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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| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Insun Jang | LG Electronics | 19, Yangjae-daero 11gil, Seocho-gu, Seoul 137-130, Korea |  | Insun.jang@lge.com |
| Namyeong Kim |  | namyeong.kim@lge.com |
| Sunhee Baek |  | sunhee.baek@lge.com |
| Jeongki Kim |  | jeongki.kim@lge.com |

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, 1058, 1730, 1747, 1789, 2125, 2319, 2348, 2479, 2966, 2967, 3153
* 1875, 2514, 2596, 3202, 3219, 3220, 3244

Revisions:

- Rev 0: Initial version of the document.

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 0.4 (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, 1057, 1058, 1730, 1747, 1789, 2125, 2319, 2348, 2479, 2966, 2967, 3153

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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. |
| 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. Moreover, examples of parameters that are common to all STAs affiliated with an MLD are added as exceptions.**TGbe editor, please make changes as shown in doc 11-21/499r0 tagged as CID 1057.** |
| 1058 | Abhishek Patil | 133.01 | 35.3.5.4 | Spec needs to provide clarity on the SSID value selected by each AP of the AP MLD and whether the AP MLD has a separate SSID. | As in comment |  |
| 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 in Per-STA Profile. According to D0.4, link ID is used to request a link and accept the link during multi-link setup. |
| 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). However, since it is always included in the Association frames, the revised spec does not mention it. |
| 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 is mandatory during mulit-link setup. Please note that EML capabilities is always included in Association frames.**TGbe editor, please make changes as shown in doc 11-21/499r0 tagged as CID 1789.** |
| 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 35.3.2.3 (Inheritance in a per-STA profile) as a reference clause defining the complete information.**TGbe editor, please make changes as shown in doc 11-21/499r0 tagged as CID 2125.** |
| 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 | 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. Moreover, examples of parameters that are common to all STAs affiliated with an MLD are added as exceptions.**TGbe editor, please make changes as shown in doc 11-21/499r0 tagged as CID 2319.** |
| 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 is mandatory during mulit-link setup. Please note that EML capabilities is always included in Association frames.**TGbe editor, please make changes as shown in doc 11-21/499r0 tagged as CID 2348.** |
| 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 11-21/499r0 tagged as CID 2479.** |
| 2966 | Tomoko Adachi | 132.61 | 35.3.5.4 | A Basic variant Multi-Link element carried in an Authentication frame only needs to provide the MLD MAC address of the MLD with which the STA is affiliated. | In 9.4.2.295b.2, fix that for the inclusion of the Basic variant Multi-Link element in the Authentication frame, the Common Info field consists of only the MLD MAC Address field and the Link Info field is not present. | RevisedAgree in principle with the commenter. Authentication frame doesn’t need to include the the Link Info field. Moreover, the Common Info field carried in Authentication frame doesn’t need to contain other common Infomration except MLD MAD address.Therefore, similar changes were applied to sentences in the clause 35.3.5.4. **TGbe editor, please make changes as shown in doc 11-21/499r0 tagged as CID 2966.** |
| 2967 | Tomoko Adachi | 132.61 | 35.3.5.4 | The MLD MAC address of the MLD with which the STA is affiliated only needs to be carried in the first exchange of the Authentication process, i.e., the Authentication frames with authentication transaction sequence numbers being 1 and 2. | Add such restriction. |  |
| 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. | Accepted**TGbe editor, please make changes as shown in doc 11-21/499r0 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 11-21/499r0 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 11-21/499r0 tagged as CID 2514.**  |
| 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, it would be better for successful setup links to include at least the link to avoid complexity.The revised text provides the rules of ML IE according to the case and a NOTE addressing the part of comment.**TGbe editor, please make changes as shown in doc 11-21/499r0 tagged as CID 2596.** |
| 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 11-21/499r0 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 11-21/499r0 tagged as CID 3219.** |
| 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. | RevisedIf an AP MLD accepts the association request for some links except a link on which Association frames are exchanged, it make some procedures to be added in 11be complex. Therefore, it would be better for successful setup links to include at least the link. The revised spec provides a NOTE addressing the comment.**TGbe editor, please make changes as shown in doc 11-21/499r0 tagged as CID 3220.** |
| 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 11-21/499r0 tagged as CID 3244.** |

**Discussion:**

***I assume below a STA is affiliated with an MLD. (Not an EHT STA which is not affiliated with an MLD)***

**Some cases of Single-link setup are allowed during multi-link setup, e.g.,**

A. Non-AP MLD may want to setup/request only one link.

B. AP MLD may accept one link only when more than one link are requested by a non-AP MLD.

**For the case, should ML IE be included in Association frames?**

**Option 1)** ML IE shall not be included, which does not mean a multi-link setup. Therefore, the multi-link setup should be the association for more than one link.

**Option 2)** ML IE shall be included (only Common Info field), which means a multi-link setup. Therefore, the multi-link setup should be the association for one or more links.

The proposed text is based on Option 2 because an implemeneted MLD has ML features basically and the MLD doesn’t need to behave depending on the number of setup links, i.e., like single EHT STA or MLD. Moreover, including ML IE announces it is ML-capable. In addition, case B always shall include ML IE because the reason of failure shall be indicated in the Status Code subfield of Per-STA Profile.

**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 35.3.5.4 is D0.4***

**35.3.1 General**

Multi-link operation (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.

with the following exceptions. (#1057, 2319)

— Listen Interval value carried in (Re)Association Request frame that a STA affiliated with a non-AP MLD transmits shall be the same for all non-AP STAs affiliated with the non-AP MLD as defined in 9.4.1.6 (Listen Interval field)

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 subcluase 35.3.5.4 is D0.4***

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. (#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 following information: . (#1789, 2348)

— The MLD MAC address of the MLD with which the non-AP STA is affiliated by setting the MLD MAC Address Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 1.

— The MLD capabilities of the MLD with which the non-AP STA is affiliated by setting the MLD Capabilities Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 1.

The Common Info field of the Basic variant Multi-Link element carried in the (Re)Association Request frame shall not include the following information:

— The Transmitting AP Link ID subfield by setting the Transmitting AP Link ID Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 0

— The Transmitting AP Change Sequence subfield by setting the Transmitting AP Change Sequence Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 0

If the non-AP STA requests one or more link(s) 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 Request frame shall include the Link Info field that contains one or more Per-STA Profile subelement(s), each of which contains the complete information of a non-AP STA that is affiliated with the non-AP MLD defined in 35.3.2.3 (Inheritance in a per-STA profile) (#2125) and that requests a link for multi-link setup (#2479) and shall set the Complete Profile subfield of the Per-STA Control field of the Basic variant Multi-Link element to 1. Otherwise, the Basic variant Multi-Link element carried in the (Re)Association Request frame shall not include the Link Info field. (#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 Per-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 (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 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 following information: . (#1789, 2348)

— The MLD MAC address of the MLD with which the AP is affiliated by setting the MLD MAC Address Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 1.

— The MLD capabilities of the MLD with which the AP is affiliated by setting the MLD Capabilities Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 1.

— The Transmitting AP Link ID subfield by setting the Transmitting AP Link ID Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 1

— The Transmitting AP Change Sequence subfield by setting the Transmitting AP Change Sequence Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 1

If the non-AP STA requests one or more link(s) 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 that contains one or more Per-STA Profile subelement(s), each of which contains the complete information of an AP affiliated with the AP MLD defined in 35.3.2.3 (Inheritance in a per-STA profile) (#2125) and corresponding to a link that is requested by the non-AP MLD and shall set the Complete Profile subfield of the Per-STA Control field of the Basic variant Multi-Link element to 1 and indicate in the Status Code subfield of the Per-STA Control field of the Basic variant Multi-Link element the following: (#1875, 2514, 2596, 3202, 3219, 3244)

— SUCCESS if the link is accepted.

— The failure cause of not accepting the link if the link is not accepted.

NOTE – If the AP MLD accepts the association request for one or more link(s) at least including the link on which the (Re)Association Request frame is received, the multi-link setup is successful. Otherwise, the multi-link setup is failed. (#2596, 3220)

The Link ID subfield of Per-STA Control field of the Per-STA Profile subelement for the corresponding AP that accepts 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.

***TGbe editor: Please add the following subclause 35.3.5.5 (Usage and Rules of Multi-Link element in the context of authentication) as follows:***

35.3.5.5. Usage and Rules of Multi-Link element in the context of authentication

When an STA affiliated with an MLD transmits an Authentication frame, the STA shall include a Basic variant Multi-Link element in the Authentication frame. (#2966)

The Basic variant Multi-Link element carried in the Authentication frame shall include the Common Info field and shall not include the Link Info field. (#2966)

The Common Info field of the Basic variant Multi-Link element carried in the Authentication frame shall include the MLD MAC address of the MLD with which the STA is affiliated by setting the MLD MAC Address Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 1. (#2966)

The Common Info field the Basic variant Multi-Link element carried in the Authentication frame shall not include the following information: (#2966)

— The Transmitting AP Link ID subfield by setting the Transmitting AP Link ID Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 0.

— The Transmitting AP Change Sequence subfield by setting the Transmitting AP Change Sequence Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 0.

— The MLD capabilities of the MLD with which the STA is affiliated by setting the MLD Capabilities Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 0.