002ab—** **Link Reason Code List field format**

The Link Reason Code Presence Indicator subfield indicates the links for which a Link Reason Code subfield is present. In bit position n of the Link Reason Code Presence Indicator subfield, a value of 1indicates that the Link Reason Code subfield is present for the link associated with the link ID n. Otherwise, the Link Reason Code subfield for the link associated with link ID n is not present.

Each Link x Reason Code subfield indicates the Reason Code for a link that has a corresponding bit set to 1 in the Link Reason Code Presence Indicator subfield, in increasing order of link ID.

Table 9-xx3 lists the Reason Codes transmitted by APs. Table 9-xx4 lists the Reason Codes transmitted by non-APs.

The Padding subfield contains either 0 or 4 bits so that the length of the Link Reason Code List field is a multiple of 8 bits. The padding bits, if present, are set to 0.

**Table 9-xx3 — Encoding of the Link x Reason Code field when transmitted by an AP**

|  |  |  |
| --- | --- | --- |
| Value  | Reason Code | Description  |
| 0 | OPERATIONS ADMIN\_MAINTENANCE | The BSS is paused due to operations, administration, and maintenance.  |
| 1 | REGULATORY RELATED  | The BSS is paused due to regulatory related measurements and restrictions. For instance, during the BSS pause, the AP may check whether it is allowed to operate as a DFS owner. |
| 2 | LOW RATE  | The recipient STA affiliated with a non-AP MLD has a poor transmission rate. The STA consumes too much medium time on the link. |
| 3 | QOS RELATED | The link is exclusively intended for traffic with QoS requirements.   |
| 4 | EPCS\_RELATED | The link is exclusively intended for EPCS traffic. |
| 5 | CHANNEL LOAD  | The BSS load is too high.  |
| 6 | COEXISTENCE, INTERNAL | The BSS operation is impacted due to internal coexistence. |
| 7 | COEXISTENCE, EXTERNAL | The BSS operation is impacted due to external coexistence. |
| 8 | R\_TWT ENABLED | R-TWT is enabled for this BSS |
| 9-14 | Reserved |  |
| 15 | OTHER\_REASON | An AP has another reason for the TID-to-link mapping. The use of this Reason Code in a TID-To-Link-Mapping element with the Priority subfield set to 1 is described in 35.3.7.1.4 (Mandatory TID-to-link mapping procedure).  |

**Table 9-xx4 — Encoding of the Link Reason Code field when transmitted by a non-AP**

|  |  |  |
| --- | --- | --- |
| Value  | Reason code | Description |
| 0 | POWER SAVING  | The STA intends to save power and disable the link.  |
| 1 | POOR RSSI | The STA has transmission range issues and cannot operate the link efficiently. |
| 2 | TRAFFIC THROUGHPUT | The STA prefers the link for higher throughput. |
| 3 | HIGH QOS REQUIREMENT | The STA prefers to have the link to ensure that the traffic QoS requirements are met. |
| 4 | EPCS\_REQUIREMENT | The STA prefers the link to ensure that EPCS requirements are met. |
| 5 | R\_TWT | The STA prefers the link for r-TWT operation |
| 6 | PREFERRED LINK  | The STA prefers to receive DL frames and UL triggers frames primarily on this link. The non-AP STA anticipates being most often awake on this link. |
| 7 | COEXISTENCE, INTERNAL | The STA is experiencing an unacceptable level of interference on the link due to internal coexistence issues  |
| 8 | COEXISTENCE EXTERNAL | The STA is experiencing an unacceptable level of interference on the link due to external co-existence issues. |
| 9-15 | Reserved  |  |

TGbe editor: ***Insert the following new subclause at the end of subclause 9.4.2*** (#6643)***:***

### **9.4.2.317 AID Bitmap element**

The AID Bitmap element is used to signal a list of AIDs in a frame transmitted by an AP. The format of this element is shown in Figure 9-1002ah (AID Bitmap element format).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Element ID Extension | Bitmap Control | Partial AID Bitmap |
| Octets: | 1 | 1 | 1 | 1 | 0 –251 |

**Figure 9-1002ah—AID Bitmap element format**

The Element ID, Length, and Element ID Extension fields are defined in [9.4.2.1 (General)](file:///C%3A%5C%5CUsers%5C%5Cpmonajem%5C%5CDocuments%5C%5CDocs%5C%5CIEEE%20802.11%5C%5C11be%5C%5CSource%5C%5CTGbe_Cl_09.doc%22%20%5Cl%20%22bookmark85).

The Bitmap Control field is a single octet. Bit 0 of the field is reserved. The remaining 7 bits of the field form the Bitmap Offset as shown in Figure 9-1002ai Bitmap Control field format.

|  |  |  |
| --- | --- | --- |
|  | B0 | B1 B7 |
|  | Reserved | Bitmap Offset |
| Bits: | 1 | 7 |
| **Figure 9-1002ai—Bitmap Control field of the AID Bitmap element** |

An AID bitmap is a bitmap consisting of 2008 bits where a bit position K is set to 1 if AID K is a member of the signaled list of AIDs and otherwise is set to 0. The AID bitmap is organized into 251 octets such that bit number *N* (0 £ *N* £ 2007) in the bitmap corresponds to bit number (*N* mod 8) in octet number ë*N* / 8û where the low order bit of each octet is bit number 0, and the high order bit is bit number 7.

The Partial AID Bitmap field consists of octets numbered *N*1 to *N*2 of the AID bitmap, where *N*1 is the largest even number such that bits numbered 1 to (*N*1 ´ 8) – 1 in the AID bitmap are all 0 and *N*2 is the smallest number such that bits numbered (*N*2 + 1) ´ 8 to 2007 in the AID bitmap are all 0. The Bitmap Offset subfield value contains the number *N*1/2, and the Length field is set to (*N*2 – *N*1) + 3.

### **9.4.2.318 ML Load element**

TGbe editor: ***Insert the following new subclause at the end of subclause 9.4.2*** (#6643)***:***

The ML Load element contains load information of APs affiliated with an AP MLD. The element is transmitted by an AP affiliated with an AP MLD in Beacon, Probe Response, TID-To-Link MappingRequest, and TID-To-Link MappingResponse frames. The format of this element is shown in Figure 9-1002ai (ML Load element format).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Element ID Extension | Link ID Bitmap  | Link 1 Load | … | Link N Load |
| Octets: | 1 | 1 | 1 | 2 | 5 |  | 5 |

**Figure 9-1002ai—ML Load element format**

The Element ID, Length, and Element ID Extension fields are defined in [9.4.2.1 (General)](file:///C%3A%5C%5CUsers%5C%5Cpmonajem%5C%5CDocuments%5C%5CDocs%5C%5CIEEE%20802.11%5C%5C11be%5C%5CSource%5C%5CTGbe_Cl_09.doc%22%20%5Cl%20%22bookmark85).

The Link ID Bitmap field indicates the links for which a Link Load field is present. In bit position n of the Link ID Bitmap field, a value of 1indicates that the Link Load field is present for the link associated with the link ID n. Otherwise, the Link Load subfield for the link associated with link ID n is not present.

Each Link x Load field indicates load information for a link that has a corresponding bit set to 1 in the Link ID Bitmap field, in increasing order of link ID.

The Link x Load field is shown in Figure9-1002aj (Link Load field format).

|  |  |  |  |
| --- | --- | --- | --- |
| Total STA Count | Channel Utilization | Enabled STA Count | BSS Utilization  |
| 2 | 1 | 1 | 1 |

**Figure 9-1002aj—Link Load field format**

The Total STA Count subfield is the same as the STA Count field defined in 9.4.2.27 (BSS Load element).

The Channel Utilization subfield is the same as the Channel Utilization field defined in 9.4.2.27 (BSS Load element).

The Enabled STA Count subfield is interpreted as an unsigned integer that indicates the total number of STAs affiliated with non-AP MLDs that are operating on an enabled link corresponding to the reported AP. A value of 254 indicates 254 or more EHT non-AP STAs are operating on the link. A value of 255 indicates that the number of EHT non-AP STAs are operating on the link is unknown.

NOTE – A link might be disabled between a non-AP MLD and its associated AP MLD via TID-to-Link mapping operation (see 35.3.7). For such non-AP MLD(s), the corresponding STA affiliated with the non-AP MLD is not operating on that link and hence is not counted towards the value carried in the STA Count field.

The BSS Utilization subfield is defined as the percentage of time, linearly scaled with 255 representing 100%, during which the AP or an associated STA is a TXOP holder transmitting UL or DL frames and related control frames. The BSS Utilization is calculated with the following formula:

BSS Utilization = (Intra-BSS UL and DL transmission durations \*255) / (dot11ChannelUtilizationBeaconIntervals × dot11BeaconPeriod × 1024)

where

UL and DL transmissions durations is defined to be the number of microseconds during which the AP or an associated STA is a TXOP owner transmitting PPDUs containing UL or DL frames and related control frames,

dot11ChannelUtilizationBeaconIntervals represents the number of consecutive Beacon intervals during which the channel busy time is measured.

### **9.6.35 Protected EHT Action frame details**

TGbe editor: Modify section 9.6.35.2 as shown below (#6643):

### **9.6.35.2 TID-To-Link Mapping Request frame format**

**Table 9-623e—TID-To-Link Mapping Request frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 1 | Category |
| 2 | (#5372)Protected EHT Action |
| 3 | Dialog Token |
| 4 | TID-To-Link Mapping (see [9.4.2.314 (TID-To-Link Mapping](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark159) [element)](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark159)) |
| 5 | ML Load  |
| 6 | AID Bitmap  |

The Category field is defined in 9.4.1.11 (Action field).

(#5372)The Protected EHT Action field is defined in 9.6.35.1 (Protected EHT Action field).

The Dialog Token field (#6760)is set to a value greater than one chosen by the STA sending the TID-To-Link Mapping Request frame to identify the request/response transaction.

The TID-To-Link Mapping field contains one or two TID-To-Link Mapping elements as specified in

9.4.2.314 (TID-To-Link Mapping element). When it contains two TID-To-Link Mapping elements, the Direction subfield in one of the TID-To-Link Mapping elements is set to 0(#6760) and the Direction sub- field in the other of the TID-To-Link Mapping elements is set to 1(#6760).

If the frame is transmitted by an AP affiliated with an AP MLD, the ML Load field is optionally present. Otherwise, the ML Load field is not present.

The AID Bitmap element is always present in a TID-To-Link Mapping Request frame with a broadcast RA to indicate a list of target MLDs and is not present in an individually addressed TID-To-Link Mapping Request frame. The TID-To-Link Mapping Request frame is an Action No Ack frame when the AID Bitmap element is present.

TGbe editor: Modify section 9.6.35.3 as shown below (#6643):

### **9.6.35.3 TID-To-Link Mapping Response frame format**

The TID-To-Link Mapping Response frame is sent by a STA affiliated with an MLD in response to a TID-To- Link Mapping Request frame to accept or reject a proposed TID-to-link mapping, or sent by a STA affiliated with an MLD to suggest a preferred TID-to-link mapping. The Action field of the TID-To-Link Mapping Response frame contains the information shown in [Table 9-623f (TID-To-Link Mapping Response frame](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark194) [Action field format)](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark194).

**Table 9-623f—TID-To-Link Mapping Response frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 1 | Category |
| 2 | (#5372)Protected EHT Action |
| 3 | Dialog Token |
| 4 | Status Code |
| 5 | TID-To-Link Mapping (see [9.4.2.314 (TID-To-Link Mapping](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark159) [element)](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark159)) |
| 6 | ML Load |

The Category field is defined in [9.4.1.11 (Action field)](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark71).

The EHT Action field is defined in [9.6.34.1 (EHT Action field)](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark186).

When the TID-To-Link Mapping Response frame is transmitted as a response to a TID-To-Link Mapping Request frame, the Dialog Token field is the value in the corresponding TID-To-Link Mapping Request frame. When the TID-To-Link Mapping Response frame is transmitted as an unsolicited response, then the Dialog token is set to 0.The Status Code is defined in [9.4.1.9 (Status Code field)](file:///C%3A%5CUsers%5Cpmonajem%5CDocuments%5CDocs%5CIEEE%20802.11%5C11be%5CSource%5CTGbe_Cl_09.doc#bookmark69).

The TID-To-Link Mapping field contains zero, one, or two TID-To-Link Mapping elements as specified in

9.4.2.314 (TID-To-Link Mapping element) in order to suggest a preferred mapping. The field contains zero, one, or two TID-To-Link Mapping elements if the Status Code is set to SUCCESS or 133(DENIED\_TID\_TO\_LINK\_MAPPING). The field contains one or two TID-To-Link Mapping elements if the Status Code is set to 134 (PREFERRED\_TID\_TO\_LINK\_MAP- PING\_SUGGESTED). Otherwise, it does not contain a TID-To-Link Mapping element. When it contains two TID-To-Link Mapping elements, the Direction subfield in one of the TID-To-Link Mapping elements is set to 0 (Downlink) and the Direction subfield in the other of the TID-To-Link Mapping elements is set to 1 (Uplink).

If the frame is transmitted by an AP affiliated with an AP MLD, the ML Load field is optionally present. Otherwise, the ML Load field is not present.

### 11.2.3.15 TIM Broadcast

***TGbe editor: Please update the subclause as follows*** (#6643)***:***

The following events about the operational parameters of the AP shall classify as a critical update:

1. Inclusion of a Channel Switch Announcement element
2. Inclusion of an Extended Channel Switch Announcement element
3. Modification of the EDCA parameters element
4. Inclusion of a Quiet element
5. Modification of the DSSS Parameter Set
6. Modification of the HT Operation element
7. Inclusion of a Wide Bandwidth Channel Switch element
8. Inclusion of a Channel Switch Wrapper element
9. Inclusion of an Operating Mode Notification element
10. Inclusion of a Quiet Channel element
11. Modification of the VHT Operation element
12. Modification of the HE Operation element
13. Insertion of a Broadcast TWT element
14. Inclusion of the BSS Color Change Announcement element
15. Modification of the MU EDCA Parameter Set element
16. Modification of the Spatial Reuse Parameter Set element
17. Modification of the UORA Parameter Set element
18. Modification of the EHT Operation element
19. Inclusion, removal or modification of a TID-To-Link Mapping element with the Priority subfield of the TID-To-Link Control field equal to 1, except for modification of the Mapping Switch Time or the Expected Duration fields

## Discovery of an AP MLD

* + - 1. **AP behavior**

***TGbe editor: Please update the following 6th paragraph as follows***(#6643)***:***

(#6970)The TBTT offset between two APs affiliated with the same AP MLD shall never be larger than 254 TUs. An AP affiliated with an AP MLD shall not set the Neighbor AP TBTT Offset subfield to 255 for an AP affiliated with the same AP MLD, except under the rules defined in [35.3.11 (Multi-link procedures for](file:///C%3A%5CUsers%5Cpmonajem%5CDownloads%5C11-21-1327-06-00be-cc36-resolution-for-cid-5154.docx#bookmark30) [channel switching, extended channel switching, and channel quieting(#4112)(#2324)(#2600))](file:///C%3A%5CUsers%5Cpmonajem%5CDownloads%5C11-21-1327-06-00be-cc36-resolution-for-cid-5154.docx#bookmark30) and except if the link on which the reported AP is operating is disabled as advertised according to the procedures in 35.3.7.1.5(Advertised TID-to-link mapping in Beacon and Probe Response frames).

* TWT Information frame exchange for individual TWT

***TGbe editor: Please add the following paragraph to the end of 26.8.4.2*** (#6643)***:***

Additional rules for individual TWT agreement suspension and resumption corresponding to non-AP STAs affiliated with non-AP MLDs in case the link to which the agreement applies is either disabled or enabled are described in 35.3.7.1.1 (General).

* TWT Information frame exchange for broadcast TWT

***TGbe editor: Please add the following paragraph to the end of 26.8.4.3*** (#6643)***:***

Additional rules for broadcast TWT schedule suspension and resumption corresponding to non-AP STAs affiliated with non-AP MLDs in case the link to which the schedule applies is either disabled or enabled are described in 35.3.7.1.1 (General).

### 35.3.7.1 TID-to-link mapping

### 35.3.7.1.1 General

TGbe editor: Modify section 35.3.7.1.1 as shown below (#6643):

(#5244)The TID-to-link mapping mechanism allows an AP MLD and a non-AP MLD that performed or are performing multi-link setup to determine how UL and DL Qos traffic corresponding to TID values between 0 and 7 will be assigned to the setup links for the non-AP MLD.

An AP MLD may support TID to link mapping negotiation. A non-AP MLD that performs multi-link (re)setup on at least two links with an AP MLD that sets the TID-To-Link Mapping Negotiation Supported subfield of the MLD Capabilities field of the Basic Multi-Link element to a nonzero value shall support TID-to-link mapping negotiation with the TID-To-Link Mapping Negotiation Supported subfield of the MLD Capabilities field of the Basic Multi-Link element to at least 1. An MLD with dot11EHTBaseLineFeaturesImplementedOnly equal to true shall not set the TID-To-Link Mapping Negotiation Supported subfield of MLD Capabilities field of the Basic Multi-Link element to 3.By default, all TIDs shall be mapped to all setup links for (#2068)both DL and UL (see 35.3.7.1.2 (Default mapping mode)). When a negotiated aTID-to-link mapping is in effect according to the procedures defined in 35.3.7.1.3 (Negotiation of TID-to-link mapping), 35.3.7.1.4 (Mandatory TID-to-link mapping procedure), 35.3.7.1.5 (Advertised TID-to-link mapping in Beacon and Probe Response frames), and 35.3.7.1.6 (Association Procedures for TID-to-link mapping) then (#7060)a TID can be mapped to a link set(#2908), which is a subset of setup links, spanning from only one setup link to all the setup links.

(#8237)A setup link is defined as enabled for a non-AP MLD if at least one TID is mapped to that link either in DL or in UL and is defined as disabled if no TIDs are mapped to that link both in DL and UL. At any point in time, a TID shall always be mapped to at least one setup link both in DL and UL, (#4051)(#6577)which means that a TID-to-link mapping change is only valid and successful if it will not result in having a single TID for which the link set is made of zero setup links. (#4050)By default, all setup links shall be enabled (see 35.3.7.1.2 (Default mapping mode)).

* (#1496)(#5365)If a link is enabled for a non-AP MLD, then:

may be used for individually addressed frame exchange, subject to the power state of the non-AP STA operating on that link

* MSDUs or AMSDUs as defined in 10.23.2 with TIDs mapped to that link may be transmitted on that link between the corresponding STA and AP affiliated with the non-AP MLD and AP MLD, respectively, in the direction (DL/UL) corresponding to the TID-to-link mapping.
* If the established TID-to-link mapping maps all TIDs to a subset of links while mapping some TIDs to a different subset of links, the STA affiliated with the non-AP MLD associated to an AP MLD and operating on the enabled link may transmit MSDUs or AMSDUs with a TID not mapped to that link to the AP operating on that link and affiliated with its associated AP MLD if the affiliated AP does not include the MU EDCA Parameters Set element in the Beacon frames, or if the affiliated AP includes the MU EDCA Parameters Set element in the Beacon frames that the affiliated AP transmits and the non-AP STA has updated its CWmin[AC], CWmax[AC], AIFSN[AC] and MUEDCATimer[AC] state variables to the values contained in the dot11MUEDCATable for the AC of that TID following 26.2.7 (EDCA operation using MU EDCA parameters). The non-AP STA's operation follows 26.2.7 (EDCA operation using MU EDCA parameters) or 35.17.3.2 (EDCA operation using EPCS EDCA parameters) when applicable, except that the non-AP STA does not count down the MUEDCATimer[AC] timer for the AC of that TID.
* If the established TID-to-link mapping does not map all TIDs to a subset of links while mapping some TIDs to a different subset of links, the STA affiliated with the non-AP MLD associated to an AP MLD and operating on the enabled link may not transmit MSDUs or AMSDUs with a TID not mapped to that link
* Individually addressed Management frames and Control frames may be sent on any enabled links between the corresponding STA affiliated with the non-AP MLD and AP affiliated with the associated AP MLD (#8237)both in DL and UL.

NOTE 1— for the TIDs of an AC that contains one or more unmapped TIDs for a link, if the AP includes the MU EDCA Parameters Set element with a zero value for AIFSN[AC] and a non-zero value of MUEDCATimer[AC], then the non-AP STA does not transmit the MSDUs or AMSDUs of the TIDs until triggered by its AP and while the non-AP STA reports UL MU Disable equal to 0, or as allowed by UORA.

(#5365)(#6281)If a link is disabled for a non-AP MLD, it shall not be used for individually addressed frame exchange between the corresponding STA affiliated with the non-AP MLD and AP affiliated with the associated AP MLD, including Management frames.

A STA affiliated with an MLD that operates on a disabled link shall suspend all wireless functionalities on that link until the link is enabled.

NOTE 2— Suspension of wireless functionalities refers to functionalities such as frame generation, schedules, scoreboard maintenances, etc., while still preserving previously negotiated parameters with the peer EHT STA(s).(#5365)NOTE 2—Group addressed frames delivery procedure is defined in 35.3.15 (Multi-link group addressed frame delivery and reception).

(#4052)If a TID is mapped in DL to a set of enabled links for a non-AP MLD, then:

— (#1226)The non-AP MLD may retrieve (#5365)individually addressed buffered BUs buffered at the AP MLD that are MSDUs or A-MSDUs corresponding to that TID on any link within this set of enabled links.— The AP MLD may use any link within this set of enabled links to transmit (#5365)individually addressed MSDUs or A-MSDUs (#4451)corresponding to that TID, subject to the power state of the non-AP STA on each of these links.

(#1788)(#1680)(#4053)NOTE 2—If the default mode is used, the non-AP MLD can retrieve BUs buffered by the AP MLD on any setup link but the AP MLD can recommend a link as defined in 35.3.12.4 (Traffic indication).

A non-AP MLD shall not retrieve buffered BUs in DL on a link to which not all TIDs are mapped in DL unless the non-AP MLD has received a Multi-Link Traffic element indicating that there are buffered BU(s) for the non-AP MLD on that link.

(#4052)A non-AP MLD may retrieve buffered BUs that are MMPDUs buffered at the AP MLD on any enabled link. An AP MLD may use any enabled links to transmit individually addressed bufferable management frames that are not measurement MMPDUs, subject to the power state of the non-AP STA on each of the links.

(#5753)If a STA affiliated with a non-AP MLD is in active mode on a link with a set of TIDs mapped for DL transmission, its associated AP affiliated with the AP MLD shall transmit to the STA:

— MSDUs/A-MSDUs corresponding to that set of negotiated TIDs for the non-AP MLD, and

— MMPDUs that are not measurement MMPDUs for the non-AP MLD or its affiliated STAs,

unless it is transmitted to another STA affiliated with the same non-AP MLD and in active mode.

(#5753)NOTE 3—Operation with STAs affiliated with a non-AP MLD in power save mode are defined in 35.3.12.4 (Traffic indication).

### 35.3.7.1.2 Default mapping mode

TGbe editor: Modify section 35.3.7.1.2 as shown below (#6643):

(#1790)(#2427)(#2907)(#3377)(#3027)(#2908)Under this mode, all TIDs are mapped to all setup links for DL and UL, and all setup links are enabled. A non-AP MLD and an AP MLD that performed multi-link setup shall operate under this mode if a TID-to-link mapping is not advertised by the AP MLD (see 35.3.5.1.5(Advertised TID-to-link mapping in Beacon and Probe Response frames)), and if a TID-to-link mapping negotiation for a different mapping did not occur, was unsuccessful, or was torn down.

### 35.3.7.1.3 Negotiation of TID-to-link mapping

TGbe editor: Modify section 35.3.7.1.3 as shown below (#6643):

An MLD that supports TID-to-link mapping negotiation has dot11TIDtoLinkMappingActivated equal to true and shall set to a nonzero value the TID-to- link Mapping Negotiation Supported subfield in the MLD Capabilities field of the (#6700)Basic Multi-Link element that it transmits. An MLD that does not support TID-to-link mapping negotiation has dot11TIDtoLinkMappingActivated equal to false and shall set the TID-to-link Mapping Negotiation Supported subfield to 0. If the TID-to-link Mapping Negotiation Supported subfield value received from a peer MLD is equal to 1, the MLD that initiates a TID-to-link mapping negotiation to the peer MLD shall send only the TID-to-link Mapping element where all TIDs are mapped to the same link set. If the TID-to-link Mapping Negotiation Supported subfield value received from a peer MLD is equal to 2 or 3, the MLD that initiates a TID-to-link mapping negotiation to the peer MLD shall send the TID-to-link Mapping element where each TID is mapped to the same or different link set.

After the multi-link (re)setup is successful, to negotiate a new TID-to-link mapping, an initiating non-AP MLD with dot11TIDtoLinkMappingActivated equal to true shall send an individually addressed TID-to-link Mapping Request frame to a responding MLD that has indicated support of TID-to-link mapping negotiation.

An AP MLD with dot11TIDtoLinkMappingActivated equal to true that initiates a TID-to-link mapping negotiation may perform one of the following:

- Send an individually addressed TID-to-link Mapping Request frame to a non-AP MLD

- Send a group addressed TID-to-link Mapping Request frame to the broadcast address that includes an AID Bitmap element

- Advertise a TID-to-link Mapping as defined in 35.3.7.1.5 (Advertised TID-to-link mapping in Beacon and Probe Response frames)

The AP MLD shall include a Reason Code for each link whose TID settings are requested to be changed in the TID-to-Link Mapping element of a TID-to-Link Mapping frame. The AP MLD should include in the TID-to-link Request fames an ML Load element if any link has a Reason Code equal to LOW RATE, QOS RELATED or CHANNEL LOAD in the TID-to-Link Mapping element.

Except for conditions described in 35.3.7.1.4 (Mandatory TID-to-link mapping procedure), an MLD that receives an individually addressed TID-to-Link Mapping Request frame or a group addressed TID-to-Link Mapping Request frame that includes an AID Bitmap element which indicates the MLD’s AID shall send an individually addressed TID-to-link Mapping Response frame to the initiating MLD according to the following rules:

— If the responding MLD accepts the requested TID-to-link mapping in the TID-to-Link Mapping element in the received TID-to-link Mapping Request frame, it shall set to 0 (SUCCESS) the Status Code in the TID-to-link Mapping Response frame. TID-to-link Mapping Response frame may include TID-to-link Mapping element with link specific Reason Codes to all links to signal responding MLD preferences to use the mapped links.

— Otherwise, the responding MLD shall indicate rejection of the proposed TID-to-link mapping by setting to either 133 (DENIED\_TID\_TO\_LINK\_MAPPING) or 134 (PREFERRED\_TID\_TO\_LINK\_MAPPING\_SUGGESTED) the Status Code in the TID-to-link Mapping Response frame and including link specific Reason Codes in the TID-To-Link Mapping element when using either value. The responding MLD may suggest a preferred TID-to-link mapping by setting to 134 (PREFERRED\_TID\_TO\_LINK\_MAPPING\_SUGGESTED) the Status Code in the TID-to-link Mapping Response frame and including the TID-to-link Mapping element in the TID-to- link Mapping Response frame.

If a TID-to-link mapping request is rejected as allowed by in 35.3.7.1.4 (Mandatory TID-to-link mapping procedure), the previously established TID-to-link mapping shall remain unchanged.

An MLD may suggest a preferred TID-to-link mapping to a peer MLD by sending an unsolicited TID-to- link Mapping Response frame with the Dialog Token field set to 0 that includes the TID-to-link Mapping element and sets the Status Code to 134 (PREFERRED\_TID\_TO\_LINK\_MAPPING\_SUGGESTED). An MLD shall not send an unsolicited TID-to-link Mapping Response frame that includes the TID-to-link Mapping element and sets the Status Code to either 0 (SUCCESS) or 133 (DENIED\_TID\_TO\_LINK\_MAPPING).

If indicated by a peer MLD, an MLD should take into account the preferred TID-to-link mapping when it initiates a new TID-to-link mapping. In addition, an AP MLD should take into account the traffic flow(s) affiliated with the non-AP MLD and the capabilities and constraints (if any) of the non-AP MLD.

NOTE 1—A non-AP MLD can indicate its constraints (such as single radio) during multi-link setup.

NOTE 2––A non-AP MLD can indicate its link preferences by using the link specific Reason Codes in the TID-To-Link Mapping element.

A multi-link multi-radio (MLMR) non-AP MLD should accept a TID-to-link mapping initiated by its associated AP MLD if the Priority subfield of the TID-To-Link Control field in the TID-To-Link Mapping Request frame is set to 0.

When two MLDs have negotiated a TID-to-link mapping, either MLD may teardown the negotiated TID-to- link mapping by sending an individually addressed TID-To-Link Mapping Teardown frame, except a non-AP MLD shall not tear down a negotiated TID-to-link mapping if the current TID-to-link mapping was established by a negotiation in which the AP requested a mandatory TID-to-link mapping. Instead, the non-AP MLD may initiate a new TID-to-link mapping negotiation. After teardown, if a mapping scheme is advertised by the AP MLD as described in 35.3.4.1.5 (Advertised TID-to-link mapping in Beacon and Probe Response frames)), the MLDs shall operate in the established mode as described in 35.3.4.1.5 (Advertised TID-to-link mapping in Beacon and Probe Response frames), otherwise they shall operate in the default mapping mode (see 35.3.7.1.2 (Default mapping mode)).

If an MLD has successfully negotiated the TID-to-link mapping with a peer MLD, both the MLD and the peer MLD shall update uplink and/or downlink TID-to-link mapping information according to the negotiated TID-to-link mapping. In case a TID-to-link mapping of a specific TID is missing in the negotiation, the most recent TID-to-link mapping of this TID remains unchanged and valid. If an MLD has failed to negotiate the TID-to-link mapping with a peer MLD, the most recent TID-to-link mapping of all TID remains unchanged and valid. (#7851)

NOTE 3—If there is no successfully negotiated TID-to-link mapping for a TID, and that TID is not included in an AP advertised mapping according to 35.3.7.1.5 (Advertised TID-to-link mapping in Beacon and Probe Response frames), then the TID is mapped to all setup links for DL and UL.(#5248, 6954)

Each AP affiliated with an AP MLD may transmit an ML Load element in their Beacons and Probe Responses to avoid ML-Probe Requests that query BSS Load elements on different links.

When an MLD has successfully negotiated with a peer MLD an uplink and/or downlink TID-to-link mapping in which the bit position i of the Link Mapping Of TID n (#6363, 7412, 7817, 8192) field in the TID-to-link Mapping element in the (Re)Association Request frame, TID-To-Link Mapping Request frame (#8193), Beacon frame, or Probe Response frame is set to 0, the TID n shall not be mapped to the link associated with the link ID i in an uplink and/or downlink.

When an MLD has successfully negotiated with a peer MLD an uplink and/or downlink TID-to-link mapping in which the bit position i of the Link Mapping Of TID n field in the TID-to-link Mapping element in the (Re)Association Request frame, TID-To-Link Mapping Request frame (#8193), Beacon frame, or Probe Response frame is set to 1, the TID n shall be mapped to the link associated with the link ID i in an uplink and/or downlink.

### 35.3.7.1.4 Mandatory TID-to-link mapping procedure

TGbe editor: Add a new section 35.3.7.1.4 as shown below and renumber sections accordingly (#6643):

An AP MLD may set the Priority subfield of the TID-To-Link Control field in a TID-to-link Mapping element to 1 to indicate that the requested TID-to-link mapping is mandatory.

An AP should only send the Priority subfield of the TID-To-Link Control field in a TID-to-link Mapping element to 1 (mandatory) when the alternative action by the AP MLD for the non-AP MLD is disassociation. An AP MLD should not use NO REASON Reason Code in a mandatory TID-to-link mapping, if the AP MLD requests to disable a link. An AP shall include ML Load element to a TID-To-Link Mapping Request frame, if the frame requests disabling over 50% of a non-AP MLD links.

An AP that sets the Priority subfield value to 1 shall set the Mapping Switch Time field to the time remaining in units of TUs until a DTIM Beacon at which the indicated TID-to-link mapping is required.

The AP should allow enough time for the responding non-AP MLDs to repond to the request frame by setting the initial value of the Mapping Switch Time field to a sufficiently large value.

A non-AP MLD that receives from its associated AP MLD a TID-To-Link Mapping element with the Priority subfield value set to 1 may send a TID-to-link Mapping Request frame before the indicated mapping switch time to request an alternate preferred mapping, except if the frame carrying the TID-To-Link Mapping element is a Beacon or a Probe Response frame. The non-AP STA shall include a link specific Reason Code in the TID-to-link Mapping element of the TID-to-link Mapping Request frame to request alternate preferred mapping.

An AP MLD that receives a TID-to-Link Mapping Request frame before the indicated mapping switch time of a mandatory mapping request should take into account the input received from the non-AP MLD, including the link specific Reason Codes, as part of determining the response. If the alternate mapping requested by the non-AP MLD is not acceptable the AP may ignore the request frame sent by the non-AP MLD. If no alternate mapping has been successfully negotiated with the AP by the indicated mapping switch time then the originally announced mapping is used to establish a mapping for the non-AP MLD and the established mapping is effective after the indicated mapping switch time.

A non-AP MLD that receives a mandatory TID-to-link mapping request from an AP MLD shall schedule the transmission of a TID-To-Link Mapping Response frame with status set to SUCCESS before the indicated mapping switch time with Dialog Token in the TID-To-Link Mapping Response frame equal to the Dialog Token in the mandatory AP request, if any of the following happens:

* The non-AP MLD that is permitted to send a TID-To-Link Mapping Request frame with an alternate mapping in response to a mandatory AP request does not send a TID-to-Link Mapping Request frame with an alternate mapping or
* The non-AP MLD sends a TID-To-Link Mapping Request frame with an alternate mapping and does not receive a TID-To-Link Mapping Response frame from the AP with the status SUCCESS

NOTE — A non-AP MLD that receives an individual or group addressed mandatory TID-to-link mapping request does not send a TID-To-Link Mapping Response frame with any status other that SUCCESS, but may request an alternate TID-to-link mapping as described above.

NOTE 2— A non-AP MLD that receives a mandatory TID-to-link mapping advertisement as described in section 35.3.7.1.5 (Advertised TID-to-link mapping in Beacon and Probe Response frames) does not send any response frames or suggest alternate TID-to-link mapping.

Figure 35.x shows a number of possible frame exchange sequences starting with a mandatory TID-to-Link mapping Request frame.



**Figure 35.x Example frame exchange sequences tarting with a mandatory TID-to-Link mapping Request frame**

### 35.3.7.1.5 Advertised TID-to-link mapping in Beacon and Probe Response frames

TGbe editor: Add a new section 35.3.7.1.5 as shown below and renumber sections accordingly (#6643):

An AP MLD may advertise a mandatory TID-To-Link mapping by including a TID-To-Link Mapping element in the Beacon and Probe Response frames that the APs affiliated with the AP MLD transmit and setting the Priority subfield of the TID-To-Link Control field to 1.

An AP affiliated with an AP MLD shall not transmit a Beacon or Probe Response frame that includes a TID-To-Link Mapping element with the Priority subfield of the TID-To-Link Control field set to 0.

An advertised TID-To-Link Mapping element shall include a Link Mapping of TID n field for all TIDs.

NOTE 1— Since the Link IDs can be different for MLDs affiliated with each BSSID in a multiple BSSID set, inheritance will not apply to TID-To-Link mapping for APs that are part of a multiple BSSID set, and therefore the TID-To-Link Mapping element needs to be carried in each Nontransmitted BSSID Profile to which an advertised mapping applies.

An AP MLD shall include two TID-To-Link Mapping elements in the Beacon and Probe Response frames that the APs affiliated with the AP MLD transmit, if there is already an ongoing advertised TID-to-link mapping and a new TID-to-link mapping will replace it. In this case, the AP MLD shall set the Mapping Switch Time field of the existing TID-To-Link Mapping element to zero to indicate the currently advertised TID-to-link mapping and shall set the Mapping Switch Time field of the new TID-To-Link Mapping element to a nonzero value to indicate a TID-to-link mapping that will be advertised in the future. The value of the Expected Duration field of the existing TID-To-Link Mapping element shall indicate a remaining duration that ends on or before the Mapping Switch Time field of the new TID-To-Link Mapping element reaches zero.

All APs affiliated with an AP MLD that advertises a TID-to-link mapping shall include the same TID-to-link mapping in all Beacon and Probe Response frames from the time at which the TID-to-link mapping is first advertised until the time at which the TID-to-link mapping is no longer advertised, and shall include the Mapping Switch Time field and the Duration field in all Beacons. When a new TID-to-link mapping is advertised in a Beacon frame, the Mapping Switch Time field shall be set to the time remaining in units of TUs until a DTIM Beacon at which the indicated TID-to-link mapping is required and shall be set to 0 after that DTIM Beacon until the TID-to-link mapping is no longer advertised. The Mapping Switch Time field should initially be set to a sufficiently large value.

When the Mapping Switch Time field of an advertised TID-To-Link Mapping element reaches 0 in a Beacon or a Probe Response frame received by a STA affiliated with a non-AP MLD from an AP affiliated with its associated AP MLD, the non-AP MLD shall update its TID-to-link mapping according to the rules that establish a TID-to-link mapping in this subclause and with the consequences of the updated mapping defined in 35.3.7.1.1 (General).

The following rules define the TID-to-link mapping that is established in a non-AP MLD after the Mapping Switch Time field of an advertised TID-To-Link Mapping element reaches 0 in a newly changed TID-To-Link Mapping element is received by a non-AP MLD in a Beacon or a Probe Response frame from its associated AP MLD:

- If the advertised TID-to-link mapping maps all TIDs to a subset of links while mapping some TIDs to a different subset of links, then a non-AP MLD that does not have in its MLD setup any of the links which have all TIDs mapped in the advertised TID-to-link mapping shall use default mapping.

- If the advertised TID-to-link mapping maps all TIDs to a subset of links while mapping some TIDs to a different subset of links, then a non-AP MLD that sets the TID-To-Link Mapping Negotiation Supported subfield of the MLD Capabilities field of the Multi-Link element to 1 shall map all TIDs to the subset of links that have all TIDs mapped in the advertised TID-to-link mapping

- Otherwise, the set of mapped links for each TID and direction for a non-AP STA are the set of links that are included in the non-AP STA’s MLD setup and have been mapped to that TID for that direction in the advertised TID-to-link mapping.

NOTE 2—A non-AP MLD ignores links that are included in the link mappings of an advertised TID-to-link mapping that are not part of the non-AP STA’s MLD setup procedure. For example, if the AP MLD operates links 1,2, and 3, and it advertises that link 3 is disabled and all TIDs are mapped to links 1 and 2, then for a non-AP MLD that is associated with the AP MLD using links 1 and 2 the default mapping will apply. In this case, for a non-AP MLD that is associated with the AP MLD using links 1 and 3, link 3 will be disabled.

NOTE 3—As another example, if the AP MLD operates links 1,2, and 3, and it advertises a TID-to-link mapping that maps all TIDs to links 1 and 2 while mapping only TID 5 to link 3, then:

* A non-AP MLD that is associated on links 2 and 3 and sets the TID-To-Link Mapping Negotiation Supported subfield of the MLD Capabilities field of the Multi-Link element to 2, will map all TIDs to link 2 and only TID 5 to link 3
* A non-AP MLD that is associated on links 1,2, and 3 and sets the TID-To-Link Mapping Negotiation Supported subfield of the MLD Capabilities field of the Multi-Link element to 1, will map all TIDs to links 1 and 2 and disables link 3
* A non-AP MLD that is associated only on link 3 will map all TIDs to link 3

NOTE 4—In absence of an advertised mapping by the AP a default TID-to-link mapping is assumed unless an individual TID-to-link mapping is negotiated.

NOTE 5—No frames are transmitted by non-AP STAs affiliated with the associated non-AP MLDs in response to an advertised TID-to-link mapping.

An AP MLD shall not advertise in the Beacon and Probe Response frames that its affiliated APs transmit a TID-to-link mapping that has more than one link to which only some TIDs are mapped.

NOTE 6—An AP MLD can designate at most one link as a link preferred for high-QoS traffic by mapping to it a partial set of TIDs. All other links can either be mapped with all TIDs or disabled.

An AP MLD shall not advertise in the Beacon and Probe Response frames that its affiliated APs transmit a TID-to-link mapping that has different mapping in DL and UL and that has different mapping for TIDs corresponding to the same AC.

An AP MLD shall not advertise a TID-to-link mapping that does not map all TIDs to at least one link.

A non-AP MLD that is associated with an AP MLD that advertises a TID-to-link mapping may initiate a negotiation for a TID-to-link mapping that is not established as described in this section. Any MLD shall not initiate a negotiation for a TID-to-link mapping that maps TIDs to a link that does not have this TID mapped to it in the advertised TID-to-link mapping.

### 35.3.7.1.6 Association Procedures for TID-to-link mapping

TGbe editor: Add a new section 35.3.7.1.6 as shown below and renumber sections accordingly (#6643):

In a multi-link (re)setup procedure, a non-AP MLD may initiate a TID-to-link mapping negotiation by including the TID-to-link Mapping element in the (Re)Association Request frame if an AP MLD has indicated a support of TID-to-link mapping negotiation.

After receiving the (Re)Association Request frame, the AP MLD shall reply to the (Re)Association Request frame according to 11.3.5.3 (AP, AP MLD, or PCP association receipt procedures), 11.3.5.5 (AP, AP MLD, or PCP reassociation receipt procedures), and

35.3.5 (Multi-link (re)setup), and perfom the following TID-to-link mapping negotiation procedure: (#6406)

— Where the AP MLD advertises a TID-To-Link Mapping according to 35.3.7.1.5(Advertised TID-to-link mapping in Beacon and Probe Response frames), if the non-AP MLD does not include at least one TID-to-link Mapping Request element or requests a mapping that maps TIDs to a link in a direction that is not enabled in the advertised mapping, the AP shall include in the (Re)Association Response frame a TID-To-Link Mapping element with the Mapping Switch Time Present subfield equal to 0 and indicating the TID-to-link mapping that is advertised in Beacons for each of the links accepted in the association procedure. After the transmission of the (Re)Association Response frame the TID-to-link mapping included in that frame is established and shall be used during the association unless and until a new TID to link mapping is advertised or negotiated.

— Otherwise, the AP MLD can accept the requested TID-to-link mapping in the TID-to-link Mapping element in the received (Re)Association Request frame only if it accepts the multi-link (re)setup for all links on which at least one TID is requested to be mapped. The AP MLD that accepts the requested TID-to-link mapping (#5215) shall not include in the (Re)Association Response frame the TID-to-link Mapping element.

— Otherwise, if the AP MLD does not accept the requested TID-to-link mapping, the AP MLD shall indicate rejection of the proposed TID-to-link mapping by including in the (Re)Association Response frame the TID-to-link Mapping element that suggests a preferred TID-to-link mapping, and the default TID-to-link mapping remains established until a new TID to link mapping is advertised or negotiated.

The AP MLD that rejects a (Re)Association Request may include a TID-to-link Mapping-related status code and link specific reason codes in the TID-To-Link Mapping element in the (Re)Association Response frame even if the non-AP MLD does not initiate a TID-to-link mapping negotiation. Status codes 133 (DENIED\_TID\_TO\_LINK\_MAPPING) or 134 (PREFERRED\_TID\_TO\_LINK\_MAPPING\_SUGGESTED) may be used.

TGbe editor: Add a new section 35.3.7.2 as shown below and renumber sections accordingly (#6643):

**35.3.7.2 Affiliated AP disablement and enablement**

An AP MLD shall use the procedures described in 35.3.7.1.5 (Advertised TID-to-link mapping in Beacon and Probe Response frames) in order to disable or enable a link for all associated non-AP MLDs. Further rules pertaining to the disablemenet and enablement are described in the sections below 35.3.7.2.1 Affiliated AP link disablement and 35.3.7.2.2 Affiliated AP link enablement.

**35.3.7.2.1 Affiliated AP disablement**

Upon receiving an MLME-BSS-DISABLE.request primitive, the affiliated AP shall advertise a TID-to-link mapping in Beacon and Probe Response frames that does not map and TIDs to the disabled link.

When an AP MLD advertises that a link is disabled for all associated non-AP MLDs, after the Mapping Switch Time field reaches zero:

* the Disabled Link Indication subfield shall be set to 1 in the MLD Parameters subfield corresponding to the AP affiliated with the AP MLD and operating on the link which is included in the Neighbor AP Information field in the Reduced Neighbor Report element carried in the Beacon or Probe Response frames transmitted by any of the APs affiliated with the AP MLD, and shall be set to 0 otherwise. If the Disabled AP Link Indication subfield corresponding to a reported AP is set to 1, then the Neighbor AP TBTT Offset subfield included in the same TBTT Information field of the Reduced Neighbor Report element shall be set to 255.
* an EHT STA affiliated with a non-AP MLD should not use the link for transmitting individually addressed management frames to the AP affiliated with the AP MLD which is operating on a link that is disabled
* an EHT STA affiliated with a non-AP MLD shall not transmit ML probe request, Authentication and (Re)association Request frames to the AP affiliated with the AP MLD while the link is disabled (as indicated in the Expected Duration field in the advertised TID-to-link Mapping element with Mapping Copunt Switch subfield equals to 0).
* A non-AP STA affiliated with the non-AP MLD shall not delete the GTK/IGTK/BIGTK values

NOTE 1—When an AP MLD advertises that a link is disabled for all associated non-AP MLDs, a non-AP MLD remains associated with the AP MLD.

NOTE 2––The AP affiliated with an AP MLD which is operating on the link to become disabled may disassociate or use BTM in advance for non-MLD non-AP STAs.

NOTE 3–– The non-AP MLD uses the GTK/IGTK/BIGTK for the reception of protected broadcast/groupcast management frames when the link becomes enabled again.

An AP affiliated with an AP MLD that intends to turn its operating link into a disabled link should verify that it is not associated with any non-MLD non-AP STA on the link to become disabled.

An AP MLD shall include a Reason Code for every advertised disabled link. AP MLD is allowed to use Reason Codes OPERATION AND MAINTENANCE, REGULATORY RELATED, COEXISTENCE, INTERNAL or COEXISTENCE, EXTERNAL on a link that is advertised as disabled.

All APs affiliated with AP MLD shall transmit a BSS Load element for all links if the AP MLD disables over 50% links of the affiliated APs.

**35.3.7.2.2 Affiliated AP enablement**

Upon receiving the MLME-BSS-ENABLE.request primitive, the affiliated AP shall advertise a TID-to-link mapping in Beacon and Probe Response frames that maps at least one TID to the enabled link.

When an AP MLD stops advertising that a link is disabled for all associated non-AP MLDs:

* the Disabled AP Link Indication subfield shall be set to 0 in the MLD Parameters subfield corresponding to the AP affiliated with the AP MLD and operating on the link which is included in the Neighbor AP Information field in the Reduced Neighbor Report element carried in the Beacon or Probe Response frames transmitted by any of the APs affiliated with the AP MLD
* the AP operating on this link shall retain continuous TSF time and keys as before this link was advertised as disabled for all associated non-AP MLDs
* frame exchange operation on this link between the affiliated AP and non-AP STAs affiliated with the associated non-AP MLD can be initiated by any member of the BSS that is affiliated with an MLD following CCA performance until a frame is detected by which it can set its NAV, or a period equal to NAVSyncDelay has transpired, whichever is earlier. The frame exchange is initiated using all the link parameters that were defined before the link has been defined as an unavailable link subject to power state (see 35.3.11) and enablement status (see 35.3.6.1) of the affiliated non-AP EHT STA.

**35.3.11.4 Traffic indication**

***Tgbe editor: Please modify the 4th paragraph in subclause 35.3.11.4 Traffic indication as follows***) (#5030, #6743, #5759)

An AP MLD may recommend a non-AP MLD to use one or more enabled links to retrieve individually addressed buffered BU(s), if present, by advertising the recommended links in the Multi-Link Traffic element in the Beacon frames it transmits.(#3256)(#3322). An AP MLD may also recommend a non-AP MLD to use one or more enabled links for all exchanges both for DL and UL by advertising the recommended links in a Link Recommendation frame.

***Tgbe editor: Please modify the following paragraph in subclause 35.3.11.4 Traffic indication as follows (#***6766, #6767, #6895, #7671, #8179)

When a non-AP MLD in PS mode that is in the default mapping mode (see 35.3.6.1.2 (Default mapping mode)) detects that the bit corresponding to its AID is 1 in the TIM element and the Multi-Link Traffic element is present in a Beacon frame, any STA affiliated with the non-AP MLD that operates on the link(s) indicated as recommended for that non-AP MLD in the MultiLink Traffic element should issue a PS-Poll frame, or a U-APSD trigger frame if the STA is using U-APSD and all Acs are delivery enabled, to retrieve buffered BU(s) in the AP MLD.

***Tgbe editor: Please insert the following paragraphs after paragraph 11 in subclause 35.3.11.4 Traffic indication (#***6766, #6767, #6895, #7671, #8179, #6743, #5759)

The APs affiliated with an AP MLD may also schedule for transmission a group-addressed Link Recommendation frame to provide link recommendation for a set of non-AP MLDs as follows:

* The bit corresponding to the AID of a non-AP MLD shall be set to 1 in the Partial AID Bitmap subfield of the AID Bitmap element in the Link Recommendation frame if the AP wants to provide a link recommendation for this non-AP MLD.
* The Multi-Link Traffic element includes Per-Link Traffic Indication Bitmap subfield(s) that corresponds to the AID(s) of the non-AP MLD(s), starting from the bit number *k* of the traffic indication virtual bitmap, in the Per-Link Traffic Indication Bitmap List field. The AID Offset subfield of the Multi-Link Traffic Control field of the Multi-Link Traffic element contains the value *k*. The order of the Per-Link Traffic Indication Bitmap subfield(s) follows the order of the bits that are set to 1 in the Partial AID Bitmap subfield of the AID Bitmap element carried in the Link Recommendation frame that corresponds to the AID(s) of the non-AP MLD(s). The bit position *i* of the Per-Link Traffic Indication Bitmap subfield in the Multi-Link Traffic element that corresponds to the link with the link ID equal to *i* on which a STA affiliated with the non-AP MLD is operating shall be set to 1 to indicate to the non-AP MLD that it should exchange frames on this link both in DL and UL.
* A link shall not be recommended if it is disabled for the non-AP MLD.

If a non-AP MLD receives a Link Recommendation frame with the bit corresponding to its AID set to 1 in the Partial AID Bitmap subfield of the AID Bitmap element in the Link Recommendation frame, it should exchange frames both in DL and UL on enabled links identified as recommended in the Multi-Link Traffic element in the Link Recommendation frame.

* + 1. **EHT Action frame details(#1119)(#1488)**
			1. **EHT Action field**

***Tgbe editor: Please change the following Table 9-623a EHT Action field values as follows (#***6766, #6767, #6895, #7671, #8179, #6743, #5759)

**Table 9-623a—EHT Action field values**

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | EHT Compressed Beamforming/CQI |
| 1 | EML Operating Mode Notification. |
| 2 | Link Recommendation |
| 3–255 | Reserved |

***Tgbe editor: Please add the following subclause 9.6.34.4 Link Recommendation frame format as follows (#***6766, #6767, #6895, #7671, #8179, #6743, #5759)

**9.6.34.4 Link Recommendation frame format**

The Link Recommendation frame is an Action No Ack frame of category EHT. The Action field of an Link Recommendation frame contains the information shown in [Table 9-xxx](#bookmark188) [(Link Recommendation frame Action field format(#6078))](#bookmark188).

**Table 9-xxx—Link Recommendation frame Action field format(#6078)**

|  |  |
| --- | --- |
| **Order(#6078)** | **Meaning** |
| 1 | Category |
| 2 | EHT Action |
| 3 | Reason Code |
| 4 | AID Bitmap element |
| 5 | Multi-Link Traffic element (see 9.4.2.315 (Multi-Link Traffic element)) |

The Category field is defined in Table 9-79 (Category values). The EHT Action field is defined in Table 9-623a (EHT Action field values). The Reason Code field is defined in 9.4.1.7 (Reason Code field) and provides the reason why the AP MLD is sending the link recommendation.

The AID Bitmap element is described in 9.4.2.317 (AID Bitmap element) and is used to identify the non-AP MLDs for which a link recommendation is provided.

The Multi-Link Traffic element is described in 9.4.2.315 (Multi-Link Traffic element) and is used to describe the link recommendations for all the non-AP MLDs that are identified in the AID Bitmap element.

* + - 1. **Multi-Link Traffic element(#2341)**

***TGbe editor: Please modify following paragraphs in subclause 9.4.2.311 Multi-Link Traffic element as follows (#***6766, #6767, #6895, #7671, #8179, #6743, #5759)

The Per-Link Traffic Indication List field is defined in [Figure 9-1002ad (Per-Link Traffic Indication List](#bookmark165) [field format)](#bookmark165). The Per-Link Traffic Indication List field contains Per-Link Traffic Indication Bitmap sub- fields that correspond to the AIDs of the non-AP MLDs starting from the bit numbered *k* of the traffic indi- cation virtual bitmap or the Partial AID bitmap. The Per-Link Traffic Indication List field contains *l* Per-Link Traffic Indication Bitmap subfields, where *l* is the number of the bits that correspond to the AIDs of the non-AP MLDs set to 1, counting from the bit numbered *k* of the traffic indication virtual bitmap:

* + in the Partial Virtual Bitmap sub- field of the TIM element that is included in a Beacon frame with the Multi-Link Traffic element
	+ or in the Partial AID Bitmap subfield of the AID Bitmap element that is included in a Link Recommendation frame with the Multi-Link Traffic element.

***TGbe editor: Please modify following paragraphs in subclause 9.4.2.311 Multi-Link Traffic element as follows (#***6766, #6767, #6895, #7671, #8179, #6743, #5759)

Each bit in the Per-Link Traffic Indication Bitmap subfield corresponds to a link on which a STA affiliated with a non-AP MLD is operating, with the bit position *i* of the bitmap, B*i*, corresponding to a link with link ID equal to *i*. In a Beacon frame, when the Per-Link Traffic Indication Bitmap subfield corresponds to a non-AP MLD that has successfully negotiated TID-to-link mapping, a value of 1 in the bit position *i* in the bitmrap indicates that there is buffered BU(s) with TID(s) mapped to the link with the link ID equal to *i* or MMPDU(s); a value of 0 in a bit position in the bitmap indicates that there is no buffered BU(s) with TID(s) mapped to the corre- sponding link nor MMPDU(s). In a Beacon frame, when the Per-Link Traffic Indication Bitmap subfield corresponds to a non- AP MLD that is in the default mapping mode, a value of 1 in the bit position *i* in the bitmap indicates that the link with the link ID equal to *i* is recommended for retrieving buffered BU(s).

In a Link Recommendation frame, when the Per-Link Traffic Indication Bitmap subfield corresponds to a non- AP MLD, a value of 1 in the bit position *i* in the bitmap indicates that the link with the link ID equal to *i* is recommended for frame exchanges both in DL and in UL.