IEEE P802.11
Wireless LANs

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|

|  |
| --- |
| Country Element |
| Date: 2022-03-08 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Youhan Kim | Qualcomm |  |  | youhank@qti.qualcomm.com |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

 |

Abstract

This submission proposes resolutions for the following comments from comment collection on P802.11-REVme D1.0:

1988, 2089

NOTE – Set the Track Changes Viewing Option in the MS Word to “All Markup” to clearly see the proposed text edits.

**Revision History:**

R0: Initial version.

# CID 1988, 2089

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page.Line** | **Comment** | **Proposed Change** |
| 1988 | 9.4.2.8 |  | CID 22 follow-up -- the alternative subsequently developed was better | Make the changes shown under "ALTERNATIVE" under "Proposed changes" under CID 22 in 21/0829 (latest revision) |
| 2089 | 9.4.2.8 |  | CID 22 follow-up -- the alternative subsequently developed was better | Make the changes shown under "ALTERNATIVE" under "Proposed changes" under CID 22 in 21/0829 (latest revision) with the following editorial change:"The Operating Class field specifies the operating class to which the Subband Triplet fields, if any, within the Operating/Subband Sequence field (see Figure 9-166) pertain.NOTE--The Operating/Subband Sequence field ends at the next Operating Class field, if any." |

**Discussion**

Following was CID 22 in CC35:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page.Line** | **Comment** | **Proposed Change** |
| 22 | 9.4.2.8 | 992.24 | Fig 9-166 shows an "Operating Extension Identifier" field but no description of this field is provided in this subclause and a search of that string yields no result. | Try "The first octet in each Subband Triplet field or Operating Triplet field contains an unsigned integer and identifies the type of field. If the integer has a value less than or equal to 200, then the Triplet field is a Subband Triplet field and the first octet in the Triplet is the First Channel Number field. If the integer has a value of 201 or greater, then the Triplet field is an Operating Triplet field and the first octet in the Triplet is the Operating Extension Identifier field." |

And the resolution for CID 22 was (11-21/684r13):

|  |
| --- |
| REVISED (MAC: 2021-10-18 15:39:31Z): Incorporate the changes shown in 11-21/0829r6 (<https://mentor.ieee.org/802.11/dcn/21/11-21-0829-06-000m-resolutions-for-some-comments-on-11me-d0-0-cc35.docx>) for CID 22, which clarify that the Operating Extension Identifier field is an arbitrary value above 200 (or 233 for 6 GHz operation) that may be used more than once within the Country element. |

While the text change for CID 22 in 11-21/829r6 had many changes, following change is what is mainly under discussion in CIDs 1988 and 2089.

Original text in IEEE 802.11-2020 (P960, 4th paragraph)

|  |
| --- |
| The first octet in each Subband Triplet field or Operating Triplet field contains an unsigned integer and identifies the type of field. If the integer has a value less than or equal to 200, then the field is a Subband Triplet field. If the integer has a value of 201 or greater, then the field is an Operating Triplet field. |

Change made by CC35 CID 22 (REVme D1.0 P1190L27)

|  |
| --- |
| The first octet in each Subband Triplet field or Operating Triplet field identifies the type of field. If it is less than or equal to 233 in the 6 GHz band or 200 otherwise, then the field is a Subband Triplet field (see Figure 9-212). Otherwise, the field is an Operating Triplet field (see left half of the Figure 9-214). |

At a high level, CIDs 1988 and 2089 are saying that the above changes need to be “undone”.

Why? To answer that, let us re-trace the history of the Country element.

Country element (initially called Country Information element) was first introduced by 802.11d-2001. Note that at the time, Operating Class was not defined yet. The Country Information element was present in the Beacon and Probe Response frames, and had the following format to allow STAs to identify:

* Regulatory domain (Country String)
* Channels allowed in the regulatory domain (First Channel Number + Number of Channels)
* Allowed maximum TX power in each of the channels (Max. TX Power Level)



**Country Information element format in 802.11d-2001**

The relationship between the Channel Number and the channel center frequency in the 5 and 6 GHz is

Channel center frequency = ChannelStartingFrequency + 5 × ChannelNumber (MHz)

(It is essentially the same in the 2.4 GHz as well, but with a special treatment for channel 14. But that is not relevant to the current discussion.)

For the 5 GHz band, the ChannelNumber ranges from 1~200 (REVme D1.0 P3499L48).

For example, the following three subband triplets is one of the ways to indicate the WLAN channels shown in the subsequent figure.

|  |  |  |  |
| --- | --- | --- | --- |
|  | First Channel Number | Number of Channels | Max. TX Power Level |
| Triplet #1 | 36 | 4 | 17 dBm |
| Triplet #2 | 52 | 4 | 24 dBm |
| Triplet #3 | 149 | 4 | 30 dBm |



802.11j-2004 then introduced the regulatory class (later renamed to what is now the operating class). The operating class allows an AP to specify additional “behaviors” of the spectrum, such as whether dynamic frequency selection (DFS) is required.

With the introduction of the operating classes, IEEE 802.11 needed to find a way to extend the Country element to be able specify the operating class when necessary, while still allowing devices which do not understand operating classes to be able to parse the Country element. The solution introduced in 802.11j-2004 exploited the following:

* The “channel number” in either the 2.4 or 5 GHz band does not exceed 200
* Receivers stop parsing the remaining portion of the Country element if sees an invalid First Channel Number field
	+ REVme D1.1 P2203L35

|  |
| --- |
| When dot11OperatingClassesRequired is true, or where operating classes domain information ispresent and the STA parsing a Country element finds an invalid First Channel Number field orOperating Class field with a value that is reserved, the STA shall ignore the remainder of theCountry element and shall parse any remaining management frame body for additional elements |

Hence, if the “First Channel Number” field in the Country element was set to a value >= 201, then receivers who supported operating classes were to interprete the next two octets in a different manner as shown below.



**Country element format in IEEE 802.11-2020**

IEEE 802.11ax-2021 added support for the 6 GHz band. Following figure shows the WLAN channels available in the 6 GHz band in the FCC regulatory domain.



Yes, there are WLAN channels whose channel number exceeds 200 (see the channels with gray background). However, this does not mean that the Country element cannot indicate channels in the gray area. It just means that the Country element cannot indicate ONLY the channels within the gray area.

* At this point, there are no known regulatory regions where only the channels in the gray area can be used (thus need to be signaled separately in the Country element)
* If there is a need to indicate U-NII 8 separately in the Country element, then the Starting Channel Number would be 189, hence there is no issue.

I.e., there is no realistics scenarios which cannot be signaled by IEEE 802.11-2020 + IEEE 802.11ax-2021.

The change made by CID 22 in CC35 (and thus the current state of REVme D1.0) resulted in changing the ‘threshold’ which determines whether this triplet is a subband triplet or an operating triplet from 200 to 233.

 🡪 

Note that there are already numerous 6 GHz WLAN products in the market, and many of them use a value between 201 and 233 to indicate an Operating Triplet (as per IEEE 802.11-2020 + IEEE 802.11ax-2021).

So, suppose a 6 GHz AP follows REVme D1.0 and tries to signal only the channel in the gray area in the 6 GHz channel figure above. I.e., include a Subband Triplet with the Starting Channel Number > 200. Then a non-AP STA already in the field which follows IEEE 802.11-2020 + IEEE 802.11ax-2021 will interpret it as an Operating Triplet, not a Subband Triplet, resulting in interop issue.

Similarly, suppose a 6 GHz AP already in the field (following IEEE 802.11-2020 + IEEE 802.11ax-2021) used value 201 to indicate an Operating Triplet. If a non-AP STA uses REVme D1.0, then that STA would misinterpret the Operating Triplet as a Subband Triplet, again leading to interop issue.

Hence, we should revert back the technical changes done by CID 22 in CC35 as suggested by CIDs 1988 and 2089. The proposal in CIDs 1988 and 2089 in LB 258 also has some editorial updates, which can be adopted.

Just as a reference, following is the ‘difference’ between IEEE 802.11-2020 + IEEE 802.11ax-2021 and the result of REVme D1.1 (which includes the CID22 from CC35) and the proposed edits from CID 1988 and 2089.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| * Country element

The Country element contains the information required to allow a STA to identify the regula-tory domain in which the STA is located and to configure its PHY for operation in that regulatory domain. The format of this element is as shown in Figure 9-210 (Country element format).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Country String | Triplet | Padding (if needed) |
| Octets: | 1 | 1 | 3 | *Q×*3 | 0 or 1 |
| * Country element format
 |

The Element ID and Length fields are defined in 9.4.2.1 (General).The AP and mesh STA set the Country String field to the value contained in dot11CountryString before transmission in a Beacon or Probe Response frame. Upon reception of this element, a STA sets the dot11CountryString to the value contained in this field. The three octets of the Country String have additional structure as defined by dot11CountryString (see Annex C).If dot11OperatingClassesRequired is false, then the Triplet field is a single Subband Triplet Sequence field, as shown in Figure 9-211 (Subband Triplet Sequence format), that is composed of *Q* Subband Triplet fields, where *Q* is one or more. The format of the Subband Triplet field is shown in Figure 9-212 (Subband Triplet field format).

|  |  |
| --- | --- |
|  | One or more |
|  | Subband Triplet |
| Octets: | 3 |
| * Subband Triplet Sequence format
 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | First Channel Number | Number of Channels | Maximum Transmit Power Level |
| Octets: | 1 | 1 | 1 |
| * Subband Triplet field format
 |

If dot11OperatingClassesRequired is true, then the Triplet field is composed of zero or more Subband Triplet fields followed by one or more Operating/Subband Sequence fields(#1481), as shown in Figure 9-213 (Triplet field format if dot11OperatingClassRequired is true). If the Country element is included in a frame transmitted in the 6 GHz band, the Triplet field is composed of zero Subband Triplet fields and only has one or more Operating/Subband Sequence fields. Each Operating/Subband Sequence field(#1481) is composed of one Operating Triplet field followed by one Subband Triplet Sequence field, as shown in Figure 9-214 (Format of m-th Operating/Subband Sequence field). Each Subband Triplet Sequence field is composed of zero or more Subband Triplet fields. If dot11OperatingClassesRequired is true, the number of triplets in the Triplet field is , where *N* is the total number of Subband Triplet fields and *M* is the total number of Operating/Subband Sequence fields(#1481) contained in (#1484)the Country element and *P(m)* is the number of Subband Triplet fields making up Operating/Subband Sequence field *m*.

|  |  |  |
| --- | --- | --- |
|  | Zero or more | One or more indexed by  |
|  | Subband Triplet | Operating/Subband Sequence |
| Octets: | 3 | 3 |
| * Triplet field format if dot11OperatingClassRequired is true
 |

|  |  |  |
| --- | --- | --- |
|  | Operating Triplet | Subband Triplet Sequence made up of (#1483)*P(m)* Subband Triplet fields, where  |
|  | Operating Extension Identifier | Operating Class | Coverage Class |
| Octets: | 1 | 1 | 1 | 3 *× P(m)* |
| * Format of *m*-th Operating/Subband Sequence field
 |

The number *Q* of Subband fields or Operating triplet fields in the element is determined by the Length field.An operating class for an 80+80 MHz channel width is expressed by two consecutive Operating/Subband Sequence fields(#1481), where the first Operating/Subband Sequence field contains an Operating Triplet field indicating an 80 MHz channel spacing with an 80+ behavior limit and the second Operating/Subband Sequence field contains an Operating Triplet field indicating an 80 MHz channel spacing without an 80+ behavior limit.Operating/Subband Sequence fields that contain an Operating Class field for which the Channel spacing (MHz) column in the appropriate table in Annex E equals 80 or 160 contain zero Subband Triplet fields.NOTE 1—Any Operating Triplet field indicating 80 MHz, 160 MHz, and 80+80 MHz can be omitted from the Country element (see 10.22.3 (Operation with operating classes)).NOTE 2—The Transmit Power Envelope element is always used for TPC for 80 MHz, 160 MHz, or 80+80 MHz operating classes instead of Subband Triplet fields (see 11.38.1 (Basic VHT BSS functionality)).An Operating/Subband Sequence field contains zero Subband Triplet fields if all the following conditions are true:* The operating class table number indicated in the Country String field is Table E-4 (Global operating classes) (see dot11CountryString).
* The “Channel starting frequency” column in Table E-4 (Global operating classes) is greater than or equal to 5.925 and less than or equal to 7.125 for the operating class indicated in the Operating Class field.
* The “Channel spacing” column in Table E-4 (Global operating classes) is greater than or equal to 40 MHz for the operating class indicated in the Operating Class field.

NOTE 3—Any Operating Triplet field for an operating class for which the “Channel starting frequency” column in Table E-4 (Global operating classes) is greater than or equal to 5.925 and less than or equal to 7.125 can be omitted from the Country element (see 10.22.3 (Operation with operating classes)).NOTE 4—The Transmit Power Envelope element is always used for TPC for operating classes in the 6 GHz band instead of Subband Triplet fields (see 26.15.8 (Additional rules for PPDUs sent in the 6 GHz band)).The first octet in each Subband Triplet field or Operating Triplet field identifies the type of field. If it is less than or equal to 200, then the field is a Subband Triplet field (see Figure 9-212 (Subband Triplet field format)). Otherwise, the field is an Operating Triplet field (see left half of Figure 9-214 (Format of m-th Operating/Subband Sequence field)).The First Channel Number field indicates the lowest channel number in the Subband Triplet field. No channel is indicated by more than one pair of First Channel Number and Number of Channels fields within a Subband Triplet Sequence field. [For example, the (First Channel Number, Number of Channels) pairs (2,4) and (5,2) in 2.4 GHz each indicate channel 5, therefore are not used within the same Subband Triplet Sequence field.] The First Channel Numbers are monotonically increasing within a Subband Triplet Sequence field. The First Channel Number and the Number of Channels pairs in a Country element are used to describe channels only in the band on which the frame containing the element is transmitted.NOTE – It is not possible to indicate a first channel number above 200 in the 6 GHz band (i.e., a first channel above approximately 7 GHz), since this would be interpreted as the Operating Extension Identifier field of an Operating Triplet field.Outside the 2.4 GHz band, the channel numbers that are included in a group of channels are separated by the BSS bandwidth. For Subband Triplet fields that are not within an Operating/Subband Sequence field, the BSS bandwidth is 20 MHz. For Subband Triplet fields that are within an Operating/Subband Sequence field, the BSS bandwidth is as indicated by the operating class in the same Operating/Subband Sequence field. In the 2.4 GHz band, the channel numbers that are included in a group of channels are separated by 5 MHz (for both 20 and 40 MHz BSS bandwidth), except that channel 14 is treated as if it were 5 MHz above channel 13.NOTE 5—For example, the channels 1 to 11 in the 2.4 GHz band can be represented using one Subband Triplet field with First Channel Number = 1 and Number of Channels = 11. The channels 36, 40, 44, and 48 with 20 MHz BSS bandwidth in the 5 GHz band can be represented using one Subband Triplet field with First Channel Number = 36 and Number of Channels = 4. The six channels 183, 184, 185, 187, 188, and 189 (but not 186) with 10 MHz BSS bandwidth can be represented using three Subband Triplet fields: one with First Channel Number = 183 and Number of Channels = 4, one with First Channel Number = 184 and Number of Channels = 1 and one with First Channel Number = 188 and Number of Channels = 1.The Maximum Transmit Power Level field is a 2s complement signed integer. The Maximum Transmit Power Level field indi-cates the maximum power, in dBm, allowed to be transmitted. As the method of measurement for maximum transmit power level differs by regulatory domain, the value in this field is interpreted according to the regulations applicable for the domain identified by the Country String.The Maximum Transmit Power Level field is reserved if it is within an Operating/Subband Sequence field with the operating class for which the “Channel starting frequency” column in Table E-4 (Global operating classes) (#1868)is greater than or equal to 5.925 and less than or equal to 7.125.NOTE 6—Maximum transmit power information for channels in the 6 GHz band is conveyed using the Transmit Power Envelope element (see 10.22.4 (Operation with the Transmit Power Envelope element)).The Operating Extension Identifier field is an arbitrary value, subject to the minimum defined above for Operating Triplet fields.NOTE 7—The same value might be used in more than one Operating Triplet field within the Country element.An operating class is an index into a set of values for radio equipment sets of rules.The Operating Class field specifies the operating class to which the immediately following Subband Triplet fields, if any, within the Operating/Subband Sequence field (see Figure 9-214) pertain.NOTE – The Operating/Subband Sequence field ends at the next Operating Class field, if any.A coverage class is an index into a set of values for aAirPropagationTime. The Coverage Class field is reserved in a DMG BSS. Otherwise, it specifies the aAirPropagationTime characteristic used in BSS operation, as shown in Table 9-131 (Coverage Class field parameters). The characteristic aAirPropagationTime describes variations in actual propagation time that are accounted for in a BSS and, together with maximum transmit power level, allow control of BSS diameter.

|  |
| --- |
| * Coverage Class field parameters
 |
| Coverage class value | aAirPropagationTime (µs) |
| 0–31 | , where *n* is the value of the coverage class |
| 32–255 | Reserved |

The Padding field is used to add, if needed, a single octet (with the value 0) to the Country element so that its length is evenly divisible by 2. |

**Proposed Resolution: CIDs 1988, 2089**

REVISED

**Note to commenter:**

The changes made by CID 22 in CC35 can cause interop issue in Country element parsing with STAs following the IEEE 802.11-2020 and IEEE 802-11ax-2021 in the 6 GHz band. Hence, the instruction editor below implements the proposal by CIDs 1988 and 2089 on top of REVme D1.1, reverting back some the technical changes done by the CID 22.

**Instruction to TGme Editor:**

Implement the proposed text updates for CIDs 1988 and 2089 in <https://mentor.ieee.org/802.11/dcn/22/11-22-0436-00-000m-country-element.docx>

(Note to Editor: The same resolution applies for both CIDs 1988 and 2089.)

**Proposed Text Updates: CIDs 1988, 2089**

* Country element

*Instruction to TGme Editor: Update REVme D1.1 P1191L30 as shown below*

The first octet in each Subband Triplet field or Operating Triplet field identifies the type of field. If it is less than or equal to 200, then the field is a Subband Triplet field (see Figure 9-212 (Subband Triplet field format)). Otherwise, the field is an Operating Triplet field (see left half of Figure 9-214 (Format of m-th Operating/Subband Sequence field)).

The First Channel Number field indi-cates the lowest channel number in the Subband Triplet field. No channel is indicated by more than one pair of First Channel Number and Number of Channels fields within a Subband Triplet Sequence field. [For example, the (First Channel Number, Number of Channels) pairs (2,4) and (5,2) in 2.4 GHz each indicate channel 5, therefore are not used within the same Subband Triplet Sequence field.] The First Channel Numbers are monotonically increasing within a Subband Triplet Sequence field. The First Channel Number and the Number of Channels pairs in a Country element are used to describe channels only in the band on which the frame containing the element is transmitted.

NOTE – It is not possible to indicate a first channel number above 200 in the 6 GHz band (i.e. a first channel above approximately 7 GHz), since this would be interpreted as the Operating Extension Identifier field of an Operating Triplet field.

*Instruction to TGme Editor: Update REVme D1.1 P1192L20 as shown below*

The Operating Class field specifies the operating class to which the immediately following Subband Triplet fields, if any, within the Operating/Subband Sequence field (see Figure 9-214) pertain.

NOTE – The Operating/Subband Sequence field ends at the next Operating Class field, if any.

 [End of File]