IEEE P802.11
Wireless LANs

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| Comment resolutions for subclause 31.1, 32.1, 32.2, 32.3, 32.4  |
| Date: 2019-1-10 |
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Abstract

This submission proposes resolutions for multiple comments related to TGba D1.0 with the following CIDs (27 CIDs):

* CID
* 96, 152, 153, 210, 241, 250, 251, 242, 244, 319,
* 320, 322, 411, 833, 933, 650, 653, 657, 680, 681,
* 764, 834, 924, 274, 276, 277, 867

Revisions:

* Rev 0: Initial version of the document.

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGba Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGba Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGba Editor: Editing instructions preceded by “TGba Editor” are instructions to the TGba editor to modify existing material in the TGba draft. As a result of adopting the changes, the TGba editor will execute the instructions rather than copy them to the TGba Draft.***

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| **CID** | **Commenter** | **Clause Number** | **Page** | **Line** | **Comment** | **Proposed Change** | **Resolution** |
| 96 | Alfred Asterjadhi | 31.1 | 49 | 9 | It would be beneficial if we have a list of the main MAC features in the introduction subclause | As in comment. | Rejected.The list of MAC features is defined in Clause 4. It is redundant to have the same list Clause 31.The current structure is following the 802.11ax. |
| 152 | Allert Van Zelst | 32.1 | 65 | 43 | On-Off Keying could cause issues with energy detection that could be done with a period equal to the slot time of 9 us. One particular case I'm most concerned about is an 11ba device in an OBSS on a secondary 20 channel. For such a device we won't receive the LSIG, nor an RTS/CTS. In this cause we'd need to rely on energy detection, but that could be flaky given OOK off periods as large as 8 us. A solution is to change the modulation scheme to one without silence periods. Another advantage is that this would allow WUR operation in the DFS bands. | Change the modulation scheme to one without silence periods | Rejected.Based on the 11-13/230r3 “Comment resolution tutorial”, this is an invalid comment. The comment identifies a potentially “big issue”, but doesn’t provide specific changes – it is essentially giving the group to do more work. Also, there is little chance for a STA to do energy detection exactly in the 8 usec silent period. Moreover, if this is the case, the current SIFS which is 16 usec also becomes a problem for the secondary channels. |
| 153 | Allert Van Zelst | 32.1 | 65 | 65 | The pulsy nature of On-Off Keying could cause false radar detects, hence WUR transmissions are not allowed in the DFS band. In case we change the modulation scheme to one without silence periods, we can allow WUR in DFS bands, and such a change would also solve potentially flaky energy detection on WUR signals. | Change the modulation scheme to one without silence periods | Rejected.The radar detection issue has been already addressed by not allowing WUR operation in the DFS band. |
| 210 | Bo Sun | 32.1 | 65 | 26 | This paragraph is redundant to the last sentence in the first paragraph in subclause 32.1And the statement in this paragraph is less accurate. | Remove the paragraph "The WUR PHY is based on the PHY defined in Clause 17 (Orthogonal frequency division multiplexing(OFDM) PHY specification)" | Accepted. |
| 241 | Eunsung Park | 32.1 | 65 | 37 | 11ac already supports 160 MHz transmission. Include 160 MHz as an optional feature for a WUR transmission. | Change the sentence as follows:" The Wake-up Radio PHY provides support for 20 MHz and optionally 40 MHz, 80 MHz and 160 MHz continuous channel widths ..." | Rejected.Since WUR cannot operate in the DFS band and a 160 MHz contiguous channel has to include a DFS band, 160 MHz cannot be supported in TGba. |
| 250 | Eunsung Park | 32.2.2 | 69 | 18 | 11ac already supports 160 MHz transmission, and thus, WUR can also consider supporting it. | Change the sentence as follows:"For the FDMA WUR PPDUs with 40 MHz, 80MHz and 160MHz channel bandwidth, ..." | Rejected.Since WUR cannot operate in the DFS band and a 160 MHz contiguous channel has to include a DFS band, 160 MHz cannot be supported in TGba. |
| 251 | Eunsung Park | 32.2.2 | 69 | 22 | 11ac already supports 160 MHz transmission, and thus, WUR can also consider supporting it. | Change the sentence as follows:"The 40 MHz preamble, 80 MHz preamble or 160 MHz preamble is the duplication of 20MHz preamble, ..." | Rejected.Since WUR cannot operate in the DFS band and a 160 MHz contiguous channel has to include a DFS band, 160 MHz cannot be supported in TGba. |
| 242 | Eunsung Park | 32.1 | 65 | 44 | 1024 QAM was adopted as an optional feature in 11ax, and thus, WUR can also consider supporting it. | Change the sentence as follows:"... the BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM, and 1024-QAM are used for the coefficient of Wake-up radio PHY subcarriers." | Rejected.There is no technical benefit to support 1024 QAM for the coefficient of wake-up radio PHY subcarriers.  |
| 244 | Eunsung Park | 32.1 | 65 | 59 | 11ac already supports 160 MHz transmission. Include 160 MHz as an optional feature for a WUR transmission. | Change the sentence as follows:"- FDMA transmissions for 40 MHz, 80 MHz and 160MHz contiguous channel widths- FDMA transmission with preamble puncturing for 80 MHz and 160MHz" | Rejected.Since WUR cannot operate in the DFS band and a 160 MHz contiguous channel has to include a DFS band, 160 MHz cannot be supported in TGba. |
| 319 | Hongyuan Zhang | 32.1 | 65 | 38 | "the Wake-up PHY may support preamble puncturing transmission where one or more of the non-primary WUR 20MHz channels are zeroed out"--this is not just preamble puncturing, but whole packet puncturing, better use more precise term, not need to reuse the 11ax term, which was intended for different things | Change preamble puncturing to sub-channel puncturing or something similar. | Revised.Agree with the commenter.TGba editor to replace “preamble puncturing” to “subchannel puncturing” in P69L40 and P69L61 in TGba Draft 1.1. |
| 320 | Hongyuan Zhang | 32.1 | 65 | 44 | "The Wake-up radio PHY subcarriers are modulated using the Multicarrier On-Off Keying (MC-OOK) and the BPSK, QPSK, 16-QAM, 64-QAM, and 256-QAM are used for the coefficient of Wake-up radio PHY subcarriers."-- How to generate OOK waveform is up to implementation, multicarrier with BPSK, QPSK,... are just examples, as also stated in 32.2.3. Even if Tx use other modulation methods to generate the ON waveform, interop is still guranteed. | Make multicarrier with BPSK~256QAM as example or use the word "may", instead of mandatory language | Revised.In 11-17/575r11 “Spec Framework Document”, R3.3.B and R3.3.C, MC-OOK has been agreed to generate the OOK waveform. However, the coefficients of the subcarriers are not defined but three examples are provided in the Appendix AB.TGba editor to make the changes shown in doc.: IEEE 802.11-19/0064r2 under all headings that include CID 320. |
| 322 | Hongyuan Zhang | 32.1 | 65 | 54 | According to 9.10.2, WUR data field with 48 bits (or minimal-length (ML) WUR frame) is mandatory and more than 48 bits is optional. Even though this is MAC definition, but this has some PHY Rx implications. Maybe it is better to add that WUR receive STA shall be able to decode data field with 48 bits, and is optional to decode data field with >48 bits | Add decoding Data field with 48 bits as mandatory WUR receive STA requirement, and decoding Data field with >48 bits as optional WUR receive STA requirement | Rejected.Since the spec clearly defines that the support of the VL WUR frame is optional (see P22L7 of TGba Draft 1.1), there is no need to duplicate the description in Clause 32. |
| 411 | James Lepp | 32.1 | 65 | 26 | It states on line 26 that WUR PHY is based on chapter 17 but on line 43 it adds 64-QAM and 256-QAM (which come in later OFDM PHYs) as well as channel widths larger than 20MHz. Which is it? | A few options to resolve this. Easiest is to remove 31.9 FDMA operation and stick to the primary 20MHz. Other option is to admit Chapter 17 PHY is not enough and base it on 11ac (chapter 21) or 11ax (chapter 27/28), though that may increase the complexity requirements of the target IoT low power devices. | Revised.The line 26 has been deleted based on the comment resolution of CID 210. |
| 833 | Po-Kai Huang | 32.1 | 65 | 24 | WUR transmtiter STA and WUR receiver STA are defined only in 32.1 and not used elsewhere. To simplify the term we introduce in 11ba, we can just replace WUR transmitter STA with WUR AP and WUR receiver STA with WUR non-AP STA without defining WUR transmitter STA and WUR receiver STA. | As in comment. | Revised.Agree with the commenter. WUR receiver STA should be replaced with WUR non-AP STA and WUR transmitter STA should be replaced with WUR AP.TGba editor to make the changes shown in doc.: IEEE 802.11-19/0064r2 under all headings that include CID 833. |
| 933 | RUI YANG | 32.1 | 65 |  | It was agreed in the TGba that the OOK waveform CAN be generated, but not necessarily, by using OFDM signal. | Remove this sentence. How the MC-OOK may be generated can be introduced in latter clauses. | Rejected.There is no line number in the comment. It is unclear which sentence the commenter is referring to. In 11-17/575r11 “Spec Framework Document”, R3.3.B and R3.3.C, MC-OOK has been agreed to generate the OOK waveform. |
| 650 | Miguel Lopez | 32.2.2 | 68 | 49 | The text reads "The FDMA WUR PPDUs with 40 MHz and 80 MHz channel bandwidth are defined in Figure 32-2 (WUR FDMA PPDU for 40 MHz channel widths) and Figure 32-3". However, the figures do not define, the figures exemplify. | Change "defined" to "exemplified" in line 1. | Revised.Agree with the commenter.TGba editor to make the changes shown in doc.: IEEE 802.11-19/0064r2 under all headings that include CID 650 |
| 653 | Miguel Lopez | 32.2.2 | 69 | 23 | The text reads: "In each 20 MHz sub-channel with duplicated 20 MHz preamble, one 4MHz WUR signal centered in the 20MHz sub-channel is transmitted following the 20MHz preamble." It states that one 4 MHz WUR signal is transmitted. However, the bandwidth of the WUR signal is never properly defined in the spec. In addition, all the other bandwidths in the sentence refer to channel bandwidths, not to signal bandwidth. | Change the sentence to "In each 20 MHz sub-channel with duplicated 20 MHz preamble, one WUR signal centered in the 20 MHz sub-channel is transmitted following the 20 MHz preamble." | Accepted. |
| 657 | Miguel Lopez | 32.2.6 | 76 | 56 | The Description column of Table 32-3 reads "Duration of WUR LDR OOK symbol in WUR-Data field". This terminology is inconsistent with the terminology used in Tables 32-10 and 32-11. | Change the text in the column labeled Description to "Duration of WUR LDR MC-OOK symbol in WUR-Data field" | Revised.Agree with the commenter that throughout Clause 32, there is inconsistency in using OOK and MC-OOK. TGba editor: Find all the instances of “OOK” in Clause 32 and replace them with “MC-OOK”. |
| 680 | Miguel Lopez | 32.4 | 93 |  | The entry in the column labeled "Modulation" reads "OOK". This is inconsistent with the terminology in Table 32.10 | Change entry to "MC-OOK" | Revised.Agree with the commenter that throughout Clause 32, there is inconsistency in using OOK and MC-OOK. TGba editor: Find all the instances of “OOK” in Clause 32 and replace them with “MC-OOK”. |
| 681 | Miguel Lopez | 32.4 | 93 |  | The entry in the column labeled "Modulation" reads "OOK". This is inconsistent with the terminology in Table 32.11 | Change entry to "MC-OOK" | Revised.Agree with the commenter that throughout Clause 32, there is inconsistency in using OOK and MC-OOK. TGba editor: Find all the instances of “OOK” in Clause 32 and replace them with “MC-OOK”. |
| 764 | Oghenekome Oteri | 32.2.2 | 68 |  | The signal bandwidths of WUR-Sync and WUR-Data fields are not mentioned for single PPDU format. | Add a sentence to describe the signal bandwidth of WUR part of the PPDU. | Revised.The definition of each field of WUR PPDU is in a separate subclause. TGba editor to make the changes shown in doc.: IEEE 802.11-19/0064r2 under all headings that include CID 764. |
| 834 | Po-Kai Huang | 32.2.1 | 68 | 1 | Here, the sentence says that the legacy preamble is used to protect WUR PSDU. WUR PSDU is also used for description in various places. I assume that WUR PSDU includes WUR sync field and WUR Data field. However, it may not be obvious because PSDU in 802.11 2016 refers only to the data field. Further, in 32.3, PSDU only includes WUR MPDU. | Replace WUR PSDU with a better name and definition in clause 3. | Revised.The PSDU should just include WUR MPDU and not WUR-Sync same as the other amendments. This is also the definition in Table 32-2. Therefore, the legacy preamble should be used to protect WUR-Sync and WUR PSDU (i.e. WUR Data field), not just WUR PSDU.TGba editor to make the changes shown in doc.: IEEE 802.11-19/0064r2 under all headings that include CID 834. |
| 924 | Rui Cao | 32.2.8.1 | 80 | 59 | "W is a 64 us long sequence." "Sequence" is a digital concept. | Change to "W is a 32-bit sequence". | Revised.Agree with the commenter. TGba editor to make the changes shown in doc.: IEEE 802.11-19/0064r2 under all headings that include CID 924 |
| 274 | Eunsung Park | 32.3.1 | 91 | 33 | If the last information of the data field is "0", the last symbol is OFF, and thus, the last OFF period can be excluded from TXTIME. By doing so, L-LENGTH can be reduced up to 4us and other STAs can perform backoff procedure earlier. | Add the following equation.TXTIME = T\_L-STF + T\_L-LTF + T\_L-SIG + T\_RL-SIG + T\_WUR-Sync + T\_Sym\*(N\_Sym-1) if the last information of the data field is "0" | Rejected.Since the last OFF symbol is also part of the last bit information “0”, it should be protected by the correct LENGTH field value that includes the last OFF symbol.  |
| 276 | Eunsung Park | 32.3.1 | 92 | 17 | If the last information of the data field is "0", the last symbol is OFF, and thus, the last OFF period can be excluded from TXTIME. By doing so, L-LENGTH can be reduced up to 4us and other STAs can perform backoff procedure earlier. | Add the following equation.TXTIME = T\_L-STF + T\_L-LTF + T\_L-SIG + T\_RL-SIG + max\_i\_BW /in Omega\_20MHz {T\_WUR-Sync,i\_BW + T\_Sym,i\_BW\*(N\_Sym,i\_BW-1)} if the last information of the data field is "0" | Rejected.Since the last OFF symbol is also part of the last bit information “0”, it should be protected by the correct LENGTH field value that includes the last OFF symbol. |
| 277 | Eunsung Park | 32.4 | 93 | 32 | Modify the description of symbol structure for LDR and HDR in Table 32-15 as in Table 32-10 and Table 32-11. | See the comment. | Revised.Agree with the commenter. For the consistency of the spec, the terms SymLDROn, SymLDROff, SymHDROn, SymHDROff should be used.TGba editor to make the changes shown in doc.: IEEE 802.11-19/0064r2 under all headings that include CID 277. |
| 867 | Pooya Monajemi | 32.3.2 | 93 | 12 | 3msec is extremely long for TGba frames. In highly dense situations with many devices deciding to go to WUR mode this translates to a significant chunk of spectrum wasted on wake up frames, especially given the relaxed WUR contention rules. | Reduce aPPDUMaxTime | Rejected.The aPPDUMaxTime is the maximum time value of a WUR PPDU that has the Frame Body field, which is optional. The length of an individually addressed WUR Wake-up frame, which doesn’t have the Frame Body field is less than 1 msec at LDR. At HDR, the time is reduced to ¼.  |

32. Wake-Up Radio (WUR) PHY specification32.1 Introduction

**TGba Editor: *Change the following sentences in P69L16 of this subclause in TGba Draft 1.1 as follows:***

A WUR AP shall be capable of transmitting the WUR PPDU.(#833)
A WUR non-AP STA shall be capable of receiving the WUR PPDU.(#833)
(#833)

**TGba Editor: *Change the paragraph below in P69L44 of this subclause in TGba Draft 1.1 as follows:***

The WUR PHY subcarriers are modulated using the MC-OOK and the BPSK, QPSK, 16-QAM, 64-QAM, and 256-QAM may be (#320) used for the coefficient of WUR PHY subcarriers. For a WUR PPDU with 20 MHz channel width, the WUR-Sync and WUR-Data fields are generated by MC-OOK, which uses contiguous 13 subcarriers with a subcarrier spacing of 312.5 kHz and the center subcarrier being null.(#320)

A WUR AP(#833) shall support the following features:
— A WUR PPDU with 20 MHz channel width, low data rate, and single stream.
— A WUR PPDU with 20 MHz channel width, high data rate, and single stream.

A WUR non-AP(#833) STA shall support the following features:
— A WUR PPDU with 20 MHz channel width, low data rate, and single stream.

A WUR AP(#833) may support the following features:
— FDMA transmissions for 40 MHz and 80 MHz contiguous channel widths.
— FDMA transmission with preamble puncturing for 80 MHz

**32.2 WUR PHY
32.2.1 Introduction**

**TGba Editor: *Change Table 32-2 below in P71L64 of this subclause in TGba Draft 1.1 as follows (#834):***

During transmission, a PSDU is processed and appended to the PHY preamble including legacy preamble and WUR-Sync field to create the WUR PPDU. At the legacy receivers, the legacy preamble is accordingly processed to aid in protection of the WUR-Sync and the PSDU.(#834) At the wake-up receiver, the WUR-Sync field is accordingly processed to aid in the detection, demodulation, and delivery of the PSDU.

**32.2.2 WUR PPDU format**

**TGba Editor: *Change Table 32-2 below in P72L22 of this subclause in TGba Draft 1.1 as follows (#764):***

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| * Fields of the WUR PPDU
 |
| **Field** | **Description** |
| L-STF | Non-HT Short Training field (21.3.4.2 (Construction of L-STF)) |
| L-LTF | Non-HT Long Training field(21.3.4.3 (Construction of L-LTF)) |
| L-SIG | Non-HT SIGNAL field (21.3.4.4 (Construction of L-SIG) and 21.3.8.2.4 (L-SIG definition)) |
| BPSK-Mark | A BPSK modulated OFDM symbol (32.2.8.2.1 (BPSK-Mark Definition)) |
| WUR-Sync | Wake-Up Radio Synchronization field(32.2.8.3 (WUR-SYNC field)) |
| WUR-Data | Wake-Up Radio Data field carrying the PSDU(32.2.9 (WUR-Data field)) |

**TGba Editor: *Change the paragraph below in P72L47 of this subclause in TGba Draft 1.1 as follows:***

The examples of FDMA WUR PPDUs with 40 MHz and 80 MHz channel bandwidth are illustrated in Figure 32-2 (WUR FDMA PPDU for 40 MHz channel widths) and Figure 32-3 (WUR FDMA PPDU for 80 MHz channel widths), respectively. (#650)

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 and BPSK-mark fields. In each 20 MHz subchannel with duplicated 20 MHz preamble, one (#653)WUR signal centered in the 20 MHz subchannel is transmitted following the 20 MHz preamble.

**32.2.8 WUR preamble
32.2.8.1 Introduction**WUR supports two data rates for the WUR-Data field: (i) Low data rate of 62.5 kb/s. (ii) High data rate of 250 kb/s.

**TGba Editor: *Change the paragraph below in P84L64 of this subclause in TGba Draft 1.1 as follows:***

The data rate of the WUR-Data field of a WUR PPDU will be indicated using the WUR-Sync field. There will not be an explicit field in a WUR PPDU to indicate the data rate. To indicate low data rate (LDR) for the WUR-Data field of a WUR PPDU, a repeated sequence ([W W]) is transmitted. Here, W is a 32-bit sequence and 64 µs long(#924). To indicate high data rate (HDR) for the WUR-Data field of a WUR PPDU, a bitwise complement of the sequence W is transmitted.

**32.4 Parameters for WUR-MCSs**

**TGba Editor: *Change Table 32-13 below in P98L32 of this subclause in TGba Draft 1.1 as follows:***

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| * WUR PPDU Data Rates
 |
| Data Rate | Modulation | SymbolStructure | Equivalent Information Bit Duration | *NSPDB* | Data rate (kb/s) |
| LDR | MC-OOK | Information 0 | [SymLDROn, SymLDROff, SymLDROn, SymLDROff](#277) | 16 µs | 4 | 62.5 |
| Information 1 | [SymLDROff, SymLDROn, SymLDROff, SymLDROn](#277) |
| HDR | MC-OOK | Information 0 | [SymHDROn, SymHDROff](#277) | 4 µs | 2 | 250 |
| Information 1 | [SymHDROff, SymHDROn](#277) |