IEEE P802.11  
Wireless LANs

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| CRs on 28.3.18 Transmit specification | | | | |
| Date: 2017-05-03 | | | | |
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Abstract

This submission shows

* Resolution for a comment received from TGax comment collection (TGax Draft D1.0)
* The proposed changes are based on 11ax D1.2.

The submission provides resolutions to comment related to TX specification.

* The submission provides solutions to 23 CIDs:   
  7231, 9037, 7835, 9038, 3314, 3392, 3659, 3746, 4127, 4230,

7836, 9039, 3560, 3724, 4122, 4256, 9079, 4877, 4878, 8572,

10069, 10070, 4879

Revisions:

* Rev 0: Initial version of the document.

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 TGax Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGax Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGax Editor: Editing instructions preceded by “TGax Editor” are instructions to the TGax editor to modify existing material in the TGax draft. As a result of adopting the changes, the TGax editor will execute the instructions rather than copy them to the TGax Draft.***

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| **CID** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 7231 | 350.01 | In subclause 28.3.14.2 (Power pre-correction), sentence reads "An AP indicates in the AP Tx Power subfield of the Common Info field in Trigger frame the combined transmit power of all the transmit antennas used to transmit the Trigger frame normalized to 20 MHz bandwidth." There should be accuracy requirements for the "the combined transmit power of all the transmit antennas". However, I could not find it. | Add a suclause under 28.3.18 describing transmit power accuracy requirement for AP. | Reject.  Considering the HE trigger-based PPDUs as a new feature that are transmitted from different STAs to AP side, inaccuracy of the each transmit power of STAs can result in severe interference in UL MU transmission. The requirements for power pre-correction is added to existed requirements in previous specs.  For the opposite direction that STA receiving the Trigger frame from the single AP, existed requirements are enough. |
| 9037 | 350.06 | "The bandwidth of the spectral mask applied to an HE PPDU shall be determined by the bandwidth indicated in the Bandwidth subfield of the HE-SIG-A field.". This is different from e.g. VHT, where a 20 MHz PPDU could be sent with an 80 MHz mask (see e.g. defintion of 80 MHz mask PPDU). Why the change? | If no compelling reason for changing relative to VHT, delete first sentence of 28.3.18.1 | Revised.  Improvements need to be made to support dense deployment scenarios such as dense residential apartments, and stadiums, etc. If we follow the 11ac rule, 80MHs spectral mask can be allowed for 20MHz PPDU. Even though it makes the implementation simple, it can also cause interference to adjacent 20MHz sub-channels. Given busy medium with those interference, the AP and STAs in OBSSs may lose the chance to occupy those 20MHz sub-channels.  Given those rationales, the bandwidth limitation to spectral mask is agreed by 15/1311 and 16/1191.  The name of Bandwidth is not correct. “Bandwidth subfield” needs to be replaced with “Bandwidth field”  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |
| 7835 | 350.17 | Is this "non-requirement" stated somewhere? | Add to the NOTE a reference to where this is stated normatively. | Rejected.  The sub-clause 28.3.18.1 (Transmit spectral mask) is the non-requirement for the RF LO. Requirement for RF LO is described in 28.3.18.4.2 (Transmit center frequency leakage).  NOTE 3 is enough to understand the text as it has been for previous specification like 11ac. |
| 9038 | 353.55 | Update definition of 80 MHz mask PPDU (definition section) to cover the case of preamble puncturing. | See comment | Revised.  Agreed in principle. “channel puncturing” is replaced with “preamble puncturing" that is the official terminology.    TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |

**Discussion**

The modifications improve the wording.

**Changes to Section 28.3.18.1 Transmit spectral mask**

***To TGax editor:*** ***P381L08*** *replace the current text with the proposed changes below.*

***------------- Begin Text Changes --------------------------------------------------***

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.

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| --- |
| (Figure omitted) |
| * Example transmit spectral mask for an 80 MHz mask PPDU |

For an 160 MHz mask PPDU of HE format, 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. Example transmit spectral mask for an 160 MHz mask PPDU shows an example of the resulting overall spectral mask when the -40 dBr spectrum level is above -59 dBm/MHz.

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| (Figure omitted) |
| * Example transmit spectral mask for an 160 MHz mask PPDU |

***------------- End Text Changes ---------------------------------------------------***

***To TGax editor:*** ***P382L41*** *replace the current text with the proposed changes below.*

***------------- Begin Text Changes --------------------------------------------------***

Example transmit spectral mask for an 80+80 MHz mask PPDU shows an example of a transmit spectral mask for a noncontiguous transmission using two 80 MHz channels where the center frequency of the two 80 MHz channels are separated by 160 MHz and the -40 dBr spectrum level is above -59 dBm/MHz.

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| (figure omitted) |
| * Example transmit spectral mask for an 80+80 MHz mask PPDU |

Different center frequency separation between the two 80 MHz frequency segments of the spectral mask as well as different peak levels of each 80 MHz frequency segment of the spectral mask are possible, in which case a similar procedure in determining the spectral mask as in Example transmit spectral mask for an 80+80 MHz mask PPDU is followed.

***------------- End Text Changes ---------------------------------------------------***

***To TGax editor:*** ***P383L55*** *replace the current text with the proposed changes below.*

***------------- Begin Text Changes --------------------------------------------------***

When preamble puncturing happens in an HE MU PPDU, the HE MU PPDU is still treated as an 80 MHz PPDU if the Bandwidth field on HE-SIG-A field of the HE MU PPDU is set to 4 or 5 or an 160 MHz or 80+80 MHz PPDU if the Bandwidth field on HE-SIG-A field of the HE MU PPDU is set to 6 or 7, therefore the spectral mask is the same as those defined for the total channel width.(#9038)

***------------- End Text Changes ---------------------------------------------------***

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| **CID** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 3314 | 353.62 | Spectral flatness procedure needs more clarity | Delete the sentence: "Demodulate the HE PPDUs .........procedure:" and place with the following sentence. " The HE PPDUs shall be demodulated using the following (or equivalent) procedure:" | Accepted.  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |
| 3392 | 353.62 | Spectral flatness procedure needs more clarity | Delete the sentence: "Demodulate the HE PPDUs .........procedure:" and place with the following sentence. " The HE PPDUs shall be demodulated using the following (or equivalent) procedure:" | Accepted.  The same resolution as CID 3314 is applied  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |
| 3659 | 353.62 | Spectral flatness procedure needs more clarity | Delete the sentence: "Demodulate the HE PPDUs .........procedure:" and place with the following sentence. " The HE PPDUs shall be demodulated using the following (or equivalent) procedure:" | Accepted.  The same resolution as CID 3314 is applied  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |
| 3746 | 353.62 | Spectral flatness procedure needs more clarity | Delete the sentence: "Demodulate the HE PPDUs .........procedure:" and place with the following sentence. " The HE PPDUs shall be demodulated using the following (or equivalent) procedure:" | Accepted.  The same resolution as CID 3314 is applied  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |
| 4127 | 353.62 | Spectral flatness procedure needs more clarity | Delete the sentence: "Demodulate the HE PPDUs .........procedure:" and place with the following sentence. " The HE PPDUs shall be demodulated using the following (or equivalent) procedure:" | Accepted.  The same resolution as CID 3314 is applied  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |
| 4230 | 353.62 | Spectral flatness procedure needs more clarity | Delete the sentence: "Demodulate the HE PPDUs .........procedure:" and place with the following sentence. " The HE PPDUs shall be demodulated using the following (or equivalent) procedure:" | Accepted.  The same resolution as CID 3314 is applied  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |

**Discussion**

The modifications improve the wording.

**Changes to Section 28.3.18.2 Spectral flatness**

***To TGax editor:*** ***P383L62*** *replace the current text with the proposed changes below.*

***------------- Begin Text Changes --------------------------------------------------***

Spectral flatness measurements shall be conducted using BPSK modulated HE PPDUs. The HE PPDUs shall be demodulated using the following (or equivalent) procedure:(#3314)

***------------- End Text Changes ---------------------------------------------------***

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| **CID** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 7836 | 355.01 | Use proper normative verbs | Change "requirements apply" to "requirements shall apply". Same thing at P355L44. | Accepted.  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |

**Discussion**

The modifications improve the wording.

**Changes to Section 28.3.18.2 Spectral flatness**

***To TGax editor:*** ***P384L63*** *replace the current text with the proposed changes below.*

***------------- Begin Text Changes --------------------------------------------------***

The requirements shall apply to 20 MHz, 40 MHz, 80 MHz, and 160 MHz contiguous transmissions as well as 80+80 MHz transmissions. (#7836)

***------------- End Text Changes ---------------------------------------------------***

**Changes to Section 28.3.18.4.3 Transmitter constellation error**

***To TGax editor:*** ***P385L41*** *replace the current text with the proposed changes below.*

***------------- Begin Text Changes --------------------------------------------------***

The requirements shall apply to 20 MHz, 40 MHz, 80 MHz, and 160 MHz contiguous transmissions as well as 80+80 MHz noncontiguous transmissions. (#7836)

***------------- End Text Changes ---------------------------------------------------***

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| **CID** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 9039 | 355.25 | Change "all transmission modes" to "all transmission modes except 80+80 MHz where the RF LO falls outside both frequency segments" | See comment | Accepted.  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |

**Discussion**

The modifications improve the wording.

**Changes to Section 28.3.18.4.2 Transmit center frequency leakage**

***To TGax editor:*** ***P385L22*** *replace the current text with the proposed changes below.*

***------------- Begin Text Changes --------------------------------------------------***

The TX LO leakage requirement for all transmission modes except 80+80 MHz where the RF LO falls outside both frequency segments shall be the following. The power measured at the location of the RF LO using resolution BW 78.125 kHz shall not exceed the maximum of -32 dB relative to the total transmit power and -20 dBm, or equivalently max(P - 32, -20), where P is the transmit power per antenna in dBm. The transmit center frequency leakage is specified per antenna. (#9039)

For an 80+80 MHz transmission where the RF LO falls outside both frequency segments, the RF LO shallmeet the spectral mask requirements as defined in 28.3.18.1 (Transmit spectral mask).

***------------- End Text Changes ---------------------------------------------------***

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| **CID** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 3560 | 355.38 | The EVM for MCS7 (-27 dB) is based on the maximum tx power of MCS7. Clarification is needed why it is being used for BPSK...64-QAM as shown in Table 28-45. The EVM value was selected for UL OFDMA PPDUs. This should be noted or expanded in the text in clause 28.3.18.4.4 | Add the following underlined text (without the underline) in the "Note" on line 40 in Table 28-45 as follows: "which EVM is test is conducted. "EVM of -27 dB, is used when the Tx Power is less than the maximum power of MCS7, and assists the AP in managing RUs for UL OFDMA PPDU transmissions." | Revised.  Agreed in principle.  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |
| 3724 | 355.38 | The EVM for MCS7 (-27 dB) is based on the maximum tx power of MCS7. Clarification is needed why it is being used for BPSK...64-QAM as shown in Table 28-45. The EVM value was selected for UL OFDMA PPDUs. This should be noted or expanded in the text in clause 28.3.18.4.4 | Add the following underlined text (without the underline) in the "Note" on line 40 in Table 28-45 as follows: "which EVM is test is conducted. "EVM of -27 dB, is used when the Tx Power is less than the maximum power of MCS7, and assists the AP in managing RUs for UL OFDMA PPDU transmissions." | Revised.  Agreed in principle.  The same resolution as CID 3560 is applied  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |
| 4122 | 355.38 | The EVM for MCS7 (-27 dB) is based on the maximum tx power of MCS7. Clarification is needed why it is being used for BPSK...64-QAM as shown in Table 28-45. The EVM value was selected for UL OFDMA PPDUs. This should be noted or expanded in the text in clause 28.3.18.4.4 | Add the following underlined text (without the underline) in the "Note" on line 40 in Table 28-45 as follows: "which EVM is test is conducted. "EVM of -27 dB, is used when the Tx Power is less than the maximum power of MCS7, and assists the AP in managing RUs for UL OFDMA PPDU transmissions." | Revised.  Agreed in principle.  The same resolution as CID 3560 is applied  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |
| 4256 | 355.38 | The EVM for MCS7 (-27 dB) is based on the maximum tx power of MCS7. Clarification is needed why it is being used for BPSK...64-QAM as shown in Table 28-45. The EVM value was selected for UL OFDMA PPDUs. This should be noted or expanded in the text in clause 28.3.18.4.4 | Add the following underlined text (without the underline) in the "Note" on line 40 in Table 28-45 as follows: "which EVM is test is conducted. "EVM of -27 dB, is used when the Tx Power is less than the maximum power of MCS7, and assists the AP in managing RUs for UL OFDMA PPDU transmissions." | Revised.  Agreed in principle.  The same resolution as CID 3560 is applied  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |
| 4877 | 356.08 | Change "Relative constellation error in an HE trigger-based PPDU (dB)" to " Relative constellation error in an HE trigger-based PPDU when transmit power is larger than the maximum power of MCS7 (dB) | as in comment | Accepted.  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |
| 9079 | 355.48 | The potential LO leakage tones for 20 MHz operating devices are the center of primary 20 MHz of the HE PPDU tone plan and +/-3 tones. The potential LO leakage tones for 40MHz operating devices are the center of the primary 40 MHz of the PPDU tone plan and +/-3 tones. For 80 MHz capable devices that transmits 20 MHz or 40 MHz PPDU, the potential LO leakage tone exist outside the PPDU bandwidth and should not affect the transmitter modulation accuracy test. | Explicitly specify the LO leakage tones for 20 in 40 and 80 in 80 | Revised.  More missing cases are added on top of commented cases.  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |

**Discussion**

The modifications improve the wording and description in Table 28-45.

**28.3.18.4.4 Transmitter modulation accuracy (EVM) test**

***To TGax editor:*** ***P386L42*** *replace the current text with the proposed changes below.*

***------------- Begin Text Changes --------------------------------------------------***

In this case, transmit modulation accuracy of each segment shall meet the required value in Table 28-45

(Allowed relative constellation error versus constellation size and coding rate) using only the occupied data subcarriers within the corresponding segment. For HE trigger-based PPDU transmission, two sets of EVM requirements are defined in Table 28-45 for different transmission power levels to assist AP in better managing the interference among multiple STAs responding to a Trigger frame.(# 3560)

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| * Allowed relative constellation error versus constellation size and coding rate | | | | | |
| Modulation | | Coding rate | Relative constellation error in an HE SU PPDU, HE extended rate SU PPDU and HE MU PPDU (dB) | Relative constellation error in an HE TB PPDU when transmit power is larger than the maximum power of MCS7 (dB) (#4877) | Relative constellation error in HE TB PPDU when transmit power is less than or equal to the maximum power of MCS7 (dB) |
| Without DCM | With DCM |
| N/A | BPSK | 1/2 | –5 | –13 | –27 |
| BPSK | QPSK | 1/2 | –5 | –13 | –27 |
| QPSK | 16-QAM | 1/2 | –10 | –13 | –27 |
| QPSK | 16-QAM | 3/4 | –13 | –13 | –27 |
| 16-QAM | N/A | 1/2 | –16 | –16 | –27 |
| 16-QAM | N/A | 3/4 | –19 | –19 | –27 |
| 64-QAM | N/A | 2/3 | –22 | –22 | –27 |
| 64-QAM | N/A | 3/4 | –25 | –25 | –27 |
| 64-QAM | N/A | 5/6 | –27 | –27 | –27 |
| 256-QAM | N/A | 3/4 | –30 | –30 | –30 |
| 256-QAM | N/A | 5/6 | –32 | –32 | –32 |
| 1024-QAM | N/A | 3/4 | –35 | –35 | –35 |
| 1024-QAM | N/A | 5/6 | –35 | –35 | –35 |
| NOTE—The maximum power of MCS7 can be measured by setting the Target RSSI subfield as defined in Table 9-25g (Target RSSI subfield encoding) in the Trigger frame to 127 for the same data-carrying subcarriers which EVM test is conducted. | | | | | |

LO leakage that can potentially show up in center frequency of the HE PPDU tone plan and its ±3 tone neighbors shall be excluded from the computation of the transmitter modulation accuracy test. The potential LO leakage tones for 20 MHz operating devices are the center of primary 20 MHz of the HE PPDU tone plan and ±3 tones. The potential LO leakage tones for 40MHz operating devices are the center of the primary 40 MHz of the PPDU tone plan and ±3 tones. The potential LO leakage tones for 80 MHz operating devices are the center of the primary 80 MHz of the PPDU tone plan and ±3 tones. The potential LO leakage tones for 160 MHz operating devices are the center of the 160 MHz of the PPDU tone plan and ±3 tones. The potential LO leakage tones for 80+80 MHz operating devices exist outside the PPDU bandwidth and should not affect the transmitter modulation accuracy test. For 40 MHz capable devices that transmits 20 MHz, the potential LO leakage tones exist outside the PPDU bandwidth and should not affect the transmitter modulation accuracy test. For 80 MHz capable devices that transmits 20 MHz or 40 MHz PPDU, the potential LO leakage tones exist outside the PPDU bandwidth and should not affect the transmitter modulation accuracy test. For 160 or 80+80 MHz capable devices that transmits 20 MHz or 40 MHz PPDU or 80MHz PPDU, the potential LO leakage tones exist outside the PPDU bandwidth and should not affect the transmitter modulation accuracy test.

***------------- End Text Changes ---------------------------------------------------***

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| **CID** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 4878 | 357.31 | Change to "the i\_s OFDMA symbol of frame i\_f" in both line 31 and 34 | as in comment | Accepted.  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |

**Discussion**

The modifications improve the wording.

**28.3.18.4.4 Transmitter modulation accuracy (EVM) test**

***To TGax editor:*** ***P387L36*** *replace the current text with the proposed changes below.*

***------------- Begin Text Changes --------------------------------------------------***

*I0*(*if*, *is*, *iss*, *isc*) *Q0*(*if*, *is*, *iss*, *isc*) denotes the ideal symbol point in the complex plane in *isc*-th data tone of the RU under test, spatial stream *iss*, and the *is* OFDM symbol of frame *if*.(#4878)

*Ie*(*if*, *is*, *iss*, *isc*) *Qe*(*if*, *is*, *iss*, *isc*) denotes the equalized observed symbol point in the complex plane of the *isc*-th data tone of the RU under test, spatial stream *iss*, and the *is* OFDM symbol of frame *if*. (#4878)

*P0* is the average power of constellation

*Nf* is the number of tested frames

*NST* is the number of data tones of the occupied RU

*NSS* is the number of spatial streams of the data

*NSYM* is the number of data OFDM symbols

***------------- End Text Changes ---------------------------------------------------***

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| **CID** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 8572 | 359.00 | Text describing EVM computation is inconsistent with motioned document 1427r2 - parts should either be modified or removed | Make the following changes:  a. On line 2, change "step e)" to "step f)" b. Step h (lines 20-25) should be deleted from D1.0 | Accepted.  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |
| 10069 | 359.02 | contentwise, e) is a wrong reference. The average unoccupied subcarrier error vector magnitude for each unoccupied 26-tone RU is calculated with step f) not step e). | As in the comment. | Accepted.  The same resolution as CID 8572 is applied  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |
| 10070 | 359.19 | step h) is not present as approved texts in 16/1427. Since mask-like EVM is decided to use with step g), step h) is not necessary. | remove step h) and Equation (28-127) | Accepted.  The same resolution as CID 8572 is applied  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |
| 4879 | 359.20 | Remove the step h). The limit of unused tone EVE already defined in the step g). | as in comment | Accepted.  The same resolution as CID 8572 is applied  TGax Editor: make changes according to this document 11-17-0290-03-00ax CRs on TX specification. |

**Discussion**

The modifications improve the wording.

**28.3.18.4.4 Transmitter modulation accuracy (EVM) test**

***To TGax editor:*** ***P389L13*** *replace the current text with the proposed changes below.*

***------------- Begin Text Changes --------------------------------------------------***

the average unoccupied subcarrier error vector magnitude for each unoccupied 26-tone RU as calculated in step f) shall meet the staircase mask requirement in Equation (28-123). (#8572)

(28-123)



where

*m* defines the gap in the units of 26-tone RU to the occupied RU from either side and is a positive integer with *m*= 1 being the adjacent 26-tone RU.

*UsedToneErrorRMS* is the relative constellation error for the HE trigger based PPDU defined in Allowed relative constellation error versus constellation size and coding rate

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***------------- End Text Changes ---------------------------------------------------***