IEEE P802.11
Wireless LANs

|  |
| --- |
| Proposed Draft Text for EHT-STF |
| Date: 2020-08-20 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Eunsung Park | LG Electronics | 19, Yangjae-daero 11gil, Seocho-gu, Seoul 137-130, Korea |  | esung.park@lge.com |
| Dongguk Lim |  | dongguk.lim@lge.com |
| Jinsoo Choi |  | js.choi@lge.com |

Abstract

This submission proposes the draft text on EHT-STF for 802.11be D0.1. This document is based on the following motions in [1].

Motions 112: #SP8, #SP9, #SP10

Motions 115: # SP56, #SP82, #SP83

Texts highlighted in yellow are TBD

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Revision based on the email discussion
* Rev 2: Revision based on the discussion during conference call
* Rev 3: Revision based on the email discussion

References:

[1] 802.11-20/0566r48 Compendium of Stras Polls and Potential Changes to the Specification Framework Document

34.3.11.9 EHT-STF

The main purpose of the EHT-STF field is to improve automatic gain control estimation in a MIMO transmission. The EHT-STF field is positioned immediately after the EHT-SIG field for EHT MU PPDU. The EHT-STF field is positioned immediately after the U-SIG field for EHT TB PPDU. The duration of the EHT-STF field for EHT MU PPDU is *T*EHT-STF-NT (periodicity of 0.8 μs with 5 periods as given in Table 34-x1 (Timing-related constants)) and the duration of the EHT-STF field for EHT TB PPDU is *T*EHT-STF-T (periodicity of 1.6 μs with 5 periods as given in Table 34-x1 (Timing-related constants)). For the EHT-STF field, the *M* sequence is defined by Equation (27-22).

For a 20 MHz transmission, the frequency domain sequence for EHT MU PPDU is given by Equation (34-1).

*EHTS*-112:16:112 = *HES*-112:16:112 (34-1)

where *EHTSa:b:c* means coefficients of the EHT-STF on every *b* subcarrier indices from *a* to *c* subcarrier indices and coefficients on other subcarrier indices are set to zero and *HES*-112:16:112 is defiend in Equation (27-23).

For a 40 MHz transmission, the frequency domain sequence for EHT MU PPDU is given by Equation (34-2).

*EHTS*-240:16:240 = *HES*-240:16:240  (34-2)

where *HES*-240:16:240 is defined in Equation (27-24).

For an 80 MHz transmission, the frequency domain sequence for EHT MU PPDU is given by Equation (34-3).

*EHTS*-496:16:496 = *HES*-496:16:496 (34-3)

where *HES*-496:16:496 is defined in Equation (27-25).

For a 160 MHz transmission, the frequency domain sequence for EHT MU PPDU is given by Equation (34-4).

*EHTS*-1008:16:1008 = *HES*-1008:16:1008 (34-4)

where *HES*-1008:16:1008 is defined in Equation (27-26).

For an 80+80 MHz transmission, the lower 80 MHz segment for EHT MU PPDU shall use the EHT-STF pattern for the 80 MHz defined in Equation (34-3).

For an 80+80 MHz transmission, the frequency domain sequence of the upper 80 MHz segment for and EHT MU PPDU is given by Equation (34-5).

*EHTS*-496:16:496 = *HES*-496:16:496 (34-5)

where = *HES*-496:16:496 is defined in Equation (27-27).

For a 320 MHz transmission, the frequency domain sequence for EHT MU PPDU is given by Equation (34-6).

*EHTS*-2032:16:2032 = {*M*, 1, -*M*, 0, -*M*, 1, -*M*, 0, *M*, 1, -*M*, 0, -*M*, 1, -*M*, 0, -*M*, -1, *M*, 0, *M*, -1, *M*, 0, -*M*, -1, *M*, 0, *M*, -1, *M*}·(1+j)/$\sqrt{2}$ (34-6)

For a 160+160 MHz transmission, the frequency domain sequence of the lower 160 MHz segment for EHT MU PPDU is given by Equation (34-7).

*EHTS*-1008:16:1008 = {*M*, 1, -*M*, 0, -*M*, 1, -*M*, 0, *M*, 1, -*M*, 0, -*M*, 1, -*M*}·(1+j)/$\sqrt{2}$ (34-7)

For a 160+160 MHz transmission, the frequency domain sequence of the upper 160 MHz segment for EHT MU PPDU is given by Equation (34-8).

*EHTS*-1008:16:1008 = {-*M*, -1, *M*, 0, *M*, -1, *M*, 0, -*M*, -1, *M*, 0, *M*, -1, *M*}·(1+j)/$\sqrt{2}$ (34-8)

For a 20 MHz transmission, the frequency domain sequence for EHT TB PPDU is given by Equation (34-9).

*EHTS*-120:8:120 = *HES*-120:8:120 (34-9)

where *HES*-120:8:120 is defined in Equation (27-28).

For a 40 MHz transmission, the frequency domain sequence for EHT TB PPDU is given by Equation (34-10).

*EHTS*-248:8:248 = *HES*-248:8:248 (34-10)

where *HES*-248:8:248 is defined in Equation (27-30).

For an 80 MHz transmission, the frequency domain sequence for EHT TB PPDU is given by Equation (34-11).

*EHTS*-504:8:504 = *HES*-504:8:504 (34-11)

where *HES*-504:8:504 is defined in Equation (27-32).

For a 160 MHz transmission, the frequency domain sequence for EHT TB PPDU is given by Equation (34-12).

*EHTS*-1016:8:1016 = *HES*-1016:8:1016 (34-12)

where *HES*-1016:8:1016 is defined in Equation (27-34).

For an 80+80 MHz transmission, the lower 80 MHz segment for EHT TB PPDU shall use the EHT-STF pattern for the 80 MHz defined in Equation (34-11).

For an 80+80 MHz transmission, the frequency domain sequence of the upper 80 MHz segment for EHT TB PPDU is given by Equation (34-13).

*EHTS*-504:8:504 = *HES*-504:8:504 (34-13)

where *HES*-504:8:504 is defined in Equation (27-36).

For a 320 MHz transmission, the frequency domain sequence for EHT TB PPDU is given by Equation (34-14).

*EHTS*-2040:8:2040 = {*M*, -1, *M*, -1, -*M*, -1, *M*, 0, -*M*, 1, *M*, 1, -*M*, 1, -*M*, 0, *M*, -1, *M*, -1, -*M*, -1, *M*, 0, -*M*, 1, *M*, 1, -*M*, 1, -*M*, 0, -*M*, 1, -*M*, 1, *M*, 1, -*M*, 0, *M*, -1, -*M*, -1, *M*, -1, *M*, 0, -*M*, 1, -*M*, 1, *M*, 1, -*M*, 0, *M*, -1, -*M*, -1, *M*, -1, *M*}·(1+j)/$\sqrt{2}$ (34-14)

The value of the EHT-STF sequence at indices ±8, ±1016, ±1032 and ±2040 is *EHTS*±8 = *EHTS*±1016 = *EHTS*±1032 = *EHTS*±2040 = 0

For a 160+160 MHz transmission, the frequency domain sequence of the lower 160 MHz segment for EHT TB PPDU is given by Equation (34-15).

*EHTS*-1016:8:1016 = {*M*, -1, *M*, -1, -*M*, -1, *M*, 0, -*M*, 1, *M*, 1, -*M*, 1, -*M*, 0, *M*, -1, *M*, -1, -*M*, -1, *M*, 0, -*M*, 1, *M*, 1, -*M*, 1, -*M* }·(1+j)/$\sqrt{2}$) (34-15)

The value of the EHT-STF sequence at indices ±8 and ±1016 is *EHTS*±8 = *EHTS*±1016 = 0

For a 160+160 MHz transmission, the frequency domain sequence of the upper 160 MHz segment for EHT TB PPDU is given by Equation (34-16).

*EHTS*-1016:8:1016 = {-*M*, 1, -*M*, 1, *M*, 1, -*M*, 0, *M*, -1, -*M*, -1, *M*, -1, *M*, 0, -*M*, 1, -*M*, 1, *M*, 1, -*M*, 0, *M*, -1, -*M*, -1, *M*, -1, *M*}·(1+j)/$\sqrt{2}$ (34-16)

The value of the EHT-STF sequence at indices ±8 and ±1016 is *EHTS*±8 = *EHTS*±1016 = 0

For an OFDMA transmission and a non-OFDMA transmission with puncturing, the coefficients in Equation (34-1) to Equation (34-16) are set to zero if those values are corresponding to subcarrier indices that are not modulated in the Data field, such as subcarriers falling within RUs that have no users assigned to them in OFDMA or subcarriers which are punctured.

The time domain representation of the signal for EHT MU PPDU on frequency segment *iSeg* and transmit chain *iTX* shall be as specified in Equation (34-17).

$$r\_{EHT-STF}^{\left(i\_{seg},i\_{TX}\right)}\left(t\right)=w\_{T\_{EHT-STF-NT}}\left(t\right)\sum\_{r=0}^{N\_{RU}-1}\frac{α\_{r}β\_{r}}{\sqrt{N\_{STS,r,total}}} (34-17)$$

$$\sum\_{k\in K\_{r}}^{}\sum\_{u=0}^{N\_{user}-1}\sum\_{m=1}^{N\_{STS,r,u}}\left(\left[Q\_{k}^{\left(i\_{seg}\right)}\right]\_{i\_{TX}, M\_{r,u}+m}EHTS\_{k}∙exp\left(j2πk∆\_{F,EHT}\left(t-T\_{CS, EHT}\left(M\_{r,u}+m\right)\right)\right)\right)$$

where

$α\_{r}$ is defined in 34.3.9.3 (Transmitted signal)

$β\_{r}$ is the per-RU power normalization factor and defined by

$$β\_{r}={\left(\sqrt{\frac{\left|K\_{r}\right|}{\left|K\_{r}^{EHT-STF}\right|}}\right)}/{\left(\sqrt{\sum\_{r=0}^{N\_{RU}-1}α\_{r}^{2}\left|K\_{r}\right|}\right)}$$

 $\left|K\_{r}\right|$ is the cardinality of the set of subcarriers $K\_{r}$, as defined in 34.3.10 (Mathematical description of signals)

 $K\_{r}^{EHT-STF}$ is the set of subcarriers that have nonzero values within $K\_{r}$ in the EHT-STF field

$T\_{CS, EHT}\left(M\_{r,u}+m\right)$ represents the cyclic shift for space-time stream $M\_{r,u}+m$ as defined in 34.3.11.2.2 (Cyclic shift for EHT modulated field)

$Q\_{k}^{\left(i\_{seg}\right)}$ is defined in 34.3.10 (Mathematical description of signals)

$w\_{T\_{EHT-STF-NT}}$ is the windowing function for EHT-STF field in the EHT MU PPDU

$\left|K\_{r}^{EHT-STF}\right|$ is the cardinality of the set of subcarriers $K\_{r}^{EHT-STF}$

$N\_{RU},N\_{STS,r,total},N\_{user,r}$ and $N\_{STS,r,u}$ are defined in 34-x2 (Frequently used parameters).

The time domain representation of the signal for an EHT TB PPDU transmitted by user *u* in the *r-*th RU on frequency segment *iSeg* and transmit chain *iTX* shall be as specified in Equation (34-18).

$$r\_{EHT-STF,r,u}^{\left(i\_{seg},i\_{TX}\right)}\left(t\right)=\frac{1}{\sqrt{\left|K\_{r}^{EHT-STF}\right|N\_{STS,r,total}}}w\_{T\_{EHT-STF-T}}\left(t\right) (34-18)$$

$$\sum\_{k\in K\_{r}}^{}\sum\_{m=1}^{N\_{STS,r,u}}\left(\left[Q\_{k,u}^{\left(i\_{seg}\right)}\right]\_{i\_{TX},m}EHTS\_{k}∙exp\left(j2π∆\_{F,EHT}\left(t-T\_{CS, EHT}\left(M\_{r,u}+m\right)\right)\right)\right)$$

where

$w\_{T\_{EHT-STF-T}}$ is the windowing function for EHT-STF field in the EHT TB PPDU

$Q\_{k,u}^{\left(i\_{seg}\right)}$ is defined in 34.3.10 (Mathematical description of signals).