### IEEE P802.11Wireless LANs

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| 11be D1.0 CR for 3.2 |
| Date: 2021-12-14 |
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|  |  |  |  |  |

Abstract

This submission proposes resolutions for the following CIDs:

5777, 5293, 6624, 6636, 7488, 5571, 6105, 6166, 4093, 4315, 6581

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Revision for 5777, 5293, 6624, 6636 and delete unrelevant texts to focus on the resolution of these 4 CIDs.
* Rev 2: Revision for 5293 and 6624 based on the offline discussion with Ming. Changes are highlighted with blue.
* Rev 3: Remove controversial CIDs 6624 and 5777. Revision based on discussion with Yongho. Changes are marked with green to clarify that for AP MLD, Maximum Number Of Simultaneous Links is based on operation.
* Rev 4: Editorial fix of editor instruction.
* Rev 5: Revised based on comments from Yongho Seok for CID 6624 and 5777. Changes are marked with gray.
* Rev 6: Revision on one sentence based on the discussion with Liwen. Editioral revision based on suggestion from Payam and Tomo. Add paragraph based on discussion with Yunbo and Yiqing. Changes are colored yellow.
* Rev 7: Add cosigners

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 D1.0 Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGbe D1.5 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.***

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| **CID** | **Commenter** | **Clause** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 6636 | Pooya Monajemi | 3.2 | 41.16 | In some scenarios an MLD may operate using only one STA. This includes cases where a link is removed after an AP of an AP MLD shuts down. Definition should support this case. | Either change to "capability to have more than one affiliated station", or change to "one or more affiliated station" | Revised – TGbe has accepted the MLD reconfiguration proposal. An AP MLD with two affiliated APs might remove one of the affiliated APs, and the AP MLD has only one affiliated AP after one of the affiliated APs is removed. Further, the non-AP MLD that is associated with the AP MLD with two setup links also has only one affiliated non-AP STA after one of the affiliated APs is removed. We clarify above and do fix bugs along the line.TGbe editor to make the changes shown in 11-21/2009r7 under all headings that include CID 6636. |

**Propose:**

**item with CID tag 6636: This handles the texts needed for MLD to operate with one or more links due to link removal**

***TGbe editor: Modify 35.3.1 General as follows (track change on):***

**35.3 Multi-link operation**

 **35.3.1 General**

MLO enables a non-AP MLD to discover, authenticate, associate, and set up multiple links with an AP MLD. Each link enables channel access and frame exchanges between the non-AP MLD and the AP MLD based on the supported capabilities exchanged during association.

(#1057)(#2319)A STA, which is affiliated with an MLD, may select and manage its (#6601)capabilities and operating parameters independently from the other STA(s) affiliated with the same MLD, unless specified otherwise.

(#1057)(#2319)NOTE 1—For example, each AP, which is affiliated with an AP MLD, may select its BSS color corresponding to the BSS that the AP generates differently.

(#5606)NOTE 2—Examples of operating parameters that are selected at the MLD level (i.e., not independently selected by affiliated STAs) are the listen interval (see 35.3.12.6 (Operation for MLD listen interval)) and the WNM sleep interval (see 11.2.3.1 (General)).

An EHT AP shall have dot11MultiLinkActivated set to true and shall be affiliated with an AP MLD. The EHT AP and its affiliated AP MLD follow the rules defined in 35.3 (Multi-link operation).

An AP MLD may operate with one or more affiliated APs.(#6636)

A non-AP MLD may operate with one or more affiliated non-AP STAs. (#6636)

NOTE – An AP MLD might operate with a single affiliated AP, for example, after removing some of its affiliated APs. Similarly, a non-AP MLD might operate with a single affiliated non-AP STA, for example, after the associated AP MLD has removed some of its affiliated APs. See 35.3.6.2.2 (Removing affiliated APs). (#6636)

***TGbe editor: Modify 35.3.6 Multi-link reconfiguration as follows (track change on):***

35.3.6 Multi-link reconfiguration [#4659][#5305][#6587][#6641][#6728]

35.3.6.1 General

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

### 35.3.6.2 Adding or removing affiliated APs

### 35.3.6.2.1 Adding new affiliated APs

An AP MLD may add new affiliated APs anytime. A new affiliated APs shall be announced through the Basic Multi-Link element (by changing the Maximum Number Of Simultaneous Links field of the MLD Capabilities field), and through the Reduced Neighbor Report element (by including a TBTT(#6636) Information field for the new AP) in the Beacon and Probe Response frames.

NOTE—The MAC address of any new co-hosted AP is assumed to be within the address space defined by the value of the Max Co-Hosted BSSID Indicator field (see 9.4.2.249 (HE Operation element) and 26.17.7 (Co-hosted BSSID set)). Similarly, the MAC address of any new nontransmitted BSSID is assumed to be within the address space defined by the value of the MaxBSSID Indicator (see 9.4.2.45 (Multiple BSSID element) and 11.1.3.8 (Multiple BSSID procedure)).

### 35.3.6.2.2 Removing affiliated APs

An AP MLD may remove one or more of its affiliated APs. The AP MLD shall announce the removal of any affiliated AP through a Reconfiguration Multi-Link element (see 9.4.2.295b.4 (Reconfiguration Multi-Link element)) transmitted in all Beacon frames of all its affiliated APs, as well as all Probe Response frames it transmits, until the affiliated AP has been removed.

For each affiliated AP that the AP MLD intends to remove, the Reconfiguration Multi-Link element shall include a Per-STA Profile subelement with the subfields of the Per-STA Control field set as following: The Link ID subfield shall identify the AP, the Complete Profile subfield shall be set to 0, the Delete Timer Present subfield shall be set to 1, and the Delete Timer subfield shall be set to the number of target beacon transmission times (TBTTs) of that affiliated AP before it is removed. The initial value of the Delete Timer subfield shall be longer than the MLD max idle period. The Per-STA Profile subelement shall not include a STA Profile field.

Additionally, in order to terminate the BSS a to-be-removed affiliated AP belongs to (see 6.3.12 (Stop)), the SME of that affiliated AP shall perform the following,

1. It shall follow the procedure in 11.21.7.3 (BSS transition management request) to notify all associated STAs that support BTM of the BSS termination, with the BSS Transition Management Request frame fields set as follows:
* The Disassociation Imminent, BSS Termination Included, and Link Removal Imminent subfields of the Request Mode field are set to 1; other subfields of the Request Mode field are reserved.
* The Disassociation Timer field is set to the number of target beacon transmission times (TBTTs) of the affiliated AP before it transmits a Disassociation frame to the STA(s) receiving the BSS Transition Management Request frame. The Disassociation Timer field value shall point to a TBTT at or later than the TBTT pointed to by the value of the Delete Timer field of the Reconfiguration Multi-Link element in transmitted beacons.
* The BSS Termination Duration field shall be present and contain a BSS Termination Duration subelement (see 9.4.2.36 (Neighbor Report element)), with the BSS Termination TSF field of the subelement set to the value of the TSF timer when the BSS the affiliated AP belongs to will be terminated. The BSS Termination TSF field value shall indicate a time that is later than the TBTT the Disassociation Timer field value points to.
* No other optional fields shall be present in the BSS Transition Management Request frame.
1. It shall start a disassociation timer with the initial value set to the value of the Disassociation Timer field, and shall decrement the timer by one after transmitting each Beacon frame, until the timer has the value of 0. The Disassociation Timer field in all subsequent transmitted BSS Transition Management Request frames shall be set to the value of this timer.
2. Once the disassociation timer reaches a value of 0, and before the TSF indicated by the BSS Termination TSF field, it shall follow the procedure in 11.3.6.8 (AP, AP MLD, or PCP disassociation initiation procedure) to transmit Disassociation frames to all associated STAs that are not affiliated with a non-AP MLD. The affiliated AP shall not transmit Disassociation frames until the disassociation timer has a value of 0.

At the TBTT indicated by the value of the Delete Timer subfield in transmitted Reconfiguration Multi-Link elements, an associated non-AP MLD shall consider the link corresponding to the removed AP nonexistent, and the SME of the affiliated STA associated with the removed affiliated AP shall delete any information maintained for that link.

NOTE – An AP MLD with two APs affiliated with the AP MLD might remove one of the APs affiliated with the AP MLD, and in such case, the AP MLD results in having only one AP affiliated with the AP MLD after one of the APs affiliated with the AP MLD is removed. Further, the non-AP MLD that is associated with the AP MLD with two setup links also results in having only one non-AP STA affiliated with the non-AP MLD after one of the APs affiliated with the AP MLD is removed. (#6636)

If an AP affiliated with an AP MLD is removed, any STR or NSTR requirements and capabilities that correspond to a link pair that includes the link corresponding to the removed AP shall no longer apply. (#6636)

***TGbe editor: Modify 35.3.15.2 Multi-link device capability signaling as follows (track change on):***

**35.3.16.2 Multi-link device capability and operation(#6636) signaling**

(#2139)(#1465)(#1796)(#4076)(#5764)(#6312)(#4403)(#8248)(#6856)(#6857)(#6983)An AP MLD shall set the Maximum Number Of Simultaneous Links subfield in the (#6700)Basic Multi-Link element to the number of affiliated APs minus 1, in which the number of affiliated APs in the AP MLD shall be greater than 1 when the AP MLD is operating with more than one affiliated APs. (#6636)

***TGbe editor: Change the name of the “MLD Capabilities Present” subfield in Figure 9-1002g—Presence Bitmap subfield of the Basic Multi-Link element format to “MLD Capabilities and Operations Present”. Apply the name change of the subfield through the specification.*** (#6636)

***TGbe editor: Change the name of the “MLD Capabilities” field in Figure 9-1002h—Common Info field of the Basic Multi-Link element format to “MLD Capabilities and Operations”. Apply the name change of the field through the specification.*** (#6636)

***TGbe editor: Modify* 4.3.16a Extremely high throughput (EHT) STA** ***as follows (track change on):***

**4.3.16a Extremely high throughput (EHT) STA**

…………….(existing texts)………………………..

The main MAC features in an EHT STA that are not present in HE STA or VHT STA or HT STA are the following:

…………….(existing bullets)………………………..

— In an AP MLD that is not an NSTR mobile AP MLD(#5386), mandatory support for STR operation on each pair of links, if the AP MLD operates with more than one affiliated APs(#6636)

…………….(existing bullets)………………………..

…………….(existing texts)………………………..

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| **CID** | **Commenter** | **Clause** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 5293 | Jarkko Kneckt | 3.2 | 41.16 | An MLD device should be possible to have one STA. Requiring more than one STA complicates operation and implementation. There may be cases, where MLD desires to setup only a single link and it should be supported by 802.11be. All 802.11be STAs should use the same link setup signaling, to enable flexilibility to add/delete ilnks without need to perform new ML authentication and association. | Please change:" more than one " to "one or more". | Revised – For the problem of MLD association with only one link, we note that it is possible that AP MLD only supports 2.4 GHz and 5 GHz, and non-AP MLD only supports 5 GHz and 6 GHz. As a result, the only overlapping link is 5 GHz, and this is a strong reason why you need to enable MLD association with only one link if client prefers to use MLD association for all AP MLDs all the time.TGbe editor to make the changes shown in 11-21/2009r7 under all headings that include CID 5293. |

**Discussion:**



it is possible that AP MLD only supports 2.4 GHz and 5 GHz, and non-AP MLD only supports 5 GHz and 6 GHz. As a result, the only overlapping link is 5 GHz, and this is another reason why you need to enable MLD association with only one link if client prefers to use MLD association for all AP MLDs all the time.

**Propose:**

**Item with CID tag 5293: This handles the texts needed to have MLD association with one link due to AP MLD supporting 2.4/5 and non-AP MLD supporting 5/6**

***TGbe editor: Modify 35.3.5.1 Multi-link (re)setup procedure as follows (track change on):***

 **35.3.5.1 Multi-link (re)setup procedure**

…………….(existing texts)………………………..

(#2063)In the (Re)Association Request frame, the non-AP MLD indicates the link(s) that are requested for (re)setup (#1805)and the capabilities and operational parameters of the requested link(s) as described in 35.3.5.4 (Usage and rules of Basic Multi-Link element in the context of multi-link (re)setup(#6700)). (#2475)The non-AP MLD may request to (re)set up(#6452) link(s) with a subset of APs affiliated with the AP MLD.(#5293)

…………….(existing texts)………………………..

In the (Re)Association Response frame, the AP MLD shall indicate(#6272) the requested link(s) that are accepted and the requested link(s) that are rejected for (re)setup (#1805)and the capabilities and operational parameters of the requested link(s) as described in 35.3.5.4 (Usage and rules of Basic Multi-Link element in the context of multi-link (re)setup(#6700))(#5255). (#2475)The AP MLD may not accept all the links that are requested for (re)setup. The AP MLD may accept a subset of the links that are requested for (re)setup(#5299)(#2593). The (Re)Association Response frame shall be sent to the non-AP STA affiliated with the non-AP MLD that sent the (Re)Association Request frame. (#5293)

……………(existing texts)………………………

After successful multi-link (re)setup between a non-AP MLD and an AP MLD, the non-AP MLD and the AP MLD set up(#6452) link(s) for multi-link operation (#1783)(see 35.3 (Multi-link operation) and the rest of the subclause 35.3 (Multi-link operation)), and the non-AP MLD is (re)associated with the AP MLD (i.e., in State 3 or State 4, see 11.3.2 (State variables))(#5298). (#5293)

***TGbe editor: Modify* 35.3.5.4 Usage and rules of Basic Multi-Link element in the context of multi-link (re)setup *as follows (track change on):***

**35.3.5.4 Usage and rules of Basic Multi-Link element in the context of multi-link
(re)setup**

(#6752)(#8234)(#6360)A non-AP MLD may initiate a multi-link setup with an AP MLD to (#2478)(re)set up one or more links with AP(s) affiliated with the AP MLD. When a non-AP MLD initiates a multi-link (re)setup with an AP MLD, a STA that is affiliated with the non-AP MLD shall transmit an (Re)Association Request frame on the link that it desires to use as part of the multi-link (re)setup(#3153). An AP that is affiliated with the AP MLD shall transmit an (Re)Association Response frame on the link on which it received the (Re)Association Request frame. (#5293)

……………(existing texts)………………………

The (#6700)Basic Multi-Link element carried in the (Re)Association Request frame shall include the Common Info field and may include the Link Info field.(#5293)

……………(existing texts)………………………

The (#6700)Basic Multi-Link element carried in the (Re)Association Response frame shall include the Common Info field and may include the Link Info field. (#5293)

……………(existing texts)………………………

***TGbe editor: Modify 35.3.16.2 Multi-link device capability signaling as follows (track change on):***

…………….(existing texts)………………………..

(#2139)(#1465)(#1796)If a multi-radio non-AP MLD requests more than one link during multi-link setup, the multi-radio non-AP MLD(#5293) shall set the Maximum Number Of Simultaneous Links subfield in the (#6700)Basic Multi-Link element (#4404)carried in transmitted Management frames to a value equal to or larger than 1.

…………….(existing texts)………………………..

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| **CID** | **Commenter** | **Clause** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 6624 | Po-Kai Huang | 3.2 | 41.16 | MLD definition limits the framework to have at least two STAs. There is really no reason to have this specific limitation. An non-AP MLD may try to setup 2 links and the AP MLD may only accept one. Due to the framework limitation, now we can not even proceed in this case, and the AP MLD will have to reject assocaiton of this case with the reason code like "framework not support". Technically, all the proposal for MLD will still work when one link is setup. The operation basically fall back to legacy, and there is no reason to limit the design by limiting the framework this way. Note that this is TBD under motion 23. "NOTE 2 - It is TBD for a MLD to have only one STA." | Change the definition to allow MLD defintion be "A device that is a logical entity and has one or more one affiliated station (STA) and has a single medium access control (MAC) service access point (SAP) to logical link control (LLC), which includes one MAC data service." | Revised – The MLD definition is changed as follows:A logical entity that is capable of supporting more than one affiliated station (STA) but can also operate using one or more affiliated STAs, and has one medium access control (MAC) data service and a singleMAC service access point (SAP) to the logical link control (LLC) sublayer.TGbe editor to make the changes shown in 11-21/2009r7 under all headings that include CID 6624. |
| 5777 | Laurent Cariou | 3.2 | 41.16 | MLD definition should allow to have a single STA, for many reasons, including the fact that an AP can be removed to the associated MLD or that the association response only accepts one link out of two links. | as in comment | Revised – The MLD definition is changed as follows:A logical entity that is capable of supporting more than one affiliated station (STA) but can also operate using one or more affiliated STAs, and has one medium access control (MAC) data service and a singleMAC service access point (SAP) to the logical link control (LLC) sublayer.TGbe editor to make the changes shown in 11-21/2009r7 under all headings that include CID 6624. |

**3.2 Definitions specific to IEEE 802.11**

**TGbe Editor: *Change paragraphs below of this subclause as follows***

**multi-link device (MLD):** A logical entity ~~and has~~ , that is capable of supporting more than one affiliated station (STA) but can also operate using one or more affiliated STAs, and has one medium access control (MAC) data service and a singleMAC service access point (SAP) to the logical link control (LLC) sublayer.(#6624)

***TGbe editor: Modify 35.3.1 General as follows (track change on):***

**35.3 Multi-link operation**

**35.3.1 General**

(…existing texts…)

An EHT AP shall have dot11MultiLinkActivated set to true and shall be affiliated with an AP MLD. The EHT AP and its affiliated AP MLD follow the rules defined in 35.3 (Multi-link operation).

A non-AP EHT STAwith dot11MultiLinkActivated set to true shall be affiliated with a non-AP MLD. The non-AP EHT STA and its affiliated non-AP MLD follow the rules defined in 35.3 (Multi-link operation). (#6624)

A non-AP EHT STA with dot11MultiLinkActivated set to false shall not be affiliated with any non-AP MLD. (#6624)

The MAC address of a non-AP EHT STA with dot11MultiLinkActivated set to false shall be set to the MLD MAC address of the non-AP MLD that the non-AP EHT STA is affiliated with when dot11MultiLinkActivated is set to true. (#6624)

NOTE 1 - A non-AP EHT STA might set dot11MultiLinkActivated to true or false. (#6624)

NOTE 2 - The (Re)Association Request frame sent by a non-AP EHT STA with dot11MultiLinkActivated set to false does not include the Basic Multi-Link element (see Table 9-62 and Table 9-64) and the setting of the Address 2 field of the (Re)Association Request frame is described in 9.2.4.3.8 (TA field). (#6624)

***TGbe editor: Modify* 35.3.5.4 Usage and rules of Basic Multi-Link element in the context of multi-link (re)setup *as follows (track change on):***

**35.3.5.4 Usage and rules of Basic Multi-Link element in the context of multi-link
(re)setup**

…………….(existing texts)………………………..

The (#6700)Basic Multi-Link element carried in the (Re)Association Request frame shall include the Common Info field and the Link Info field.

NOTE- When a (Re)Association Request frame is sent from a non-AP EHT STA that does not support the multi-link operation, the Basic Multi-Link element is not carried in the (Re)Association Request frame.(#6624)

…………….(existing texts)………………………..

The (#6700)Basic Multi-Link element carried in the (Re)Association Response frame shall include the Common Info field and the Link Info field.

NOTE- When a (Re)Association Response frame is sent to a non-AP EHT STA that does not support the multi-link operation, the Basic Multi-Link element is not carried in the (Re)Association Response frame. (#6624)

…………….(existing texts)………………………..

**B.4.3 IUT configuration**

***TGbe editor: Change the table in B.4.3 as follows:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CFEHTMLD | EHT MLD Operation | Clause 35 | CFEHT AND CFAP: MCFEHT AND CFSTAofAP: O(#6624) | Yes: No: N/A: |