IEEE P802.11
Wireless LANs

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| Resolution for CID 1038 (CC 34) |
| Date: Feb 26, 2021 |
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 Abstract

This submission proposes resolutions for CID 1038 received for TGbe CC34.

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Revised based on feedback from several members (added as co-authors)
* Rev 2:
	+ Revised based on feedback from Jeongki
	+ The text was updated to D1.0 as baseline
* Rev 3: Updated based on additional feedback from Arik
* Rev 4: Updated text in clause 9 to clarify that the ‘presence’ subfield is carried in the STA Control field and the subfield carrying the power difference is carried in the STA Info field.
* Rev 5: Added two options to signal the beacon Tx power information. This is based on feedback from Jarkko and Guogang when the document was presented on TGbe MAC call on 5/27/21
	+ Option 1: Provide TxPower difference (when nonzero) in an optional 1 octet field in STA Info field for a reported link in an ML Probe Response frame carrying complete profile for the link
		- same as previous revisions
	+ Option 2: Explicitly provide TxPower for each AP via the TPC Report element carried in the frame body for the reporting AP and per-STA profile for each reported AP.

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.***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Pg/Ln** | **Section** | **Comment** | **Proposed Change** | **Resolution** |
| 1038 | Abhishek Patil | 129/01 | 35.3.4 | Each AP of an AP MLD may operate at different transmit power. This may be by choice or due to regulator requirements. The standard must provide sufficient information for a non-AP MLD to determine if it can close the DL with all the APs of the AP MLD before it initiates an ML setup with the AP MLD. | The commenter will provide contribution (Also see 11-20/508) | **Revised**Agree with the comment. Information regarding the transmit power of other APs affiliated with the AP MLD will help the non-AP MLD make an informed decision when selecting an AP MLD for performing multi-link setup. It will also provide benefits to the AP MLD and improves the overall system performance since this scheme helps the non-AP MLD establish ML-setup with an AP MLD where all the links have good connectivity. As a result, all the STAs of the non-AP MLD can be served at a higher MCS (lesser airtime) and lower retries.A new subclause was added to Clause 35.3.4 (Discovery of an AP MLD) to describe the operation. Clause 9 (Basic variant ML IE) was updated to describe the field for carrying the transmit power difference.Two options are provided for the group to consider.**TGbe editor please implement changes as shown in doc 11-21/0386r4 tagged as 1038.** |

***TGbe editor: Please note baseline is 11be D1.0***

**OPTION #1: Provide TxPower difference (if nonzero) in an optional (1-octet) subfield carried in the STA Info field of per-STA profile corresponding to a reported AP**

**35.3.4 Discovery of AP MLD**

***TGbe editor: Please insert the following (new) subclause as shown below:***

**35.3.4.x Estimating Link Reachability**

An AP affiliated with an AP MLD can independently select the transmit power for the Beacon frames that it transmits based on deployment scenario or to satisfy regulatory requirements. In addition, the pathloss characteristics for each band are different. Therefore, it is possible that there will be a situation in which a STA of a non-AP MLD is able to receive Beacon frames transmitted by an AP affiliated with an AP MLD while another STA affiliated with the same non-AP MLD is unable to receive Beacon frames from another AP affiliated with the same AP MLD. This subclause defines a mechanism by which an AP affiliated with an AP MLD advertises information that can help a non-AP MLD determine reachability for requested links.

An AP affiliated with an AP MLD shall, when responding to an ML probe request that is requesting the complete profile of another AP affiliated with the same AP MLD, provide the difference between the reporting AP’s beacon transmit power (expressed in EIRP) normalized to 20 MHz and the beacon transmit power of the reported AP (expressed in EIRP) normalized to 20 MHz, if the difference is nonzero. The AP shall transmit an ML probe response that carries the Beacon TxPower Difference subfield with the same TXVECTOR parameters as its Beacon frames.

Based on the presence of and the value carried in the Beacon TxPower Difference subfield, a non-AP MLD may estimate the difference in the receive power for the requested link of the AP MLD (using Equation (35-x1) and Equation (35-x2)). A non-AP MLD may, based on this estimate, make decisions on selecting a suitable AP MLD for performing multi-link setup. For example, if the non-AP MLD estimates that it would not be able to receive Beacon frames from one or more reported AP(s) affiliated with the AP MLD, it can decide to select a different AP MLD for performing multi-link setup.

An example of reachability estimation is shown in Figure 35-xxx (Example of reachability estimation).



**Figure 35-xxx – Example of reachability estimation**

In the example shown in Figure 35-xxx (Example of reachability estimation), STA1 affiliated with a non-AP MLD (N) sends an ML probe request to AP1 affiliated with an AP MLD (A), requesting the complete information of AP2 and AP3, which are also affiliated with MLD A. AP1 responds with an ML probe response which is transmitted at the same transmit power as its Beacon frames and provides the beacon transmit power difference between AP1 and AP2 (carried in the Per-STA Profile subelement of the Basic variant Multi-Link element corresponding to AP2), and the beacon transmit power difference between AP1 and AP3 (carried in the Per-STA Profile subelement of the Basic variant Multi-Link element corresponding to AP3). Using this information, the MLD N can compute an estimate of the received power for Beacon frames transmitted on L2 by AP2 and on L3 by AP3, respectively.

The computation of difference in the received power on links L1 and L2 is shown in Equation (35-x1).

 (35-x1)

where,

 is the difference in receive power between link L2 and link L1 in dB

 is the difference in transmit power between link L2 and link L1 in dB

 is the estimated difference in the path loss between link L2 and link L1 in dB

NOTE – The estimated difference in the path loss between the reporting link and the reported link depends on the device implementation and is outside the scope of this standard.

The computation of the estimated received power on link L2 is shown in Equation (35-x2).

= (35-x2)

where,

 is the estimated receive power on link L2 in dBm

 is the actual received power on link L1 in dBm

**9.4.2.295b.2 Basic variant Multi-Link element**

***TGbe editor: Please make the following change to the figure and text in clause 9.4.2.295b.2 as shown below:***

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 | B11 15 |
| Link ID | Complete Profile | MAC Address Present | Beacon Interval Present | DTIM Info Present | NSTR Link Pair Present | NSTR Bitmap Size | Beacon TxPower Difference Present | Reserved |
| Bits: |  | 4 |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 5 |

### Figure 9-788eo—STA Control field format

***TGbe editor: Please insert the following paragraph after the paragraph starting: “If the Complete Profile subfield is equal to 1 and the NSTR Link Pair Present subfield is equal to 1 in the STA Control field, …” as follows:***

The Beacon TxPower Difference Present subfield of the STA Control field is set to 1 and the Beacon TxPower Difference subfield is present in the STA Info field of that Per-STA Profile subelement when all the following conditions are satisfied:

* The Basic variant Multi-Link element is carried in an ML probe response
* The Complete Profile subfield is set to 1
* The difference between beacon transmit power of the reported AP and the reporting AP is nonzero

Otherwise, the Beacon TxPower Difference Present subfield of the STA Control field is set to 0 and the Beacon TxPower Difference subfield is not included in the STA Info field of that Per-STA Profile subelement.

***TGbe editor: insert the following (new) paragraph after the paragraph starting “The DTIM Count field and the DTIM Period field are …” as follows:***

The Beacon TxPower Difference subfield of the STA Info field is 1 octet in length and represents a 2s complement signed integer in dB. It carries the difference between the beacon transmit power (expressed in EIRP) normalized to 20 MHz of the AP reported in the Per-STA Profile subelement and the beacon transmit power (expressed in EIRP) normalized to 20 MHz of the AP transmitting the Basic variant Multi-Link element if the difference is nonzero. Otherwise, the Beacon TxPower Difference subfield is not present if the difference is zero.

NOTE – For example, if the beacon transmit power (in EIRP) normalized to 20 MHz of the AP that carries the ML probe response is 23 dBm and the beacon transmit power (in EIRP) normalized to 20 MHz of an AP that is reported in the Per-STA Profile subelement of the Basic variant Multi-Link element carried in the ML probe response is 20 dBm then the Beacon TxPower Difference subfield of the Per-STA profile subelement corresponding to that AP carries the binary value 11111101.

----------- END OF OPTION #1 --------------

**OPTION #2: Provide Txpower information in a (4-octet) TPC Report element corresponding to each AP of the AP MLD. For the reporting AP, the element is carried in the frame body of an ML probe response. For a reported AP, the element is carried in the STA Profile field of the per-STA profile subelement.**

**35.3.4 Discovery of AP MLD**

***TGbe editor: Please insert the following (new) subclause as shown below:***

**35.3.4.x Estimating Link Reachability**

An AP affiliated with an AP MLD can independently select the transmit power for the Beacon frames that it transmits based on deployment scenario or to satisfy regulatory requirements. In addition, the pathloss characteristics for each band are different. Therefore, it is possible that there will be a situation in which a STA of a non-AP MLD is able to receive Beacon frames transmitted by an AP affiliated with an AP MLD while another STA affiliated with the same non-AP MLD is unable to receive Beacon frames from another AP affiliated with the same AP MLD. This subclause defines a mechanism by which an AP affiliated with an AP MLD advertises information that can help a non-AP MLD determine reachability for requested links.

An AP affiliated with an AP MLD shall, when responding to an ML probe request that is requesting the complete profile of another AP affiliated with the same AP MLD, include TPC Report element in the Probe Response frame body and in the STA Profile field of the Per-STA Profile subelement corresponding to the reported AP. The Transmit Power field and Link Margin field of the TPC Report element shall carry the transmit power and link margin respectively for the reporting AP (as defined in 9.4.2.16 (TPC Report element)). The Transmit Power field of the TPC Report element contained in the STA Profile field shall carry the transmit power at which a Beacon frame is transmitted by the reported AP on its link and the Link Margin field is reserved. The AP shall transmit an ML probe response that carries the complete profile for one or more reported APs with the same TXVECTOR parameters as its Beacon frames.

A non-AP MLD, that receives an ML probe response carrying complete profile of one or more reported APs may determine the TxPower for reporting AP based on the TPC Report element carried in the Probe Response frame body and that of a reported AP based on the TPC Report element carried in the Per-STA Profile subelement corresponding to the reported AP. A non-AP MLD may derive the path-loss on the reported link based on the received power of the ML probe response frame. Based on the difference in transmit power between the reporting and reported link, the non-AP MLD may estimate the difference in the receive power for the requested link of the AP MLD (using Equation (35-x1) and Equation (35-x2)). A non-AP MLD may, based on this estimate, make decisions on selecting a suitable AP MLD for performing multi-link setup. For example, if the non-AP MLD estimates that it would not be able to receive Beacon frames from one or more reported AP(s) affiliated with the AP MLD, it can decide to select a different AP MLD for performing multi-link setup.

An example of reachability estimation is shown in Figure 35-xxx (Example of reachability estimation).



**Figure 35-xxx – Example of reachability estimation**

In the example shown in Figure 35-xxx (Example of reachability estimation), STA1 affiliated with a non-AP MLD (N) sends an ML probe request to AP1 affiliated with an AP MLD (A), requesting the complete information of AP2 and AP3, which are also affiliated with MLD A. AP1 responds with an ML probe response which is transmitted at the same transmit power as its Beacon frames and provides the beacon transmit power for AP1 (carried in the frame body), the beacon transmit power for AP2 (carried in the Per-STA Profile subelement of the Basic variant Multi-Link element corresponding to AP2), and the beacon transmit power for AP3 (carried in the Per-STA Profile subelement of the Basic variant Multi-Link element corresponding to AP3). Using this information, the MLD N can compute an estimate of the received power for Beacon frames transmitted on L2 by AP2 and on L3 by AP3, respectively.

The computation of difference in the received power on links L1 and L2 is shown in Equation (35-x1).

 (35-x1)

where,

 is the difference in receive power between link L2 and link L1 in dB

 is the difference in transmit power between link L2 and link L1 in dB

 is the estimated difference in the path loss between link L2 and link L1 in dB

NOTE – The estimated difference in the path loss between the reporting link and the reported link depends on the device implementation and is outside the scope of this standard.

The computation of the estimated received power on link L2 is shown in Equation (35-x2).

= (35-x2)

where,

 is the estimated receive power on link L2 in dBm

 is the actual received power on link L1 in dBm

***TGbe editor: Please update the add the following Table as shown below:***

**Table 9-39—Probe Response frame body**

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| 13 | TPC Report | The TPC Report element is present if dot11SpectrumManagementRequired is true or dot11RadioMeasurementActivated is true or is optionally present if dot11MultiLinkActivated is true (see 35.3.4.x (Estimating Link Reachability)). |

----------- END OF OPTION #2 --------------

**Discussion:**

Option #1 is preferred due to its lower overhead:

* 1 octet field is optionally present if the TxPower difference between reported and reporting link is non-zero

Option #2 requires 4 octets per link (reporting and reported).

**SP #1: Which option and corresponding changes, as proposed in doc 11-21/0386r4, do you support as a resolution to CID 1038?**

Option 1:

Provide TxPower difference (if nonzero), in an optional (1-octet) subfield carried in the STA Info field of the per-STA profile (carrying complete information) corresponding to a reported AP, in an ML probe response

Option 2:

Provide Txpower information in a (4-octet) TPC Report element corresponding to each AP of the AP MLD. For the reporting AP, the element is carried in the frame body of an ML probe response. For a reported AP, the element is carried in the STA Profile field of the per-STA profile subelement.