IEEE P802.11
Wireless LANs

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| Proposed resolution for comments related to OFDMA random access procedure (RAPS element) |
| Date: 2017-05-05 |
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Abstract

The submission provides resolutions to TGax D1.0 comments related to clause 27.5.2.6 Random access procedure, concerning the RAPS element.

This submission proposes solutions to the following CIDs (10 CIDs): 5386, 5401, 5722, 6182, 7043, 7410, 7414, 8282, 8300, 8557.

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Minor modification (typos and minor text clarification).
* Rev 2: clarification on the usage of the default values for OCWmin and OCWmax

1. **Introduction**

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.***

The following comments relate to the general usage of RAPS element:

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| **CID** | **Commenter** | **Section** | **Pg / Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 5386 | Geonjung Ko | 27.5.2.6.2 | P173L31 | We need a clarification on what "the HE AP" means.For a STA which associated with an AP, "the HE AP" would be the AP that the STA associated with. Also it should be clarified for a STA which has not associated with any APs. Without the clarification, the STA would initialize its OBO counter every time the STA receives a Beacon frame from neighboring APs. | A STA which associated with an AP initializes its OBO counter on the reception of the RAPS element from the associated AP.A STA which has not associated with any APs initializes its OBO counter on the reception of the RAPS element from the intended AP. | Revised. Agree in principle.As proposed in the proposed change text, the Non-associated STA uses the RAPS of the intended AP, for setting its OCW range. TGax Editor to make the changes to 802.11ax D1.2 as shown in 11-17/0645r2 under all headings that include CID 5386. |
| 5722 | Guoqing Li | 27.5.2.5 | P172L49 | This note should be written in normative text with "shall" language | change to something like "A STA shall not transmit ....if it does not receive..." | Rejected.The proposed change by the commenter is related to a note and hence this part of the text is not normative. |
| 7410 | Lei Huang | 27.5.2.6.1 | P172L39 | Currently it is optional for AP to send RAPS element. If AP does not send RAPS element, an STA does not transmit any HE trigger-based PPDU using random access RUs. This would cause unnecesary transmission delay for STA. | 1. Define a default value for OCWmin and OCWmax;2. If an HE STA does not receive the RAPS element, the HE STA shall perform UL OFDMA-based random access procedure based on the default values of OCWmin and OCWmax. | Revised.NOTE 1 (27.5.2.6.1) is amended so that if an associated STA does not receive the RAPS, the STA does not transmit using random access RU.Default values are only provided to unassociated stations for supporting quick registration, before the next TBTT (default values to be erased when receiving RAPS).TGax Editor to make the changes to 802.11ax D1.2 as shown in 11-17/0645r2 under all headings that include CID 7410. |
| 7414 | Lei Huang | 27.5.2.6.2 | P173L27 | The statement "An HE AP indicates the values of OCWmin and OCWmax in the RAPS element in a Beacon or Probe Response frame for the random access operation. OCWmax is the upper limit of OCW." is redundant since there is the similar statement in Section 27.5.2.6.1 (see L38-L43 of P172). | delete "An HE AP indicates the values of OCWmin and OCWmax in the RAPS element in a Beacon or Probe Response frame for the random access operation. OCWmax is the upper limit of OCW." | Revised.Agree in principle.The redundant sentence on HE AP is deleted and replaced by a sentence clarifying the behavior of the HE STA.TGax Editor to make the changes to 802.11ax D1.2 as shown in 11-17/0645r2 under all headings that include CID 7414. |
| 8282 | Pascal Viger | 27.5.2.6.1 | P172L45 | HE STA shall use the most recently RAPS element, but this element should be received from the intended AP ! | Modify the sentence of 4th paragraph: "An HE STA shall use the OCWmin and OCWmax values indicated in the RAPS element within Beacon or Probe Response frames most recently received by the AP emitting the Trigger Frame, regardless of the access category...". | Revised.Agree in principle. The proposed changes included in the current document clarify the obtaining rules of the OCWmin and OCWmax values TGax Editor to make the changes to 802.11ax D1.2 as shown in 11-17/0645r2 under all headings that include CID 8282. |
| 8300 | PatriceNezou | 27.5.2.6.1 | P172L49 | An AP only "may" include RAPS element even if UL OFDMA-based random access is unable. How can the STA set OCWmin and OCWmax itself if no RAPS is sent by the AP? | A non-AP STA must define default values for OCWmin and OCWmax | *Revised**Comment very similar to previous CID#7410*.as per #7410 resolution. |
| 8557 | Rojan Chitrakar | 27.5.2.6.1 | P172L33 | STAs with limited/inaccurate transmission power adjustment capabilities may not be able to accurately match the "Target RSSI" level specified in the Trigger Frame. This may cause large differences in the received power among STAs, leading to severe Multi-User Interference (MUI). As an example, an STA located very close to the AP may cause high RSSI at the AP even at minimum transmission power. This issue would be even more serious in the case of random access since the AP cannot know which STAs will actually transmit. | In order to enable the AP to reduce the chances of Multi-User Interference (MUI), aside from AID = 0, add two more special AIDs to identify RUs for random access with some restrictions as below:AID = 2008: Only STAs whose estimated received signal power at the AP does not exceed the "Target RSSI" specified in the Trigger frame, when the STA transmits at the transmit power level calculated as per Eqn. 28-118, may transmit on the RU.AID = 2009: Only STAs that cause the estimated received signal power at the AP to exceed the "Target RSSI" specified in the Trigger frame, even when the STA transmits at minimum transmit power level calculated as per Eqn. 28-118, may transmit on the RU. The definition of AID = 0 remains the same: AID = 0 : Random access with no restriction. | WithdrawnThe commenter withdrawn the comment. |

The following comments relate to the usage of RAPS element in case of multiple BSS support:

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| **CID** | **Commenter** | **Section** | **Pg / Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 5401 | Geonjung Ko | 27.5.2.6.2 | P173L01 | There is always the Beacon frame from the transmitted BSSID, but Beacon frames from the nontransmitted BSSIDs may not exist. Moreover, a STA cannot determine whether a Trigger frame is soliciting STAs only associated with the BSS of the transmitted BSSID or at least two BSSs using the TA field.STAs associated with the BSS of the nontransmitted BSSID should have an opportunity to participate in the random access. Also all of STAs associated with BSSs of the transmitted BSSID and nontransmitted BSSIDs need to have fair opportunities. | STAs associated with BSSs of nontransmitted BSSIDs should use the RAPS element in a Beacon frame from the transmitted BSSID.Also it should be allowed that STAs associated with the BSS of the transmitted BSSID decrement OBO counters on the Trigger frame with the TA field set to the nontransmitted BSSID and STAs associated with BSSs of nontransmitted BSSIDs decrement OBO counters on the Trigger frame with the TA fiels set to the transmitted BSSID. | Revised.If a STA doesn’t found a RAPS for its associated or intended AP in the last received frame carrying a RAPS element, a STA will inherit the RAPS element from the transmitted BSSID. Otherwise, a STA will use the latest RAPS element received from the AP it is associated to (see previous CID 5386).A trigger frame is defined as mutli BSS if the TA field is set to the transmitted BSSID. As a consequence, The STA associated with a transmitted BSSIDs will not consider a trigger frame received with a TA field set to a non-transmitted BSSID, since this is not a trigger frame for its own BSS nor a multi BSS trigger frame.TGax Editor to make the changes to 802.11ax D1.2 as shown in 11-17/0645r2 under all headings that include CID 5401 |
| 6182 | Jin-Sam Kwak | 27.5.2.6.2 | P173L01 | The spec should define the random access procedure when the multiple BSSID function is used. | As per comment | Revised.Agree in principle.The random access procedure when the multiple BSSID is included in the proposed textTGax Editor to make the changes to 802.11ax D1.2 as shown in 11-17/0645r2 under all headings that include CID 6182. |
| 7043 | Ju-Hyung Son | 27.5.2.6.2 | P173L01 | Please specify UL OFDMA-based random access when a BSS is operating in Multiple BSSID mode. An HE STA in Multiple BSSID mode would receive RAPS elements and Trigger frames from its multiple BSSs in Multiple BSSID set. Please clarify how to decrement/initialize its OBO in multiple BSSID mode. | As per comment. | Revised.Agree in principle.Rules for OBO decrement/initialize in the case of multi BSS is included in the proposed text.TGax Editor to make the changes to 802.11ax D1.2 as shown in 11-17/0645r2 under all headings that include CID 7043. |
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Discussion:

The comments are asking for details of the random access procedure in the context of Multiple BSSIDs.

Proposed Resolution:

The mechanism aims to be simple, but offering as much flexibility as possible to the AP:

1. Each virtual AP can advertise its own RAPS element :
	* A RAPS (if any) is by default first provided in the transmitted BSSID profile (txBSSID) of beacons.
	* nonTxBSSID virtual AP advertises via the Nontransmitted BSSID Profile which is carried in the Multiple BSSID element. Such virtual AP can tune its RAPS (according to number of registered stations, contention…) for its specific BSS.
	* If a nonTxBSSID virtual AP does not advertise its own RAPS, the STAs associated with this BSS inherit the RAPS from TxBSSID.

According to D1.2, a HE STA can support receiving TF addressed to STAs belonging to a single BSSID (that the STA is associated with), but also receiving TF addressed to STAs belonging to multiple BSSIDs (Trigger Frame with TA field set to the transmitted BSSID, and STA with *Rx Multi-BSS Control Frame = 1* in HE Cap) :

1. Single-BSS TF: Random Access RUs, in a TF with “TA = nonTxBSSID”, can be used only by STAs associated with that non-transmitted BSS
	1. RA RU is identified with AID12=0 or 2045
	2. STA uses the RAPS of its own BSS
2. Multi-BSS TF : The physical AP is offered a possibility to address all stations of various BSSs at same time.
	1. RA RU is identified with AID12=2045:

Can only be used by non associated STA to transmit data to the txBSSID

* 1. RA RU is identified with AID12=0:

accessible only by the stations registered to the txBSSID

1. **Proposed changes**

TGax Editor: Please modify this section as follows.

**Red text refers to changes related to general usage of RAPS element.**

**Green text refers to proposed changes related to multiple BSS support.**

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

A STA that supports UORA(#8142) shall set the UL OFDMA RA Support subfield in the HE MAC Capabilities Information field of the HE Capabilities element to 1. Otherwise, it shall set the UL OFDMA RA Support subfield to 0.(#8063, #6702)

UORA(#8142) is a mechanism for HE STAs to randomly select resource units (RUs) assigned by an AP in a soliciting Trigger frame that contains RUs for random access. An RU for random access is(#Ed) identified by an AID12 subfield contained in a User Info field of a Trigger frame that is equal to one of the following:

* 0 to indicate a random RU that is intended for associated STAs
* 2045 to indicate a random RU that is intended for unassociated STAs(#3074)

An HE AP may transmit a Basic Trigger frame or a BSRP Trigger frame that contains one or more RUs for random access.

The HE AP may include the RAPS element (see 9.4.2.220 (OFDMA-based Random Access Parameter Set (RAPS) element) in Beacon ~~and,~~ Probe Response, and (Re)-Association frames it transmits. The AP shall indicate the range of OFDMA contention window (OCW) in the RAPS element for HE STAs to initiate random access following the Trigger frame transmission.

(#6182, #7043) The HE AP, corresponding to the transmitted BSSID of the Multiple BSSID Set (see 11.11.14 (Multiple BSSID Set)) may include the RAPS element in Beacon, Probe Response, and (Re)-Association frames it transmits. It may also include one RAPS element in the nontransmitted BSSID profile(s), each RAPS element been used to configure the random access procedure of the BSS it belongs to.

A~~n~~ non-AP HE STA shall ~~use the~~ obtain its OCWmin and OCWmax values (see 9.4.2.220 (OFDMA-based Random Access Parameter Set (RAPS) element), from the values indicated in the RAPS element within the most recently received frame carrying RAPS element sent by the AP to which the STA is associated, (#5386, #8282) regardless of the access category of traffic the HE STA intends to transmit.

In the case a STA with dot11MultiBSSIDActivated set to true and associated with the nontransmitting BSSID, does not find a RAPS element for its intended AP within the nontransmitted profile in the Multiple BSSID element of the frames carrying RAPS element it receives, the STA inherits the RAPS element from the transmitted BSSID profile (#5401).

NOTE 1 — If the an associated STA does not receive the RAPS element, the STA does not transmit any HE TB PPDU using random access RUs.

NOTE 2 — When a STA is associated with a nontransmitted BSS and does not receives RAPS element from is associated BSS or from the transmitted BSS, it shall not transmit any HE TB PPDU using random access RUs. (#6182, #7043)

An unassociated HE STA shall initialize the range of OFDMA contention window (OCW) upon reception of the RAPS element from the intended HE AP (#5386). If the HE STA has not received RAPS element from the AP it wishes to communicate with, it shall use the default value OCWmin = 7 and OCWmax = 31 to be used upon reception of a Trigger frame containing RU with an AID12 subfield equal to 2045. Each time an unassociated HE STA communicates with a different AP using random access it shall initiate its OBO based on the default values or based on the parameters from the received RAPS element for that AP (#8300, #7410).

A(#6703) non-AP STA with dot11OFDMARandomAccessOptionImlemented set to true ~~shall maintain an internal OFDMA backoff (OBO) counter. The STA(#6704)~~  (#7414) shall follow the random access procedure defined in 27.5.2.6.2 (UORA procedure) to contend for an RU assigned for random access.

* **UORA procedure**

In this subclause, the random access procedure is described with respect to UL OFDMA contention parameters. The procedure is also illustrated in Figure 27-4 (Illustration of the UORA(#8142) procedure(#7103, #7413)).

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| * **Illustration of the UORA(#8142) procedure(#7103, #7413)**
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~~The OFDMA contention window (OCW) is an integer with an initial value of OCWmin. An HE AP indicates the values of OCWmin and OCWmax in the RAPS element in a Beacon or Probe Response frame for the UORA(#8142) operation~~. ~~OCWmax is the upper limit of OCW~~ (#7414).

An HE STA shall maintain an internal OFDMA contention window (OCW), and an internal OFDMA backoff (OBO) counter. OCW is an integer within the range [OCWmin, OCWmax]. (#7414)

For an initial HE TB PPDU transmission or following a successful HE TB PPDU transmission, ~~when an HE STA obtains the value of OCWmin from the HE AP indicated in the RAPS element, it~~ (#7414) an HE STA shall set the value of OCW to the OCWmin and shall initialize its OBO counter to a random value in the range of 0 and ~~OCWmin~~ OCW.

NOTE—Upon reception of RAPS element containing modified values, the STA does not re-initialize its OBO counter. The modified RAPS values will be used the next time the OBO counter has to be initialized. (#5392, #9415)

(#3074)An HE AP that transmits a Trigger frame for random access, uses the AID value 0 to indicate random RUs allocated for STAs associated with it, and the AID value 2045 to indicate random RUs allocated for STAs not associated with it.

For an HE STA that is associated with the AP, if the OBO counter of an HE STA(#Ed) is smaller than the number of RUs assigned to AID12 subfield value 0(#6161) in a Trigger frame with the TA field set to the BSSID of the AP with which the STA is associated (#6182, #7043), then the HE STA shall decrement its OBO counter to zero. Otherwise, the HE STA decrements its OBO counter by the number of RUs assigned to AID12 subfield value 0(#6161) in a Trigger frame with the TA field set to the BSSID of the AP with which the STA is associated (#6182, #7043). For an HE STA, that is not associated with the AP having a pending frame for the AP sending the trigger frame (#5401, #6182, #7043), if the OBO counter is smaller than the number of RUs assigned to AID12 subfield value 2045 in a Trigger frame, then the HE STA shall decrement its OBO counter to zero. Otherwise, the HE STA decrements its OBO counter by a value equal to the number of RUs assigned to AID12 subfield value 2045 in a Trigger frame.(#3074) In the example shown in Figure 27-4 (Illustration of the UORA(#8142) procedure(#7103, #7413)), HE STA 1 and HE STA 2, both associated with the AP and having a pending frame for the AP, decrement their nonzero OBO counters by the number of User Info fields in the Trigger frame where the AID12 subfield is 0(#9103). HE STA 3, which is not associated with the AP but has a pending frame for the AP, decrements its nonzero OBO counter by the number of User Info fields in the Trigger frame where the AID12 subfield is 2045(#9103). HE STA 4, which is associated with the AP and has a pending frame for the AP, is assigned RU6 and does not decrement its nonzero OBO counter. HE STA 4 will transmit its pending frame in an HE TB PPDU using the assigned RU6. HE STA 4 still has pending frame for the AP so it maintains OBO counter and resumes random access in next Trigger frame.(#8152, #9103, #Ed)

For an HE STA associated with the AP, if the OBO counter is 0 or decrements to 0(#Ed), then the STA randomly selects one of the RUs assigned to AID12 subfield value 0(#6161). For an HE STA not associated with the AP, if the OBO counter is 0 or if the OBO counter decrements to 0, then the STA randomly selects one of the RUs assigned to AID12 subfield value 2045.(#3074) If the selected RU is idle as a result of both physical and virtual carrier sensing as defined in subclause 27.5.2.4 (UL MU CS mechanism), the HE STA transmits its HE TB PPDU in the (#Ed)selected RU. If the selected RU is considered busy as a result of either physical or virtual carrier sensing, then the HE STA shall not transmit its HE TB PPDU in the (#Ed)selected RU. Instead, the STA (#3074)randomly selects any one of the RUs that are assigned to AID12 subfield value 0(#6161) if it is an associated STAs or AID12 subfield value 2045 if it is an unassociated STA(#3074) in the subsequent Trigger frame. If the OBO counter is not zero and does not decrement(#6710) to 0, the STA resumes with its OBO counter in the next Trigger frame with RUs assigned for random access. In the example shown in Figure 27-4 (Illustration of the UORA(#8142) procedure(#7103, #7413)), after receiving Trigger frame 1, HE STA 1 transmits an HE TB PPDU because its OBO counter decrements to 0. HE STA 1 then randomly selects RU2 from RU1, RU2, and RU3 which are assigned to AID12 subfield value 0. HE STA 2, HE STA 3, and HE STA 4 hold their OBO counters and wait for the next Trigger frame because their OBO counters don't decrement to 0. On receiving Trigger frame 2, HE STA 2, HE STA 3, and HE STA 4 decrement their OBO counters to 0 and each transmit their pending frame in an HE TB PPDU on a randomly selected RU.(#8152, #Ed)

If the HE TB PPDU is successfully transmitted in the randomly selected RU, then the STA shall set its OCW to OCWmin.

NOTE—If the transmitted HE TB PPDU does not solicit an immediate response, then the STA follows the OCW reset rule that applies to successful transmission.

The MU acknowledgment procedure for UORA(#8142) follows the procedure as defined in 10.3.2.10.3 (Acknowledgement procedure for an UL MU transmission).

If a STA transmits an HE TB PPDU that solicits an immediate response in a random access RU and the expected response is not received, the transmission is considered unsuccessful and the STA invokes the UORA(#8142) retransmission procedure as defined in 27.5.2.6.3 (Retransmission procedure for UORA).