IEEE P802.11
Wireless LANs

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| **TGbe D0.3 Comment Resolutions****for Subclause 35.3.5.4** |
| **Date:** 2021-03-29 |

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Abstract

This submission proposes resolutions for multiple comments on TGbe D0.3 regarding the usage and rules of Multi-Link element in the context of mulit-link setup with the following CIDs (20 **CIDs**):

* 1056, 1057, 1730, 1747, 1789, 2125, 2319, 2348, 2479, 2966, 3153, 1875, 2514, 2596, 3202, 3219, 3220, 3244

Revisions:

- Rev 0: Initial version of the document.

- Rev 1: Some Changes based on offline feedback

- Rev 2: Added an option and relevant texts to discuss an item which considers the case “a non-AP MLD requests one link only” as multi-link setup or not based on offline feedback

- Rev 3: Updated some texts based on D1.0 and 390r2

- Rev 4: Updated based on live comments in the call and some suggestions on offline feedback (green part), and Removed Option 1.

- Rev 5: Updated use cases for signel-link setup in discussion section (blue part) and removed two “otherwise” parts regarding the condition of including Link Info field in (Re)Association Reqeust/Response frames based on offline feedback

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 0.4. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGbe Draft 1.0 (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.***

**- General**

1056, 1730, 1057, 2319

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| **CID** | **Commenter** | **Page** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| 1056 | Abhishek Patil | 132.24 | 35.3.5.4 | Motion 115 #SP89 says that the Beacon and Probe Response frame includes the MLD MAC address if the AP supports SAE authentication. | Update this clause to add a requirement that the Basic ML IE is included in the Beacon and non-ML Probe Resp frame and carries MLD MAC | RevisedThe motion 115 #SP89 has been reflected by approved 290r0 from Editor, which apperars in sub cluase 35.3.4.3. Therefore, it was not described in subcluase 35.3.5.4. |
| 1730 | Hanseul Hong | 132.34 | 35.3.5.4 | After the Multi-link setup procedure, STA MLD and AP MLD should know the mapping relation between each AP affiliated in AP MLD and each STA affiliated in each STA. Specifically, STA MLD should know which STA uses which link(with AP's MAC address). In addition, AP MLD should know which STA is communicating with which AP. | Specify the STA's MAC address and mapping relation with each AP during ML setup procedure. The Multi-link element used for ML setup may be different from basic-varient Multi-link element. | RevisedAgree in principle with the commenter.Mapping can be enabled by using Link ID and STA’s MAC address in Per-STA Profile according to D0.4 and CR doc. 11-21/254. |
| 1057 | Abhishek Patil | 133.01 | 35.3.5.4 | This paragraph is out of place. It shouldn't come under ML IE description for ML setup. Move it to MLO general clause (35.3.1). Provide examples such as each AP of the AP MLD can independently select its BSS color (see 11-20/314) | As in comment | RevisedAgree in principle with the commenter. The sentence was moved to the subclause 35.3.1 (General) and an example of BSS color was added as NOTE.**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 1057.** |
| 2319 | Ming Gan | 132.01 | 35.3.5.4 | It is vague for unless specified. If no parameter is specified here, suggest to remove this sentence | As in comment | RevisedThat means unless the standard specifically mentions that the parameters are the same for all STAs of the MLD. Therefore, the revised text provides an example of BSS color was added as NOTE. And the sentence was moved to the subclause 35.3.1 (General) as CID 1057.**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 2319.** |

**- Common Info field during Multi-link setup**

1747, 1789, 2348

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| **CID** | **Commenter** | **Page** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| 1747 | Hanseul Hong | 132.26 | 35.3.5.4 | The negotiation process of EMLSR/EMLMR can be made with multi-link element. Specify how the Multi-link element is used in negotiation process of EMLSR/EMLMR | As in the comment | RevisedAgree in principle with the commenter.Common Info field of Basic-varaint ML IE carried in Association frames shall include the EML capabilities including the fields to enable/disable EMLSR and EMLMR mode. Therefore, based on the value of the fields, the negotiation can be performed between an AP MLD and a non-AP MLD. (Please refer to doc. 21/319, 21/355). The revised spec provides that including the EML capabilities is mandatory during mulit-link setup.**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 1747.** |
| 1789 | Insun Jang | 132.27 | 35.3.5.4 | We've agreed to signal the number of maximum STAs supproting frame exchanges simultaneously and EMLSR mode in Association Request frame. Therefore, contents regarding them needs to be added in 35.3.5.4 (Usage and rules of Basic variant Multi-link element in the context of multi-link setup) | As in the comment, contents regarding those signalings needs to be added in 35.3.5.4 (Usage and rules of Basic variant Multi-link element in the context of multi-link setup) | RevisedAgree in principle with the commenter. According to doc. 21/222, 21/319, 21/355, MLD capabilities and EML capabilities shall be included in Basic-variant Multi-Link element carried in Assocition Request and Response frames. Therefore, the revised spec provides that including the MLD capabilities and EML capabilities is mandatory during mulit-link setup.**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 1789.** |
| 2348 | Minyoung Park | 132.47 | 35.3.5.4 | The following sentence "MLD level information shall include at least the MLD MAC address." is unclear. The MLD level information must include the capabilities of an MLD as well. | Change the sentence as follows: "The MLD level information shall include at least the MLD MAC address and the MLD level capabilities." | Revised Agree in principle with the commenter. According to doc. 21/222, 21/319, 21/355, MLD capabilities and EML capabilities shall be included in Basic-variant Multi-Link element carried in Assocition Request and Response frames. Therefore, the revised spec provides that including the MLD capabilities and EMLE capabilities is mandatory during mulit-link setup.**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 2348.** |

**- Editorial**

2125, 2479, 3153

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| **CID** | **Commenter** | **Page** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| 2125 | Laurent Cariou | 0.00 | 35.3.5.4 | Remove (such as capabilities) | as in comment | RevisedAgree in principle with the commenter. I removed the text. However, for clarification, I added the subclause 35.3.2.2 (Complete or partial per-STA profile) as a reference clause defining the complete information.**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 2125.** |
| 2479 | Payam Torab Jahromi | 132.40 | 35.3.5.4 | ML IE in Association Request identifies the AP corresponding to each non-AP STA, not the "link". Generally link is on client side. | Change the paragraph to "The Basic variant Multi-Link element carried in the (Re-)Association Request frame shall include one or more STA profile subelement(s), each of which contains the complete information (such as capabilities) of a non-AP STA affiliated with the non-AP MLD, and the requested AP STA corresponding to that non-AP STA."Also P132L54 change "a link" to "an AP". | RevisedAgree in principle with the commenter. In terms of multi-link setup, requesting “Link” looks good. However, it is proper to describe that the non-AP STA requests a link rather than that the non-AP STA is corresponding to a link. Also, the usage of link ID after the sentence makes it more clear. Similar change was applied to the sentences.**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 2479.** |
| 3153 | Yongho Seok | 132.29 | 35.3.5.4 | "When a non-AP MLD initiates a multi-link setup with an AP MLD, a non-AP STA that is affiliated with the non-AP MLD shall transmit an (Re-)Association Request frame on the link it is operating on."A STA can't send any frame on a link/channel on which it does not operate. Remove "on the link it is operating on.". | As in comment. | RevisedAgree in principle with the commenter. It may be redundant. However, to deliver what the link is clearly, “on a link that it desires to use as part of the multi-link setup” is added**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 3153** |

**- Considerations of Single-link Setup Case for MLO**

1875, 2514, 2596, 3202, 3219, 3220, 3244

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| **CID** | **Commenter** | **Page** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| 1875 | Jarkko Kneckt | 132.27 | 35.3.5.4 | All 802.11be STAs should use the same association signaling. The ML Setup should be able to create a single link. | Please enable MLD setup for a single link MLD. | RevisedAgree in principle with the commenter. Some cases of single-link setup should be considered, e.g., Requesting one link only (on a non-AP MLD) or Accepting one link only (on an AP MLD).The revised text provides the rules of ML IE by considering the cases.**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 1875.** |
| 2514 | Pooya Monajemi | 132.50 | 35.3.5.4 | AP MLD may only accept the link on which the request was sent. Text is not clear about how this case is handled. | Clarify if in this case an ML element is not included (or if it is included with zero STA profiles). | RevisedAgree in principle with the commenter. Some cases of single-link setup should be considered, e.g., Requesting one link only (on a non-AP MLD) or Accepting one link only (on an AP MLD).The revised text provides the rules of ML IE by considering the cases.**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 2514.** |
| 3202 | Young Hoon Kwon | 132.32 | 35.3.5.4 | Even if a non-AP MLD transmits an Association Request frame with ML element, it is possible that an AP MLD decide to associate with the non-AP MLD on one link only. In this case, it is not clear if the association is a multi-link setup or a single link association. Further clarification is needed. | As shown in the comment. | RevisedAgree in principle with the commenter. Some cases of single-link setup should be considered, e.g., Requesting one link only (on a non-AP MLD) or Accepting one link only (on an AP MLD).The revised text provides the rules of ML IE by considering the cases.**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 3202.** |
| 3219 | Young Hoon Kwon | 132.51 | 35.3.5.4 | What if the AP MLD decides to associate with the non-AP MLD on one link only? For example, if the AP MLD supports link1 and link2, and the non-AP MLD supports link1 and link3. In this case, the AP MLD will associate with the non-AP MLD on link1 only. Further clarification is needed. | As shown in the comment. | RevisedAgree in principle with the commenter. Some cases of single-link setup should be considered, e.g., Requesting one link only (on a non-AP MLD) or Accepting one link only (on an AP MLD).The revised text provides the rules of ML IE by considering the cases.**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 3219.** |
| 3244 | Young Hoon Kwon | 132.27 | 35.3.5.4 | Does thi imply that a non-AP MLD cannot initiate a multi-link setup with an AP MLD to setup one link? Further clarification is needed. | As shown in the comment. | RevisedAgree in principle with the commenter. Some cases of single-link setup should be considered, e.g., Requesting one link only (on a non-AP MLD) or Accepting one link only (on an AP MLD).The revised text provides the rules of ML IE by considering the cases.**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 3244.** |
| 2596 | Rojan Chitrakar | 132.50 | 35.3.5.4 | What about the link in which the (Re-)Association Response frame is sent in? In this case a per-sta profile for that link is not carried in the (Re-)Association Response frame. I assume if a Association response frame is sent with a status of "Success" in a link, that link is always accepted by the AP MLD. | Clarify that the link in which an Association response frame is sent with a status of "Success" is always accepted by the AP MLD. | RevisedAgree in principle with the commenter. Some cases of single-link setup should be considered, e.g., Requesting one link only (on a non-AP MLD) or Accepting one link only (on an AP MLD).Moreover, When the AP affiliated with the AP MLD cannot accept the link on which the (Re)Association Request frame was received, the AP shall treat the multi-link (re)setup as a failure. The revised text provides the rules of ML IE by considering the cases.**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 2596.** |
| 3220 | Young Hoon Kwon | 132.51 | 35.3.5.4 | What if the AP MLD decides to associate with the non-AP MLD without the link that the Association is received? For example, if the AP MLD supports link1/link2/link3, and the Association Request is received on link1, but the AP MLD associates on link2 and link3 only. Further clarification is needed. | As shown in the comment. | RevisedWhen the AP affiliated with the AP MLD cannot accept the link on which the (Re)Association Request frame was received, the AP shall treat the multi-link (re)setup as a failure The revised text provides the rules of ML IE by considering the case.**TGbe editor, please make changes as shown in doc 11-21/499r5 tagged as CID 3220.** |

**Discussion:**

***I assume below an MLD has more than one STA.
Note that “An MLD can have one STA only or an EHT STA may not be affiliated with an MLD” which is a different issue.***

**Single-link setup between a non-AP MLD and an AP MLD can happen during multi-link (ML) setup as follows.**

1) Non-AP MLD may intend to setup/request only one link where the (Re)Association Reqeust frame is transmitted

**Discussion point:** It shall be considered as the legacy association or may be the multi-link setup which reaches to the discussion on “wheteher ML IE can be included in the Association Request frame or not” for the case

- Reference from D0.4

In Association Reqeust frame, “The Basic variant Multi-Link element is present if the STA is affiliated with a non-AP MLD and initiates a multi-link setup with an AP affiliated with an AP MLD. Otherwise it is not present.”

“A (Re)Association Request/Response frame exchange that results in a successful association is for a multi-link setup if both the frames carried Basic variant Multi-link element. Otherwise the association is not for a multi-link setup”

In Association Response frame, “The Basic variant Multi-Link element is present if the AP is affiliated with an AP MLD and the soliciting Association Request frame is received from a STA affiliated with a non-AP MLD includes the Basic variant Multi-Link element. (#2093) Otherwise it is not present”

It depends on the following text in this document (the first sentence 35.3.5.4)

A non-AP MLD may initiate a multi-link setup with an AP MLD to setup **“more than one link (Opt 1)”** or “**one or more link(s) (Opt 2)”** with a subset of APs that are affiliated with the AP MLD.

**Option 1)** it shall be considered as **the legacy association without including Basic variant ML IE**

- It says that the non-AP MLD doesn’t need to announce ML-capable (i.e., Common Info is not even needed), just follows the legacy association rules.

**Option 2)** it can be considered as **the ML setup by including Basic variant ML IE**

- It is a non-AP MLD’s decision to make

As some cases

- Non-AP MLD may want to request more than one link and to use ML functions, and had no choice as a result of ML probing (e.g., due to capabilities) but requests one link.

- Non-AP MLD may want to request one link at time and to use ML functions

In addition, AP MLD may accept one link only (on which Association frames are exchanged) when more than one link are requested by a non-AP MLD. I think the AP MLD would include Basic variant ML IE even though the AP MLD accepts one link only, which clearly shall be considered as ML setup.

This document is based on Option 2 due to its majority during live/offline discussion.

**Proposed spec text:**

**35.3 Multi-link operation**

***TGbe editor: Please modify the subclause 35.3.1 (General) as follows:***

***TGbe editor: Please note that the baseline of this subcluase 35.3.1 (General) is D1.0***

**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.

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

NOTE – 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. (#1057, 2319)

***TGbe editor: Please modify the subclause 35.3.5.4 (Usage and Rules of Multi-Link element in the context of multi-link (re)setup) as follows:***

***TGbe editor: Please note that the baseline of this subclause 35.3.5.4 is D1.0 and 390r2***

35.3.5.4. Usage and Rules of Multi-Link element in the context of multi-link (re)setup

A non-AP MLD may initiate a multi-link setup with an AP MLD to setup one or more link(s) with a subset of APs that are affiliated with the AP MLD. (#1875, 2514, 2596, 3202, 3219, 3244) When a non-AP MLD initiates a multi-link setup with an AP MLD, a non-AP STA that is affiliated with the non-AP MLD shall transmit an (Re)Association Request frame on a link that it desires to use as part of the multi-link setup. (#3153) An AP that is affiliated with the AP MLD and that received the (Re)Association Request frame shall transmit an (Re)Association Response frame.

The non-AP STA shall include a Basic variant Multi-Link element in the (Re)Association Request frame that it transmits.

The Basic variant Multi-Link element carried in the (Re)Association Request frame shall include the Common Info field and may include the Link Info field. (#1875, 2514, 2596, 3202, 3219, 3244)

The Common Info field of the Basic variant Multi-Link element carried in the (Re)Association Request frame shall include the MLD MAC address, the MLD Capabilities, and the EML Capabilities subfields, and shall not include the Link ID Info, the BSS Parameters Change Count, and Medium Synchronization Delay Information subfields. (#1747, 1789, 2348)

NOTE – The presence of the subfields in the Common Info field is signaled via the Multi-Link Control field of the Basic variant Multi-Link element as defined in 9.4.2.295b.2 (Basic variant Multi-Link element). (#1747, 1789, 2348)

If the non-AP STA requests one or more link(s) in addition to the link on which the (Re)Association Request frame is transmitted for multi-link setup, the Basic variant Multi-Link element carried in the (Re)Association Request frame shall include the Link Info field and for each requested link in addition to the link on which the (Re)Association Request frame is transmitted, the Link Info field shall contain the corresponding Per-STA Profile subelement(s). For each Per-STA Profile subelement included in the Link Info field, the Complete Profile subfield of the STA Control field shall be set to 1 (see 35.3.2.2 (Complete or partial per-STA profile)). (#2125, 2479, 1875, 2514, 2596, 3202, 3219, 3244)

NOTE – If the Basic variant Multi-Link element carried in the (Re)Association Request frame does not include Link Info field, it means that the non-AP MLD requests the link only on which the Association Request frame is transmitted. (#1875, 2514, 2596, 3202, 3219, 3244)

The Link ID subfield of the STA Control field of the Per-STA Profile subelement for the corresponding non-AP STA that requests a link for multi-link setup with the AP MLD is set to the link ID of an AP of the AP MLD that is operating on that link. The link ID is obtained during discovery.

The AP shall include a Basic variant Multi-Link element in the (Re)Association Response frame that it transmits.

The Basic variant Multi-Link element carried in the (Re)Association Response frame shall include Common Info field and may include Link Info field. (#1875, 2514, 2596, 3202, 3219, 3244)

The Common Info field of the Basic variant Multi-Link element carried in the (Re)Association Response frame shall include the MLD MAC address, the MLD Capabilities, the EML Capabilities, the Link ID Info, and the BSS Parameters Change Count subfields. (#1747, 1789, 2348)

NOTE – The presence of the subfields in the Common Info field is signaled via the Multi-Link Control field of the Basic variant Multi-Link element as defined in 9.4.2.295b.2 (Basic variant Multi-Link element). (#1747, 1789, 2348).

If the non-AP STA requests one or more link(s) in addition to the link on which the (Re)Association Request frame is not transmitted for multi-link setup, the Basic variant Multi-Link element carried in the (Re)Association Response frame shall include the Link Info field and for each requested link in addition to the link on which the (Re)Association Request frame is transmitted, the Link Info field shall contain the corresponding Per-STA Profile subelement(s). For each Per-STA Profile subelement included in the Link Info field, the Complete Profile subfield of the STA Control field shall be set to 1 (see 35.3.2.2 (Complete or partial per-STA profile)) (#2125) and the Status Code field included in the STA Profile subfield of the Per-STA Profile subelement shall indicate SUCCESS if the link is accepted or the failure cause if the link is not accepted (#1875, 2514, 2596, 3202, 3219, 3244).

If the link on which the (Re)Association Request frame was received cannot be accepted by the AP MLD, the AP MLD shall treat the multi-link (re)setup as a failure and shall not accept any requested links. (#2596, 3220)

The Link ID subfield of the STA Control field of the Per-STA Profile subelement for the AP corresponding to a link requested by an STA of non-AP MLD with a non-AP MLD is set to the link ID of the AP of the AP MLD that is operating on that link.

Each Per-STA profile subelement included in the Basic variant Multi-Link element carried in the (Re)Association Request frame and the (Re)Association Response frame shall not include another Basic variant Multi-Link element.

An STA affiliated with an MLD shall include a Basic variant Multi-Link element containing the MLD MAC address of the MLD with which the STA is affiliated in the Authentication frame that it transmits.

***TGbe editor: Please remove the following paragraph (moved to 35.3.1 (General))***

SP: Do you support to incorporate the changes proposed by the following CIDs in 11-21/499r5?

* 1056, 1057, 1730, 1747, 1789, 2125, 2319, 2348, 2479, 2966, 3153, 1875, 2514, 2596, 3202, 3219, 3220, 3244

Alternative SP (except for single-link setup case): Do you support to incorporate the changes proposed by the following CIDs in 11-21/499r5?

* 1056, 1057, 1730, 1747, 1789, 2319, 2348, 2966, 3153, 3220

\*\* CIDs related to single-link setup case: 2125, 2479, 1875, 2514, 2596, 3202, 3219, 3244