IEEE P802.11
Wireless LANs

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| PDT for CC36 Resolution for SN indication  |
| 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.
* Rev1: Update according to the feedback from co-author
* Rev2-3: Update according to the feedback during the call and offline discussion
* Rev 4: address some editorial issue

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** |
| 5380 | Jay Yang | 274/05 | 35.3.13.2 | 11be shall define a mechanism to detect the missing issue or duplicated issue before non-AP MLD intends to switch the groupcast data frame indicated link at any time. | SN is a simple tool and is widely used to detect the duplicated issue according to 802.11 SPEC, suggest using MLD SN for groupcast data frame to address to duplicate or missing issue, which the MLD SN carried in MGMT frame can facilitate the non-AP MLD detect in advance. | **Revised—****Agree in principle with the comment. More detailed discussion for this aspect** **And the proposal change****can be found in** 11-21/1330r4**TGbe editor please implement changes as shown in doc** 11-21/1330r4**tagged as 5380** |
| 6648 | Prabodh Varshney | 274/05 | 35.3.13.2 | Define a mechanism to detect the missing issue or duplicated issue before non-AP MLD intends to switch the groupcast data frame indicated link at any time. | SN is a simple tool and is widely used to detect the duplicated issue. Suggest using MLD SN for groupcast data frame to address to duplicate or missing issue, which the MLD SN carried in MGMT frame can facilitate the non-AP MLD detect in advance. | **Revised—****Agree in principle with the comment. More detailed discussion for this aspect** **And the proposal change****can be found in** 11-21/1330r4**TGbe editor please implement changes as shown in doc** 11-21/1330r4**tagged as 5380** |

## Discussion

MLD-level sequence numbers on groupcast traffics (group addressed data frames) proposed by Qi from Apple makes it possible for a non-AP MLD to detect the duplicated groupcast traffic and identify possibly missing frames. This works all fine as long as the link it uses to receive groupcast traffic properly. The non-AP MLD may want to select another available link to receive groupcast traffic due to any reason at any time. The non-AP MLD should be able to move from one available link to another available link without missing any groupcast frames. The non-AP MLD, expecially for single radio non-AP MLD doesn’t know how far the other APs have proceeded in the sequence number space applied to the groupcast traffic and thus doesn’t know which of the other available links would be such that the non-AP MLD would not miss any groupcast frames in the transition to the new link.

In following Figure, we have the example case of three links between an AP MLD and a single radio non-AP MLD, and the non-AP MLD using originally the link1 to receive groupcast frames. At time point t1, the single radio non-AP MLD would like to start using one of the two other available links (link2, link3) to receive groupcast frames. At that point of time, it should select the link2 as the new link as that is the link which runs with the smaller SN than its current link.



If the missing frame issue is unavoidable when the single radio non-AP MLD determines to swich the receving link, the single radio non-AP MLD may elect to use the link(link2 in the following figure) where there is less group addressed data frames missing.

The single radio non-AP MLD doesn’t, however, have such knowledge available per the current features and procedures.



The multiple Radio non-AP MLD may keep the radio awake on current link and wake up another radio on the target link to determine the missing issue and duplicated issue at the DTIM interval, which may cause the power consumption increasing linearly during switching procedure.

In following Figure, we have the example case of three links between an AP MLD and a multiple radio non-AP MLD, and the non-AP MLD using originally the link1 to receive groupcast frames. At time point t1, the non-AP MLD would like to start using link2 to receive groupcast frames, the non-AP MLD has to enable two radios till the SNS is known from the next group addressed data frames on the target link at time point t2 if it intends to avoid the missing frame issue.



Solution:

1. For an AP MLD to indicate the delta sequence number space based on the SNS carried in the last group addressed data frame transmitted in current and the other available links via ML probe response frame and (Re)association response frame.
2. For a non-AP MLD to retieve the delta SNS on a batch of candidate links via ML probe request/response exchange and use that information to determine which of the other available links it could use to receive group addressed data frame frames without missing any(or with missing less) group addressed data frame frames.

Add new figure according to the comments from Abhi and other members:

Comments from Abhi:

A non-AP MLD has started receiving group addressed frames on a particular link, it shall complete receiving all group addressed frames on the same link – in other words, it shall not switch the group address reception to another link while there are pending group address transmissions going on the current link.

New discussion:

The following discussion focus on the link switch operation after receiving the last groupcast BU(more data=0) on current link, which is aligned with the baseline.

The groupcast traffic is delivered with a general data rate , like 6Mbps at 5GHz band, the length of each IPTV data frame is about 1400 bytes, because the groupcast traffic is not aggregated, AP will deliver the buffer groupcast traffic one by one.  the duration of each frame is about 1400\*8/6=1.9ms.

Let’s assume the groupcast traffic obtained from the network stack in a constant speed when the application subscribes the IPTV service.

The groupcast traffics are delivered at each DTIM interval, each link may have different DTIM interval, different data rate and different Beacon transmission time slot etc.

 The following cases depicts why we need a signaling to indicate the missing issue if the single radio MLD plans to switch to another link.

Case 1:

After receiving the groupcast BU, the non-AP MLD may still on current link(like link1) to do other operations, like receiving the unicast BU before the next DTIM, and then switches the link to Link2 at T1. Meanwhile the new obtained groupcast frames from the network stack, like SN=X in the figure that is pending and buffered in the queue of Link1, has been already delivered on Link2, that’s, the groupcast frame with SN=X is missing at this moment.



Case 2:

The last groupcast frame(labeled with SN=m) may be pending in the HW queue and defered for several milliseconds on current link due to channel competing issue, meanwhile, the AP MLD may receive new groupcast frames from the network stack, but the AP MLD can’t continue to transmit the new obtained groupcast frame(labeled with SN = m+1) after the last one where the more data flag is set to 0.   The SN=X is missing if the non-AP MLD switches to link2 after receiving the last groupcast BU on current link.



Case 3:

The AP MLD may cut off the SP of groupcast frame delivery, and schedules some low latency traffics instead, the second half of groupcast BU (black block in the following figure) will be deferred to next DTIM interval. The non-AP MLD may switch to L2 at T1, and the groupcast frame with SN=m and n are missing if all groupcast BUs has been delivered on Link2. 

Comments on the overhead issue from Abhi, Qi and other members:

As we don’t have any rule for the non-AP MLD in the proposed text, it will be more flexible and leave it to implementation for non-AP MLD to retrieve the Delta SNS information or not. E.g, the single radio non-AP MLD may retrieve the Delta SNS information if it subscribes the IPTV service, while it may not retrieve it in other senarios. We can add a note if some members still have some concern on the overhead issue.

Why we use Delta GSNS not GSNS?

If we provide the GSNS of each link, e.g. as shown in following figure,  to non-AP MLD, where there may be two different illustrations:

Delta GSNS1 = 4000 -100 =3900, **Link2 is ahead of link1**

Delta GSNS2= 100 + 4096 -4000 =196.(SN rotate issue), **Link1 is ahead of link2**



***TGbe editor: Please note Baseline is 11be D1.2***

***TGbe editor: Please revise subclause 9.4.2.295b.2 as follows:***

**9.4.2.295b.2 Basic variant Multi-Link element**

The format of the STA Control field is defined in Figure 9-788eo (STA Control field for[mat(#1906)(#1907)(#1078)(#1475)(#2981))](file:///C%3A%5CUsers%5Czhijiey%5CAppData%5CLocal%5CTemp%5C7zO8C194FB8%5CTGbe_Cl_09.doc#bookmark103).(#5380)

B0 B3 B4 B5 B6 B7 B8 B9 B10 B11B15

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Link ID | Complete Profile | MACAddress Present | Beacon Interval Present | DTIM Info Present | NSTRLink Pair Present | NSTRBitmap Size | Delta GSNS Present | Reserved |  |

Bits: 4 1 1 1 1 1 1 1 5

**Figure 9-788eo—STA Control field format(#1906)(#1907)(#1078)(#1475)(#2981)**

The DTIM Info Present subfield indicates the presence of the DTIM Info subfield in the STA Info field and is set to 1 if the DTIM Info subfield is present in the STA Info field; otherwise set to 0. (#8287)A non-AP STA sets the DTIM Info Present subfield to 0 in the transmitted (#6700)Basic Multi-Link element. An AP sets this subfield to 1 when the element carries complete profile.

(#8287)(#1078)(#1475)(#2981)If the value of the Maximum Number Of Simultaneous Links subfield in the MLD Capabilities field is greater than 0, the NSTR Link Pair Present subfield in the STA Control field indicates if at least one NSTR link pair is present in the MLD that contains the link corresponding to that STA. It is set to 1 if there is at least one such link pair; otherwise it is set to 0.

(#8288)If the Complete Profile subfield is equal to 1 and the NSTR Link Pair Present subfield is equal to 1 in the STA Control field, then the STA Info field contains an NSTR Indication Bitmap subfield whose size is indicated in the NSTR Bitmap Size subfield; otherwise, the NSTR Indication Bitmap subfield is not pres-ent in the STA Info field. The NSTR Bitmap Size subfield in the STA Control field is set to 1 if the length of the corresponding NSTR Indication Bitmap subfield is 2 octets and is set to 0 if the length of the correspond-ing NSTR Indication Bitmap subfield is 1 octet. The NSTR Bitmap Size subfield in the STA Control field is reserved if the NSTR Link Pair Present subfield in that field is 0.

The Delta GSNS subfield indicates the presence of the Delta GSNS Info subfield in the STA Info field and is set to 1 if the Delta GSNS is present in the STA Info field; otherwise set to 0. A non-AP STA sets the Delta GSNS subfield to 0 in transmitted Basic variant Multi-Link element. An AP sets this sub­field to 1 when the element carries complete profile.(#5380)

(#8288)(#6366)The format of the STA Info field is defined in Figure 9-788ep (STA Info field for-mat(#5044)(#6366)).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| STA Info Length | STA MAC Address | Beacon Interval | DTIM Info | NSTR Indication Bitmap | Delta GSNS |

Octets: 1 0 or 6 0 or 2 0 or 2 0 or 1 or 2 0 or 2

**Figure 9-788ep—STA Info field format(#5044)(#6366)**

Each bit B*j* in the NSTR Indication Bitmap subfield included in the Per-STA Profile subele-ment with Link ID subfield equals to *i* (where ) is set to 1 if the link pair corresponding to Link IDs equal to <*i*, *j>* is NSTR and the (#6700)Basic Multi-Link element contains a Per-STA Profile subele-ment with Link ID value equals to *j*; otherwise it is set to 0. Bit B*i* in the NSTR Indication Bitmap subfield included in the Per-STA Profile subelement with Link ID subfield value equals to *i* is reserved.

The Delta GSNS subfieldis defined in Figure 9-xxx.

|  |  |
| --- | --- |
| Delta SNS | Reserved |

 Bits: 12 4 **Figure 9-xxxx—** **Delta GSNS** **subfield format**

The computation of delta GSNS between the reporting AP(on L1) and reported AP(on L2) within same AP MLD is shown in following Equation

Where,

 is the delta GSNS between L2 and L1, can be a negative or positive value, is set to 0x100 if indicating an unavaible value.

 is the latest SNS of group addressed data frame of reporting AP on L1.

 is the latest SNS of group addressed data frame of reported AP on L2. (#5380)

(#4735)The contents of the STA Profile field are defined in 35.3.2.2 (Advertisement of complete or partial per-link information(#1859)).