### IEEE P802.11Wireless LANs

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| Draft Spect Text for FDMA WUR Generation |
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Abstract

This document proposes a draft spec text on FDMA WUR waveform generation to be incorporated in P802.11ba D0.3 regarding the following motion in SFD.

R.3.5.A: [Assigned D0.3] the concept of FDMA transmission scheme is shown below.

– Each 20MHz only contains one 4MHz sub-channel for wake-up signal transmission.

– Similar to 11ax’s 20MHz only operation, one wake-up receiver can stay in one of the sub-channel in wide bandwidth. [Motion, March 2018]

Revision History:

* Rev 0: Initial version of the document
* Rev 1: Documentation format change



***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*: *Create the following subsections under 32.3.3 and add the spec text under the section 32.3.3.3***

* Transmitter block diagram

32.3.3.1 WUR-PPDU waveform generation for Sync field and high rate Data field

32.3.3.2 WUR-PPDU waveform generation for low rate Data field

32.3.3.3 WUR-PPDU waveform generation for FDMA transmission

**Channel 0**

**Manchester-**

**based encoder**

Channel 0

On-WG*iTX*

*TSym*

Analog

and RF

Window

…..

**Channel K-1**

**Manchester-**

**based encoder**

Channel K-1

On-WG*iTX*

**Off-WG**

*TSym*

Figure 32-CA WUR signal generator for FDMA transmission of the data field, where K can be 2 or 4 according to 40 MHz or 80 MHz FDMA transmission

**Option 1: Digital domain waveform generation**

Multicarrier based OOK (MC-OOK) ‘On’ symbol for 80 MHz FDMA WUR PPDU can be generated with 256-point IFFT, and sampling at 80 MHz with the following instructions for each individual 20 MHz Channel,

* For Channel 0 in Figure 32-CA, thirteen subcarriers (-102 ~ -90) of subcarrier spacing with 312.5 KHz for 80 MHz OFDM symbol can be occupied with a TBD sequence, but subcarrier -96 can be Null.
* For Channel 1 in Figure 32-CA, thirteen subcarriers (-38 ~ -26) of subcarrier spacing with 312.5 KHz for 80 MHz OFDM symbol can be occupied with a TBD sequence, but subcarrier -32 can be Null.
* For Channel 2 in Figure 32-CA, thirteen subcarriers (26 ~ 38) of subcarrier spacing with 312.5 KHz for 80 MHz OFDM symbol can be occupied with a TBD sequence, but subcarrier 32 can be Null.
* For Channel 3 in Figure 32-CA, thirteen subcarriers (90 ~ 102) of subcarrier spacing with 312.5 KHz for 80 MHz OFDM symbol can be occupied with a TBD sequence, but subcarrier 96 can be Null.

For 2 usec ‘On’ OOK, the first 128 samples of the 256-IFFT outputs are selected, the last 32 samples of those 128 samples are prepended to the 128 samples and ends up generating 160 samples, representing the MC-OOK 2 usec ‘On’ symbol.

For 4 usec ‘On’ OOK, the last 64 samples of the 256-IFFT outputs are prepended to the 256 samples and ends up generating 320 samples, representing the MC-OOK 4 usec ‘On’ symbol.

Whereas Multicarrier based OOK (MC-OOK) ‘On’ symbol for 40 MHz FDMA WUR PPDU can be generated with 128-point IFFT, and sampling at 40 MHz with the following instructions for each individual 20 MHz Channel,

* For Channel 0 in Figure 32-CA, thirteen subcarriers (-38 ~ -26) of subcarrier spacing with 312.5 KHz for 40 MHz OFDM symbol can be occupied with a TBD sequence, but subcarrier -32 can be Null.
* For Channel 1 in Figure 32-CA, thirteen subcarriers (26 ~ 38) of subcarrier spacing with 312.5 KHz for 40 MHz OFDM symbol can be occupied with a TBD sequence, but subcarrier 32 can be Null.

For 2 usec ‘On’ OOK, the first 64 samples of the 128-IFFT outputs are selected, the last 16 samples of those 64 samples are prepended to the 64 samples and ends up generating 80 samples, representing the MC-OOK 2 usec ‘On’ symbol.

For 4 usec ‘On’ OOK, the last 32 samples of the 128-IFFT outputs are prepended to the 128 samples and ends up generating 160 samples, representing the MC-OOK 4 usec ‘On’ symbol.

**Option 2: Analog domain waveform generation [1]**

Multicarrier based OOK (MC-OOK) ‘On’ symbol for 20 MHz WUR waveform can be generated according to 32.3.3.1 or 32.3.3.2 depending on WUR\_DATARATE. The 40 MHz or 80 MHz FDMA WUR PPDU can be generated by shifting the 20 MHz WUR waveform to the corresponding channel as seen in the Equation below.

$$w\left[n\right]=w\_{20}[n]∙e^{j2πf\_{0}n}$$

where $w\left[n\right]$ and $w\_{20}\left[n\right] $are the frequency shifted WUR PPDU, and 20 MHz WUR PPDU generated in section 32.3.3.1 or 32.3.3.2, respectively. $f\_{0}$ can be the frequency to be shifted.

**SP1: Which option do you prefer?**

**Option 1/Option 2/Abstain**

**TGba Editor: *Instruction*: *Replace TBD by the right Section number in the following sections.***

**32.3.4.2 Construction of the L-STF**

See section 21.3.4.2.

**32.3.4.3 Construction of the L-LTF**

See section 21.3.4.3.

**32.3.4.4 Construction of the L-SIG**

See section 21.3.4.4.

**TGba Editor: *Instruction*: *Add the following spec texts in Section 32.3.4.7 and 32.3.4.8***

**32.3.4.7 Construction of the WUR-Data**

Construct the WUR-Data waveform as follows.

1. Determine the WUR\_DATARATE from the WUR\_TXVECTOR.
2. Manchester based enoder: Pulse combination is determined according to the input bits as described in 32.3.9.
3. The output of Manchester based encoder determines which samples to take either from On-WG*iTX* or from Off-WG. The On-WG*iTX* or Off-WG is a type of buffer which stores corresponding waveform samples. The waveform samples stored in On-WG*iTX* are generated as in 32.3.3.1 or 32.3.3.2 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*).
4. Apply windowing as described in *TBD*.
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.

**32.3.4.8 Construction of the WUR-Data for the multiband transmission**

Construct the WUR-Data waveform for the multiband transmission as follows.

1. Determine the WUR\_BANDWIDTH from the WUR\_TXVECTOR.
2. Determine the WUR\_DATARATE for each 20 MHz Channel from the WUR\_TXVECTOR.
3. Manchester based enoder for each 20 MHz Channel: Pulse combination is determined according to the input bits as described in 32.3.9.
4. The output of Manchester based encoder determines which samples to take either from On-WG*iTX* of each 20 MHz Channel or from Off-WG. The On-WG*iTX* or Off-WG is a type of buffer which stores corresponding waveform samples. The waveform samples stored in On-WG*iTX* of each each 20 MHz Channel are generated as in 32.3.3.3 depending on the WUR\_BANDWIDTH and 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*).
5. The outputs of the waveform generator for each 20 MHz Channel are added with the outputs of the other 20 MHz Channels, sample by sample.
6. Apply windowing as described in *TBD*.
7. 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.

Reference

[1] R. Cao, et. al. “PAPR Reduction in WUR FDMA Mode”, IEEE 11-18/776r0, May 2018, Warsaw, Poland

**SP2: do you agree to approve the spectext proposal in this document 11-18/0785r1?**

**Y/N/Abs**