###  **IEEE P802.11Wireless LANs**

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| LB275 CR for Transmit Power Envelope (TPE) |
| Date: 2023-08-22 |
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**Abstract**

This submission proposes resolutions for the following 6 CIDs for TGbe LB275:

* 19622,19623,19668,19908,19621,19382

**Revisions:**

* Rev 0: Initial version of the document (inherited the same proposal from 23/0728r2)
* Rev 1: two editorial updates based on Ming’s inputs.

***TGbe editor: Please note Baseline is REVme\_D2.0 and 11be D4.0***

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| --- | --- | --- | --- | --- | --- | --- |
| CID | Commenter | Clause | Page | Comment | Proposed Change | Resolution |
| 19622 | Yanjun Sun | 35.15.2 | 638.41 | TPE with EIRP for 320MHz/puncturing is missing. | As in comment | RevisedAgree with the commenter in principleTgbe editor please implement changes as shown in doc 11-23/1410r0 tagged as #19622 |
| 19623 | Yanjun Sun | 35.15.2 | 638.41 | TPE with PSD for 320MHz/puncturing is missing. | As in comment | RevisedAgree with the commenter in principleTgbe editor please implement changes as shown in doc 11-23/1410r0 tagged as #19623 |
| 19668 | Laurent Cariou | 35 | 483.04 | Transmit Power related rules need to be amended for 320 MHz. | as in comment | RevisedAgree with the commenter in principleTgbe editor please implement changes as shown in doc 11-23/1410r0 tagged as #19622 and #19623, same as above |
| 19908 | Liwen Chu | 35.15.1 | 635.12 | Please clarify the transmit power operaiton at 320MHz. | As in comment. | RevisedAgree with the commenter in principleTgbe editor please implement changes as shown in doc 11-23/1410r0 tagged as #19622 and #19623, same as above |
| 19621 | Yanjun Sun | 9.4.2.160 | 229.30 | Transmit Power Envelope element for 320 MHz and puncturing is missing. Add it. | There were two proposals discussed for a long time and no technical issues were raised, so my suggestion is to adopt one of them. The simpler version is in 22/1482r3 and the more complex/flexible version is in 23/728r2 that has more rules on future expansion. Given that 11ax rules for future expansion failed to work due to unforeseen 11be features, and TPE element itself is already extensible for future feature expansion, it looks more reasonable to adopt the simpler version in 23/1482r3. | RevisedAgree with the commenter in principleTgbe editor please implement changes as shown in doc 11-23/1410r0 tagged as #19622 and #19623, same as above |
| 19382 | Thomas Derham | 11.2.3.14 | 366.07 | Modification to contents of Transmit Power Envelope (TPE) should trigger a BSS critical update.For example in 6 GHz operation, TPE signals Regulatory Client limits which might dynamically change based on a new AFC response or a change of regulatory mode.Critical update is particularly useful in EHT/MLO operation because the STA can detect the TPE update on any link that is active, and apply the new power limits before any subsequent transmissions occur on the corresponding link.Since TPE element is not newly defined in 11be, to avoid making existing implementations non-compliant, this requirement probably needs to apply only to EHT AP.(Note that any changes to the related Regulatory info field already trigger a critical update since HE Operation element is already specified in this list since 11ax). | Add a new item in the list (below r1) as follows: "Modification of the Transmit Power Envelope element, if the AP is an EHT AP." | RevisedTgbe editor please add a new item in the list (below r1) as follows: "Inclusion, modification or removal of a Transmit Power Envelope element, if the AP is an EHT 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.***

***Discussion for CID 19622:***

*Issue: for TPE indicating an EIRP, there is no normative text on how to interpret reserved values for the Maximum Transmit Power Count subfield, so the behavior of a legacy STA is unknown if any value between 4-7 is used*



*To avoid interop issues with the legacy STAs deployed in the field, the group has discussed two options in the past:*

* *Option1: Append a new subfield to the existing TPE, which is an extensible element*
	+ *Pros: lowest overhead (1 octet only), proposed text in* [*23/0728r2*](https://mentor.ieee.org/802.11/dcn/23/11-23-0728-02-00be-lb271-cr-for-35-15-2.docx) *has been discussed*
* *Option2: Carry an EHT TPE together with the legacy TPE in a Beacon frame*
	+ *Pros: more flexibility for future expansion, not getting enough support due to larger overhead*
* *Option3: any other proposal?*

*The text below is copied from* [*23/0728r2*](https://mentor.ieee.org/802.11/dcn/23/11-23-0728-02-00be-lb271-cr-for-35-15-2.docx) *based on option1.*

Tgbe Editor: modify the following paragraph (P1234L50 in 11meD2.0) in 9.4.2.161 Transmit Power Envelope element as follows (track change enabled)

~~Local~~ Maximum Transmit Power For *X* MHz fields (where *X* = 20, 40, 80, or 160/80+80) define the local maximum transmit power limit of *X* MHz PPDUs, except for an HE TB PPDU and for an EHT TB PPDU where *X* MHz is the bandwidth of the pre-HE and pre-EHT modulated fields of the HE TB PPDU and EHT TB PPDU transmitted by a STA. Each ~~Local~~ Maximum Transmit Power For *X* MHz field is encoded as an 8-bit 2s complement signed integer in the range –64 dBm to 63 dBm with a 0.5 dB step. Setting this field to 63.5 dBm indicates 63.5 dBm or higher (i.e., no local maximum transmit power constraint).(#19622)

Tgbe Editor: modify Table 9-691 Transmit Power Envelope element format as follows (track change enabled)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Transmit Power Information |  Maximum Transmit Power  | Extension Maximum Transmit Power |
| Octets: | 1 | 1 | 1 | variable | variable(#19622) |
| * **Transmit Power Envelope element format(11ax)**
 |  |

Tgbe Editor: Insert a new Figure 9-xxx-Extension Maximum Transmit Power field format if the Maximum Transmit Power Interpretation subfield is 0 or 2 as follows

|  |  |
| --- | --- |
|  | Maximum Transmit Power For 320 MHz  |
| Octets: | 1 |

**Figure 9-xxx-Extension Maximum Transmit Power field format if the Maximum Transmit Power Interpretation subfield is 0 or 2**(#19622)

Tgbe Editor: Insert the following paragraph after the Figure 9-xxx-Extension Maximum Transmit Power field format if the Maximum Transmit Power Interpretation subfield is 0 or 2

(#19622)The maximum Transmit Power For 320 MHz fields define the local maximum transmit power limit of 320 MHz PPDUs, except for an EHT TB PPDU where 320 MHz is the bandwidth of the pre-EHT modulated fields of the EHT TB PPDU transmitted by a STA. The Maximum Transmit Power For 320 MHz field is encoded as an 8-bit 2s complement signed integer in the range –64 dBm to 63 dBm with a 0.5 dB step. Setting this field to 63.5 dBm indicates 63.5 dBm or higher (i.e., no local maximum transmit power constraint).

 Tgbe Editor: Insert the following paragraphs at the end of 9.4.2.161 Transmit Power Envelope element

(#19622)The format of the Extension Maximum Transmit Power field is defined in Figure 9-xxx (Extension Maximum Transmit Power field format if the Maximum Transmit Power Interpretation subfield is 0 or 2) if the Maximum Transmit Power Interpretation subfield is 0 or 2.

(#19622)The Extension Maximum Transmit Power field is included only if the conditions defined in 35.16.3 (EHT operation with the Transmit Power Envelope element) are met.

TGbe Editor: Insert the following subclause 35.15.4 EHT operation with the Transmit Power Envelope element

(#19622)**35.15.4 EHT operation with the Transmit Power Envelope element**

An EHT STA follows the rules defined in 10.22.4 (Operation with the Transmit Power Envelope element) and the rules defined in this subclause.

The Extension Maximum Transmit Power field shall be included in the Transmit Power Envelope element by an AP only if the following condition is met:

* the AP is operating in the 6 GHz band, the Maximum Transmit Power Interpretation subfield is 0 or 2, and the EHT BSS operating channel width is 320 MHz.

If the Extension Maximum Transmit Power field is included and if the Maximum Transmit Power Interpretation subfield is 0 or 2, then the Maximum Transmit Power Count field shall be set to 3.

In a Transmit Power Envelope element transmitted by an EHT AP with the Maximum Transmit Power Interpretation subfield set to 0 or 2, the Maximum Transmit Power For X MHz subfield shall be included (where X = 20, 40, 80, 160/80+80, or 320) if X is less than or equal to the operating channel width of the corresponding EHT BSS.

**Discussion on CID 19623**

There were 3 candidates solutions discussed:

* Option1: use the reserved values in the Maximum Transmit Power Count subfield in TPE defined in 11ax to indicate 320 MHz TPE
* Option2: proposal in this CR, inherited from [*23/0728r2*](https://mentor.ieee.org/802.11/dcn/23/11-23-0728-02-00be-lb271-cr-for-35-15-2.docx)
* Option3: define a new EHT TPE and send it together with HE TPE in the same frame
* Option4: any alternative?

**Issue with option1: unknown behavior for HE STAs already in the field (i.e. backward compatibility risk)**

TPE in HE has two flavors: EIRP and PSD. For EIRP, there is no rule defined on how an HE STA interprets a reserved value (e.g. 4-7) in the Maximum Transmit Power Count subfield. For PSD, the HE rules were defined without knowing static puncturing rules in EHT, so HE STA behavior is unknown if we try to use the reserved value in some cases. Please see an example below.

HE BSS: 40 MHz operating bandwidth

EHT BSS: 320 MHz operating bandwidth with S40 punctured



In this case, two HE rules would result into two possible conflicting settings on the first 2 PSD values in TPE.

1) Max Transmit Power field for P160 based on the following 11ax rule: “If the BSS bandwidth is 20, 40, 80 or 160 MHz, then the Maximum Transmit PSD 1-N subfields correspond to 20 MHz channels from lowest to highest frequency, respectively, within the indicated bandwidth”



2) Max Transmit Power field for P160 based on the 11ax text: “If N is greater than 8, the Maximum Transmit PSD 1-8 subfields correspond to the 20 MHz channels from lowest to highest frequency, respectively, within the 160 MHz channel containing the primary 20 MHz channel”



In summary, option1 not only requires amendment in 11me but also faces the risk of backward compatibility for HE STAs already in the field.

Both option2 (proposal in this CR, inherited from [*23/0728r2*](https://mentor.ieee.org/802.11/dcn/23/11-23-0728-02-00be-lb271-cr-for-35-15-2.docx)) and option3 (define a new EHT TPE and send it together with HE TPE in the same frame) can handle 320 MHz without concerns on backward compatibility. As TPE is an extensible element, both solutions can be expanded later for future amendement. The main difference between option2 and option3 is that option3 has larger overhead in Beacon frames (e.g. at least 4 octets extra overhead for each co-hosted BSS).

Tgbe Editor: Insert the following paragraphs at the end of 9.4.2.161 Transmit Power Envelope element

(#19623)The format of the Extension Maximum Transmit Power field is defined in Figure 9-xx2 (Extension Maximum Transmit Power field format if the Maximum Transmit Power Interpretation subfield is 1 or 3) the same as the Maximum Transmit Power field if the Maximum Transmit Power Interpretation subfield is 1 or 3, as defined in Figure 9-617b (Maximum Transmit Power field format if the Maximum Transmit Power Interpretation subfield is 1 or 3).

|  |  |  |
| --- | --- | --- |
|  | Extension Transmit PSD Information  | Maximum Transmit PSD Values |
| Octets: | 1 | variable |

**Figure 9-xx2-Extension Maximum Transmit Power field format if the Maximum Transmit Power Interpretation subfield is 1 or 3**(#19623)

The format of the Extension Transmit PSD Information subfield is defined in Figure 9-xx3 (Extension Transmit PSD Information subfield format). The Extension Count subfield determines the value of an integer *K*, which indicates the number of 20 MHz channels for which a maximum transmit PSD is included in the Maximum Transmit PSD Values subfield of the Extension Maximum Transmit Power field.

 B0 B3 B4 B7

|  |  |  |
| --- | --- | --- |
|  | Extension Count | Reserved |
| Bits: | 4 | 4 |

**Figure 9-xx3—Extension Transmit PSD Information subfield format** (#19623)

The format of the Extension Maximum Transmit PSD Values subfield is the same as the Maximum Transmit Power field as defined in Figure 9-694 (Maximum Transmit Power field format if Maximum Transmit Power Interpretation subfield is 1 or 3).

TGbe Editor: Insert the following sentence to 9.4.2.161 (Transmit Power Envelope element) , at 11meD2.0P1235L58, right after “If N is greater than 0 and less than 2, 4, or 8 for 40, 80, or 160 MHz BSS bandwidth, respectively, then the indicated bandwidth is the primary 20 MHz, primary 40 MHz, or primary 80 MHz channel for N equal to 1, 2, or 4, respectively.”

(#19623)If the Extension Maximum Transmit Power field is included and the Maximum Transmit Power Interpretation subfield is 1 or 3, then:

* If N+K is equal to 2, 4, 8 or 16 for 40, 80, 160 or 320 MHz EHT BSS bandwidth, respectively, then the indicated bandwidth is the EHT BSS bandwidth.
* If N+K is less than 4, 8 or 16 for 80, 160 or 320 MHz EHT BSS bandwidth, respectively, then the indicated bandwidth is the primary 40 MHz, primary 80 MHz or primary 160 MHz channel for N+K equal to 2, 4, 8 respectively.
* If N+K is greater than 2, 4, 8 or 16 for 40, 80,160 or 320 MHz EHT BSS bandwidth, respectively, then the indicated bandwidth is wider than the EHT BSS bandwidth.
	+ The Maximum Transmit PSD 1-M subfields correspond to the 20 MHz channels within the EHT BSS bandwidth in the order as described in this subclause, where M is 4, 8, or 16 for 80, 160 or 320 MHz EHT BSS bandwidth, respectively.
	+ The Maximum Transmit PSD (M+1)-(N+K) subfields are reserved for future use

(#19623)If the Extension Maximum Transmit Power field is **not** included, the Maximum Transmit Power Interpretation subfield is 1 or 3, and N is greater and 0, then:

* If N is less than 2, 4, 8 or 16 for 40, 80, 160 or 320 MHz BSS bandwidth, respectively, then the indicated bandwidth is the primary 20 MHz, 40 MHz, primary 80 MHz channel or primary 160 MHz channel for N equal to 1, 2, 4, 8 respectively.

TGbe Editor: Insert the following text to the end of subclause 35.15.4 (EHT operation with the Transmit Power Envelope element)

(#19623)The Extension Maximum Transmit Power field shall be included in the Transmit Power Envelope element by an AP only if the following conditions is met:

* the AP is operating in the 5GHz or 6 GHz band, the AP is announcing a BSS operating channel width to EHT non-AP STAs in EHT Operation element that is different from a non-EHT BSS operating channel width that it announces to non-EHT non-AP STAs (see 35.165.1 Basic EHT BSS operation), the Maximum Transmit Power Interpretation subfield is 1 or 3, the value of *N* determined from the Maximum Transmit Power Count subfield is greater than 0, and the number of 20 MHz subchannels to be covered by Transmit Power Envelope element is greater than the number of 20 MHz subchannels contained within the HE BSS operating channel width.

(#19623)If the Extension Maximum Transmit Power field is included and if the Maximum Transmit Power Interpretation subfield is 1 or 3, then:

* the Transmit Power Information field and the Maximum Transmit Power field shall be computed with the non-EHT BSS operating channel width of the AP that is different from the EHT BSS operating channel width.
* the Extension Maximum Transmit Power field shall be computed as follows:
	+ The Extension Count subfield of the Extension Transmit PSD Information subfield is set to the value of *K*, corresponding to the number of 20 MHz subchannels for each of which the Transmit Power Envelope element has included a maximum transmit PSD, minus the number of 20 MHz subchannels contained within the non-EHT BSS operating channel.
	+ the Maximum Transmit PSD 1-*K* subfields correspond
	to 20 MHz channels from lowest to highest frequency, respectively, within the EHT BSS operating channel, excluding the 20 MHz channels within the non-EHT BSS operating channel.