IEEE P802.11
Wireless LANs

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| CC36 Resolution for CIDs related to MLO Power-save – Part 1 |
| Date: July 16, 2021 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Abhishek Patil | Qualcomm Inc |  |  | appatil@qti.qualcomm.com |
| Gaurang Naik |  |  |  |
| George Cherian |  |  |  |
| Alfred Asterjadhi |  |  |  |
| Duncan Ho |  |  |  |
| Yanjun Sun |  |  |  |
| Abdel Karim |  |  |  |
| Tomo Adachi | Toshiba |  |  |  |
| Insun | LGE |  |  |  |
| Rubayet Shafin | Samsung |  |  |  |

 Abstract

This submission proposes resolutions for following 26 CID received for TGbe CC36:

4465, 6210, 6300, 5259, 4466, 5260, 8342, 7725, 6211, 4386, 6134, 4387, 4467, 6302, 7415, 6301, 7416, 6212, 7061, 4067, 4388, 7417, 4114, 6735, 4468, 7419

**Revisions:**

* Rev 0: Initial version of the document.
* Rev 1: Updated based on feedback from various members listed as co-authors (tagged as [#1])
* Rev 2: Live edits as the doc was discussed during 7/21 TGbe MAC call.
	+ CIDs 6134, 4387 and 7061 are deferred
* Rev 3: Updated resolution for CIDs 6134, 4387 based on offline discussions.
	+ Changes with respect to r2 highlighted in green
	+ CID 7061 remains deferred

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

***Editing instructions formatted like this are intended to be copied into the TGbe 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.***

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| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 4465 | Arik Klein | 35.3.10.1 | 265.53 | Use unified terminology: STA affiliated with non-AP MLD rather than "STA of a non-AP MLD" | Revise the sentence as follows: " Each STA \*affiliated with\* a non-AP MLD that is operating on an enabled link..." | **Revised**Agree with the comment. The text was updated to align with the rest of the spec. ‘STA of a non-AP MLD’ is replaced with ‘STA affiliated with a non-AP MLD’**TGbe editor, please make change as shown in doc 11-21/1172r2 tagged 4465** |
| 6210 | Michael Montemurro | 35.3.10.1 | 265.53 | Presumably a "STA of a non-AP MLD" is a STA affiliated with a non-AP MLD. | Change "STA of a non-AP MLD" to "STA affiliated with a non-AP MLD" | **Revised**Agree with the comment. The text was updated to align with the rest of the spec. ‘STA of a non-AP MLD’ is replaced with ‘STA affiliated with a non-AP MLD’**TGbe editor, please make change as shown in doc 11-21/1172r2 tagged 4465** |
| 6300 | Ming Gan | 35.3.10.1 | 265.53 | Please change "of" to "affiliated with" | as in the comment | **Revised**Agree with the comment. The text was updated to align with the rest of the spec. ‘STA of a non-AP MLD’ is replaced with ‘STA affiliated with a non-AP MLD’**TGbe editor, please make change as shown in doc 11-21/1172r2 tagged 4465** |
| 5259 | Insun Jang | 35.3.10.1 | 265.56 | We need to add the active mode case for exchanging frames | As in the comment | **Rejected**Per baseline spec, a non-AP STA can exchange frames when it is in awake state (applies to both Power-Save mode and Active mode). Please see 11ax D8.0 P313 paragraph stating line 50. The cited sentence is sufficient and covers both power-save modes. |
| 4466 | Arik Klein | 35.3.10.1 | 265.55 | Need to clarify that the following sentence is correct when the non-AP STA is in PS mode and in awake state "Frame exchanges on an enabled link are possible when the STA of the non-AP MLD operating on that link is in the awake state" | Consider revising the sentence as follows:" Frame exchanges on an enabled link are possible when the STA of the non-AP MLD operating on that link is in the awake state \*of Power Save mode\* " | **Rejected**Per baseline spec, a non-AP STA can exchange frames when it is in awake state (applies to both Power-Save mode and Active mode). Please see 11ax D8.0 P313 paragraph stating line 50. The cited sentence is sufficient and covers both power-save modes. |
| 5260 | Insun Jang | 35.3.10.1 | 265.64 | Please specify PM = 1, e.g., the value of power management subfileld is 1 | As in the comment | **Revised**Agree in principle. The text was updated to clarify that the Power Management subfield in Frame Control field is set to 1 or 0.**TGbe editor, please make change as shown in doc 11-21/1172r2 tagged 5260** |
| 8342 | Zhiqiang Han | 35.3.10.1 | 265.65 | Change "non-AP MLD" to "the non-AP MLD" | as in comment. | **Accepted** |
| 7725 | Xiaofei Wang | 35.3.10.1 | 266.01 | "a little later" is not correct, change to "a little while later" | as in comment | **Revised**Agree in principle although used alternative terms, namely “After a period of time, …”**TGbe editor, accepted change is shown in doc 11-21/1172r2 tagged 7725** |
| 6211 | Michael Montemurro | 35.3.10.1 | 266.03 | Presumably transmitting a frame really means transmitting a trigger frame. | Change "transmitting a frame" to "transmitting a trigger frame" | **Revised**Agree in principle. The text was updated to clarify that the non-AP STA operating on a link transmits a PS-Poll or U-APSD trigger frame to indicate awake state to the corresponding AP on the link.**TGbe editor, please make change as shown in doc 11-21/1172r2 tagged 6211** |
| 4386 | Arik Klein | 35.3.10.1 | 265.60 | Please specify in the description that the Figure 35-7 illustrates the power save operation for each STA affiliated with a non-AP MLD in the UL direction during multi link operation (no DL frame are included in the illustration) | Revise the sentence as follows:" Figure 35-7 illustrates the power save operation for each STA affiliated with a non-AP MLD \*in the UL direction\* during multi-link operation" | **Revised**The illustration and the text were updated to clarify that the power-save operation affects both UL and DL (frame exchange implies both directions).**TGbe editor, please make change as shown in doc 11-21/1172r2 tagged 4386** |
| 6134 | Mark RISON | 35.3.10.1 | 266.08 | Why would STA 1 spontaneously wake up to send a PS-Poll in Figure 35-7? | Clarify | **Revised**The description text and Figure 35-10 was updated to explain that the AP affiliated with the AP MLD indicates in the Beacon frame that there is traffic for TID mapped to link 1. STA 1 wakes up to receive the Beacon frame and based on the traffic indication transmits a PS-Poll frame to inform the AP that it has transitioned to awake state so that it can receive DL frames.**TGbe editor, please make change as shown in doc 11-21/1172r3 tagged 6134** |
| 4387 | Arik Klein | 35.3.10.1 | 266.09 | Please add a caption / designation for the Power Save mode on Link 1, which includes the portions of Doze states and the portion of the Awake state. | As in comment | **Revised**The figure was updated to mark the instances when the respective non-AP STAs on each link are in Power-Save Mode. Other details were added to the figure based on offline discussions with various members.**TGbe editor, please make change as shown in doc 11-21/1172r3 tagged 4387** |
| 4467 | Arik Klein | 35.3.10.2 | 266.27 | typo - add "s" to the word "links" in the following sentence "...by monitoring Beacon frames on one or more enabled \*link\*." | As in comment | **Accepted** |
| 6302 | Ming Gan | 35.3.10.2 | 266.28 | Please change "link" to "links" | as in the comment | **Accepted** |
| 7415 | SunHee Baek | 35.3.10.2 | 266.29 | Change "one or more APs of the AP MLD" to "one or more APs affiliated with AP MLD". | As in comment. | **Accepted** |
| 6301 | Ming Gan | 35.3.10.2 | 266.29 | Please change "of" to "affiliated with" | as in the comment | **Accepted** |
| 7416 | SunHee Baek | 35.3.10.2 | 266.30 | Change "the other STA(s) of the non-AP MLD" to "the other STA(s) affiliated with non-AP MLD". | As in comment. | **Accepted** |
| 6212 | Michael Montemurro | 35.3.10.2 | 366.28 | Presumably this sentence refers to STAs and APs affiliated with an AP MLD | Change "With these mechanisms, a non-AP MLD can receive basic information about the AP MLD and one or more APs of the AP MLD on a single link while the other STA(s) of the non-AP MLD are in doze state."to"With these mechanisms, a non-AP MLD can receive basic information about the AP MLD and one or more APs affiliated with the AP MLD on a single link while the other STA(s) affiliated with the non-AP MLD are in doze state. | **Accepted** |
| 7061 | Sigurd Schelstraete | 35.3.10.3 | 266.50 | "At least one STA affiliated with a non-AP MLD may send at least one keepalive frame (...) if the non-AP MLD wants to avoid getting disassociated". Shouldn't that be "must send"? | Clarify | **Revised**Agree in principle. Normative “shall” verb is used. If a non-AP MLD intends to avoid disassociation is required to send at least one frame on one of the link it has setup with the AP MLD**TGbe editor, accepted change is shown in doc 11-21/1172r2 tagged 7061** |
| 4067 | Abhishek Patil | 35.3.10.3 | 266.59 | The frame exchanges would occur on an 'enabled link' | Replace the term 'setup link' with 'enabled link'. | **Accepted** |
| 4388 | Arik Klein | 35.3.10.3 | 266.57 | Replace the "setup link" with "enabled link", since frame exchange is allowed only on enabled links, as defined in section 35.3.6.1.1 | The revised sentence shall be: " A non-AP MLD is considered inactive if the AP MLD has not received a Data frame, PS-Poll frame, or Management frame(protected or unprotected as specified in this paragraph) of a frame exchange sequence initiated by the non-AP MLD on any \*enabled\* link for a time period greater than or equal to the time specified by the Max Idle Period subfield | **Revised****TGbe editor, please make change as shown in doc 11-21/1172r2 tagged 4067** |
| 7417 | SunHee Baek | 35.3.10.3 | 266.64 | The two conditions described by front and last "if" parts need to make one "if" part because the AP MLD may disassociate the non-AP MLD when two conditions of if sentences are satisfied. | Change to "If the Idle Options subfield allows unprotected or protected keepalive frames and no protected or unprotected frames are received from any STA affiliated with the non-AP MLD for a duration of BSS MAX Idle Period, then the AP MLD may disassociate the non-AP MLD." | **Revised**The existing text was clear enough. However, in order to remove any ambiguity (as pointed by the comment), the two sentences related to AP MLD disassociating a non-AP MLD due to inactivity were updated to clarify that the two conditions need to be satisfied together (i.e., ‘and’).**TGbe editor, please make change as shown in doc 11-21/1172r2 tagged 7417** |
| 4114 | Abhishek Patil | 35.3.10.5 | 269.12 | Merge this sentence with the first paragraph. | Add this sentence as the last sentence of the paragraph starting "An MLD that implements ..." | **Accepted** |
| 6735 | Rojan Chitrakar | 35.3.10.5 | 269.12 | Combine this with the first paragraph. | As per comment | **Accepted** |
| 4468 | Arik Klein | 35.3.10.3 | 266.63 | Use unified terminology: replace "STA of non-AP MLD" with "STA affiliated with non-AP MLD" | As in comment | **Accepted** |
| 7419 | SunHee Baek | 35.3.10.5 | 269.15 | Change "a STA of non-AP MLD" to "a STA affiliated with non-AP MLD" to match subject of the sentence. | As in comment | **Accepted** |

***TGbe editor: The baseline for this document is 11be D1.01***

* + 1. **Multi-link power management**
			1. **General**

***TGbe editor: Please update the paragraphs in this subclause as shown below:***

Each STA [4465]affiliated with a non-AP MLD that is operating on an enabled link shall maintain its own power management mode and power states as defined in 11.2 (Power management) and 10.47 (Target wake time (TWT)). Frame exchanges on an enabled link are possible when the STA affiliated with [4465] the non-AP MLD operating on that link is in the awake state (see 11.2.3 (Power management in a non-DMG infrastructure network)).

[Figure 35-10 (Each STA affiliated with a non-AP MLD maintains its own power state)](#bookmark29) illustrates the power save operation for each STA affiliated with a non-AP MLD during multi-link operation. As depicted in the figure, during the initial portion of the illustration, both STAs affiliated with the non-AP MLD are in active mode and are involved in frame exchange with the respective APs on the links[4386]. [5260]Each STA affiliated with the non-AP MLD indicates that it is in active mode by setting to 0 the Power Management subfield (namely PM bit in the figure) in the Frame Control field of a transmitted frame. At some point in time, STA 2 affiliated with the[8342] non- AP MLD operating on [#1]Link 2 indicates to AP 2 that it [#1]is entering power save mode (i.e., [5260]sets PM bit to 1) and transitions to doze state. STA 2 remains in doze state for the rest of the illustration. [7725]After a period of time, STA 1 enters power save mode (i.e., [5260]sets PM bit to 1). While operating in power-save mode, STA 1 [6134]wakes up to receive the Beacon frame transmitted by AP 1 and determines that AP MLD has BUs belonging to TID(s) mapped to Link 1. Based on this determination, STA 1 indicates to AP 1 that it has transitioned to awake state by transmitting a [6211]PS-Poll or U-APSD trigger frame [6211]on [#1]Link 1. STA 1 participates in frame exchange with AP 1 while in awake state.

***TGbe editor: Please update Figure 35-10 as shown below:***



**Figure 35-10—Each STA affiliated with a non-AP MLD maintains its own power state**[4386, 6134, 4387]

* + - 1. **Basic BSS operation**

***TGbe editor: Please update the first paragraph in this subclause as shown below:***

A non-AP MLD shall be able to perform basic operations (such as receiving a traffic indication, time synchronization, receiving BSS parameter updates) by monitoring Beacon frames on one or more enabled links[4467]. This is in addition to mechanisms such as individual TWT agreement. With these mechanisms, a non-AP MLD can receive basic information about the AP MLD and all the[#1] APs [7415]affiliated with the AP MLD on a single link while the other STA(s) [7416]affiliated with the non-AP MLD are in doze state.

* + - 1. **MLD max idle period management**

***TGbe editor: Please update the second and third paragraphs in this subclause as shown below:***

At least one STA affiliated with a non-AP MLD [7061]shall send at least one keepalive frame (such as Data frame, PS-Poll frame, or Management frame) per BSS Max Idle Period if the non-AP MLD [7061]intends to avoid getting disassociated from the AP MLD due to nonreceipt of frames. A keepalive frame shall be protected or unprotected as indicated in the Idle Options subfield.

A non-AP MLD is considered inactive if the AP MLD has not received a Data frame, PS-Poll frame, or Management frame (protected or unprotected as specified in this paragraph) or a frame exchange sequence initiated by the non-AP MLD on any [4067]enabled link for a time period greater than or equal to the time specified by the Max Idle Period subfield of the BSS Max Idle Period element.[7417] An AP MLD may disassociate a non-AP MLD if:

* the Idle Options subfield of the BSS Max Idle Period element requires protected keepalive frames and no protected frames are received from any STA affiliated with the non-AP MLD for a duration of BSS Max Idle Period.
* the Idle Options subfield allows unprotected or protected keepalive frames and no protected or unprotected frames are received from any STA affiliated with the non-AP MLD for a duration of BSS Max Idle Period.
	+ - 1. **WNM sleep mode in multi-link operation**

***TGbe editor: Please update the paragraphs in this subclause as shown below:***

An MLD that implements WNM sleep mode shall indicate its capability by setting the WNM Sleep Mode field to 1 in the Extended Capabilities element that is transmitted by its affiliated STAs. All STAs affiliated with an MLD shall advertise the same WNM Sleep Mode capability.[4114]

A STA affiliated with a non-AP MLD may transmit a WNM Sleep Mode Request frame (see 9.6.13.19 (WNM Sleep Mode Request frame format)) to an AP affiliated with an AP MLD that has indicated support for WNM sleep mode capability.

[4114]

An AP affiliated with an AP MLD shall send a WNM Sleep Mode Response frame in response to a WNM Sleep Mode Request frame received from a STA [4468]affiliated with a non-AP MLD. An AP affiliated with an AP MLD may send this frame without solicitation upon the AP MLD’s deletion of all traffic filter sets established according to the traffic filtering agreement between the AP MLD and the non-AP MLD (see 9.6.13.20 (WNM Sleep Mode Response frame format)).

The WNM sleep state is maintained at the MLD level and WNM sleep mode procedures defined in 11.2.3 (Power management in a non-DMG infrastructure network) and 11.2.3.16 (WNM sleep mode) are performed at the MLD level and apply to all the STAs affiliated with the MLD.