IEEE P802.11
Wireless LANs

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| LB 266 Resolution for CID 10864 |
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Abstract

This submission proposes resolutions for the following CID for TGbe LB266:

10864

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. 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.***

***TGbe editor: The baseline for this document is 11be D2.0.***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Resolution** |
| 10864 | Yousi Lin | 35.3.17 | 461.56 | The EMLSR mode is designed to provide enhanced mechanisms for single radio non-AP MLD. It is expected that STAs may have different capabilities on single radio. For example, the STA affiliated with a non-AP MLD in the EMLSR mode can transmit and receive with single radio while the other affiliated STAs may have constrained single radio. For the STA with full capability on single radio, it is able to receive the initial frame not limited to initial Control frame initiated by an AP MLD, which can save some overhead from the Control frames. | the commenter will bring a contribution to resolve it. | RevisedAgree with the commenter. Propose to allow the EMLSR mode to support an existing single radio device architecture that has a full radio and a scanning radio.**Instruction to the editor**, ***please make the following changes with the CID tag 10864(doc.: IEEE 802.11-22/2202r0).*** |

**Discussion:**

Motivation:

The EMLSR mode is designed to provide enhanced mechanisms for a single radio non-AP MLD. Currently the architecture of some existing single radio devices, has a full radio and a scanning radio. The device uses the full radio for communication, and uses the scanning radio for scanning only. The scanning radio is required to receive PPDUs with limited capability and is not used for data transmissions, so it can be regarded as a capability limited radio, but the specific capability depends on the implementation. It is expected that the next generation WLAN devices will also keep this feature, so this is a valid architecture of the device, to which the EMLSR mode adds value.

Considering a non-AP MLD that has a full radio and a scanning radio, when it is not in EMLSR mode, it uses the full radio for communication and the scanning radio for scanning only. The two radios are used independently, and the scanning radio is not involved in data transmission. But when the non-AP MLD enables EMLSR mode, it can use the scanning radio together with the full radio for communication to enhance its capabilities in the EMLSR mode. In this case, the resources of the scanning radio, are also shared among links, so the non-AP MLD’s per link capability is changed and enhanced after enabling the EMLSR mode. Given a full radio and a scanning radio, when the STAs affiliated with the non-AP MLD are in the listening operation, one STA will have the fully functionalality and another STA will have limited capability.

As discussed above, it is likely that the non-AP MLD will have different per-link capabilities before and after enabling the EMLSR mode, depending on whether the non-AP MLD uses the scanning radio to enhance its EMLSR capability. However, the specification currently cannot support this existing device architecture. A non-AP MLD does not have a way to indicate its EMLSR NSS capability on each EMLSR link. The non-AP MLD can only announce its per-link capabilities in the EHT-MCS Map subfields when it is not in the EMLSR mode. One simple way to support this device architecture in the specification, is to reuse the NSS signaling method defined for the EMLMR mode, additionally in the EMLSR mode. Moreover, by resuing the EMLMR Supported MCS And NSS Set subfield, the NSS signaling method can be unified in both EMLSR or EMLMR mode.

The above-mentioned device architecture shows some advantages. First, it allows the non-AP MLD to use the existing scanning radio for communications to enhance the affiliated STAs’ TX/RX capabilities in EMLSR mode. Second, since in this architecture, one STA in listening operation will have fully functionalality, it is able to receive the initial frame (i.e., it is not limited to receive the initial Control frame) transmitted by an AP MLD, which can save some overhead from the Control frames. For example, when an AP MLD has some short packets to be transmitted to the non-AP MLD, it can directly send an EHT PPDU or EHT MU PPDU, depending on the capability of the STA on a fully functional link, as the initial frame of a frame exchange sequence, so that no initial control frame exchanges are needed. Also, when an AP MLD transmits group addressed frames on the fully functional link, it does not need to consider the non-AP MLD’s switching delay, which helps increase the throughput.

**Proposal:**

***TGbe editor: Change the EML Capabilties subfield related part in subclause 9.4.1.74 as follows:***

9.4.1.74 EML Control field

The EML Control field is defined in Figure 9-144i (EML Control field format).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | EMLSR Mode | EMLMR Mode | Reserved  | EMLSR/EMLMR Link Bitmap | MCS Map Count Control | EML Supported MCS And NSS Set |
| Bits: | 1 | 1 | 6 | 0 or 16 | 0 or 8 | variable |

**Figure 9-144i—EML Control field format**

|  |  |  |
| --- | --- | --- |
|  | MCS Map Count | Reserved  |
| Bits: | 2 | 6 |

**Figure 9-144j—MCS Map Count Control subfield format(#12774)**

The EML Supported MCS And NSS Set subfield indicates the combinations of MCS and number of spatial streams NSS that a non-AP MLD supports for reception and transmission (#12872) on any EMLMR link during the EMLMR operation or on any EMLSR link during the EMLSR operation. The MCS Map Count subfield is set to 0 (#13554)if the maximum of the supported channel widths for STAs affiliated with the non-AP MLD operating on either EMLMR or EMLSR links, is smaller than or equal to 80MHz. The MCS Map Count subfield is set to 1 or 2 if the maximum of the supported channel widths for STAs affiliated with the non-AP MLD operating on either EMLMR or EMLSR links is equal to(#13554)160MHz and 320MHz, respectively. The value 3 is reserved. (#11898)The MCS Map Count(#12774) Control subfield is present if either the EMLMR Mode or the EMLSR Mode subfield is equal to 1 and is not present otherwise.

The EML Supported MCS And NSS Set subfield is present if either the EMLMR Mode or the EMLSR Mode subfield is equal to 1; otherwise it is not present. The format of the EML Supported MCS And NSS Set subfield is shown in Figure 9-144k (EMLMR Supported MCS And NSS Set subfield format).

|  |  |  |  |
| --- | --- | --- | --- |
|  | MCS Map (BW ≤ 80 MHz) | MCS Map (BW = 160 MHz) | MCS Map (BW = 320 MHz) |
| Octets: | 3 | 0 or 3 | 0 or 3 |

**Figure 9-144k—EML Supported MCS And NSS Set subfield format**

The subfields of the EML Supported MCS And NSS Set subfield, and their presence, are defined in Table 9-127e (Subfields of the EML Supported MCS And NSS Set subfield).

**Table 9-127e—Subfields of the EML Supported MCS And NSS Set subfield**

|  |  |  |
| --- | --- | --- |
| **Subfield** | **Definition** | **Encoding** |
| MCS Map(BW$\leq $ 80 MHz) | (#11507)(#11899) (#11900)If present, indicates the maximum number of spatial streams supported for reception and the maximum number of spatial streams that STAs (#12344)affiliated with the non-AP MLD (#12872), operating in EMLMR mode (if the EMLMR Mode subfield is equal to 1) or operating in EMLSR mode (if the EMLSR Mode subfield is equal to 1), can transmit (#11900)after an initial frame exchange on the corresponding EMLMR or EMLSR links, for each MCS value, in a PPDU with a bandwidth of 20, 40 or 80 MHz. | The format and encoding of this subfield are defined in Figure (#10986)9-1002ai (EHT-MCS Map (BW ≤ 80 MHz, Except 20 MHz-Only Non-AP STA), EHT-MCS Map (BW = 160 MHz), and EHT-MCS Map (BW = 320 MHz) subfield format) and the associated description.(#11900)(#12871)If the MCS Map Count subfield is set to 0 or 1 or 2, then this subfield is present; otherwise, it is not present. |
| MCS Map(BW = 160 MHz) | (#11900)(#12871)If present, indicates the maximum number of spatial streams supported for reception and the maximum number of spatial streams that STAs (#12344)affiliated with the non-AP MLD (#12872), operating in EMLMR mode (if the EMLMR Mode subfield is equal to 1) or operating in EMLSR mode (if the EMLSR Mode subfield is equal to 1), can transmit (#11900)after initial frame exchange on the corresponding EMLMR or EMLSR links, for each MCS value, in a PPDU with a bandwidth of 160 MHz.  | The format and encoding of this subfield are defined in Figure (#10986)(#11506)9-1002ai (EHT-MCS Map (BW ≤ 80 MHz, Except 20 MHz-Only Non-AP STA), EHT-MCS Map (BW = 160 MHz), and EHT-MCS Map (BW = 320 MHz) subfield format) and the associated description.(#11900)(#12871) If the MCS Map Count subfield is set to 1 or 2, meaning that the maximum operating channel width of the non-AP MLD for the EMLMR or EMLSR operation is equal to or greater than 160 MHz, then this subfield is present; otherwise, it is not present. |
| MCS Map(BW = 320 MHz) | (#11900)(#12871)If present, indicates the maximum number of spatial streams supported for reception and the maximum number of spatial streams that STAs (#12344)affiliated with the non-AP MLD (#12872), operating in EMLMR mode (if the EMLMR Mode subfield is equal to 1)or operating in EMLSR mode (if the EMLSR Mode subfield is equal to 1), can transmit (#11900)after initial frame exchange on the corresponding EMLMR or EMLSR links, for each MCS value, in a PPDU with a bandwidth of 320 MHz. | The format and encoding of this subfield are defined in Figure (#10986)(#11506)9-1002ai (EHT-MCS Map (BW ≤ 80 MHz, Except 20 MHz-Only Non-AP STA), EHT-MCS Map (BW = 160 MHz), and EHT-MCS Map (BW = 320 MHz) subfield format) and the associated description.(#11900)(#12871) If the MCS Map Count subfield is set to 2, meaning that the maximum operating channel width of the non-AP MLD for the EMLMR or EMLSR operation is equal to 320 MHz, then this subfield is present; otherwise, it is not present. |

***TGbe editor: Change the“EMLMR Supported MCS And NSS Set” to “EML Supported MCS And NSS Set” throughout the specification.***

***TGbe editor: Change the subclause 9.4.2.313.2 as follows:***

9.4.2.313.2 EHT MAC Capabilities Information field(#1126)

The format of the EHT MAC Capabilities Information field is defined in Figure 9-1002s (EHT MAC Capabilities Information field format(#4918)(#6630)(#2920)(#1977)).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B3 | B4 | B5 | B6 B7 | B8 | B9  |
|  | EPCS Priority Access Supported | EHT OM Control Support | Triggered TXOP Sharing Mode 1 Support | Triggered TXOP Sharing Mode 2 Support | Restricted TWT Support | SCS Traffic Description Support | Maximum MPDU Length | Maximum A-MPDU Length Exponent Extension | EHT TRS Support |
| Bits: | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
|  | B10 | B11 | B12 B13 | B14 | B15 |  |  |  |  |
|  | TXOP Return Support In TXOP Sharing Mode 2 | Two BQRs Support | EHT Link Adaptation Support | Fully Functional Link | Reserved |  |  |  |  |
| Bits: | 1 | 1 | 2 | 1 | 1 |  |  |  |  |

**Figure 9-1002ae—EHT MAC Capabilities Information field format**

The subfields of the EHT MAC Capabilities Information field are defined in Table 9-401j (Subfields of the EHT MAC Capabilities Information field).

**Table 9-401j—Subfields of the EHT MAC Capabilities Information field**

|  |  |  |
| --- | --- | --- |
| **Subfield** | **Definition** | **Encoding** |
| … |
| EHT Link Adaptation Support | Indicates support for link adaptation using the ELA Control subfield. | If the +HTC-HE Support subfield in HE MAC Capabilities Information field in HE Capabili-ties element is equal to 1:Set to 0 (No feedback) if the STA does not provide EHT MFB.Set to 2 (Unsolicited) if the STA can receive and provide only unsolicited EHT MFB.Set to 3 (Solicited and unsolicited) if the STA is capable of receiving and providing EHT MFB in response to EHT MRQ and if the STA can receive and provide unsolic-ited EHT MFB.The value 1 is reserved.EHT MFB and EHT MRQ are MFB and MRQ using ELA Control subfield, respectively.Reserved if the +HTC-HE Support subfield in HE MAC Capabilities Information field in HE Capabilities element is 0. |
|  Fully Functional Link | Indicates the existence of the fully functional link for a non-AP MLD operating in the EMLSR mode. | If a STA affiliated with a non-AP MLD that is operating in EMLSR mode is capable of receiving an initial frame of a frame exchange sequence during the listening operation, that is sent by an AP MLD subject to the non-AP MLD’s per-link spatial stream capabilities and operating mode defined by the exchanged OM Control, EHT OM Control or OMN frames, then this subfield is set to 1 by the non-AP MLD, and the EMLSR link on which the STA is operating is a fully functional link. Otherwise, it is set to 0.  |

***TGbe editor: Change the subclause 35.3.17 as follows:***

35.3.17 Enhanced multi-link single radio operation

…

When a non-AP MLD is operating in EMLSR mode on the EMLSR links, the (#13409)STAs operating on the EMLSR links and affiliated with the non-AP MLD, shall not operate in dynamic SM power save mode (11.2.6(SM power save)) on the EMLSR links.

A non-AP MLD with dot11EHTEMLSROptionImplemented equal to true and that has one affiliated STA with the Fully Functional Link subfield equal to 1, shall indicate the number of spatial streams NSS that the non-AP MLD supports for reception and transmission during EMLSR operation in the EML Supported MCS And NSS Set subfield of the EML Control field of the EML Operating Mode Notification frame.

When a non-AP MLD with (#11811)dot11EHTEMLSROptionActivated equal to true intends to (#12675)enable the EMLSR mode on the EMLSR links, a (#12242)non-AP STA affiliated with the non-AP MLD shall transmit an EML Operating Mode Notification frame with the EMLSR Mode subfield of the EML Control field of the frame set to 1 to an AP affiliated with an AP MLD with (#11811)dot11EHTEMLSROptionActivated equal to true. An AP affiliated with the AP MLD that received the EML Operating Mode Notification frame from the (#12242)non-AP STA affiliated with the non-AP MLD should transmit an EML Operating Mode Notification frame (#11456)with the EML Control field set to the same value as the EML Control field in the received EML Operation Mode Notification frame, after the AP MLD is ready to serve the non-AP MLD in the EMLSR mode operation, to one of the (#12242)non-AP STAs affiliated with the non-AP MLD within the timeout interval indicated in the Transition Timeout subfield in the EML Capabilities subfield of the Basic Multi-Link element starting at the end of the PPDU (#12676)that is transmitted by the AP affiliated with the AP MLD (#11582)carrying the immediate acknowledgement to the EML Operating Mode Notification frame transmitted by the STA affiliated with the non-AP MLD. After the successful transmission of the EML Operating Mode Notification frame (#13411)(#11454)(#14000)by the (#12242)non-AP STA affiliated with the non-AP MLD, the non-AP MLD shall operate in the EMLSR mode and the other STAs operating on the corresponding EMLSR links shall transition to active mode after the transition delay indicated in the Transition Timeout subfield in the EML Capabilities subfield of the Basic Multi-Link element or immediately after receiving an EML Operating Mode Notification frame from one of the APs operating on the EMLSR links and affiliated with the AP MLD. Any of the other STAs operating on the corresponding EMLSR link shall not transmit a frame with the Power Management subfield set to 1 before receiving the EML Operating Mode Notification frame from (#13415)one of the APs operating on the EMLSR links and affiliated with the AP MLD or before the end of the timeout interval.

…

When a non-AP MLD is operating in the EMLSR mode with an AP MLD supporting the EMLSR mode(#8047), the following applies:

—The non-AP MLD shall be able to listen on the (#11457)EMLSR link(s), by having its affiliated STA(s) corresponding to those links in awake state. The listening operation for the STA affiliated with the non-AP MLD and with the Fully Functional Link subfield equal to 0 includes CCA and receiving the initial Control frame of frame exchanges that is initiated by the AP MLD. The listening operation for the STA affiliated with the non-AP MLD and with the Fully Functional Link subfield equal to 1, includes CCA and receiving the initial frame of frame exchanges initiated by the AP MLD.

(#12677)NOTE 2—A STA operating on one of the EMLSR links can change its power management mode and follows the procedure in 11.2 (Power management). A STA can listen on one of the EMLSR links in active mode or in PS mode when it is in awake state.

—An AP affiliated with the AP MLD that initiates frame exchanges (#10434)that are not group addressed Data or Management frames with the non-AP MLD on one of the EMLSR links, except the fully functional link if one of the STAs affiliated with the non-AP MLD sets the Fully Functional Link subfield to 1, shall begin the frame exchanges by transmitting the initial Control frame to the non-AP MLD with the limitations specified below. If a non-AP STA affiliated with the non-AP MLD sets the Fully Functional Link subfield to 1, an AP affiliated with the AP MLD that initiates frame exchanges that are not group addressed Data or Management frames with the non-AP MLD on the full functional link, shall begin the frame exchanges by transmitting the initial frame to the non-AP MLD with the limitations specified below:

•The initial Control frame of frame exchanges shall be sent in the non-HT PPDU or non-HT duplicate PPDU format using a rate of (#10134)6 Mb/s, 12 Mb/s, or 24 Mb/s.

• The initial frame of frame exchanges shall be sent in a PPDU format subject to its per-link spatial stream capabilities and operating mode, defined by exchanged OM Control, EHT OM Control or OMN frames.

•The non-AP MLD shall indicate the minimum MAC padding duration of the Padding field of the initial Control frame or the initial frame in the EMLSR Padding Delay subfield of the EML Capabilities subfield in the Common Info field of the Basic Multi-Link element (#11458)carried in a (Re)Association Request frame that it transmits. (#13418)The AP affiliated with the AP MLD shall set the MAC padding duration of the Padding field of the initial Control frame or the initial frame to be greater than or equal to the MAC padding duration in the EMLSR Padding Delay subfield.

•The initial Control frame shall be an MU-RTS Trigger frame or a BSRP Trigger frame. A (#12242)non-AP STA affiliated with a non-AP MLD that is in the listening operation and that receives an MU-RTS Trigger Frame or BSRP Trigger frame addressed to it shall respond as defined in (#13812)35.5.2.3 (Non-AP STA behavior for UL MU operation) except when the frame exchanges initiated by the initial Control frame or the initial frame on one of the EMLSR links overlaps with group addressed frame transmissions on the other EMLSR link where the non-AP STA intends to receive the group addressed frames. The number of spatial streams for the response to the BSRP Trigger frame shall be limited to one on any EMLSR link, except the fully functional link, if one of the STAs affiliated with the non-AP MLD sets the Fully Functional Link subfield to 1.

—After receiving the initial Control frame of frame exchanges and transmitting an immediate response frame as a response to the initial Control frame, a (#12242)non-AP STA affiliated with the non-AP MLD that was listening on the corresponding link that is not a fully functional link shall be able to transmit or receive frames on the link (#13814)on which the initial Control frame was received and shall not transmit or receive on the other EMLSR link(s) until the end of the frame exchanges, and subject to its spatial stream capabilities, operation mode, (#10088)and the minimum MAC padding duration of the Padding field of the initial Control frame, the STA affiliated with the non-AP MLD shall be capable of receiving a PPDU that is sent using more than one spatial stream on the link (#13814)on which the initial Control frame was received a SIFS after the end of its response frame transmission solicited by the initial Control frame. During the frame exchanges, the other AP(s) affiliated with the AP MLD shall not transmit frames to the other (#12242)non-AP STA(s) affiliated with the non-AP MLD on the other EMLSR link(s).

—After receiving the initial frame of frame exchanges and transmitting an immediate response frame to the initial frame, a non-AP STA affiliated with the non-AP MLD that was listening on the fully functional link shall be able to transmit or receive frames on the fully functional link and shall not transmit or receive on the other EMLSR link(s) until the end of the frame exchanges, and shall be able to support the following until the end of the frame exchange sequence:

* Transmit or receive PPDUs with the number of spatial streams up to the value as indicated in the EML Supported MCS And NSS Set subfield of the EML Control field of the EML Operating Mode Notification frame at a time on the link for which the initial frame exchange was made.

—The non-AP MLD shall be switched back to the listening operation on the EMLSR links after the time indicated (#10100)by the non-AP MLD in the EMLSR Transition Delay subfield of the EML Capabilities subfield in the Common Info field of the Basic Multi-Link element if any of the following conditions is met and this is defined as the end of the frame exchanges:

•The MAC of the STA affiliated with the non-AP MLD that received the initial Control frame or the initial frame does not receive a PHY-RXSTART.indication primitive during a timeout interval of aSIFSTime + aSlotTime + aRxPHYStartDelay starting at the end of the PPDU transmitted by the STA (#11461)affiliated with the non-AP MLD as a response to the most recently received frame from the AP affiliated with the AP MLD or starting at the end of the reception of the PPDU containing a frame for the STA from the AP affiliated with the AP MLD that does not require immediate acknowledgement.

•The MAC of the (#12242)non-AP STA affiliated with the non-AP MLD that received the initial Control frame or the initial frame receives a PHY-RXSTART.indication primitive during a timeout interval of aSIF-STime + aSlotTime + aRxPHYStartDelay starting at the end of the PPDU transmitted by the STA (#11461)affiliated with the non-AP MLD as a response to the most recently received frame from the AP affiliated with the AP MLD or starting at the end of the reception of the PPDU con-taining a frame for the STA from the AP affiliated with the AP MLD that does not require imme-diate acknowledgement and the (#12242)non-AP STA affiliated with the non-AP MLD does not detect, within the PPDU corresponding to the PHY-RXSTART.indication any of the following frames:

…•The (#12242)non-AP STA affiliated with the non-AP MLD that received the initial Control frame or the initial frame does not respond to the most recently received frame from the AP affiliated with the AP MLD that requires immediate response after a SIFS.

—The AP affiliated with the AP MLD should transmit, before the TXNAV timer expires,either another initial Control frame or initial frame, addressed to the (#12242)non-AP STA affiliated with the non-AP MLD, if the AP intends to continue the frame exchanges with the STA and did not receive the response frame from this STA for the most recently transmitted frame that requires an immediate response after a SIFS.

—(#10434)On the EMLSR link(s), the group addressed frame(s) that are expected to be received by the non-AP MLD shall be buffered and delivered following the rules defined in 35.3.15 (Multi-link operation group addressed frames(#11084)).

—When a (#12242)non-AP STA (#12682)affiliated with the non-AP MLD initiates a TXOP(#12521), the following applies:

•The non-AP MLD shall (#13006)be switched back to the listening operation on the EMLSR links after the time duration indicated in the EMLSR Transition Delay subfield after the end of the TXOP.

—(#13861)Any one of the (#12242)non-AP STAs affiliated with the non-AP MLD that is operating on one of the EMLSR links may initiate frame exchanges with the AP MLD.