### IEEE P802.11Wireless LANs

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| Spec Text Revision on WUR Waveform Generation |
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Abstract

This document proposes a revision on the draft spec text, P802.11ba D0.3 regarding the WUR Waveform Generation for signle 20 MHz channel and FDMA transmission.

Revision History:

* Rev 0: Initial version of the document
* Rev 1: Update on 32.2.4.9
* Rev 2: Edition on the Header
* Rev 3: Removal of spatial mapping procedure in 32.2.4.9
* Rev 4: Formating is modified

***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 or insert 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.***

**TGba Editor: *Instruction*: *Revise the section 32.2.3 with the followings***

* + 1. Transmitter block diagram

The generation of each field in a WUR-PPDU uses the following blocks:

—Manchester-based encoder

—Waveform signal generation

Figure 32-4 (An Example of a WUR signal generator for the WUR-Sync field ~~for Antenna~~ $i\_{TX}$) and Figure 32-5 (An Example of a WUR signal generator for the WUR-Data field ~~for Antenna~~ $i\_{TX}$) show examples of transmitter block diagrams. The actual structure of the transmitter is implementation dependent. The transmitter block diagrams for L-STF, L-LTF, and L-SIG are described in 21.3.3 (Transmitter block diagram).



**~~Figure 32-4--An Example of a WUR signal generator for the WUR-Sync field for Antenna~~** $i\_{TX}$



**Figure 32-4. An Example of a WUR signal generator for the WUR-Sync field**

An example of a WUR signal generator for the WUR-Sync field, ~~for Antenna~~ $i\_{TX}$~~,~~ is shown in 32-4 ~~(An Example of a WUR signal generator for the WUR-Sync field for Antenna~~ $i\_{TX}$~~)~~. The Sync bit sequence is then used to switch between the On waveform generator (On-WG) and the Off waveform generator (Off-WG).



**~~Figure 32-5--An Example of a WUR signal generator for the WUR-Data field for Antenna~~** $i\_{TX}$



**Figure 32-5- An Example of a WUR signal generator for the WUR-Data field**

An example of a WUR signal generator for the WUR-Data field is shown in 32-4 ~~(An Example of a WUR signal generator for the WUR-Data field for Antenna~~ $i\_{TX}$~~)~~. The information bits are mapped by a Manchester-based encoder. Each coded bit is then used to switch between the On waveform generator (On-WG) and the Off waveform generator (Off-WG).

**TGba Editor: *Instruction*: *Add the contents below into the following sections 32.2.3.1 and 32.2.3.2***

* + - 1. **WUR-PPDU waveform generation for Sync field and high rate Data field**



**Figure 32-x-An Example of an On-WG for the Sync and high rate Data fields**

For a single 20-MHz WUR channel the 2 µs MC-OOK On symbol can be constructed by the On-Waveform Generator (On-WG) using a 64-point IDFT, sampling at 20-MHz as follows:

* Thirteen subcarriers are used, (-6, -5, … -1, 0, 1, 2, … 6).
* The following subcarriers are null: (-5, -3, -1, 0, 1, 3, 5).
* The other subcarriers are selected from any of the following constellations: BPSK, QPSK, 16-QAM, 64-QAM, and 256-QAM.
* The first 32 values of the 64-point IDFT output are selected. The last 8 samples of those 32 samples are prepended to the 32 samples generating 40 samples, representing the MC-OOK 2 µs On symbol.

For a single 20-MHz WUR channel the 2 µs MC-OOK Off symbol can be constructed by the Off-Waveform Generator (Off-WG) as zero for 2 µs.

**32.2.3.2** **WUR-PPDU waveform generation for low rate Data field**



**Figure 32-y-An Example of an On-WG for the low rate Data fields**

For a single 20-MHz WUR channel the 4 µs MC-OOK On symbol can be constructed by the On-Waveform Generator (On-WG) using a 64-point IDFT, sampling at 20-MHz as follows:

* Thirteen subcarriers are used, (-6, -5, … -1, 0, 1, 2, … 6).
* The DC subcarrier is null.
* The other subcarriers are selected from any of the following constellations: BPSK, QPSK, 16-QAM, 64-QAM, and 256-QAM.
* The last 16 values of the 64-point IDFT output are prepended to the 64 samples generating 80 samples, representing the 4 µs MC-OOK On symbol.

For a single 20-MHz WUR channel the 4 µs MC-OOK Off symbol can be constructed by the Off-Waveform Generator (Off-WG) as zero for 4 µs.

**TGba Editor: *Instruction*: *Revise its content in the Section 32.2.3.3 as follows.***

**32.2.3.3 WUR-PPDU Data field waveform generation for the FDMA transmission**



**Figure 32-6. An Example of a WUR Data field signal generator for the FDMA transmission**

Multicarrier based OOK (MC-OOK) ‘On’ symbol for 20 MHz WUR waveform can be generated according to 32.2.3.1 or 32.2.3.2 depending on WUR\_DATARATE. The 40 MHz or 80 MHz FDMA WUR PPDU can be generated by multiplexing multiple 20 MHz WUR waveforms in the corresponding channel as seen in Figure 32-6.

**TGba Editor: *Instruction*:*Delete the Section 32.2.4.6 as follows.***

**~~32.2.4.6~~** ~~MC-OOK On and Off Waveform Generators~~

~~For a single 20 MHz WUR channel, the 4 μs MC-OOK On symbol can be constructed by the On-Waveform Generator (On-WG) using a 64-point IFFT, sampling at 20 MHz as follows:~~

~~—The following thirteen subcarriers are used: (-6, -5, … -1, 0, 1, 2, … 6).~~

~~—The DC subcarrier is null.~~

~~—The other subcarriers are selected from any of the following constellations: BPSK, QPSK, 16-QAM, 64-QAM, and 256-QAM.~~

~~—The last 16 values of the 64-point IFFT output are prepended to the 64 samples generating 80 sam­ples, representing the 4 μs MC-OOK On symbol.~~

~~For a single 20 MHz WUR channel, the 4 μs MC-OOK Off symbol can be constructed by the Off- Waveform Generator (Off-WG) as zero for 4 μs.~~

~~For a single 20 MHz WUR channel, the 2 μs MC-OOK On symbol can be constructed by the On-Waveform Generator (On-WG) using a 64-point IFFT, sampling at 20 MHz as follows:~~

~~—The following thirteen subcarriers are used: (-6, -5, … -1, 0, 1, 2, … 6).~~

~~—The following subcarriers are null: (-5, -3, -1, 0, 1, 3, 5).~~

~~—The other subcarriers are selected from any of the following constellations: BPSK, QPSK, 16-QAM, 64-QAM, and 256-QAM.~~

~~—The first 32 values of the 64-point IFFT output are selected. The last 8 samples of those 32 samples are prepended to the 32 samples generating 40 samples, representing the MC-OOK 2 μs On symbol.~~

~~For a single 20 MHz WUR channel, the 2 μs MC-OOK Off symbol can be constructed by the Off-Wave­form Generator (Off-WG) as zero for 2 μs.~~

**TGba Editor: *Instruction*: *Revise the following contents in Section 32.2.4.8 and 32.2.4.9***

**32.2.4.8 Construction of the WUR-Data for single 20 MHz channel**

Construct the WUR-Data waveform as follows:

1. Manchester based ennoder: Pulse combination is determined according to the input bits as described in 32.2.9 (WUR-Data field).
2. The output of Manchester based encoder determines which samples to take either from ~~On-WG~~$i\_{TX}$ On-WGor from Off-WG, depending on the WUR\_DATARATE. The samples in Off-WG have zero energy. Each symbol duration, *TSym* is 2 usec for high data rate (*TSYM-HDR*) and 4 usec for low data rate (*TSYM-LDR*).
3. Apply the CSD for each RF chain.
4. Apply the windowing.
5. Analog and RF: Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal based on the center frequency of the desired channel.

**32.2.4.9 Construction of the WUR-Sync and the WUR-Data for FDMA transmission**

Construct the WUR-Sync and the WUR-Data waveform for the FDMA transmission as follows:

1. ~~Manchester based encoder for each 20 MHz sub-channel: Pulse combination is determined accord­ing to the input bits as described in 32.2.9 (WUR-Data field).~~
2. ~~The output of the~~ $k^{th} $~~Manchester based encoder determines which samples to take either from the~~ $k^{th}$ ~~On-WG~~*~~iTX~~* ~~of corresponding 20 MHz sub-channel or from Off-WG, depending on the WUR\_BANDWIDTH and the WUR\_DATARATE, where~~ *~~k (0, 1, …, K-1)~~* ~~is the index of the 20 MHz sub-channel. The samples in Off-WG have zero energy. Each symbol duration,~~ $T\_{SYM}$~~is 2 μs for high data rate ((T~~*~~SYM-HDR~~*~~) and 4 μs for low data rate (T~~*~~SYM-LDR~~*~~).~~
3. ~~The outputs of the waveform generators across the 20 MHz sub-channels are added, sample by sam­ple.~~
4. ~~Apply the Spatial Mapping.~~
5. ~~Apply the CSD for each RF chain.~~
6. ~~Windowing: Apply windowing.~~
7. ~~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.~~
8. Determine the WUR\_DATARATE from the WUR\_TXVECTOR for each 20MHz sub-channel.
9. Sync-bit sequence generation and Manchester based encoder for each 20MHz sub-channel: Generate the Sync-bit sequence according to the WUR\_DATARATE as described in 32.2.8.3 (WUR SYNC field) and Manchester encoded bits which follow the Sync-bit sequence according to the input bits as describted in 32.2.9 (WUR-Data field) for each 20MHz-subchannel.
10. Waveform generation for the WUR-Sync field: Generate the MC-OOK waveform for the WUR-Sync field by using either HDR On-WG or Off-WG according to the Sync-bit for each 20MHz-subchannel. Each Sync-bit duration, *TSync* is 2 µs.
11. Waveform generation for the WUR-Data field: The output of the *k*th Manchester based encoder determines which samples to take either from the *k*th HDR On-WGor LDR On-WG of corresponding 20 MHz sub-channel or from Off-WG, depending on the WUR\_BANDWIDTH and the WUR\_DATARATE, where *k* (0, 1, …, *K*-1) is the index of the 20 MHz sub-channel. The samples in Off-WG have zero energy. Each symbol duration, *TSym* is 2 μs for high data rate (T*SYM-HDR*) and 4 μs for low data rate (T*SYM-LDR*).
12. CSD: Apply the CSD for each RF chain per each 20 MHz respectively according to the WUR\_DATARATE of each 20 MHz sub-channel.
13. The CSD outputs for the same RF chain per each 20 MHz sub-channel are added across the 20 MHz sub-channels, sample by sample.
14. Windowing: Apply windowing.
15. 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.