IEEE P802.11
Wireless LANs

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| --- |
| LB 266 CR for Capability Update Notification |
| Date: 2022-08-05 |
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Abstract

This submission proposes resolutions for following 1 CID received for TGbe LB266

: 10773

Revision History:

* Rev 0: Initial version of the document
* Rev 1: Capability changed to be indicated in MLD capabilities and added another status code
* Rev 2: Editorial update and wrong text fix
* Rev 3: Editorial update and wrong text fix
* Rev 4: Unified the protocol using reconfiguration ML element
* Rev 5: Changes corresponding to Gaurang’s comments
* Rev 6: Fix bugs
* Rev 7: Naming change to avoid confusion

***TGbe editor: The baseline for this document is 11be D2.3***

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).***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 10773 | Chien-Fang Hsu | 9.4.2.313 | 228.46 | In an MLD, some resources may be shared by affiliated STAs or APs, e.g. memory. When the number of enabled links changes, the shared resources can also be re-allocated so that the efficiency can be improved. For example, the max MPDU length can be increased when enabled links are less. There is no such protocol to update capabilities dynamically now. It is necessary to have a new protocol to allow capability change in the MLO. | Add a unified protocol to allow a device to update its capabilities after association when the number of enabled links changes or some other reasons apply. Capabilties such as max MPDU length, A-MSDU max length, max A-MPDU Length Exponent are candidates to be changed when the MLD has less or more enabled links to increase the efficiency. | **Revised**Agree in principle with the commentor. Add corresponding procedures to allow a STA affiliated with non-AP MLD to update its operation parameters.**TGbe editor, please apply the changes tagged as 10773 in this document.** |

***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.***

**Discussion:**

Consider a scenario, in the non-AP MLD, total 26K memory is available and the memory is shared by STAs affiliated to the non-AP MLD. After association, all 3 links are enabled, and the max MPDU length is set up to 8K for each link. For some reason, link 3 is disabled, and if the non-AP MLD can re-allocate link 1 and link 2 with 11k memory, respectively, and changes the capabilities of link 1 and link 2 accordingly, efficiency of link 1 and link 2 can be improved. However, in the current specs. there is no such mechanism that the non-AP MLD can update its capabilities while the number of enabled links changes or other usage scenarios apply. The document addresses the topic and provides protocols so that the non-AP MLD can update its capabilities dynamically.



**9.4.1.9 Status Code field**

TGbe editor: ***Add a new row in Table 9-78 (Status codes) as follows (#10773)***

|  |  |  |
| --- | --- | --- |
| **Status code** | **Name** | **Meaning** |
| … | … | … |
| <ANA> | DENIED\_OPERATION\_PARAMETER\_UPDATE | Operation paramter update denied because the requested operation parameters or capabilities are not acceptable. |

**9.4.2.312.2.2 Presence Bitmap subfield of the Multi-Link Control field in a Basic Multi-Link element**

TGbe editor: M***ake the following changes in Figure 9-1002g (#10773)***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B3 | B4 | B5 | B6 | ~~B6~~B7 B11 |
|  | Link ID Info Present | BSSParameters Change Count Present | Medium Synchronization Delay Information Present | EMLCapabilities Present | MLDCapabilities and Operations Present | AP MLD IDPresent | ExtendedMLDCapabilities and Operations Present | Reserved |
| Bits: | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ~~6~~ 5 |

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

The (#10453) AP MLD ID Present subfield is set to 1 if the (#10453) AP MLD ID field is present in the Common Info field. Otherwise the (#10453) AP MLD ID Present subfield is set to 0.

The Extended MLD Capabilities and Operations Present subfield is set to 1 if the Extended MLD Capabilities and Operations subfield is present in the Common Info field of the Basic Multi-Link element. Otherwise, the Extended MLD Capabilities and Operations Present subfield is set to 0.

**9.4.2.312.2.3 Common Info field of the Basic Multi-Link element**

TGbe editor: M***ake the following changes in Figure 9-1002h (#10773)***

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |
|  | Common Info Length | MLD MACAddress | Link ID Info | BSSParameters Change Count | Medium Synchronization Delay Information | EMLCapabilities | MLDCapabilities and Operations | AP MLD ID | Extended MLD Capabilities and Operations |
| Octets: | 1 | 6 | 0 or 1 | 0 or 1 | 0 or 2 | 0 or 2 | 0 or 2 | 0 or 1 | 0 or 2 |

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

***TGbe editor: Insert the following at the end of 9.4.2.312.2.3 (Common Info field of the Basic Multi-Link element) (#10773)***

The format of the Extended MLD Capabilities and Operations subfield is defined in Figure 9-1002la.

|  |  |  |
| --- | --- | --- |
|  | B0 | B1 B15 |
|  | Operation Parameter Update Support | Reserved |
| Bits: | 0 | 15 |

**Figure 9-1002la — Extended MLD Capabilities and Operations subfield format**

The subfields of the Extended MLD Capabilities and Operations subfield are defined in Table 9-401ia (Subfields of the Extended MLD Capabilities and Operations field).

**Table 9-401ia—Subfields of the Extended MLD Capabilities** **and Operations subfield**

|  |  |  |
| --- | --- | --- |
| **Subfield** | **Definition** | **Encoding** |
| Operation Parameter Update Support  | Indicates support of Operation Parameter update negotiation. | Set to 1 if dot11OperationParameterUpdateImplemented is true. Set to 0 otherwise.See 35.3.16.2.1 (Non-AP MLD Operation Parameter Update). |

TGbe editor: M***ake the following changes in 9.4.2.312.4 (Reconfiguration Multi-Link element) (#10773)***

**9.4.2.312.4 Reconfiguration Multi-Link element**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 B3 | B4 | B5 | B6 | B7 B10 | B11 | ~~B11~~B12 B15 |
|  | Link ID | Complete Profile | MAC Address Present | Delete Timer Present | Operation Update Type | Operation Parameters Present | Reserved |
| Bits: | 4 | 1 | 1 | 1 | 4 | 1 | 4 |

**Figure 9-1002x—STA Control field format for the Reconfiguration Multi-Link element**

The Delete Timer Present subfield is set to 1 to indicate the presence of the Delete Timer subfield in the STA Info field, and that the AP corresponding to the Per-STA Profile subelement will be removed at the time indicated by the Delete Timer subfield; it is set to 0 otherwise.

The Operation Update Type subfield is set to indicate the type of multi-link operation update in the Multi-Link Operation Update Request frame for the link indicated by the Link ID subfield as defined in Table 9-401ia.

The Operation Parameters Present subfield is set 1 to indicate the presence of the Operation Parameters subfield in the STA Info field; otherwise set to 0.

**Table 9-401ia –Operation Update Type**

|  |  |
| --- | --- |
| **Value** | **Names** |
| 0 | Operation Parameter Update |
| 1-15 | Reserved |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | STA Info Length | STA MAC Address | Delete Timer | Operation Parameters |
| Octets: | 1 | 0 or 6 | 0 or 2 | 0 or 3 |

**Figure 9-1002y—STA Info field format for the Reconfiguration Multi-Link element**

The Delete Timer subfield indicates the number of TBTTs of the AP corresponding to the Per-STA Profile subelement until the AP is removed.

The Operation Parameters subfield is defined in Figure 9-1002ya (Operation Parameters subfield format).

|  |  |  |
| --- | --- | --- |
|  | PresenceIndication | Operation Parameter Info  |
| Octets: | 1 | 2 |

**Figure 9-1002ya —** **Operation Parameters subfield format**

The Presence Indication subfield in the Operation Parameters subfield is defined in Figure 9-1002yb (Presence Indication subfield format).

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 | B1 | B2 B7 |
|  | Maximum MPDU Length Present | Maximum A-MSDU Length Present | Reserved  |
| Bits: | 1 | 1 | 6 |

**Figure 9-1002yb — Presence Indication subfield format**

The Maximum MPDU Length Present subfield is set to 1 if the Maximum MPDU Length subfield is present in the Operation Parameter Info subfield. Otherwise, the Maximum MPDU Length Present subfield is set to 0.

The Maximum A-MSDU Length Present subfield is set to 1 if the Maximum A-MSDU Length subfield is present in the Operation Parameter Info subfield. Otherwise, the Maximum A-MSDU Length Present subfield is set to 0.

The Operation Parameter Info subfield contains operation parameters to be updated and is shown in Figure 9-1—2yc (Operation Parameter Info subfield format).

|  |  |  |  |
| --- | --- | --- | --- |
|  | Maximum MPDU Length  | A-MSDULength | Pad |
| Bits: | 0 or 2 | 0 or 1 | variable |

**Figure 9-1002yc — Operation Parameter Info subfield format**

The Maximum MPDU Length subfield is in defined in Table 9-310 (Subfields of the VHT Capabilities Information field).

The A-MSDU Length subfield is defined in Table 9-221 (Subfields of the HT Capabilities Information field).

The Pad subfield contains all 0s. The number of bits in the Pad subfield is the number of bits required to make the length of the Operation Parameter Info subfield to 2 octets.

### 9.6.35.1 Protected EHT Action field

TGbe editor: Add rows to table Table 9-623c (Protected EHT Action field values) as follows (#10773)

**Table 9-623d—Protected EHT Action field values**

|  |  |  |
| --- | --- | --- |
| **Value** | **Meaning** | **Time priority** |
| 8 | Multi-Link Operation Update Request | No |
| 9 | Multi-Link Operation Update Response | No |
| ~~8~~10 - 255 |  |  |

TGbe editor: ***Insert the following new subclause at the end of subclause 9.6.35*** (#10773)

**9.6.35.10 Multi-Link Opeation Update Request frame format**

The Multi-Link Operation Update Request frame is sent by a STA affiliated with a non-AP MLD to indicate that the STA is to update its status or operation parameters specified in the Operation Update Type subfied in the Reconfiguration Multi-Link element. The Action field of the Multi-Link Operation Update Request frame contains the information is shown in Table 9-623l (Multi-Link Operation Update Request frame Action field format).

**Table 9-623l—Multi-Link Operation Update Request frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 1 | Category |
| 2 | Protected EHT Action |
| 3 | Dialog Token |
| 4 | Reconfiguration Multi-Link element(see 9.4.2.312.4 (Reconfiguration Multi-Link element)) |

The Category field is defined in 9.4.1.11 (Action field).

The Protected EHT Action field is defined in 9.6.35.1 (Protected EHT Action field).

The Dialog Token field is a set to a nonzero value chosen by the STA sending the Multi-Link Operation Update Request frame to identify the request/response transaction.

The Multi-Link Operation Update field contains the Reconfiguration Multi-Link element, specified in 9.4.2.312.4 (Reconfiguration Multi-Link element).

**9.6.35.11 Multi-Link Operation Update Response frame format**

The Multi-Link Operation Update Response frame is sent by an AP affiliated with an AP MLD in response to a Multi-Link Operation Update Request frame to accept or to reject the request of status or operation parameter update in the Multi-Link Operation Update Request frame. The Action field of the Multi-Link Operation Update Response frame contains the information shown in Table 9-623m (Multi-Link Operation Update Response frame Action field format).

**Table 9-623m—Multi-Link Operation Update Response frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 1 | Category |
| 2 | Protected EHT Action |
| 3 | Dialog Token |
| 4 | Status Code |

The Category field is defined in 9.4.1.11 (Action field).

The Protected EHT Action field is defined in 9.6.35.1 (Protected EHT Action field).

The Dialog Token field carries the same value as the Dialog Token field of the corresponding Multi-Link Operation Update Request frame.

The Status Code is defined in 9.4.1.9 (Status Code field) and is set to the value 0 (SUCCESS) or <ANA> (DENIED\_OPERATION\_PARAMETER\_UPDATE).

**35.3.16.2 Multi-link device capability and operation signaling**

TGbe editor: ***Insert the following new subclause at the end of subclause 35.3.16.2*** (#10773)

**35.3.16.2.1 Non-AP MLD Operation Parameter Update**

An MLD shall set the Operation Parameter Update Support subfield in the Common Info field of the Basic Multi-Link element it transmits in a Beacon, Probe Response, (Re)Association Request, and (Re)Association Response frames to 1 if its dot11OperationParameterUpdateImplemented is true; otherwise the MLD shall set it to 0. A STA affiliated with an MLD in which dot11OperationParameterUpdateImplemented is true is referred to as *operation parameter update capable*.

An operation parameter update capable non-AP STA affiliated with a non-AP MLD may notify an operation parameter update capable AP affiliated with the associated AP MLD of change in its operation parameters by transmitting a Multi-Link Operation Update Request frame including a Reconfigration Multi-Link element with Operation Update Type subfield set to 0 after one of the following conditions occurs:

* at least one link is enabled or disabled for the non-AP MLD;
* the associated AP MLD removes at least one of its affiliated AP;
* the associated AP MLD adds at least one affiliated AP to the AP MLD.

Otherwise, the non-AP STA shall not transmit a Multi-Link Operation Update Request frame with Operation Update Type set to 0.

In the Reconfiguration Multi-Link element of a Multi-Link Operation Update Request frame with Operation Update Type subfield set to 0 transmitted by a non-AP STA affiliated with a non-AP MLD:

* all subfields in the Presence Bitmap subfield of the Multi-Link Control field in the Reconfiguration Multi-Link element shall be set to 0;
* all subfields of the STA Control field in the Reconfiguration Multi-Link element except the Link ID and Operation Parameters Present subfields shall be set to 0;
* the Link ID subfield shall be set to the identifier of the link to which the operation parameters apply;
* the Operation Parameters Present subfield shall be set to 1;
* the Operation Parameters subfield shall indicate the updated operation parameters (as applicable).

An AP affiliated with an AP MLD shall not transmit a Multi-Link Operation Update Request frame.

An operation parameter update capable AP affiliated with an AP MLD that received a Multi-Link Operation Update Request frame including a Reconfigration Multi-Link element with Operation Update Type subfield equal to 0 shall respond with a Multi-Link Operation Update Response frame. The Status Code subfield of the Multi-Link Operation Update Response frame shall be set to one of 0 (SUCCESS) or <ANA> (DENIED\_ OPERATION\_PARAMETER \_UPDATE).

Before the AP affiliated with the AP MLD transmits the corresponding Multi-Link Operation Update Response frame with the Status Code subfield set to 0, the AP affiliated with the AP MLD shall not apply the operation parameters of the non-AP STA affiliated with the non-AP MLD indicated in the Operation Parameter Info subfield in the Reconfiguration Multi-Link element of the Multi-Link Operation Update Request frame.

Before receiving the Multi-Link Operation Update Response frame, the non-AP STA affiliated with the non-AP MLD shall not apply the operation parameters indicated in the Reconfiguration Multi-Link element of the corresponding Multi-Link Operation Update Request frame.

After receiving the Multi-Link Operation Update Response frame in which the Status Code is equal to the value 0 (SUCCESS), the non-AP STA affiliated with the non-AP MLD shall apply the operation parameters indicated in the Operation Parameter Info subfield in the Reconfiguration Multi-Link element of the corresponding Multi-Link Operation Update Request frame.

After receiving the Multi-Link Operation Update Response frame in which a Status Code is equal to the value <ANA> (DENIED\_OPERATION\_PARAMETER \_UPDATE), the non-AP STA affiliated with the non-AP MLD shall not apply the operation parameters indicated in the Operation Parameter Info subfield in the Reconfiguration Multi-Link element of the corresponding Multi-Link Operation Update Request frame. The value of the Maximum MPDU Length subfield carried in the Operation Parameter Info subfield in the Reconfiguration Multi-Link element of the Multi-Link Operation Update Request frame indicates the value to update the Maximum MPDU Length subfield received in VHT Capabilities element (if applicable) or in HE 6 GHz Band Capabilities element (if applicable) or in EHT Capabilities element (if appliable) transmitted by the non-AP STA.

The value of the Maximum A-MSDU Length subfield carried in the Operation Parameter Info subfield in the Reconfiguration Multi-Link element of the Multi-Link Operation Update Request frame indicates the value to update the Maximum A-MSDU Length subfield received in HT Capabilities element transmitted by the non-AP STA.

TGbe editor: M***ake the following changes in 35.15.1 (Basic EHT BSS operation) (#10773)***

**35.15.1 Basic EHT BSS operation**

In the 2.4 GHz band, an EHT STA shall not transmit an EHT PPDU to a recipient EHT STA that carries a frame that is not an EHT Compressed Beamforming/CQI frame (see 35.7.3 (Rules for EHT sounding protocol sequences)) and that exceeds the maximum MPDU length capability indicated in the EHT Capabilities element or in Reconfiguration Multi-Link element with Operation Update Type equal to 0 last received from the recipient EHT STA.

In the 5 GHz band, an EHT STA shall not transmit an EHT PPDU to a recipient EHT STA that carries a frame that is not an EHT Compressed Beamforming/CQI frame (see 35.7.3 (Rules for EHT sounding protocol sequences)) and that exceeds the maximum MPDU length capability indicated in the VHT Capabilities element or in Reconfiguration Multi-Link element with Operation Update Type equal to 0 last received from the recipient STA.

In the 6 GHz band, an EHT STA shall not transmit an EHT PPDU to a recipient EHT STA that carries a frame that is not an EHT Compressed Beamforming/CQI frame (see 35.7.3 (Rules for EHT sounding protocol sequences)) and that exceeds the maximum MPDU length capability indicated in the HE 6 GHz Band Capabilities element or in Reconfiguration Multi-Link element with Operation Update Type equal to 0 last received from the recipient EHT STA.

In the 2.4 GHz band, an EHT STA shall not transmit an HE PPDU to a recipient EHT STA that carries a frame that is not an HE Compressed Beamforming/CQI frame (see 26.7.3 (Rules for HE sounding protocol sequences)) and that exceeds the maximum MPDU length capability indicated in the EHT Capabilities element or in Reconfiguration Multi-Link element with Operation Update Type equal to 0 last received from the recipient EHT STA.

In the 2.4 GHz band, an EHT STA that sets the value of the Maximum MPDU Length subfield in the EHT MAC Capabilities Information field of the EHT Capabilities element to indicate 3895 octets shall set the maximum A-MSDU length in the HT Capabilities element to indicate 3839 octets. In the 2.4 GHz band, an EHT STA that sets the maximum MPDU length in the EHT Capabilities element to indicate 7991 octets or 11 454 octets shall set the maximum A-MSDU length in the HT Capabilities element to indicate 7935 octets. An EHT STA that sets the Maximum MPDU Length subfield in the Operation Parameter Info subfield of the Reconfiguration Multi-Link element corresponding to a STA operating in 2.4 GHz band to indicate 3895 octets shall set the maximum A-MSDU length in Operation Parameter Info subfield to indicate 3839 octets. An EHT STA that sets the Maximum MPDU Length subfield in the Operation Parameter Info subfield of the Reconfiguration Multi-Link element corresponding to a STA operating in 2.4 GHz band to indicate 7991 or 11454 octets shall set the maximum A-MSDU length in Operation Parameter Info subfield to indicate 7935 octets.

TGbe editor: M***ake the following changes in 9.7.3 (A-MPDU Contents) (#10773)***

**9.7.3 A-MPDU Contents**

NOTE 4—If a STA supports A-MSDUs of 7935 octets (indicated by the Maximum A-MSDU Length field in the HT Capabilities element or in Reconfiguration Multi-Link element with Operation Update Type equal to 0), A-MSDUs transmitted by that TA within an A-MPDU carried in a PPDU with FORMAT HT\_MF or HT\_GF or within an MPDU carried in a non-HT PPDU are constrained so that the length of the QoS Data frame carrying the A-MSDU is no more than 4095 octets. The 4095-octet MPDU length limit does not apply to A-MPDUs carried in VHT, HE, EHT or DMG PPDUs. The use of A-MSDU within A-MPDU might be further constrained as described in 9.4.1.13 (Block Ack Parameter Set field) through the operation of the A-MSDU Supported field.

TGbe editor: M***ake the following changes in 10.11 A-MSDU operation (#10773)***

**10.11 A-MSDU operation**

A STA shall not transmit an A-MSDU in an HT PPDU if the A-MSDU length exceeds the value indicated by the Maximum A-MSDU Length field of the HT Capabilities element or in Reconfiguration Multi-Link element with Operation Update Type equal to 0 received from the recipient STA.

**C.3 MIB Detail**

TGbe editor: M***ake the following changes in dot11HEStationConfigTable (#10773)***

-- \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

-- \* dot11EHTStationConfig TABLE

-- \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Dot11EHTStationConfigEntry ::=

 SEQUENCE {

 …

 dot11EHTEMLMROptionActivatedTruthValue,

 dot11OperationParameterUpdateImplemented

 }

dot11OperationParameterUpdateImplemented OBJECT-TYPE

 SYNTAX TruthValue

 MAX-ACCESS read-write

 STATUS current

 DESCRIPTION

 "This is a capability variable.

 Its value is determined by device capabilities.

 This attribute, when true, indicates that the station implementation is capable of supporting

 MLD operation parameter update. (See 35.3.16.2.1 Non-AP MLD Operation Parameter

 Update))"

 DEFVAL { false }

 ::= { dot11EHTStationConfigEntry 13}