IEEE P802.11  
Wireless LANs

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | CR Default UORA Parameters | | | | | | Date: 2019-01-01 | | | | | | Author(s): | | | | | | Name | Affiliation | Address | Phone | email | | Matthew Fischer | Broadcom |  |  | [Matthew.fischer@broadcom.com](mailto:Matthew.fischer@broadcom.com) | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |

Abstract

Proposed language to define default values for UORA operation by an AP.

The proposed changes address CID 16451, 16584 which referenced TGax D3.0.

Changes are referenced to TGax D3.3.

**REVISION NOTES:**

**R0**:

initial

**R1**:

27.5.5.5 – limit minimum number of RA-RU per trigger to 4, i.e. remove language of minimum of 4 to n, where n is based on the average of number of associations in the previous 10 beacon intervals

27.5.5.5 – remove language on modifying the OCWMIN, OCWMAX, number of RA-RU allocations per trigger based on number of occupied RA-RUs

Update doc references

**R2**:

9.4.2.199 – it is not the TWT but the trigger frame that contains RA-RUs

25.5.5.2 – removed explicit target RSSI requirement for eligible RA-RUs because previous statement already required that STA must meet all parameteric requirements of the Trigger

27.5.5.5 – changed a 2045 to “for unassociated STAs”

27.5.5.5 – slight rewording to “intends to transmit”

Update doc references

**R3**:

25.5.5.2 – fix language to avoid conflict between a shall and a may regarding eligible RA RU for unassociated STAs

25.5.5.2 – smoothed the language, removing redundancy

25.5.5.2 – removed conditions for considering an RA RU as ineligible as there is already a single statement indicating that a STA can choose a subset of RA RU with no further qualification as to how that choice is made. I.e. a blanke statement exists, so no further narrowing of the eligibility is required

27.5.5.5 – removed statement about AP increasing and decreasing the number of RA-RU per trigger

Update doc references

**R4**:

25.5.5.2 – keep the note, i.e undo the deletion of the note (response to discussion)

25.5.5.5 – remove stray text, various wording changes that are editorial

25.5.5.5 – change AP next RA-RU trigger requirement to be based on AP response to AUTH frame reception and change it to a range of 8 to 16 Tus

25.5.5.5 – change minimum requirement of 4 RA-RU per RA-RU trigger to 4 for >=80 MHz BSS and 1 for less than 80 MHz BSS

Update doc references

**R5**:

25.5.5.5 – remove the inserted sentence:An AP operating a BSS with a width of less than 80 MHz and transmitting a Trigger frame that allocates one or more RA-RUs for unassociated STAs shall include at least one RA-RUs for unassociated STAs

25.5.5.5 – add a qualifier to the minimum RA-RU requirement that this only applies when the trigger frame is one that meets the conditions described in the same subclause

25.5.5.5 – modify the timing requirement for the next trigger from 8 to 16 TU to 3 to 5 TU

25.5.5.5 – modify the minimum RA-RU count from 4 to 2

Update doc references

**END OF REVISION NOTES**

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 TGax Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGax Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGax Editor: Editing instructions preceded by “TGax Editor” are instructions to the TGax editor to modify existing material in the TGax draft. As a result of adopting the changes, the TGax editor will execute the instructions rather than copy them to the TGax Draft.***

**CIDs**

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| --- | --- | --- | --- | --- | --- | --- |
| 16451 | Matthew Fischer | 27.5.5.1 | 296.33 | Provide default parameters for UORA operation. | Provide default UORA parameters, including values for minimum UORA trigger frequency and minimum UORA allocations per trigger | Revise - TGax editor to make changes as shown in 11-19/0006r5 that are marked with CID 16451 which establish default operational parameters for UORA. |
| 16584 | Peter Loc |  | 296 | An HE AP has no way of knowing if there is an unassociated STA or STAs wanting to join the BSS, so it frequently allocates RA RUs with AIDs 2045 for unassociated STAs to transmit UL. This is very inefficient because most of the time, there is no STAs wanting to associate. Regardless of the setting of its dot11OFDMARandomAccessOptionImplemented, an HE STA should contend for the WM using EDCA for sending UL frames to the HE AP with which it intends to communicate, then follows the UORA procedure if its dot11OFDMARandomAccessOptionImplemented is set to true | Replace the Note with: "A non-AP STA can first contend for the WM using EDCA for sending UL frames to the AP with which it intends to communicate. " | Revise - TGax editor to make changes as shown in 11-19/0006r5 that are marked with CID 16584 which establish default operational parameters for UORA. |

**Discussion:**

The use of UORA is optional by an AP.

In order to provide some utility in the function, when it is implemented, there should be some baseline expectations of UORA RU availability and frequency.

* UORA used for association procedure (AID12=2045)
  + Need explicit expectations for AP and non-AP STA
  + Goal for an expected typical case = minimize association latency
* Define default UORA parameters to be used by AP
  + E.g. frequency of UORA, number of RA RU per trigger, initial OBO window
  + Recommendations for modifying these parameters
    - Should the need arise per dynamic scenario
* Define nature and timing of association exchange follow up triggers
* Define rules for participation in UORA by non-AP STA

**Proposed Changes to TGax D3.3:**

***TGax editor: within TGax D3.3, modify the text as shown within 9.4.2.199 TWT element:***

**9.4.2.199 TWT element**

Within a TWT element that includes a TWT setup command value of Request TWT, Suggest TWT or Demand TWT, the Broadcast TWT ID, if present, indicates a specific Broadcast TWT in which the transmit-ting STA is requesting to participate. Within a TWT element that includes a TWT setup command value of Accept TWT, Alternate TWT, Dictate TWT or Reject TWT, the Broadcast TWT ID, if present, indicates a specific Broadcast TWT for which the transmitting STA is providing TWT parameters. Within a TWT element that includes a TWT setup command value of TWT Grouping, the Broadcast subfield is 0 and the Broadcast TWT ID is not present. The value 0 in the Broadcast TWT ID subfield indicates the broadcast TWT whose membership corresponds to all STAs that are members of the BSS corresponding to the BSSID of the Management frame carrying the TWT element and which is permitted to contain Trigger frames with RA-RUs for unassociated STAs. **(#16451) (#16584)**

**27.5.5 UL OFDMA-based random access (UORA)**

**27.5.5.1 General**

***TGax editor: within TGax D3.3, in subclause 27.5.5.1 General, modify the text as shown:***

An HE STA with dot11OFDMARandomAccessOptionImplemented equal to true shall set the OFDMA RA Support subfield in the HE MAC Capabilities Information field of the HE Capabilities element to 1. Otherwise, it shall set the OFDMA RA Support subfield to 0. **(#16451) (#16584)**

NOTE—A non-AP STA(#16592) that does not support UORA can contend for the WM using EDCA for sending UL frames to the AP with which it intends to communicate.

A non-AP STA with dot11OFDMARandomAccessOptionImplemented set to true shall follow the procedure defined in 27.5.5.3 (Transmission procedure for UORA) to contend for an eligible RA-RU and 27.5.5.5 (Additional considerations for unassociated STAs). **(#16451) (#16584)**

An HE AP that transmits a Trigger frame for random access shall set the AID12 subfield of a User Info field in the Trigger frame to 0 to indicate that one or more RA-RUs are available for non-AP STAs(#16592) associated with it, and shall set the AID12 subfield in a User Info field in the Trigger frame to 2045(18/ 1266r6)(18/1812r2) to indicate that one or more RA-RUs are available for non-AP STAs(#16592) not associated with it.(#17124, #17125)

An HE AP may transmit a Basic Trigger frame, BQRP Trigger frame or BSRP Trigger frame that contains one or more RUs for random access. An AP that transmits a Trigger frame that is not a Basic Trigger frame, BQRP Trigger frame or BSRP Trigger frame shall not set the AID12 subfield of any User Info field of the frame to 0 or 2045.(#16668)

An HE AP that transmits a Basic Trigger frame should set the TID Aggregation Limit subfield in the User Info field indicating an RA-RU to 0 or 1.

The HE AP may include the UORA Parameter Set element (see 9.4.2.244 (UL OFDMA-based Random Access (UORA) Parameter Set element) in Management frames that it transmits. The AP shall indicate the range of OFDMA contention window (OCW) in the UORA Parameter Set element for non-AP STAs(#16592) to initiate random access following the Trigger frame transmission.

An HE BSS belonging to a Multiple BSSID set (see 11.11.14 (Multiple BSSID set)) may advertise OCW Range values via the UORA Parameter Set element carried in the Management frames sent by the transmitted BSSID. An HE AP may include the UORA Parameter Set element in a nontransmitted BSSID profile carried in the Multiple BSSID element (see 9.4.2.45 (Multiple BSSID element)) to provide different OCW Range values for non-AP STAs(#16592) associated with that nontransmitted BSSID.

NOTE—An AP with dot11MultiBSSIDActivated set to true can allocate RA-RUs to non-AP STAs associated with different BSSIDs in the set by transmitting a DL MU PPDU carrying BSS specific broadcast RUs (see 27.5.1.2 (RU addressing in an HE MU PPDU)) with an A-MPDU in each RU carrying a Trigger frame with at least one User Info field with the AID12 set to 0.(#16540)(18/1812r2)

A non-AP HE STA(#16592) shall maintain an internal OCW and an internal OBO counter. OCW is an inte-ger in the range *OCWmin* to *OCWmax*. A non-AP HE STA shall obtain *OCWmin* and *OCWmax* from the most recently received UORA Parameter Set element carried in the Management frames transmitted by its associated AP. A non-AP STA with dot11MultiBSSIDActivated set to true and associated with a nontrans-mitting BSSID shall inherit the OCW range values from the UORA Parameter Set element if(#15351) advertised by the transmitted BSSID if the element is not carried in the nontransmitted BSSID profile for that BSSID.

A non-AP HE STA(#16592) that has not received a UORA Parameter Set element from the AP with which it intends to communicate, shall use the default values *OCWmin* = 7 and *OCWmax* = 31 if(#15352) contend-ing for RA-RUs allocated by that AP.

Each time a non-AP HE STA associates with a different AP (or a different BSSID for non-AP STA with dot11MultiBSSIDActivated set to true), and prior an initial attempt of RA-RU transmission towards it, the non-AP STA(#16592) shall set the value of OCW to the *OCWmin* value, and shall initialize its OBO counter in the range 0 to OCW as defined in 27.5.5.3 (Transmission procedure for UORA).

**27.5.5.2 Eligible RA-RUs**

A non-AP STA(#16592) that is the intended receiver of a User Info field in a Trigger frame (i.e., the AID12 subfield equal to the 12 LSBs of the AID of the non-AP STA(#16592)) shall not contend for an RA-RU that is indicated by a Trigger frame contained in the same PPDU and shall not decrement its OBO counter. (16498, #16506, #Ed)

A non-AP STA shall consider an RU as an eligible RA-RU if it supports all the transmit parameters indicated in the Common Info field and in the User Info field allocating that RU (as described in 27.5.3.3 (Non-AP STA(#16562) behavior for UL MU operation))(#16506, #16498) and the non-AP STA(#16592) is an associated STA, the TA field of the Trigger frame is set to the BSSID of the associated BSS and the RA-RU is allocated for associated STAs

A non-AP STA may consider an RU as an eligible RA-RU if it supports all the transmit parameters indicated in the Common Info field and in the User Info field allocating that RU (as described in 27.5.3.3 (Non-AP STA(#16562) behavior for UL MU operation))(#16506, #16498), the non-AP STA(#16592) is not associated with the BSS and the RA-RU is allocated for unassociated non-AP STAs

A non-AP STA(#16592) shall not contend for an eligible RA-RU or decrement its OBO counter if it does not have pending frames for the AP.

An HE AP may indicate a set of contiguous RUs allocated for random access via the Number Of RA-RU subfield in the User Info field of the Trigger frame. If(#Ed) an AP allocates a contiguous set of RA-RUs, the first RA-RU in the set shall represent the starting RU allocation for the set.

NOTE—If(#Ed) contiguous RA-RUs are assigned, the size of all contiguous RA-RUs is the same and equal to the size of the first RU. Further, all the remaining subfields of the User Info field apply to all the contiguous RA-RUs in the set and the values for starting spatial stream and the number of spatial streams of the HE TB PPDU transmitted on each RA-RU are set to 1.

A non-AP HE STA shall determine the number of eligible RA-RUs in a contiguous set by adding the value carried in the Number Of RA-RU subfields plus one for the User Info field corresponding to an eligible RA-RU.

(#16596)A non-AP HE STA may consider as eligible RA-RUs, a subset of or all of the RA-RUs indicated by**(#16451) (#16584)** the User Info fields in a Trigger frame that carries more than one User Info field allocating RA-RUs. In this case, the number of eligible RA-RUs for that non-AP STA shall be the total number of eligible RA-RUs indicated by the selected subset of User Info fields.

NOTE—A STA that considers only a subset of User Info fields, can randomly select User Info fields from the available set of User Info fields allocating RA-RUs so that the UORA contention is not concentrated at the RA-RU set indicated by the first User Info field.

**27.5.5.3 Transmission procedure for UORA**

In this subclause, the transmit procedure using RA-RUs is described with respect to UORA parameters. The procedure is also illustrated in Figure 27-5 (Illustration of the UORA procedure(#17011)).

An HE STA that has a pending frame for the AP, upon the reception of a Trigger frame containing at least one eligible RA-RU, if the OBO counter of an HE STA is not greater than the number of eligible RA-RUs in a Trigger frame from that AP, then the HE STA shall set its OBO counter to zero and randomly select one of the eligible RA-RUs. Otherwise, the HE STA decrements its OBO counter by the number of eligible RA-RUs in the Trigger frame. (18/1266r6)

In the example in Figure 27-5 (Illustration of the UORA procedure(#17011)):

— Before Trigger frame 1 was sent by the AP, HE STA 1, STA 2, STA 3 and STA 4 had initial OBO values of 3, 5, 4 and 2 respectively.

— Upon receiving Trigger frame 1:

• STA 4, which is associated with the AP and has pending frames for the AP, is allocated a dedi-cated RU (RU6). The STA does not contend for RA-RUs and instead transmits its pending frames on RU6.

• STA 1 and STA 2, both associated with the AP and having pending frames for the AP, decrement their respective OBO counters by the number of eligible RA-RUs indicated in the Trigger (i.e., three RA-RUs for associated STAs(18/1812r2)). Since STA 1's OBO counter decrements to 0, it transmits its pending frames on RU2 which it randomly selects from the eligible set of RUs (i.e., RU1, RU2, and RU3). Since STA 2's OBO counter decrements to a nonzero value, it maintains the new OBO value (2) until it receives a later Trigger frame carrying RA-RUs for associated STAs.

• STA 3, which is not associated with the AP but has a pending frame for the AP, decrements its OBO counter by the number of eligible RA-RUs indicated in the Trigger frame (i.e., two RARUs for unassociated STAs(18/1812r2)). Since STA 3's OBO counter decrements to a nonzero value, it maintains the new OBO value (2) until it receives a later Trigger frame carrying RARUs for unassociated STAs.

— After transmission of HE TB PPDU in response to Trigger frame 1:

• STA 4 has additional frames pending for the AP. Therefore, it maintains its initial OBO value (2) until it receives a later Trigger frame carrying RA-RUs for associated STAs.

• STA 1 has additional frames pending for the AP and randomly selects a new OBO value (4).

— Upon receiving Trigger frame 2:

• STA 1, STA 2 and STA 4 decrement their respective OBO counters by number of eligible RARUs (two in this case). Since STA 2 and STA 4's OBO counters decrements to 0, they both transmit their pending frames on a randomly selected RU (RU2 in case of STA 2 and RU1 in case of STA 4). If either STAs have additional frames pending for the AP, each would randomly select a new OBO value. Since STA 1's OBO decrements to a nonzero value, it maintains the new OBO value (2) until it receives a later Trigger frame carrying RA-RUs for associated STAs.

• STA 3 decrements its OBO counter by the number of eligible RA-RUs (two in this case). Since the STA's OBO counter decrements to 0, it transmits its pending frame on a randomly selected RU (RU4 in this case).

A non-AP STA shall follow the rules in 27.5.3.3 (Non-AP STA(#16562) behavior for UL MU operation) to construct an HE TB PPDU and shall follow the rules as defined in 27.5.3.5 (UL MU CS mechanism) to determine the state of the medium before transmitting the HE TB PPDU. If CS is required and the selected RU is considered busy, then the non-AP STA shall not transmit the HE TB PPDU and the non-AP STA shall set its OBO counter to a random value drawn from a uniform distribution in the range 0 to OCW.(#16507)

The MU acknowledgment procedure for UORA follows the procedure as defined in 10.3.2.13.3 (Acknowl-edgment procedure for an UL MU transmission).

If a non-AP STA(#16592) transmits an HE TB PPDU that solicits an immediate response in an RA-RU and the expected response is not received, the transmission is considered unsuccessful. Otherwise, the transmis-sion is considered successful. After each successful HE TB PPDU transmission in an RA-RU, a non-AP HE STA shall set the value of OCW to the *OCWmin* obtained from the most recent *OCWmin* indicated in the UORA Parameter Set element from the HE AP or the default (if UORA Parameter Set element was not received) and shall initialize its OBO counter to an integer value randomly selected from a uniform distribu-tion in the range 0 to OCW. The non-AP STA(#16592) shall follow the retransmission procedure defined in 27.5.5.4 (Retransmission procedure for UORA) if the transmission is not successful.(#16870)

NOTE—A non-AP STA that transmits an HE TB PPDU in response to a Trigger frame allocating RA-RU(s) by follow-ing the UORA procedure does not update its state variables to the values contained in the MU EDCA Parameter Set element (see 27.2.7 (EDCA operation using MU EDCA parameters)).

**27.5.5.4 Retransmission procedure for UORA**

A non-AP STA(#16592) whose HE TB PPDU transmission sent in an RA-RU(#16612) of a Trigger frame is unsuccessful, may attempt to retransmit the failed PPDU using EDCA or as a response to a Trigger frame.

If the HE TB PPDU is not successfully transmitted in the selected RA-RU, then the non-AP STA(#16592) shall update its OCW to 2×OCW + 1 when the OCW is less than the value of *OCWmax*, and shall ran-domly select its OBO counter in the range of 0 and OCW. Once the OCW reaches *OCWmax* for successive retransmission attempts, the OCW shall remain at the value of *OCWmax* until the OCW is reset as described in 27.5.5.3 (Transmission procedure for UORA).

A non-AP STA(#16592) shall update its OCW value under the condition that the updated OCW remains in the range *OCWmin* to *OCWmax* obtained from the most recently received UORA Parameter Set element (see 9.4.2.244 (UL OFDMA-based Random Access (UORA) Parameter Set element)). If the updated OCW becomes greater than *OCWmax* as consequence of receiving a modified UORA Parameter Set element, then the non-AP STA(#16592) shall set the value of OCW to the new *OCWmax* value.

**27.5.5.5 Additional considerations for unassociated STAs**

An AP transmitting a Trigger frame that allocates one or more RA-RUs for unassociated STAs shall transmit the Trigger frame in an HE PPDU so that an unassociated non-AP STA(#16592) can determine the AP’s BSS color.(#15353)(18/1812r2)

An HE STA with dot11OFDMARandomAccessOptionImplemented equal to true that intends to transmit Trigger frames that allocate one or more RA-RUs for unassociated STAs shall schedule the transmission of at least one such Trigger frame within each TWT SP corresponding to a Broadcast TWT Parameter Set field in a TWT element with a Broadcast TWT ID subfield equal to 0, Flow Type subfield equal to 0, Trigger subfield equal to 1 and Broadcast TWT Recommendation subfield equal to 2. **(#16451) (#16584)**

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An AP that receives an Authentication frame within an RA-RU shall schedule for transmission at a time no less than 3 TUs and no greater than 5 TUs subsequent to the transmission of the Authentication frame that is a response to that reception, a Trigger frame that allocates one or more RA-RUs for unassociated STAs. **(#16451) (#16584)**

An AP operating a BSS with a width of 80 MHz or greater and transmitting a Trigger frame that allocates one or more RA-RUs for unassociated STAs shall include at least 2 RA-RUs for unassociated STAs for at least one transmission of such a Trigger frame within a Broadcast TWT SP that meets the conditions described above. **(#16451) (#16584)**

An HE AP shall not transmit BQRP Trigger frame or BSRP Trigger frame that contains RA-RUs for unassociated non-AP STAs(#16592).

An AP should transmit FILS Discovery frames as described in 11.47.2.1 (FILS Discovery frame transmission) at regular intervals within a beacon period to assist unassociated STA discovery of the BSS and its operating parameters(#16613).

A non-AP STA that receives a FILS Discovery frame from an AP with which it is not associated, may use the values carried in the frame to determine the operating parameters for that AP and may use the information when responding to a Trigger frame from the AP containing RA-RUs for unassociated non-AP STAs(#16592).(18/1812r2) (18/1266r6)

An unassociated non-AP STA that has not received an UORA Parameter Set element from the AP with which it intends to communicate shall use the default OCW values as defined in 27.5.5.1 (General). Each time an unassociated non-AP STA(#16592) communicates with a different AP using random access it shall initialize its OCW using the default values or the parameters from the UORA Parameter Set element received from that AP and shall initialize its OBO counter as defined in 27.5.5.3 (Transmission procedure for UORA).

An unassociated non-AP STA that supports the UORA and TWT procedure may begin listening for Trigger frames at the start of a particular broadcast TWT SP after receiving a Beacon frame, a broadcast Probe Response frame or a FILS Discovery frame containing a TWT element indicating that the particular TWT SP shall include Trigger frames with at least one RA-RU for unassociated non-AP STAs(#16592) (see 27.8.3.1 (General)).

A non-AP STA that transmits an HE TB PPDU on an RA-RU allocated in a Trigger frame sent by an AP to which the non-AP STA(#16592) is not associated shall include at most one Management frame in the HE TB PPDU.(#16539)

An AP that receives Management frames from one or more unassociated non-AP STAs carried in HE TB PPDUs transmitted on RA-RUs shall respond with a Multi-STA BlockAck frame carried either in an SU PPDU or in a DL HE MU PPDU on a broadcast RU with STA-ID 2045.(#16407)(#15686)(#15686)

An AP with dot11FILSOmitReplicateProbeResponses equal to true shall follow the procedure defined in 11.1.4.3.4 to respond with a broadcast Probe Response frame or the next Beacon frame if it receives one or more Probe Request frames via the UORA procedure.(#15092)

**(#16451) (#16584)**

**End of proposed changes.**