IEEE P802.11
Wireless LANs

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| CC36-Resolution-for-CID-5154 |
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Abstract

This submission proposes CR for CIDs 5154.

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: adding modification based on offline discussions
* Rev 2: Align the doc with 802.11be D1.2 baseline,
Modifying the Enabled Link / Disabled Link definition due to John’s comment,
Adding Link disablement Parameters field in the EHT Operation element due to Vishnu’s comments,
Adding distinction between link disablement (between AP MLD and associated non-AP MLD) and BSS Link disablement (between AP MLD and all associated non-AP MLDs operating on that link) both in Description part and text part – due to Vishnu’s comments.
* Rev 3: Align the doc with 802.11be D1.3 and additional modifications based on further offline comments (Laurent, Abhi, Kaiying):
replacing “BSS Link disablement” with “Link unavailability” and moving all normative behavior texts to section 35.3.6.3.
Removing all changes from section 35.3.6.1 (TID-To-Link mapping)
Link unavailability parameters will be included in MLE (instead of EHT Operation)
Unavailable Link Indication subfield is moved to MLD Parameters (instead of BSS Parameters)
Remove periodicity from Link Unavailability parameters
Update specific fields in RNR for critical update indication.
Updating the Discussion part accordingly

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** |
| --- | --- | --- | --- | --- | --- | --- |
| 5154 | George Cherian |  |  | The procedure, if an AP MLD chooses to disable a link (for any reason) is missing. Please specify. | As in comment | **Revised**Agree in principle with the comment. Following the discussion below, need to add a notification-based mechanism to allow the AP MLD to temporarily prohibit the frame exchange on one or more setup links (as the normative behavior defined for a disabled link).**TGbe Editor, please implement changes as shown in doc 11-21/1237r1 tagged as 5154.** |

## Discussion

According to 802.11be D1.1 section 35.3.6.1.1 the non-AP STA affiliated with a non-AP MLD can temporarily prohibit any frame exchange on the enabled link it is operating by a simple notification of entering into a Power Save mode.

The AP MLD also needs a similar notification-based mechanism (as clearly specified in CID5154) that will allow it to temporarily prohibit any frame exchange on one or more links it operating with any of the non-AP STAs affiliated with associated non-AP MLDs that are operation on any of these links for any reason it has (Reducing AP Power consumption, especially when the AP MLD handles multiple TX/RX chains on different bands).

This proposal covers the above issues (from the AP MLD perspective) and includes a mechanism to notify the unavailability of a link by the AP using Beacon and Probe Response frames.

It should be noted that unavailability of the link is a **different** operation than Deleting a link (which is discussed in the 11-21/534r7): When the link becomes unavailable by the AP MLD, all the non-AP MLDs operating on that link are kept associated with all the link parameters, so once the link becomes available the frame exchange can be immediately initiated on this link, where in case the link is deleted/removed all the related link parameters are erased and this link can’t be used anymore from this point onwards.

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 indication does not necessarily have to be sent only on the link that is intended to become unavailable.

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

The proposed solution is based on the following guidelines:

* The link(s) can become available / unavailable in a resolution of TBTTs.
* Adding an indication in the RNR element (which includes the information corresponding to the link that becomes unavailable) – to avoid any Probe Request / Association Request frames transmission by non-AP MLDs on the unavailable link(s).
Please note that these RNRs are included in the Beacon / Probe response frames of the APs affiliated with the same AP MLD (as the affiliated AP operating on the link that becomes unavailable), as shown in the example illustrated in the following diagram:


In this example, AP MLD is associated with non-AP MLD1 and non-AP MLD2 and on each enabled link, it includes the RNR elements for the affiliated APs (of the same AP MLD). An indication of link unavailability of 5 GHz Link will be included in the RNR elements corresponding to AP2, which are included in the Beacon and Probe response frames transmitted on the 2.4GHz and 6GHz links. In this way, an unassociated non-AP MLD 3 will avoid initiating the transmission of any Probe Request / Authentication / Association Request frame during the period of the unavailability of Link 2.

* Adding an indication in the Multi link element – to announce that the current link becomes unavailable for the associated MLDs operating on the link to become unavailable. It is much needed if the associated non-AP MLD has only one enabled link with the AP MLD.
* The indication for the unavailable link should be included in the MLD parameters subfield of the RNR. This will enable future extensions for the link unavailability for NSTR mobile AP MLD on the nonprimary link.
* The link unavailability / availability indication in the RNR will be defined as a Critical Update, so the non-AP MLD will be notified promptly for any change on the link status.

\*\*\*\* End of discussion part \*\*\*\*\*

*TGbe editor: Please note baseline is 11be D1.3 and REVme D0.1*

**9.4.2.170 Reduced Neighbor Report element**

**9.4.2.170.2 Neighbor AP Information field**

[CID 5154]

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

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

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

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

The Unavailable Link Indication subfield is set to 1 if the operating link of the AP described in this Neighbor AP Information field is not available, as defined in 35.3.6.3. Otherwise, it is set to 0.

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**9.4.2.** **312 Multi-Link element**

**9.4.2.312.2 Basic Multi-Link element(#6700)**

**9.4.2.312.2.1 Common Info field of the Basic Multi-Link element(#7567)**

[CID 5154]

***TGbe editor: Update the following Figure 9-1002d (Presence Bitmap subfield of the Basic Multi-Link element format) as follows:***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B3 | B4 | B5 |  B6 B11 |
|  | Link ID Info Present | BSSParameters Change Count Present | Medium Synchronization Delay Information Present | EMLCapabilities Present | MLDCapabilities Present | Link Unavailability Parameters Present | Reserved |
| Bits: | 1 | 1 | 1 | 1 | 1 | 1 | 6 |

**Figure 9-1002d—****Presence Bitmap subfield of the Basic Multi-Link element format**

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

The Link Unavailability Parameters Present subfield is set to 1 if the Link Unavailability Parameters subfield is present in the Common Info field. Otherwise, the Link Unavailability Parameters Present subfield is set to 0.

**9.4.2.312.2.2 Multi-Link Control field of the Basic Multi-Link element(#7567)**

[CID 5154]

***TGbe editor: Update the following Figure 9-1002h (Common Info field of the Basic Multi-Link element format) as follows:***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Common Info Length | MLD MACAddress | Link ID Info | BSSParameters Change Count | Medium Synchronization Delay Information | EMLCapabilities | MLDCapabilities | Link Unavailability Parameters |
| Octets: | 1 | 6 | 0 or 1 | 0 or 1 | 0 or 2 | 0 or 2 | 0 or 2 | 0 or 3 |

**Figure 9-1002e— Common Info field of the Basic Multi-Link element format**

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

The format of the Link Unavailability Parameters subfield is defined in figure 9-1002ha (Link Unavailability Parameters subfield format)

|  |  |  |
| --- | --- | --- |
|  | Link Unavailability Count | Link Unavailability Duration |
| Octets: | 1 | 2 |

**Figure 9-1002ha— Link Unavailability Parameters subfield format**

The subfields of the Link Unavailability Parameters are defined in Table 9-401ha (Subfields of Link Unavailability Parameters subfield).

**Table 9-401ha—** **Subfields of** **Link Unavailability Parameters subfield**

| **Subfield** | **Definition** | **Encoding** |
| --- | --- | --- |
|  Link Unavailability Count | This subfield indicates the number of TBTTs (in the range of [0,255]) after which the link becomes unavailable | A non-zero value indicates that the link becomes unavailable (as defined in 35.3.6.3) after an amount of TBTTs indicated by this value.The value 0 indicates that the link unavailability occurs at any time after the Beacon frame is transmitted  |
| Link Unavailability Duration | This subfield indicates the duration for which the link will be unavailable | The value is expressed in TUsA value of 65535 indicates unknown duration |

NOTE: The Link Unavailability Parameters subfield included in the Common Info field applies to the reporting AP.

**9.4.2.312.2.3 Link Info field of the Basic Multi-Link element (#7567)**

[CID 5154]

***TGbe editor: Update the following Figure 9-1002k (STA control field format) as follows:***

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 |  B11 B15 |
|  | Link ID | Complete Profile | MACAddress Present | Beacon Interval Present | DTIM Info Present | NSTRLink Pair Present | NSTRBitmap Size | Link Unavailability Parameters Present | Reserved |
| Bits: | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 5 |

**Figure 9-1002k— STA Control field format**

***TGbe editor: Add the following after the 11th paragraph of this subclause as follows:***

The Link Unavailability Parameters Present subfield is set to 1 if the Link Unavailability Parameters subfield is present in the STA Control field. Otherwise, the Link Unavailability Parameters Present subfield is set to 0.

***TGbe editor: Update the following Figure 9-1002l (STA Info field format) as follows:***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | STA Info Length | STA MACAddress | Beacon Interval | DTIM Info | NSTRIndication Bitmap | Link Unavailability Parameters |
| Octets: | 1 | 0 or 6 | 0 or 2 | 0 or 2 | 0 or 1 or 2 | 0 or 3 |

**Figure 9-1002l— STA Info field format**

***TGbe editor: Add the following after the 18th paragraph of this subclause as follows:***

The format of the Link Unavailability Parameters subfield is defined in section 9.4.2.312.2.2, figure 9-1002ha (Link Unavailability Parameters subfield format) and applies to the reported AP.

* + - 1. **TIM Broadcast**

[CID 5154]

***TGbe editor: Please update the subclause as follows:***

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. Modification of the Unavailable Link Indication subfield in the Reduced Neighbor Report element

[[CID 5154]](#bookmark21)

***[TGbe editor: Please add the following new subclause to section 35.3.6](#bookmark21)***

[35.3.6.3 AP Notification of Link Unavailability](#bookmark21)

[An AP MLD may turn any of its links into an unavailable link. When a link is notified as an unavailable link, it shall not be used for any frame exchange by any of its BSS members that are affiliated with MLD (i.e. AP MLD or non-AP MLD) as well as by an unassociated non-AP MLDs.](#bookmark21)

[An AP MLD shall notify the unavailability state of a link, using the Unavailable Link Indication subfield in the MLD Parameters subfield of the Neighbor AP Information field in the Reduced Neighbor Report element included in the Beacon or Probe Response frames transmitted by any of the APs affiliated with the AP MLD.
This way, the reporting AP (which is affiliated with AP MLD) and is operating on an available link, transmits Beacon and Probe Response frames that include a notification of the unavailability status of the links to which the reported APs affiliated with the same AP MLD pertain.](#bookmark21)

[When the Unavailable Link Indication subfield is set to 1, the reported link (i.e. the link on which the reported AP is operating) is defined as an unavailable link. Otherwise, the reported link is defined as an available link.](#bookmark21)

[When a link becomes available after a time period in which it was defined as an unavailable link, frame exchange operation on this link (subject to power state (see 35.3.11) and enablement status (see 35.3.6.1) if the intended recipient) can be immediately initiated by any member of the BSS that is affiliated with an MLD (i.e. AP MLD or non-AP MLD) and is operating on this link, using all the link parameters that were defined before the link has been defined as an unavailable link.](#bookmark21)

[The AP MLD may announce its associated non-AP MLDs ahead for the link unavailability by including the Link Unavailability Parameters subfield in the Multi-link element. This announcement may refer to the current link (where the Beacon or Probe Response frame is transmitted) or to any other reported link (whether it pertains to the same AP MLD or to another AP MLD).](#bookmark21)

[NOTE 1 - Link Unavailability Parameters subfield optionally included in the Common Info field of the Basic Multi-link element carried in the transmitted Beacon or Probe response frames refers to the reporting AP operating on the link that will become unavailable.](#bookmark21)

[NOTE 2 - Link Unavailability Parameters subfield optionally included in the Link Info field of the Basic Multi-link element carried in the transmitted Beacon or Probe response frames refers to the reported AP affiliated with the same AP MLD and operating on the link that will become unavailable.](#bookmark21)

[NOTE 3 - The Multi-link element carried in the nontranmsittted Profile subelement of the Multiple BSSID element may include the Link Unavailability Parameters subfields of the links that pertain to the reported AP affiliated with the AP MLD corresponding to the AP MLD MAC address is included in the MLD MAC Address.](#bookmark21)

[If Link Unavailability Parameters subfield is present, the AP affiliated with the AP MLD that operates on the link becoming unavailable should schedule the unavailability occurrence so that all non-AP STAs affiliated with the non-AP MLD associated with that AP MLD and are operating on that link should have the opportunity to receive at least one Beacon frame which carries the Link Unavailability Parameters subfield.](#bookmark21)

[An AP affiliated with an AP MLD shall notify the availability of an unavailable link which is announced with the Link Unavailability Duration subfield value other than 65535 in the Link Unavailability Parameters subfield carried in the Multi-link element, before the expiry of the time indicated in the Link Unavailability Duration subfield.](#bookmark21)

[Straw Poll:](#bookmark21)

[Do you support to incorporate the proposed draft text in this document 11-21/1237r3 to the next revision of TGbe Draft 1.3, for addressing the CID 5154?](#bookmark21)

[Result: Yes/No/Abstain](#bookmark21)