IEEE P802.11
Wireless LANs

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| 11be PDT: Transmit spectral mask |
| Date: 2020-08-25 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Xiaogang Chen | Intel |  |  | Xiaogang.c.chen@Intel.com |
| WookBong Lee | Samsung |  |  |  |
| Lin Yang | Qualcomm |  |  |  |
| Bin Tian | Qualcomm |  |  |  |
| Youhan Kim | Qualcomm |  |  |  |
| Bo Sun | ZTE |  |  |  |

Abstract

This contribution proposes the draft text on transmit spectral mask for TGbe D0.1.

R0: main changes comparing with 11ax include:

* Add place holders for 320MHz PPDU mask, puncture mask.
* Removed the 1st paragraph.
* Highlighted are the main changes comparing with 11ax.

R1: updated based on comments from TTT members.

R2: updated the reference to preamble puncturing subclause.

R3: incorporate the puncture mask and 320MHz mask for EHT and Non-HT dup PPDU format.

R4: add instructions to the TGbe editor.

To TGbe Editor: please incorporate all the contents after the R3 update in page 4.

35.3.17.1 Transmit spectral mask

The bandwidth of the spectral mask applied to an EHT MU PPDU and EHT TB PPDU shall be determined by the bandwidth indicated in the Bandwidth subfield of the U-SIG field.

NOTE 1—In the presence of additional regulatory restrictions, the device has to meet both the regulatory requirements and the mask defined in this subclause.

NOTE 2—Transmit spectral mask figures in this subclause are not drawn to scale.

NOTE 3—For rules regarding transmit center frequency leakage levels, see 34.3.17.x (Transmit center frequency leakage). The spectral mask requirements in this subclause do not apply to the RF LO.

For a 20 MHz mask PPDU of EHT format, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 19.5 MHz, –20 dBr at 10.5 MHz frequency offset, –28 dBr at 20 MHz frequency offset, and –40 dBr at 30 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets between 9.75 and 10.5 MHz, 10.5 and 20 MHz, and 20 and 30 MHz shall be linearly interpolated in dB domain from the requirements for 9.75 MHz, 10.5 MHz, 20 MHz, and 30 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and –53 dBm/MHz at any frequency offset. Figure 35-x1 (Example transmit spectral mask for a 20 MHz mask PPDU) shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –53 dBm/MHz.

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| Figure 35-x1 Example transmit spectral mask for a 20 MHz mask EHT PPDU |

For a 40 MHz mask PPDU of EHT format, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 39 MHz, –20 dBr at 20.5 MHz frequency offset, –28 dBr at 40 MHz frequency offset, and –40 dBr at 60 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 19.5 and 20.5 MHz, 20.5 and 40 MHz, and 40 and 60 MHz shall be linearly interpolated in dB domain from the requirements for 19.5 MHz, 20.5 MHz, 40 MHz, and 60 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and –56 dBm/MHz at any frequency offset greater than 19.5 MHz. Figure 35-x2 (Example transmit spectral mask for a 40 MHz mask PPDU) shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –56 dBm/MHz.

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| Figure 35-x2 Example transmit spectral mask for a 40 MHz mask EHT PPDU |

For an 80 MHz mask PPDU of EHT format, if the preamble puncturing is not applied, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 79 MHz, –20 dBr at 40.5 MHz frequency offset, –28 dBr at 80 MHz frequency offset, and –40 dBr at 120 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 39.5 and 40.5 MHz, 40.5 and 80 MHz, and 80 and 120 MHz shall be linearly interpolated in dB domain from the requirements for 39.5 MHz, 40.5 MHz, 80 MHz, and 120 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectrum mask and –59 dBm/MHz at any frequency offset. Figure 35-x3 (Example transmit spectral mask for an 80 MHz mask PPDU) shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –59 dBm/MHz.

For an 80 MHz mask PPDU of EHT format, if the preamble puncturing is applied, the spectral mask is subject to the interim mask defined in Figure 35-x3 and the additional restrictions defined for preamble puncturing in clause 35.3.17.1.

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| Figure 35-x3 Example transmit spectral mask for an 80 MHz mask EHT PPDU |

For a 160 MHz mask PPDU of EHT format, if the preamble puncturing is not applied, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 159 MHz, –20 dBr at 80.5 MHz frequency offset, –28 dBr at 160 MHz frequency offset, and –40 dBr at 240 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 79.5 and 80.5 MHz, 80.5 and 160 MHz, and 160 and 240 MHz shall be linearly interpolated in dB domain from the requirements for 79.5 MHz, 80.5 MHz, 160 MHz, and 240 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectrum mask and –59 dBm/MHz at any frequency offset. Figure 35-x4 (Example transmit spectral mask for a 160 MHz mask PPDU) shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –59 dBm/MHz.

For a 160 MHz mask PPDU of EHT format, if the preamble puncturing is applied, the spectral mask is subject to the interim mask defined in Figure 35-x4 and the additional restrictions defined for preamble puncturing in clause 35.3.17.1.1.

--------------------------------------------------R3 updates start here-----------------------------------------------------------------

For a 320 MHz mask PPDU of EHT format, if the preamble puncturing is not applied, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 319 MHz, –20 dBr at 160.5 MHz frequency offset, –28 dBr at 320 MHz frequency offset, and –40 dBr at 480 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 159.5 and 160.5 MHz, 160.5 and 320 MHz, and 320 and 480 MHz shall be linearly interpolated in dB domain from the requirements for 159.5 MHz, 160.5 MHz, 320 MHz, and 480 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectrum mask and –59 dBm/MHz at any frequency offset. Figure 35-x5 (Example transmit spectral mask for a 320 MHz mask PPDU) shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –59 dBm/MHz.

For a 320 MHz mask PPDU of EHT format, if the preamble puncturing is applied, the spectral mask is subject to the interim mask defined in Figure 35-x5 and the additional restrictions defined for preamble puncturing in clause 35.3.17.1.1.

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| Figure 35-x4 Example transmit spectral mask for a 160 MHz mask EHT PPDU |



Figure 35-x5 Example transmit spectral mask for a 320 MHz mask EHT PPDU

For 320 MHz Non-HT duplicate PPDU, if the preamble puncturing is not applied, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 318 MHz, –20 dBr at 161 MHz frequency offset, –28 dBr at 320 MHz frequency offset, and –40 dBr at 480 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 159 and 161 MHz, 161 and 320 MHz, and 320 and 480 MHz shall be linearly interpolated in dB domain from the requirements for 159 MHz, 161 MHz, 320 MHz, and 480 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectrum mask and –59 dBm/MHz at any frequency offset. Figure 35-x6 (Example transmit spectral mask for a 320 MHz Non-HT duplicate PPDU) shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –59 dBm/MHz.



Figure 35-x6 Example transmit spectral mask for a 320 MHz Non-HT Duplicate PPDU.

For 320 MHz Non-HT duplicate PPDU, if the preamble puncturing is applied, the spectral mask is subject to the interim mask defined in Figure 35-x6 and the additional restrictions defined for preamble puncturing in clause 35.3.17.1.2.

Measurements shall be made using a 100 kHz resolution bandwidth and a 7.5 kHz video bandwidth.

**35.3.17.1.1 Additional restrictions of preamble puncturing for EHT PPDU**

For preamble puncture, the signal leakage from the occupied subchannels to the punctured subchannels shall follow the restrictions as described below:

**Case 1):** When the lowest and/or the highest subchannel(s) is/are punctured in a PPDU, the subchannel edge mask as in figure Figure 35-P1 shall be applied at the lower edge of the lowest occupied subchannel and at the higher edge of the highest occupied subchannel. *M* is the separation in MHz between the lower edge of the lowest occupied subchannel and the higher edge of the highest occupied subchannel in the PPDU.



Figure 35-P1. Preamble puncture mask for preamble puncturing at the edge of the EHT PPDU.

In this case, the overall spectral mask is constructed in the following manner. First, the interim spectral mask (without preamble puncture) is applied according to the PPDU bandwidth. Second, the preamble puncture mask in Figure 35-P1 is applied on the lower edge and higher edge of the occupied subchannel(s). Then for each frequency where the interim spectral mask (without preamble puncture) has a value of 0dBr but the preamble puncture mask does not has a value (in the subchannels where preamble puncture is not applied), 0dBr shall be taken as the overall interim spectral mask value. For the other frequency where both the interim spectral mask (without preamble puncture) and the preamble puncture mask have values greater than or equal to -40dBr, the lower value shall be taken as the overall interim spectral mask value.

Figure 35-PE1 is an example for the construction of the overall interim spectral mask for 80MHz EHT PPDU with the lowest 20MHz subchannel punctured.



Figure 35-PE1. Example for the construction of the overall interim spectral mask for 80MHz EHT PPDU with the lowest 20MHz subchannel punctured.

**Case 2):** When there are two or more contiguous 20MHz subchannels are punctured in a PPDU, the subchannel edge mask as in figure 35-P2 shall be applied at the lower edge of the lowest punctured subchannel(s) and at the higher edge of the highest punctured subchannel(s). *M* is the contiguous occupied bandwidth in MHz adjacent to the punctured subchannel(s). Depends on the contiguous occupied bandwidth adjacent to the lower edge of the punctured subchannel(s) and the contiguous occupied bandwidth adjacent to the higher edge of the punctured subchannel(s), the mask applied at the lower edge and the mask applied at the higher edge of the punctured subchannel can have different value of *M*.



Figure 35-P2. Preamble puncture mask for preamble puncturing in the middle of the EHT PPDU when the bandwidth of the punctured subchannel is equal to or greater than 40MHz.

In this case, the overall spectral mask is constructed in the following manner. First, the interim spectral mask (without preamble puncture) is applied according to the PPDU bandwidth. Second, the preamble puncture mask in Figure 35-P2 is applied on both the lower edge and higher edge of the punctured subchannel(s). Note that for each frequency at which both the lower edge puncture mask and higher edge puncture mask have value greater than -25dBr and less than -20dBr, the larger value of the two masks shall be taken as the preamble puncture mask. Then for each frequency where the interim spectral mask (without preamble puncture) has a value but the preamble puncture mask does not have a value (in the subchannels where preamble puncture is not applied), the value of the interim spectral mask (without preamble puncture) shall be taken as the overall interim spectral mask value. For the other frequency where both the interim spectral mask (without preamble puncture) and the preamble puncture mask have values greater than or equal to -25dBr, the lower value shall be taken as the overall interim spectral mask value.

Figure 35-PE2 is an example for the construction of the overall interim spectral mask for 160MHz EHT PPDU with the 2nd lowest 40MHz subchannel punctured.



Figure 35-PE2. Example for the construction of the overall interim spectral mask for 160MHz EHT PPDU with the 2nd lowest 40MHz subchannel punctured.

**Case 3):** When the punctured subchannel is equal to 20MHz and the punctured 20MHz subchannel is not at the edge of the PPDU, the mask in Figure 35-P3 shall be applied at the punctured 20MHz subchannel.



Figure 35-P3. Preamble puncture mask for preamble puncturing in the middle of the EHT PPDU when the bandwidth of the punctured subchannel is equal to 20MHz.

In this case, the overall spectral mask is constructed in the following manner. First, the interim spectral mask (without preamble puncture) is applied according to the PPDU bandwidth. Second, the preamble puncture mask in Figure 35-P3 is applied on the punctured 20MHz subchannel. Then for each frequency where the interim spectral mask (without preamble puncture) has a value but the preamble puncture mask does not have a value (in the subchannels where preamble puncture is not applied), the value of the interim spectral mask (without preamble puncture) shall be taken as the overall interim spectral mask value. For the other frequency where both the interim spectral mask (without preamble puncture) and the preamble puncture mask have values greater than or equal to -23dBr, the lower value shall be taken as the overall interim spectral mask value.

Figure 35-PE3 is an example for the construction of the overall interim spectral mask for 80MHz EHT PPDU with the 2nd lowest 20MHz subchannel punctured.



Figure 35-PE3. Example for the construction of the overall interim spectral mask for 80MHz EHT PPDU with the 2nd lowest 20MHz subchannel punctured.

**35.3.17.1.2 Additional restrictions of preamble puncturing for Non-HT Duplicate PPDU**

If preamble puncturing is applied to a Non-HT duplicate PPDU, the signal leakage from the occupied subchannels to the punctured subchannels shall also follow the restrictions in clause 35.3.17.1.1 except the transition frequency width from 0dBr to -20dBr is 1MHz instead of 0.5MHz. For the three cases defined in clause 35.3.17.1.1, the preamble puncturing mask for Non-HT duplicated PPDU are shown in Figure 35-NonHT-1, Figure 35-NonHT-2 and Figure 35-NonHT-3 respectively.



Figure 35- NonHT-1. Preamble puncture mask for preamble puncturing at the edge of the Non-HT duplicate PPDU.



Figure 35- NonHT-2. Preamble puncture mask for preamble puncturing in the middle of the Non-HT duplicate PPDU when the bandwidth of the punctured subchannel is equal to or greater than 40MHz.



Figure 35- NonHT-3. Preamble puncture mask for preamble puncturing in the middle of the Non-HT duplicate PPDU when the bandwidth of the punctured subchannel is equal to 20MHz.

The rules of constructing the overall spectral mask for preamble punctured Non-HT duplicate PPDU is the same as the rules defined in clause 35.3.17.1.1 which are used to construct the overall spectral mask for preamble punctured EHT PPDU. Figure 35-PE1-NonHT is an example for the construction of the overall interim spectral mask for 320MHz Non-HT duplicate PPDU with the lowest 40MHz subchannel punctured.

Note: For Non-HT duplicate 80MHz and 160MHz PPDU, the mask defined in clause 21.3.17.1 (Transmit spectrum mask) shall be used as the interim spectral mask (without preamble puncture) to construct the overall preamble puncturing mask.



Figure 35-PE1-NonHT. Example for the construction of the overall interim spectral mask for 320MHz Non-HT duplicated transmission with the lowest 40MHz subchannel punctured.