IEEE P802.11
Wireless LANs

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| Proposed Spec Text for WUR FDMA Operation |
| Date: 2018-05-10 |
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Abstract

This submission proposes spec for WUR FDMA operation for the following portions of the SFD:

1. [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, see [8] [28]]

Revisions:

* Rev 0: Initial version of the document.

***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.***

3.2 Definitions specific to IEEE 802.11

***TGba Editor: Insert the following definitions maintaining alphabetical order:***

**wake-up radio (WUR) channel:** A channel in which a WUR non-AP STA in WURx awake state listens.

**wake-up radio (WUR) primary channel:** The common channel of operation for all WUR stations (STAs) in which the WUR beacons are transmitted.

**wake-up radio (WUR) primary 40 MHz channel:** The 40 MHz channel that is used to transmit 40 MHz WUR Frequency Division Multiple Access (FDMA) physical layer (PHY) protocol data units (PPDUs).

**wake-up radio (WUR) primary 80 MHz channel:** The 80 MHz channel that is used to transmit 80 MHz WUR Frequency Division Multiple Access (FDMA) physical layer (PHY) protocol data units (PPDUs).

**wake-up radio (WUR) secondary channel:** The 20 MHz channel adjacent to the WUR primary channel that together form the 40 MHz channel.

**wake-up radio (WUR) secondary 40 MHz channel:** The 40 MHz channel adjacent to the WUR primary 40 MHz channel that together form the 80 MHz channel.

* WUR Mode element

***TGba Editor: Insert the below row into Table 9-262c (Subfields of WUR Parameters field from WUR AP):***

|  |
| --- |
| * Subfields of WUR Parameters field from WUR AP
 |
| **Subfield** | **Definition** | **Encoding** |
| WUR Channel Offset | Indicates the channel offset to be transmitted the WUR Wake-up frame relative to the WUR primary channel (see 31.6 (WUR FDMA Operation)).   | Set to 0 if the WUR Wake-up frames are to be transmitted in the WUR primary channel.Set to 1 if the WUR Wake-up frames are to be transmitted in first upper 20MHz channel relative to the WUR primary channel.Set to 2 if the WUR Wake-up frames are to be transmitted in first lower 20MHz channel relative to the WUR primary channel.Set to 3 if the WUR Wake-up frames are to be transmitted in second upper 20MHz channel relative to the WUR primary channel.Set to 4 if the WUR Wake-up frames are to be transmitted in second lower 20MHz channel relative to the WUR primary channel.Set to 5 if the WUR Wake-up frames are to be transmitted in third upper 20MHz channel relative to the WUR primary channel.Set to 6 if the WUR Wake-up frames are to be transmitted in third lower 20MHz channel relative to the WUR primary channel.The value 7 is reserved.  |

***TGba Editor: Insert the below row into Table 9-262d (Subfields of WUR Parameters field from WUR non-AP STA):***

|  |
| --- |
| * Subfields of the WUR Parameters field from WUR non-AP STA
 |
| **Subfield** | **Definition** | **Encoding** |
| WUR Channel Switching | Indicates whether the WUR channel switching capability for receiving WUR Beacon and WUR Wake-up frames that are transmitted in each different channels is enabled or disabled. (see 31.6 (WUR FDMA Operation)).  | Set to 0 if the WUR channel switching capability is disabled. Set to 1 if the WUR channel switching capability is enabled. |

31.2 Channel access

***TGba Editor: Change this subclause as the following:***

A WUR AP that intends to transmit a WUR frame shall contend for the medium as defined in 10.22.2 HCF contention based channel access (EDCA) except that:

— In PHY-CCA.indication primitive and Table 10-15 (Channels indicated idle by the channel-list parameter), the primary channel is replaced by the WUR primary channel.

— The WUR AP may use any AC for sending a WUR Beacon frame, a WUR Discovery frame, or a WUR Vendor Specific frame.

— The WUR AP may use any AC for sending a WUR Wake-up frame that is addressed to more than one WUR non-AP STA.

—The WUR AP may use any AC for sending a WUR Wake up frame that is addressed to one WUR non-AP STA when the WUR AP does not have pending buffered BU(s) for the WUR non-AP STA.

—The WUR AP that sent a WUR frame using the EDCAF of a particular AC shall not update the CW and the retry counters for that AC independently of whether the WUR frame was successfully received by the intended recipient.

Channel acces on WUR primary 40 MHz channel and WUR primary 80 MHz channel is described in 31.6.1 (WUR FDMA channel access).

31.3.2 WUR Beacon generation

***TGba Editor: Change this subclause as the following:***

The AP shall define the timing for WUR by transmitting WUR Beacon frames according to dot11WBeaconPeriod. This defines a series of TWBTTs exactly dot11WBeaconPeriod TUs apart. At each TWBTT, the AP shall schedule a WUR Beacon frame on the WUR primary channel indicated by the WUR Operating Class and WUR Channel fields in the WUR Operation element as the next frame for transmission according to the medium access rules specified in Clause 10 except that one of the following conditions is met:

**31.4 WUR duty cycle operation**

***TGba Editor: Change this subclause as the following:***

WUR duty cycle operation is determined by three parameters: WUR channel, starting point, on duration, and duty cycle period as shown in Figure 31-1 (WUR Duty Cycle). The WUR channel of a WUR non-AP STA with dot11WURChannelSwitchActivated equal to false is same as the WUR primary channel. Otherwise, it is determined by is determined according to 31.6 (WUR FDMA Operation). On duration determines the time that a WUR non-AP STA is in WURx awake state for each WUR duty cycle schedule. Duty cycle period determines the elapsed time between the start times of two successive WUR duty cycle schedules. Starting point is the start time of one WUR duty cycle schedule and is decided by the WUR AP. How to indicate the starting point is TBD.WUR duty cycle operation reduces the required amount of time that a WUR non-AP STA utilizing WUR Mode needs to be in WURx awake state after the PCR component of the WUR non-AP STA enters doze state (see 31.5 (Power management with WUR)) and allows WUR AP to manage WUR activity in the BSS by scheduling WUR non-AP STA to receive WUR frame at different times.

***TGba Editor: Insert the following subclause after 31.5 (Power management with WUR).***

**31.6 WUR FDMA operation**

A WUR non-AP STA whose dot11WURChannelSwitchActivated is false shall set the WUR Channel Switching subfield of the WUR Parameters field of the WUR Mode element that it transmits to 0. Otherwise, a WUR non-AP STA shall set the WUR Channel Switching subfield of the WUR Parameters field of the WUR Mode element that it transmits to 1.

When a WUR AP receives a WUR Mode element of which the WUR Channel Switching subfield of the WUR Parameters field is equal to 0, the WUR AP shall set the WUR Channel Offset subfield of the WUR Parameters field of the WUR Mode element that it transmits to 0. Otherwise, the WUR AP shall set the WUR Channel Offset subfield of the WUR Parameters field of the WUR Mode element that it transmits to any value, subject to the negotiated WUR duty cycle schedule does not overlapp with the TWBTTs at which the WUR AP schedules for transmission WUR Beacon frames.

When a WUR non-AP STA receives a WUR Mode element of which the WUR Channel Offset subfield of the WUR Parameters field is not equal to 0, the WUR channel is determined as one of the following:

—First upper 20MHz channel relative to the WUR primary channel if the WUR Channel Offset subfield is 1.

—First lower 20MHz channel relative to the WUR primary channel if the WUR Channel Offset subfield is 2.

—Second upper 20MHz channel relative to the WUR primary channel if the WUR Channel Offset subfield is 3.

—Second lower 20MHz channel relative to the WUR primary channel if the WUR Channel Offset subfield is 4.

—Third upper 20MHz channel relative to the WUR primary channel if the WUR Channel Offset subfield is 5.

—Third lower 20MHz channel relative to the WUR primary channel if the WUR Channel Offset subfield is 6.

**31.6.1 WUR FDMA channel access**

In PHY-CCA.indication primitive and Table 10-15 (Channels indicated idle by the channel-list parameter), the primary channel, secondary 20 MHz channel, and the secondary 40 MHz channel are replaced by the WUR primary chanel, the WUR secondary 20 MHz channel, and the WUR secondary 40 MHz channel.

The WUR AP may use any AC for sending multiple WUR Wake-up frames in a WUR FDMA PPDU.

If a WUR AP inteds to transmit a WUR FDMA PPDU (as defined in 10.22.2.4 (Obtaining an EDCA TXOP) and 31.2 (Channel access)), the WUR AP shall perform exactly one of the following actions:

1. Transmit the 40 MHz WUR FDMA PPDU in the WUR primary 40 MHz channel when the following conditions are met:
	1. The WUR secondary channel was idle during an interval of PIFS immediately preceding the start of the TXOP.
	2. The WUR AP schedules one WUR frame transmission on each of 20 MHz subchannels of the WUR primary 40 MHz channel.
2. Transmit the 80 MHz WUR FDMA PPDU on the WUR primary 80 MHz channel when the following conditions are met:
	1. Both the WUR secondary channel and the WUR secondary 40 MHz channel were idle during an interval of PIFS immediately preceding the start of the TXOP.
	2. The WUR AP schedules one WUR frame transmission on each of 20 MHz subchannels of the WUR primary 80 MHz channel.
3. Transmit the 80 MHz preamble punctured WUR FDMA PPDU on the WUR primary 80 MHz channel when the following conditions are met:
	1. At least one of the 20MHz subchannels of the WUR secondary channel and the WUR secondary 40 MHz channel were idle during an interval of PIFS immediately preceding the start of the TXOP.
	2. The WUR AP schedules one WUR frame transmission on each of 20 MHz subchannels of the WUR primary 80 MHz channel, except when the subchannel was not idle or the WUR AP does not have a pending WUR frame intended for WUR non-AP STAs listening on that subchannel.

In the above, the WUR frame transmission can have any WUR signal if the WUR AP does not have a WUR Wake-up frame intended to a WUR non-AP STA.

***TGba editor: Change Annex C as the following:***

**Annex C (normative)**

**ASN.1 encoding of the MAC and PHY MIB**

**C.3 MIB Detail**

Dot11StationConfigEntry ::= SEQUENCE

{

 …

dot11FILSActivated(11ai) TruthValue(11ai),

dot11S1GOptionImplemented(11ah) TruthValue(11ah),

dot11WURChannelSwitchActivated TruthValue

}

…

dot11WURChannelSwitchActivated OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"This is a control variable.

It is written by an external management entity or the SME. Changes take

effect as soon as practical in the implementation.

This attribute when true, indicates that the capability of the STA to swtich the WUR channel for receiving WUR Beacon and WUR Wake-up frames that are transmitted in different channels is enabled (see 31.6 (WUR FDMA operation)). The capability is disabled otherwise."

DEFVAL { false }

::= { dot11StationConfigEntry <ANA>}

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-- \* End of dot11StationConfigTable TABLE

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