IEEE P802.11
Wireless LANs

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| Comment resolutions for Clause 4  |
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Abstract

This submission proposes resolutions for multiple comments related to TGba D1.0 with the following CIDs (35 CIDs):

* 1, 56, 57, 218, 349, 354, 487, 488, 489, 490,
* 491, 493, , 583, 584, , 631, , 753, 772,
* 775, , , 868, 870, 941, 946, 1081, 1084, 1107,
* 418, 58, 59, 585, 609, , 1086, 1087, 1088, 410
* 587

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Removed duplicate CIDs (509, 629, 689, 819, 831, 820)

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** |
| 1 | Albert Petrick | 4.3.15a | 21 | 12 | The WUR AP and STA are missing a block diagram that illustrates the WUR PHY and MAC interface between the primary 802.11 radio. This is a new architecture and should be in updated diagram from discussions with ARC-SC and TG11ba |  | Rejected.The 802.11ba does not define a new architecture. Similar to 802.11ax, it is adding a new capability to transmit and receive WUR PPDU. |
| 56 | Alfred Asterjadhi | 4.3.15a | 21 |  | All these paragraphs can be merged as: "A WUR AP is an AP that is capable of transmitting WUR PPDUs. A WUR STA is a non-AP STA that is capable of receiving WUR PPDUs and is not capable of transmitting WUR PPDUs." | As in comment. | Revised.Agree with the commenter. The changes are made to P21L12-23.TGba editor to make the changes shown in doc.: IEEE 802.11-19/0021r2 under all headings that include CID 56. |
| 57 | Alfred Asterjadhi | 4.3.15a | 21 | 28 | Simplifications: "without frame body field" is a "minimum length (ML) frame", a "frame with transmit ID" is a "broadcast frame", and don't need to call out unprotected (we don't do that in the baseline either. The frame is unprotected unless stated otherwise. "WUR frame with nonzero length Frame Body field" is a "variable length (VL) frame. Also please start using the definitions LDR, HDR. | As in comment (P21L28 up to P22L15). | Revised.Agree with the commenter. The changes are made to P21L25 to P22L13.TGba editor to make the changes shown in doc.: IEEE 802.11-19/0021r2 under all headings that include CID 57. |
| 218 | Dmitry Cherniavsky | 4.3.15a | 21 | 11 | The scope of WUR definition within 802.11 spec should be defined | WUR STA is not defined for DMG STA | Rejected.Invalid comment. It is unclear what the proposed change is.  |
| 349 | James Lepp | 4.3.15a | 21 | 22 | A WUR non-AP STA does not have the capability to transmit WUR PPDU. This may be the typical deployment scenario envisioned, but I don't see the need to restrict it with a "does not". | change "does not" to "may not" | Rejected.Clause 4 does not define a normative behavior. The following description can be found in the beginning of Clause 4 “This clause presents the concepts and terminology used within this standard.” And also the following “The architectural descriptions are not intended to represent any specific physical implementation ofIEEE Std 802.11.” |
| 354 | James Lepp | 4.3.15a | 21 | 65 | Receiving a WUR Beacon Frame should be optional for STAs since duty cycle is optional. There is no need to receive the Beacon in the case of a STA that doesn't use duty cycles. The synchronization capabilities the beacon provides are not needed. | Move "Receive a WUR Beacon frame" to optional. | Rejected.Similar to the 802.11 opeartion, WUR Beacon not only provides of the synchronization between AP and STA but also provides “heart beat” function so that a STA know whether it is still within the AP’s coverage range or not. Therefore, even if a STA does not support duty-cycle, it still needs the capability to receive the WUR Beacon frame. |
| 487 | Joseph Levy | 4.3.15a | 21 | 12 | A WUR AP is not defined anywhere, WUR is defined as l companion radio to a primary connectivity radio, this definition is not adequate to describe the functionality of an WUR device which contains an AP and radio capable of transmitting a WUR PPDU. The terminology and use of naming is critical to not redefining current 802.11 terms or causing confusion as to the meaning of terms in the 802.11 specification. Therefore, it is critical to define what an WUR AP is and what capabilities it has. Currently an AP is defined by 802.11 as an entity that contains one STA and provides access to the DSS via the WM for associated STAs. A STA is defined as a logical entity that is a singly addressable instance of a MAC and PHY interface to the WM. The WM is defined as the medium used to implement the transfer of PPUs between peer PHY entities of a wireless LAN. Therefore, define a WUR AP to be an AP that is capable of negotiating a WUR configuration with a WUR device with a STA that is associated with the AP. If this definition is accepted then an additional name is necessary a device (AP) that can transmit a WUR PPDU. It is important to be able to differentiate between these two device times as the current definition of an AP only allows for single frequency channel operation. Hence, a typical multi-band device contains 2 APs and a STA may be associated with either or both devices. In the case where a 5 GHz STA is associated with a 5 GHz AP and will be using a WURx operating on 2.4 GHz, it will be necessary to clearly state that the WUR configuration operation will be occurring on the devices using the 5GHz channel, but the WUR PPDUs will be transmitted on the 2.4 GHz channel. | Provide clear definitions for the different types of WUR devices and use the naming convention through out the draft, Please see 11-18/1641r0 for suggested nomenclature. | Revised.The definition of the WUR AP and its capability are revised as follows: “A WUR AP is a non-HT, HT, VHT, or HE AP that is capable of transmitting a WUR PPDU. A WUR non-AP STA is a non-HT, HT, VHT, or HE non-AP STA that is capable of receiving a WUR PPDU and is not capable of transmitting a WUR PPDU.” TGba editor: No changes required. The resolution is same as the comment resolution of the CID 56. |
| 488 | Joseph Levy | 4.3.15a | 21 | 15 | Why is it necessary for this Note be included in section 4, it does not really add any thing to understanding what WUR is and what features it offers. | Delete the Note. | Accepted. |
| 489 | Joseph Levy | 4.3.15a` | 21 | 11 | It would greatly enhance the flow and understanding of what WUR is if a brief introductory paragraph was inserted at the beginning of the WUR section (4.2.15a). | Provide a high level description on what WUR is, including the benefits/capabilities of WUR devices as well as a description of the different types of WUR devices and the key WUR features with references as to where they can be found in the specification. Some of this material is already present in this clause, but the structure is such that it is reducing the clarity of the description. Also some of this information is already present in the WUR PAR. | Revised.Agree in principle. The introductory paragraph has been added to the beginning of the subclause.TGba editor to make the changes shown in doc.: IEEE 802.11-19/0021r2 under all headings that include CID 489. |
| 490 | Joseph Levy | 4.3.15.a | 21 | 19 | The naming of a WUR non-AP STA and referring to a PCR component and a WURx is confusing as a non-AP STA should simply be the logical entity currently defined in the 802.11 specification, which can associate with an AP and exchange PDUs over the WM. The capability of a WURx to receive WUR PPDUs really has nothing to do the a non-AP STA, and therefore should not be bundled into the definition of a WUR non-AP STA. It would be clearer to have a WUR device which consists of at least 1 non-AP STA and a WURx. This would allow a non-AP STA to simply be a non-AP STA. | Use the definitions for the different types of WUR devices and the naming convention as provided in 11-18/1641r0. | Revised.The definition of the WUR AP and its capability are revised as follows: “A WUR AP is a non-HT, HT, VHT, or HE AP that is capable of transmitting a WUR PPDU. A WUR non-AP STA is a non-HT, HT, VHT, or HE non-AP STA that is capable of receiving a WUR PPDU and is not capable of transmitting a WUR PPDU.” TGba editor: No changes required. The resolution is same as the comment resolution of the CID 56 |
| 491 | Joseph Levy | 4.3.15a | 21 | 28 | The way the mandatory main features and optional main features are provided is very confusing. Some of these features relate to transmit and reception of WUR PPDUs, but these signals are not sent by a 802.11 AP nor received by an 802.11 non-AP STA. They are sent by a WUR capable device which is typically in the same device as the 802.11 AP that the non-AP STA which is collocated with a WURx is associated with. It should be clear that there are two types of WUR communication: 1) standard 802.11 communication between an AP and its associated non-AP STA to configure/setup the WUR capabilities of the WUR device 2) WUR PPDU communication between a device capable of transmitting a WUR PPDU and the WURx (this is one way communication). | Clarify the capabilities and features being introduced by WUR and be specific as to what capabilities and features the various devices have. (see 11-18/1641r1 for related discussion). | Rejected.The way the mandatory main features and optional main features are provided is same as the 802.11ac/ax amendments and there seem to be no confusion in the 802.11ac and .11ax amendments. The WUR PPDUs are sent by a WUR AP and WUR PPDUs are received by a WUR non-AP STA.  |
| 493 | Joseph Levy | 4 | 21 | 1 | Descriptive information should be provided for WUR architecture in clause 4.1 General description of the architecture, in 4.4 Logical service interfaces, and in 4.5 Overview of the services. | Add descriptive information on WUR mode general description, logical service interfaces, and overview of services. | Rejected.The commenter does not explain why the proposed changes are needed clearly. Moreover, other amendments, such as 802.11ac/ax have not made additional changes to the subclauses. |
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| 583 | Mark Hamilton | 4.3.15a | 21 | 12 | I assume a "WUR AP" is foremost an AP, and then it adds the ability to TX WUR PPDUs. | Change to "A WUR AP is an AP as described in 4.3.5, that also has the capability to transmit WUR PPDUs. | Revised.The definition of the WUR AP and its capability are revised as follows: “A WUR AP is a non-HT, HT, VHT, or HE AP that is capable of transmitting a WUR PPDU. A WUR non-AP STA is a non-HT, HT, VHT, or HE non-AP STA that is capable of receiving a WUR PPDU and is not capable of transmitting a WUR PPDU.” TGba editor: No changes required. The resolution is same as the comment resolution of the CID 56 |
| 584 | Mark Hamilton | 4.3.15a | 21 | 27 | A WUR AP is still an AP, and does all the things an AP does, PLUS it does WUR stuff. | Change the introductory phrase to be: "In addition to the AP features described in previous subclauses, the main WUR AP mandatory features are the following:" Make the similar changes to the next three paragraphs, also. | Revised.The definition of the WUR AP and its capability are revised as follows: “A WUR AP is a non-HT, HT, VHT, or HE AP that is capable of transmitting a WUR PPDU. A WUR non-AP STA is a non-HT, HT, VHT, or HE non-AP STA that is capable of receiving a WUR PPDU and is not capable of transmitting a WUR PPDU.” TGba editor: No changes required. The resolution is same as the comment resolution of the CID 56 |
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| 631 | Michael Fischer | 4.3.15a | 21 |  | There are several potential interactions between WUR and other portions of 802.11 that are not addressed in this draft. Examples include WUR operation in a mesh BSS, continuation (or lack thereof) of WUR modes across BSS transitions (both regular and fast), Direct Links. | For each facility in Clause 4, except those which are completely disjoint from WUR (e.g. DMG), and those which are completely orthogonal to WUR (e.g. interworking), add a statement stating whether they are applicable when a STA is in WUR Mode, or whether WUR Mode must be disabled to use the facility. | Rejected.The subclause clearly describes the capabilities of the WUR AP and the WUR non-AP STA and other amendments have not added such descriptions in this subclause. On the continuation of WUR modes across BSS transitions, it assumes the STA is in the Active mode when the BSS transition is complete therefore the non-AP STA can setup another WUR mode with the new AP. |
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| 753 | Nehru Bhandaru |  | 21 | 23 | Can a non-WUR non-AP STA have the capability to transmit a WUR PPDU? | Change to "A non-AP STA does not have.." | Revised.The sentence was to highlight that the WUR non-AP STA has capability to receive WUR PPDU but does not have capability to transmit WUR PPDU. The definition of the WUR AP and its capability are revised as follows: “A WUR AP is a non-HT, HT, VHT, or HE AP that is capable of transmitting a WUR PPDU. A WUR non-AP STA is a non-HT, HT, VHT, or HE non-AP STA that is capable of receiving a WUR PPDU and is not capable of transmitting a WUR PPDU.”TGba editor: No changes required. The resolution is same as the comment resolution of the CID 56 |
| 772 | Osama Aboulmagd | 4.3.15a | 21 | 19 | what does the word "component" mean in this context? Are there any other components? Is WURx a component? | delete the word "component" | Revised.The sentence has been deleted. The definition of the WUR AP and its capability are revised as follows: “A WUR AP is a non-HT, HT, VHT, or HE AP that is capable of transmitting a WUR PPDU. A WUR non-AP STA is a non-HT, HT, VHT, or HE non-AP STA that is capable of receiving a WUR PPDU and is not capable of transmitting a WUR PPDU.”TGba editor: No changes required. The resolution is same as the comment resolution of the CID 56 |
| 775 | Osama Aboulmagd | 4.3 | 21 | 1 | There are items in Clause 4 missing. For example how WURx adds to the 802.11 general architecture as a component of IEEE 802.11? The same is true for the service interfaces. | Add the missing parts including architecture components and service interface | Rejected.The comment fails to identify a specific issue to be addressed. It fails to identify changes in sufficient detail so that the specific wording of the changes that will satisfy the commenter can be determined. WURx provides a capability to receive a WUR PPDU to a WUR non-AP STA similar to the HE PHY provides a capability to receive an HE PPDU to an HE STA. Therefore, there is no missing pieces in Clause 4. |
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| 868 | Robert Stacey | 4.3.15a | 21 | 12 | Before diving into specifics, provide an overview of WUR STA characterists and the purpose of the WUR. | "A WUR non-AP STA has both a primary connectivity radio (PCR) and a wake-up radio (WUR). The PCR provides the primary means of communication between the WUR STA and other STAs while the WUR provides a very low power idle mode with an ability to receive a WUR PPDU. A WUR PPDU carries a WUR frame. A number of WUR franes are defined, each for specific purposed: - The WUR Beacon frame helps mainting timing synchronizaiton between a WUR non-AP STA and the AP. - The WUR Wake-up frame provides notification that the WUR non-AP STA should activate its PCR. - The WUR Discovery frame supports low power discovery. The WUR Vendor Specific frame format support vendor specific operation." | Revised.Agree with the commenter. An introductory paragraph has been added to the beginning of the subclause 4.3.15a.TGba editor: No changes required. The resolution is same as the comment resolution of the CID 489. |
| 870 | Robert Stacey | 4 | 21 | 4 | Surely the WUR concept deserves some discussion under 4.4 (Logical service interfaces) and 4.5 (Overview of the services). | Expand the 802.11 archetecural description to include services related to WUR operation. | Rejected.The comment fails to identify a specific issue to be addressed. It fails to identify changes in sufficient detail so that the specific wording of the changes that will satisfy the commenter can be determined. |
| 941 | Stephen McCann | 4.3.15a | 21 | 19 | Can a WUR non-AP STA and the PCR component operate in a full duplex mode? In other words receive on the WUR and transmit on the PCR at the same time? Or the other way around? | Add the following text at P21L21: "A WUR non-AP STA and the PCR component can operate in full duplex mode." | Rejected.The comment fails to identify a specific issue to be addressed. In reply to the commenter, the full duplex operation is out of the scope of the project. |
| 946 | Stephen McCann | 4.3.15a | 21 | 34 | Does the term "WUR Wake-up" need to be used, as this expands to Wake-up radio Wake-up, which is redundant. | Replace all occurances of "WUR Wake-up" with "WUR trigger" | Rejected.Adding WUR in front of a frame clarifies that a WUR frame is transmitted as a WUR PPDU and avoids confusion with other MAC frames transmitted in non-WUR PPDUs.  |
| 1081 | Xiaofei Wang | 4.3.15a | 21 | 15 | The note about WUR AP capable of transmitting non-HT preamble doesn't seem to serve any purpose. | Please explain the purpose of this note, or remove the note | Revised.Agree with the commenter. The note has been removed.. |
| 1084 | Xiaofei Wang | 4.3.15a | 21 | 27 | The list of mandatory or optional features supported by AP or STA should be placed in clause 31, instead of the architecture section. | Move the list of mandatory and optional features supported by WUR AP and STA to clause 31. | Rejected.The 802.11ac and 802.11ax amendments are also listing mandatory and optional features in Clause 4. Therefore, there is no need to move to Clause 31. |
| 1107 | Xiaofei Wang | 4.3.15a | 21 | 12 | The architecture is not very clear. As I understand it, WURx is supposed to be a separate receiver, but there is no explanation for such design in this section. | Please provide architecture design for WURx and how it is related to regular 802.11 devices | Revised.The definitions of the WUR AP and the WUR non-AP STA have been modified as follows at the beginning of subclause 4.3.15a as follows: “A WUR AP is a non-HT, HT, VHT, or HE AP that is capable of transmitting has the capability to transmit a WUR PPDU. A WUR non-AP STA is a non-HT, HT, VHT, or HE non-AP STA that is capable of receiving a WUR PPDU and is not capable of transmitting a WUR PPDU.” And also removed WURx to avoid confusion. Basically the WUR non-AP STA has a capability to receive a WUR PPDU similar to the HE STA that has a new capability to receive an HE PPDU.TGba editor: No changes required. The resolution is same as the comment resolution of the CID 56. |
| 418 | James Lepp | 31.7.1 | 56 | 64 | Since the PCR and WURx are different entities, you should describe how the assigned Group IDs are passed from the PCR to which they were assigned to the WURx where they will be used to compare with incoming Group-addressed WUR Wakeup frames. | Standardize the interface between PCR and WURx inside the non-AP STA. | Rejected.The PCR and WURx are not different entities same as the HE STA that has the capability to transmit and receive HE PPDU and VHT STA are not different entities. The WUR non-AP STA is a non-AP STA that has the capability to receive a WUR PPDU and the WUR AP is an AP that has a capability to transmit a WUR PPDU.  |
| 58 | Alfred Asterjadhi | 4.3.15a | 22 |  | Suggest we find names for these features for ease of identification. This is like the SST stuff. So maybe call it WUR SST (subchannel selective transmission) and the second one simply call it a WUR duty cycle (DC) operation. | As in comment. | Revised.Agree with the commenter. TGba editor to make the changes shown in doc.: IEEE 802.11-19/0021r2 under all headings that include CID 58. |
| 59 | Alfred Asterjadhi | 4.3.15a | 22 | 17 | This paragraph seems to have too many details for being in the general description subclause. Either remove it or make it generic, possibly merging with the paragraph below. | As in comment. | Revised.Agree with the commenter. The two paragraphs have been deleted and the revised descriptions are moved to the beginning of the subclause together. TGba editor to make the changes shown in doc.: IEEE 802.11-19/0021r2 under all headings that include CID 59. |
| 585 | Mark Hamilton | 4.3.15a | 22 | 19 | The WUR AP will use WUR (and the WURx) to wake up any non-AP STA (in WUR Mode) that has a PCR in PS mode. It doesn't matter if the PCR is in doze state or awake state (if the AP even knows). | Replace "doze state" with "PS mode" | Revised.The paragraph has been modified to more general description and the description on the doze state has been removed.TGba editor: No changes required. The change has been made based on the comment resolution of the CID 59. |
| 609 | Mark Hamilton | 4.3.15a | 22 | 23 | Transmission of WUR Discovery frames appears to be optional (based on a MIB attribute). This sentence needs to state that. | Insert "optionally", as "A WUR AP optionally sends a WUR Discovery frame ..." | Revised.The paragraph has been modified to more general description and the description on the transmission of WUR Discovery frame has been removed. Also the description that the WUR Discovery frame is optional is already in the P21L49 in D1.1.TGba editor: No changes required. The change has been made based on the comment resolution of the CID 59. |
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| 1086 | Xiaofei Wang | 4.3.15a | 22 | 4 | The sentence "Allow allocated channel for receiving WUR Wake-up frame different from the channel for receiving WUR Beacon frame." is incorrect, also, seems to be of a different format than the rest of the statements | change "Allow allocated channel for receiving WUR Wake-up frame different from the channel for receiving WUR Beacon frame." into "Receive a WUR Wake-up frame on a channel that is different from the channel for receiving WUR Beacon frames." | Revised.The description has been modified to more general description to “Support of WUR FDMA operation”.TGba editor: No changes required. The change has been made based on the comment resolution of the CID 58. |
| 1087 | Xiaofei Wang | 4.3.15a | 22 | 26 | what is the purpose of the phrase "among other benefits"? Unless the other benefits are listed, it may be better to remove this phrase. | Remove "among other benefits" | Revised.The paragraph has been removed and the content has been modified to more general description and move to the beginning of subclause 4.3.15a.TGba editor: No changes required. The change has been made based on the comment resolution of the CID 59. |
| 1088 | Xiaofei Wang | 4.3.15a | 22 | 26 | The sentence is garbled and need to be rewritten "different combinations of these WUR features can keep the PCR component of the WUR non-AP STAs in power save, react to incoming traffic and critical update of PCR's BSS parameters through a WURx with low latency for associated WUR non-AP STAs, and enhance BSS discovery." | change the sentence "different combinations of these WUR features can keep the PCR component of the WUR non-AP STAs in power save, react to incoming traffic and critical update of PCR's BSS parameters through a WURx with low latency for associated WUR non-AP STAs, and enhance BSS discovery." into "Different combinations of the WUR features can keep the PCR component of the WUR non-AP STAs in power save for an extended period of time, while able to react with low latency to incoming traffic and critical update of PCR's BSS parameters through a WURx for associated WUR non-AP STAs, and as well as enhance BSS discovery." | Revised.The paragraph has been removed and the content has been modified to more general description and move to the beginning of subclause 4.3.15a.TGba editor: No changes required. The change has been made based on the comment resolution of the CID 59. |
| 410 | James Lepp |  |  |  | Everything in IEEE 802.11 at this point is half duplex. A STA or AP is only ever transmitting or receiving. Now that 802.11ba has specified a second receiver the system is now capable of Rx on the WUR radio and Tx on the PCR radio. Whether this is allowed or disallowed has not been written in the ammendment. |  | Rejected.The comment fails to identify changes in sufficient detail so that the specific wording of the changes that will satisfy the commenter can be determined.In reply to the commenter, the full duplex operation is out of the scope of the project. |
| 587 | Mark Hamilton |  | 23 | 1 | Missing changes to clause 4.9. | Changes are needed to clause 4.9 to explain the interacting components within a non-AP WUR STA. | Rejected.The PCR and WURx are not different entities same as the HE STA that has the capability to transmit and receive HE PPDU and VHT STA are not different entities (or components). The WUR non-AP STA is a non-AP STA that has the capability to receive a WUR PPDU and the WUR AP is an AP that has a capability to transmit a WUR PPDU. Therefore, there is no need to define the interacting components in clause 4.9. |

* Wake-up radio (WUR) STA

**TGba Editor: *Change the paragraphs below of this subclause in TGba Draft 1.1 as follows (#CID 56, 57, 59, 488, 489. 689):***

A WUR AP is a non-HT, HT, VHT, or HE AP that is capable of transmitting a WUR PPDU. A WUR non-AP STA is a non-HT, HT, VHT, or HE non-AP STA that is capable of receiving a WUR PPDU and is not capable of transmitting a WUR PPDU. *(#56)* A WUR non-AP STA has a capability to receive a WUR PPDU at a very low power consumption less than 1 milliwatt. A WUR PPDU carries a WUR frame. Four WUR frames are defined: *(#489, 59)*

* The WUR Beacon frame helps mainting timing synchronizaiton between a WUR non-AP STA and the WUR AP and enables the WUR duty cycle operation. *(#489, 59)*
* The WUR Wake-up frame provides notification to the WUR non-AP STA(s) that the WUR AP has buffered data for the WUR non-AP STA(s), which enables the WUR non-AP STAs to remain in power save for longer periods of time and enables the WUR non-AP STAs to react to incoming traffic and critical update of BSS parameters with low latency. *(#489, 59)*
* The WUR Discovery frame supports low power discovery of WUR APs. *(#489, 59)*
* The WUR Vendor Specific frame supports a vendor specific operation.*(#489, 59)*

 *(#488)*

*(#56)*

 *(#56)*

A WUR AP has the following mandatory main features:

* Transmit a 20 MHz WUR PPDU at LDR.*(#57)*
* Transmit a 20 MHz WUR PPDU at HDR.(#57)
* WUR power management procedure.
* WUR wake-up operation.
* WUR duty cycle operation.
* Transmit an individually addressed FL WUR Wake-up frame. (#288) *(#57)*
* Transmit a broadcast FL WUR Wake-up frame. (#288) *(#57)*
* Transmit a WUR Beacon frame.

A WUR AP has the following optional main features:

— Transmit a 40 MHz WUR PPDU or an 80 MHz WUR PPDU.

— Transmit an 80 MHz preamble punctured WUR PPDU.

— Transmit a VL WUR frame. (#288) *(#57)*

— Transmit a protected WUR frame.

— Transmit a WUR Wake-up frame with a group ID.

— Transmit a WUR Discovery frame.

— Transmit a WUR Vendor Specific frame.

A WUR non-AP STA has the following mandatory main features:

* Receive a 20 MHz WUR PPDU at LDR. *(#57)*
* WUR power management procedure.
* WUR wake-up operation.
* Receive an individually addressed FL WUR Wake-up frame. (#288) *(#57)*
* Receive a broadcast FL WUR Wake-up frame. (#288) *(#57)*
* Receive a WUR Beacon frame.

A WUR non-AP STA has the following optional main features:

* Receive a 20 MHz WUR PPDU at HDR. *(#57)*
* Support of WUR FDMA operation (see 31.9 (WUR FDMA operation)).(#690)(#58)
* Support of the WUR duty cycle operation (see 31.5 (WUR duty cycle operation)) (#58)
* Receive a VL WUR frame. (#288)
* Receive a protected WUR frame.
* Receive a WUR Wake-up frame with group ID.
* Receive a WUR Discovery frame.
* Receive a WUR Vendor Specific frame.

(#489, 59) (#489, 59)