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

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| Comment Resolutions on BPSK Mark Symbols |
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| Author(s): |
| Name | Affiliation | Address | Phone | Email |
| Steve Shellhammer | Qualcomm |  |  | shellhammer@ieee.org |
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**Abstract**

The document provides comment resolutions for CIDs: 4030, 4031, 4036, 4038, 4076, 4098, 4103, 4104, 4118, 4119, 4120, 4128, 4134, 4135.

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| **CID** | **Clause** | **Page****/Line** | **Comment** | **Proposed Change** | **Resolution** |
| 4030 | 30.3.9.2.4 | 155/44 | BPSK-Mark1 field currently uses RLSIG. However, for WUR receivers how to design BPSK-Mark does not matter. for 3rd party WLAN devices (post-11ax) it might use this signature to detect WUR packet for power save purpose (depending on actual popularity of WUR in the field).However, RLSIG with L-LENGTH mod 3 ==0 seems to be the easiest autodetection method for both implementation and performance (wrt early detection), it is preferable to give this easiest combination to a "mainstream" amendment that will be largely deployed, rather than a narrower use case such as WUR.Actually, any other BPSK-Mark signature would also work for WUR serving the same purpose without compromise any performance. | Change BPSK-MARK1 and BPSK-MARK2 to any other BPSK design, for example RLSIG with sign flipped | **Revised**TGba Editor makes changes as shown in IEEE 802.11-19/1881r0 |
| 4031 | 30.3.9 | 152 | In 11ba preamble, the BPSK-Mark1 symbol is same as 11ax RL-SIG and modulo(length,3)=0 is used for format detection. In 11be, multiple proposals are discussed and one of the proposal used similar preamble. | It is a concern that the same preamble detection scheme could be used in 11be and 11ba. Propose to settle first the preamble design in both 11be and 11ba. | **Revised**TGba Editor makes changes as shown in IEEE 802.11-19/1881r0 |
| 4036 | 30.3.5.5 | 145/54 | The proposal to change the code bits for BPSP-Mark1 and BPSK-Mark2 described in 11-19-1586-00-00ba-cr-on-contents-of-bpsk-mark-symbols has technical merit in simplifying the design of other complementary radios which should be key to TGba deployment. | As proposed in 11-19-1586-00-00ba-cr-on-contents-of-bpsk-mark-symbols. | **Revised**TGba Editor makes changes as shown in IEEE 802.11-19/1881r0 |
| 4038 | 30.3.9.2.4 | 155/47 | In 11ba preamble, the BPSK-Mark1 symbol is same as 11ax RL-SIG and modulo(length,3)=0 is used for format detection. In the 11be, the similar approach is proposed. | Change BPSK-Mark1 symbol, and make it different from 11ax RL-SIG. | **Revised**TGba Editor makes changes as shown in IEEE 802.11-19/1881r0 |
| 4076 | 30.3.9.2.4 | 155/44 | "WUR PPDU identifier is "BPSK-Mark1=L-SIG && LENGTH%3==0". This design is supposed to be simplest pattern to distinguish from HE PPDUs. However, this design may complicate 11ax or future devices. "The BPSK-Mark1 field is a repeat of the L-SIG field." BPSK-Mark1 uses 52-tone design as L-SIG instead of 11ax 56-tone RL-SIG. The RL-SIG detection module optimized for HE PPDU will show higher miss rate for WUR PPDU, and cause degraded power save performance.To improve the auto-detection performance for WUR PPDU, we can modify BPSK-Mark1 to some other BPSK modulated pattern, instead of repetition of L-SIG. Additionally, by having WUR using another identifier, the pattern of ""BPSK-Mark1=L-SIG && LENGTH%3==0"" can be left for main-stream wifi standards to make better use of it. " | Change BPSK-MARK1 to some other BPSK design, one simple example is, flipped RL-SIG. May also consider to change the BPSK design of BPSK-MARK2. | **Revised**TGba Editor makes changes as shown in IEEE 802.11-19/1881r0 |
| 4098 | 30.3.9.2.4 | 155/44 | WUR PPDU identifier is "BPSK-Mark1=L-SIG && LENGTH%3==0". This design is supposed to be simpliest pattern to distinguish from HE PPDUs. However, this design may complicate 11ax or future devices. "The BPSK-Mark1 field is a repeat of the L-SIG field." BPSK-Mark1 uses 52-tone design as L-SIG instead of 11ax 56-tone RL-SIG. The RL-SIG detection module optimized for HE PPDU will show higher miss rate for WUR PPDU, and cause degraded power save performance.To improve the auto-detection performance for WUR PPDU, we can modify BPSK-Mark1 to some other BPSK modulated pattern, instead of repetition of L-SIG. Additionally, by having WUR using another identifier, the pattern of "BPSK-Mark1=L-SIG && LENGTH%3==0" can be left for main-stream wifi standards to make better use of it. | Change BPSK-MARK1 to some other BPSK design, one simple example is, flipped RL-SIG. May also consider to change the BPSK design of BPSK-MARK2. | **Revised**TGba Editor makes changes as shown in IEEE 802.11-19/1881r0 |
| 4103 | 30.3.5.5 | 156/56 | "the repeat SIGNAL field" should be "a repeat of the L-SIG field" | See comment. The draft uses "L-SIG filed" and "SIGNAL field" exchangeably. It would be better to use L-SIG field. | **???** |
| 4104 | 30.3.5.6 | 160/21 | "the repeat SIGNAL field" should be "a repeat of the L-SIG field" | See comment. The draft uses "L-SIG filed" and "SIGNAL field" exchangeably. It would be better to use L-SIG field. | **Revised**TGba Editor makes changes as shown in IEEE 802.11-19/1881r0 |
| 4118 | 30.3.5.5 | 145/54 | The BPSK-Mark1 is a repeat of the L-SIG, similar to the RL-SIG in 802.11ax. Similarly, BPSK-Mark2 is a repeat of L-SIG. There is interest in the 802.11be Task Group in using the RL-SIG in 802.11be. To avoid confusion between 802.11ba and 802.11be we should change the contents of the BPSK Mark Symbols while maintaining the use of BPSK modulation.Instead of using the same code bits as in L-SIG for BPSK-Mark1 and BPSK-Mark2 we should invert the code bits from L-SIG and use those as the code bits for BPSP-Mark1 and BPSK-Mark2. | On Page 145 Line 56 change "the repeat" to "derived from the"On Page 145 Line 63 after Item c) add a new items which states "Exclusive OR (XOR) each of the output bits of the BCC interleaver with 1"On Page 146 Line 21 change "the repeat" to "derived from the"On Page 146 Line 28 after Item c) add a new items which states "Exclusive OR (XOR) each of the output bits of the BCC interleaver with 1"On Page 155 Line 47 change "a repeat of" to "derived from"On Page 156 Line 6 change "a repeat of" to "derived from" | **Revised**TGba Editor makes changes as shown in IEEE 802.11-19/1881r0 |
| 4119 | 30.3.9.2.4 | 155 | In 11ba preamble, the BPSK-Mark1 symbol is the same as 11ax RL-SIG and modulo(length,3)=0 is used for format detection. This similar approach is also proposed in 11be. | change BPSK-Mark1 symbol, and make it different from 11ax preamble (RL-SIG) | **Revised**TGba Editor makes changes as shown in IEEE 802.11-19/1881r0 |
| 4120 | 30.3.9.2.4 | 155/44 | Modulation on the BPSK-Mark OFDM symbol | It would be beneficial to use a different autodetection Mark1 symbol (example, BPSK with some sign masking)(without degrading autodetection performance). Using a BPSK Mark1 symbol will complicate the autodetection and add more burden for next-gen WiFi devices. | **Revised**TGba Editor makes changes as shown in IEEE 802.11-19/1881r0 |
| 4128 | 30.3.9.2.4 | 155/44 | WUR PPDU identifier is "BPSK-Mark1=L-SIG && LENGTH%3==0". This design rule is the simpliest to differentiate WUR PPDU from HE PPDUs. However, this rule may result in complexities for 11be or future devices. On the other hand, this design rule does not bring further benefit for WUR design.To improve the auto-detection performance for WUR PPDU, we can modify BPSK-Mark1 to some other BPSK modulated pattern, instead of repetition of L-SIG. Additionally, by having WUR using another identifier, the pattern of "BPSK-Mark1=L-SIG && LENGTH%3==0" can be left for main-stream wifi standards to make better use of it. | Change BPSK-MARK1 to some other BPSK design, e.g., BPSK with some mask sequence applied on BPSK-MARK1 && LENGTH%3 !=3. | **Revised**TGba Editor makes changes as shown in IEEE 802.11-19/1881r0 |
| 4135 | 30.3.9.2.5 | 156/6 | "The BPSK-Mark2 field is a repeat of the L-SIG field and is used to spoof VHT STAs from false PPDU format detection." The VHT STA are not present in 2.4 GHz. The BPSK-Mark2 field is not necessary when the WUR frame is transmitted in 2.4 GHz. | Remove the BPSK-Mark2 field in 2.4 GHz band. | **Rejected**The Task Group does not want a different preamble depending upon the frequency band of operation |

**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 considering to also use the RL-SIG [1-5], 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.

One comment (4128) suggested changing the LENGTH field in L-SIG so that “LENGTH%3 !=3”. This suggestion is assumed to be equivalent to “LENGTH%3 !=0”. Making this change would make 802.11ba PPDUs difficult to distinguish from 802.11ac PPDUs, so it is best to keep LENGTH divisible by three.

1. Sameer Vermani, et. al., “Forward Compatibility for Wi-Fi Preamble Design,” IEEE 802.11-19/1519r0, September 2019.
2. Rui Cao, Hongyuan Zhang and Sudhir Srinivasa, “EHT Preamble Design,” IEEE 802.11-19/1540r0, September 2019
3. Xiaogang Chen, et. al., 11be Preamble Structure, IEEE 802.11-19/1516r0, September 2019
4. Dongguk Lim, et. al, Further discussion for 11be preamble, IEEE 802.11-19/1486r0, September 2019
5. Li-Hsiang Sun, et. al., Preamble Design Consideration for 11be follow-up, IEEE 802.11-19/1569r0, September 2019

**Proposed Resolution**

TGba Editor make the following changes to draft 4.0,

* Construction of the BPSK-Mark1

Construct the BPSK-Mark1 field as derived from the L-SIG 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 L-SIG 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.

TGba Editor, in Equation (30-7) change “$D\_{k, 20}"$ to change $"-D\_{k, 20}"$.

* 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.

TGba Editor, in Equation (30-8) change “$D\_{k, 20}"$ to change $"-D\_{k, 20}"$.

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| **CID** | **Clause** | **Page****/Line** | **Comment** | **Proposed Change** | **Resolution** |
| 4134 | 30.3.9.2.5 | 158/27 | In 30.3.9.2.5, "p2 is the second pilot value in the sequence defined in 17.3.5.10 (OFDM modulation)."But, in 30.3.9.2.4, p1 is the the second pilot value in the sequence defined in 17.3.5.10 (OFDM modulation). If p1 is the second pilot value, please roll back the change from p2 to p1 in 30.3.9.2.5.If p1 and p2 are different, please specify how it is different. | As in comment. | **Revised**TGba Editor makes changes as shown in IEEE 802.11-19/1881r0 |

**Discussion**

The commenter is correct, the pilot should be the third pilot value in the sequence. The L-SIG is the first pilot value in the sequence and the BPSK-Mark1 is the second value in the sequence, so the BPSK-Mark2 should be the third pilot value in the sequence.

**Proposed Resolution**

TGba Editor make the following changes to draft 4.0 in subclause 30.3.9.2.5, Page 156, Line 27.

 is the third pilot value in the sequence defined in 17.3.5.10 (OFDM modulation).(#3128, #3290, #3328)