IEEE P802.11  
Wireless LANs

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| CR for OPS | | | | |
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Abstract

This document provides CR for CIDs: 17000 15022 17025 15877 15878 17027 15816 15821 15180 15115 15117 15169 16469 15170 15171 17026 15730 15172 16470 16471 15116 16473 15118 16474 15822 15167 15168

R1:

* Minor modification for (#15822) to also include Intra-PPDU power save in the modifications

R2:

* Add a definition for OPS period.

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. The introduction and the explanation of the proposed changes are 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.***

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| **CID** | **Clause Number(C)** | **Page** | **Comment** | **Proposed Change** | **Resolution** |
| 17000 | 3.2 | 38.46 | "opportunistic power save (OPS) STA: A non-AP HE STA that supports the opportunistic power save mechanism.  opportunistic power save (OPS) AP: An HE AP that supports the opportunistic power save mechanism."  If we would like to define OPS STA and OPS AP like this, there should be definition of "opportunistic power save mechanism." | Add definition of opportunistic power save mechanism, e.g., "Opportunistic power save (OPS) mechanism: a power save mechanism to allow OPS STAs to opportunistically go to doze state for a defined period." | Revised – apply the changes as proposed in doc 1497r2. |
| 15022 | 9.4.2.6 | 130.27 | Remove FILS Discovery frame from line 27. The additional rules cover the DTIM Control field being reserved on line 36 | As in comment | Revised – agree with the comment. Apply the changes as proposed in doc 1497r2. |
| 17025 | 9.4.2.6 | 130.27 | "When a TIM element is included in a TIM frame or FILS Discovery frame,..." When a TIM element is included in an OPS frame, the DTIM Count field is also reserved. | As in comment. | Revised – this is clarified in the following paragraph. |
| 15877 | 9.4.2.6 | 130.42 | OPS can be used without TWT. The related changes are needed for TIM element also. | As in the comment | Revised – apply the changes as proposed in doc 1497r2. |
| 15878 | 9.4.2.6 | 130.42 | This bullet doesn't apply to OPS frame. | As in the comment | Revised – apply the changes as proposed in doc 1497r2. |
| 17027 | 9.4.2.6 | 130.43 | "Bit N in the traffic indication virtual bitmap is 0 if the OPS AP does not intend to transmit to the OPS STA including to trigger the OPS STA for an UL MU transmission during the TWT SP and before the next TWT SP." In an unscheduled opportunistic power save, an OPS AP should not send frames during the OPS period. Please add this rule. | As in comment. | Revised – apply the changes as proposed in doc 1497r2. |
| 15816 | 9.4.2.246 | 179.40 | "may go to doze state" is not fully sufficient as OPS STA that are active can also be unavailable | change the text to "can go to doze state or be unavailable" | Revised – agree with the comment. Apply the changes as proposed in doc 1497r2. |
| 15821 | 27.14.3.1 | 363.23 | "Opportunistically go to doze state": this is not fully accurate as active STAs can also be unavailable. | Modify the sentence and throughout the spec to clarify that active STAs can be unavailable | Revised – agree with the comment. Apply the changes as proposed in doc 1497r2. |
| 15180 | 27.14.3 | 363.28 | FILS, OPS, TIM frames... Please clarify that they are broadcast. And "beacons" maybe replace with "Beacon frames" | As in comment. | Revised – apply the changes as proposed in doc 1497r2. |
| 15115 | 27.14.3.2 | 363.39 | Clarify that OPS frame is sent as a broadcast frame | As in comment | Revised – apply the changes as proposed in doc 1497r2. |
| 15117 | 27.14.3.2 | 363.39 | When FD frame carrying TIM element is within a TWT SP, it shall not carry OPS element | Clarify that in scheduled mode, FD frame doesn't carry OPS element. Similar text needed in 9.6.8.36 | Revised – it is not required to include OPS element, but it could be added. Apply the changes as proposed in doc 1497r2. |
| 15169 | 27.14.3.2 | 363.41 | When is the AP scheduling for transmission? | Please clarify | Revised – agree with the comment. Tha AP can send it at any time. Apply the changes as proposed in doc 1497r2. |
| 16469 | 27.14.3.2 | 363.44 | It says "The AP should transmit a FILS Discovery frame instead of an OPS frame if the target transmission time aligns with the transmission time of a FILS Discovery frame." It seems "shall" is more suitable | Change "should" to "shall". Do the same change for P363 L64. | Reject – using FD is more efficient in such case as the AP does not need to send 2 frames. But it is not a “shall” as the AP is free to do what it wants, without issues. |
| 15170 | 27.14.3.2 | 363.45 | If the target transmission time aligns. It would be good to clarify what the epsilon of error is in this case. I think one cannot guarantee a one microsecond level resolution of the alignments. | As in comment. | Revised – we can say ”closely”. Again here, the rule does not need to be too strict and precise as it is a recommendation. Apply the changes as proposed in doc 1497r2. |
| 15171 | 27.14.3.2 | 363.46 | Includes the OPS duration... Please cite the field and specify that the duration is indicated in that field. I think this is an issue that comes up throughout. Please use capital letters for the names of a field, frame, or the likes. | As in comment. | Revised – agree with the comment. Apply the changes as proposed in doc 1497r2. |
| 17026 | 27.14.3.2 | 363.48 | "The TIM element is encoded specifically as defined in 9.4.2.6 (TIM element) in order to provide the information of which STAs are scheduled and not scheduled during the OPS period." The TIM element does not provide whether the STA is scheduled. \* Bit N in the traffic indication virtual bitmap is 0 if the OPS AP does not intend to transmit to the OPS STA including to trigger the OPS STA for an UL MU transmission during the TWT SP and before the next TWT SP. \* Otherwise, bit N in the traffic indication virtual bitmap for the OPS STA is 1. If "Otherwise" is limited to a specific information, , please change 9.4.2.6 (TIM element). | As in comment. | Revised – agree with the comment. Apply the changes as proposed in doc 1497r2. |
| 15730 | 27.14.3.2 | 363.49 | During a long TWT SP, the AP may transmit an OPS frame that indicates to a STA in TWT SP that the AP will not transmit anything for the non-AP STA for the duration of the opportunistic power save SP, i.e. 20ms. This may cause a long pause to the TWT SP and shorten the remaining time in TWT SP to be too short to transmit the remainder of the traffic. As the outcome, the STA may need to switch to active mode to get enough transmission time. Once STA is in active mode, then it can only follow the OPS instructions. To simplify the TWT SP handling it would be better if the opportunistic power save just terminates the ongoing TWT SP and the STA would not wake up to receive the remainder of the TWT SP. This way the TWT schedule is not affected by the OPS frame transmission and the following waking ups can be done according to TWT schedule. | Change the reception of the OPS frame. If a STA in PS mode has TWT SP ongoing and receives a FILS Discovery or OPS frame indicating that the AP will not transmit anything to the STA, then all ongoing TWT SPs are terminated and the AP will serve the STA earliest at the next TWT SP or after the duration indicated in the OPS frame which ever occurs first. |  |
| 15172 | 27.14.3.2 | 363.51 | "Including to trigger the STA"... suggest using correct terminology. Send a Trigger frame that solicits an HE TB PPDU or something like that. | As in comment. | Revised – agree with the comment. Apply the changes as proposed in doc 1497r2. |
| 16470 | 27.14.3.3 | 363.51 | Generaly speaking, trigger frame is not individually addressed frames. It does not make sense to say "including to trigger the STA to send HE TB PPDUs" | Change it to "the AP should not send individually addressed frames to the STA and Trigger frames to the STA to solicit the HE TB PPDUs during the OPS period" | Revised – agree with the comment. Apply the changes as proposed in doc 1497r2. |
| 16471 | 27.14.3.2 | 363.57 | TWT flow identifier field is for individual TWT. It is abused here | Change "TWT flow identifier field" to "Broadcast TWT Recommendation field" or "TWT Flow Identifier/Broadcast TWT Recommendation". Do the same change for P363 L3. | Revised – agree with the comment. Apply the changes as proposed in doc 1497r2. |
| 15116 | 27.14.3.2 | 363.58 | The field TWT Flow Identifier doesn't apply to broadcast TWT | Throughout this section, replace the field TWT Flow identifier with Broadcast TWT Recommendation field | Revised – agree with the comment. Apply the changes as proposed in doc 1497r2. |
| 16473 | 27.14.3.2 | 363.61 | "TWT Flow Identified field" has a typo, it should be The TWT Flow Identifier subfiled. But it it better to replace it to "TWT Flow Identifier/Broadcast TWT Recommendation", keeping aligned with the terminology in the TWT element | Change "TWT flow Identified field" to "Broadcast TWT Recommendation field" or "TWT Flow Identifier/Broadcast TWT Recommendation" | Revised – agree with the comment. Apply the changes as proposed in doc 1497r2. |
| 15118 | 27.14.3.2 | 364.02 | In order to be effective, the TIM frame should align with the start of the B-TWT SP. | replace target time' with 'start time' | Revised – apply the changes as proposed in doc 1497r2. |
| 16474 | 27.14.3.2 | 364.06 | Generaly speaking, trigger frame is not individually addressed frames. It does not make sense to say "including to trigger the STA to send HE TB PPDUs" | Change it to "the AP should not send individually addressed frames to the STA and Trigger frames to the STA to solicit the HE TB PPDUs during the OPS period" Do the same change for P364 L24 and P364 L25. | Revised – same resolution as 16470. Apply the changes as proposed in doc 1497r2. |
| 15822 | 27.14.3.3 | 364.12 | This applies to active STAs as well as PS STAs and this should be more explicitly written | Modify the sentence and throughout the spec to clarify that active STAs can be unavailable | Revised – agree with the comment. Apply the changes as proposed in doc 1497r2. |
| 15167 | 27.14.3.3 | 364.27 | One cannot restrict access without explicitly restricting it. And there is nothing in the paragraph above that is even remotely hinting into restrictions. And technically the STA does not access the channel using EDCA but rather contends using EDCA | As in comment. | Revised – agree with the comment. Propose to remove the note. Apply the changes as proposed in doc 1497r2. |
| 15168 | 27.14.3.3 | 364.34 | How does the STA know that the AP is using TIM element for OPS ? | Please clarify | Revised – if the STA is an OPS STA and the associated AP is an OPS AP, TIM element is always encoded with the OPS encoding when transmitted in any TIM frames. Therefore it should not operate with TIM broadcast procedure. Apply the changes as proposed in doc 1497r2. |

1. **Proposed changes**

***11ax Editor: Include the following sentence in subclause 3.2 Definitions specific to IEEE 802.11***

**[…]**

**opportunistic power save mechanism:** A power save mechanism to allow OPS STAs to opportunistically go to doze state or be unavailable for a defined period. (#17000)

**opportunistic power save (OPS) period:** A period during which an OPS STA is allowed to be unavailable if it is explicitly not scheduled by its associated OPS AP.

**opportunistic power save (OPS) STA:** A non-AP HE STA that supports(#11445) the opportunistic power save mechanism.

**opportunistic power save (OPS) AP:** An HE AP that supports(#11446) the opportunistic power save mechanism.

**[…]**

***11ax Editor: Modify clause 9.3.2.6 TIM element as below***

* TIM element

Change the 4th paragraph as follows:

The DTIM Count field indicates how many Beacon frames (including the current frame) appear before the next DTIM. A DTIM count of 0 indicates that the current TIM is a DTIM. The DTIM Count field is a single octet. When a TIM element is included in a TIM frame, the DTIM Count field is reserved.

Insert the following at the end of the subclause:

When included in an OPS frame or a FILS Discovery frame by an OPS AP for unscheduled opportunistic power save (see 27.14.3 (Opportunistic power save)), the following apply:

* The DTIM Count field is reserved
* The DTIM Period field is reserved
* Bit *N* in the traffic indication virtual bitmap that corresponds to an OPS STA with AID *N* is determined as follows:
* Bit *N* in the traffic indication virtual bitmap is 0 if the OPS AP does not intend to transmit to the OPS STA including to trigger the OPS STA for an UL MU transmission during the OPS period. (#15877, #17027)
* Otherwise, bit *N* in the traffic indication virtual bitmap for the OPS STA is 1.
* Bit *N* in the traffic indication virtual bitmap that corresponds to an non-OPS STA with AID N is determined as follows:
* Bit *N* in the traffic indication virtual bitmap is 1 to indicate that AP has buffered frames for the STA and set to 0 otherwise.(#12032)

When included in a TIM frame or a FILS Discovery frame by an OPS AP for scheduled opportunistic power save (see 27.14.3 (Opportunistic power save)), the following apply:

* The DTIM Count field is reserved
* The DTIM Period field is reserved
* Bit *N* in the traffic indication virtual bitmap that corresponds to an OPS STA with AID *N* is determined as follows:
* Bit *N* in the traffic indication virtual bitmap is 0 if the OPS AP does not intend to transmit to the OPS STA including to trigger the OPS STA for an UL MU transmission during the TWT SP and before the next TWT SP.
* Otherwise, bit *N* in the traffic indication virtual bitmap for the OPS STA is 1.
* Bit *N* in the traffic indication virtual bitmap that corresponds to an non-OPS STA with AID N is determined as follows:
* Bit *N* in the traffic indication virtual bitmap is 1 to indicate that AP has buffered frames for the STA and set to 0 otherwise.(#12032) (#15877, #15878)

***11ax Editor: Modify clause 27.14.3 Opportunistic power save as below***

* Opportunistic power save
* General

An OPS STA is a non-AP HE STA that sets the OPS Support subfield in the HE MAC Capabilities Information field of the HE Capabilities element to 1.

An OPS AP is an AP HE STA that sets the OPS Support subfield in the HE MAC Capabilities Information field in HE Capabilities element to 1.

Opportunistic power save mechanism has the objective to allow OPS STAs to opportunistically be unavailable to save power for a defined period. The opportunistic power save mechanism has two modes: unscheduled and scheduled.(#Ed)

In the unscheduled mode, an OPS AP sends an OPS frame or a FILS discovery frame at any time to provide the scheduling information for all OPS STAs for the OPS period that follows the transmission of the OPS frame or FILS discovery frame. Based on this information, the OPS STAs may opportunistically be unavailable during the OPS period.

In the scheduled mode, an OPS AP splits a beacon interval into several periodic broadcast TWT SPs and provides, at the beginning of each SP, the scheduling information for all OPS STAs. Based on this information, the OPS STAs may opportunistically be unavailable until the next TWT SP.(#11019)

* AP operation for opportunistic power save

(#11019)To enable unscheduled opportunistic power save, an OPS AP shall schedule for transmission at any time an OPS frame or a FILS Discovery frame with the RA field set to the broadcast address that includes a TIM element (see 9.4.2.6 (TIM element)) and an OPS element (see 9.4.2.246 (OPS element)). The AP should transmit a FILS Discovery frame instead of an OPS frame if the target transmission time closely aligns with the transmission time of a FILS Discovery frame. The OPS Duration field in the OPS element shall be set to (#15171) the duration of the OPS period that immediately follows the transmission of the OPS frame or FILS Discovery frame. The TIM element is encoded specifically as defined in 9.4.2.6 (TIM element) in order to provide the information of which STAs are (#17026) not scheduled during the OPS period. If the OPS AP sets the bit corresponding to an OPS STA in the traffic indication virtual bitmap carried by the Partial Virtual Bitmap field of the TIM element of the OPS frame or FILS Discovery frame to 0, the AP should send neither individually addressed frames to the STA nor Trigger frames that solicit an HE TB PPDU from the STA during the OPS period. (#15172, #16470)

To enable scheduled(#11019) opportunistic power save, an OPS AP shall include a TWT element in beacon frames to set a periodic Broadcast TWT SP with the following information:

* The Broadcast TWT Recommendation field set to 3
* The Broadcast TWT ID subfield is set to 0

At the beginning of these periodic TWT SPs with the Broadcast TWT Recommendation field set to 3, the AP shall schedule for transmission(#11019) a TIM frame or a FILS Discovery frame with the RA field set to the broadcast address that includes a TIM element (see 9.4.2.6 (TIM element)). The FILS Discovery frame may include or not an OPS element. The AP should transmit a FILS Discovery frame instead of a TIM frame if the TWT SP start time closely (#15170) aligns with the transmission time of a FILS Discovery frame. If the OPS AP also operates with TIM Broadcast and uses TIM frames for Opportunistic power save mechanism, the OPS AP should align the transmission time of a TIM frame for TIM Broadcast, with the start time of the broadcast TWT SP(#13513) with the Broadcast TWT Recommendation field set to 3. If the OPS AP sets the bit corresponding to an OPS STA in the traffic indication virtual bitmap carried in the Partial Virtual Bitmap field of the TIM element of the TIM frame or FILS Discovery frame to 0, the AP should send neither individually addressed frames to the STA, nor Trigger frames that solicit an HE TB PPDU from the STA (#15172, #16470) during the TWT SP and until the next TWT SP with the Broadcast TWT Recommendationfield set to 3.

* STA operation for opportunistic power save

(#11019)With unscheduled opportunistic power save, an OPS STA with AID *N* that is in active mode or in PS mode (#15822) that is in the awake state that receives a TIM element and an OPS element in an OPS frame or a FILS Discovery frame from the associated OPS AP, the STA may be unavailable until the end of the OPS period indicated in the OPS element, if the bit N in the traffic indication virtual bitmap carried in the Partial Virtual Bitmap field of the current TIM element is set to 0, unless other conditions not related to operation with the OPS AP require the STA to be in the awake state. At the end of the OPS period, the STA shall be in the awake state, unless determined otherwise by other power save protocols.

With scheduled opportunistic power save, an OPS STA with AID *N* that is in active mode or in PS mode (#15822) that is in the awake state and that receives from the OPS AP with which it associated a TIM element with bit *N* of the traffic indication virtual bitmap field equal to 0 in a TIM frame or FILS Discovery frame within a broadcast TWT SP with the Broadcast TWT Recommendationfield set to 3 may be unavailable during the TWT SP and until the next TWT SP with the Broadcast TWT Recommendation field set to 3, unless other conditions not related to operation with the OPS AP require the STA to be in the awake state.(#12034) (#15167)An OPS STA shall not operate with TIM broadcast procedure if its associated AP is an OPS AP .(#11046)

***11ax Editor: Modify clause 11.2.3.2 Non-AP STA power management modes as below***

* Non-AP STA power management modes

A non-AP STA can be in one of two power management modes:

* Active mode: The STA receives and transmits frames at any time and the STA remains in the awake state, unless the STA is allowed to be temporarily unavailable with Opportunistic power save procedure as defined in 27.14.3 (Opportunistic power save) (#15822), or with Intra-PPDU power save procedure as defined in 27.14.1 (Intra-PPDU power save for non-AP HE STAs) (#15822).

***11ax Editor: Modify clause 11.2.3.9 STAs operating in the active mode as below***

* STAs operating in the active mode

A STA operating in this mode shall have its receiver activated continuously, unless the STA is allowed to be temporarily unavailable with Opportunistic power save procedure as defined in 27.14.3 (Opportunistic power save) (#15822), or with Intra-PPDU power save procedure as defined in 27.14.1 (Intra-PPDU power save for non-AP HE STAs); such STAs do not need to interpret the TIM elements in Beacon frames.