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

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| Comment Resolutions on BPSK-Mark Comments |
| Date: 2019-05-15 |
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**Abstract**

The document provides comment resolutions for CIDs: 2110, 2563, 2652, 2660, 2792.

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| **CID** | **Clause** | **Page/Line** | **Comment** | **Proposed Change** | **Resolution** |
| 2110 | 31.2.5 | 93.34 | "An 11ac capable receiver, after it has received the LSIG and MARK fields in the WUR preamble will do a QBPSK check on the next symbol. However, only the central 4 MHz of the tones is energized, the others contain noise. Therefore, the detection outcome is undetermined, maybe 50% are BPSK detections and 50% are QBSPK detections.When the receiver detects BPSK it will initiate an 11a packet reception. When it detects QPSK it will attempt decode the two symbols following the LSIG as VHT-SIG-A. This will almost certainly fail on a CRC error (there is a 1/256 chance that the 8-bit CRC unintentionally passes). That could mean that in half of the cases the receiver will enter an error state which may eventually cause to the receiver to change its behavior." | Replace MARK symbol by a valid VHT-SIG-A1 and VHT-SIG-A2 symbol. | **Revised**TGba Editor makes changes as shown in 802.11-19/424r2 |
| 2652 | 31.2.5 | 93.34 | The non-WUR portion of the preamble is intended to cause the legacy STAs to classify the WUR PPDU as a non-HT (11a) PPDU. However, it is possible for a legacy STA to misclassify the WUR PPDU as a VHT (11ac) PPDU. | Modify the design of the non-WUR portion of the PPDU so that causes legacy STAs to classify the WUR PPDU as a non-HT (11a) PPDU | **Revised**TGba Editor makes changes as shown in 802.11-19/424r2 |
| 2563 | 31.2.2 | 87.10 | The absence of 52 BPSK tones in the second symbol after LSIG causes random 11ac false detects on the first ON-OFF or OFF-ON OOK symbol in existing devices which can cause undesired behavior and significant performance degradation. |  | **Revised**TGba Editor makes changes as shown in 802.11-19/424r2 |
| 2660 | 31.2.9.3 | 104 | The first WUR-Sync symbol resembles a QBPSK symbol, which may cause an 11ac STA to determine that the 11ba frame is actually a VHT PPDU. This would cause false detection and create a receive state machine issue. | Redesign the WUR preamble and make it more coexistent with HE, VHT, HT and legacy. | **Revised**TGba Editor makes changes as shown in 802.11-19/424r2 |
| 2792 | 31.2.8 | 98.10 | The first WUR-Sync symbol may be detected as a QBPSK symbol, which would lead it to be classified as a VHT PPDU. And there is non-zero probability that the VHT-SIG-A CRC may pass. In this case, the receiver would perform AGC thinking that the 2nd WUR-Sync symbol is a VHT-STF. This would then prevent a WUR RX capable VHT receiver to not be able to receive the WUR packet. | Revisit WUR PPDU design such that a WUR PPDU does not get classified as a VHT PPDU. | **Revised**TGba Editor makes changes as shown in 802.11-19/424r2 |

**Discussion**

As described in document 802.11-19/0423r1, it is possible for a legacy STA to classify as VHT versus the intended non-HT. This can be addressed by adding a second BPSK-Mark symbol. That is the method recommended here in the proposal resolution.

**Proposed Resolution**

This addresses CIDs: 2110, 2565, 2652 and 2660

TGba Editor: Make the following Editing Instructions shown in Track Changes, and with “Equation Editing Instructions.”

**In 31.2.1 Introduction**

During transmission, a PSDU is processed and appended to the PHY preamble including legacy preamble, BPSK-Mark1, BPSK-Mark2, and WUR-Sync field to create the WUR PPDU.



Figure 31-1 – WUR PPDU format

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| * Fields of the WUR PPDU(#764)
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| **Field** | **Description** |
| L-STF | Non-HT Short Training field(see 21.3.4.2 (Construction of L-STF)) |
| L-LTF | Non-HT Long Training field(see 21.3.4.3 (Construction of L-LTF)) |
| L-SIG | Non-HT SIGNAL field(see 21.3.4.4 (Construction of L-SIG)) and 21.3.8.2.4 (L-SIG definition)) |
| BPSK-Mark1 | A BPSK modulated OFDM symbol(see 31.2.9.2.4 BPSK-Mark Definition) |
| BPSK-Mark2 | A BPSK modulated OFDM symbol(see 31.2.9.2.4a BPSK-Mark2 Definition) |
| WUR-Sync | Wake-Up Radio Synchronization field(see 31.2.9.3 WUR-SYNC field) |
| WUR-Data | Wake-Up Radio Data field carrying the PSDU(see 31.2.10 WUR-Data field) |

31.2.3 WUR FDMA PPDU Format



Figure 31-2 – WUR FDMA PPDU for 40 MHz channel widths



Figure 31-3 – WUR FDMA PPDU for 80 MHz channel widths

The 40 MHz preamble or 80 MHz preamble is the duplication of 20 MHz preamble, which is composed of L-STF, L-LTF, L-SIG,BPSK-Mark1 and BPSK-Mark2 fields. In each 20 MHz subchannel with duplicated 20 MHz preamble, one WUR signal centered in the 20 MHz subchannel is transmitted following the 20 MHz preamble.(#653)

 31.2.5.5 Construction of the BPSK-Mark1

Construct the BPSK-Mark1 field as the repeat SIGNAL field as defined in 31.2.9.2.4 BPSK-Mark1 Definition with the following highlights:

* In a WUR PPDU, set the BPSK-Mark1 field as described in 31.2.9.2.4 BPSK-Mark1 Definition.
* BCC encoder: Encode the BPSK-Mark1 field by a convolutional encoder at the rate of R=1/2 as described in 21.3.10.5.3 (Binary convolutional coding and puncturing).
* BCC interleaver: Interleave as described in 21.3.10.8 (BCC interleaver).
* Constellation Mapper: BPSK modulate as described in 21.3.10.9 (Constellation mapping).
* Pilot insertion: Insert pilots as described in 21.3.10.11 (OFDM modulation).
* Duplication and phase rotation: Duplicate the BPSK-Mark1 field over each occupied 20 MHz of the CH\_BANDWIDTH. Apply appropriate phase rotation for each 20 MHz subchannel as described in 21.3.7.4 (Transmitted signal) and 21.3.7.5 (Definition of tone rotation).
* IDFT: Compute the inverse discrete Fourier transform.
* CSD: Apply CSD for each transmit chain and frequency segment as described in 21.3.8.2.1 (Cyclic shift for pre-VHT modulated fields).
* Insert GI and apply windowing: Prepend a GI (LONG\_GI) and apply windowing as described in 21.3.7.4 (Transmitted signal).
* Analog and RF: Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 21.3.7.4 (Transmitted signal) and 21.3.8 (VHT preamble)for details.

31.2.5.6 Construction of the BPSK-Mark2

Construct the BPSK-Mark2 field as the repeat SIGNAL field as defined in 31.2.9.2.4 BPSK-Mark2 Definition with the following highlights:

* In a WUR PPDU, set the BPSK-Mark2 field as described in 31.2.9.2.4 BPSK-Mark2 Definition.
* BCC encoder: Encode the BPSK-Mark2 field by a convolutional encoder at the rate of R=1/2 as described in 21.3.10.5.3 (Binary convolutional coding and puncturing).
* BCC interleaver: Interleave as described in 21.3.10.8 (BCC interleaver).
* Constellation Mapper: BPSK modulate as described in 21.3.10.9 (Constellation mapping).
* Pilot insertion: Insert pilots as described in 21.3.10.11 (OFDM modulation).
* Duplication and phase rotation: Duplicate the BPSK-Mark2 field over each occupied 20 MHz of the CH\_BANDWIDTH. Apply appropriate phase rotation for each 20 MHz subchannel as described in 21.3.7.4 (Transmitted signal) and 21.3.7.5 (Definition of tone rotation).
* IDFT: Compute the inverse discrete Fourier transform.
* CSD: Apply CSD for each transmit chain and frequency segment as described in 21.3.8.2.1 (Cyclic shift for pre-VHT modulated fields).
* Insert GI and apply windowing: Prepend a GI (LONG\_GI) and apply windowing as described in 21.3.7.4 (Transmitted signal).
* Analog and RF: Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 21.3.7.4 (Transmitted signal) and 21.3.8 (VHT preamble)for details.

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| * Timing-related constants(#565)
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| Parameter | Value | Description |
|  | 312.5 kHz | Subcarrier frequency spacing for WUR PPDU |
| *TDFT,WUR* | 3.2 µs | IDFT/DFT period for the WUR PPDU |
| *TGI,WUR* | 0.8 µs | Guard interval duration for the WUR PPDU |
| *TGI,L-LTF* | 1.6 µs | Guard interval duration for the L-LTF field |
| *TSym-LDR* | 4 µs | Duration of WUR LDR MC-OOK symbol in WUR-Data field |
| *TSym-HDR* | 2 µs | Duration of WUR HDR MC-OOK symbol in WUR-Data field |
| *TSym* | *TSym-LDR* or *TSym-HDR* depending on WUR data rate | Duration of MC-OOK symbol in WUR-Data field |
| *TSync* | 2 µs | Duration of MC-OOK symbol in WUR-Sync field |
| *TL-STF* | 8 µs = 10 × *TDFT,*WUR /4 | Non-HT Short Training field duration |
| *TL-LTF* | 8 µs = 2 × *TDFT,*WUR + *TGI,*L-LTF | Non-HT Long Training field duration |
| *TL-SIG* | 4 µs | Non-HT SIGNAL field duration |
| *TBPSK-Mark1* | 4 µs | BPSK-Mark1 field duration |
| *TBPSK-Mark2* | 4 µs | BPSK-Mark2 field duration |
| *TWUR-Sync-LDR* | 128 µs | WUR-Sync field duration for WUR LDR |
| *TWUR-Sync-HDR* | 64 µs | WUR-Sync field duration for WUR HDR |
| *TWUR-Sync* | *T*WUR-Sync-LDR or *T*WUR-Sync-HDR depending on WUR data rate | WUR-Sync field duration for WUR PPDU |



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| * Timing boundaries for the WUR PPDU Fields
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31.2.8 Mathematical description of signals

Equations Editing Instructions: In Equation 31-2 change $r\_{BPSK-Mark}^{(i\_{TX})} \left(t-t\_{BPSK-Mark}\right)$ with $r\_{BPSK-Mark1}^{(i\_{TX})} \left(t-t\_{BPSK-Mark1}\right)$. After that term add the following term $r\_{BPSK-Mark2}^{(i\_{TX})} \left(t-t\_{BPSK-Mark2}\right)$.

In the equations below Equation 31-2 change $r\_{BPSK-Mark}^{(i\_{TX})}=t\_{L-SIG}+T\_{L-SIG}$ to $r\_{BPSK-Mark1}^{(i\_{TX})}=t\_{L-SIG}+T\_{L-SIG}$

Also, add the equations: $r\_{BPSK-Mark2}^{(i\_{TX})}=t\_{Mark1}+T\_{Mark2}$

31.2.9.2 Non-WUR portion of WUR PHY preamble

The Non-WUR portion of the WUR PHY preamble consists of four fields: L-STF, L-LTF, L-SIG, BPSK-Mark1 and BPSK-Mark2.

* + - * 1. BPSK-Mark1 Definition

The BPSK-Mark1 field is a repeat of the L-SIG field and is used to spoof HT devices from false packet type detection.

The time domain waveform of the BPSK-Mark1 field, transmitted on transmit chain , shall be as specified in Equation (31-7).

Equations Editing Instructions: In Equation 31-7, change “BPSK-Mark” to “BPSK-Mark1” in the two occurrences.

31.2.9.2.5 BPSK-Mark2 Definition

The BPSK-Mark2 field is a repeat of the L-SIG field and is used to spoof VHT devices from false packet type detection.

The time domain waveform of the BPSK-Mark2 field, transmitted on transmit chain , shall be as specified in Equation (31-8).

Equation Editing Instructions: Construct Equation 31-8, by duplicating Equation 31-7 and replace “BPSK-Mark” with “BPSK-Mark2”, in the two occurrences.

where

 is the second pilot value in the sequence defined in 17.3.5.10 (OFDM modulation).

Other variables are defined below Equation (31-4) and Equation (31-6).

**31.2.10 WUR Padding field for FDMA PPDU**

Equation Editing Instructions: In Equation 31-10 change “$T\_{BPSK-Mark}$” to “$T\_{BPSK-Mark1}$” and add another term “$T\_{BPSK-Mark2}$”.

* + 1. WUR transmit procedure

After the PHY legacy preamble transmission is started, the PHY entity immediately initiates BPSK-Mark1 transmission and performs any required scrambling and data encoding if needed as defined by parameters of the TXVECTOR, as described in 31.1.2 TXVECTOR and RXVECTOR parameters. After the BPSK-Mark1 transmission the PHY entity immediately initiates BPSK-Mark2 transmission and performs any required scrambling and data encoding if needed as defined by parameters of the TXVECTOR, as described in 31.1.2 TXVECTOR and RXVECTOR parameters. After BPSK-Mark2 transmission is started, the PHY entity initiates transmission of WUR-Sync field according to the data rate defined in TXVECTOR.



* PHY transmit procedure for a single channel WUR PPDU(#229,#969,#1216)



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| * PHY transmit procedure for a WUR PPDU with FDMA(#206,#230,#970,#1217)
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* PHY transmit state machine(#1219)



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| * PHY receiver procedure for WUR PPDU(#231,#1221,#1253,#823)
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* + 1. TXTIME and PSDU length calculation

The value of the TXTIME parameter shall be calculated for a WUR PPDU as follows:

Equations Editing Instructions: In Equations 31-11 change “$T\_{BPSK-Mark}$” to “$T\_{BPSK-Mark1}$” and add another term: “$T\_{BPSK-Mark2}$”

*TL-STF*, *TL-LTF*, *TL-SIG*, *TBSPK-Mark1*, *TBSPK-Mark2*, *TWUR-Sync*, and *TSym*are defined in Table 31-3 Timing-related constants, and *NSym* is the number of MC-OOK symbols in the WUR-Data field.

Equations Editing Instructions: In Equations 31-15 change “$T\_{BPSK-Mark}$” to “$T\_{BPSK-Mark1}$” and add another term: “$T\_{BPSK-Mark2}$”