IEEE P802.11  
Wireless LANs

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| Spatial reuse | | | | |
| Date: 2021-10-25 | | | | |
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**PART 1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Resolution** |
| 7437 | 9.4.2.170.2 | 0.00 | The introduction of TBTT Information Length value 10 is not usable, since per 11.49 an (HE) STA that sees this value (which is <=13) will ignore this Neighbor AP Information field and so will not discover the AP. | Remove, or clarify how this value is to be used | Revised – agree with the commenter. That value can be re-included later if we find a need for it. Remove that value in table 9-281. Apply the changes marked as #7437 in this document. |
| 7438 | 9.4.2.170.2 | 0.00 | MLD Parameters subfield seems to have very little value and will lead to back-compatibility issues, beacon bloat and implementation complexity. The STA will anyway discover other colocated APs advertised using existing RNR mechanism and will establish their relationshp to the same MLD as it does so | Remove the subfield and related definitions, and/or ensure that all STAs (including HE STAs) will understand the same RNR info (without repeating/duplicating info for the same link/BSS) | Reject – RNR is backward compatible. RNR has been chosen as the most appropriate and efficient container for basic discovery. |
| 5594 | 9.4.2.22 | 120.06 | The removed text eliminated the description of what the Quiet Element attempts to accomplish. While the original desription is no longer valid, it would be clearer to include a description. | Replace with "The Quiet element defines an interval during which certain STAs are prohibited from using the channel. This interval might be used ..." | Revised – agree with the commenter. Apply the changes marked as #5594 in this document. |
| 6229 | 9.4.2.22 | 120.06 | the new added change is not correct, changing the intention of quiet interval, should keep "an interval during which no transmission occurs in the current channel" or "an interval during which no transmission from the same BSS occurs in the current channel" | as in the comment | Revised – the situation is now that in some cases, the quiet element leads to no transmission for some of the STAs. Proposed resolution in CID5594 suggestion seems to be accurate. Apply the changes marked as #6229 in this document. |
| 5321 | 9.4.2.36 | 120.30 | The Neighbor Report element includes only the P20 channel number of the reported AP. If the Neighbor Report reports an AP MLD, the affiliated APs primary channels are not possible to signal, because they are typically included to Reduced Neighbor Report (RNR) and RNR is not allowed to add to the Neighbor Report. | Please add the Primary channel information for APs affiliated with the candidate AP MLD to the Neighbor Report,. | Reject – the logic that has been followed so far on this topic is that if the transmitter wants to include in its frame a description of more than one AP of an AP MLD, it will include a Neighbor Report for each of these APs and include for each of them the ML element. |
| 5323 | 9.4.2.36 | 120.30 | The Neighbor Report element does not provide good tools to assist on candidate AP scanning. The candidate AP may transmit beacons/discovery frames in multiple ways: 1.Higher MCSs 2. non-HT Duplicate PPDUs in 6 GHz with larger BW; 3. ER SU format The scanning STA should have information to select the scanning mode for the candidate AP MLD / AP. | Please add information to assist on scanning of the candidate APs / affilaited APs of the AP MLDs. For instance, the transmitted Beacon and other discovery frames type should be included to the Neighbor Report information. |  |
| 5325 | 9.4.2.170 | 123.21 | The RNR element should signal whether AP sends beacon in non-HT PPDU format. This helps STA to optimize scanning of the AP and helps to determine whether AP optimizes its range. | Please add a bit to signal whether AP sends Beacons on non-HT PPDU or Non-HT Duplicate PPDU. |  |
| 5326 | 9.4.2.170 | 123.21 | It may be good to clarify whether AP receives PPDUs on any supported format from non-associated STAs. This may help the scannig STA to select PPDU type and TX BW to ensure correct delivery of the frames to the AP. | Please add a bit to the RNR to signal whether the reported AP receives frames from non-associated STAs on any PPDU format it supports. |  |
| 5327 | 9.4.2.170 | 123.21 | Low Power Indoor (LPI) AP in the 6 GHz band may transmit Beacons on larger than 20 MHz BW. To maximize the range from which the scanning STA is able to receive these Beacon frames, the scanning STA should have out-of-band infromation to use wider than 20MHz RX BW. | Please add a bit to the RNR to signal whether the reported AP transmits Beacons on wider than 20 MHz BW. |  |
| 4259 | 9.4.2.170.2 | 123.51 | This TBTT Information Set field carries much more informaiton now. Should we call it something else? | As in comment. | Reject – it was already the case since a long time now. Best practice is probably to not change names. |
| 6010 | 9.4.2.170.2 | 124.05 | The changes in Table 9-281 are not in line with the RNR in subclause 35 where the RNR for MLD is always 16 byte long. Fix the issue. | As in comment | Revised – agree with the commenter. Remove Length 10 so that the only option is value 16. Apply the changes marked as #6010 in this document. |
| 4258 | 9.4.2.170.2 | 124.06 | Not certain if the underlining worked well in this table. Please double check. | As in comment. | Revised – apply the changes marked as #4258 in this document |
| 6231 | 9.4.2.170.2 | 124.16 | Is the TBTT Information Length subfield of 4 needed? Based on the subclause AP MLD discovery, it always carries Neighbor AP TBTT Offset subfield, the BSSID subfield, the Short-SSID subfield, the BSS Parameters subfield and the 20 MHz PSD subfield. | as in the comment | Revised – agree with the commenter. Those were asked to be added last time, but without any usage for it so far. We can always re-include them later if a clear use case is identified. Remove value 4 from the table. Apply the changes marked as #6231 in this document. |
| 7806 | 9.4.2.170.2 | 124.16 | MLD Parameters subfield contains the Link ID subfield which is a representation of the tuple consisting of Operating Class, Operating Channel and BSSID of the AP affiliated with the AP MLD. But for TBTT Information Length subfield value as 4, the BSSID subfield is absent and therefore, Link ID for this AP can not be identified. | Delete the case TBTT Information Length subfield value as 4. | Revised – agree with the commenter. Apply the changes marked as #7806 in this document. |
| 6232 | 9.4.2.170.2 | 124.31 | Is the TBTT Information Length subfield of 10 needed? Based on the subclause AP MLD discovery, it always carries Neighbor AP TBTT Offset subfield, the BSSID subfield, the Short-SSID subfield, the BSS Parameters subfield and the 20 MHz PSD subfield. | as in the comment | Revised – agree with the commenter. Apply the changes marked as #6232 in this document |
| 6970 | 9.4.2.170.2 | 125.05 | The Neighbor AP TBTT offset subfield does not indicate the correct TBTT offset when the TBTT offset of the corresponding AP exceeds 254 TUs.  So, if TBTT offset of AP2 is exceed 254 TUs, a STA MLD that receives RNR element transmitted by AP1 unable to figure out actuall TBTT of Link2.  In other words, there may be a situation where the STA MLD that has performed multi-link setup through Link1 (with AP1) does not know the TBTT of Link2 (AP2) even if setup procedure on Link2 was completed. | In order to prevent a case where the TBTT information of the link that has been setup is not known, the TBTT information field should provide more accurate TBTT offset information for the APs affiliated with same MLD. | Revised – agree with the commenter. Define a rule so that the TBTT offset is never larger than 254 TUs between APs of the same AP MLD. Apply the changes marked as #6970 in this document. |
| 7700 | 9.4.2.170.2 | 125.32 | The sentence "If the reported AP is affiliated to the same MLD as a nontransmitted BSSID that is in the same multiple BSSID set as the reporting AP, the MLD ID subfield is set to the same value as in the BSSID Index field in the Multiple BSSID-Index element in the nontransmitted BSSID profile corresponding to the nontransmitted BSSID." is confusing since it the report AP is affiliated with teh same MLD, the case is already covered by the sentence before. Either change the sentence before, or change this sentence. | as in comment | Reject – first sentence covers the case where the AP is affiliated to AP MLD with transmitted BSSID or AP not part of MBSSID set. Second sentence covers the case where the AP is affiliated to AP MLD with nontransmitted BSSID. |
| 8275 | 9.4.2.170.2 | 125.32 | The sentence conflicts with the next one. This sentence describes a general solution and there is only one condition: the reported AP is affiliated to the same MLD as the reporting AP. But the next sentence adds another condition(Multiple BSSID set). | Please make sure the MLD assignment is unique and two cases are not overlapped. | Revised – the term reporting AP is clarifying things here. But add clarification that the reporting AP is sending the frame. Apply the changes marked as #8275 in this document |
| 5122 | 9.4.2.170.2 | 125.35 | The maximum value of the BSSID index is 255, but the MLD ID subfield is set to 255 for different purposes. So when an MLD receives the MLD ID of 255, it is difficult to determine whether the reported AP is in the same multiple BSSID set as the reporting AP. | Add desription that MLD ID of 255 does not mean the BSSID index. | Revised – add a NOTE to make that clarification. Apply the changes marked as #5122 in this document. |
| 8163 | 9.4.2.170.2 | 125.36 | "If the reported AP is part of another AP MLD, the MLD ID subfield is set to a value higher than 0 and lower than 255 if no Multiple BSSID element is carried in the same frame or a value higher than and lower than 255 if a Multiple BSSID element is carried in the same frame, where n is the value contained in the MaxBSSID Indicator field in the Multiple BSSID element." Lack of a sentence to clarify that if two reported APs that are part of same another AP MLD, the MLD ID subfield for these two reported AP shall set to same value. | provide a description for clarification | Revised – this clarification is needed only for this condition, as it’s clear already for the other cases. Clarify this uniqueness in this sentence. Apply the changes marked as #8163 in this document. |
| 8276 | 9.4.2.170.2 | 125.36 | The MlD ID value is not unique in this paragraph, how to use the MLD ID. | Please clarify it in some subclause. | Revised – make the clarification as suggested in resolution to CID 8163. Apply the changes marked as #8276 in this document |
| 5123 | 9.4.2.170.2 | 125.38 | When the MaxBSSID Indicator field is set to 8, there is no way to set MLD ID for the reported AP that is part of another AP MLD. Similarly, when the MaxBSSID Indicator field is large and there are many reported APs, there is no space for MLD ID of the reported AP that is part of another AP MLD. | The MLD ID can be 255 for that case. | Revised – same issue identified in CID8164. Apply the suggestion to not use BSSID Index value 255 for an AP affiliated to an AP MLD. Apply the changes marked as #5123 in this document. |
| 8164 | 9.4.2.170.2 | 125.41 | since 255 is used for a reported AP that is not part of an AP MLD, 255 shall not be used for BSSID Index for EHT AP anymore. | as in comment | Revised – agree with the commenter. Apply the changes marked as #8164 in this document |
| 8277 | 9.4.2.170.2 | 125.43 | In which case, the reporting AP does not have this information? Please clarify it | as in comment. | Reject – this wording is used in baseline to refer to when the reporting AP does not know how to populate that field. |
| 4099 | 9.4.2.170.2 | 125.46 | "is given uniquely" doesn't capture the intention | Replace "... is given uniquely ..." with "...is assigned such that it unique ..." | Revised – agree with the commenter. Apply the changes marked as #4099 in this document |
| 6233 | 9.4.2.170.2 | 125.52 | Change "to" to "with" | as in the comment | Revised – agree with the commenter and extend the fixes to the entire subclause. Apply the changes marked as #6233 in this document. |
| 4260 | 9.4.2.170.2 | 125.53 | What is the maximum number of links that can be had? If 16 then how do you report the one that has link ID 15? | As in comment. | Reject – Max is 15. |
| 5368 | 9.4.2.170.2 | 126.25 | basic rule related to Link ID shall be defined. | as the comments. | Reject – unclear what the commenter asks. Some rules are defined here and also in 35.3.4.4 |

1. **PART 1 Proposed spec text**

**9.4.2.22 Quiet element**

***Change the first paragraph as follows:***

(#5594, #6229)(#2215)The Quiet element defines an interval during which certain STAs are prohibited from using the channel. ~~during which no transmission occurs in the current channel.~~ ~~This interval~~ This interval might be used to assist in making channel measurements without interference from other STAs in the BSS, or to protect channel access at the start of restricted TWT service periods (see 35.7.4.2 (Quieting STAs during restricted TWT service periods(#2215))). The format of the Quiet element is shown in Figure 9-284 (Quiet element format).

***Change the third paragraph as follows:***

(#2132)(#2166)~~The~~For a non-EHT AP, the Quiet Count field is set to the number of TBTTs until the beacon interval during which the next quiet interval starts. The value of 0 is reserved. For an EHT AP:

* the Quiet Count field is equal to the number of TBTTs until the beacon interval during which the next quiet interval starts if the field is set to a value lower than or equal to 127.
* the Quiet Count field minus 127 is equal to the number of TBTTs in the past to reach the beacon interval during which the ongoing quiet interval started if the field is set to a value higher than 127.

(#2132)(#2166)NOTE—An EHT AP must not advertise the quiet count value greater than 127. A quiet count value greater than 127 is possible when the Quiet element is carried in the per-STA profile of Basic variant Multi-Link ele- ment.

***TGbe editor: Modify subclause 9.4.2.170 Reduced Neighbor Report element as shown below:***

**9.4.2.170 Reduced Neighbor Report element** **9.4.2.170.2 Neighbor AP Information field**

***Change the sixth paragraph and*** [***Table 9-281 (TBTT Information field con-***](#bookmark89)[***tents(#1205)(#1728)(#2567))***](#bookmark89) ***as follows:***

The TBTT Information Length subfield is 1 octet in length and indicates the length of each TBTT Information field included in the TBTT Information Set field of the Neighbor AP Information field. If the TBTT Information Field Type subfield is 0, the TBTT Information Length subfield:

— contains the length in octets of each TBTT Information field that is included in the TBTT Informa- tion Set field of the Neighbor AP Information field

— (#1015)(#1124)(#2567)is set to 1, 2, 5, 6, 7, 8, 9, 11, ~~or~~ 12, 13, or 16; other values are reserved. (#7437, #6010, #6231, #7806, #6232)

indicates the TBTT Information field contents as shown in [Table 9-281 (TBTT Information field con-](#bookmark89) [tents(#1205)(#1728)(#2567))](#bookmark89).

**Table 9-281—TBTT Information field contents(#1205)(#1728)(#2567)**

|  |  |
| --- | --- |
| **TBTT Information Length subfield value** | **TBTT Information field contents** |
| 1 | The Neighbor AP TBTT Offset subfield |
| 2 | The Neighbor AP TBTT Offset subfield and the BSS Parameters subfield |
|  | (#6010, #6231, #7806) |
| 5 | The Neighbor AP TBTT Offset subfield and the Short SSID subfield |
| 6 | The Neighbor AP TBTT Offset subfield, the Short-SSID sub- field, and the BSS Parameters subfield |
| 7 | The Neighbor AP TBTT Offset subfield and the BSSID subfield |
| 8 | The Neighbor AP TBTT Offset subfield, the BSSID subfield, and the BSS Parameters subfield |

**Table 9-281—TBTT Information field contents(#1205)(#1728)(#2567)**

|  |  |
| --- | --- |
| **TBTT Information Length subfield value** | **TBTT Information field contents** |
| 9 | The Neighbor AP TBTT Offset subfield, the BSSID subfield, the BSS Parameters subfield, and the 20 MHz PSD subfield |
|  | (#7437, #6010, #4258, #6232) |
| 11 | The Neighbor AP TBTT Offset subfield, the BSSID subfield and the Short SSID subfield |
| 12 | The Neighbor AP TBTT Offset subfield, the BSSID subfield, the Short-SSID subfield and the BSS Parameters subfield |
| 0, 3, 4, ~~10,~~, 10, 14, 15 | Reserved(#7437,#6010) |
| 13 | The Neighbor AP TBTT Offset subfield, the BSSID subfield, the Short-SSID subfield, the BSS Parameters subfield and the  20 MHz PSD subfield |
| 16 | The Neighbor AP TBTT Offset subfield, the BSSID subfield, the Short-SSID subfield, the BSS Parameters subfield, the 20 MHz PSD subfield and the MLD Parameters subfield |
| 17~~4~~–255 | The first 16~~3~~ octets of the field contain the Neighbor AP TBTT Offset subfield, the BSSID subfield, the Short-SSID subfield the BSS Parameters subfield, ~~and~~ the 20 MHz PSD subfield and the MLD Parameters subfield (i.e., same contents as when the length of the TBTT Information field is 16~~3~~). The remaining octets are reserved |

***Change*** [***Figure 9-632 (TBTT Information field for-***](#bookmark90)[***mat(#1901)(#1902)(#2566)(#2969)(#1016)(#1017)(#1205)(#1125))***](#bookmark90) ***as follows:***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Neighbor AP TBTT Offset | BSSID  (optional) | Short SSID (optional) | BSS parame- ters | 20 MHz PSD | MLD Parame- ters |
| Octets: | 1 | 0 or 6 | 0 or 4 | 0 or 1 | 0 or 1 | 0 or 3 |

**Figure 9-632—TBTT Information field for- mat(#1901)(#1902)(#2566)(#2969)(#1016)(#1017)(#1205)(#1125)**

***Insert the following at the end of this subclause:***

The format of the MLD Parameters subfield is defined in [Figure 9-632b (MLD Parameters subfield for-](#bookmark91) [mat(#1068)((#1901)(#1902)(#1016)(#1017)(#1903))](#bookmark91).

B0 B7 B8 B11 B12 B19 B20 B23

|  |  |  |  |
| --- | --- | --- | --- |
| MLD ID | Link ID | BSS Parameters Change Count | Reserved |

Bits: 8 4 8 4

**Figure 9-632b—MLD Parameters subfield for- mat(#1068)((#1901)(#1902)(#1016)(#1017)(#1903)**

The MLD ID subfield indicates the identifier of the AP MLD with (#6233) which the reported AP is affiliated. If the reported AP is affiliated with (#6233)the same MLD as the reporting AP sending the frame (#8275), the MLD ID subfield is set to 0. If the reported AP is affiliated with (#6233)the same MLD as a nontransmitted BSSID that is in the same multiple BSSID set as the reporting AP, the MLD ID subfield is set to the same value as in the BSSID Index field in the Multiple BSSID-Index element in the nontransmitted BSSID profile corresponding to the nontransmitted BSSID. If the reported AP is affiliated with (#6233) another AP MLD, the MLD ID subfield is set to a value that is unique for this AP MLD in frames sent by the reporting AP and that is (#8163, #8276) higher than 0 and lower than 255 if no Multiple BSSID element is carried in the same frame or a value higher than 2*n* – 1 and lower than 255 if a Multiple BSSID element is carried in the same frame, where *n* is the value contained in the MaxBSSID Indicator field in the Multiple BSSID element(#2972)(#3361)(#1041)(#1923)(#1973). The MLD ID subfield is set to 255 if the reported AP is not part of an AP MLD, or if the reporting AP does not have that information(#2156).

(#3014)NOTE 1—The MLD ID is used to identify the list of reported APs affiliated with (#6233) the same AP MLD, especially when APs from multiple AP MLDs are reported, and is assigned such that it is unique to an AP MLD only in the frames which carries the Reduced Neighbor Report element describing reported APs affiliated with (#6233) the AP MLD. Following the rules to set the MLD ID field, another AP may use a different MLD ID for the same AP MLD.

NOTE 2—An MLD ID subfield set to 255 does not mean that the reported AP has BSSID Index set to 255. (#5122)

(#1019)(#1775)(#2157)(#2568)(#2974)(#3015)(#3259)(#3362)(#2976)The Link ID subfield indicates the

link identifier of the reported AP within the AP MLD with (#6233) which the reported AP is affiliated. The Link ID subfield is set to 15 if the reported AP is not part of an AP MLD, or if the reporting AP does not have that information.

NOTE 2—The link identifier is unique to an AP within an AP MLD.

(#1068)The BSS Parameters Change Count subfield is an unsigned integer, initialized to 0, that increments when a critical update to the Beacon frame of the reported AP occurs. The critical updates are defined in

11.2.3.15 (TIM Broadcast). The BSS Parameters Change Count subfield is set to 255(#2156) if the reported AP is not part of an AP MLD, or if the reporting AP does not have that information.

***TGbe editor: Modify subclause 35.3.4 Discovery of an AP MLD as shown below:***

35.3.4 Discovery of an AP MLD

35.3.4.1 AP behavior

[…]

If an AP affiliated with an MLD is reported in a Reduced Neighbor Report element with the MLD Parameters subfield present in the TBTT Information field for that AP, the MLD ID, the link ID, and the BSS Parameters Change Count subfields shall be set as described in 9.4.2.170.2 (Neighbor AP Information field). If an AP is affiliated with an AP MLD, it shall not have a BSSID Index set to 255. (#8164)

**35.3.4.1 AP behavior**

***TGbe editor: Add the following sentence at the end of subclause 35.3.4.1 AP behavior: (#6970)***

The TBTT offset between two APs affiliated with the same AP MLD shall never be larger than 254 TUs.

**PART 2**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Resolution** |
| 5322 | 9.4.2.36 | 120.30 | The Neighbor Report element does not provide signaling details how to recommend BSS transition to a candidate AP MLD. For instance, each affiliated AP in the AP MLD may be recommended each affiliated AP separtely. The outcome may be larger Neighbor element sizes, missing information of some affiliated APs and more challenging element parsing. | Please add details how AP MLD is is included to the candidate AP list. It seems to make sense to report a candidate AP MLD is reported only one-time in the Neighbor Report and provide sufficient details for the affiliated APs. | Revised – agree with the commenter. We need to adapt the BSS Transition Management protocol to MLO. Propose to keep the design simple. Apply the changes marked as #5322 in this document |

1. **PART 2 Proposed spec text**

***TGbe editor: Create new subclause 35.3.X BSS transition management for MLDs as shown below:***

**35.3.X BSS transition management for MLDs**

A STA affiliated with an MLD shall have dot11BSSTransitionActivated equal to true.

A STA affiliated with an MLD shall follow the procedure define in 11.21.7 (BSS transition management for network load balancing), except that:

* if the Neighbor Report element of an AP includes a Multi-link element in the BSS Transition Candidate List Entries field of a BSS Transition Management Query/Request or Response frame, it describes the preference for a target AP MLD candidate and not for a target BSS candidate.
* The Preference field value of a Neighbor Report element that includes a Multi-link element describing an AP MLD provides the indication of preference for the given AP MLD, within the given list at the given time.
* If an MLD intends to provide preference for APs affiliated with the same reported AP MLD, it shall include in the Multi-link element in the Neighbor Report element of at least one affiliated reported AP that is a recommended AP:
  + a LinkID Info field in the Common Info field
  + and a Per-STA profile only for each of the recommended affiliated APs, and with all the fields set to 0 in the STA Control field, except the Link ID field.
* When an AP affiliated with an AP MLD transmits a BSS Transition Management Request frame with the Disassociation Imminent field set to 1, the Disassociation Timer field in the BSS Transition Management Request frame shall be set to 0 or set to the number of TBTTs that will occur prior to the AP MLD disassociating the non-AP MLD.

NOTE – An AP MLD can use this protocol to recommend a non-AP MLD to do MLD re-association with the same AP MLD with a different set of setup links.