IEEE P802.11
Wireless LANs

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| 11ax Comment Resolutions for Clause 28.3.10.10 |
| Date: 2017-05-05 |
| Author(s): |
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Abstract: This document contains proposed resolutions for comments in *Clause 28.3.10.10* from 11ax D1.2 with the CIDs below.

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| ***Clause 28.3.10.10**** 7860,5107,8975,5108,8976,4892,6119,9489,8978,8979,8982,8983,8984,
* 4893,8577,8573,9065,9189,9190,9485,9486,5274,8986,9067,8989,8990,9752
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| 7860 | Mark RISON | 28.3.10.10 | 301.18 | Does the frequency portion corresponding to RUs not allocated to any user carry HE-LTF symbol? | Clarify | **Revised.**Change to as in the resolution of CID7860 in doc IEEE802.11-17/0720r0. |

**Discussions:**

Symbols in HE fields are only modulated on subcarriers within allocated RUs. HE-LTF symbols are not transmitted on subcarriers within RUs which are not allocated to any user.

ax editor: please make the following change in D1.2 *Clause 28.3.10*.*10*

* On P340L11 (CID #7860): Add the following sentences

For an OFDMA transmission, the values of HE-LTF sequence (defined in Equation (28-35) to Equation (28-50)) are set to zero if they are assigned to subcarriers within RUs that are not allocated to any user (see 28.3.9 (Mathematical description of signals)).

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| 5107 | Dong Guk Lim | 28.3.10.10 | 301.37 | Table 28-12 (Frequently used parameters) does not provide any function related with NHE-LTF, so the function of number of HE-LTF symbol would need to be clarified by considering the total number of space time stream. | Provide the function of relation between number of LTF symbol and total number of space time stream like as table 21-13 in 802.11-2016. | **Revised.**Change to as in the resolution of CID5107 in doc IEEE802.11-17/0720r0. |

ax editor: please make the following change in D1.2 *Clause 28.3.10*.*10*

* On P330L32 (CID #5107):

In an HE SU PPDU, HE ER SU PPDU and HE MU PPDU with a single RU (the RU having an MU-MIMO allocation or an SU allocation), the number of HE-LTF symbols, NHE-LTF, is a function of the total number of space-time streams NSTS as shown in Table21-13 (Number of VHT-LTFs required for different numbers of space-time streams) in 21.3.8.3.5 VHT-LTF definition.

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| 8975 | Sigurd Schelstraete | 28.3.10.10 | 301.40 | Delete "with more than one RU" | See comment | **Rejected.**Before this statement, there is description of how to calculate the number of HE-LTF symbols, N\_HE-LTF, for HE MU PPDU with a single RU. This statement is about how to calculate the number of HE-LTF symbols, N\_HE-LTF for HE MU PPDU with more than one RUs. The commenter needs to give more details on why he wants to delete “with more than one RU”. |

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| 5108 | Dong Guk Lim | 28.3.10.10 | 301.43 | Table 28-12 (Frequently used parameters) does not provide any function related with NHE-LTF, so the function of number of HE-LTF symbol would need to be clarified by considering the total number of space time stream. | Provide the function of relation between number of LTF symbol and total number of space time stream like as table 21-13 in 802.11-2016. | **Revised.**Change to as in the resolution of CID5108 in doc IEEE802.11-17/0720r0. |

ax editor: please make the following change in D1.2 *Clause 28.3.10*.*10*

* On P330L36 (CID #5108):

In an HE MU PPDU with more than one RU and in an HE TB PPDU, NHE-LTF may take any value among one, two, four, six or eight, which is greater than or equal to the maximum value of the initial number of HE-LTF symbols for each RU r, which is calculated as a function of NSTS,r,total, separately based on 21-13 (Number of VHT-LTFs required for different numbers of space-time streams) in 21.3.8.3.5 VHT-LTF definition.

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| CID | Commenter | Section | Page | Comment | Proposed Change | Resolution |
| 4892 | Bin Tian | 28.3.10.10 | 302.4 | 1x LTF and 1.6us CI support for UL MU-MIMIO (trigger-based PPDU) is listed as optional, which should be conditional mandatory. | Move the line 4 P302 to Line 62 P301. | **Revised.**Change to as in the resolution of CID4892 in doc IEEE802.11-17/0720r0. |
| 6119 | Jian Yu | 28.3.10.10 | 301.64 | Add 4X HE-LTF and 0.8us GI as an optional mode | As in comment | **Revised.**Change to as in the resolution of CID4892 in doc IEEE802.11-17/0720r0. |
| 9489 | Yan Zhang | 28.3.10.10 | 302.5 | HELTF4x,TGI1,Data is missing from "The optional combinations of HE-LTF mode and GI duration" | Add a new bullet 4xLTF, TGI1,Data for HE SU PPDU or HE SU extended PPDU or HE MU PPDU | **Revised.**Change to as in the resolution of CID4892 in doc IEEE802.11-17/0720r0. |
| 8976 | Sigurd Schelstraete | 28.3.10.10 | 301.48 | Change "transmission of 1x HE-LTF" to "1x HE-LTF mode" for consistentcy with previous sentence | See comment | **Revised.**Change to as in the resolution of CID8976 in doc IEEE802.11-17/0720r0. |

**Discussions:**

The commentor is right that “an HE STA shall support 1.6 μs GI duration on both HE-LTF and data symbols when the HE-LTF is 1x (transmit and receive) for full bandwidth UL MU-MIMO if the STA supports UL MU-MIMO”. Hence, “1x HE-LTF, TGI1,Data in a non-OFDMA, MU-MIMO HE trigger-based PPDU” is a mandatory combination. The commentors are right that “HELTF4x,TGI1,Data” is an optional combination.

Throughout the spec, 2x HE-LTF and 4x HE-LTF and most of 1x HE-LTF are used without being followed by “mode”. To keep the text consistent, it is better to delete “mode” after 1x HE-LTF. It is not correct to use “transmission of 1x HE-LTF” since it will be reception of 1x HE-LTF for an AP declaring support for Full Bandwidth UL MU-MIMO. It is also not correct to use “UL MU-MIMO PPDU” since UL MU-MIMO is not a type of PPDU format.

ax editor: please make the following changes in D1.2 *Clause 28.3.10.10*:

* On P330L44 (CID #4892, CID #6119, CID#9489, CID#8976):

An HE PPDU supports 3 HE-LTF modes, which are 1x HE-LTF, 2x HE-LTF and 4x HE-LTF. It is optional to support the 1x HE-LTF in an HE SU PPDU and HE extended range SU PPDU. It is mandatory to support 1x HE-LTF for full bandwidth UL MU-MIMO, for a STA declaring support for UL MU-MIMO. The 1x HE-LTF is disallowed in an HE MU PPDU, and in an HE trigger-based PPDU with more than one RU allocations. In an HE SU PPDU, HE MU PPDU and HE extended range SU PPDU, the combination of HE-LTF modes and GI duration is indicated in HE-SIG-A field. In an HE trigger-based PPDU, the combination of HE-LTF modes and GI duration is indicated in the Trigger frame that triggers the transmission of the PPDU. The mandatory combinations of HE-LTF modes and GI duration are:

— 2x HE-LTF, TGI1,Data

— 2x HE-LTF, TGI2,Data

— 4x HE-LTF, TGI4,Data

— 1x HE-LTF, TGI2,Data in a non-OFDMA, MU-MIMO HE TB PPDU

The optional combinations of HE-LTF mode and GI duration are:

— 1x HE-LTF, TGI1,Data in an HE SU PPDU or HE ER SU PPDU

— 4x HE-LTF, TGI1,Data in an HE SU PPDU, HE ER SU PPDU or HE MU PPDU

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| 8978 | Sigurd Schelstraete | 28.3.10.10 | 302.8 | "HE-LTF symbol duration". Previosuly, the term HE-LTF mode was used. Use one term consistently. | See comment | **Revised.**Change to as in the resolution of CID8978 in doc IEEE802.11-17/0720r0. |

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| 8979 | Sigurd Schelstraete | 28.3.10.10 | 302.22 | Delete "transmitted and located" | See comment. Similar change on page 302.39, page 303.1, page 303.21, page 304.1, page 304.30, page 305.1, page 306.1, page 307.1, | **Revised.**Change to as in the resolution of CID8979 in doc IEEE802.11-17/0720r0. |

ax editor: please make the following changes in D1.2 *Clause 28.3.10.10*:

* On P331L1~4 (CID #8978), make the following changes:

The duration of each HE-LTF symbol excluding GI is *T*HE-LTF is defined in Equation (28-34). In an HE SU PPDU, HE MU PPDU or HE ER SU PPDU, the combination of HE-LTF mode and GI duration is indicated in HE-SIG-A field. In an HE TB PPDU, the combination of HE-LTF mode and GI duration is indicated in the Trigger frame that triggers the transmis-sion of the PPDU.

* On P331L16 (CID #8979):

In a 20 MHz transmission, the 1x HE-LTF sequence transmitted on subcarriers [-122:122] is given by Equation (28-35).

* On P331L32(CID #8979):

In a 20 MHz transmission, the 2x HE-LTF sequence transmitted on subcarriers [-122:122] is given by Equation (28-36).

* On P332L1 (CID #8979):

In a 20 MHz transmission, the 4x HE-LTF sequence transmitted on subcarriers [-122:122] is given by Equation (28-37).

* On P332L21 (CID #8979):

In a 40 MHz transmission, the 1x HE-LTF sequence transmitted on subcarriers [-244:244] is given by Equation (28-38).

* On P333L1 (CID #8979):

In a 40 MHz transmission, the 2x HE-LTF sequence transmitted on subcarriers [-244:244] is given by Equation (28-39).

* On P333L30 (CID #8979):

In a 40 MHz transmission, the 4x HE-LTF sequence transmitted on subcarriers [-244:244] is given by Equation (28-40).

* On P334L1 (CID #8979):

In an 80 MHz transmission, the 1x HE-LTF sequence transmitted on subcarriers [-500:500] is given by Equation (28-41).

* On P335L1 (CID #8979):

In an 80 MHz transmission, the 2x HE-LTF sequence transmitted on subcarriers [-500:500] is given by Equation (28-42).

* On P336L1 (CID #8979):

In an 80 MHz transmission, the 4x HE-LTF sequence transmitted on subcarriers [-500:500] is given by Equation (28-43).

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| 8982 | Sigurd Schelstraete | 28.3.10.10 | 310.60 | Change "For an 80+80 MHz transmission" to "For an 80+80 MHz transmission using 1x HE-LTF" | See comment. | **Revised.**Change to as in the resolution of CID8982 in doc IEEE802.11-17/0720r0. |
| 8983 | Sigurd Schelstraete | 28.3.10.10 | 311.1 | Change "For an 80+80 MHz transmission" to "For an 80+80 MHz transmission using 2x HE-LTF" | See comment. | **Revised.**Change to as in the resolution of CID8983 in doc IEEE802.11-17/0720r0. |
| 8984 | Sigurd Schelstraete | 28.3.10.10 | 311.6 | Change "For an 80+80 MHz transmission" to "For an 80+80 MHz transmission using 4x HE-LTF" | See comment. | **Revised.**Change to as in the resolution of CID8984 in doc IEEE802.11-17/0720r0. |

ax editor: please make the following changes in D1.2 *Clause 28.3.10.10*:

* On P39L62 (CID #8982):

For an 80+80MHz transmission using 1x HE-LTF, …..

* On P340L1 (CID #8983):

For an 80+80MHz transmission using 2x HE-LTF, ….

* On P340L7 (CID #8984):

For an 80+80MHz transmission using 4x HE-LTF,….

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| CID | Commenter | Section | Page | Comment | Proposed Change | Resolution |
| 4893 | Bin Tian | 28.3.10.10 | 311.11 | Change "In an UL MU-MIMO transmission not using single stream pilots" to "In a full bandwidth UL MU-MIMO transmission not using 1x LTF or not using signal stream pilots in in HE-LTF" | As in comment | **Revised.**Change to as in the resolution of CID4893 in doc IEEE802.11-17/0720r0. |

**Discussions:**

The commentor is right that masking should not be applied to 1x HELTF in a non-OFDMA UL MU-MIMO transmission although multiple stream pilots are used.

ax editor: please make the following changes in D1.2 *Clause 28.3.10.10*:

* On P340L13 (CID #4893):

In an UL MU-MIMO transmission using neither single stream pilots in HE-LTF nor 1x HE-LTF, the HE-LTF sequence per frequency segment is generated by maskingthe non-zero elements in the common HE-LTF sequence repeatedly with a distinct orthogonal code as defined by Equation (28-51).

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| CID | Commenter | Section | Page | Comment | Proposed Change | Resolution |
| 8573 | Rui Cao | 28.3.10.10 | 311.20 | "HELTFk is the k-th element of the common HE-LTF sequence generated by ... ", the usage of "k-th" is vague, which can mean k starts from 1 at the left most of the HELTF sequence. Need to clarity the wording. | Change it to "HELTFk is value of the common HE-LTF sequence on subcarrier k ..." or refer to Equations (28-58) and (28-59) for the definition of k. | **Revised.**Change to as in the resolution of CID8573 in doc IEEE802.11-17/0720r0. |

ax editor: please make the following changes in D1.2 *Clause 28.3.10.10*:

* On P340L23 (CID #8573):

Where HELTFk is the value of the common HE-LTF sequence on subcarrier k, generated by one of the equations from (Equation (28-35) to Equation (28-50) depending on the bandwidth and the HE-LTF mode (excluding the 1x HE-LTF which shall not be masked).

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| CID | Commenter | Section | Page | Comment | Proposed Change | Resolution |
| 9065 | Sriram Venkateswaran | 28.3.10.10 | 311.17 | For greater clarity, HELTF should include r, u, and m as its subscripts | This change will affect the draft in multiple places, but is suggested to improve clarity. Add subscripts m,r,u to HE-LTF | **Revised.**Change to as in the resolution of CID9065 in doc IEEE802.11-17/0720r0. |
| 4906 | Bo Yu | 28.3.10.10 | 313.23 | TGI in equations (28-58) and (28-59) should be replaced by TGI,HE-LTF. TGI is not defined. | As in comment | **Revised.**Change to as in the resolution of CID9065 in doc IEEE802.11-17/0720r0. |
| 9189 | SUNGEUN LEE | 28.3.10.10 | 313.23 | TGI in HE-LTF equation, i.e., Eq (28-58) should be clarified more from the parameter table. | Replace TGI to TGI,HE-LTF and also update the description in parameter table accordingly | **Revised.**Change to as in the resolution of CID9065 in doc IEEE802.11-17/0720r0. |
| 9190 | SUNGEUN LEE | 28.3.10.10 | 313.38 | TGI in HE-LTF equation, i.e., Eq (28-59) should be clarified more from the parameter table. | Replace TGI to TGI,HE-LTF and also update the description in parameter table accordingly | **Revised.**Change to as in the resolution of CID9065 in doc IEEE802.11-17/0720r0. |
| 9485 | Yan Zhang | 28.3.10.10 | 313.23 | TGI in equations (28-58) should be replaced by TGI,HE-LTF. TGI is not defined. | As in comment | **Revised.**Change to as in the resolution of CID9065 in doc IEEE802.11-17/0720r0. |
| 9486 | Yan Zhang | 28.3.10.10 | 313.38 | TGI in equations (28-59) should be replaced by TGI,HE-LTF. TGI is not defined. | As in comment | **Revised.**Change to as in the resolution of CID9065 in doc IEEE802.11-17/0720r0. |

**Discussions:**

The commentor is right that  defined in equation (28-53) is a function of m, u and k. So it is more accurate to include m, and u as its subscripts. Index r is not necessary since k and r are one to one mapping. In addition, the statement “ if single stream pilots are not used” is not accurate since non-OFDMA UL MI-MIMO transmission with 1x HE-LTF should use multiple stream pilots in HE-LTF, and masking with orthogonal codes should not be applied to HE-LTF sequence.

ax editor: please make the following changes in D1.2 *Clause 28.3.10.10*:

* On P340L19 (CID #9065):

 (28-51)

* On P342L13 (CID #9065, CID #4906, CID #9189, CID #9485):

 (28-56)

* On P342L29(CID #9065, CID #4906, CID #9190, CID #9486):

 (28-57)

where  is the HELTF sequence applied on subcarrier k for the mth spatial stream of user u. if single stream pilots are used or the 1x HE-LTF is used for non-OFDMA UL MU-MIMO, otherwise.

 is defined in 28.3.9 (Mathematical description of signals).

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| 5274 | Dorothy Stanley | 28.3.10.10 | 313.5 | Regarding "When the 1x HE-LTF is used for non-OFDMA UL MU-MIMO, neither masking by orthogonal code nor single stream pilot are not used.", there are too many negatives in the sentence and I can't parce the meaning. Please clarify | As in comment | **Revised.**Change to as in the resolution of CID5274 in doc IEEE802.11-17/0720r0. |
| 8986 | Sigurd Schelstraete | 28.3.10.10 | 313.5 | "neither masking by orthogonal code nor single stream pilot are not used.". What does this mean? Neither is used? Avoid double negation for clarity. | Clarify | **Revised.**Change to as in the resolution of CID5274 in doc IEEE802.11-17/0720r0. |

ax editor: please make the following change in D1.2 *Clause 28.3.10*.*10*

* On P342L5 (CID #5274, CID #8986):

When the 1x HE-LTF is used for non-OFDMA UL MU-MIMO, neither masking by orthogonal code nor single stream pilot are used.

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| CID | Commenter | Section | Page | Comment | Proposed Change | Resolution |
| 9067 | Sriram Venkateswaran | 28.3.10.10 | 313.16 | Beta\_r can be used to simplify equation 28-58 and also make it consistent | Use beta\_r in equation 28-58 to simplify it and make it consistent | **Rejected.**In the spec, Beta\_r was only used in general mathematical equations (28-3) and (28-4) for power normalization factor. For each specific field equation, Beta\_r is always replaced by the corresponding equations described in (28-5). To make the spec consistent, we should not use Beta\_r in equation (28-58). |

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| CID | Commenter | Section | Page | Comment | Proposed Change | Resolution |
| 8989 | Sigurd Schelstraete | 28.3.10.10 | 314.1 | "When a 1x, 2x or 4x HE-LTF is transmitted". This means always, since these are the only HE-LTF modes that are defined. | Delete "When a 1x, 2x or 4x HE-LTF is transmitted" | **Revised.**Change to as in the resolution of CID8989 in doc IEEE802.11-17/0720r0. |
| 8990 | Sigurd Schelstraete | 28.3.10.10 | 314.1 | Is this paragraph in the right place? Why is this specfifc to HE-LTF. The spatial mapping matrix is applied starting at HE-STF. | Move paragraph to more appropriate section. | **Revised.**Change to as in the resolution of CID8989 in doc IEEE802.11-17/0720r0. |
| 9752 | Yongho Seok | 28.3.10.10 | 314.1 | "When a 1x, 2x or 4x HE-LTF is transmitted,..."There is no other HE-LTF mode in addition to 1x, 2x and 4x.Please change it as the following:"It is recommended that the spatial mapping matrix applied to..." | As per comment | **Revised.**Change to as in the resolution of CID8989 in doc IEEE802.11-17/0720r0. |

**Discussions:**

The commentors are right that the statement does not depend on which HE-LTF mode is used. The more appropriate place to put this statement is in HE-STF subclause since spatial mapping matrix is applied starting from HE-STF.

ax editor: please make the following changes in D1.2 *Clause 28.3.10.10*:

* On P343L1 (CID #8989, CID #8990, CID #9752): Move the following paragraph to the end of subclause 28.3.10.9, and with the following changes,

It is recommended that the spatial mapping matrix applied to HE-STF and beyond is chosen such that it preserves the smoothness of the physical channel, achieved by limiting the variation of each element's real and imaginary values in the spatial mapping matrix across successive tones within one RU.