IEEE P802.11
Wireless LANs

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| [The Comment resolution for clause 32.3.7.3 NGV portion of NGV format preamble] |
| Date: 2020-05-xx |
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|  |  |  |  |  |

Abstract

This submission proposes resolutions for following CIDs

6,17,118,119,120,148,149,150,168,169,291,292,293,294,295,296,297,298,300,301,302,303,304,305,306,307,308,309,310,311,312,313,315,316,317,318,319,322,323 (total 39 CID)

Revisions:

* Rev 0: Initial version of the document.

## CID 291

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| 291 | 45.12 | 32.3.7.3.2 | fill TBD | as in comment | Revised TGbd editor to make the changes shown in 11-20/1061r0 |

Discussion:

We have agreed that 11bd can use the 2 antennae and support the up to 2 spatial streams. So, for efficient transmission and to reduce the unintended beamforming, we shall add the description and values for the cyclic shift.

### Propose:

***TGbd editor: please change the TBD in 32.3.7.3.2 Cyclic shift for NGV modulated fields to follows***

The cyclic shift values defined in this subclause apply to the NGV-STF, NGV-LTF, and Data fields of the NGV PPDU. The cyclic shift values defined in 32.3.7.2.1 (Cyclic shift for pre-NGV modulated fields) apply to NGV-SIG and RNGV-SIG field in the NGV format preamble.

Throughout the NGV modulated fields of the preamble, cyclic shifts are applied to prevent unintended beamforming when correlated signals are transmitted in multiple spatial streams. The same cyclic shift is also applied to these streams during the transmission of the Data field of the NGV PPDU. The cyclic shift value for the NGV modulated fields for spatial stream m out of Nss, the number of spatial streams is shown in Table 21-11 (Cyclic shift values for the VHT modulated fields of a PPDU). The row for Nsts, the total number of space-time stream is replaced with Nss, the number of spatial streams. (#291)

## CID 6, 118, 292, 293, 294

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| 6 | 45.54 | 32.3.7.3.3 | The text in Table 32-10, B14-B17, refers to CRC computation in 11ax, however, the text in the referenced section 27.3.11.7.3, specifies CRC calculations for SIG-A and SIG-B, and NGV-SIG of course is not listed. | Modify the text to clarify that what part of calculations in 27.3.11.7.3 is applicable, for example SiG-B w/ L=13 | Rejected, Since the different sizes of information for CRC calculation can be used in 11ax, L that meaning the size of information is described in clause 27.3.11.7.3.So, because the value of L is already defined in the description of table 32-10, it does not need to modify it.  |
| 118 | 46.12 | 32.3.7.3.3 | In Equation 32-12, start value of iBW is not defined in the first summation. It should be 0. "p\_{0}p\_{k}" should be replace with "p\_{2}P\_{k}" (Uppercase P) | As in comment | Revised In principle, the commenter is right.The initial value for iBW should be set to 0 in equation 32-9. And since the NGV-SIG is the third symbol, n should be 2. TGbd editor to make the changes shown in 11-20/1061r0 |
| 292 | 45.40 | 32.3.7.3.3 | need a space between to and 1. For example, Set to 1 for 8 symbols. |  | Accepted.  |
| 293 | 46.10 | 32.3.7.3.3 | In Equation (32-12) Nsr should be 26. It has nothing to do with channel bandwidth. | as in comment | Revised In principle, the commenter is right.Since Nsr is defined for NGV-modulated fields and the value is different in a non-NGV-modulated field, it should be fixed as 26.TGbd editor to make the changes shown in 11-20/1061r0 |
| 294 | 46.38 | 32.3.7.3.3 | fill TBD | as in comment | Revised In principle, the commenter is right.The cyclic shift value is defiend in clause 32.3.7.3.1. So, we can refer this clause. TGbd editor to make the changes shown in 11-20/1061r0 |

### Propose:

***Gbd editor: please modify the 6th row of table 32-10 as follows***

|  |  |  |  |
| --- | --- | --- | --- |
| ··· | ··· | ··· | ··· |
| B8-B9 | Midamble Periodicity  | 2bit  | Set to 0 to for 4 symbols. Set to~~1~~ 1 to for 8 symbols. (# 292)Set to 2 to for 16 symbols. Value 3 is reserved. |
| ··· | ··· | ··· | ··· |

***TGbd editor: please modify the equeation 32-12 as follows***

$r\_{NGV-SIG}^{\left(i\_{TX}\right)}\left(t\right)=\frac{1}{\sqrt{N\_{TX}N\_{NGV-SIG}^{Tone}}}w\_{T\_{NGV-SIG}}(t)\sum\_{i\_{BW}=0}^{N\_{10MHz}-1}\sum\_{k=-N\_{SR}26}^{N\_{SR}26}\left(\begin{matrix}γ\_{k-K\_{shift}(i\_{BW}),BW}(D\_{k,20}+p\_{02}pP\_{k})\\ ∙exp⁡(j2π(k-K\_{shift}\left(i\_{BW}\right))∆\_{F,NGV}(t-T\_{GI}-T\_{cs}^{i\_{TX}})\end{matrix}\right)$(33-12) (#118, #293)

***TGbd editor: please modify the text of L38P45 as follow***

$T\_{cs}^{i\_{TX}}$ represents the cyclic shift for transmitter chain  with a value given in ~~TBD~~ 32.3.7.2.1 Cyclic shift for pre-NGV modulated fields. (#294)

## CID 119, 295,

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| 119 | 46.54 | 32.3.7.3.4 | In Equation 32-13, start value of iBW is not defined in the first summation. It should be 0. "p\_{0}p\_{k}" should be replace with "p\_{3}P\_{k}" (Uppercase P) | As in comment | Revised In principle, the commenter is right.The initial value for iBW should be set to 0 in equation 32-9. And since the RNGV-SIG is the fourth symbol, n should be 3. TGbd editor to make the changes shown in 11-20/1061r0 |
| 295 | 46.51 | 32.3.7.3.4 | In Equation (32-13) Nsr should be 26. It has nothing to do with channel bandwidth. | as in comment | Revised In principle, the commenter is right.Since Nsr is defined for NGV-modulated fields and the value is different in a non-NGV-modulated field, it should be fixed as 26.TGbd editor to make the changes shown in 11-20/1061r0 |

### Propose :

***TGbd editor: please modify the equeation 32-13 as follows***

$r\_{RNGV-SIG}^{\left(i\_{TX}\right)}\left(t\right)=\frac{1}{\sqrt{N\_{TX}N\_{RNGV-SIG}^{Tone}}}w\_{T\_{RNGV-SIG}}(t)\sum\_{i\_{BW}=0}^{N\_{10MHz}-1}\sum\_{k=-N\_{SR}26}^{N\_{SR}26}\left(\begin{matrix}γ\_{k-K\_{shift}(i\_{BW}),BW}(D\_{k,20}+p\_{03}pP\_{k})\\ ∙exp⁡(j2π(k-K\_{shift}\left(i\_{BW}\right))∆\_{F,NGV}(t-T\_{GI}-T\_{cs}^{i\_{TX}})\end{matrix}\right)$(#119, #295)

## CID 296, 297, 298

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| 296 | 47.13 | 32.3.7.3.5 | In Equation (32-14), 28.28 should be 28,28. period should be comma in L13 and L16 | as in comment | Accepted  |
| 297 | 47.20 | 32.3.7.3.5 | In Equation (32-15), 58.58 should be 58,58. period should be comma in L20 and L23 | as in comment | Accepted |
| 298 | 47.46 | 32.3.7.3.5 | fill TBD | as in comment | Revised In principle, the commenter is right.The cyclic shift value is defiend in clause 32.3.7.3.1. So, we can refer this clause.TGbd editor to make the changes shown in 11-20/1061r0 |

### Propose:

***TGbd editor: please modify the clause 32.3.7.3.5 as follow***

···

For a 10 MHz transmission, the frequency domain sequence is given by Equation (33-14).

$NGVS\_{-28.,28}=VHTS\_{-28.,28}$ (33-14) (#296)

Where $VHTS\_{-28.,28}$ is defined in Equation (21-29) (#296)

For a 20 MHz transmission, the frequency domain sequence is given by Equation (33-15).

$NGVS\_{-58.,58}=VHTS\_{-58.,58}$ (33-15) (#297)

Where $VHTS\_{-58.,58}$ is defined in Equation (21-30) (#297)

NOTE—Equation (33-14), Equation (33-15) do not show the phase rotation per 10 MHz subchannel

The time domain representation of the signal on transmit chain  shall be as specified in Equation (32-16).

$r\_{NGV-STF}^{\left(i\_{TX}\right)}\left(t\right)=\frac{1}{\sqrt{N\_{STS}N\_{NGV-STF}^{Tone}}}w\_{T\_{NGV-STF}}(t)\sum\_{k=-N\_{SR}}^{N\_{SR}}\sum\_{m=1}^{N\_{STS}}\left(\begin{matrix}\left[Q\_{k}\right]\_{i\_{TX},m}γ\_{k,BW}NGVS\_{k}\\ ∙exp⁡(j2πk)∆\_{F,NGV}(t-T\_{CS,NGV}(m))\end{matrix}\right)$ (32-16)

where

$N\_{NGV-STF}^{Tone}$ has the value given in Table 33-x1 (Tone scaling factor and guard interval duration values for PHY fields)

$T\_{CS,NGV}(m)$ is given in ~~TBD~~ 32.3.7.2.1 Cyclic shift for pre-NGV modulated fields. (#298)

$Q\_{k}$ is defined in 33.3.7.3 (Transmitted signal)

$γ\_{k,BW}$ is defined in defined in Equation (32-4) and Equation (32-5).

## CID 17, 120, 148, 149, 150, 168, 169, 300, 301,302,303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 315, 316, 317, 318, 319, 322, 323

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| 17 | 49.21 | 32.3.7.3.6 | In 20MHz transmission, the sequence for 1x NGV-LTF is consist of sequences located even tone indices of sequence for 2x NGV-LTF. And the (32-22) has some errors. So, the sequence in (32-22) should be corrected. | modify the LTF sequence of (32-22) like as "{1,0,-1,0,1,0,-1,0,-1,0,1,0,1,0,1,0,-1,0,1,0,1,0,1,0,1,0,1,0,-1,0,1,0,-1,0,-1,0,-1,0,-1,0,-1,0,1,0,-1,0,-1,0,-1,0,1,0,1,0,-1,0,1,0,0,0,-1,0,1,0,1,0,-1,0,1,0,-1,0,-1,0,1,0,1,0,1,0,-1,0,1,0,1,0,1,0,1,0,1,0,-1,0,1,0,-1,0,-1,0,-1,0,-1,0,-1,0,1,0,-1,0,-1,0,-1,0,1,0,1 } " | Revised In principle, the commenter is right. 1x NGV-LTF sequence has some errors.We agreed that the LTF sequence of 1x LTF that mapped on the even tone index is used for the 2x LTF sequence. So, the 2x LTF sequence should be consist of the 1x LTF sequence that mapped on even tone index. TGbd editor to make the changes shown in 11-20/1061r0 |
| 120 | 50.40 | 32.3.7.3.6 | In Equation 32-25, RHS should be [P\_{NGV-LTF}]\_{1,n} | As in comment | Revised, In principle, commenter is right. R matrix should be conist of the first row of P matrix. TGbd editor to make the changes shown in 11-20/1061r0 |
| 148 | 50.02 | 32.3.7.3.6 | Error in the duration in "OFDM symbol of 3.2 ╬╝s excluding GI" | change "OFDM symbol of 3.2 ╬╝s excluding GI" to "OFDM symbol of 6.4 ╬╝s excluding GI" | Revised, In principle, commenter is right. Since 2x downclocking is applied to 11bd, the duration of OFDM symbol is 6.4us. TGbd editor to make the changes shown in 11-20/1061r0 |
| 149 | 50.39 | 32.3.7.3.6 | Equation (32-25) should be corrected to [R\_NGV-LTF]\_m,n =[P\_NGV-LTF]\_1,n. | As in the comment. | Revised Refer the comment resolution for CID 120.  |
| 150 | 50.44 | 32.3.7.3.6 | Equation (32-26) is redundant, and can be combined with Equation (32-27). N\_STS<=4 is not needed in Equation (32-27). | Change "P\_NGV-LTF is defined in Equation (32-27)" to "P\_NGV-LTF=P\_4x4", and delete Equation (32-27). | Revised,In principle commenter is right. Since NGV supports up to 2 SS, P matrix should be P4x4.TGbd editor to make the changes shown in 11-20/1061r0 |
| 168 | 49.41 | 32.3.7.3.6 | Is the phase rotation referred to the variable Gamma in Eq (32-28). | If so, please remove this note. If not, please be more specific about for what phase rotation. | Rejected,As commenter mentioned, phase rotation defiend in table 32-9 is applied to NGV-LTF. But, since the basic sequence for NGV-LTF is described in Equation (32-20), Equation (32-21), Equation (32-22), and Equation (32-23), this note needs to indicate that the phase rotation is not applied thise sequence. And the same note is described in 21.3.8.3.5. VHT-LTF definition of 802.11REVmd\_D3.0 |
| 169 | 50.39 | 32.3.7.3.6 | The left hand side should be P and the subscript of R may need fixed. | If so, please remove this note. If not, please be more specific about for what phase rotation. | Revised Refer the common resolution for CID 120 |
| 300 | 48.42 | 32.3.7.3.6 | Duration of each NGV-LTF symbol in Equation 32-17 and in Table 32-6 (Timing-related constants) is not matched. One indicates the duration including GI. The other indicates the duration excluding GI. Considering the Table already defined in early subclause, better to delete the Equation (32-17) and related text in the spec. or just delete "excluding GI" in "The duration of each NGV-LTF symbol duration excluding GI is T\_NGV-LTF, defined in Equation (32-17)" | as in comment | Revised In principle commenter is right. The duration of NGV-LTF is already defined in table 32-6. So, it is better to align with table. TGbd editor to make the changes shown in 11-20/1061r0 |
| 301 | 48.52 | 32.3.7.3.6 | font type of LTF\_left and LTF\_right should be italic as shown in Equation (32-18) and Equation (32-19) | as in comment | Accepted |
| 302 | 48.61 | 32.3.7.3.6 | font type of LTF\_left and LTF\_right should be italic as shown in Equation (32-18) and Equation (32-19) | as in comment | Accepted |
| 303 | 48.65 | 32.3.7.3.6 | 1x NGV-LTF should be NGV-LTF-1x to be consistent through the spec | as in comment | Accepted |
| 304 | 49.01 | 32.3.7.3.6 | In Equation (32-20), 28.28 should be 28,28. period should be comma | as in comment | Accepted |
| 305 | 49.09 | 32.3.7.3.6 | In Equation (32-21), 28.28 should be 28,28. period should be comma | as in comment | Accepted |
| 306 | 49.09 | 32.3.7.3.6 | Equation (32-21) is hard to understand. It seems to mean below and indices (-28, 28) is omitted. Refer to Equation (21-36).NGV\_LTF = {1, 1, ..... -1, -1} = VHT-LTF | as in comment | Revised A similar description has been used in 11ac. For a clear understanding, we need an equal operator in this equation.TGbd editor to make the changes shown in 11-20/1061r0 |
| 307 | 49.15 | 32.3.7.3.6 | 28.28 should be 28,28. period should be comma | as in comment | Accepted  |
| 308 | 49.18 | 32.3.7.3.6 | 1x NGV-LTF should be NGV-LTF-1x to be consistent through the spec | as in comment | Accepted |
| 309 | 49.21 | 32.3.7.3.6 | In Equation (32-22), 58.58 should be 58,58. period should be comma | as in comment | Accepted |
| 310 | 49.29 | 32.3.7.3.6 | 2x NGV-LTF should be NGV-LTF-2x to be consistent through the spec | as in comment | Accepted  |
| 311 | 49.33 | 32.3.7.3.6 | Equation (32-23) is hard to understand. It seems to mean below and indices (-58, 58) is omitted. Refer to Equation (21-37).NGV\_LTF = {..........} = VHT-LTF | as in comment | Revised A similar description has been used in 11ac. For a clear understanding, we need an equal operator in this equation.TGbd editor to make the changes shown in 11-20/1061r0 |
| 312 | 49.33 | 32.3.7.3.6 | 58.58 should be 58,58. period should be comma | as in comment | Accepted |
| 313 | 49.39 | 32.3.7.3.6 | 58.58 should be 58,58. period should be comma | as in comment | Accepted |
| 315 | 49.63 | 32.3.7.3.6 | In the bottome of Figure 32-9, [A\_NGV-LTF]\_Nsts,n (k is omitted) is missing | as in comment | Revised In principle, commeter is right. The missed equation should be inserted in figure 32-9.TGbd editor to make the changes shown in 11-20/1061r0 |
| 316 | 50.24 | 32.3.7.3.6 | in Equation (32-24), k\_pilot should K\_pilot in italic. This term is used for different amenments including 11ac, 11ax and it should be differentiated with subcarrier index k (small italic k) | as in comment | Accepted |
| 317 | 50.30 | 32.3.7.3.6 | k\_pilot should K\_pilot in italic. This term is used for different amenments commonly including 11ac/11ax and it should be differentiated with subcarrier index k (small italic k) | as in comment | Accepted |
| 318 | 50.32 | 32.3.7.3.6 | k\_pilot should K\_pilot in italic. This term is used for different amenments commonly including 11ac/11ax and it should be differentiated with subcarrier index k (small italic k) | as in comment | Accepted |
| 319 | 50.34 | 32.3.7.3.6 | k\_pilot should K\_pilot in italic. This term is used for different amenments commonly including 11ac/11ax and it should be differentiated with subcarrier index k (small italic k) | as in comment | Accepted |
| 322 | 50.54 | 32.3.7.3.6 | i\_tx should be i\_TX as shown in Equation (32-28) | as in comment | Accepted  |
| 323 | 51.20 | 32.3.7.3.6 | fill TBD | as in comment | Revised.For cyclic shift value for NGV modulated field is defined in clause 32.3.7.3.2. So, we can refer this clause. TGbd editor to make the changes shown in 11-20/1061r0 |

### Propose :

Discussion : In 20MHz transmission, NGV-LTF-2x sequence is equal to VHT-LTF sequence for 40MHz transmission. VHT-LTF sequence for 40MHz transmission is defined as follow.



 = {$1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1 ,1 ,1 ,1 ,1,-1,-1, 1,1,-1,1,-1,1,1,1,1$, 1, $1, -1, -1, 1, 1, -1, 1, -1,1, -1, -1 ,-1 ,-1 ,-1 ,1,1,-1, -1,1,-1,1,-1,1,1,1,1$, -1, -1, -1, 1, 0 , 0, 0, -1, 1, 1, -1, $1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1 ,1 ,1 ,1 ,1,-1,-1, 1,1,-1,1,-1,1,1,1,1$, 1, $1, -1, -1, 1, 1, -1, 1, -1,1, -1, -1 ,-1 ,-1 ,-1 ,1,1,-1, -1,1,-1,1,-1,1,1,1,1$ }

For the sequence of NGV-LTF-1x, we only take the sequence that is mapped on the even tone in frequency in the above LTF sequence. In the above sequence, the value as marked with red is the sequence was mapped on even tone index. So, the NGV-LTF-1x sequence can be composed with sequences maked as red in the above

***TGbd editor: please replace the equation (32-22) with following***

$NGV-LTF\_{-58,58}=${1,0,-1,0,1,0,-1,0,-1,0,1,0,1,0,1,0,-1,0,1,0,1,0,1,0,1,0,1,0,-1,0,1,0,-1,0,-1,0,-1,0,-1,0,-1,0,1,0,-1,0,-1,0,-1,0,1,0,1,0,-1,0,1,0,0,0,-1,0,1,0,1,0,-1,0,1,0,-1,0,-1,0,1,0,1,0,1,0,-1,0,1,0,1,0,1,0,1,0,1,0,-1,0,1,0,-1,0,-1,0,-1,0,-1,0,-1,0,1,0,-1,0,-1,0,-1,0,1,0,1 } (#17, #309)

***TGbd editor: please replace the text from L1 to L4 in P50 with following***

The generation of time domain symbol of NGV-LTF-1x is equivalent to modulating every other tone in an OFDM symbol of ~~3.2~~ 6.4(#148) μs excluding GI, and then only transmit the first half of the OFDM symbol in time domain, as shown in Figure 32-10 (Generation of NGV-LTF-1x symbols).

***TGbd editor: please replace the text in L39P50 with following***

$\left[R\_{NGV-LTF}\right]\_{m,n}=\left[RP\_{NGV-LTF}\right]\_{1,n}, 1\leq m,n\leq N\_{NGV-LTF}$ (#120, #149, #169)

***TGbd editor: please modify the equations (32-26) and (32-27) as following***

$P\_{NGV-LTF}$ ~~is defined in Equation (33-27) (32-26)~~

$P\_{NGV-LTF}= P\_{4×4},N\_{STS}\leq 4$ (32-2~~7~~6) (#150)

Where

$P\_{4×4}$ is defined in Equation (19-27)

***TGbd editor: please replace the text in L42P48 with following***

The duration of each NGV-LTF symbol ~~excluding GI~~(#300) is TNGV-LTF, defined in Equation (32-17).

***TGbd editor: please modify the equation (32-18) and (32-19) as following***

~~LTF~~~~left~~ *LTFleft* = $\left\{1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1 ,1 ,1 ,1 ,1,-1,-1, 1,1,-1,1,-1,1,1,1,1\right\}$ (32-18). (#301)

~~LTF~~~~right~~ *LTFright* = $\left\{1, -1, -1, 1, 1, -1, 1, -1,1, -1, -1 ,-1 ,-1 ,-1 ,1,1,-1, -1,1,-1,1,-1,1,1,1,1\right\}$ (32-19). (#302)

***TGbd editor: please modify the text of L65P48 as following***

In a 10 MHz transmission, the ~~1x~~ NGV-LTF-1x (#303) sequence transmitted is given by Equation (32-20).

***TGbd editor: please modify the equation (32-21) as following***

$NGV-LTF\_{-28.,28} \begin{matrix}= \left\{1, 1,LTF\_{left},0,LTF\_{right},-1,-1\right\}\\= VHT-LTF\_{-28.,28}\end{matrix}$ (32- 21) (#305, #306)

Where

$VHT-LTF\_{-28.,28}$ is defiend in equation (21-36) (#307)

***TGbd editor: please modify the text of L18P49 as following***

In a 20 MHz transmission, the ~~1x~~ NGV-LTF-1x(#308) sequence transmitted is given by Equation (32-22).

***TGbd editor: please modify the text of L28P49 as following***

In a 20 MHz transmission, the ~~2x~~ NGV-LTF-2x (#310) sequence transmitted is given by Equation (32-23).

***TGbd editor: please modify the equation (32-23) as following***

$NGV-LTF\_{-58.,58}\begin{matrix}=\left\{LTF\_{left},1,LTF\_{right},-1,-1,-1,1,0,0,0,-1,1,1,-1,LTF\_{left},1,LTF\_{right}\right\}\\= VHT-LTF\_{-58.,58}\end{matrix}$(#311, #312)

Where

$VHT-LTF\_{-58.,58}$ *is* defiend in equation (21-37) (#313)

***TGbd editor: please replace the figure 32-9 with following***

(#315)

***TGbd editor: please modify the equation (32-24) as following***

$A\_{NGV-LTF}^{k}=\left\{\begin{matrix}R\_{NGV-LTF},if k\in kK\_{pilot}\\P\_{NGV-LTF},otherwise\end{matrix}\right.$ (32-24) (#316)

where

$kK\_{pilot}$ is the set of subcarrier indices for the pilot tones.$ $(#317)

For a 10 MHz transmission,$ kK\_{pilot}=\left\{\pm 8,\pm 22\right\}$ (#318)

For a 20 MHz transmission,$ kK\_{pilot}=\left\{\pm 12,\pm 26,\pm 54\right\}$ (#319)

***TGbd editor: please modify the text of L54P50 as following***

The time domain representation of the waveform transmitted on transmit chain *~~i~~~~tx~~ iTX* (#322)shall be as described by Equation (32-28).

***TGbd editor: please modify the text of L54P50 as following***

$T\_{CS,NGV}(m)$ is given in ~~TBD~~ 32.3.7.3.2 Cyclic shift for NGV modulated fields (#323)