IEEE P802.11
Wireless LANs

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| --- |
| Resolution to CID related to DMG Link Margin element |
| Date: 2018 January 14 |
| Author(s): |
| Name | Company | Address | Phone | email |
| Alecsander Eitan | Qualcomm |  |  | eitana@qti.qualcomm.com |
| Solomon Trainin | Qualcomm |  |  | strainin@qti.qualcomm.com |
| Assaf Kasher | Qualcomm |  |  | akasher@qti.qualcomm.com |
| Payam Torab | Facebook |  |  | ptorab@fb.com |
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Abstract

This submission proposes resolution to CID 3043, 3044, 3045, 3046, 3047, 3048, 3049, 3050, 3000, 3042, 3075, 3587 and 3591.

The resolutions are in reference to Draft IEEE P802.11ay/D2.2 and IEEE 802.11REVmd\_D2.0.

Also, changes in document 18/1786 (editorial fixes to start several indices in the DMG Link Margin element from 1 instead of 0), is assumed to have been incorporated.

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| --- | --- | --- | --- |
| CID | Clause | Comment | Proposed change |
| 3043 | 9.4.2.142.4 | Averaging method for RCPI (in DMG Link Margin element) | Add text to specify how the averaging is performed and that only PPDUs with MCS>0 are counted. |

**Proposed resolution 3043:** Revised.

**Discussion:**

PPDUs used for RCPI measurement and averaging method must be specified for interoperability. PPDUs used for measurement over an interval are those that are not transmitted using control mode, and intended for the STA, i.e., MAC-level decoding is required. Averaging of the RCPI measured values performed in linear power units.

***TGay Editor: Revise Sections “9.4.2.142.4 Parameters Across RX Chains field” and “29.3.9.2 Received channel power indicator (RCPI) measurement” as following.***

**9.4.2.142.4 Parameters Across RX Chains field**

The Parameters Across RX Chains field is defined in Figure 34. It is present in the DMG Link Margin element when the Number of RX Chains Reported (NRX) within the Rate Adaptatuin Control field is nonzero.

|  |  |  |  |
| --- | --- | --- | --- |
|  | RCPI1 | … | RCPINRX |
| Octets: | 1 |  | 1 |

**Figure 34 —Parameters Across RX Chains field format**

The RCPI*i* subfield, 1 ≤ *i* ≤ *NRX*, where *NRX* is the value of the Number of RX Chains Reported subfield within the Rate Adaptation Control field, contains the RCPI ~~for each RF chain. The RCPI calculation is 6 defined in 29.3.9.2.~~ (see 20.3.10 and 29.3.9.2) for the ith RF chain averaged across all PPDUs received within a measurement interval that are intended for the receiver, and are transmitted using an MCS other than MCS 0 or EDMG MCS 0. The value of the subfield is found by computing the arithmetic mean of RF power measurements in mW, converting the result to dBm, and encoding the dBm value as defined in 9.4.2.37.

**29.3.9.2 Received channel power indicator (RCPI) measurement**

…

The RCPI for each RF chain shall be equal to the received RF power at that RF chain with an accuracy of ± 5 dB with 95% confidence interval within the specified dynamic range of the receiver. …

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| CID | Clause | Comment | Proposed change |
| 3044 | 9.4.2.142.5 | Averaging method for SNR (in DMG Link Margin element) | Add text to specify how the averaging is performed and that only PPDUs with MCS>0 are counted. |

**Proposed resolution 3044:** Revised.

**Discussion:**

PPDUs used for SNR measurement and averaging method across PPDUs must be specified for interoperability. PPDUs used for measurement over an interval are those that are not transmitted using control mode, and intended for the STA, i.e., MAC-level decoding is required.Averaging of the SNR measured values should be performed in linear power units.

***TGay Editor: Revise the second paragraph in Section 9.4.2.142.5 as following.***

The SNR Per STSi subfield, 1 ≤ *i* ≤ *NSTS*, where *NSTS* is the value of the Number of Space-Time Streams Reported subfield within the Rate Adaptation Control field, contains the SNR of space-time stream *i*~~. The SNR subfield levels are unsigned integers referenced to a level of –8 dB. Each step is 0.25 dB. SNR values less than or equal to –8 dB are represented as 0. SNR values greater than or equal to 55.75 dB are represented as 255.~~ averaged across all PPDUs received within a measurement interval that are intended for the receiver, and are transmitted using an MCS other than MCS 0 or EDMG MCS 0. The value of the subfield is found by computing the arithmetic mean of PPDU signal-to-noise ratios with signal and noise power in mW, converting the result to decibles, and encoding the dB value in the same way as the SNR subfield in the Channel Measurement Feedback element (9.4.2.136).

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| --- | --- | --- | --- |
| CID | Clause | Comment | Proposed change |
| 3045 | 9.4.2.142.1 | Field "Link Margin" in "DMG Link Margin element" is not defined well. | The "Link Margin" field cannot support any MIMO and it should be backward compatible with DMG. Hence it is suggested to set it to value -128 when the field "Indication for Parameters Across PPDUs" is 1. |
| 3046 | 9.4.2.142.1 | Field "MCS" in "DMG Link Margin element" is not defined well. | The "MCS" field cannot support any MIMO and it should be backward compatible with DMG. Hence it is suggested to set it to value 255 when the field "Indication for Parameters Across PPDUs" is 1.AND add text to section "9.4.2.142.1 General" which indicates that value 255 is an NA value |
| 3047 | 9.4.2.142.1 | Field "SNR" in "DMG Link Margin element" is not defined well. | The "SNR" field cannot support any MIMO and it should be backward compatible with DMG. Hence it is suggested to set it to value 0 when the field "Indication for Parameters Across PPDUs" is 1. |
|  |  |  |  |

**Proposed resolution 3045-3047:** Revised.

**Discussion:**

All 3 fields – Link Margin, MCS and SNR - are meant to be reserved when multiple space-time streams are reported in the DMG Link Margin element, and this is stated in Draft 2.1 P099L13-16,

The Number of Space-Time Streams Reported (NSTS) subfield indicates the number of space-time streams being reported. Each entry, i, corresponds to a space-time stream. If the value of this field is greater than 0, the MCS, Link Margin and SNR fields in the DMG Link Margin element are reserved. For a non-EDMG STA, this field is set to 1.

Few errors are resolved here,

* Link Margin, SNR and MCS fields are reserved when NSTS >1 (not 0), and a better place in the text to state this is where each field is defined
* Link Margin, SNR and MCS fields being reserved does not depend on the Number of RX Chains Reported (NRX), but only on NSTS, i.e., these fields are meaningful with NRX > 0 as long as NSTS = 1

Also, the NTX subfield within the Rate Adaptation Control field of the DMG Link Margin element is unused and is removed as part of the edits.

***TGay Editor: Revise Section “9.4.2.142 DMG Link Margin element as following.***

**9.4.2.142 DMG Link Margin element**

**9.4.2.142.1 General**

…

The MCS field is set to an integer representation of the MCS that the STA sending this element recommends that the peer STA indicated in the RA field of the Link Measurement Report frame use to transmit frames to this STA. The reference PER for selection of the MCS is 10-2 for an MPDU length of 4096 octets. The method by which the sending STA determines a suitable MCS for the peer STA is implementation specific. Values 0-12 and values 25-31 indicate MCS 0 to MCS 12 and MCS 25 to MCS 31, respectively. The MCS field is reserved when the value of the Number of Space-Time Streams Reported (NSTS) subfield within the Rate Adaptation Control field (9.4.2.142.3) is greater than 1.

The Link Margin field contains the measured link margin of Data frames received from the peer STA indicated in the RA field of the Link Measurement Report frame and is coded as a 2s complement signed integer in units of decibels. A value of –128 indicates that no link margin is provided. The method used to measure the link margin is beyond the scope of this standard. The Link Margin field is reserved when the value of the Number of Space-Time Streams Reported (NSTS) subfield within the Rate Adaptation Control field (9.4.2.142.3) is greater than 1.

The SNR field indicates the SNR measured during the reception of a PPDU. Values are from –13 dB

to 50.75 dB in 0.25 dB steps. The SNR field is reserved when the value of the Number of Space-Time Streams Reported (NSTS) subfield within the Rate Adaptation Control field (9.4.2.142.3) is greater than 1.

**9.4.2.142.3 Rate Adaptation Control/EDMG TPC field**

The Rate Adaptation Control/EDMG TPC field format is defined in Figure 31.

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| --- | --- | --- | --- | --- | --- |
|  | B0 ~~B2~~ B3 | ~~B3 B5~~ | ~~B6 B8~~ B4 B7 | ~~B9~~ B8 | ~~B10~~ B9 |
|  | Number of RX Chains Reported (NRX) | ~~Number of TX Chains Reported (NTX)~~  | Number of Space-Time Streams Reported (NSTS) | Indication for Parameters Across PPDUs | Indication for Parameters Across LDPC Codewords |
| Bits: | ~~3~~ 4 | ~~3~~ | ~~3~~ 4 | 1 | 1 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | ~~B11~~ B10 | ~~B12~~ B11 | ~~B13~~B12 | ~~B14 B29~~B13 B28 | ~~B30~~ B29 | ~~B31~~B30 B39 |
|  | Indication for Parameters Across SC Blocks or OFDM Symbols | IsEDMG | IsSC | Number of PPDUs | Indication of EDMG TPC | Reserved |
| Bits: | 1 | 1 | 1 | 16 | 1 | 10 |

**Figure 31 —Rate Adaptation Control/EDMG TPC field format**

…

…

The Number of Space-Time Streams Reported (NSTS) subfield indicates the number of space-time streams being reported. Each entry, *i*, corresponds to a space-time stream. If the value of this field is greater than 0, the MCS, Link Margin and SNR fields in the DMG Link Margin element are reserved. For a non-EDMG STA, ~~this field is set to 1~~ the value of this field does not exceed 1.

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| CID | Clause | Comment | Proposed change |
| 3048 | 9.4.2.142 | The 11ay spec has no text to extend the "9.4.2.142.2 Activity field" when values 1-3 and maybe others. E.g. how is transmit power changed in MIMO and MU-MIMO. | A lot of technical details are missing.Will provide submission to the missing parts. |
| 3049 | 9.4.2.142.1 | Field "Activity field" in "DMG Link Margin element" is has 3 options: Change MCS, Power up and Power down. However these commands have no associated value to do. These actions are used when the RECEIVER is controlling the MCS and Tx power which the receiver uses. For fast and accurate control (of the receiver) there is a need to facilitate the action request to include a value (for each). | Three new actions to be added to the Action list for codes 1-3 where the "Link Margin" field is reused to inform the recepient station exactly how to change the MCS or the Tx Power. |
| 3050 | 9.4.2.142.8 | The "EDMG TPC" includes only files "Activity" and "Link margin". The "Activity" filed is has 3 options: Change MCS, Power up and Power down. However these commands have no associated value to do. These actions are used when the RECEIVER is controlling the MCS and Tx power which the receiver uses. For fast and accurate control (of the receiver) there is a need to facilitate the action request to include a value (for each). | Three new actions to be added to the Action list for codes 1-3 where the "Link Margin" field is reused to inform the recepient station exactly how to change the MCS or the Tx Power |

**Proposed resolution 3048-3050:** Revised.

**Discussion:**

The Activity field has *Decrease(d) transmit power* and *Increase(d) transmit power*. However, there is no definition how to increase/decreas the power. This deficit applies to DMG as well, but we will not change it at this time.

We suggest reusing the Link Margin field (for these cases) to specify the amount of increase/decreas power value.

The Activity field has *Change(d) MCS*. However, there is no definition how to change the MCS. This deficit applies to DMG as well, but we will not change it at this time.

We suggest reusing the Link Margin field (for these cases) to specify the required new MCS.

***TGay Editor: Add at the end of 9.4.2.142.8 section (P114L11):***

When Activity field is 1, the Link Margin field contains the new requested MCS.

When Activity field is 2 or 3, the Link Margin field contains the amount of transmit power change in 2’s complement format and in steps of 0.25 dB.

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| --- | --- | --- | --- |
| CID | Clause | Comment | Proposed change |
| 3000 | 9.4.2.142.5 | SNR is called out in .25dB steps and -8 dB to 55.75 dB. The represents 8-bits or - 1 octet. This should call out 1 Octet or reference Figure 33. | 14 add sentence" The SNR subfields values are 1 Octet each as shown in Figure 33" |

**Proposed resolution:** Revise.

**Discussion:**

Accept the suggested additional clarification, with revised text.

***TGay Editor: Modify at the end of the 1st paragraph after Figure 35 (P112L12):***

Each SNR Per STS*i* subfield, 1 ≤ *i* ≤ NSTS, where NSTS is the value of the Number of Space-Time Streams Reported subfield within the Rate Adaptation Control field, contains the SNR of the space-time stream *i*. The SNR subfield levels are 8 bit unsigned integers referenced to a level of –8 dB. Each step is 0.25 dB. SNR values less than or equal to –8 dB are represented as 0. SNR values greater than or equal to 55.75 dB are represented as 255.

|  |  |  |  |
| --- | --- | --- | --- |
| CID | Clause | Comment | Proposed change |
| 3042 | 9.6.6.4 | The "Radio Measurement" is extended to support statistics/averaging within some period. Meaning that multiple measurements are done and reported as "one" value and not a list. However the "Radio Measurement" as defined in 802.11-2016 and used in 11ay is for single measurement or multiple when each value is reported. | Suggested to add additional values to "Table 9-306--Radio Measurement Action field values" where the new values indicate measurements averaging.In addition text is missing to explain how the periodic reports work, as well as parameters to configure the periodic reports. |

**Proposed resolution:** Revise.

**Discussion:**

We do not see a need for new entries in Table 9-306 (Radio Measurement Action field values), as long as the combining (in this case averaging) details are specified, and they are, as listed below.

**Discussion of Parameters Across RX Chains field:**

The Parameters Across RX Chains field includes only RCPI.

The resolution of CID 3043 (above) already solves this issue, hence no additional change needed.

**Discussion of Parameters Across PPDUs field:**

The Parameters Across PPDUs field include SNR per STS, MCS per STS and Link Margin Per STS.

**Discussion of Parameters Across PPDUs field, SNR per STS subfield:**

The resolution of CID 3044 (above) already solves this issue, hence no additional change needed.

**Discussion of Parameters Across PPDUs field, MCS per STS subfield:**

The averaging is performed only if the MCS is unchanged, hence no averaging is needed.

**Discussion of Parameters Across PPDUs field, Link Margin per STS subfield:**

The text in the amendment in section 9.4.2.142.5, page 100, lines 22-26 states that the value is in decibel units and that “The method used to measure link margin is beyond the scope of this standard”. However, the averaging method for these measuerements are specified as arithmetic mean. Knowing the method and number of PPDUs in the data set enables the transmitter to correlate changes in successive reports of average link margin to PPDUs.

***TGay Editor: Modify Section 9.4.2.142.5 as following.***

The Link Margin Per STS*i* subfield, 1≤ *i* ≤ NSTS, where NSTS is the value of the Number of Space-Time Streams Reported subfield within the Rate Adaptation Control field, contains the link margin measured ~~link margin of Data frames of space-time stream~~ *~~i~~* ~~and is coded~~ on space-time stream *i* and averaged across all PPDUs received within a measurement interval that are intended for the receiver, and are transmitted using an MCS other than MCS 0 or EDMG MCS 0. The value of the subfield is found by computing the arithmetic mean of link margin values in decibels, and encoding the result as a 2s complement signed integer in units of decibels. A value of –128 indicates that no link margin is provided. The method used to measure link margin is beyond the scope of this standard.

**Discussion of Parameters Across LDPC Codewords field:**

The Parameters Across PPDUs field include: Average Iterations per STS, Max Iteration per STS and Nonzero Syndromes Per STS.

**Discussion of Parameters Across LDPC Codewords field, Average Iterations per STS subfield:**

There is a need to specify that the average is performed linearly.

***TGay Editor: Modify the second paragraph of section 9.4.2.142.6 (P113L01):***

Each Average Iterations subfield, 1 ≤ *i* ≤ NSTS, where NSTS is the value of the Number of Space-Time Streams Reported subfield within the Rate Adaptation Control field, indicates the average number of iterations used by the LDPC decoder on PSDUs received ~~with an MCS different than MCS 0~~ within a measurement interval that are intended for the receiver, and are transmitted using an MCS other than MCS 0 or EDMG MCS 0. One iteration includes processing of all rows. ~~Values are from 0.0 to +25.5 in 0.1 steps.~~ The value of the subfiled is found by computing the arithmetic mean of number of iterations across all LDPC codewords in each PSDU, and across all PSDUs in the measurement set, and encoding as an 8-bit unsigned integer with 0 to 255 representing 0.0 to +25.5 iterations in 0.1 steps. This statistic is reset when the reset condition defined below in this subclause is met.

**Discussion of Parameters Across LDPC Codewords field, Max Iterations per STS subfield:**

There is a need to specify the method.

***TGay Editor: Modify the third paragraph of section 9.4.2.142.6 (P113L06):***

Each Max Iteration subfield, 1 ≤ *i* ≤ NSTS, where NSTS is the value of the Number of Space-Time Streams Reported subfield within the Rate Adaptation Control field, indicates the maximum number of iterations used by the LDPC decoder on PSDUs received within a measurement interval that are intended for the receiver, and are transmitted using an MCS other than MCS 0 or EDMG MCS 0. One iteration includes processing of all rows. The value of the subfiled is the maximum number of iterations across all LDPC codewords in each PSDU, and across all PSDUs in the measurement set, encoded as an 8-bit unsigned integer with 0 to 255 representing 0.0 to +25.5 iterations in 0.1 steps. This statistic is reset when the reset condition defined below in this subclause is met.

**Discussion of Parameters Across LDPC Codewords field, Nonzero Syndromes per STS subfield:**

There is a need to specify the method.

***TGay Editor: Modify the fourth paragraph of section 9.4.2.142.6 (P113L11):***

Each Nonzero Syndromes subfield, 1 ≤ *i* ≤ NSTS, where NSTS is the value of the Number of Space-Time Streams Reported subfield within the Rate Adaptation Control field, indicates the number of LDPC codewords ~~within the PSDU received with an MCS different than MCS 0 and that have nonzero syndrome~~ with nonzero syndrome, summed across all PSDUs received within a measurement interval that are intended for the receiver, and are transmitted using an MCS other than MCS 0 or EDMG MCS 0. This statistic is reset when the reset condition defined below in this subclause is met.

**Discussion of Parameters Across SC Blocks or OFDM Symbols field:**

The Parameters Across SC Blocks or OFDM Symbols field includes EVM per STS.

**Discussion of Parameters Across SC Blocks or OFDM Symbols field, EVM per STS subfield:**

There is a need to specify that the average is performed over the decibel units.

***TGay Editor: Modify the second paragraph of section 9.4.2.142.7 (P113L29):***

Each EVMi subfield, 1 ≤ *i* ≤ NSTS, where NSTS is the value of the Number of Space-Time Streams Reported subfield within the Rate Adaptation Control field, indicates the ~~average~~ EVM ~~in dB~~ of the SC data symbols or OFDM data subcarriers ~~averaged across all PPDUs and SC blocks or OFDM symbols, 31 having same modulation and MCS. Values are from –5.0 dB to +46.0 dB in 0.2 dB steps.~~ for PSDUs received within a measurement interval that are intended for the receiver, and are transmitted using an MCS other than MCS 0 or EDMG MCS 0. The value of the subfield is found by computing the arithmetic mean of EVM values in dB, across all SC data symbols or OFDM data subcarriers in each PSDU, and across all PSDUs in the measurement set, and encoding the result as an 8-bit unsigned integer with 0 to 255 representing –5.0 dB to +46.0 dB in 0.2 dB steps. This statistic is reset when the reset condition defined in 9.4.2.142.6 is met.

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| CID | Clause | Comment | Proposed change |
| 3075 | 9.6.6.4 | The Measurement Method FIELD has been changed to a Measurement Method SUBFIELD in this paragraph, but other mentions of the Measurement Method FIELD (e.g. in subclause 9.4.2.20.16, or in subclause 9.4.2.21.15). This must either be a FIELD or a SUBFIELD, but it should be the same in all clauses. | Decide whether this is a field or a subfield. |

**Proposed resolution:** Reject.

**Discussion:**

The naming rules are clear, and Measurement Method is a subfield, hence the name is ok.

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| --- | --- | --- | --- |
| CID | Clause | Comment | Proposed change |
| 3591 | 9.4.2.142.3 | Grammar, wrong reference | Change "The Number of PPDUs subfield contains the number of PPDUs used over which the RCPI and SNR measurements were taken (see 9.4.2.142.5 and 9.4.2.142.6)" to "The Number of PPDUs subfield contains the number of PPDUs over which the RCPI and SNR measurements were taken (see 9.4.2.142.4 and 9.4.2.142.5)" |

**Proposed resolution:** Accept.

**Discussion:**

Correct

***TGay Editor: Change the following paragraph of subclause 9.4.2.142.3 in Draft 2.2 (P111L28)***

The Number of PPDUs subfield contains the number of PPDUs used over which the RCPI and SNR measurements were taken (see 9.4.2.142.~~5~~4 and 9.4.2.142.~~6~~5).

|  |  |  |  |
| --- | --- | --- | --- |
| CID | Clause | Comment | Proposed change |
| 3587 |  | Link Measurement Report frame needs to include one form of Link Margin value |  |

**Proposed resolution:** Revise.

**Discussion:**

The commenter requests that at least one of the Link Margin related information to be present when operating in TDD mode.

***TGay Editor: Add the following new paragraph at the end of section* 10.40.6.2.2  *(Draft2.2 P230L14)***

A DMG STA that has TDD Channel Access Supported set to one, shall also set to one at least one of the following capabilities: Parameters Across PPDUs Supported subfield, Parameters Across LDPC Codewords Supported subfield and Parameters Across SC Blocks or OFDM Symbols Supported subfield.