IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| PDT PHY Transmitter Block Diagram | | | | |
| Date: 2025-01-09 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Yusuke Asai | NTT |  |  | yusuke.asai@ntt.com |
| Mengshi Hu | Huawei Technologies Co., Ltd |  |  | humengshi@huawei.com |
| Jianhan Liu | MediaTek Inc. |  |  | jianhan.liu@mediatek.com |
| Qinghua Li | Intel |  |  | qinghua.li@intel.com |
| Eugene Baik | Qualcomm Technologies, Inc |  |  | eugeneb@qti.qualcomm.com |
| Shengquan Hu | MediaTek Inc. |  |  | shengquan.hu@mediatek.com |
| Bo Sun | Sanechips |  |  | Sun.bo1@sanechips.com.cn |
| Youhan Kim | Qualcomm Technologies, Inc. |  |  | youhank@qti.qualcomm.com |
| Alice Chen | Qualcomm Technologies, Inc. |  |  | alicel@qti.qualcomm.com |
| Ross Jian Yu | Huawei Technologies Co., Ltd |  |  | ross.yujian@huawei.com |
| Jiyang Bai | TCL |  |  | jiyangbai@gmail.com |
| Rui Cao | NXP Semiconductors |  |  | rui.cao\_2@nxp.com |
| Lin Yang | Qualcomm Technologies, Inc |  |  | linyang@qti.qualcomm.com |

Abstract

This document contains Proposed Draft Text (PDT) for the Transmitter Block Diagram subsection of the proposed TGbn (UHR, Ultra High Reliability) amendment to the 802.11 standard

# Revision information

The following is a summary of the important changes that occurred within each revision of this document:

|  |  |
| --- | --- |
| **Revision** | **Major changes** |
| 0 | Initial revision |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

**Introduction**

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 TGbn Draft. The abstract, revision information, introduction, explanation of the proposed changes, and references sections are not part of the adopted material.

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

**Explanation of the proposed changes:**

The proposed changes to the 802.11 TGbn draft within this document are based on the following motions adopted by the TGbn task group.

**Relevant passing motions:**

(Motion numbers are from [a].)

(Reference numbers are from the SFD ([11-24/209r7](https://mentor.ieee.org/802.11/dcn/24/11-24-0209-07-00bn-specification-framework-for-tgbn.docx)).)

* “PHY Version Identifier” is set to 1 in U-SIG field for UHR PPDUs.

[Motion #22, [1] and [38]]

* TGbn defines unequal modulation (UEQM) over different spatial streams.

[Motion #23, [1] and [39]]

* UHR defines unequal modulation only for LDPC.

[Motion #53, [1] and [159]]

* UHR defines unequal modulation which uses joint LDPC encoding across multiple spatial streams while at least one spatial stream uses a different modulation order compared to the first spatial stream, and is applicable only to non-MU-MIMO beamformed transmissions using 2 to 4 spatial streams in a UHR MU PPDU.

[Motion #117, [1] and [159, 186, 187]]

* TGbn defines Enhanced Long Range (ELR) PPDU and potentially other Range Extension mechanisms.

[Motion #24, [1] and [40]]

* The BW of ELR PPDU is 20MHz and one Spatial stream is used for ELR transmission.

[Motion #92, [1] and [175]]

* In the ELR transmission, a repeating of 52-tone RRU is used in 20MHz.
  + The same data is repeated in four 52-tone RRUs in 20 MHz.
  + The subcarrier allocation of 52-tone RRU equals the 52-tone RU defined in 11be.

[Motion #93, [1] and [175]]

* 11bn defines the following PPDU frame format for ELR
  + PE TBD

L-SIG

RL-SIG

ELR-Data

L-LTF

L-STF

ELR-mark2

ELR-mark1

ELR-STF

ELR-LTF

ELR-SIG

U-SIG1

U-SIG2

[Motion #81, [1] and [170]]

* ELR PPDU starts with L-STF, L-LTF, L-SIG, RL-SIG, and U-SIG in the PPDU for the ELR transmission.

[Motion #32, [1] and [84]]

NOTE from the editor: There is no L-preabmle terminology in Draft P802.11 REVme D7.0.

* ELR-SIG is located right after ELR-LTF in ELR PPDU.
  + Note that ELR-LTF is the short name of UHR-LTF for ELR PPDU

[Motion #36, [1] and [88]]

* ELR PPDU only supports the following two modulation and coding schemes:
  + BPSK with coding rate R=1/2
  + QPSK with coding rate R=1/2

[Motion #76, [1] and [169]]

* ELR transmission shall apply the phase rotations as below for both BPSK and QPSK modulations
  + The rotation of -1 will be applied on data subcarriers of lower half of RU3 and upper half of RU4 for 52-tone regular RU (RRU52) on 20MHz



[Motion #77, [1] and [169]]

**Legends:**

* Yellow marker: Related to UEQM transmission [b].
* Green marker: Related to ELR PPDUs [c].

**Text to be adopted begins here:**

***TGbn editor: Please add the following new subclauses for Enhanced Long Range PPDU to the 802.11bn draft D0.1:***

* + 1. **Transmitter block diagram**

The generation of each field in an UHR PPDU uses many of the following blocks:

1. Pre-FEC PHY padding
2. Scrambler
3. FEC (BCC or LDPC) encoders
4. Post-FEC PHY padding
5. Stream parser
6. Segment parser (for RU or MRU size larger than 996 tones)
7. BCC interleaver
8. Constellation mapper
9. Pilot insertion
10. Replication over multiple 20 MHz (for bandwidth greater than 20 MHz)
11. LDPC tone mapper
12. Segment deparser
13. Frequency domain duplication over 52-tone regular RUs (RRU52s) if a UHR ELR PPDU is transmitted.
14. CSD per spatial stream insertion
15. Spatial mapper
16. Frequency mapping
17. IDFT
18. CSD per chain insertion
19. GI insertion
20. Windowing

[Figure 38-aa (Transmitter block diagram for the L-SIG, RL-SIG, and U-SIG fields for an UHR MU PPDU)](#_bookmark52) to [Figure 38-mm (](#_bookmark59)Transmitter block diagram for the Data field of a UHR ELR PPDU transmission with LDPC encoding[)](#_bookmark59) show example transmitter block diagrams. The actual structure of the transmitter is implementation dependent.

In particular, [Figure 38-aa (Transmitter block diagram for the L-SIG, RL-SIG, and U-SIG fields for an UHR](#_bookmark52) [MU PPDU)](#_bookmark52) shows the transmit process for the L-SIG, RL-SIG, and U-SIG fields of an UHR MU PPDU using one 80 MHz frequency subblock. These transmit blocks are also used to generate the L-STF and L- LTF fields of the UHR MU PPDU with the following exceptions:

— The BCC encoder and interleaver as well as constellation mapper are not used when generating the L-STF and L-LTF fields.

NOTE—For an UHR MU PPDU, the duplication on 20 MHz channels is subject to the availability of 20 MHz channels in the case of preamble puncturing. The U-SIG field contents may be different in different 80 MHz frequency subblocks for PPDU bandwidth greater than 80 MHz.



**Figure 38-aa—Transmitter block diagram for the L-SIG, RL-SIG, and U-SIG fields for a UHR MU PPDU**

[Figure 38-bb (Transmitter block diagram for the L-SIG, RL-SIG, and U-SIG fields of an UHR TB PPDU)](#_bookmark53) shows the transmit process for the L-SIG, RL-SIG, and U-SIG fields of an UHR TB PPDU. These transmit blocks are also used to generate the L-STF and L-LTF fields of the UHR TB PPDU with the following exception:

— The BCC encoder, interleaver, and constellation mapper are not used when generating the L-STF and L-LTF fields.

The L-SIG, RL-SIG, and U-SIG fields are duplicated over multiple 20 MHz if the UHR modulated fields are allocated in an RU or MRU > 242 tones.



**Figure38-bb—Transmitter block diagram for the L-SIG, RL-SIG, and U-SIG fields of an UHR TB PPDU**

[Figure 38-cc (Transmitter block diagram for the UHR-SIG field for a UHR MU PPDU)](#_bookmark54) shows the transmit process for the UHR-SIG field of an UHR MU PPDU. This block diagram is for transmitting UHR-SIG in one 20 MHz subchannel. Refer to [38.3.14.9.2 (UHR-SIG content channels)](#_bookmark113) for the methods of transmitting UHR-SIG in 40 MHz, 80 MHz, 160 MHz, and 320 MHz.



**Figure 38-cc—Transmitter block diagram for the UHR-SIG field for an UHR MU PPDU**

.

Figure 38-dd (Transmitter block diagram for the UHR ELR-SIG field of a UHR ELR PPDU) shows the transmit process for the UHR ELR-SIG field of a UHR ELR PPDU.



**Figure 38-dd— Transmitter block diagram for the UHR ELR-SIG field of a UHR ELR PPDU**

[Figure 38-ee (Transmitter block diagram for the UL transmission or DL non-MU-MIMO transmission of a](#_bookmark55) [Data field with BCC encoding on an RU or MRU size equal to or smaller than a 242-tone RU when EQM applies)](#_bookmark55) shows the transmitter blocks for the UL transmission or DL non-MU-MIMO transmission of a Data field with BCC encoding on an RU or MRU smaller than or equal to 242 tone if the number of spatial streams is less than or equal to 4. [Figure 38-ee (Transmitter block diagram for the UL transmission or DL non-MU-MIMO](#_bookmark55) [transmission of a Data field with BCC encoding on an RU or MRU size equal to or smaller than a 242-tone](#_bookmark55) [RU when EQM applies)](#_bookmark55) applies to the Data field of an UHR MU PPDU that is transmitted on an RU or MRU allocated to a single user and the Data field of an UHR TB PPDU (whether or not it is spatially multiplexed with other users).

A subset of these transmitter blocks consisting of the CSD blocks, as well as the blocks to the right of, and including, the spatial mapping block, are also used to generate the UHR-LTF and UHR-STF fields.



**Figure 38-ee—Transmitter block diagram for the UL transmission or DL non-MU-MIMO transmission of a Data field with BCC encoding on an RU or MRU size equal to or smaller than a 242-tone RU when EQM applies**

[Figure 38-ff (Transmitter block diagram for the UL transmission or DL non-MU-MIMO transmission of a](#_bookmark56) [Data field with LDPC encoding on an RU or MRU size equal to or smaller than a 996-tone RU when EQM applies)](#_bookmark56) shows the transmitter blocks for the UL transmission or DL non-MU-MIMO transmission of a Data field with LDPC encoding on an RU or MRU that is the same size or smaller than a 996-tone RU when EQM applies. [Figure 38-ff (Transmitter](#_bookmark56) [block diagram for the UL transmission or DL non-MU-MIMO transmission of a Data field with LDPC](#_bookmark56) [encoding on an RU or MRU size equal to or smaller than a 996-tone RU when EQM applies)](#_bookmark56) applies to the Data field of an UHR MU PPDU that is transmitted on an RU or MRU allocated to a single user and the Data field of an UHR TB PPDU (whether or not it is spatially multiplexed with other users).



**Figure 38-ff—Transmitter block diagram for the UL transmission or DL non-MU- MIMO transmission of a Data field with LDPC encoding on an RU or MRU size equal to or smaller than a 996-tone RU when EQM applies**

Figure 38-gg (Transmitter block diagram for the DL SU transmission or DL non-MU-MIMO transmission of a Data field with LDPC encoding on an RU or MRU equal to or smaller than a 996-tone RU when UEQM applies) shows the transmitter blocks used to generate the Data field of a DL transmission or DL non-MU-MIMO transmission with LDPC encoding on an RU or MRU whose size is the same as or smaller than a 996-tone RU when UEQM is applied to the spatial streams of the user.



**Figure 38-gg— Transmitter block diagram for the DL SU transmission or DL non-MU-MIMO transmission of a Data field with LDPC encoding on an RU or MRU equal to or smaller than a 996-tone RU when UEQM applies**

[Figure 38-hh (Transmitter block diagram for the DL MU-MIMO transmission of a Data field with BCC](#_bookmark57) [encoding on a 242-tone RU when EQM applies)](#_bookmark57) shows the transmitter blocks for the transmission, in an UHR MU PPDU, of the Data field with BCC encoding on a 242-tone RU allocated to more than one user when EQM applies.



**Figure 38-hh—Transmitter block diagram for the DL MU-MIMO transmission of a Data field with BCC encoding on a 242-tone RU when EQM applies**

[Figure 38-ii (Transmitter block diagram for the DL MU-MIMO transmission of a Data field with LDPC](#_bookmark58) [encoding on a 242-, 484-, 484+242-, or 996-tone RU or MRU when EQM applies)](#_bookmark58) shows the transmitter blocks for the transmission, in an UHR MU PPDU, of the Data field with LDPC encoding on a 242-, 484-, 484+242-, or 996-tone RU or MRU allocated to more than one user when EQM applies.



**Figure 38-ii—Transmitter block diagram for the DL MU-MIMO transmission of a Data field with LDPC encoding on a 242-, 484-, 484+242-, or 996-tone RU or MRU when EQM applies**

[Figure 38-jj (Transmitter block diagram for the Data field of an UHR SU transmission with LDPC encoding on RU or MRU size](#_bookmark59) [larger than a 996-tone RU)](#_bookmark59) shows the transmitter blocks used to generate the Data field of a single-user UHR transmission with LDPC encoding on RU or MRU size larger than 996 tone.



**Figure 38-jj—Transmitter block diagram for the Data field of an UHR SU transmission with LDPC encoding on RU or MRU size larger than a 996-tone RU when EQM applies**

Figure 38-kk (Transmitter block diagram for the DL SU transmission or DL non-MU-MIMO transmission of a Data field with LDPC encoding in an RU or MRU larger than a 996-tone RU when UEQM applies) shows the transmitter blocks used to generate the Data field of a DL SU transmission or DL non-MU-MIMO transmission with LDPC encoding in an RU or MRU whose size is larger than a 996-tone RU when UEQM is applied to the spatial streams of the user.

**Figure 38-kk— Transmitter block diagram for the DL SU transmission or DL non-MU-MIMO transmission of a Data field with LDPC encoding on an RU or MRU larger than a 996-tone RU when UEQM applies**

Figure 38-ll (Transmitter block diagram for the Data field of a UHR ELR PPDU transmission with BCC encoding) shows the transmit blocks used to generate the Data field of a UHR ELR PPDU with BCC encoding.



**Figure 38-ll— Transmitter block diagram for the Data field of a UHR ELR PPDU transmission with BCC encoding**

Figure 38-mm (Transmitter block diagram for the Data field of a UHR ELR PPDU transmission with LDPC encoding) shows the transmit blocks used to generate the Data field of a UHR ELR PPDU with LDPC encoding.



**Figure 38-mm— Transmitter block diagram for the Data field of a UHR ELR PPDU transmission with LDPC encoding**

**Text to be adopted ends here.**

**References:**

[a] Alfred Asterjadhi, “TGbn Motions List – Part 1,” 11-24/171r26.

<https://mentor.ieee.org/802.11/dcn/24/11-24-0171-26-00bn-tgbn-motions-list-part-1.pptx>

[b] Rui Cao, “PDT PHY Unequal Modulation (UEQM) and New MCSs, 11-24/1985r2.

<https://mentor.ieee.org/802.11/dcn/24/11-24-1985-02-00bn-pdt-phy-unequal-modulation-ueqm-and-new-mcs.docx>

[c] Lin Yang, “PDU PHY Enhanced Long Range (ELR),” 11-24/1981r3.

<https://mentor.ieee.org/802.11/dcn/24/11-24-1981-03-00bn-pdt-elr.docx>

**Visio files for the figures:**

