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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| LB266 CR for preamble puncturing | | | | |
| Date: 2023-01-16 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | Email |
| Yanjun Sun | Qualcomm |  |  |  |
| Alfred Asterjadhi |  |  |  |  |
| George Cherian |  |  |  |  |
| Youhan Kim |  |  |  |  |
| Bin Tian |  |  |  |  |
| Abhishek Patil |  |  |  |  |
| Duncan Ho |  |  |  |  |
| Gaurang Naik |  |  |  |  |
| Abdel Karim Ajami |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

**Abstract**

This submission proposes resolutions for the following 8 CIDs for TGbe LB266:

* 11014,11930,11931,13450,10988,11011,13562,12693

**Revisions:**

* Rev 0: Initial version of the document.
* Rev 1: 12193 is removed as it was withdrawn by the commenter; revised the text on EHT SU transmission based on inputs from Yongho to align with existing text better; rebased the text with D2.2 of 11be and D2.0 of 11me
* Rev 2: fixed typos of “Disabled Subchannel Bitmap” w/ “Disabled Subchannel Bitmap **subfield**”
* Rev 3: for the resolution related to CIDs 10988 and 11011, simplified a line by removing redundant text based on Yongho’s suggestion; added discussions to recap the problem and other candidate resolutions.
* Rev 4: added a rule that in an EHT TPE with multiple PSD values, “If N is 8 for a 320 MHz EHT BSS bandwidth, then the indicated bandwidth is the primary 160 MHz channel.”, based on Ming’s input that HE TPE allows such flexibility of including values only for the primary
* Rev 5: allow EHT AP to only include PSD values for Primary 20/40/80/160 based on Guogang’s inputs; based on Ming’s inputs, add an explicit Count field to indicate the number of PSDs values in the Extension Maximum Transmit Power field instead of deriving it based on the Length field for easier future expansion
* Rev 6: 2 editorial updates: typo fix and call out the container of the subfield explicitly; based on Ming's inputs, describe 3 cases as in legacy TPE based on N and K: PSD values cover whole BSS bandwidth, only primaries, or include subchannels outside of EHT BSS BW
* Rev 7: fixed indentation on the last line;

***TGbe editor: Please note Baseline is REVme\_D2.0 and 11be D2.2***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CID | Commenter | Clause | Page | Comment | Proposed Change | Resolution |
| 11014 | Yanjun Sun | 35.16.2 | 532.57 | Please to replace “ Disabled Subchannel Bitmap field” with “ Disabled Subchannel Bitmap subfield” throughout this subclause to aligned with the latest EHT Option element format | As in comment | Accepted |
| 11930 | Alfred Asterjadhi | 35.16.2 | 533.02 | Sentence is a bit confusing as it states “for the PPDU bandwidth that is equal to the operating channel width of the BSS”. What about for PPDUs with BW less than the width of the BSS? Please clarify | As in comment. | Revised  Agree with the commenter in principle that the current text may cause confusion. The text has been revised to clarify that it refers to the PPDU bandwidth column in Table 36-30 (Definition of the Punctured Channel Information field in the U-SIG for an EHT MU PPDU using non-OFDMA transmissions) .  Tgbe editor please implement changes as shown in doc 11-22/1482r2 tagged as #11930 |
| 13450 | Liwen Chu | 35.16.2 | 533.11 | Based on the paragraphes starting from P33L11, the following dynamic chennal puncture are allowed: 1, DL EHT MU PPDU addressed to a single STA (or multiple STAs) without soliciting any responding frame or with soliciting responding frame(s) by using Trigger frame. 2, UL EHT MU PPDU addressed to a single STA without soliciting responding frame. 3, EHT TB PPDU from a single STA or multiple STAs solicited by Trigger frame. 4, non-HT duplicate PPDU without carrying Trigger frame addressed to single or multiple STAs without oliciting any frame.  One simplification is that DL/UL EHT MU PPDU addressed to a single STA and MU-RTS and solicited CTS can’t use dynamic channel puncture. | As in comment. | Revised  Agree with the commenter in principle. We adopted the simplification suggested by the commenter and added clarifications for different PPDU types.  Tgbe editor please implement changes as shown in doc 11-22/1482r2 tagged as #13450 |
| 11931 | Alfred Asterjadhi | 35.16.2 | 533.22 | This paragraph is a bit too generic and may cause confusion. Suggest to explicitly call out the cases when the additional puncturing patterns can be used within PPDU exchange sequences, e.g., when this can happen in an EHT MU PPDU, TB PPDU, or non-HT dup PPDU cases. Similar consideration for the last paragraph of this subclause. | As in comment. | Revised  Agree with the commenter in principle. We added more clarifications for different PPDU types.  Tgbe editor please implement changes as shown in doc 11-22/1482r2 tagged as #11931 |
| 10988 | Yanjun Sun | 9.4.2.157 | 201.43 | Extension of Transmit Power Envelope element for 320MHz and puncturing is missing. | Please add the extension for completeness. | Revised  Agree with the commenter in principle. Details on TPE for EHT has been added.  Tgbe editor please implement changes as shown in doc 11-22/1482r7 tagged as #10988 |
| 11011 | Yanjun Sun | 35.16.2 | 533.56 | Details are missing on how TPE are indicated if an EHT includes the Disabled Subchannel Bitmap subfield in management frames | Please add the missing details | Revised  Agree with the commenter in principle. Details on TPE for EHT has been added.  Tgbe editor please implement changes as shown in doc 11-22/1482r7 tagged as #10988 |
| 13562 | Jian Yu | 35.16.2 | 533.64 | The supported puncturing pattern is too restricted. If there are multiple static holes or interferences, then it is difficult to do sounding for OFDMA transmission. | Enable more patterns, e.g., the one supported in OFDMA | Rejected  First, in D2.2, there is not support for sounding NDP with multiple static holes based on the following text: “In the EHT sounding NDP, the 242-tone RUs overlapping the 20 MHz channels that are signaled as punctured through the Punctured Channel Indication field of the U-SIG field are punctured. The allowed punctured patterns are given in Table 36-30 (Definition of the Punctured Channel Information field in the U-SIG for an EHT MU PPDU using non-OFDMA transmissions).”  Second, there was related discussion in 21/1778r2 but the TG couldn’t reach consensus. |
| 12693 | Arik Klein | 35.16.2 | 532.62 | It is not clear why “..the Disabled Subchannel Bitmap field of the EHT Operation element shall be one of the non-OFDMA puncturing patterns defined in Table 36-30” as a mandatory requirement? For instance, the common use case of having more than a single punctured RU in each 80 MHz segment (especially if BW equals or above 160) can’t be described in the Disabled Channel bitmap which directly reduces the actual BW to be used for the entire EHT sounding sequence (i.e. the NDPA frame, sounding NDP and the corresponding BFRP) | Add the OFDMA puncturing pattern to be supported in the Disabled Channel Bitmap as a minimum, in order to support the use cases of more than a single punctured RU-242 (especially in 5GHz bands and 6 GHz bands) | Rejected  First, in D2.2, there is not support for sounding with multiple static holes based on the following text: “In the EHT sounding NDP, the 242-tone RUs overlapping the 20 MHz channels that are signaled as punctured through the Punctured Channel Indication field of the U-SIG field are punctured. The allowed punctured patterns are given in Table 36-30 (Definition of the Punctured Channel Information field in the U-SIG for an EHT MU PPDU using non-OFDMA transmissions).”  Second, there was related discussion in 21/1778r2 but the TG couldn’t reach consensus. |

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: Please update the 2nd last sentence 1st paragraph of 35.15.2 (P573L22 in D2.2) as follows (track change enabled):***

**35.15.2 Preamble puncturing operation**

… …

The puncturing pattern indicated in the Disabled Subchannel Bitmap field of the EHT Operation element shall be one of the non-OFDMA puncturing patterns defined in Table 36-30 (Definition of the Punctured Channel Information field in the U-SIG for an EHT MU PPDU using non-OFDMA transmissions) whose corresponding PPDU bandwidth value in the Table is equal to the operating channel width of the BSS. (#11930)

… …

***Discussion for CIDs 13450 and 11931:***

*We propose 3 changes to address the CIDs:*

* *Although the NOTE below prohibits dynamic puncturing for “SU” transmission implicitly, it was unclear. Based on suggestion in CID 13450, normative text has been added for clarity and simplicity, based on the new “EHT SU transmission” term approved in 22/1546/r3 (*(i.e., non-OFDMA EHT MU PPDU to a single user)*). Similarly, as an immediate acknowledge to a MU transmission without a triggering frame cannot learn dynamic puncturing pattern (e.g. DL MU PPDU (with implicit BAR to one STA)*🡪*BA), a similar rule has been added.*
* *The sentence starting with “in this case” wasn’t clear enough and has been revised for clarity.*
* *In addition, we added a NOTE to summarize the cases in which dynamic puncturing is disallowed based on rules in other subclauses so that readers can refer to all these puncturing rules in one place. They include MU-RTS and its solicited CTS, EHT sounding NDP and CF-End for which questions were often received. CF-End cannot have dynamic puncturing mainly due to the following behavior in the baseline spec: “After receiving a CF-End frame with a matching BSSID(TA) without comparing Individual/Group bit, an AP may respond by transmitting a CF-End frame after SIFS”.*

***Tgbe editor: Please update the 3rd paragraph and the following NOTE (P573L46 in D2.2) in 35.15.2 as follows (track change enabled):***

(#13450)An EHT SU transmission that contains an MPDU soliciting an immediate response shall not puncture 20 MHz subchannels which are not indicated to be punctured in the Disabled Subchannel Bitmap subfield in the EHT Operation element, unless the EHT SU transmission carries a triggering frame that solicits a TB PPDU from a responding EHT STA.

(#11931)An EHT MU PPDU that is not an EHT SU transmission and solicits an immediate response from a STA without including a triggering frame shall not puncture 20 MHz subchannels which are not indicated to be punctured in the Disabled Subchannel Bitmap subfield in the EHT Operation element.

(#11931)NOTE – For example, an EHT MU PPDU using DL OFDMA that sets the ACK policy to implicit BAR to one of the users without including a triggering frame cannot puncture 20 MHz subchannels which are not indicated to be punctured in the Disabled Subchannel Bitmap subfield in the EHT Operation element.

Otherwise, an EHT STA may puncture other subchannels in addition to those indicated in the Disabled Subchannel Bitmap subfield in the EHT Operation element in an EHT MU PPDU or a non-HT duplicate PPDU. If the EHT STA punctures other subchannels in an EHT MU PPDU or a non-HT duplicate PPDU in addition to those indicated in the Disabled Subchannel Bitmap subfield and solicits a response to the PPDU, the EHT STA shall use a triggering frame to solicit the response in a TB PPDU and assign an RU or MRU within the nonpunctured subchannel set to a responding EHT STA. (#11931)

(#13450)

(#11931)NOTE—No other subchannels can be punctured in addition to those indicated in the Disabled Subchannel Bitmap subfield (if present) in the EHT Operation element in the following cases:

* A PPDU carrying an MU-RTS Trigger frame or the solicited CTS frame (see 35.2.2.1 (MU-RTS Trigger frame transmission)).
* An EHT sounding NDP for non-TB sounding (see 35.7.2 (EHT sounding protocol)).
* A PPDU that carries a CF-End frame from a non-AP EHT STA, as it might be followed by another CF-End frame after SIFS (see 10.23.2.10 (Truncation of TXOP)).

… …

**NOTE: the following changes are copied from the text on TPE in** [**22/1208**](https://mentor.ieee.org/802.11/dcn/21/11-21-1208-13-00be-cc36-resolution-for-cids-for-35-3-4-2.docx) **in case you’ve reviewed it before.**

**Discussion on the problem and candidate solutions**

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 [22/1208](https://mentor.ieee.org/802.11/dcn/21/11-21-1208-13-00be-cc36-resolution-for-cids-for-35-3-4-2.docx)
* Option3: define a new EHT TPE and send it together with HE TPE in the same frame

**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 [22/1208](https://mentor.ieee.org/802.11/dcn/21/11-21-1208-13-00be-cc36-resolution-for-cids-for-35-3-4-2.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: 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).(#10988)

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(#10988) |
| * **Transmit Power Envelope element format(11ax)** | | | | |  |

Tgbe Editor: add 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**(#10988)

Tgbe Editor: add 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

(#10988)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: Add the following paragraphs at the end of 9.4.2.161 Transmit Power Envelope element

(#10988)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 and is defined in Figure 9-xx2 (Extension Maximum Transmit Power field format if the Maximum Transmit Power Interpretation subfield is 1 or 3) 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**(#10988)

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** (#10988)

The format of the 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).

(#10988)The Extension Maximum Transmit Power field is included only following conditions defined in 35.16.3 (EHT operation with the Transmit Power Envelope element).

TGbe Editor: Add the following subclause 35.15.3 EHT operation with the Transmit Power Envelope element

(#10988)**35.15.3 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 one of the following conditions 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.
* 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 the BSS operating channel width that it announces to non-EHT non-AP STAs (see 35.15.1 Basic EHT BSS operation) and 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 covered by Transmit Power Envelope element is greater than the number of 20 MHz subchannels contained within the HE BSS operating channel width.

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 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 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 BSS operating channel.

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.

TGbe Editor: Add 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.”

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

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.