### IEEE P802.11 Wireless LANs

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| --- | --- | --- | --- | --- |
| 11be D3.1 CR power management across links | | | | |
| Date: 2023-05-6 | | | | |
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Abstract

This submission proposes resolutions for the following CID:

16312, 16334

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Adding MIB
* Rev 2: editorial changes

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 TGbe D3.1 Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGbe D3.1 Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 16312 | Juseong Moon | 35.3.12.4 | 540.17 | It is not clear how STAs can transmit PS-Poll over multiple links with NAVSyncDelay. When STAs of a non-AP STA MLD wakes up from the doze state, the STAs can not transmit PS-Poll during NAVSyncDelay timer before successful reception of frames. A STA received TIM can immediately transmit PS-Poll but other STAs of the same non-AP STA MLD may not transmit PS-Poll due to NAVSyncDelay which delays BU transmission over indicated multiple links. Even though APs of the AP MLD can transmit TF to solicit PS-Poll transmission, it is difficult to estimate exact STAs' wakeup time and STAs' wakeup status. If the STA received TIM can transmit PS-Poll with other links' wakeup status, APs may transmit TF or BU directly. | Please define a method to indicate other links' wakeup status. | Revised.  Agree to the comment in principle.  MLPS Control was added to achieve power management across multi-links.  MLPS subfield was added to achieve power management across multi-links.  Tgbe editor: please implement changes as shown in this document tagged as 16312,16334 in option |
| 16334 | Yongho Kim | 35.3.17 | 565.12 | In a scenario where an EMLSR non-AP MLD receives a TIM and a multi-link traffic indication in a beacon frame from its associated MLD, it can suffer from MediumSyncDelay or NAVSyncDelay when it has to send multiple PS-Poll frames. Therefore, PS-Poll frame which can indicate multiple links wake up status is needed to reduce delay caused by ediumSyncDelay or NAVSyncDelay. | As in comment, please define a PS-poll frame which can indicate wake-up status of multiple links. | Revised.  Agree to the comment in principle.  MLPS Control was added to achieve power management across multi-links.  MLPS subfield was added to achieve power management across multi-links.  Tgbe editor: please implement changes as shown in this document tagged as 16312,16334 in option |

**Discussion:**

As the comments point out that NAVSyncDealy impedes a STA affiliated with a non-AP MLD to retrieve BUs from its associated AP if the STA is just waked from doze by another STA affiliated with the non-AP MLD according to received MLTI in Beacon frame.

In EMLSR, MediumSyncDelay leads to worse situation because of additional transition delay between listening on each EMLSR link and receiving/transmiting on a link.

The problem has been discussed several times in the group.

Document [1] proposes to introduce a new A-Control (MLPS Control) to indicate power management mode of each STA affiliated with a non-AP MLD. During the discussion, some members have concerns on whether the MLPM subfield indicating the power management mode of non-AP STA(s) affiliated with a non-AP MLD is needed. In this document, the subfield is removed.

Document [2] proposes to use reserved bit B14 of Frame Control field in PS-Poll frame or QoS Null frame to indicate power management mode of all EMLSR/EMLMR STAs affiliated with a non-AP MLD. The solution works with PS-Poll piggybacking the power state of other affiliated STAs, even if no APSD is configured. It brings benefits to compete TXOPs on all EMLSR/EMLMR links for predictable traffics, which matches the purpose of the EMLSR/EMLMR.

While the solution in [2] is expanded for retrieving BUs based on MLTI for traffic indication purpose, all STAs affiliated with the non-AP MLD have to be awake. So the solution in [1] is better in this case.

It is worth to point out that the group has decided to remove “dot11EHTBaseLineFeaturesImplementedOnly” from the 11be draft. So the MLTI is just for link recommendation and non-AP MLD does not have to retrieve BUs on link(s) specified by MLTI.

**End of discussion**

**SP:**

**Which option do you select to resolve CID 16312 and 16334?**

1. Option A
2. Option B
3. Both option A and option B
4. Neither option A nor option B

**Option A:**

***TGbe editor: Please modify the following subclause 9.2.4.6.4 HE variant in TGbe D3.1:***

**9.2.4.6.4 HE variant  
*Change Table 9-25 (Control ID subfield values) as follows:***

**Table 9-25—Control ID subfield values**

|  |  |  |  |
| --- | --- | --- | --- |
| **Control ID value** | **Meaning** | **Length of the Control Information subfield (bits)** | **Content of the Control Information subfield** |
| **…** |  |  |  |
| 10(16312,16334) | multi-link power save (MLPS) | 20 | See 9.2.4.7.12 (MLPS Control) |
| 11–14 ~~7–14~~ | Reserved |  |  |
| 15 | Ones need expansion surely (ONES) | 26 | Set to all 1s |

***TGbe editor: Please add the following subclause 9.2.4.7.12 MLPS Control after 9.2.4.7.11 ELA Control in TGbe D3.1:***

**9.2.4.7.12 MLPS Control (#16312,16334)**

The Control Information subfield in an MLPS Control subfield contains the power management mode of non-AP STA(s) affiliated with a non-AP MLD.

The format of this subfield is shown in Figure 9-abc (Control Information subfield format in an MLPS Control subfield).

|  |  |  |
| --- | --- | --- |
|  | B0 B15 | B16 B19 |
|  | MLPS Link Bitmap | Reserved |
| Bits: | 16 | 4 |

**Figure 9-abc—Control Information subfield format in an MLPS Control subfield**

The MLPS Link Bitmap subfield indicates the link(s) on which non-AP STA(s) affiliated with a non-AP MLD operate that adopt the power management mode indicated in the Power Management subfield in the Frame Control field. The bit position *i* of the MLPS Link Bitmap subfield corresponding to a link with link ID equal to *i* is set to 1 to indicate that the power management mode indicated in the Power Management subfield in the Frame Control field will be adopted by the non-AP STA affiliated with the non-AP MLD that operates on that link. Otherwise, the bit position i is set to 0.

***TGbe editor: Please modify the following subclause 35.3.12.1 General in TGbe D3.1:***

**35.3.12 Multi-link power management  
35.3.12.1 General**

…

***TGbe editor: Please add the following paragraph and figure at the end of subclause 35.3.12.1 General in TGbe D3.1:***

(#16312, 16334) An AP that is affiliated with an AP MLD shall set the MLPS Support subfield in the Common Info field of the Basic Multi-Link element it transmits to 1 if its dot11MLPSOptionImplemented is true; otherwise the AP shall set it to 0.

(#16312, 16334) A non-AP STA affiliated with a non-AP MLD shall not transmit a frame with MLPS Control subfield to its an AP affiliated with an AP MLD that has dot11MLPSOptionImpemented equal to false.

(#16312, 16334) A non-AP STA affiliated with a non-AP MLD may transmit a frame with MLPS Control subfield to an AP affiliated with an AP MLD that has dot11MLPSOptionImpemented equal to true, to change the power management mode of all or part of non-AP STA(s) affiliated with the same non-AP MLD. The bit position of the MLPS Link Bitmap subfield corresponding to the link on which the frame is transmitted shall be set to 1. The power management mode indicated by the Power Management subfield in the frame shall be adopted by the STA(s) affiliated with the non-AP MLD operating on the link(s) indicated by the MLPS Link Bitmap subfield in the frame upon the successful completion of the frame exchanged sequence.

(#16312, 16334) STA(s) affiliated with a non-AP MLD in power save mode and operate on enabled link(s) may retrieve buffered BU(s) through one of the STAs issuing a trigger frame with MLPS Control subfield. Bit positions of the MLPS Link Bitmap subfield in the trigger frame corresponding to the links on which the STAs are retrieving buffered BU(s), shall be set to 1. The bit position of the MLPS Link Bitmap subfield corresponds to the link on which the frame is transmitted shall be set to 1.

**Option B:**

***TGbe editor: Please modify the following subclause 9.2.4.1.1 in TGbe D3.1:***

* **General**

The first three subfields of the Frame Control field of a PV0 frame are Protocol Version, Type, and Subtype. The remaining subfields of the Frame Control field depend on the setting of the Type and Subtype subfields.

For a frame carried in a non-S1G PPDU, when the Type subfield is not 1 or the Subtype subfield is not 6, the remaining subfields within the Frame Control field are To DS, From DS, More Fragments, Retry, Power Management, More Data, Protected Frame / MLPS(#16312,16334), and +HTC. In this case, the format of the Frame Control field is shown in Figure 9-3 (Frame Control field format in non-S1G PPDUs when Type subfield is not equal to 1 or Subtype subfield is not equal to 6).

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0     B1 | B2   B3 | B4      B7 | B8 | B9 | B10 | B11 | B12 | B13 | B14 | B15 |
|  | Protocol  Version | Type | Subtype | To DS | From DS | More  Fragments | Retry | Power  Management | More Data | Protected Frame / MLPS | +HTC |
| Bits: | 2 | 2 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| * **Frame Control field format in non-S1G PPDUs when Type subfield is not equal to 1 or Subtype subfield is not equal to 6 (#16312,16334)** | | | | | | | | | | | |

***TGbe editor: Please modify the following subclause 9.2.4.1.9 Protected Frame subfield in TGbe D3.1:***

* **Protected Frame / (#16312,16334)MLPS subfield**

The Protected Frame subfield is set to 1 if the Frame Body field contains information that has been processed by a cryptographic encapsulation algorithm. (#16312,16334) The MLPS (multi-link power save) subfield is set to 1 in PS-Poll and QoS Null frame if sent by a STA affiliated with a non-AP MLD to indicate that the power management mode indicated in the Power Management subfield in the Frame Control field will be adopted by the STA(s) affiliated with the non-AP MLD that operate on all enabled link(s). It is set to 0 otherwise. The Protected Frame subfield is reserved in Control frames of subtype Control Frame Extension. When the Protected Frame subfield is equal to 1, the Frame Body field is protected utilizing the cryptographic encapsulation algorithm and expanded as defined in Clause 12 (Security). The Protected Frame subfield is set to 0 in Data frames of subtype Null, QoS CF-Poll, and QoS CF-Ack +CF-Poll (see, for example, 12.3.4.2 (TKIP MPDU formats) and 12.5.2.1 (General) that show that the frame body needs to be 1 octet or longer to apply the encapsulation).

***TGbe editor: Please modify the following subclause 35.3.12.1 General in TGbe D3.1:***

**35.3.12 Multi-link power management  
35.3.12.1 General**

…

***TGbe editor: Please add the following paragraph and figure at the end of subclause 35.3.12.1 General in TGbe D3.1:***

(#16312, 16334) An AP that is affiliated with an AP MLD shall set the MLPS Support subfield in the Common Info field of the Basic Multi-Link element it transmits to 1 if its dot11MLPSOptionImplemented is true; otherwise the AP shall set it to 0.

(#16312, 16334) A non-AP STA affiliated with a non-AP MLD shall not transmit a PS-Poll or Qos Null frame with MLPS subfield set to 1 to an AP affiliated with an AP MLD that has dot11MLPSOptionImpemented equal to false.

(#16312, 16334) A non-AP STA affiliated with a non-AP MLD may transmit a QoS Null frame with MLPS subfield set to 1 to an AP affiliated with an AP MLD that has dot11MLPSOptionImpemented equal to true, to change the power management mode of all the non-AP STA(s) affiliated with the same non-AP MLD. With the MLPS subfield set to 1, the power management mode indicated by the Power Management subfield in the frame shall be adopted by the STA(s) affiliated with the non-AP MLD that operates on all enabled link(s) upon the successful completion of the frame exchanged sequence.

(#16312, 16334) STA(s) affiliated with a non-AP MLD in power save mode and that operate on enabled link(s) may retrieve buffered BU(s) through one of the STAs issuing a PS-Poll or QoS Null frame with MLPS subfield set to 1.

**Common for both option A and option B:**

***TGbe editor: Please modify the following subclause 9.4.2.311.1.2 in TGbe D3.1:***

**Common Info field of the Basic Multi-Link element**

***TGbe editor: Please modify the following figure:***

B0 B3 B4 B5 B6 B7 B11 B12 B13 B14 B15

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Maximum |  | TID-To-Link | Frequency |  |  |  |
| Number Of Simultaneous Links | SRS  Support | Mapping Negotiation Support | Separation For STR/AP MLD  Type Indication | AAR  Support | MLPS Support | Reserved |

Bits: 4 1 2 5 1 1 3

**Figure 9-1002k—MLD Capabilities And Operations subfield format (#16312, 16334)**

***TGbe editor: Please modify the following table:***

**Table 9-401i—Subfields of the MLD Capabilities And Operations subfield *(contin-***

|  |  |  |
| --- | --- | --- |
| …. | …. | … |
| AAR Support | An AP MLD indicates support for receiving a frame with an AAR Con- trol subfield | If the +HTC-HE Support subfield is 1: Set to 1 if the AP MLD supports the AAR Control subfield functionality.  Set to 0 otherwise.  Reserved for non-AP MLD or if the +HTC-HE Support subfield is 0.  See 35.3.16.8.3 (AP assisted medium synchro- nization recovery procedure). |
| MLPS Support (#16312, 16334) | An AP MLD indicates support for receiveing a frame with an MLPS Control subfield and a PS-Poll or QoS Null frame with an MLPS subfield | Set to 1 if the AP MLD supports the MLPS Control subfield functionality and/or the MLPS subfield functionality.  Set to 0 otherwise.  Reserved for non-AP MLD.  See 35.3.12 (Multi-link power management). |

**Annex C**(normative)  
**ASN.1 encoding of the MAC and PHY MIB  
C.3 MIB Detail**

***TGbe editor: Please add a new MIB attribute in Annex C as shown below (tracking on):***

Dot11EHTStationConfigEntry ::=

SEQUENCE{

dot11EHTPPEThresholdsRequired TruthValue,

dot11TIDtoLinkMappingActivated TruthValue,

dot11EHTEPCSPriorityAccessActivated TruthValue,

dot11MSDTimerDuration Unsigned32,

(#16903)dot11MSDTXOPMax Unsigned32,

dot11MultiLinkActivated TruthValue,

dot11MLDAssociationSAQueryMaximumTimeout Unsigned32,

dot11EHTMCSFeedbackOptionImplemented INTEGER,

dot11EHTEMLSROptionImplemented TruthValue,

dot11EHTEMLSROptionActivated TruthValue,

dot11EHTEMLMROptionImplemented TruthValue,

dot11EHTEMLMROptionActivated TruthValue,

dot11OperationParameterUpdateImplemented TruthValue,

dot11EHTLinkReconfigurationOperationActivated TruthValue,

dot11MLPSOptionImplemented TruthValue

}

dot11MLPSOptionImplemented OBJECT-TYPE  
 SYNTAX TruthValue  
 MAX-ACCESS read-write  
 STATUS current  
 DESCRIPTION  
 "This is a capability variable.  
 Its value is determined by device capabilities. This attribute, when true, indicates that the station implementation is capable of supporting for receiveing a frame with an MLPS Control subfield and a PS-Poll or QoS Null frame with an MLPS subfield operation."

DEFVAL { false }  
::= { dot11EHTStationConfigEntry <Last assigned + 1> }

**Reference:**

[1] Minyoung Park 11-22-2045-01-00be-lb266-cr-misc-part2

[2] Xiangxin Gu 11-22-1205-04-00be-indicating-to-operate-in-EML-mode-via-PS-Poll-or-QoS-Null