IEEE P802.11  
Wireless LANs

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| --- | --- | --- | --- | --- |
| TPC, Operating Classes and Channel Switching | | | | |
| Date: 2012-05-03 | | | | |
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##### Abstract:

MAC CIDs 4248, 4252, 4257, 4258, 4259, 4260, 4346, 4461, 4462, 4254, 4249***,*** 4749, 4336, 4571, 5411, 4337, 4872, 5260, 4335, 4250, 4253 and 4256 using 11acD2.1 as the baseline.

##### Changes indicated by a mixture of Word track-changes and instructions. For equation changes, Tex notation is sometimes used. E.g. a\_{xyz}^b denotes axyzb

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4248 | Brian Hart | | 10.8 | | | 136 | | 1 | | Units of power control are undefined of Max Power Env (ditto for fields in country element) | | Fix. Commenter will bring presentation | | Revised. See 12/0379r<motioned-Revision> |
| 4252 | Brian Hart | | 3.2 | | | 34 | | 5 | | Definitionf transmit power in the baseline is very ambiguous for countries (or regs within a country) where TX power is not so regulated as EIRP | | P#, SC, LN from 11mbD12. Fix. Commenter will bring presentation | | Revised. See 12/0379r<motioned-Revision> |
| 4257 | Brian Hart | | 8.5.2.6 | | | 77 | | 22 | | AP does not have a way to switch ch and power at the same time. Likely to be important for TDWR spectrum | | Fix. Commenter will bring presentation | | Revised. See 12/0379r<motioned-Revision> |
| 4258 | Brian Hart | | 8.5.2.6 | | | 77 | | 22 | | AP does not have a way to switch ch and op class at the same time. Likely to be important for TDWR spectrum | | Fix. Commenter will bring presentation | | Revised. See 12/0379r<motioned-Revision> |
| 4259 | Brian Hart | | 8.3.3.2 | | | 38 | | 1 | | VHT only allows wide ch bw element in CSA frame. Needs to be allowed in ECSA, beacon and probe response | | Fix. Commenter will bring presentation | | Revised. See 12/0379r<motioned-Revision> |
| 4260 | Brian Hart | | 8.5.2.6 | | | 77 | | 22 | | (Minor) AP on school bus crossing from US to Mexico and vice versa daily cannot switch countries during a channel switch | | Fix. Commenter will bring presentation | | Revised. See 12/0379r<motioned-Revision> |
| 4346 | Brian Hart | | 8.5.2.6 | | | 77 | | 22 | | 1) Also need to allow Wide BW Ch SW element in beacons, probe responses and ECSA frames; 2) No ability provided to change ch and TX power at the same time, which may be important for TDWR spectrum; or change operating class; or country; or country table | | Fix. Commenter will bring presentation | | Revised. See 12/0379r<motioned-Revision> |
| 4461 | Brian Hart | | 10.38.1 | | | 140 | | 56 | | "ECSA" but this is optimistic - e.g. no update to ECSA to allow wide bandwidth element in ECSA | | Fix. Commenter will bring presentation | | Revised. See 12/0379r<motioned-Revision> |
| 4462 | Brian Hart | | 10.38.1 | | | 140 | | 61 | | New Operating Class field identifies the primary 40 MHz channel" does not acknowledge that the operating class has many purposes, most especially for expressing time/location/AP-state-dependent regulatory info to assoc clients. We cannot grandfather this feature at 40 MHz. See also P142L7 | | Fix. Commenter will bring presentation | | Revised. See 12/0379r<motioned-Revision> |
| 4254 | Brian Hart | | 8.4.2.10 | | | 530 | | 1 | | Legacy power constraint mechanism is ambiguous/a hack when clients may be homologated under one of several regulations with different units, since the max power may be different; then the constrained power varies by client. Problem seems to be carried forward to extended power constraint | | Fix. Commenter will bring presentation | | Revised. See 12/0379r<motioned-Revision> |
| 4249 | Brian Hart | | 10.22.6.4.1 | | | 139 | | 10 | | Operating class expresses bandwidth, position of primary wrt bandwidth (tho there are other ways to solve this problem) AND time/location/AP-state dependence of enabling signal sent to clients by AP, where applicable. So we cannot just terminate the operating class concept at 40 MHz. | | Fix. Commenter will bring presentation | | Revised. See 12/0379r<motioned-Revision> |
| 4749 | Mark RISON | | 8.4.2.164 | | | 75 | |  | | The VHT Transmit Power Envelope element format makes no sense. There is only one "Maximum Transmit Power", and it therefore applies to all "Segment Channel Width"s. Therefore the {centre freq, channel width} pairs serve no purpose (the set of supported channel widths is indicated elsewhere). [Compare with the Extended Power Constraint element, where the power constraint can vary per segment width.] | | Delete all but the Maximum Transmit Power from the VHT Transmit Power Envelope element, and change the Length in 8.4.2.1 to 3 (it was stated in a D1.0 comment resolution that the same max tx power applies to all widths and segments) | | Revised. The VHT Transmit Power element is merged with the Extended Power Constraint element and now has one octet local power constraint per bandwidth. See 12/0379r<motioned-Revision> |
| 4336 | Brian Hart | | 8.4.2.164 | | | 75 | | 22 | | Element ID and Length fields not defined | | Define | | Revised. See 12/0379r<motioned-Revision> |
| 4571 | Erik Lindskog | | 8.4.2.164 | | | 75 | | 23 | | The VHT Transmit Power Envelope element format seems to have an error. The different "Segment Channel Width's" all seem to share the same "Maximum Transmit Power". Presumably this is not the intent here. | | Make the 'Maximum Transmit Power' field part of what is repeated for each segment. | | Revised. The VHT Transmit Power element is merged with the Extended Power Constraint element and now has one octet local power constraint per bandwidth. See 12/0379r<motioned-Revision> |
| 5411 | Yusuke Asai | | 8.4.2.164 | | | 75 | | 30 | | The order of last three paragraphs does not corresponds to the order of fields of the element. | | Place the last paragraph between second-last and third-last paragraphs. | | Revised. The VHT Transmit Power element is merged with the Extended Power Constraint element and now has one octet local power constraint per bandwidth. The new fields are described in order. See 12/0379r<motioned-Revision> |
| 4337 | Brian Hart | | 8.4.2.164 | | | 75 | | 36 | | num of chs | | Typically we try to use ch for the \*whole\* ch. "num of 20 Mhz subchannels" | | Revised. The VHT Transmit Power element is merged with the Extended Power Constraint element and now has one octet local power constraint per bandwidth and no “number of chanels”. See 12/0379r<motioned-Revision> |
| 4872 | Mark RISON | | 8.4.2.164 | | | 75 | | 36 | | Why is the segment channel width given as a number of (presumably 20 MHz) channels rather than the enum used for EPC (from VHT Op)? | | Use the same encoding as in Tables 8-53b and 8-53j (not 8-183w) | | Revised. The VHT Transmit Power element is merged with the Extended Power Constraint element and now has one octet local power constraint per bandwidth. See 12/0379r<motioned-Revision> |
| 5260 | Simone Merlin | | 8.4.2.164 | | | 75 | | 36 | | "The Segment Channel Width field, which is 1 octet in length, is set to the number of channels in the frequency segment"  "the transmission bandwidth defined by the VHT Transmit Power Envelope element."  what does it mean? How is the BW defined based on number channels? | | clarify how the BW is related to the number of channels | | Revised. The VHT Transmit Power element is merged with the Extended Power Constraint element and now has one octet local power constraint per bandwidth. See 12/0379r<motioned-Revision> |
| 4335 | Brian Hart | | 8.4.2.164 | | | 75 | | 40 | | Units are unspecified. Can't just say "as per units used by local regulators" since e.g. FCC uses many units in same regulations: e.g. conducted, EIRP, conducted/MHz and EIRP/MHz | | Fix. Commenter will bring presentation | | Revised. See 12/0379r<motioned-Revision> |
| 4988 | Peter Ecclesine | | 10.1 | | | 138 | | 5 | | The transmit power constraint mechanism is fundamentally flawed for the following reason:  If we change operation frequency or bandwidth, we cannot specify concurrent transmit power limits to take effect at the same time, because power constraints are defined for the current channel. An example is changing frequency to a channel where the regulatory power limit depends on distance from a radar, and so is unknown to BSS members that do not have geolocation information. | | Make an IE/action frame element that concurrently changes the allowed transmit power after the channel switch, like the 11af Draft 1.06 Channel Power Management Announcement element. | | Revised. See 12/0379r<motioned-Revision> |
| 4250 | Brian Hart | | e.1 | | | 333 | | 46 | | No operating class expression for 80+80 | | Fix. Commenter will bring presentation | | Revised. See 12/0379r<motioned-Revision> |
| 4253 | | Brian Hart | | e.1 | 333 | | 46 | | 11k/11v/... use the (operating class,channel) tuple to identify a (sub)channel. How will this work with 80+80 MHz? Defining all combinations of 80+80 is inadequate since we need O(N^2) values. | | Fix. Commenter will bring presentation | | Revised. A 80+ operating class is added in 12/0379r<motioned-Revision> so 80+\*0 can be represented by a operating class duple. The commenter is invited to bring a presentation to address the array of 11k/11v/… frames/elements/fields | |
| 4256 | | Brian Hart | | e.1 | 333 | | 46 | | Operating class tables. Need to deal with the case of legacy STAs and newer STAs. A) Global Table used for everywhere but US/EU/JP? Add note; but still better to align operating classes where no country-specific time/location/AP-state-dependent regs are being expressed by op class (e.g. renumber new US operating classes 35,36 to 128,129 to align with global table); b) the alternative is problematic since have to deal with a channel switch also changing op class tables, clients expressing op class capability for a mixture of tables, legacy clients that understand a country-specific table only but not the global op classes, etc | | Fix. Commenter will bring presentation | | Revised. See 12/0379r<motioned-Revision> | |

***Discussion*:** See 12/0297. This document does not address clarifications to measurement elements/frames and the like to deal with 80+80 MHz (etc).

Changes from rev3:

1. Given favorable feedback from the March meeting for change sets 1-6 and 8Alternate, these have been collapsed together; and other change sets have been removed
2. Combined VHT Transmit Power Envelope and Extended Power Constraint elements into a new format, still called VHT Transmit Power Envelope
3. Reduced the number of units to one (but preserved the option of alternate units for future regulations)
   1. To further enhance future-proofing, allowed multiple VHT Transmit Power Envelope elements in Beacons and Probe Responses (see [detailed explanation below](#ssou))
   2. Added a new Behavior Limit “UseEirpForVhtTxPowEnv”, applied to all current operating classes (but preserved the option of alternative units for future operating classes subject to non-EIRP regulations)
4. Added a shall: “ VHT transmit power 20 or 40 limits shall equal the limit in the Country element if the Country is in EIRP”
5. Added a should: “clients should be able to TPC down to 0 dBm”
6. Updated the PICS
7. Other minor clean up
8. Added a few more CIDs to be resolved by this doc
9. Applied the Country and TX power changes to TDLS
10. 80 and 160 MHz operating triplets transmitted only if they express distinctive regulatory permissions

Summary of Pros and Cons of Channel Switching and Extended Channel Switching

Channel Switch elements/frames

* Con: 11n can’t switch to 40 MHz using beacons/probe responses
* Pro: Understood by 11a
* Pro: 20 MHz switching via the Channel Switch element in beacons/probe responses is industry certified
* (Pro: Country independent – but, for 5 GHz, need to know the country *anyway*)
* (Pro: No dependence on operating classes, which may not have been defined for the current country – but, since 11mb, now are defined)
* Con: No operating class for regulatory domains and bands that require the AP to express time/location/AP-state dependent rules

Extended Channel Switch elements/frames

* Pro: 11n can switch to 40 MHz using beacons/probe responses
* Con: Not understood by 11a (but can send Channel Switch element/frame alongside)
* Con: Not industry certified
* (Con: Need to know the country – but, for 5 GHz, need to know the country *anyway*)
* (Con: Global operating classes are only defined recently - but do now exist)
* Pro: Can deliver an operating class if needed for regulatory domains and bands that require the AP to express time/location/AP-state dependent rules

In the typical case of switching an 80 MHz BSS with 11a and 11n clients, we seem to be stuck with sending both (CSA for 11a; ECSA for 11n with 40 MHz). This situation really was created in 11a/11n days and not made worse by 11ac. For instance, even if sending both CSA and ECSA elements in a Beacon or Probe Response, only a single Channel Wrapper element is needed.

How to use the single set of units

The 802.11 update procedure is as follows.

1. New spectrum becomes available without a TPC requirement or with a TPC requirement that uses EIRP or EIRP/MHz (or anything else that can be unambiguously converted to EIRP for an allowed transmission bandwidth).
   1. Then the Regulatory Standing Committee creates a new operating class entry that includes UseEirpForVhtTxPowEnv in the Behavior Limits column.
2. New spectrum becomes available with an explicit TPC requirement that cannot be unambiguously converted to EIRP. Call this X (e.g. X = conducted).
   1. Then the Regulatory Standing Committee creates a new value for the Local Maximum Transmit Power Units Interpretation subfield, a new Behavior Limit for X (e.g. “UseConductedForVhtTxPowEnv”), and a new operating class entry that includes the new Behavior Limit in the Behavior Limits column.
   2. If the new non-EIRP TPC rules do not overlap with existing spectrum already associated in 802.11 with EIRP TPC rules, then done.
   3. If the new non-EIRP TPC rules *overlap* existing spectrum already associated in 802.11 with EIRP TPC rules (this should be unlikely), then there are two scenarios:
      1. ANDed rules for newly homologated devices, but devices homogated before the rule change can continue operation unchanged [akin to 5.2 GHz, where new radar signatures were belatedly added to the existing DFS signatures]
      2. Changed rules for newly homologated devices, but devices homogated before the rule change can continue operation unchanged [akin to 5.2 GHz, where DFS rules were belatedly added]
      3. ORed rules (and clients can homologate under one or both) [akin to 5.8 GHz where UNII was ORed with 15.247 rules]
   4. We can deal with these (hopefully unlikely) scenarios by defining parsing rules up front. 1) Allow multiple VHT Transmit Power Envelope elements in Beacons and Probe Responses, ordered by Units Interpretation, then 2) If a client doesn’t understand a Units Interpretation in a VHT Transmit Power Envelope element, ignore it. If the client understands the new regulations, it will know whether
      1. In the OR case, the legacy client just finds the legacy rules and the newly minted client can pick either VHT Transmit Power Envelope element (and units)
      2. In the AND case, the newly homologated client is constrained by the new regulations, so will use the later-transmitted, newly-defined VHT Transmit Power Envelope (and possibly the earlier-transmitted, previously-defined VHT Transmit Power Envelope element, according to what the regulations might say)
   5. We do not attempt to deal with the case that regulations mandate TPC along two dimensions simultaneously (e.g. must reduce both radiated and conducted powers to independently specified levels under AP control) (this should be very unlikely)

Note: in the FCC (and similarly Europe), we have to be able to express TPC in terms of EIRP because of 15.407(h)(1):

“UNII devices operating in the 5.25–5.35 GHz band and the 5.47–5.725 GHz band shall employ a TPC mechanism. The UNII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm. A TPC mechanism is not required for systems with an e.i.r.p. of less than 500 mW.”

If this had been written differently e.g. “conducted” rather than EIRP, then we would need a “conducted” alternative, but to date there is lots of vague TPC language (for which EIRP suffices) plus variations on EIRP TPC language such as 15.407(h)(1), but we’re not (yet) aware of explicit non-EIRP TPC language.

**3.2 Definitions specific to IEEE 802.11**

***Instructions to 11ac editor: Delete all instances of “Extended Power Constraint” from clause 6, and all rows in tables used to describe “Extended Power Constraint” (including once from MLME-START.request in 6.3.11.2.2 Semantics of the service primitive and one row from table in 6.3.11.2.2 Semantics of the service primitive).***

***Instructions to 11ac editor: After the deletion of the Extended Power Constraint from the Beacon and Probe Response frames, renumber the “order”column as required***

**Table 8-20—Beacon frame body**

|  |  |  |
| --- | --- | --- |
| 62 | VHT Transmit Power  Envelope element | (#4748)One VHT Transmit Power Envelope element is  present for each distinct value of the Local Maximum Transmit Power Units Interpretation subfield that is supported for the BSS if both the following conditions are met:  — dot11VHTOptionImplemented is true;  — Either dot11SpectrumManagementRequired is true  or (#4748)dot11RadioMeasurementActivated is  true.  Otherwise, this parameter is not present. |
|  |  |  |
| 63 | Channel Switch Wrapper element | The Channel Switch Wrapper element is optionally present if  dot11VHTOptionImplemented is true and at least one of  a Channel Switch Announcement element or an Extended Channel Switch Announcement element is also present in the Beacon frame and the Channel Switch Wrapper element contains at least one subelement |

**Table 8-27—Probe Response frame body**

|  |  |  |
| --- | --- | --- |
| 63 | VHT Transmit Power  Envelope element | (#4748)One VHT Transmit Power Envelope element is  present for each distinct value of the Local Maximum Transmit Power Units Interpretation subfield that is supported for the BSS if both the following conditions are met:  — dot11VHTOptionImplemented is true;  — Either dot11SpectrumManagementRequired is true  or (#4748)dot11RadioMeasurementActivated is  true.  Otherwise, this parameter is not present. |
|  |  |  |
| 64 | Channel Switch Wrapper element | The Channel Switch Wrapper element is optionally present if  dot11VHTOptionImplemented is true and at least one of  a Channel Switch Announcement element or an Extended Channel Switch Announcement element is also present in the Probe Response frame and the Channel Switch Wrapper element contains at least one subelement |

**Table 8-54—Element IDs**

|  |  |  |  |
| --- | --- | --- | --- |
| VHT Transmit Power Envelope (see 8.4.2.164 (VHT Transmit Power Envelope element)) | 195 | 4 to 7 | Yes |
| v |  |  |  |
| Channel Switch Wrapper (see 8.4.2.<editorToAssignXXX1>) | <To be assigned by ANA> | 7 to 257 | Subelements |

***Advice to 11ac editor: Discuss with ANA how ANA can recover Element ID = 196. E.g. reassign 196 to Channel Switch Wrapper so that the order column for the Beacon/Probe Response above keeps the element IDs in ascending order.***

**8.4.2.10 Country element**

The Country element contains the information required to allow a STA to identify the regulatory 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 8-90.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Country String | Triplet field |  |  | Pad (if needed) |
| Octets: | 1 | 1 | 3 | Q\*3 |  |  | 0 or 1 |

Figure 8-90—Country element format

|  |  |
| --- | --- |
|  | One or more |
|  | Subband Triplet |
| Octets: | 3 |

Figure 8-90xxxNEW-3p4—Format of Subband Triplet Sequence

|  |  |  |  |
| --- | --- | --- | --- |
|  | First Channel Number | Number of Channels | Maximum Transmit Power Level |
| Octets: | 1 | 1 | 1 |

Figure 8-90xxxNEW-3p5—Format of Subband Triplet field

|  |  |
| --- | --- |
|  | One or more Operating/Subband Sequence fields, indexed by m = 1, 2, … M, M >= 1 |
|  | Operating/Subband Sequence |
| Octets: | Variable |

Figure 8-90xxxNEW-3p6—Format of Triplet field if dot11OperatingClassesRequired is true

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Operating triplet | | | Subband Triplet Sequence , made up of P(m) Subband Triplet fields, where P(m) >= 0 |
|  |
|  | Operating Extension Identifier | Operating Class | Coverage Class |
| Octets: | 1 | 1 | 1 | 3P(m) |

Figure 8-90xxxNEW-5—Format of m-th Operating/Subband Sequence field

The element ID for this element is set to the value for Country, specified in Table 8-54. The length of the

element is variable, as the element contains the variable-length Triplet field.

If dot11OperatingClassesRequired is false, then the Triplet field is a single Subband Triplet Sequence field, as shown in Figure 8-90xxxNEW-3p4, 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 8-90xxxNEW-3p5.

If dot11OperatingClassesRequired is true, then the Triplet field is composed of one or more Operating/Subband Sequences, as shown in Figure 8-90xxxNEW-3p6. Each Operating/Subband Sequence is composed of one Operating Triplet field followed by one Subband Triplet Sequence field, as shown in Figure 8-90xxxNEW-5. Each Subband Triplet Sequence field is composed of zero or more Subband Triplets fields. If dot11OperatingClassesRequired is true, the number of triplets in the Triplet field is Q = sum\_{m=1}^{M} 1+P(m). ***TGac editor – convert to properly formatted equation.***

The number Q of Subband or Operating triplets in the element is determined by the Length field.

An operating class for an 80+80 channel bandwidth is expressed by two consecutive Operating/Subband Sequences, where the first Operating/Subband Sequence field contains an Operating Triplet for an 80 MHz Channel Spacing with a 80+ Behavior Limit and the second Operating/Subband Sequence field contains an Operating Triplet for an 80 MHz Channel Spacing without a 80+ Behavior Limit.

Operating/Subband Sequence fields for 80, 160 or 80+ MHz operating classes contain zero Subband Triplet fields.

NOTE – The VHT Transmit Power Envelope element is always used for TPC for 80, 160 or 80+80 MHz operating classes instead of subband triplets (see 10.38.1).

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

The minimum length of the element is 8 octets.

The Country String field of the element is 3 octets in length. The AP and mesh STA set this field to the value contained in the dot11CountryString attribute before transmission in a Beacon or Probe Response frame. Upon reception of this element, a STA sets the value of the dot11CountryString to the value contained in this field.

NOTE The three octets of the Country String have additional structure as defined by dot11CountryString (see Annex C).

The First Channel Number field indicates the lowest channel number in the Subband triplet. The group of channels described by each pair of the First Channel Number and the Number of Channels fields within a Subband Triplet Sequence field do not have overlapping channel identifiers. [For example, the pairs (2,4) and (5,2) overlap and are not used within the same Subband Triplet Sequence field.]

The First Channel Numbers are monotonically increasing within a Subband Triplet Sequence field.

The Number of Channels field of the subelement is 1 octet in length.

The Maximum Transmit Power Level field is a signed number and is 1 octet in length. The Maximum Transmit Power Level field indicates 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.

An operating class is an index into a set of values for radio equipment sets of rules. The Operating Class

field is 1 octet in length.

A coverage class is an index into a set of values for aAirPropagationTime. The Coverage Class field is 1

octet in length.

The Coverage Class field of the operating triplet specifies the aAirPropagationTime characteristic used in

BSS operation, as shown in Table 8-56. 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.

The Pad field is 0 or 1 octet in length. The length of the Country element is evenly divisible by 2. The Pad is used to add a single octet to the element if the length is not evenly divisible by 2. The value of the Pad field is 0.

**8.4.2.17 Power Capability element**

The Minimum Transmit Power Capability field is set to the nominal minimum transmit power with which the STA is capable of transmitting in the current channel, with a tolerance ± 5 dB. The field is coded as a signed integer in units of decibels relative to 1 mW.Further interpretation of this field is defined in 10.8.2 (Association based on transmit power capability).

The Maximum Transmit Power Capability field is set to the nominal maximum transmit power with which the STA is capable of transmitting in the current channel, with a tolerance ± 5 dB. The field is coded as a signed integer in units of decibels relative to 1 mW. Further interpretation of this field is defined in 10.8.2 (Association based on transmit power capability).

**8.4.2.70.4 Peer-to-Peer Link event report**

The STA Tx Power field indicates the target transmit power at the antenna (i.e. EIRP) in dBm with a tolerance of ± 5 dB of the lowest basic rate of the reporting STA.

**8.4.2.71.5 Diagnostic Information subelement descriptions**

The Tx Power field indicates the target transmit power level(s) at the antenna(s) (i.e. EIRP), where the actual power is within ±5 dB to the target. Each transmit power level is encoded in a single octet as a 2’s complement value in dBm, rounded to the nearest integer. If the Tx Power Mode field is 0 then the Tx Power field contains one or more transmit power levels in increasing numerical order. If the Tx Power Mode field is 1, the Tx Power field contains the STA’s minimum and nonzero maximum transmit power levels, in that order.

**8.4.2.73.5 Radio Information subelement**

The Transmit Power field is the transmit power used to transmit the current Location Track Notification

frame containing the Location Parameters element with the Radio Information subelement and is a signed

integer, one octet in length, reported as an EIRP in dBm. A value of –128 indicates that the transmit power is unknown. The tolerance for the transmit power value reported in the Radio Information subelement is ± 5 dB. This tolerance is defined as the maximum possible difference, in decibels, between the reported power value and the total transmitted power across all antennas of the STA, which are measured when transmitting Location Request frames.

**8.4.2.164 VHT Transmit Power Envelope element**

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | Zero or one | Zero or one | Zero or one |
|  | Element ID | Length | Transmit Power Information | Local Maximum Transmit Power for 20 MHz | Local Maximum Transmit Power for 40 MHz | Local Maximum Transmit Power for 80 MHz | Local Maximum Transmit Power for 160/80+80 MHz |
| Octets | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**Figure 8-401by—VHT Transmit Power Envelope element format**

The VHT Transmit Power Envelope element conveys the maximum transmit power for various transmission

bandwidths. The format of the VHT Transmit Power Envelope element is shown in Figure 8-

401by.

The Element ID field is set to the value for the VHT Transmit Power Envelope element defined in Table 8-54 (Element IDs).

The format of the Transmit Power Information field is defined in Figure 8-yyyyNEW-1.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Local Maximum Transmit Power Count | Local Maximum Transmit Power Units Interpretation | Reserved |
| Bits: | 0 2 | 3 5 | 6 7 |

Figure 8-yyyyNEW-1: Format of Transmit Power Information field

The Local Maximum Transmit Power Count subfield indicates the number of Local Maximum Transmit Power for X MHz fields (where X = 20, 40, 80 or 160/80+80) minus 1 in the VHT Transmit Power Envelope element, as shown in Table 8-yyyyNEW-1

Table 8-yyyyNEW-1: Meaning of Local Maximum Transmit Power Count subfield

|  |  |
| --- | --- |
| Value | Field(s) Present |
| 0 | Local Maximum Transmit Power for 20 MHz |
| 1 | Local Maximum Transmit Power for 20 MHz and Local Maximum Transmit Power for 40 MHz |
| 2 | Local Maximum Transmit Power for 20 MHz, Local Maximum Transmit Power for 40 MHz, and Local Maximum Transmit Power for 80 MHz |
| 3 | Local Maximum Transmit Power for 20 MHz, Local Maximum Transmit Power for 40 MHz, Local Maximum Transmit Power for 80 MHz, and Local Maximum Transmit Power for 160/80+80 MHz |
| 4-7 | Reserved |

The Local Maximum Transmit Power Units Interpretation subfield provides additional interpretation for the units of the Local Maximum Transmit Power for X MHz fields (where X = 20, 40, 80 or 160/80+80) and is defined in Table 8-yyyyNEW-2. Allowed values are further constrained as defined in Annex E.

Table 8-yyyyNEW-2: Definition of Local Maximum Transmit Power Units Interpretation subfield

|  |  |
| --- | --- |
| Value | Units Interpretation of the Local Maximum Transmit Power for X MHz fields |
| 0 | EIRP |
| 1-7 | Reserved |

NOTE - This table is only expected to be updated if regulatory domains mandate the use of transmit power control with limits than cannot be converted into an EIRP value per PPDU bandwidth.

Local Maximum Transmit Power for X MHz fields (where X = 20, 40, 80 or 160/80+80) define the local maximum transmit power limit of the transmission bandwidth X MHz. Each Local Maximum Transmit Power for X MHz field is each encoded as an 8-bit 2's complement signed integer in the range of -64 dBm to 63 dBm with a 0.5 dB step. The value of 63.5 dBm indicates 63.5 dBm or higher (i.e. no local maximum transmit power constraint).

**8.4.2.<editorToAssignXXX1> Channel Switch Wrapper element**

The Channel Switch Wrapper contains sub-elements that indicate characteristics of the BSS after a channel switch. The format of the Channel Switch Wrapper element is defined in Figure 8-yyyyNEW-3.

Figure 8-yyyyNEW-3: Format of the Channel Switch Wrapper element

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | Zero or one | Zero or one | Zero or more |
|  | Element ID | Length | New Country subelement | Wide Bandwidth Channel Switch subelement | New VHT Transmit Power Envelope subelement |
| Octets |  |  | Variable | Variable | Variable |

The Element ID field is set to the value for the Channel Switch Wrapper element defined in Table 8-54 (Element IDs).

The New Country subelement is present when an AP performs extended channel switching to a new Country, Operating Class Table or a changed set of Operating Classes relative to the contents of the Country element sent in the Beacon; otherwise this subelement is not present. The format of the New Country subelement is defined to be the same as the format of the Country element (see 8.4.2.10 (Country element)), except that no Subband Triplet fields are present in the New Country subelement. The Country string within the New Country subelement indicates the Country and Operating Class Table of the BSS after extended channel switching and Operating Triplet fields within the New Country subelement indicate the operating classes of the BSS after extended channel switching (see 10.38.1).

The Wide Bandwidth Channel Switch subelement is present when channel switching to a BSS Operating Channel Width of 40 MHz or wider; if switching to a 20 MHz BSS Operating Channel Width then this subelement is not present. The format of the Wide Bandwidth Channel Switch subelement is defined to be the same as the Wide Bandwidth Channel Switch element (see 8.4.2.163), except that when the New Channel Bandwidth field is set to zero, then it signifies a 40 MHz BSS Operating Channel Width only. The Wide Bandwidth Channel Switch subelement indicates the BSS operating bandwidth after channel switching (see 10.38.1).

***Note to reader (not for inclusion in the draft): the alternative to the above refinement of the New Channel Bandwidth field is to include a Secondary Channel Offset subelement, but this is more bloated, doesn’t add any value to 11n STAs (since they don’t understand the channel wrapper without an upgrade, and then the upgrade could instead inform them of the Wide Bandwidth Channel Switch element instead), and in March the direction was to dispense with the Secondary Channel Offset subelement .***

Each New VHT Transmit Power Envelope subelement that is present is defined to have the same format as the VHT Transmit Power Envelope element (see 8.4.2.164) and includes a distinct value of the Local Maximum Transmit Power Units Interpretation. Each New VHT Transmit Power Envelope subelement indicates the local maximum transmit powers for the BSS for the indicated bandwidths with an indicated units interpretation after channel switching (see 10.38.1).

***TGac editor: Delete section 8.4.2.165 Extended Power Constraint elementand notify the ANA that the element ID is released***

**8.5.2.6 Channel Switch Announcement frame format**

***Change Figure 8-436 as follows (adding Wide Bandwidth Channel Switch, and New VHT Transmit Power Envelope elements):***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  | Zero or one | Zero or more |
|  | Category | Spectrum Management Action | Channel Switch Announcement element | Secondary Channel Offset element | Mesh Channel Switch Parameters element | Wide Bandwidth Channel Switch element | New VHT Transmit Power Envelope element |
| Octets: | 1 | 1 | 5 | 3 | 6 | 0 or 5 | Variable |

***Change the last 2 paragraphs of this subclause and insert subsequent paragraphs as follows:***

The Secondary Channel Offset element is defined in 8.4.2.22 (Secondary Channel Offset element). This element is present when switching to a 40 MHz or wider channel (in which case the Secondary Channel Offset field of this element represents the position of the secondary 20 MHz channel relative to the primary 20 MHz channel). It may be present when switching to a 20 MHz channel (in which case the Secondary Channel Offset field is set to SCN).

The Mesh Channel Switch Parameters element is defined in 8.4.2.105. This element is present when a mesh STA performs an MBSS channel switch. Otherwise, t~~T~~he Mesh Channel Switch Parameters element is not present ~~included for channel switch other than MBSS~~.

The Wide Bandwidth Channel Switch element is defined in 8.4.2.163 (Wide Bandwidth Channel Switch element). This information element is present when switching to a channel width wider than 40 MHz.

Each New VHT Transmit Power Envelope element that is present is defined to have the same format as the VHT Transmit Power Envelope element (see 8.4.2.164) and includes a distinct value of the Local Maximum Transmit Power Units Interpretation. If present, the New VHT Transmit Power Envelope element indicates the local maximum transmit powers for the BSS for the indicated bandwidths with an indicated units interpretation after channel switching (see 10.38.1).

**8.5.8.7 Extended Channel Switch Announcement frame format**

The Extended Channel Switch Announcement frame is transmitted by an AP in an infrastructure BSS, a STA in an IBSS, or a mesh STA in an MBSS to advertise a channel switch. The format of the Extended Channel Switch Announcement frame Action field is shown in Figure 8-449.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  | Zero or one | Zero or one | Zero or more |
|  | Category | Public Action | Channel Switch Mode | New Operating Class | New Channel Number | Channel Switch Count | Mesh Channel Switch Parameters element | New Country element | Wide Bandwidth Channel Switch element | New VHT Transmit Power Envelope element |
| Octets: | 1 | 1 | 1 | 1 | 1 | 1 | 6 | Variable | Variable | Variable |

The Category field is set to the value for public action defined in Table 8-38.

The Public Action field is set to indicate an Extended Channel Switch Announcement frame, as defined in

Table 8-210.

The Channel Switch Mode, New Operating Class, New Channel Number, and Channel Switch Count fields are as described in the Extended Channel Switch Announcement element (see 8.4.2.55).

Mesh Channel Switch Parameters element is defined in 8.4.2.105. This element is present when a mesh STA performs MBSS channel switch. The Mesh Channel Switch Parameters element is not included for channel switch other than the MBSS channel switch.

The New Country element is present when an AP performs extended channel switching to a new Country, Operating Class Table or a changed set of Operating Classes relative to the contents of the Country element sent in the Beacon; otherwise this element is not present. The format of the New Country element is defined to be the same as the format of the Country element (see 8.4.2.10 (Country element)), except that no Subband Triplet fields are present in the New Country element. The Country string within the New Country element indicates the Country and Operating Class Table of the BSS after extended channel switching and Operating Triplet fields within the New Country element indicate the operating classes of the BSS after extended channel switching (see 10.38.1).

This Wide Bandwidth Channel Switch element is present when extended channel switching to a channel width wider than 40 MHz; otherwise this element is not present. The Wide Bandwidth Channel Switch element is defined in 8.4.2.163 (Wide Bandwidth Channel Switch element). The Wide Bandwidth Channel Switch element indicates the BSS operating bandwidth after extended channel switching (see 10.38.1).

Each New VHT Transmit Power Envelope element that is present is defined to have the same format as the VHT Transmit Power Envelope element (see 8.4.2.164) and includes a distinct value of the Local Maximum Transmit Power Units Interpretation. If present, the New VHT Transmit Power Envelope element indicates the maximum transmit powers for the BSS for the indicated bandwidths with an indicated units interpretation after extended channel switching (see 10.38.1).

**8.5.13.7 TDLS Channel Switch Request frame format**

***Insert a row for Order 8 in Table 8-244 as follows:***

**Table 8-244—Information for TDLS Channel Switch Request frame**

|  |  |  |
| --- | --- | --- |
| Order | Information | Notes |
| 8 | Wide Bandwidth Channel Switch | Wide Bandwidth Channel Switch element (optional). The Wide Bandwidth Channel Switch element is included when a switch to an 80 MHz, 160 MHz or 80+80 MHz direct link is indicated. See 8.4.2.163 (Wide Bandwidth Channel Switch element). |
| 9 | Country | Country element (optional). The Country element is included to change operating classes when a switch to a direct link is indicated. The Country element indicates the same country as the BSS and includes zero Subband Triplet fields. |
| 10 | VHT Transmit Power Envelope | VHT Transmit Power Envelope element (optional). The VHT Transmit Power Envelope element is included for TPC when a switch to a direct link is indicated. |

**9.18.5 Operation with operating classes and the VHT Transmit Power Envelope element**

When dot11OperatingClassesImplemented is true, the following statements apply:

— When dot11OperatingClassesRequired is false, or where operating classes domain information is not present in a STA, that STA is not required to change its operation in response to an element or element-specific Information field that contains an operating class.

— When dot11OperatingClassesRequired is true, or where operating classes domain information is present in a STA, the STA shall indicate current operating class information in the Country element and Supported Operating Classes element, excepting that a VHT STA may omit, from the Country element, any Operating Triplet field for an Operating Class for which the Channel spacing (MHz) column indicates 80 MHz or wider and for which the Behavior limits set column in Annex E contains only any subset of “80+” and “UseEirpForVHTTxPowEnv” (including a blank entry).

***Note to reader, not for inclusion in the draft. The purpose of the Country element in Beacons and Probe Responses is to express regulatory permissions to nearby STAs so that a nearby STA can communicate legally with the sender of the Country element. Operating classes report regulatory permissions and also are overloaded with bandwidth information, yet bandwidth information is already available in the HT/VHT Operation elements and this does not need to be sent twice. For this reason, going forward, we should only include operating triplets in the country element if their operating classes express regulatory permissions (that the nearby STA doesn’t already know by virtue of being allowed by regulators to be sold)***

— When dot11OperatingClassesRequired and dot11ExtendedChannelSwitchActivated are true and a STA is capable of operating as specified in more than one operating class, the STA shall include the Supported Operating Classes element in Association frames and Reassociation frames.

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

A VHT STA that has dot11SpectrumManagementRequired or dot11RadioMeasurementActivated equal to true shall determine a local maximum transmit power from a VHT Transmit Power Envelope element for which the Local Maximum Transmit Power Units Interpretation subfield indicates EIRP.

A STA that sends two or more VHT Transmit Power Envelope elements in a frame shall order the elements by increasing Local Maximum Transmit Power Units Interpretation subfield.

When a VHT STA finds an unknown value in the Local Maximum Transmit Power Units Interpretation subfield in a VHT Transmit Power Envelope element, then the STA shall ignore that and subsequent VHT Transmit Power Envelope elements.

A STA that receives two or more VHT Transmit Power Envelope elements in the same frame with known value in the Local Maximum Transmit Power Units Interpretation subfield shall process all the elements according to the local regulations known at the STA.

NOTE – In the case of two VHT Transmit Power Envelope elements received in the same frame by a STA, each with a known Local Maximum Transmit Power Units Interpretation subfield, then the expected possibilities are a) the STA complies with either element (shared spectrum), b) the STA complies with both elements (tightened regulations) or c) the STA complies with the second element (changed regulations).

***Note to reader, not for inclusion in the draft. We could use the 2 reserved bits in the Transmit Power Information field in the VHT Transmit Power Envelope element to make this explicit. But let’s keep them reserved until we see this scenario actually happening.***

**10.8.2 Association based on transmit power capability**

A STA shall provide an AP with its minimum and maximum transmit power capability for the current channel when associating or reassociating, using a Power Capability element in Association Request frames or Reassociation Request frames. An AP may use the minimum and maximum transmit power capability of associated STAs as an input into the algorithm used to determine the local transmit power constraint for any BSS it maintains. The specification of the algorithm is beyond the scope of this standard.

An AP may reject an association or reassociation request from a STA if it considers the STA’s minimum or maximum transmit power capability to be unacceptable. For example, a STA’s power capability might be unacceptable if it violates local regulatory constraints or increases the probability of hidden STAs by a significant degree. The criteria for accepting or rejecting an association or reassociation on the basis of transmit power capability are beyond the scope of this standard.

If the Beacon or Probe Response frame most recently received by a VHT STA that has dot11SpectrumManagementRequired or dot11RadioMeasurementActivated equal to true from an AP includes one or more VHT Transmit Power Envelope elements, then the units of the Minimum Transmit Power Capability and Maximum Transmit Power Capability fields within the Power Capability element sent in the STA’s (Re)Association Request frame to the AP shall be interpreted according to the Local Maximum Transmit Power Units Interpretation subfield in the Transmit Power Information field in the VHT Transmit Power Envelope element (see 8.4.2.164 (VHT Transmit Power Envelope element)) sent first in the Beacon or Probe Response frame; otherwise the units of the Minimum Transmit Power Capability and Maximum Transmit Power Capability fields within the Power Capability element sent in the STA’s (Re)Association Request frame to the AP shall be interpreted as EIRP.

***Note to reader, not for inclusion in the draft. EIRP for transmit power capability aligns 802.11 with industry work***

If a STA sends a Country element, a Power Constraint element and a VHT Transmit Power Envelope element, where the interpretation of the Maximum Transmit Power Level field in the Country element for a 20 or 40 MHz Subband Triplet field is the same as the Local Maximum Transmit Power Units Interpretation subfield, then at least one of local power constraints indicated by the Local Maximum Transmit Power for 20 MHz and Local Maximum Transmit Power for 40 MHz fields in the VHT Transmit Power Envelope element shall be the same as the indicated local power constraint expressed by the combination of Country element and Power Constraint element.

NOTE – An example of when the interpretation of the Maximum Transmit Power Level field in the Country element for a 20 or 40 MHz Subband Triplet field is the same as the Local Maximum Transmit Power Units Interpretation subfield is when both are EIRP.

**10.8 TPC procedures**

**10.8.4 Specification of regulatory and local maximum transmit power levels**

***Change the 2nd paragraph as follows:***

A STA shall determine a local maximum transmit power for the current channel by selecting the minimum of the following:

— Unless the STA is a VHT STA and has received a VHT Transmit Power Envelope element for a channel width of 20 and 40 MHz, ~~A~~any local maximum transmit power received in the combination of a Country element and a Power Constraint element from the AP in its BSS, PCP in its PBSS(11ad), another STA in its IBSS, or a neighbor peer mesh STA in its MBSS and,

— Any local maximum transmit power received in a VHT Transmit Power Envelope element from the AP in its BSS, another STA in its IBSS, or a neighbor peer mesh STA in its MBSS,(#4679) and

— Any local maximum transmit power for the channel regulatory domain known by the STA from other sources.

The Local Power Constraint field of any transmitted Power Constraint element and each Local Maximum Transmit Power for X MHz field (where X = 20, 40, 80 or 160/80+80) in the VHT Transmit Power Envelope element shall be set to a value that allows the mitigation requirements to be satisfied in the current channel.

A STA that transmits a VHT Transmit Power Envelope element shall set the Local Maximum Transmit Power Units Interpretation subfield in the Transmit Power Information field to an allowed value as defined in Annex E.

***Change the 6th paragraph as follows:***

An AP in a BSS, a STA in an IBSS, and a mesh STA in an MBSS shall advertise the regulatory maximum transmit power for that STA’s operating channel in Beacon frames and Probe Response frames using a Country element. An (#4484)AP in a BSS, a (#4484)STA in an IBSS, and a (#4484)mesh STA in an MBSS shall advertise the local maximum transmit power for that STA’s operating channel in Beacon frames and Probe Response frames using the combination of a Country element and a(#4455) Power Constraint element.

A VHT AP in a BSS, a VHT STA in an IBSS, and a VHT mesh STA in a MBSS shall advertise the local maximum transmit power for that STA's operating channel in Beacon frames and Probe Response frames using a VHT Transmit Power Envelope element. The VHT Transmit Power Envelope element element shall include a local power constraint for all channel widths supported by the BSS.(#4484)

VHT STAs that have dot11RadioMeasurementActivated equal to true should be able to reduce their EIRP to 0 dBm.

NOTE: When the local maximum transmit power is set by an AP for radio resource management, a typical low value for the local power constraint is 0 dBm. A STA that cannot reduce its transmit power to this level or below will not be able to associate to the AP.

***EDITORIAL NOTE—P802.11ad inserts a paragraph here to cover PBSS***

***Change the last paragraph as follows:***

Where TPC is being used for radio measurement without spectrum management, the inclusion of a Power Constraint element and an VHT Transmit Power Envelope element in Beacon, DBand Beacon, Announce(11ad) and Probe Response frames shall be optional.

**10.22.6.4.1 General**

A wideband TDLS off-channel TDLS direct link is a 40 MHz, 80 MHz, 160 MHz or 80+80 MHz off-channel TDLS direct link.

A wideband off-channel TDLS direct link may be started if both TDLS peer STAs indicated wideband support in the Supported Channel Width Set field of the VHT Capabilities element included in the TDLS Setup Request frame or the TDLS Setup Response frame.

Switching to a wideband off-channel direct link is achieved by including any of the following information in the TDLS Channel Switch Request frame:

— an Operating Class element indicating 40 MHz Channel Spacing

— Secondary Channel Offset element indicating SCA or SCB

— Wide Bandwidth Channel Switch element indicating 80 MHz/160 MHz/80+80 MHz channel width

The operating class in TDLS Channel Switch Request frame shall have a value representing 5 GHz for the channel starting frequency.

When announcing new TPC parameters for an off-channel direct link, that come into effect at the same time as the switch to the direct link, the TDLS peer VHT STA initiating the switch shall include at least one VHT Transmit Power Envelope element in a transmitted TDLS Channel Switch Request frame. The receipient TDLS peer VHT STA that has dot11SpectrumManagementRequired or dot11RadioMeasurementActivated equal to true shall use the parameters in these received element(s) in the recipient STA’s TPC calculations for the off-channel.

When announcing new operating classes or both a new operating class table index and new operating classes, that come into effect at the same time as the switch to the direct link and that express new regulatory requirements, the TDLS peer VHT STA initiating the switch shall include a Country element in a transmitted TDLS Channel Switch Request frame. The Country element shall contain all the Operating Classes for the off-channel direct link in Operating Triplet fields and zero Subband Triplet fields. The Country element shall include one Operating Triplet field that contains the same Operating Class as the Operating Class field in the same frame. The country indicated by the Country string in the TDLS Channel Switch Request frame shall be equal to the country indicated by the Country string of the BSS. The receipient TDLS peer VHT STA that has dot11MultiDomainCapabilityActivated, dot11SpectrumManagementRequired or dot11RadioMeasurementActivated equal to true shall use the parameters in the received Country element in the TDLS Channel Switch Request frame in order to maintain regulatory compliance.

The TDLS peer STA initiating the switch to the wideband off-channel shall be the DO STA on that channel.

**10.38.1 Basic VHT BSS functionality**

A VHT AP announces a switch of operating channel, operating bandwidth or both, by either

— using the Channel Switch Announcement Element, Channel Switch Announcement Frame or both, following the procedure described in 10.9.8.2 (Selecting and advertising a new channel in an infrastructure BSS)

— using the Extended Channel Switch Announcement Element, Extended Channel Switch Announcement Frame or both, following the procedure described in 10.10 (Extended channel switching

(ECS)) and in addition following the procedures in this section.

A VHT AP can also announce a new Country string (including a new Operating Table index), new operating classes or new TPC parameters for the BSS that come into effect at the same time as the switch of operating channel, operating bandwidth, or both.

The New Channel Number field in the Channel Switch Announcement Element, Extended Channel Switch Announcement Element, Channel Switch Announcement Frame or Extended Channel Switch Announcement Frame, identifies the primary 20 MHz channel after the switch. The value of the New Channel Number field is set equal to dot11CurrentPrimaryChannel (see 22.3.14 (Channelization)) after the switch.

When announcing a switch to a 20 MHz operating bandwidth using the Channel Switch Announcement element in a frame, then neither a Wide Bandwidth Channel Switch element, a Wide Bandwidth Channel Switch subelement nor a Secondary Channel Offset element shall be present in the frame, excepting that a Secondary Channel Offset element may be present in a Channel Switch Annnouncement frame if the Secondary Channel Offset field within the Secondary Channel Offset element is set to SCN.

When announcing a switch to a 20 MHz operating bandwidth using the Extended Channel Switch Announcement element in a frame or the Extended Channel Switch Announcement frame, then the Wide Bandwidth Channel Switch element shall not be present in the same frame.

NOTE— A Secondary Channel Offset element is never present with the Extended Channel Switch Announcement element in a frame or in the Extended Channel Switch Announcement frame. Instead, the indicated operating class within the Extended Channel Switch Announcement element or frame identifies the BSS operating channel bandwidth.

***Note to reader (not for inclusion in the draft). “, either in conjunction with a channel switch or alone” is deleted below since it’s not necessary, and we also allow country switching etc, so this language is somewhat limiting.***

When announcing a switch to a 40 MHz operating bandwidth using the Channel Switch Announcement frame, then the Secondary Channel Offset Element shall be present in the frame.

When announcing a switch to a 40 MHz operating bandwidth using the Channel Switch Announcement element in a Beacon or Probe Response frame, then the Wide Bandwidth Channel Switch subelement shall also be present in the Channel Switch Wrapper element in the same frame.

When announcing a switch to a 40 MHz operating bandwidth using the Extended Channel Switch Announcement element in a Beacon or Probe Response frame, then the Wide Bandwidth Channel Switch subelement may be present in the Channel Switch Wrapper element in the same frame.

NOTE—The indicated operating class within the Extended Channel Switch Announcement element or frame identifies the bandwidth and the relative position of the primary 20 MHz and secondary 20 MHz channels, hence a Channel Switch Wrapper element is not required when the Extended Channel Switch Announcement element only is used.

When announcing a switch to a 80 MHz, 80+80 MHz or 160 MHz operating bandwidth using the Channel Switch Announcement frame, then both the Secondary Channel Offset element and the Wide Bandwidth Channel Switch element shall be present in the frame. When announcing a switch to a 80 MHz, 80+80 MHz or 160 MHz operating bandwidth using the Channel Switch Announcement element or Extended Channel Switch Announcement element, then a Wide Bandwidth Channel Switch element subelement shall be present in the Channel Switch Wrapper element in the same frame as the Channel Switch Announcement element or Extended Channel Switch Announcement element respectively. When announcing a switch to a 80 MHz, 80+80 MHz or 160 MHz operating bandwidth using the Extended Channel Switch Announcement frame, then the Wide Bandwidth Channel Switch element shall be present in the frame.

When announcing a switch to a 80 MHz, 80+80 MHz or 160 MHz BSS operating channel bandwidth by using the Extended Channel Switch Announcement element or Extended Channel Switch Announcement frame, then a), the value of the New Operating Class field identifies the primary 40 MHz channel and b) Operating Triplet fields within the New Country subelement or element respectively shall indicate all the operating class(es) for the switched BSS.

When announcing new TPC parameters for the BSS, that come into effect at the same time as the switch, a VHT AP in a BSS, a VHT STA in an IBSS, and a mesh VHT STA in an MBSS shall include a) at least one New VHT Transmit Power Envelope element in a transmitted Channel Switch Announcement frame or Extended Channel Switch Announcement frame and b) at least one New VHT Transmit Power Envelope subelement in a transmitted Channel Wrapper element in Beacon and Probe Response frames. A receipient VHT STA in the BSS STA that has dot11SpectrumManagementRequired or dot11RadioMeasurementActivated equal to true and that maintains association with the BSS after the switch shall use the parameters in these received elements and subelements in the recipient STA’s TPC calculations for the new operating channel and operating bandwidth (see 10.8 (TPC procedures)). If both New VHT Transmit Power Envelope elements and New VHT Transmit Power Envelope subelements are transmitted for the switch, the set of New VHT Transmit Power Envelope elements and set of subelements shall contain the same set of values for the Local Maximum Transmit Power Units Interpretation subfield, and New VHT Transmit Power Envelope elements and subelements that have the same value for the Local Maximum Transmit Power Units Interpretation subfield shall also have the same values for their other fields.

When announcing a new Country string (including Operating Table index), new operating classes or both, that come into effect at the same time as the switch, a VHT AP in a BSS, a VHT STA in an IBSS, and a mesh VHT STA in an MBSS shall include a) a New Country element in a transmitted Extended Channel Switch Announcement frame and b) a New Country subelement in a transmitted Channel Wrapper element. The New Country element or subelement shall contain all the Operating Classes for the BSS after the switch. The New Country element or subelement, transmitted in an Extended Channel Switch Announcement frame or in the same frame as an Extended Channel Switch Announcement element respectively, shall include one Operating Triplet field that contains the same Operating Class as the New Operating Class field in the Extended Channel Switch Announcement frame or Extended Channel Switch Announcement element. A recipient VHT STA in the BSS STA that has dot11MultiDomainCapabilityActivated, dot11SpectrumManagementRequired or dot11RadioMeasurementActivated equal to true and that maintains association with the BSS after the switch shall use the parameters in these received elements and subelements in order to maintain regulatory compliance. If both New Country elements and New Country subelements are transmitted for the switch, their fields shall be the same.

A Channel Switch Wrapper element shall not be included in Beacons and Probe Responses if the element contains zero subelements.

NOTE – Channel Switch Wrapper is not defined to carry subelements in the case of a switch to 20 MHz and when no change to the Country string, operating classes or TPC parameters are announced.

A VHT STA uses only the VHT Transmit Power Envelope element for TPC of 80, 160 or 80+80 MHz transmissions. A VHT STA shall include zero Subband Triplet fields in a Operating/Subband Sequence field in the Country element of an 80, 160 or 80+ MHz Operating Class.

A STA that advertises a channel switch using one or more Channel Switch Announcement frames or elements, Extended Channel Switch Announcement frames or elements or a , includes a New Country subelement, Wide Bandwidth Channel Switch subelement or a New VHT Transmit Power Envelope subelement in a Channel Wrapper

B.4.12 Spectrum management extensions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item | IUT configuration | References | Status | Support |
| SM1.1 | VHT Transmit Power Envelope element(s) in Beacon and Probe Response frames | 8.4.2.164 (VHT Transmit Power Envelope element) | CF10 & CFac:M | Yes No N/A |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SM20 | Channel switch procedure |  |  |  |
| SM20.1 | Transmission of channel switch announcement and channel switch procedure by an AP | 10.9.8 | (CF1 and CF10):M | Yes No N/A |
| SM20.2 | Transmission of channel switch announcement and channel switch procedure by a STA | 10.9.8 | (CF2.1 and CF10):M | Yes No N/A |
| SM20.3 | Reception of channel switch announcement and channel switch procedure by a STA | 10.9.8 | CF10:M | Yes No N/A |
| SM20.4 | Transmission of channel wrapper element and procedures, in conjunction with channel switch announcement or extended channel switch announcement | 10.38.1 | (CF1 or (CF2 and CF2.2) or CF21) and (CF10 or CF13) and CFac:M | Yes No N/A |
| SM20.5 | Reception of channel wrapper element and procedures, in conjunction with channel switch announcement or extended channel switch announcement | 10.38.1 | (CF2 or CF21) and (CF10 or CF13) and CFac:M | Yes No N/A |

**Table D-2—Behavior limits sets**

|  |  |  |
| --- | --- | --- |
| Encoding | Behavior limits set | Description |
| 19 | 80+ | In an channel bandwidth that contains two or more frequency segments, the frequency segment that does not contain the primary 80 MHz channel (see Note 2) |
| 20 | UseEirpForVhtTxPowEnv | A STA that sends one or more VHT Transmit Power Envelope elements shall indicate EIRP in the Local Maximum Transmit Power Units Interpretation subfield in one of the VHT Transmit Power Envelope elements |
| 21-255 | Reserved | Reserved |
| NOTE 1—The fields that specify the 40 MHz channels are described in 20.3.15.4.  NOTE 2 - For an example using an operating class with an 80+ Behavior limit, see 8.4.2.10 (Country element). | | |

***TGac editor: As well as the changes marked below, in all tables in Annex E, in the Behavior Limits column, for all existing rows except the header row, insert “UseEirpForVHTTxPowEnv” or “, UseEirpForVHTTxPowEnv” as appropriate***

**Table E-1—Operating classes in the United States**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| ~~34~~-35-127 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| <AssignedByANA. ANA – please we must use 128 here to align with global table>128 | 128 | 5 | 80 | - | 42, 58, 106, 122, 138, 155 |  |
| <AssignedByANA. ANA – please we must use 128 here to align with global table>129 | 129 | 5 | 160 | - | 50, 114 |  |
| <AssignedByANA. ANA – please we must use 130 here to align with global table>130 | 130 | 5 | 80 | - | 42, 58, 106, 122, 138, 155 | 80+ |
| 131-255 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |

**Table E-2—Operating classes in Europe**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| ~~18~~19-127 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| <AssignedByANA. ANA – please we must use 128 here to align with global table>128 | 128 | 5 | 80 | - | 42, 58, 106, 122 |  |
| <AssignedByANA. ANA – please we must use 128 here to align with global table>129 | 129 | 5 | 160 | - | 50, 114 |  |
| <AssignedByANA. ANA – please we must use 130 here to align with global table>130 | 130 | 5 | 80 | - | 42, 58, 106, 122 | 80+ |
| 131-255 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |

**Table E-3—Operating classes in Japan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| ~~60~~60-127 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| <AssignedByANA. ANA – please we must use 128 here to align with global table>128 | 128 | 5 | 80 | - | 42, 58, 106, 122 |  |
| <AssignedByANA. ANA – please we must use 129 here to align with global table>129 | 129 | 5 | 160 | - | 50, 114 |  |
| <AssignedByANA. ANA – please we must use 130 here to align with global table>130 | 130 | 5 | 80 | - | 42, 58, 106, 122 | 80+ |
| 131-255 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |

**Table E-4—Global Operating classes**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Operating class | Global operating class (see Table E-4) | Channel starting frequency (GHz) | Channel spacing (MHz) | Channel set | Channel center frequency index | Behavior limits set |
| 128 | E-1-<NoteAnaDependence>128,E-2-<NoteAnaDependence>128, E-3-<NoteAnaDependence>128 | 5 | 80 | - | 42, 58, 106, 122, 138, 155 |  |
| 129 | E-1-<NoteAnaDependence>129,E-2-<NoteAnaDependence>129,E-3-<NoteAnaDependence>129 | 5 | 160 | - | 50, 114 |  |
| 130 | E-1-<NoteAnaDependence>130,E-2-<NoteAnaDependence>130,E-3-<NoteAnaDependence>130 | 5 | 80 | - | 42, 58, 106,  122, 138,  155 | 80+ |
| 131-179 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |

NOTE 1—The following example Country element (see Figure 8-90) describes USA operation (‘55’, ‘53’) using both

Table E-1 class 12 (non-global) and Table E-4 class 81 (global) for 2.4 GHz band, 11 channels at 100 mW limit (in

hexadecimal): ‘07’, ‘0F’, ‘55’, ‘53’, ‘04’, ‘C9’, ‘0C’, ‘0’, ‘01’, ‘0B’, ‘64’, ‘C9’, ‘51’, ‘0’, ‘01’, ‘0B’, ‘64’.

NOTE 2—The following example Country element describes US operation for a 80+80 MHz BSS using Table E-4 classes 116, 128 and 130 at a 100 mW limit for 40 MHz. the contents (in decimal) are: ‘07’ [Country element ID], ‘18’ [Length], ‘85’, ‘83’, ‘04’ [Country string indicating US and Table E-4], ‘201’, ‘116’, ‘0’ [Operating Triplet field for 20/40 with 20 on the lower 20 MHz], ‘36’, ‘1’, ‘20’ [Subband triplet field indicating 20 dBm on the 40 MHz channel 36+40], ‘201’,’128’, ‘0’ [Operating Triplet field for 80 MHz] , ‘201’, ‘130’, ‘0’, ‘201’, ‘128’, ‘0’ [Pair of Operating Triplet field indicating 80+80 MHz]. The Operating Triplet fields for 80 and 80+80 MHz only express BSS operating channel bandwidths rather than specific regulatory permissions so are optional.