802.11ba Draft Specification

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| Proposed Text for WUR MAC Revision |
| Date: 2018-07-08 |
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Abstract

This submission contains spec text to be incorporated in P802.11ba D0.4 related to WUR MAC revision.

Revision History:

* Rev 0: Initial version of the document
* Rev 1: Fix the following based on the comments from the presentation. Changes are marked with Green
	+ Editorial change.
	+ Remove revision for 31.7.1
	+ Revision in 31.6.2

***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: Modify “Table 9-217******—TFS Action Code field values”******to “Table 9-200******—TFS Action Code field values”***

**TGba Editor: *Instruction: Modify 9.4.2.262 as the following: (Track Change on)***

* WUR Mode element

The WUR Mode element is used to negotiate the parameters related to WUR operation. The format of the WUR Mode element is shown in Figure 9-589a (WUR Mode element format).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Element ID Extension | Action Type | WUR Mode Response Status | WUR Parameters Control | WUR Parameters |
| Octets: | 1 | 1 | 1 | 1 | 1 | 1 |  variable |
| * WUR Mode element format
 |

The Element ID, Length, and Element ID Extension fields are defined in 9.4.2.1 (General).

The Action Type field is a number that identifies the type of WUR mode operation. The Action Type values are shown in Table 9-262a (Action Type definitions).

|  |
| --- |
| * Action Type definitions
 |
| Action Type value | Meaning |
| 0 | Enter WUR Mode Request |
| 1 | Enter WUR Mode Response |
| 2 | Enter WUR Mode Suspend Request |
| 3 | Enter WUR Mode Suspend Response |
| 4 | Enter WUR Mode Suspend |
| 5 | Enter WUR Mode |
| 6-255 | Reserved |

The WUR Mode Response Status field indicates the status returned by the AP responding to the non-AP STA’s WUR Mode request operation and its values are defined in Table 9-262b (WUR Mode Response Status Definition). This field is valid only when the Action Type field is set to “Enter WUR Mode Response” or “Enter WUR Mode Suspsend Response” and is reserved otherwise.

|  |
| --- |
| * WUR Mode Response Status Definition
 |
| Value | Meaning |
| 0 | Accept. |
| 1 | Denied. |
| 2-255 | Reserved |

The WUR Parameters Control field indicates the configuration of the following WUR Parameters field. The format of the WUR Parameter Control field is shown in Figure 9-589b (WUR Parameters Control field format).

|  |  |  |
| --- | --- | --- |
|  | B0 | B1                                 B7 |
|  | Group ID List Present | Reserved |
| Bits: | 1 | 7 |
| * WUR Parameters Control field format
 |

The Group ID List Present subfield is set to 1 if the Group ID List subfield is present in the following WUR Parameters field and set to 0 otherwise.

The subfields of the WUR Parameters field sent from WUR AP are defined in Table 9-262c (Subfields of WUR Parameters field from WUR AP).

|  |
| --- |
| * Subfields of WUR Parameters field from WUR AP
 |
| **Subfield** | **Definition** | **Encoding** |
| WUR ID | A WUR identifier that uniquely identifies the WUR STA within the BSS of the AP  | An WUR identifier provided by the AP. The size of the field is 12 bits. |
|  |  |  |
| WUR Channel Offset | Indicates the channel offset to be transmitted the WUR Wake-up frame relative to the WUR primary channel (see 31.9 (WUR FDMA operation)).  | The size of the field is 3 bits. The encoding is described in Table X.  |
| Reserved | Reserved field  | The size of the field is 1 bit. |
| Starting time of the WUR duty cycleStarting Time Of The WUR Duty Cycle | TSF time of the starting point of the WUR duty cycleTSF time of the starting point of the WUR duty cycle schedule | The size is 5 bytesThe size of the field is 5 octets in units of unit us.µs.  |
| Group ID List | Indicates one or more group IDs assigned to the STA | The format is shown in Figure 9-589c (Group ID List subfield format). |

 Table X - WUR Channel Offset subfield encoding

|  |  |
| --- | --- |
| WUR Channel Offset subfield | Meaning |
| 0 | The WUR Wake-up frames are to be transmitted in the WUR primary channel. |
| 1 | The WUR Wake-up frames are to be transmitted in first upper 20MHz channel relative to the WUR primary channel. |
| 2 | The WUR Wake-up frames are to be transmitted in first lower 20MHz channel relative to the WUR primary channel. |
| 3 | The WUR Wake-up frames are to be transmitted in second upper 20MHz channel relative to the WUR primary channel. |
| 4 | The WUR Wake-up frames are to be transmitted in second lower 20MHz channel relative to the WUR primary channel. |
| 5 | The WUR Wake-up frames are to be transmitted in third upper 20MHz channel relative to the WUR primary channel. |
| 6 | The WUR Wake-up frames are to be transmitted in third lower 20MHz channel relative to the WUR primary channel. |
| 7 | Reserved |

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0                      B3 | B4                                  B15 |  |
|  | Group ID Bitmap Size | Starting Group ID | Group ID Bitmap |
| Bits: | 4 | 12 | variable |
| * Group ID List subfield format
 |

WUR AP indicates the start time of one WUR duty cycle schedule in the Starting Time Of The WUR Duty Cycle subfield of the WUR Parameters field in the WUR Mode element (see 31.5 (WUR duty cycle operation)).

The Group ID Bitmap Size field is set to 0 to indicate that the Group ID Bitmap field is not present, is set to 1 to indicate that the Group ID Bitmap field contains a 16-bit bitmap, is set to 2 to indicate that the Group ID Bitmap field contains a 32-bit bitmap, and is set to 3 to indicate that the Group ID Bitmap field contains a 64-bit bitmap. The values of 4 to 15 are reserved.

The Starting Group ID field contains the value of the first group ID of the Group ID Bitmap field if the Group ID Bitmap Size field is set to a non-zero value. Otherwise, the Starting Group ID field is reserved.

The Group ID Bitmap field if present, together with the Starting Group ID field, indicates the group IDs
assigned by the WUR AP to the WUR STA. Bit position n of the Group ID Bitmap field, if equal to 1, indicates the group ID with a value equal to (SGID + n) is assigned to the WUR STA, where SGID is the value of the Starting Group ID field. Bit position n of the Group ID Bitmap field, if equal to 0, indicates the group ID with a value equal to (SGID + n) is not assigned to the WUR STA. The Starting Group ID field value is treated as a 12-bit unsigned integer.

The subfields of the WUR Parameters field sent from WUR non-AP STA are defined in Table 9-262d (Subfields of the WUR Parameters field from WUR non-AP STA).

|  |
| --- |
| * Subfields of the WUR Parameters field from WUR non-AP STA
 |
| **Subfield** | **Definition** | **Encoding** |
| On Duration | Indicates the preferred On Duration that the WURx of the WUR non-AP STA will be in WURx awake state for each the WUR duty cycle schedule (see 31.5 (WUR duty cycle operation)). | The size of the field is 4 bytes. The unit of the field is 256 µs.The size of the field is 4 octets. The unit of the field is 256 µs. |
| Duty Cycle Period | Indicates the preferred elapsed time between the start times of two successive WUR duty cycle schedules with units indicated by the Duty Cycle Period Units field in the most recently received WUR Operation element from the associated WUR AP (see 31.5 (WUR duty cycle operation)). | The size of the field is 2 bytes.The size of the field is 2 bytes.The size of the field is 2 octets. |
|  |  |  |

**TGba Editor: *Instruction: Modify 9.4.2.263 as the following: (Track Change on)***

* + - 1. WUR Capabilities element

A WUR STA declares that it has WUR capability by transmitting the WUR Capabilities element. The WUR Capabilities element contains a number of fields that are used to advertise WUR capabilities of a WUR STA. The WUR Capabilities element is defined in Figure 9-589d (WUR Capabilities element format).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Element ID** | **Length** | **Element ID Extension** | **Supported Bands** | **WUR Capabilities Information** |
| Octets: | 1 | 1 | 1 | 1 | 2 |
| * WUR Capabilities element format
 |

The Element ID, Length, and Element ID Extension fields are defined in 9.4.2.1 (General).

For WUR AP, the Supported Bands field is reserved.

For WUR non-AP STA, the Supported Bands field indicates the supported bands for the WUR operating channel. The format of the Supported Bands field is shown in Figure 9-589e ( Supported Bands field format).

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 | B1 | B2                   B7 |
|  | 2.4 GHz | 4.9 and 5 GHz | Reserved |
| BBits:  | 1 | 1 | 6 |
| * Supported Bands field format
 |

B0 of the Supported Bands field is set to 1 to indicate the support of 2.4 GHz band. Otherwise, B0 of the Supported Bands field is set to 0. B1 of the Supported Bands field is set to 1 to indicate the support of 4.9 and 5 GHz band. Otherwise, B1 of the Supported Bands field is set to 0. B0 of the Supported Bands field is set to 1 to indicate the support of 2.4 GHz band. Otherwise, B0 of the Supported Bands field is set to 0. B1 of the Supported Bands field is set to 1 to indicate the support of 4.9 and 5 GHz band. Otherwise, B1 of the Supported Bands field is set to 0. B0 of the Supported Bands field is set to 1 to indicate the support of 2.4 GHz band. Otherwise, B0 of the Supported Bands field is set to 0. B1 of the Supported Bands field is set to 1 to indicate the support of 4.9 and 5 GHz band. Otherwise, B1 of the Supported Bands field is set to 0.

The format of the WUR Capabilities Information field is defined in Figure 9-589f (WUR Capabilities Information field format).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0         B7 | B8  | B9          B10 | B11 | B12 | B13 | B14 B15 |
|  | PCR Transition Delay | Nonzero Length Frame Body Support | Group IDs Support | Protection Support | 20 MHz WUR PPDU with HDR Support | WUR Channel Switching Support | Reserved |
| BBits:  | 8 | 1 | 2 | 1 | 1 | 1 | 2 |
| * WUR Capabilities Information field format
 |  |  |  |

The subfields of the WUR Capabilities Information field is defined in Table 9-262e (Subfields of the WUR Capabilities Information field).

|  |
| --- |
| * Subfields of the WUR Capabilities Information field
 |
| Subfield | Definition | Encoding |
| PCR Transition Delay | Indicates the maximum time that the STA requires to transition its PCR component from doze state to awake state | The indicated value is equal to 256\*(value of the field plus 1) µs.  Reserved for a WUR AP. |
| Nonzero Length Frame Body Support | Indicates support for the reception of nonzero length Frame Body field in a WUR frame. | Set to 1 to indicate support for the reception of nonzero length Frame Body field in a WUR frame. Set to 0 otherwise.Reserved for a WUR AP. |
| Group IDs Support | Indicates Group IDs support. | Set to 0 to indicate no support for group IDs. Set to 1 to indicate support for 16 group IDs. Set to 2 to indicate support for 32 group IDs. Set to 3 to indicate support for 64 group IDs.Reserved for a WUR AP. |
| Protection Support | Indicate support for the reception of protected WUR frame. | Set to 1 to indicate support for the reception of protected WUR frame. Set to 0 otherwise.Reserved for a WUR AP. |
| 20 MHz WUR PPDU with HDR Support | Indicate support for the reception of 20 MHz WUR PPDU with HDR. | Set to 1 to indicate support for the reception of 20 MHz WUR PPDU with HDR. Set to 0 otherwise.Reserved for a WUR AP. |
| WUR Channel Switching Support | Indicates whether the WUR channel switching capability for receiving WUR Beacon and WUR Wake-up frames that are transmitted in different channels is enabled or disabled (see 31.9 (WUR FDMA operation)). | Set to 0 if the WUR channel switching capability is supported. Set to 1 if the WUR channel switching capability is not supported. |

**TGba Editor: *Instruction: Modify 31.2 as the following: (Track Change on)***

* Channel access

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 10-10 (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 frame.
* 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 regardless of whether the WUR frame was successfully received by the intended recipient.

Channel access on WUR primary 40 MHz channel and WUR primary 80 MHz channel is described in 31.9.1 (WUR FDMA channel access).

**TGba Editor: *Instruction: Modify 31.5 as the following: (Track Change on)***

* WUR duty cycle operation

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 31.6 (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.

A WUR AP shall support WUR duty cycle operation if dot11WUROptionImplemented is true.

A WUR non-AP STA establishes WUR duty cycle operation with the WUR AP to which it is associated through WUR Mode Setup as described in 31.6.1 (WUR Mode Setup).

WUR duty cycle operation is determined by the following parameters: starting point, on duration, duty cycle period as shown in Figure 31-1 (WUR Duty Cycle), and WUR channel.

|  |
| --- |
|  |
| * WUR Duty Cycle
 |

A WUR AP indicates the minimum wake-up duration in the Minimum Wake-up Duration field of the WUR Operation element and duty cycle period unit in the Duty Cycle Period Units field of the WUR Operation element.

A WUR AP indicates the starting point in the Starting Time Of The WUR Duty Cycle subfield of the WUR parameters field in the WUR Mode element.

A WUR non-AP STA indicates the duty cycle period in the Duty Cycle Period subfield of the WUR parameters field in the WUR Mode element.

A WUR non-AP STA indicates the on duration in the On Duration subfield of the WUR parameters field in the WUR Mode element.

For a WUR non-AP STA, if the value indicated by the On Duration subfield of the WUR Parameters field in the WUR Mode element is larger than the the value indicated by the Duty Cycle Period subfield of the WUR Parameters field in the WUR Mode element, then the on duration indicated by the WUR non-AP STA is treated as being equal to the value indicated by the Duty Cycle Period subfield of the WUR Parameters field in the WUR Mode element

NOTE – Due to different granularity of On Duration subfield and Duty Cycle Period field, a WUR non-AP STA that wants to have WURx always in WURx awake state can not indicate the same value for the on duration and the duty cycle period. In this case, the WUR non-AP STA can still set the value of the On Duration subfield to be larger than the the value of Duty Cycle Period subfield.

A WUR non-AP STA shall set the On Duration subfield of the WUR Parameters field in the WUR Mode element to indicate a duration that is larger than or equal to the duration indicated by the Minimum Wake-up Duration field in the most recently received WUR Operation element from the associated WUR AP.

A WUR non-AP STA may set the On Duration subfield of the WUR Parameters field in the WUR Mode element to indicate a duration that is smaller than the duration indicated by the Duty Cycle Period subfield of the WUR Parameters field in the WUR Mode element.

The on duration in a duty cycle period of an established WUR duty cycle operation is called a WUR duty cycle schedule.

If a WUR non-AP STA is in WUR mode, and the PCR component of the WUR non-AP STA is assumed to be in doze state, the WURx of the WUR non-AP STA shall be in WURx awake state for each WUR duty cycle schedule.

A WUR non-AP STA whose dot11WURChannelSwitchImplemented is false shall set the WUR Channel Switching Support subfield of the WUR Capabilities Information field of the WUR Capabilties element to 0.

When a WUR AP receives a WUR Capabilities element of which the WUR Channel Switching Support subfield of the WUR Capabilities Information 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 to 0.

The WUR channel of a WUR non-AP STA with dot11WURChannelSwitchImplemented equal to false is the same as the channel for receiving WUR Beacon frame.

**TGba Editor: *Instruction: Modify 31.7.2 as the following: (Track Change on)***

* AP Operation

When a traffic filtering agreement is established for a non-AP STA in WUR Mode and Bit 1 of the TFS Action Code field is set to 1, then the AP should transmit a WUR Wake-up frame to the non-AP STA when the AP receives an individually addressed buffered BU destined to the non-AP STA that matches the traffic filter set.

When a traffic filtering agreement is established for a non-AP STA in WUR Mode and Bit 1 of the TFS Action Code field is set to 0, then the AP should not transmit a WUR Wake-up frame to the non-AP STA when the AP receives an individually addressed buffered BU destined to the non-AP STA that matches the traffic filter set.

**TGba Editor: *Instruction: Modify 31.9 as the following: (Track Change on)***

* WUR FDMA operation

A WUR non-AP STA whose dot11WURChannelSwitchImplemented is true shall set the WUR Channel Switching Support subfield of the WUR Capabilities Information field of the WUR Capabilties element that it transmits to 1.

When a WUR AP receives a WUR Capabilities element of which the WUR Channel Switching subfield of the WUR Capabilities Information field is equal to 1, 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 as defined in Table 9-262c (Subfields of WUR Parameters field from WUR AP), subject to the negotiated WUR duty cycle schedule does not overlap with the TWBTTs at which the WUR AP schedules for transmission WUR Beacon frames.

The WUR channel of a WUR non-AP STA with dot11WURChannelSwitchImplemented equal to true is defined by the WUR Channel Offset subfield of the WUR Parameters field of the WUR Mode element that it receives from its associated WUR AP.

**TGba Editor: *Instruction: Modify Annex C as the following: (Track Change on)***

ASN.1 encoding of the MAC and PHY MIB

* MIB Detail

*Change Dot11StationConfigEntry as follows:*

Dot11StationConfigEntry ::= SEQUENCE

 {

 …,

 dot11FutureChannelGuidanceActivated TruthValue,

 dot11WUROptionImplemented TruthValue,

 dot11WURBeaconPeriod Unsigned32,

 dot11WURChannelSwitchImplemented TruthValue,

 }

Insert the following after the dot11FutureChannelGuidanceActivated OBJECT-TYPE element in the Dot11StationConfig TABLE:

(…existing texts….)

dot11WURChannelSwitchImplemented OBJECT-TYPE

 SYNTAX TruthValue

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"This is a capability variable.

Its value is determined by device capability.

This attribute when true, indicates that the STA is capable of switching the WUR channel for receiving WUR Beacon and WUR Wake-up frames that are transmitted in different channels (see 31.9 (WUR FDMA operation)). The capability is disabled otherwise."

DEFVAL { false }

::= { dot11StationConfigEntry <ANA>}

**TGba Editor: *Instruction: Modify 31.6.2 as the following: (Track Change on)***

* non-AP STA operation

The WURx of a WUR non-AP STA can be in one of two states:

* WURx Awake: the WURx of the WUR non-AP STA is fully powered to receive WUR frame.
* WURx Doze: the WURx of the WUR non-AP STA is not able to receive WUR frame.

NOTE 1—The PCR component of a WUR non-AP STA can be in awake or doze state as defined in 11.2.1 (General).

NOTE 2—The PCR component of a WUR non-AP STA can be in active mode or power save (PS) mode as defined in 11.2.3.2 (STA power management modes).

If a WUR non-AP STA is in WUR Mode, then:

* The WURx of the WUR non-AP STA shall be in WURx awake state during the ON Duration of the duty cycle schedule agreed between WUR AP and WUR non-AP STA if the PCR component of the WUR non-AP STA is in the doze state.
* The WURx of the WUR non-AP STA may be in WURx doze state after the WUR non-AP STA uses the PCR component to complete a successful frame exchange with the WUR AP, which informs the WUR AP that the PCR component of the WUR non-AP STA is the awake state.
* The WUR non-AP STA may not listen for Beacon frame if the PCR component of the WUR non-AP STA is in PS mode (see 11.2.3.1 (General)).
* The existing negotiated service period between WUR AP and WUR non-AP STA for the WUR non-AP STA’s PCR schedule is suspended:
* The PCR component of the WUR non-AP STA may not be in the awake state during the negotiated service period of PCR schedule between the WUR AP and the WUR non-AP STA except that the PCR component of the STA is expected to be in awake state at the next service period following the existing PS operation (e.g., TWT) agreed between the AP and the non-AP STA after receiving a WUR Wake-up frame addressed to itself with an indication of individually addressed buffered BU(s).
* The parameters of the negotiated service period for the WUR non-AP STA’s PCR schedule between the WUR AP and the WUR non-AP STA are maintained by the WUR non-AP STA.

(….existing texts…..)

**TGba Editor: *Instruction: Modify 31.7 as the following: (Track Change on)***

* Wake-up Operation

(….existing texts…..)

* AP Operation

An AP that transmits a WUR Wake-up frame to a non-AP STA that indicates the availability of individually addressed buffered BU(s) via the PCR shall follow the existing PCR operation, which is any PS operation that the AP and the non-AP STA has agreed to use (e.g., baseline PM change, U-APSD, TWT, etc.), to deliver individually addressed buffered BU(s) to the non-AP STA. Individually addressed buffered BU(s) are delivered at specific times, which are provided along with the agreed PS operation.

When the AP schedules a transmission to the non-AP STA, the AP shall ensure that either of the conditions below is met:

* The PCR transition delay indicated by the non-AP STA in the WUR Capabilities elements following the most recent transmitted WUR Wake-up frame intended to the non-AP STA has expired.
* The non-AP STA has indicated that it is in awake state by transmitting a frame through the PCR to the AP.

NOTE—The frames scheduled by the AP to be delivered via the PCR are not limited to individually addressed buffered BU(s) only.

An AP that transmits a WUR Wake-up frame to a non-AP STA that indicates the availability of group addressed buffered BU(s) via the PCR shall follow existing PCR operation, which is any PS operation that the AP and the non-AP STA has agreed to use (e.g., DTIM, FMS, etc.), to deliver group addressed buffered BU(s) to the non-AP STA. Group addressed buffered BU(s) are delivered at specific times, which are provided along with the agreed PS operation.

* (….existig texts…..)non-AP STA Operation

A non-AP STA that receives a WUR Wake-up frame addressed to itself with an indication of individually addressed buffered BU(s) shall follow existing PCR operation, which is any PS operation AP and the non-AP STA has agreed to use (e.g., baseline PM change, U-APSD, TWT, etc.), to retrieve individually addressed buffered BU(s) and follow the wake up timing information (e.g., the next service period) that is provided along with the agreed PS operation.

NOTE—For example, rule b), c), and d) in 11.2.3.8 (Receive operation for STAs in PS mode during the CP) describes one operation for a non-AP STA to retrieve individually addressed buffered BU(s) using PS-Poll or U-APSD.

A non-AP STA that receives a WUR Wake-up frame with an indication of buffered group addressed BU(s) shall follow existing PCR operation, which is any PS operation that the AP and the non-AP STA has agreed to use (e.g., DTIM, FMS, etc.) to receive group addressed BU(s) and follow the wake up timing information (e.g., the next DTIM TBTT) that is provided along with the agreed PS operation.

NOTE—For example, rule e) in 11.2.3.8 (Receive operation for STAs in PS mode during the CP) describes one operation for a non-AP STA to receive group addressed frame.

(….existig texts…..)