IEEE P802.11
Wireless LANs

|  |
| --- |
| 11be PDT PHY - EHT DUP mode |
| Date: 2021-01-21 |
| Author(s): |
| Name | Affiliation | Address | Phone | Email |
| Srinath Puducheri Sundaravaradhan | Broadcom |  |  | srinath.sundar@gmail.com |
| Jianhan Liu | Mediatek |  |  | jianhan.liu@mediatek.com |

**Abstract**

The baseline for this text is 802.11be D0.3.

This document contains draft text of the following motions in [1]:

Motion 122: #SP162, #SP163, #SP170

Motion 137: #SP280

Motion 135: #SP210

**Version history:**

Rev0: initial PDT on EHT-DUP mode

Rev1: updated based on review comments and feedback received during the 11be PHY ad-hoc call on Jan 25, 2021

Rev2: updated based on review comments and feedback received during the 11be PHY ad-hoc call on Jan 28, 2021

**Summary of proposed changes:**

1. Addition of a new section 36.3.X on “EHT-duplicate transmission”:
	* Provides an introduction to DUP mode with a high-level description and pointers to other sections containing more information.
	* Recommend inserting this section before 36.3.5 (Transmitter block diagram) to provide context.
2. Addition of a new section 36.3.12.Y on “Frequency-domain duplication” under 36.3.12 (Data field):
	* This describes the actual frequency domain duplication operation, including sign-flip for PAPR reduction.
	* Recommend inserting this section after segment-deparser (when it is added).
3. Modifications to the following existing sections to account for the new EHT-DUP mode:
	* 3.4 Abbreviations and acroyms
	* 36.1.1 Introduction to the EHT PHY
	* 36.3.2.1 Subcarriers and Resource allocation for wideband
	* 36.3.5 Transmitter block diagram
	* 36.3.6.10 Construction of Data field in an EHT PPDU
	* 36.3.10.2 Subcarrier indices in use
	* 36.3.10.4 Transmitted signal
	* 36.3.12.8 Constellation mapping
	* 36.3.18.4.3 Transmitter constellation error
	* 36.3.19.2 Receiver minimum input sensitivity
	* 36.3.19.3 Adjacent channel rejection
	* 36.5 Parameters for EHT-MCSs

***Proposed changes to 11be D0.3:***

**3.4 Abbreviations and acroyms**

EHT-DUP EHT duplication

**36.1.1 Introduction to the EHT PHY**

***P153, L60 insert new text:***

The EHT PHY provides support of MRU assigned to a single STA. The EHT PHY also supports preamble puncturing of EHT MU PPDU.

The EHT PHY provides support for EHT duplication (EHT-DUP) mode for single user transmission in the 6 GHz band. EHT-DUP mode is signaled as EHT-MCS 14 with a single spatial stream.

***P154, L61 insert new text:***

An EHT STA may support the following features:

* EHT-MCSs 10 to 13 (transmit and receive) if the STA is not a 20 MHz-only non-AP STA.‌ﾠEHT-MCSs 8 to 13 (transmit and receive) if the STA is a 20 MHz-only non-AP STA.
* Single spatial stream EHT-MCS 14 (transmit and receive) in 6 GHz LPI (definition of LPI is TBD) channel.

**36.3.2.1** **Subcarriers and Resource allocation for wideband**

***P176, L27 delete existing text, insert new text:***

For an EHT PPDU using non-OFDMA transmission:

* ~~The tone plan of an 80/160 MHz EHT PPDU is identical to that of HE PHY defined in Clause 27 (High Efficiency (HE) PHY specification), with the exception of pilot locations and the exception of any punctured 80 MHz segment.~~
* The tone plan of an 80MHz EHT MU PPDU in EHT-DUP mode (described in 36.3.X (EHT-duplicate transmission)) is identical to that of a DL-OFDMA transmission comprising two 484-tone RUs as shown in Figure 36-4 (RU locations in an 80MHz EHT PPDU).
* The tone plan of an 80 MHz EHT PPDU that is not an EHT MU PPDU in EHT-DUP mode, is identical to that of HE PHY defined in Clause 27 (High Efficiency (HE) PHY specification), with the exception of pilot locations and the exception of any puncturing.
* The tone plan of a 160 MHz EHT PPDU is identical to that of HE PHY defined in Clause 27 (High Efficiency (HE) PHY specification), with the exception of pilot locations and the exception of any punctured 80 MHz segment.

***Add the following new section to sub-clause 36.3, preceding 36.3.5 (Transmitter Block Diagram):***

**36.3.X EHT-duplicate transmission**

EHT-duplicate (EHT-DUP) transmission is a mode wherein the transmitted data in the payload portion of the PPDU is duplicated in frequency.

EHT-DUP mode is an optional mode that is applicable only in the 6 GHz band. EHT-DUP mode is applicable only for single user transmission in an EHT MU PPDU. EHT-DUP mode shall only be used with bandwidth 80/160/320 MHz and without preamble puncturing.

EHT-DUP mode is applicable only in conjunction with BPSK-DCM modulation, rate-1/2 LDPC coding, Nss=1.

EHT-DUP mode is signaled by setting the PPDU type And Compression Mode subfield of U-SIG (Table 36-19) to 1 to indicate an EHT transmission to single-user, and setting the MCS subfield of the User field in EHT-SIG (Table 36-31) to 14.

In EHT-DUP mode, the encoding and modulation are described as follows:

* For an 80 MHz EHT MU PPDU transmitted in EHT-DUP mode, encoding and BPSK-DCM modulation are done for the first 484-tone RU, and then the first 484-tone RU is duplicated to the second 484-tone RU along with a partial sign-change to reduce PAPR.
* For an 160 MHz EHT MU PPDU transmitted in EHT-DUP mode, encoding and BPSK-DCM modulation are done for the first 996-tone RU, and then the first 996-tone RU is duplicated to the second 996-tone RU along with a partial sign-change to reduce PAPR
* For a 320 MHz EHT MU PPDU transmitted in EHT-DUP mode, encoding and BPSK-DCM modulation are done for first 2x996-tone RU, and then the first 2x996-tone RU is duplicated to the second 2x996-tone RU along with a partial sign-change to reduce PAPR.

The above frequency domain duplication occurs after LDPC tone mapping and segment deparsing operations (TBD section). The details of the duplication and partial sign-change operations are described in 36.3.12.Y (Frequency-domain duplication).

The EHT-STF, EHT-LTF, and pilot subcarriers for an 80 MHz EHT MU PPDU transmitted in EHT-DUP mode are constructed in an identical manner to those of an EHT MU PPDU transmitted in OFDMA format with 484-tone RU1 and RU2 occupied.

The EHT-STF, EHT-LTF, and pilot subcarriers for a 160/320 MHz EHT MU PPDU transmitted in EHT-DUP mode are constructed in an identical manner to those of a 160/320 MHz EHT MU PPDU transmitted in non-OFDMA format.

**36.3.5 Transmitter block diagram**

***P199, L40-41 delete existing text, insert new text:***

~~n) Frequency domain duplication for EHT-MCS 14 if bandwidth is greater than or equal to 80 MHz~~

~~o) Segment deparser (for RU/MRU size larger than 996 tone)~~

n) Segment deparser

o) Frequency domain duplication

**36.3.6.10 Construction of Data field in an EHT PPDU**

***P209, L21 delete the following:***

~~NOTE - EHT Duplicate mode is not included in the description below for simplicity~~

***P209, L58 insert a new item at ‘l)’ and re-number subsequent items***

1. Segment deparser: In a 2x996-tone RU, 4x996-tone RU, 996+484-tone MRU, 996+484+242-tone MRU, 2x996+484-tone MRU, 3x996-tone MRU, or 3x996+484-tone MRU, merge the multiple frequency subblocks into one frequency segment as described in 36.3.12.4 (Stream parser). This block is bypassed for RUs or MRUs of other sizes.
2. Frequency-domain duplication: for an EHT MU PPDU transmitted to a single-user with EHT-MCS 14, perform frequency-domain duplication as described in 36.3.12.Y (Frequency-domain duplication). This block is bypassed for all other cases.
3. Pilot insertion: Insert pilots following the steps described in 36.3.12.9 (Pilot subcarriers).

**36.3.10.2 Subcarrier indices in use**

***P216, L56 insert new text:***

For an 80 MHz non-OFDMA EHT PPDU transmission that is not in EHT-DUP mode, the 80 MHz is divided into 1024 subcarriers. The signal is transmitted on subcarriers -500 to -3 and 3 to 500, with 0 being the center subcarrier.

For an 80 MHz non-OFDMA EHT MU PPDU transmission in EHT-DUP mode, the 80 MHz is divided into 1024 subcarriers. The signal is transmitted on subcarriers -500 to -259, -253 to -12, 12 to 253, and 259 to 500, with 0 being the center subcarrier.

**36.3.10.4 Transmitted signal**

***P221, L48 insert new text:***

For pre-EHT modulated fields, is the set of subcarriers indices in the allocated 20 MHz channels. For EHT modulated fields in a non-punctured non-OFDMA EHT PPDU that is not in EHT-DUP mode, is the set of subcarriers indices from to as defined in Table 36-10 (Subcarrier allocation related constants for the EHT-modulated fields in a full bandwidth non-OFDMA EHT PPDU) excluding DC subcarriers. For EHT modulated fields in a non-punctured non-OFDMA EHT MU PPDU transmitted in EHT-DUP mode, is the set of subcarriers indices for the tones in the r-th RU~~, where~~ . For EHT modulated fields in a punctured non-OFDMA EHT PPDU and an OFDMA EHT PPDU, is the set of subcarriers indices for the tones in the r-th RU or MRU.

**36.3.12.8 Constellation mapping**

***P303, L18 delete existing text, insert new text:***

DCM is ~~an~~ ~~optional~~ a modulation scheme that is applied to EHT-MCSs 14 and 15. It only applies to BPSK and N\_ss = 1.

***P303, L37 delete existing text (moved to new section 36.3.X (EHT-duplicate transmission)):***

~~DUP mode is used in combination with EHT-MCS0 + DCM and N\_ss=1.~~

~~DUP80 mode is defined as a 484-tone RU whose content is replicated twice to occupy 80 MHz bandwidth. Within each 484-tone RU, DCM is applied as described above.~~

~~DUP160 mode is defined as a 996-tone RU whose content is replicated twice to occupy 160 MHz bandwidth. Within each 996-tone RU, DCM is applied as described above.~~

~~DUP320 mode is defined as a 2x996-tone RU whose content is replicated twice to occupy 320 MHz bandwidth. Within each 2x996-tone RU, DCM is applied as described above.~~

***Add the following new section to sub-clause 36.3.12, after segment de-parser and preceding 36.3.12.9 (Pilot subcarriers):***

**36.3.12.Y Frequency domain duplication**

For an EHT PPDU that is not encoded with EHT-MCS 14, frequency domain duplication is not performed and is specified in equation (36-X3).

 (36-X3)

where

For an EHT MU PPDU transmitted to a single user with EHT-MCS 14, the output of the segment deparser is further duplicated to map to two RUs according to equations (36-X1) and (36-X2).

 (36-X1)

 (36-X2)

where

 since for EHT-MCS 14

 , since EHT-MCS 14 is only supported for single-user transmission

 , since EHT-MCS 14 is only supported for single-user transmission

Here, maps to data subcarriers in RU1 and maps to data subcarriers in RU2, where RU1 and RU2 correspond to:

* 484-tone RUs for an 80 MHz PPDU (defined in Table 36-5),
* 996-tone RUs for a 160 MHz PPDU (defined in Table 36-6),
* 2x996-tone RUs for a 320 MHz PPDU (defined in Table 36-7).

**36.3.18.4.3 Transmitter constellation error**

***P337 Modify Table 36-52 (Allowed relative constellation error versus constellation size and coding rate) as follows:***

* **Under column “Modulation”, replace “BPSK-DCM” with “BPSK-DCM (EHT-MCS 15)” and “BPSK-DCM-DUP” with “BPSK-DCM (EHT-MCS 14)”**

**36.3.19.2 Receiver minimum input sensitivity**

***P344 Modify Table 36-54 (Receiver minimum input level sensitivity) as follows:***

* **Under column “Modulation”, replace “BPSK-DCM” with “BPSK-DCM (EHT-MCS 15)” and “BPSK-DCM-DUP” with “BPSK-DCM (EHT-MCS 14)”**

**36.3.19.3 Adjacent channel rejection**

***P344 Modify Table 36-55 (Minimum required adjacent and nonadjacent channel rejection levels) as follows:***

* **Under column “Modulation”, replace “BPSK-DCM” with “BPSK-DCM (EHT-MCS 15)” and “BPSK-DCM-DUP” with “BPSK-DCM (EHT-MCS 14)”**

**36.5 Parameters for EHT-MCSs**

***P364, L46 delete existing text, insert new text:***

The rate-dependent parameters for ~~BPSK-DCM-DUP~~ EHT-DUP mode are provided in Table 36-74 (~~EHT-MCSs for BPSK-DCM-DUP~~ EHT-MCS 14 for EHT-DUP mode, NSS,u = 1).

***P365, L5 delete existing text, insert new text:***

~~BPSK-DCM and BPSK-DCM-DUP~~ EHT-MCS 14 and 15 are supported only with = 1.

***P365, L8 delete existing text, insert new text:***

~~EHT-MCSs are defined for user u in SU transmission or MU transmission.~~ EHT-MCSs 0-13 and 15 are defined for user u in SU transmission or MU transmission. EHT MCS 14 is defined for user u in SU transmission only, and for bandwidths 80 MHz, 160 MHz and 320 MHz only.

***P380 Change table 36-74 as follows:***

* **Modify caption as “~~EHT-MCSs for BPSK-DCM-DUP~~ EHT MCS 14 for EHT-DUP mode, = 1”**
* ***Delete column “~~EHT MCS Index~~”***
* ***Under column “Modulation” replace “~~BPSK-DCM-DUP~~” with “BPSK-DCM”***

**References:**

1. IEEE 802.11-19/1262r23, “Specification Framework for TGbe,” <https://mentor.ieee.org/802.11/dcn/19/11-19-1262-23-00be-specification-framework-for-tgbe.docx>