IEEE P802.11
Wireless LANs

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| Proposed Draft Text (PDT-PHY): U-SIG |
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Abstract

This submission proposes the PHY draft text on U-SIG for TGbe D0.1

Revision 1 incorporates comments from Yujin Noh (mainly editorial).

* + - 1. U-SIG
				1. General

The U-SIG field carries information necessary to interpret EHT PPDUs. The integer fields of the U-SIG field are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.

* + - * 1. Content

The U-SIG field is designed to bring forward compatibility to the EHT preamble via the introduction of version independent fields. These are fields that will be consistent in location and interpretation across multiple 802.11 PHY amendments. The intent of the version independent content is to achieve better coexistence among future 802.11 generations. In addition, the U-SIG can have some version dependent fields which are fields specific to a PHY amendment. The size of the U-SIG for the case of an Extended Range Mode (if such a mode were to be adopted) is TBD. The U-SIG includes version independent bits followed by version dependent bits. PHY version identifier field shall be one of the version independent fields in the U-SIG. The purpose of PHY Version Identifier is to simplify autodetection for future 802.11 generations, i.e., value of this field is used to identify the exact PHY version starting with 802.11be.

The U-SIG field for an EHT MU PPDU contains the fields listed in Table 34-18 (U-SIG field of an EHT MU PPDU).

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| Table 34-18 U-SIG field of an EHT MU PPDU |
| Two Parts of U-SIG | Bit | Field | Number of bits | Description |
| U-SIG-1 | B0-B2 | PHY Version Identifier | 3 | Differentiate between different PHY amendments. Set to a TBD value for EHT. |
|  | B3-B5 | BW | 3 | Conveys the PPDU BW. |
|  | B6 | UL/DL | 1 | Indicates whether the PPDU is sent UL or DL. Set to 1 if the PPDU is addressed to an AP. Set to 0 otherwise. See TXVECTOR parameter UPLINK\_FLAG.(#24500) |
|  | TBD | BSS Color | TBD | (#24500)An identifier of the BSS.See TXVECTOR parameter BSS\_COLOR. |
|  | TBD | TXOP | TBD | Set to TBD to indicate no duration information.Set to a value less than TBD to indicate the closest minimum bound on the duration information for NAV setting and protection of the TXOP as follows:If TBD bit is 0, the TXOP duration indicated is TBD bits, in units of TBD µs.If TBD bit is 1, the TXOP duration indicated is TBD bits, in units of TBD µs, plus TBD µs.See TXVECTOR parameter TXOP\_DURATION (#24368) |
|  | TBD | Reserved | TBD | Reserved and set to 1 |
|  | TBD | Punctured Channel Indication | TBD | This shall allow even an OBSS or unassociated device to decode the puncturing pattern of at least the specific 80 MHz that contains the 20 MHz |
|  | TBD | Reserved | TBD | Reserved and set to 1 |
|  | TBD | PPDU type | TBD |  |
|  | TBD | Compression Mode | TBD |  |
|  | TBD | Reserved | TBD | Reserved and set to 1 |
|  | TBD | EHT-SIG MCS | TBD | .(#24501) |
|  (#24191) | TBD | Number of EHT-SIG symbols | TBD | (#24500) |
|  | B16-B19 | CRC | 4 | CRC for bits 0–41 of the U-SIG field (see 27.3.11.7.3 (CRC computation)). Bits 0–41 of the U-SIG field correspond to bits 0–25 of U-SIG1 followed by bits 0–15 of U-SIG2). |
|  | B20-B25 | Tail | 6 | Used to terminate the trellis of the convolutional decoder.Set to 0. |

The U-SIG field for an EHT TB PPDU contains the fields listed in Table 34-19 (U-SIG field of an EHT TB PPDU).

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|  Table 34-19 U-SIG field of an EHT TB PPDU |
| Two Parts of U-SIG | Bit | Field | Number of bits | Description |
| U-SIG-1 | B0-B2 | Version Identifier | 3 | Differentiate between different PHY amendments. Set to a TBD value for EHT. |
|  | B3-B5 | BW | 3 | Conveys the PPDU BW. |
|  | B6 | UL/DL | 1 | Indicates whether the PPDU is sent UL or DL. Set to 1 if the PPDU is addressed to an AP. Set to 0 otherwise. See TXVECTOR parameter UPLINK\_FLAG.(#24500) |
|  | TBD | BSS Color | TBD | (#24500)An identifier of the BSS.See TXVECTOR parameter BSS\_COLOR. |
|  | TBD | TXOP | TBD | Set to TBD to indicate no duration information.Set to a value less than TBD to indicate the closest minimum bound on the duration information for NAV setting and protection of the TXOP as follows:If TBD bit is 0, the TXOP duration indicated is TBD bits, in units of TBD µs.If TBD bit is 1, the TXOP duration indicated is TBD bits, in units of TBD µs, plus TBD µs.See TXVECTOR parameter TXOP\_DURATION (#24368) |
|  | TBD | Reserved | TBD | Reserved and set to 1 |
|  | TBD | Reserved | TBD | Reserved and set to 1 |
|  | TBD | PPDU type | TBD |  |
|  | TBD | Reserved | TBD | Reserved and set to 1 |
|  | TBD | SR | TBD | Size of the SR Field for TB PPDU is TBD |
|  | TBD | CRC | 4 | CRC for bits 0–41 of the U-SIG field (see 27.3.11.7.3 (CRC computation)). Bits 0–41 of the U-SIG field correspond to bits 0–25 of U-SIG1 followed by bits 0–15 of U-SIG2). |
|  | TBD | Tail | 6 | Used to terminate the trellis of the convolutional decoder.Set to 0. |

* + - * 1. CRC computation

The CRC computation defined in this subclause applies to U-SIG, the Common field of EHT-SIG, and the User Block field of EHT-SIG.

The CRC is calculated over bits 0 to 41 of the U-SIG field and over bits 0 to *L* of the EHT-SIG field (*L*= *x* for each Common field where *x* = *N* × TBD, and *L*= TBD for an User Block field that contains one User field and *L* = TBD for an User Block field that contains two User fields). Bits 0 to 41 of the U-SIG field correspond to bits 0–25 of U-SIG-1 followed by bits 0–15 of U-SIG-2).

The value of the CRC field shall be the 1s complement of



where





*G*(*D*) is defined in 19.3.9.4.4 (CRC calculation for HT-SIG)



*mL* is the serial input shown in Figure 34-XXX (CRC calculation)

The CRC field is transmitted from *c4* to *c7* with *c7* first.

Figure 34-XXX (CRC calculation) shows the operation of the CRC. First, the shift register is reset to all 1s. The bits are then passed through the XOR operation at the input. When the last bit has entered, the output is generated by shifting the bits out of the shift register, *c7* first, through an inverter.

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| Figure 34-XXX CRC calculation |

As an example, if bits $\left\{m\_{0}….m\_{41}\right\}$ are given by {1 1 0 1 1 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 1 0 1 0}, the output bits $\left\{B\_{7}…B\_{4}\right\}$, where *B*7is output first, are {0 1 1 1}.

* + - * 1. Encoding and modulation

For an EHT MU PPDU and EHT TB PPDU, the U-SIG field is composed of two parts, U-SIG-1 and U-SIG-2, each containing 26 data bits. U-SIG-1 is transmitted before U-SIG-2. The data bits of the U-SIG OFDM symbols shall be BCC encoded at rate, R = 1/2, interleaved, mapped to a BPSK constellation, and have pilots inserted following the steps described in 17.3.5.6 (Convolutional encoder), 27.3.12.8 (BCC interleavers), 17.3.5.8 (Subcarrier modulation mapping), and 17.3.5.9 (Pilot subcarriers), respectively. This process happens on a per-80MHz frequency segment basis as U-SIG field may have different contents in different 80MHz frequency segments, while always having identical content in every 20MHz segment of a given 80MHz segment. For every 80MHz segment in the EHT PPDU, the first and second half of the stream of 104 complex numbers generated by these steps (before pilot insertion) is divided into two groups of 52 complex numbers, where respectively, the first 52 complex numbers form the first OFDM symbol of U-SIG and the second 52 complex numbers form the second OFDM symbol of U-SIG.

For U-SIG in 80 MHz frequency segment *i80FS*, the complex number assigned to the *k-*th data subcarrier of the *n-*th symbol is denoted as $d\_{k,n}^{i\_{80FS}}$. The time domain waveform for the U-SIG field of an EHT MU PPDU and EHT TB PPDU, transmitted on frequency segment *i80FS* and transmit chain *iTX*, shall be as specified in Equation (27-16).(M218)

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$$r\_{U-SIG}^{\left(i\_{80FS},i\_{TX}\right)}\left(t\right)=\frac{1}{\sqrt{N\_{TX} ∙ N\_{U-SIG}^{Tone}∙\frac{\left|Ω\_{20MHz}\right|}{N\_{20MHz}}}}\sum\_{n=0}^{1}w\_{T\_{SYML}}\left(t-nT\_{SYML}\right)∙\sum\_{i\_{BW}\in Ω\_{20MHz}}^{}\sum\_{k=-28}^{28}η\_{U-SIG,k}\left(\begin{matrix}γ\_{\left(k-K\_{Shift}\left(i\_{BW}\right)\right),BW}(D\_{k,n,20}^{i\_{80FS}}+p\_{n+2}P\_{k}) \\∙exp⁡(j2π(k-K\_{Shift}\left(i\_{BW}\right))∆\_{F,Pre-EHT}(t-nT\_{SYML}-T\_{GI,Pre-EHT}-T\_{CS}^{i\_{TX}})\end{matrix}\right)$$

where

*TSYML* is given in Table 34-xx (Timing-related constants)

$K\_{Shift}\left(i\right)=(N\_{20MHz}-1-2i)∙32$

$D\_{k,n,20}^{i\_{80FS}}=\left\{\begin{matrix}0, k=0,\pm 7,\pm 21\\d\_{M\_{20}^{r}\left(k\right),n}^{i\_{80FS}}, otherwise\end{matrix}\right.$

$$M\_{20}^{r}\left(k\right)=\left\{\begin{array}{c}\begin{matrix}k+28, -28\leq k\leq -22\\k+27, -20\leq k\leq -8 \\k+26, -6\leq k\leq -1 \end{matrix}\\k+25, 1\leq k\leq 6 \\k+24, 8\leq k\leq 20 \\k+23, 22\leq k\leq 28 \end{array}\right.$$

$$η\_{U-SIG,k}=\left\{\begin{matrix}\left[\frac{1}{\sqrt{2}},1\right], for an EHT TB PPDU\\1, otherwise\end{matrix}\right.$$

*Pk* and *pn* are defined in 17.3.5.10 (OFDM modulation)

$ N\_{U-SIG}^{Tone}$ is defined in Table XXX (Number of modulated subcarriers and guard interval duration values for EHT PPDU fields)

$T\_{CS}^{i\_{TX}}$ represents the cyclic shift for transmit chain *iTX* with a value given in XXX (Cyclic shift for pre-EHT modulated fields).