IEEE P802.11
Wireless LANs

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| PDT for CC34 Resolution for CID3222  |
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|  |  |  |  |  |

Abstract

This submission proposes CR for CID 3222 (CC34).

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Alignement to the baseline of 802.11 D1.0 , Adding Link Disablement Count field.
* Rev 2: Updating the doc, based on received comments from: Abhi, Insun
* Rev 3: Adding text for Option 2 + SP for selecting one of the options.

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGbe Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGbe Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGbe Editor: Editing instructions preceded by “TGbe Editor” are instructions to the TGbe editor to modify existing material in the TGbe draft. As a result of adopting the changes, the TGbe editor will execute the instructions rather than copy them to the TGbe Draft.***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Pg/Ln** | **Section** | **Comment** | **Proposed Change** | **Resolution** |
| 3222 | Young Hoon Kwon | 133/27 | 35.3.6.1.1 | Link is disabled if no TIDs are mapped to that link, and TID-to-link mapping is a negotiation between an AP MLD and a non-AP MLD. Therefore, even if an AP MLD intends to disable a link BSS-wide for any reason, the AP MLD cannot disable the link if there's any non-AP MLD does not agree to, which makes the AP's operation difficult. A mechanism is needed that an AP MLD can disable a link BSS-wide without having individual negotiation with each and every associated non-AP MLDs. | As shown in the comment | **Revised**Agree in principle with the comment.Need to add a notification-based mechanism (in addition to the negotiation mechanism), where the AP can quickly & temporarily disable or enable one or more links without the need to negotiate it with any of its associated non-AP MLDs.**TGbe editor please implement changes as shown in doc 11-21/0792r1 tagged as 3222.** |

## Discussion

According to the 802.11be D1.0, the non-AP MLD may use its Power Save mechanism to disable a link with the corresponding AP MLD. This “disable” operation simply prohibits the non-AP MLD and the peer AP MLD to use this link for any frame exchange from this point onwards, till the link becomes “enabled”. During this “disable” period the link is still set between the MLDs but can not be used for frame exchange.

The AP MLD also needs such a similar mechanism to temporarily disable one or more setup links with one or more non-AP MLDs, from various aspects, such as: AP Power Save that is currently required by the EU regulations (mainly when the equipment is in IDLE, i.e.: not in use) and “Power Consumption level” certification which becomes de-facto a must feature in EU and North America markets, etc.

This mechanism needs to be notification-based (as opposed to negotiation-based): the AP informs the non-AP MLD(s) that a specific link (in DL direction) is disabled or enabled. The implication for the non-AP MLD(s) is to avoid using the disabled link for any further frame exchange (including management frames) until the link becomes enabled.

2 options are proposed for signalling:

* Option 1 (indirect indication) – Use the currently defined TID-To-Link mapping **element**, where in case that no TID is mapped to a specific link, the link is considered as disabled.
* Option 2 (Direct indication) – Use a new Link bitmap element, where each bit indicates whether the link is disabled / enabled.

In addition, the proposed mechanism suggests an alternative to the “known” CSA mechanism in case of associated non-AP MLDs only (that may be lengthy due to sending the same notification several times ahead so all the STAs will receive it prior to the actual channel switching).

Actually, it takes advantage that there is more than a single setup link between the AP MLD and the non-AP MLD, so the frame does not necessarily have to be sent only on the link that is intended to be disabled.

Therefore, the switching time between the notification (for disabling a link) and the actual disablement of the link is significantly decreased.

*======= Proposed Text – Option 1 ==========*

*TGbe editor: Please note baseline is 11be D1.0*

9.4.1 Fields that are not elements

[CID 3222]

*TGbe editor: Add the following new subclause after 9.4.1.67e as follows:*

**9.4.1.67f** Link Disablement Count **field**

The Link Disablement Count field indicates the number of TBTTs corresponding to the link on which the Link Enablement Notification frame (which includes Link Disablement Count field) is transmitted until the link indicated as disabled in the TID-To-Link mapping element actually becomes disabled.

The Link Disablement Count field is shown in Figure 9-XX (Link Disablement Count field format)

|  |  |
| --- | --- |
|  | Link Disablement Count |
| Octets: | 1 |

**Figure 9-XX -** **Link Disablement Count field format**

* Action frame format details

9.6.35.1 Protected EHT Action field

***TGbe editor: Change Table 9-526q as follows:***

|  |
| --- |
| Table 9-526p – Protected EHT Action field values |
| Value | Meaning | Time Priority |
| 0 | TID-to-Link Mapping Request | No |
| 1 | TID-to-Link Mapping Response  | No |
| 2 | TID-to-Link Mapping Teardown | No |
| 3 | NSEP Priority Access Enable Request | No |
| 4 | NSEP Priority Access Enable Response | No |
| 5 | NSEP Priority Access Teardown | No |
| 6 | Link Enablement Notification [CID 3222] | No |
| ~~1~~7–255 | Reserved |  |

***TGbe editor: Insert the following new subclause at the end of subclause 9.6.35.7:***

[CID 3222]

9.6.35.8 Link Enablement Notification frame format

The Link Enablement Notification frame is an Action frame of category Protected EHT. An AP affiliated with an AP MLD uses the Link Enablement Notification frame to notify one or more new link enablement or disablement, using a TID-to-link mapping, with one or more associated non-AP MLD(s) which have setup link(s) with the AP MLD. The Action field of the Link Enablement Notification frame contains the information shown in Table 9-526w (Link Enablement Notification frame Action field format).

|  |
| --- |
| Table 9-526w – Link Enablement Notification frame Action field format |
| Order | Information |
| 1 | Category  |
| 2 | Protected EHT Action  |
| 3 | TID-to-Link Mapping (see 9.4.2.295d (TID-to-Link Mapping element)) |
| 4 | Link Disablement Count subfield (see 9.4.1.67f Link Disablement Count field) |

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

The Protected EHT Action field is defined in 9.6.36.1 (General).

The TID-to-Link Mapping field contains one TID-to-Link Mapping element as specified in 9.4.2.295d (TID-to-Link Mapping) element)), where the Direction subfield is set to 1 (Downlink).

The Link Disablement Count subfield is present if the TID-to-Link mapping element included in the Link Enablement Notification frame indicates at least one disabled link. Otherwise – it is not present. The Link Disablement Count subfield indicates the number of TBTTs until the DL TID-to-Link Mapping is being updated according to the TID-to-Link mapping element indicated in the Link Enablement Notification frame. The value 1 indicates that the Mapping update occurs at the next TBTT (i.e. the ensuing Beacon frame is generated only on the links defined as enabled according to the new TID-to-Link mapping), and the value 0 indicates that the Mapping update occurs at any time after the frame containing the element is transmitted.

* **TID-to-link mapping**

***TGbe editor: Insert the following paragraph to the new subclause, as follows:***

[CID 3222]

35.3.6.1.6 Notification of Link enablement (using TID-To-Link Mapping element)

An AP MLD shall use the Link Enablement Notification frame to notify the disablement of one or more enabled links and /or the enablement of one or more enabled links in DL direction with one or more non-AP MLD(s) it is associated with.

NOTE: If the included TID-To-Link Mapping element indicates that no TIDs are mapped to one or more links, these links are considered as disabled links. In such a case, the intended recipient(s) of the Link Enablement Notification frame shall not use the disabled link(s) for any further frame exchange with the AP MLD.

Any AP affiliated with an AP MLD may initiate for transmission an individually addressed or broadcast Link Enablement Notification frame. In case that the Link Enablement Notification frame is sent with the broadcast address, the Address 3 (BSSID) field shall be set to the MAC address of the affiliated AP.

In case that the Link Enablement Notification frame is sent with the broadcast address by an AP affiliated with the AP MLD, the TID-To-Link Mapping element shall apply for all the non-AP MLDs which are associated with the AP MLD and their affiliated non-AP STA has correctly received the Link Enablement Notification frame.

In case that an AP affiliated with an AP MLD initiates for transmission an individually addressed Link Enablement Notification frame which includes notification of the disablement of one or more enabled links, the AP MLD shall disable the one or more enabled links only after the TXOP in which it has received the immediate acknowledgement from the intended recipient (i.e. non-AP STA affiliated with the non-AP MLD).

In case that an AP affiliated with an AP MLD initiates for transmission an individually addressed Link Enablement Notification frame which includes notification of the enablement of one or more disabled links, the AP MLD shall enable the one or more disabled links only after the TXOP in which it has received the immediate acknowledgement from the intended recipient (i.e.non-AP STA affiliated with the non-AP MLD).

In case that the Link Enablement Notification frame is sent with the broadcast address by an AP affiliated with the AP MLD and the TID-To-Link Mapping element indicates at least one disabled link, the Link Enablement Notification frame should be scheduled so that all non-AP STAs operating on the link and are affiliated with non-AP MLD have the opportunity to receive at least one Link Enablement Notification frame.

In case that the Link Mapping Presence Indicator subfield indicates that the Link Mappings of all TIDs are included in the TID-To-Link Mapping element (i.e. all bits are equal to 1), the non-AP MLD shall determine link disablement or enablement status for each of the setup links based on the Link Mapping fields that have been included in the TID-To-Link Mapping element.

In case that the Link Mapping Presence Indicator subfield indicates that not all the Link Mappings of TIDs are included in the TID-To-Link Mapping element (i.e. one or more bits are equal to 0), the non-AP MLD shall determine link disablement or enablement status for each of the setup links based on the following:

* For the TIDs whose Link Mapping fields are included in the TID-To-Link Mapping element of the received Link Enablement Notification frame, it shall use these Link Mapping fields.
* For the TIDs whose Link Mapping fields are excluded from the TID-To-Link Mapping element of the received Link Enablement Notification frame, it shall use the Link Mapping fields of these TIDs that have been received in the most recent TID-To-Link Mapping element with Direction subfield set to 1 (that is included either in Link Enablement Notification frame or in TID-to-Link Mapping Response frame if the TID-To-Link Mapping Negotiation is supported).
	+ If no Link Mapping field has been received for specific TID (in the DL direction) from the associated AP MLD, the non-AP MLD shall assume the default Link Mapping for this TID (i.e. all links are mapped to this TID).

***======= End of Proposed Text – Option 1 ==========***

*======= Proposed Text – Option 2 ==========*

*TGbe editor: Please note baseline is 11be D1.0*

9.4.1 Fields that are not elements

[CID 3222]

*TGbe editor: Add the following new subclause after 9.4.1.67e as follows:*

**9.4.1.67f** Link Disablement Count **field**

The Link Disablement Count field indicates the number of TBTTs corresponding to the link on which the Link Enablement Notification frame (which includes Link Disablement Count field) is transmitted until the link indicated as disabled in the TID-To-Link mapping element actually becomes disabled.

The Link Disablement Count field is shown in Figure 9-XX (Link Disablement Count field format)

|  |  |
| --- | --- |
|  | Link Disablement Count |
| Octets: | 1 |

**Figure 9-XX - Link Disablement Count field format**

9.4.2 Elements

[CID 3222]

9.4.2.1 General

*Insert a new row to Table 9-92 (Element IDs (#3221)*

Table 9-92 – element IDs (#3221)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Element | Element ID | Element ID extension | Extesible | Fragmentable |
| Link Disablement (see 9.4.2.295f (Link Disablement element)) | <ANA> | <ANA> | Yes | No |

9.4.2.295f Link Disablement element

The Link Disablement element includes the Link Disablement bitmap subfield and the Link Disablement Count field for the Downlink direction (i.e. from AP MLD to non-AP MLD)

The Link Disablement element is defined in Figure YY (Link Disablement element format)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Element ID Extension | Link Disablement bitmap | Link Disablement Count |
| Octets: | 1 | 1 | 1 | 2 | 0 or 1 |

**Figure YY - Link Disablement element format**

The Element ID, Length, and Element ID Extension fields are defined in 9.4.2.1 (General)

The Link disablement bitmap subfield is used to indicate the Disable / Enable status of each of the setup links of the AP MLD (with any of its associated non-AP MLDs). Each bit that is equal to 1 in the Link disablement bitmap subfield indicates that this link is disabled. Each bit that is equal to 0 in the Link disablement bitmap subfield indicates that this link is enabled. A link that has not been setup with any of the associated non-AP MLDs is set to 1.

Note: The definitions of enabled / disabled links are defined – see section 35.3.6.1.1

The Link Disablement Count field is defined in 9.4.1.67f (Link Disablement Count field). The Link Disablement Count subfield is not present if all setup links are enbled. Otherwise – it is present.

The Link Disablement Count subfield indicates the number of TBTTs until the Link disablement bitmap is being updated according to the Link Disablement element indicated in the Link Enablement Notification frame. The value 1 indicates that the link disable/enable update occurs at the next TBTT (i.e. the ensuing Beacon frame is generated only on the links defined as enabled according to the new Link disablement bitmap), and the value 0 indicates that the link disable/enable occurs at any time after the frame containing the element is transmitted.

* Action frame format details

9.6.35.1 Protected EHT Action field

***TGbe editor: Change Table 9-526q as follows:***

|  |
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| Table 9-526p – Protected EHT Action field values |
| Value | Meaning | Time Priority |
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| 1 | TID-to-Link Mapping Response  | No |
| 2 | TID-to-Link Mapping Teardown | No |
| 3 | NSEP Priority Access Enable Request | No |
| 4 | NSEP Priority Access Enable Response | No |
| 5 | NSEP Priority Access Teardown | No |
| 6 | Link Enablement Notification [CID 3222] | No |
| ~~1~~7–255 | Reserved |  |

***TGbe editor: Insert the following new subclause at the end of subclause 9.6.35.7:***

[CID 3222]

9.6.35.8 Link Enablement Notification frame format

The Link Enablement Notification frame is an Action frame of category Protected EHT. An AP affiliated with an AP MLD uses the Link Enablement Notification frame to notify one or more new link enablement or disablement, using a TID-to-link mapping, with one or more associated non-AP MLD(s) which have setup link(s) with the AP MLD. The Action field of the Link Enablement Notification frame contains the information shown in Table 9-526w (Link Enablement Notification frame Action field format).

|  |
| --- |
| Table 9-526w – Link Enablement Notification frame Action field format |
| Order | Information |
| 1 | Category  |
| 2 | Protected EHT Action  |
| 3 | Link Disablement (see 9.4.2.295f (Link Disablement element)) |

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

The Protected EHT Action field is defined in 9.6.36.1 (General).

The Link Disablement element is defined in 9.4.2.295f (Link Disablement element)

* **TID-to-link mapping**

***TGbe editor: Insert the following paragraph to the new subclause, as follows:***

[CID 3222]

35.3.6.1.6 Notification of Link enablement

An AP MLD shall use the Link Enablement Notification frame to notify the disablement of one or more enabled links and /or the enablement of one or more enabled links in DL direction with one or more non-AP MLD(s) it is associated with.

NOTE: If any of the links is indicated as disabled, the intended recipient(s) of the Link Enablement Notification frame shall not use the disabled link(s) for any further frame exchange with the AP MLD.

Any AP affiliated with an AP MLD may initiate for transmission an individually addressed or broadcast Link Enablement Notification frame. In case that the Link Enablement Notification frame is sent with the broadcast address, the Address 3 (BSSID) field shall be set to the MAC address of the affiliated AP.

In case that the Link Enablement Notification frame is sent with the broadcast address by an AP affiliated with the AP MLD, the Link Disablement element shall apply for all the non-AP MLDs which are associated with the AP MLD and their affiliated non-AP STA has correctly received the Link Enablement Notification frame.

In case that an AP affiliated with an AP MLD initiates for transmission an individually addressed Link Enablement Notification frame which includes notification of the disablement of one or more enabled links, the AP MLD shall disable the one or more enabled links only after the TXOP in which it has received the immediate acknowledgement from the intended recipient (i.e. non-AP STA affiliated with the non-AP MLD).

In case that an AP affiliated with an AP MLD initiates for transmission an individually addressed Link Enablement Notification frame which includes notification of the enablement of one or more disabled links, the AP MLD shall enable the one or more disabled links only after the TXOP in which it has received the immediate acknowledgement from the intended recipient (i.e.non-AP STA affiliated with the non-AP MLD).

In case that the Link Enablement Notification frame is sent with the broadcast address by an AP affiliated with the AP MLD and the Link Disablement element indicates at least one disabled link, the Link Enablement Notification frame should be scheduled so that all non-AP STAs operating on the link and are affiliated with non-AP MLD have the opportunity to receive at least one Link Enablement Notification frame.

If TID-To-Link mapping negotiation is supported (i.e. TID-To-Link Mapping Negotiation Supported is set to a nonzero value in MLD capabilities subfield of Basic variant MLE) then the Link Disabled element which is included in the Link Enablement Notification frame shall limit the usage of any of the links (by both AP MLD and associated non-AP MLDs) if one or more of the setup links are indicated as “disabled”

If TID-To-Link mapping negotiation is not supported (i.e. TID-To-Link Mapping Negotiation Supported is set to 0 in MLD capabilities subfield of Basic variant MLE) then the Link Disablement element which is included in the Link Enablement Notification frame shall take precedence over the negotiated TID-To\_Link mapping and shall limit the usage of any of the links (by both AP MLD and associated non-AP MLDs) if one or more of the setup links are indicated as “disabled”.

Note: In this case the non-AP MLD which has correctly received shall consider both Link Enablement Notification frame (which includes Link disablement element with one or more “disabled” setup links) and the DL TID-To-Link Mapping element prior to initiating any response transmission to the associated AP MLD.

*======= End of Proposed Text – Option 2 ==========*

## Summary

2 options are proposed for indicating a (temporarily) disablement/enablement of the link:

Option 1 (Indirect) – using the currently defined TID-To-Link mapping element (preferred)

Pros: No need for new element definition and following the proposed solution of the commenter of CID3222. Same element rules the exact mapping of TIDs and links as well as the disabled links.

Option 2 (Direct) – using a new element of Link disablement bitmap

Pros: simple indication per link.

Cons: Due to duplication in setting of Disabled links by both TID-To-Link Mapping element (if negotiation is supported) and Link Disablement element – need to set the relationship between these elements.

Straw Poll 1:

Which of the following options do you support for the purpose of indicating a (temporarily) link disablement / enablement:

Option 1 (indirect) – Using the currently defined TID-To-Link mapping element, as defined in 802.11 D1.0 section 9.4.2.295d?

Option 2 (direct) – Using a new Link disablement bitmap element.

Option 3 – Abstain

Result: Option 1 / Option 2 / Option 3

Straw Poll 2:

Do you support to incorporate the proposed draft text in this document 11-21/0792rX to the next revision of TGbe Draft 1.0?

Result: Yes/No/Abstain