IEEE P802.11
Wireless LANs

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| PDT for CC36 Resolution for CID 5378  |
| Date: 2021-07-16 |
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Abstract

This submission proposes CR for CID 5386 (CC36).

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: revised according to the feedback from co-author

SP: The non-AP MLD shall configure one link with the associated AP MLD to receive group addressed data frames in R1.

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** | **Pg/Ln** | **Section** | **Comment** | **Proposed Change** | **Resolution** |
| 5378 | Jay Yang | 273/19 | 35.3.13 | 11be shall define a mechanism to address the constraint issue between two non-AP MLDs that elect different links to receive groupcast data frame and operate others into PS mode, and the similar issue between non-AP MLDs and legacy STAs.e.g.  non-AP MLD1 and non-AP MLD2 set up multiple link connection with AP MLD on link1 and link2, non-AP MLD1 elects link1 on awake state to receive groupcast data frame, let link2 enter PS mode. while non-AP MLD2 keep awake on link2 to receive groupcast data frame, and let link1 enter PS mode. The groupcast frame will be buffered on both links and cause a higher delay issue | In order to address the groupcast data frame delay issue caused by non-AP MLD ,AP MLD may not buffer the groupcast data frame on the link where the associated non-AP MLD doesn't intend to receive the groupcast data frame. | **Revised—****Agree in principle with the comment. More detailed discussion for this aspect** **And the proposal change****can be found in 11-21/1261r1.****TGbe editor please implement changes as shown in doc 11-21/1261r1 tagged as 5378.** |

## Discussion

A groupcast data frame shall be duplicated on all enabled links by AP MLD according to the passed motion meantions as below:

The followings are supported in R1:

* If a non-AP MLD intends to receive group addressed data frame, the non-AP MLD shall follow the baseline rules to receive the group address data frames on any one link that the non-AP MLD selects to receive group addressed data frames.
* A group addressed data frame that is expected to be received by the non-AP MLD shall be scheduled for transmission in all the links setup with the non-AP MLD.

[Motion 144, #SP327, [26] and [241]]

**Problems:**

**1. Delays experienced by legacy STAs due to STAs affiliated with non-AP MLD in power save mode**

In order to reduce power consumption, a non-AP MLD may keep only one of its STAs related to an enabled link in active mode e.g. to receive groupcast data frames and operate other STAs related to enabled links in power save mode. The non-AP MLD receives groupcast frames without any delays over the link corresponding to the STA in active mode as long as the AP corresponding to that link has no non-AP STAs that are in power save mode. But the other STAs affiliated with the non-AP MLD in power save mode make the corresponding APs to buffer the duplicated groupcast data frames and deliver them only after DTIM Beacon. All STAs served by these APs experience this as groupcast frame delivery delay. Such a delay is unnecessary if the buffering is due to power saving STAs of non-AP MLD which uses some other STAs in active mode to receive groupcast frames.

An example of this is shown in following figure, which illustrates a case of a non-AP MLD connected to an AP MLD over three links. A legacy STA is simultaneously associated with the AP2 responsible for link 2. Both the legacy STA and non-AP MLD subscribe to the IPTV service delivered in groupcast manner by the AP MLD (or by the AP2 from the legacy STA perspective). The non-AP MLD decides to receive the groupcast frames on the link3 and operates the corresponding STA, STA 3, in active mode. It also decides to operate the other STAs (STA1 and STA2) that relate to the other enabled links in power save mode. This means that AP1 and AP2 have to buffer the groupcast data frames and transmit them after the DTIM Beacon. The legacy STA served by the AP2 will thus receive groupcast frames related to e.g. the IPTV service with substantial delay.



Legacy STA experiencing delays in groupcast frame delivery due to a STA of non-AP MLD in power save

**2. Delays experienced by non-AP MLDs due to STAs in power save mode in other non-AP MLDs**

Similar delays may be experienced also by non-AP MLD due to incompatible power saving mode combinations of STAs of non-AP MLDs. If an AP MLD serves two or more non-AP MLDs which have independently selected the STA that they operate in active mode to receive groupcast data frames while keeping the other STAs in power save mode, one or more of the APs may have at least one STA in power save mode. These APs deliver groupcast data frames only after DTIM Beacons and corresponding active mode STAs and associated non-AP MLDs experience this as service delay.

An example of this is shown in following figure which illustrates a case of two non-AP MLDs connected to the AP MLD with the AP1 serving the STA1s, the AP2 serving the STA2s, and the AP3 serving the STA3s, correspondingly. Let’s assume that both the non-AP MLDs subscribe to the same IPTV service delivered in groupcast manner. The non-AP MLD1 decides independently to operate its STA3 in active mode to receive groupcast frames while it operates the other STAs (STA1 and STA2) in power save mode. The non-AP MLD2 on the other hand decides to operate its STA2 in active mode to receive groupcast frames while it operates the other STAs (STA1 and STA3) in power save mode. Because of this, each AP of the AP MLD serves at least one STA in power save mode and they all need to apply buffering the groupcast data frames including the IPTV service frames. Both the non-AP MLD experience this as IPTV service delay which is due to independently determined STA power management modes.



Two non-AP MLDs experiencing delays in groupcast frame delivery due to incompatible power saving combinations

Solution:

1. **non-AP MLD to indicate the groupcast data frames receving link.**

 The non-AP MLD sends the identifier of the link which the non-AP MLD uses to receive groupcast frames via the signaling carried in a unicast frame, or A-control field.( the link is called indicating link.)

Based on the above info, the AP MLD may assume that the non-AP MLD doesn’t use any of the un-indicating links to receive groupcast frames and thus it doesn’t have to buffer the groupcast data frames on those links where the corresponding STAs of the non-AP MLD in power save.

1. **an AP MLD to signal a suggestion to an associated non-AP MLD on the link which the non-AP MLD uses to receive groupcast frames**

Because AP affilicated with AP MLD knows each associated STA PS state, AP MLD may give a recommendation to an associated non-AP MLD on the link that the non-AP MLD uses to receive groupcast frames transmitted by the AP MLD based on signaling of the link on which other associated non-AP MLD intend to receive the groupcast frame or not.

***TGbe editor: Please note Baseline is 11be D1.01***

**9.2.4.6.3aHE variant**

***TGbe editor: Please revise the Table 9-22a as follows:***

**Table 9-22a—Control ID subfield values**

|  |  |  |  |
| --- | --- | --- | --- |
| **Control ID value** | **Meaning** | **Length of the Control Information subfield (bits)** | **Content of the Control Information subfield** |
| 0 | Triggered response scheduling (TRS) | 26 | See 9.2.4.6a.1 (TRS Control) |
| 1 | Operating mode (OM) | 12 | See 9.2.4.6a.2 (OM Control) |
| 2 | HE link adaptation (HLA) | 26 | See 9.2.4.6a.3 (HLA Control) |
| 3 | Buffer status report (BSR) | 26 | See 9.2.4.6a.4 (BSR Control) |
| 4 | UL power headroom (UPH) | 8 | See 9.2.4.6a.5 (UPH Control) |
| 5 | Bandwidth query report (BQR) | 10 | See 9.2.4.6a.6 (BQR Control) |
| 6 | Command and status (CAS) | 8 | See 9.2.4.6a.7 (CAS Control) |
| 7 | EHT operating mode (EHT OM) | 6 | See [9.2.4.6a.8 (EHT OM Control)](file:///C%3A%5CUsers%5Czhijiey%5CAppData%5CLocal%5CTemp%5C7zO433BEC8B%5CTGbe_Cl_09.doc#bookmark1) |
| 8 | Single response scheduling (SRS) | 10 | See [9.2.4.6a.9 (SRS Control)](file:///C%3A%5CUsers%5Czhijiey%5CAppData%5CLocal%5CTemp%5C7zO433BEC8B%5CTGbe_Cl_09.doc#bookmark4) |
| 10 | AP assistance request (AAR) | 20 | See [9.2.4.6a.10 (AAR Control)](file:///C%3A%5CUsers%5Czhijiey%5CAppData%5CLocal%5CTemp%5C7zO433BEC8B%5CTGbe_Cl_09.doc#bookmark6) |
| 11 | Goup addressed data frame receiving link indication (GCI) |  20 |  See 9.2.4.6a.x (GCI Control) |
| 9, 11–14~~7–14~~ | Reserved |  |  |
| 15 | Ones need expansion surely (ONES) | 26 | Set to all 1s |

***TGbe editor: Please add a new subclause 9.2.4.6a.x as follows:***

9.2.4.6a.x GCI Control

The Control Information subfield in a GCI Control subfield contains information of the link on which that the non-AP MLD expects to receive the group addressed data frames.

The format of the subfield is shown in Figure 9-22x (Control Information subfield format in a GCI Control subfield)

B0 B15 B16 B19

|  |  |
| --- | --- |
| Group addressed data frames indication Link Bitmap | Reserved |

 Bits: 16 4

**Figure 9-22x—Control Information subfield format in a GCI Control subfield**

If a frame carrying the GCI Control subfield is transmitted by a non-AP MLD to its associated AP MLD, the Group addressed data frames indication Link Bitmap subfield indicates the link identifiers of the STAs affililiated with the non-AP MLD that the non-AP MLD uses to receive group addressed data frames. If a frame carrying the GCI Control subfield is transmitted by an AP MLD to an associated non-AP MLD, the group addressed data frames indication Link Bitmap subfield indicates the link identifiers of the links that the AP MLD recommands to the non-AP MLD to use to receive group addressed data frames.

***TGbe editor: Please revise subclause 35.3.14.1 as follows:***

**35.3.14.1 Group addressed frame delivery**

Each AP affiliated with an AP MLD shall schedule for transmission buffered group addressed frames immediately after every DTIM beacon except that a TWT scheduling AP affiliated with that AP MLD shall schedule for transmission the buffered group addressed frames during the broadcast TWT SPs located within the beacon interval during which the DTIM Beacon frame is transmitted (see 26.8.3.2 (Rules for TWT scheduling AP)).

An AP MLD shall not buffer group addressed data frames on the links where there is no non-MLD non-AP STA associated or no non-MLD non-AP STAs operating in the PS mode, and no associated non-AP MLDs expect to receive the group addressed data frames. Otherwise, the AP MLD shall buffer group addressed data frames on the link where there is at least one non-MLD non-AP STA operating in the PS mode or/and at least one non-AP MLD that is in a PS mode expects to receive the group addressed data frames following the rule defined in (11.2.3.6 AP operation) .

Each AP affiliated with an AP MLD shall schedule:

—the transmission of the buffered group addressed Management frames independently from the transmission of buffered group addressed Management frames of other AP(s) affiliated with the same AP MLD.

 —the transmission of the buffered group addressed data frames that are expected to be received by a non-AP MLD in all the links setup with the non-AP MLD

***TGbe editor: Please revise subclause 35.3.14.2 as follows:***

**35.3.14.2 Group addressed frame reception**

A non-AP STA affiliated with a non-AP MLD shall follow the item (e) defined in 11.2.3.7 (Receive operation for STAs in PS mode) to receive the group addressed BUs sent by the AP affiliated with the associated AP MLD on the corresponding link.

If an indication of buffered group addressed frames in the TIM element about an AP in an AP MLD is received by any STA affiliated with a non-AP MLD, the STA affiliated with the non-AP MLD that is associated with the AP and that stays awake to receive group addressed BUs shall elect to receive all group addressed frames that are scheduled for delivery in that link.

A non-AP MLD shall transmit a frame with the GCI Control subfield to the associated AP MLD to indicate the link that it uses to receive group addressed data frames both after the multi-link setup and after the non-AP MLD has changed the link that it uses to receve group addressed data frames. The AP MLD shall determine whether to buffer the group addressed data frame or not on the link according to the receving link indication in GCI Control subfield carried in a frame transmitted by non-AP MLDs where the non-AP MLDs are in PS mode following the rule in 35.14.1 (Group addressed frame delivery)

In order for an AP MLD to indicate one or more candidate links which an associated non-AP MLD is recommended to use to receive groupcast data frames transmitted by the AP MLD, the AP MLD shall transmit a frame with the GCI Control subfield to the non-AP MLD.