### **IEEE P802.11Wireless LANs**

|  |
| --- |
| PDT EHT Ranging NDP |
| Date: 2023-05-16 |
| Author(s): |
| Name | Affiliation | Email |
| Steve Shellhammer | Qualcomm Technologies, Inc. | shellhammer@ieee.org |
| Ali Raissinia | Qualcomm Technologies, Inc. | alirezar@qti.qualcomm.com |
| Yanjun Sun | Qualcomm Technologies, Inc. | yanjuns@qti.qualcomm.com |

**Introduction**

This document provides proposed draft text for IEEE 802.11bk draft.

The following Motions apply to this PDT:

Both the EHT Ranging NDP and the EHT TB Ranging NDP shall use the 2x LTF with 1.6 µs GI. (11-23-40: 202301-06)

Both the EHT Ranging NDP and the EHT TB Ranging NDP will support up to eight EHT-LTF Repetition Blocks, and will not support extra EHT LTFs

(11-23-08: 202301-08)

Both the EHT Ranging NDP and the EHT TB Ranging NDP use only the 2x LTF with 1.6 µs GI. (11-23-08: 202301-11)

The EHT Ranging NDP shall use the EHT MU PPDU preamble (11-23-40/202301-05)

EHT TB Ranging NDP uses the EHT TB PPDU preamble. (11-23-40: 202301-07)

The EHT Ranging NDP and the EHT TB Ranging NDP shall only have an 8 µs PE duration. (202303-02)

***TGbk editor: Please add the following subclause TBD:***

**36.3.XX EHT Ranging NDP**

The format of the EHT Ranging NDP is shown in Figure 36-A (EHT ranging NDP format)



*Figure 36-A: EHT ranging NDP format*

The EHT Ranging NDP has the following properties:

— It is an EHT MU PPDU with a single EHT-SIG symbol encoded using EHT-MCS 0 and no Data field. The EHT-SIG field only contains a Common field as defined in Table 36-37 (Common field for EHT sounding NDP) and no User Specific field.

— An EHT Ranging NDP is indicated by setting the PPDU Type and Compression mode subfield of the U-SIG to 1. The EHT Ranging NDP only supports EHT U-SIG bandwidth subfield values of 320 MHz-1 and 320 MHz-2.

— In the EHT Ranging NDP, the 242-tone RUs overlapping the 20 MHz channels that are signaled as punctured through the Punctured Channel Indication field of the U-SIG field are punctured. The allowed punctured patterns are TBD.

— The L-STF and L-LTF fields in an EHT ranging NDP are the same as the L-STF and L-LTF fields in an EHT MU PPDU. The subfields in L-SIG, RL-SIG, U-SIG, and EHT-SIG have the same bit assignments and definitions as the subfields in a EHT MU PPDU unless specified otherwise.

— The EHT-STF field in an EHT Ranging NDP is the same as the EHT-STF field in an EHT MU PPDU.

— Uses EHT-LTFs or secure EHT-LTFs when the TXVECTOR parameter SECURE\_LTF\_FLAG is set to 0 or 1 respectively.

— Secure EHT-LTFs use randomized EHT-LTF sequences, pseudorandom and deterministic per stream phase rotation and when the TXVECTOR parameter TX\_WINDOW\_FLAG is set to 1, a frequency domain flat top window is used instead of the frequency domain rectangular window; see 36.4.TBD (Construction of secure EHT-LTF symbols).

— Uses EHT-LTF repetitions, if indicated in the TXVECTOR parameter LTF\_REP by values larger than one.

— The EHT-LTF field consists of one or more EHT-LTF User Blocks; each EHT-LTF User Block contains one or more EHT-LTF Repetition Blocks, where the number of EHT-LTF Repetition Blocks is equal to LTF\_REP. An EHT-LTF Repetition Block in an EHT-LTF User Block comprises one or more EHT-LTF symbols, $N\_{EHT-LTF}$, calculated using the number of space- time streams NUM\_STS for this user, as defined in Table 21-13 (Number of VHT-LTFs required for different numbers of space-time streams).

— When the TXVECTOR parameter SECURE\_LTF\_FLAG is equal to 0, the number of EHT-LTF User Blocks is equal to 1, and the same EHT-LTF User Block is applied to all users. When the TXVECTOR parameter SECURE\_LTF\_FLAG is equal to 1, an EHT-LTF User Block contains all EHT-LTF symbols for one user, and the number of EHT-LTF User Blocks in the EHT-LTF field is equal to the number of Users, NUM\_USERS, and each EHT-LTF User Block contains all the EHT-LTF symbols for one user.

— No beamforming steering matrix is applied to the waveform. The Beamformed field in EHT-SIG of an EHT Ranging NDP is always set to 0.

— For transmission of EHT-STFs and EHT-LTFs, if NSTS = NTx, the Q matrix shall be an Identity matrix, and if NSTS < NTx, the Q matrix shall be based on an antenna selection matrix with no antenna swapping. The Q matrix becomes an Identity matrix when all 0 rows are removed.

— Has a Packet Extension (PE) field that is 8 µs in duration. No energy is transmitted during the first 1.6 µs of the PE field if the EHT-LTF field is using the secure EHT-LTF, similar to no energy being transmitted during the GI of EHT-LTF symbols.

— For decoding the EHT-LTF fields, a PHY-RXLTFSEQUENCE.request primitive issued from the MAC provides the LTF\_REP, LTF\_NSTS, and LTF\_OFFSET parameters, which are not encoded in the EHT-SIG, but included in the preceding Ranging NDP Announcement frame. The LTF\_OFFSET parameter indicates the number of secure EHT-LTF symbols to skip for receiving the corresponding user’s EHT-LTF User Block.

— When the TXVECTOR parameter NUM\_USERS is greater than 1, the TXVECTOR parameter NUM\_STS[1] is used to set the NSS subfield and the Number of EHT-LTF Symbols subfield within the Common field of the EHT-SIG for the EHT sounding NDP. The Number of EHT-LTF Symbols subfield is set according to Table 21-13 (Number of VHT-LTFs required for different numbers of space-time streams). Otherwise, the TXVECTOR parameter NUM\_STS is used to set the NSS subfield and the Number of EHT-LTF Symbols subfield within the Common field of the EHT-SIG for the EHT sounding NDP. The Number of EHT-LTF Symbols subfield is set according to Table 21-13 (Number of VHT-LTFs required for different numbers of space-time streams).

— The only supported mode is 2x EHT-LTF with 1.6 µs GI. The other combinations of EHT-LTF modes and GI duration are disallowed. No energy is transmitted during the GI of the EHT-LTF symbols when secure EHT-LTF are used, which is referred to as a zero-power GI.

— The number of EHT-LTF symbols in the EHT-LTF field in an EHT Ranging NDP depends on the number of space-time streams NUM\_STS, the number of EHT-LTF repetitions, LTF-REP, and when secure EHT-LTFs are used, the number of users NUM\_USERS.

NOTE—See examples in Figure 36-B (An example of EHT-LTF field in an EHT ranging NDP with NUM\_USERS=1, NUM\_STS=2 and LTF\_REP =2) and Figure 36-C (Example of Secure EHT-LTF field with NUM\_USERS=2, NUM\_STS=[2,1] and LTF\_REP =[2,2]).



*Figure 36-B: An example of EHT-LTF field in an EHT ranging NDP with NUM\_USERS=1, NUM\_STS=2 and LTF\_REP =2*



*Figure 36-C —An example of secure EHT-LTFs with NUM\_USERS=2, NUM\_STS=[2,1] and LTF\_REP =[2,2]*

When the TXVECTOR parameter SECURE\_LTF\_FLAG is equal to 0, EHT-LTFs as defined in Subclause 36.4.TBD (EHT-LTF) are used in the EHT Ranging NDP. There is a single EHT-LTF User Block in an EHT-LTF field, and the total number of EHT-LTF symbols in the EHT-LTF field is the product of the number of symbols in an EHT-LTF Repetition Block, $N\_{EHT-LTF} $, and the number of EHT-LTF repetitions, given in LTF\_REP.

The construction of the EHT-LTFs in an EHT Ranging NDP is done by repeating the steps in Subclause 36.4.TBD (Construction of EHT-LTF) LTF\_REP times, i.e., a value of LTF\_REP equal to 1 indicates a single EHT-LTF Repetition Block, and a value of LTF\_REP greater than 1 indicates the use of repetitions, i.e., multiple EHT-LTF Repetition Blocks are included in an EHT-LTF User Block. If the TXVECTOR parameter SECURE\_LTF\_FLAG is equal to 0, the TXVECTOR parameter NUM\_USERS is not present which is then assumed to be 1, and all the EHT-LTF symbols belong to a single EHT-LTF User Block.

When the TXVECTOR parameter SECURE\_LTF\_FLAG is equal to 1, secure EHT-LTFs as defined in 36.4.TBD (Construction of secure EHT-LTF symbols), are used and the Packet Extension field will be partially replaced by a zero power GI in its first 1.6 µs, see Figure 36.4.D (EHT Ranging NDP format with secure EHT-LTFs). For the secure EHT-LTF symbol or Packet Extension field with zero power GI, the time domain signal has zero power during the period of the GI. The TXVECTOR parameters LTF\_KEY, NUM\_STS and LTF\_REP will be in array form with NUM\_USERS entries. The repetitions of the EHT-LTF symbols are repetitions of the EHT-LTF Repetition Block. The randomized EHT-LTF sequences are different in each of the EHT-LTF Repetition Blocks. The total number of EHT-LTF symbols in an EHT-LTF User Block is the product of the number of symbols in an EHT-LTF Repetition Block, $N\_{EHT-LTF}$, and the number of EHT-LTF repetitions given in LTF\_REP.

For secure EHT-LTF transmissions, the number of EHT-LTF repetitions given in LTF\_REP shall be greater than 1, and there are a minimum of two EHT-LTF Repetition Blocks in each EHT-LTF User Block.



*Figure 36.D — EHT Ranging NDP format with secure EHT-LTFs*

NOTE— The intended receiver of the Secure EHT-LTFs can use implementation specific methods to detect the occurrence of an attack. It can explore the EHT-LTF repetitions to check the consistency of the channel estimation or the signal to interference ratio (SIR) drop from impact of an attack. Please see Annex AE for more details on SIR drop due to an attack.

The secure EHT-LTFs of each User Block are concatenated one after another and form the EHT-LTF field of an EHT Ranging NDP; the total number of EHT-LTF symbols in an EHT-LTF field shall not exceed a maximum of 64 secure EHT-LTF symbols over all users, all space time streams and number of EHT-LTF repetitions.

In each EHT-LTF User Block within the EHT-LTF field, the number of Tx antennas are the same as the number indicated in NUM\_STS for the corresponding EHT-LTF User Block and may vary from one EHT-LTF User Block to another. Within the EHT-STF field, the number of Tx antennas should match the first EHT-LTF User Block. In the pre-EHT modulated fields, the number of Tx antennas used shall be no less than the minimum number of Tx antennas used in the EHT modulated fields. The sum of the Tx power across all Tx antennas shall remain constant throughout the entire EHT Ranging NDP PPDU.