IEEE P802.11
Wireless LANs

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| TID to Link Mapping for QoS  |
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Abstract

Proposed draft text for enhancements to TID mapping.

The submission proposes text changes to resolve CID 11107 from LB266. All proposed changes are based on 802.11be Draft 2.0.

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

# Revision History

|  |  |  |
| --- | --- | --- |
| **Date** | **Revision** | **Changes** |
| 2022-09-06 | 0 | Initial draft |
| 2022-09-09 | 1 | Restrictions for advertised mapping modes, added normative text for MU-EDCA mapping operation, editorials and clarifications, added authors |
| 2022-09-15 | 2 | Clarifications on MU-EDCA norative behavior. Exception added for a single-link ML setup, RTWT exception removed. Revised author list. |
| 2022-09-21 | 3 | Definition of mapping mode, added discussion, added clarification on individual negotiation following advertisement.  |

# LB266 Comments and discussion [against Draft 2.0]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **P.L** | **Clause** | **Comment** | **Proposed Change** | **Proposed Resolution** |
| 11107 | 220.12 | 9.4.2.312.2.2 | Capability 2 is onerous for implementations, and capability 1 is a very limited form of T2LM. | Introduce a capability 1.5 whereby the MLD supports at least one link (e.g. N-1 links) with all TIDs mapped, and supports another link that has some TIDs mapped. Then renumber the capabilities: 0->0, 1->1, 1.5->2, 2->3. | Resolution: Revised, please implement the changes as shown in document 22/1510r[motioned revision] marked #11107. |
|  |  |  |  |  |  |

**Discussion:**

Please see the embedded slide for discussion on this topic.



### 3.2 Definitions specific to IEEE 802.11

TGbe editor: Add a new definition in subclase 3.2 as shown below (#11107):

**TID to link mapping mode:** A mode that defines the contention behavior of a STA when transmitting MSDUs with a TID on a link to which the TID is mapped, as described in 35.3.7.1 (TID-to-link mapping).

### **9.4.2.312.2.2** Common Info field of the Basic Multi-Link element

TGbe editor: Modify one row in Table 9-401i in section 9.4.2.312.2.2 as shown below (#11107):

**Table 9-401i— Subfields of the MLD Capabilities and Operations field *(continued)***

|  |  |  |
| --- | --- | --- |
| **Subfield** | **Definition** | **Encoding** |
| TID-To-Link Map- ping Negotiation Sup- port | Indicates support for TID-to-link mapping negotiation. | Set to 0 if dot11TIDtoLinkMappingActivated is false and TID-to-link mapping is not supported by the MLD.  Set to 1 if dot11TIDtoLinkMappingActivated is true and the MLD only supports the mapping of all TIDs to the same link set, both for the DL and UL, in unrestricted modeSet to 2 if dot11TIDtoLinkMappingActivated is true and the MLD only supports the mapping, for both UL and DL, of all TIDs to all or a subset of links in unrestricted mode, except optionally in one link mapping some TIDs in MU EDCA mode. TIDs mapped to the same AC are mapped to the same link set and in the same mode.Set to 3 if dot11TIDtoLinkMappingActivated is true and the MLD supports the mapping of each TID to the same or different link set either in unrestricted mode or in MU-EDCA mode.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 (#11107):

### **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 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| Link Mapping Of TID 0(Optional) | … | Link Mapping Of TID 7(Optional) | MU EDCA Mappping(Optional) |

 Octets: 0 or 2 0 or 2 0 or 2

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

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 B1 | B2 | B3 | B4 | B5 B6 |  B7 | B8 |  | B15 |
| Direction | Default Link Mapping | Mapping Switch Time Present | Expected Duration Present | Reserved | MU EDCA Present | Link Mapping Presence Indicator (Optional)  |
| Bits: | 2 | 1 | 1 | 1 | 3 |  1 |  | 0 or 8 |  |

**Figure 9-1002an—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 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 MU EDCA Present subfield is set to 1 if the MU EDCA Mapping 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 (i.e., it identifies the TID(s) for which the mapping is provided 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 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 in a Beacon or Probe Response frame and the indicated TID-to-Link mapping is not yet established; otherwise it is not present. The absence of Mapping Switch Time field in the TID-To-Link Mapping element in a Beacon or Probe Response frame transmitted by an AP affiliated with an AP MLD indicates that the indicated TID-to-Link mapping is already established. The 2 octet Mapping Switch Time field has units of TUs and is set to the time at which the the new mapping is established using as a timebase the value of the TSF corresponding to the BSS identified by the BSSID of the frame containing the TID-To-Link Mapping element: i.e., bits 10 to 25 of the TSF or rem(floor(TSF / 1024), 65536)) of that time.

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 present, 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 not present. The Expected Duration field is present if the TID-To-Link Mapping element is carried in a Beacon or a Probe Response frame transmitted by an AP affiliated with an AP MLD, and is not present otherwise.

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 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 (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. 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.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| MU EDCA Indicator | Link ID for MU EDCA | Reserved |
| Bits: | 0 or 8 | 0 or 4 | 0 or 4 |

**Figure 9-xx1—MU EDCA Mapping field format**

The MU EDCA Mapping field, defined in Figure 9-xx1(MU EDCA Mapping field format), may be present when the TID-To-Link Mapping element is transmitted by an AP affiliated with an AP MLD.

The MU EDCA Indicator subfield indicates which TIDs are requested to be mapped in MU EDCA mode. Bit position n in the MU EDCA Indicator subfield is set to 1 to indicate that TID n is requested to be mapped in MU EDCA mode, and otherwise is set to 0.

The Link ID for MU EDCA subfield indicates the link ID in which the indicated TIDs are requested to be mapped in MU EDCA mode.

Except as indicated by the MU EDCA Indicator and the Link ID for MU EDCA subfields, all other TIDs indicated in the TID-To-Link Mapping (using Link Mapping of TID n field) element are requested to be mapped in unrestricted mode.

### 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 (#11107):

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 it transmits 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 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), 35.3.7.1.7 (Advertised TID-to-link mapping in Beacon and Probe Response frames), and 35.3.7.1.8 (Association Procedures for TID-to-link mapping) then a TID can be mapped to a link set, which is a subset of setup links, spanning from only one setup link to all the setup links.

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, which means that a TID-to-link mapping change is only valid and successful if it will not result in having any TID for which the link set for DL or UL is made of zero setup links. By default, all setup links shall be enabled (see 35.3.7.1.2 (Default mapping mode)).

* 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 and only MSDUs or A- MSDUs with TIDs mapped to that link may be transmitted on that link between the corresponding STA and AP of the non-AP MLD and AP MLD in the direction (DL/UL) corresponding to the TID-to-link mapping.

* 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.
* 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 both in DL and UL.

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 1— 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).NOTE 2—Group addressed frames delivery procedure is defined in 35.3.15 (Multi-link group addressed frame delivery and reception).

If a TID is mapped in UL to a set of enabled links for a non-AP MLD, then the non-AP MLD may use any link within this set of enabled links to transmit individually addressed MSDUs or A-MSDUs corresponding to that TID.

A TID may be mapped to a link in either the MU-EDCA mode or the unrestricted mode, as indicated by the MU EDCA Mapping field of the TID-To-Link Mapping element. If no mapping mode is indicated for a TID’s mapping to a link, that mapping is assumed to be in the unrestricted mode.

If a TID is mapped in MU-EDCA mode to a link, when a non-AP STA affiliated with a non-AP MLD performs EDCA contention to transmit MSDU’s corresponding to that TID on that link:

* If the link is the only enabled link in the non-AP MLD’s ML setup, then the affiliated non-AP STA shall ignore the MU-EDCA mapping mode
* Otherwise, the non-AP STA shall use the latest MU-EDCA parameter set announced by the AP affiliated with the AP MLD that operates on the link and access the WM following the rules in 26.2.7 (EDCA operation using MU EDCA parameters) with the below modifications:
	+ A non-AP STA shall not use dot11EDCATable to update the CWmin[AC], CWmax[AC] and AIFSN[AC].

If the MUEDCATimer[AC] of a non-AP STA reaches 0, either by counting down or due to a reset following the reception of an MU EDCA Reset frame, the STA regardless of whether it sent a frame with an OM Control subfield with the UL MU Disable subfield set to 1 or with the UL MU Disable subfield set to 0 and the UL MU Data Disable subfield set to 1 shall update CWmin[AC], CWmax[AC] and AIFSN[AC] to the values that are contained in the most recently received MU-EDCA Parameter Set element sent by the AP with which the STA is associated, except that if the MU-EDCA parameters announced by the AP operating on the link indicate AIFSN[AC]=0, then the value of the AIFSN is assumed to be 15.

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

— The non-AP MLD may retrieve 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 individually addressed MSDUs or A-MSDUs corresponding to that TID, subject to the power state of the non-AP STA on each of these links.

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 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 that are not a TPC Request frame or a Link Measurement Request frame, subject to the power state of the non-AP STA on each of the links.

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 a TPC Request frame or a Link Measurement Request frame 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.

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

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 associated with an AP MLD shall operate under this mode if a TID-to-link mapping is not advertised by the AP MLD (see 35.3.7.1.7(Advertised TID-to-link mapping in Beacon and Probe Response frames)), and a TID-to-link mapping negotiation for a different mapping did not occur, was unsuccessful or was torn down.

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

tGbe editor: Add a new section 35.3.7.1.7 as shown below and renumber sections accordingly (#11107):

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.

An AP that advertises a TID-to-link mapping shall include the Mapping Switch Time field and set it to the time, in units of tUs, of a DTIM Beacon of one of the aPs affiliated with the AP MLD. Beginning at the indicated time, the indicated TID-to-link mapping is established and the Mapping Switch Time field is no longer included.

A TID-to-link mapping that is advertised by an AP MLD shall comply to one of the following:

* All TIDs are mapped to the same link set, both for DL and UL, in unrestricted mode
* All TIDs are mapped to the same link set, both for DL and UL. All mappings are in unrestricted mode except for one enabled link, where a subset of TIDs are mapped in MU-EDCA mode. TIDs mapped to the same AC are mapped to the same link set and in the same mapping mode.

The Direction field of an advertised TID-To-Link Mapping element shall be set to 2.

NOTE 1— An advertised TID-to-link mapping will include a mapping for all TIDs

NOTE 2— Since the Link IDs can be different for MLDs affiliated with each BSSID in a multiple BSSID set, inheritance will not apply to advertised 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 established advertised TID-to-link mapping and a new non-default advertised TID-to-link mapping will replace it. In this case, the AP MLD shall not include the Mapping Switch Time field in the currently established advertised TID-To-Link Mapping element, and shall include the Mapping Switch Time field in the new TID-To-Link Mapping element, in order to indicate an advertised TID-to-link mapping that will be established 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 at the same time as indicated by the Mapping Switch Time field of the new TID-To-Link Mapping element.

NOTE 3— If the newly advertised TID-to-link mapping is the default mapping, the AP MLD sets the Expected Duration field of the currently advertised TID-to-link mapping to the remaining time until the default mapping is established as described in 9.4.2.314 (TID-To-Link Mapping element) and does not include the TID-To-Link Mapping element for the newly advertised TID-to-link mapping in the Beacon and Probe Response frames. After the establishment of the default mapping, no TID-To-Link Mapping elements are included in the Beacon or Probe Response frames transmitted by the APs affiliated with the AP MLD.

All APs affiliated with an AP MLD that advertises a TID-to-link mapping shall include the same 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 Expected Duration field in all TID-to-link mapping elements in Beacons. From when a new TID-to-link mapping is advertised in a Beacon frame until the advertised TID-to-link mapping is established, the Mapping Switch Time field shall be included in the TID-To-Link Mapping element and set to the time, in units of TUs, at which the TID-to-link mapping will be established, then not included thereafter. The time indicated by the Mapping Switch Time field shall be the TBTT of the DTIM Beacon of one of the APs affiliated with the AP MLD. The Mapping Switch Time field should initially be set to a sufficiently large value. After an advertised TID-to-link mapping is established, the duration indicated by Expected Duration field shall indicate the time when the advertised TID-to-link mapping is expected to end. During the advertisement of the TID-to-link mapping the time indicated may be updated to indicate an earlier time than initially indicated, but shall not be updated to indicate a later time than initially indicated. The duration indicated by Expected Duration field shall be exact when the duration is smaller than two DTIM periods of the AP transmitting the frame carrying the field.

At the time indicated by the Mapping Switch Time field of a TID-To-Link Mapping element 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 TID-to-link mapping that is established in a non-AP MLD beginning at the time indicated by the Mapping Switch Time field in a newly changed TID-To-Link Mapping element received by a non-AP MLD in a Beacon or a Probe Response frame from its associated AP MLD is derived as follows:

- If the advertised mapping does not include any mappings in MU-EDCA mode for the links included in the non-AP MLD’s multi-link setup, the set of mapped links for each TID and direction for a non-AP MLD are the set of links that are included in the non-AP MLD multi-link setup with the associated AP MLD and have been mapped to that TID for that direction in the advertised TID-to-link mapping.

- If the advertised mapping includes mappings in MU-EDCA mode for a link included in the non-AP MLD’s multi-link setup and the non-AP MLD sets the TID-To-Link Mapping Negotiation Supported subfield of MLD Capabilities field of the Basic Multi-Link element to 2 or 3, the set of mapped links for each TID and direction for a non-AP MLD are the set of links that are included in the non-AP MLD multi-link setup with the associated AP MLD and have been mapped to that TID for that direction in the advertised TID-to-link mapping. For each mapping, the mapping mode follows the mode signaled by the advertised mapping for the corresponding TID and link.

- If the advertised mapping includes mappings in MU-EDCA mode for a link included in the non-AP MLD’s multi-link setup and the non-AP MLD sets the TID-To-Link Mapping Negotiation Supported subfield of MLD Capabilities field of the Basic Multi-Link element to 0 or 1, the set of mapped links for each TID and direction for a non-AP MLD are the set of links that are included in the non-AP MLD multi-link setup with the associated AP MLD and have been mapped to that TID for that direction in the unrestricted mode in the advertised TID-to-link mapping.

NOTE 4—An individually negotiated TID-to-link mapping whose negotiation was completed prior to the establishment of an advertised TID-to-link mapping is discarded at the time of the establishment of the advertised TID-to-link mapping.

NOTE 5—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 MLD multi-link setup procedure. For example, if the AP MLD operates on 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 6—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 successfully negotiated.

NOTE 7—No TID-To-Link Mapping Request nor TID-To-Link Mapping Response frames are transmitted by non-AP STAs affiliated with the associated non-AP MLDs in response to an advertised TID-to-link mapping.

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 different from the TID-to-link mapping established from the advertisement as described in this section. Any MLD shall not initiate a negotiation for a TID-to-link mapping that maps a TID to a link if the requested TID is not already mapped to the link in the advertised TID-to-link mapping, or one that maps a TID to a link in unrestricted mode if that TID is mapped to that link in MU-EDCA mode in the advertised TID-to-link mapping.