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

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| Contents of BPSK Mark Symbols | | | | |
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**Discussion**

In the current 802.11ba draft 3.1, the BPSK-Mark1 and BPSK-Mark2 are a repeat of L-SIG. This is similar to RL-SIG in 802.11ax. In 802.11ba, the value of the Length Field in the L-SIG is divisible by three. In 802.11ax, the Length Field modulo 3 has a value of either 1 or 2. The value of the Length Field allows an 802.11ax receiver to distinguish between an 802.11ax PPDU and an 802.11ba PPDU, since the Length Field Modulo 3 is different for 802.11ax and for 802.11ba.

The 802.11be task group is looking to also use the RL-SIG [1], similar to 802.11ax, and in order to distinguish the PPDU from an 802.11ax PPDU, they would need to use a Length Field which is divisible by three. The advantage of using the RL-SIG structure in 802.11be is that the hardware for identifying the RL-SIG is already developed for 802.11ax receivers. If 802.11be changed the symbol after the L-SIG, then new circuits would need to be included in the 802.11be receivers to handle that change. So, it is very beneficial to keep the RL-SIG structure in 802.11be and then set the Length Field to be divisible by three.

If this is done, then the 802.11ba and 802.11be symbols after L-SIG would become almost identical, with the only difference being the extra tones in 802.11be (as in 802.11ax) on the symbol after L-SIG. So, it becomes prudent to change the contents of the BPSK-Mark1 and BPSK-Mark2 symbols so as to not look similar to the RL-SIG in 802.11be. The good news is that the 802.11ba receiver does not utilize the detailed contents of the BPSK-Marks, since they are only processed by the non-WUR receivers. So as long as we continue to use BPSK modulation in the BPSK-Marks they will serve their purpose in 802.11ba. Moreover, no change to the 802.11ba receiver is required if we were to change the content of the BPSK Marks.

A good choice for the BPSK-Mark contents to distinguish from 802.11be (and 802.11ax) is to complement the code bits from the L-SIG and use those complemented code bits in the BPSK-Marks (doing a masked repetition instead of plain repetition). This will also maximize the Hamming Distance between the RL-SIG in 802.11be and the BPSK-Mark1 in 802.11ba. This only requires a small change in the 802.11ba transmitter and no change in the 802.11ba receiver. This allows 802.11be to use the RL-SIG in the preamble and to set the Length Field in L-SIG to be divisible by three, to enable easy differentiate from 802.11ax.

[1] Sameer Vermani, et. al., “Forward Compatibility for Wi-Fi Preamble Design,” IEEE 802.11-19/1519r0, September 2019.

**Proposed Resolution**

TGba Editor make the following changes to draft 3.1,

* Construction of the BPSK-Mark1

Construct the BPSK-Mark1 field as derived from the SIGNAL field as defined in 30.3.9.2.4 (BPSK-Mark1 Definition) with the following highlights:

1. In a WUR PPDU, set the BPSK-Mark1 field as described in 30.3.9.2.4 (BPSK-Mark1 Definition).
2. 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).
3. BCC interleaver: Interleave as described in 21.3.10.8 (BCC interleaver).
4. Exclusive OR (XOR) each of the output bits of the BCC interleaver with 1
5. Constellation Mapper: BPSK modulate as described in 21.3.10.9 (Constellation mapping).
6. Pilot insertion: Insert pilots as described in 21.3.10.11 (OFDM modulation).
7. 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).
8. IDFT: Compute the inverse discrete Fourier transform.
9. CSD: Apply CSD for each transmit chain as described in 21.3.8.2.1 (Cyclic shift for pre-VHT modulated fields).
10. Insert GI and apply windowing: Prepend a GI (LONG\_GI) and apply windowing as described in 21.3.7.4 (Transmitted signal).
11. 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.

* Construction of the BPSK-Mark2

Construct the BPSK-Mark2 field as derived from the SIGNAL field as defined in 30.3.9.2.5 (BPSK-Mark2 Definition) with the following highlights:

1. In a WUR PPDU, set the BPSK-Mark2 field as described in 31.2.9.2.4 BPSK-Mark2 Definition.
2. 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).
3. BCC interleaver: Interleave as described in 21.3.10.8 (BCC interleaver).
4. Exclusive OR (XOR) each of the output bits of the BCC interleaver with 1
5. Constellation Mapper: BPSK modulate as described in 21.3.10.9 (Constellation mapping).
6. Pilot insertion: Insert pilots as described in 21.3.10.11 (OFDM modulation).
7. 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).
8. IDFT: Compute the inverse discrete Fourier transform.
9. 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).
10. Insert GI and apply windowing: Prepend a GI (LONG\_GI) and apply windowing as described in 21.3.7.4 (Transmitted signal).
11. 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.

* BPSK-Mark1 Definition

The BPSK-Mark1 field is derived from the L-SIG field and is used to spoof HT STAs from false packet type detection.

* BPSK-Mark2 Definition

The BPSK-Mark2 field is derived from the L-SIG field and is used to spoof VHT STAs from false packet type detection.