IEEE P802.11
Wireless LANs

|  |
| --- |
| RegInfo Back Compatibility for 6 GHz LPI and Standard Power |
| Date: 2023-11-1 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Thomas Derham | Broadcom |  |  | thomas.derham@broadcom.com |
| Brian Hart | Cisco Systems |  |  |  |
| Hassan Yaghoobi | Intel |  |  |  |

Abstract

This submission proposes text that defines a back-compatible means for an AP to signal it is operating a BSS under both LPI and SP rules, and some related clarifications.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CID | Clause | Page | Line | Comment | Proposed Change |
| 6077 | E.2.7 | 5545 | 17 | Value 4 may have backwards compatibility issues. | Instead use 0 to signal LPI and another (currently reserved) bit to signal "+ indoor SP" |
| 6078 | E.2.7 | 5545 | 11 | Is there any regulatory use for value 3 in Table E-12? If not allowed, it is misleading in that it implies an option that is not actually available. | Delete value 3. Delete Note 2 below. |

***Discussion:***

The Regulatory Info field in HE Operation element carries information related to regulatory rules specific to the country and band the BSS is operating in.

In REVme D4.1, for 6 GHz operation, value 4 of this field is defined (see Annex E.2.7) to indicate an AP that meets the criteria of both an LPI Access Point and SP Access Point. For example, in the US, such an AP would have regulatory certification as a Composite Device with both 6ID (LPI Access Point) and 6SD (SP Access Point) classes. The AP can then operate a single BSS in which non-AP STAs have regulatory certification as any combination of 6CD (dual client), 6XD (LPI client), 6FX (SP client), 6PP (subordinate) and 6FC (fixed client), whereby those non-AP STAs operate under regulatory control of that AP.

The same approach also applies to other countries where both LPI and SP operation is defined.

However, most existing 6 GHz STAs in the field do not understand this value, since it was Reserved in 802.11ax-2020, and was originally defined in a subsequent draft of REVme.

While other workarounds to this issue are possible, they all have significant deficiencies, e.g.:

* Deploying 2 BSSs (one advertising RegInfo=0 and the other advertising RegInfo=1) increases beacon and mcast overhead, and causes issues with management of AP MLDs
* Time-based switching of the BSS between different “modes” (RegInfo=0 or RegInfo=1) would be very hard to manage and substantially reduce the utility of SP (e.g. AP would need to return to LPI mode when LPI-only clients are expected to be present, which generally results in lower power for the SP/dual clients too)

Therefore, a backwards-compatible extension to the RegInfo field is proposed to handle this issue.

This proposal also provides some additional flexibility to handle additional regulatory signaling that might be needed in the future as regulatory rules are clarified.

In addition, various clarification text is proposed regarding the use of TPE contents.

***Proposed resolution for CID 6078:***

REJECT. Value 3 is used to indicate an 802.11 AP operated by a device in a regulatory mode that permits a certain power limit based on reception of an enabling signal from an indoor AP (e.g. in LPI Client-to-Client communications as described in FCC’s FNRPM of Nov 1 2023). Whether or not a non-AP STA that associates with such an AP needs to know the AP’s regulatory operating mode in order to determine its own transmit power, is dependent on regulatory rules which are in general not yet finalized. Since this value is already defined in REVme, it is prudent to leave it as-is until regulatory requirements are clear.

***Proposed resolution for CID 6077:***

REVISED. Agree in principle; adopt changes as per CID 6077 in 11-23-1903r0.

***TGme editor: make the following changes under the indicated CIDs***

* + - 1. HE Operation element

<snip>

The 6 GHz Operation Information field provides channel and bandwidth information related to 6 GHz operation (see 27.3.23.2 (Channel allocation in the 6 GHz band)). The format of the 6 GHz Operation Information field is defined in Figure 9-876 (6 GHz Operation Information field format(11ax)).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  | Primary Channel | Control | Channel Center Frequency Segment 0 | Channel Center Frequency Segment 1 | Minimum Rate |
| Octets: | 1 | 1 | 1 | 1 | 1 |
| * 6 GHz Operation Information field format(11ax)
 |

The Primary Channel field indicates the channel number of the primary channel in the 6 GHz band.

The Control field is defined in Figure 9-877 (Control field format(11ax)).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0         B1 | B2 | B3        B6 |         B7 |
|  | Channel Width | Duplicate Beacon | Regulatory Info | Reserved |
| Bits: | 2 | 1 | 4 | 1 |
| * Control field format(11ax)
 |

* Operation with the Transmit Power Envelope element

A STA that (11ax)is not operating in the 6 GHz band, is extended spectrum management capable, and(11ax) has dot11SpectrumManagementRequired or dot11RadioMeasurementActivated equal to true shall determine a local maximum transmit power from a Transmit Power Envelope element for which (11ax)the Maximum Transmit Power Interpretation subfield indicates EIRP.

(11ax)A STA that is operating in the 6 GHz band shall determine local and regulatory client maximum transmit powers from Transmit Power Envelope element(s) and other sources known to the STA, according to local regulations known at the STA (see 11.7.5 (Specification of regulatory and local maximum transmit power levels) and E.2.7 (6 GHz band(11ax)(#600))). A STA shall ignore Transmit Power Envelope element(s) indicating transmit power category values that the STA is unable to interpret for the current country.

NOTE 1—The Default category value (0) is applicable to, and so can be interpreted for, all countries (see 11.7.5 (Specification of regulatory and local maximum transmit power levels)). An AP in the 6 GHz band has dot11SpectrumManagementRequired equal to true and therefore transmits a Country element in Beacon and Probe Response frames.(11ax)

* Specification of regulatory and local maximum transmit power levels

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

* Any regulatory maximum transmit power received in a Country element from the AP in its BSS, PCP in its PBSS, another STA in its IBSS, or a neighbor peer mesh STA in its MBSS
* If the STA is extended spectrum management capable, any regulatory client maximum transmit power applicable to the STA (see E.2 (Band-specific operating requirements)) that is received in a Transmit Power Envelope element from the AP in its BSS, another STA in its IBSS, or a neighbor peer mesh STA in its MBSS.(11ax)
* Any regulatory maximum transmit power for the channel in the current regulatory domain known by the STA from other sources

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

* Unless the STA is extended spectrum management capable and has received a Transmit Power Envelope element for a channel width of 20 MHz and 40 MHz, 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, another STA in its IBSS, or a neighbor peer mesh STA in its MBSS
* If the STA is extended spectrum management capable, any local maximum transmit power applicable to the STA (see E.2 (Band-specific operating requirements)) that is received in a Transmit Power Envelope element from the AP in its BSS, another STA in its IBSS, or a neighbor peer mesh STA in its MBSS
* Any local maximum transmit power for the channel (11ax)in the current regulatory domain known by the STA from other sources

NOTE 1—A STA might receive a maximum transmit power in a Transmit Power Envelope element from the AP in its BSS, another STA in its IBSS, or a neighbor peer mesh STA in its MBSS in various management frames, including Beacon frames, Probe Response frames, FILS Discovery frames, and (prior to a channel switch) New Transmit Power Envelope elements (in Channel Switch Wrapper elements, Future Channel Guidance elements, Channel Switch Announcement elements/frames, or Extended Channel Switch Announcement elements/frames). Other sources from which a STA might receive a maximum transmit power for a channel include Reduced Neighbor Report elements (20 MHz PSD subfield) sent by a ((#2210)colocated) AP. If this information is received by a STA, any requirements on its usage depend on local regulations known at the STA (see E.2 (Band-specific operating requirements)).(11ax)

NOTE 2—The determination of a maximum transmit power from Transmit Power Envelope element(s) is specified in 10.22.4 (Operation with the Transmit Power Envelope element).(11ax)

* 6 GHz band(11ax)(#600)

(#600)When operating in the 6 GHz band, Table E-4 (Global operating classes) is used for the operating classes, so the third octet of the dot11CountryString is 4. For example, when operating in the 6 GHz band in the United States, the Country String field in the Country element is set to (in hexadecimal) 0x55, 0x53, 0x04.

NOTE 1—The first two octets indicate the United States. The third octet indicates that Table E-4 (Global operating classes) is in use (see Annex C).

The Regulatory Info subfield in the Control field of the 6 GHz Operation Information field of the HE Operation element (#4019)expresses the current operational mode of the AP and is interpreted by STAs with dot11ExtendedRegInfoSupport set to false as shown in Table E-12 (Regulatory Info subfield interpretation by STAs with dot11ExtendedRegInfoSupport set to false(#600)), and is interpreted by STAs with dot11ExtendedRegInfoSupport set to true as shown in Table E12bis (Regulatory Info subfield interpretation by STAs with dot11ExtendedRegInfoSupport set to true), when operating in the 6 GHz band.

NOTE – STAs with dot11ExtendedRegInfoSupport set to false parse bits B3 thru B5 of the Control field as the Regulatory Info subfield, and ignore bit B6 of the Control field.

Each regulatory domain might have additional regulations for each Regulatory Info subfield value. Operation in such regulatory domains is subject to the additional regulations. Some values defined in Table E-12 (Regulatory Info subfield encoding(#600)) might not be valid in all regulatory domains. If a certain Regulatory Info subfield encoding value is not valid in a regulatory domain, then the value is not used when operating in that regulatory domain.(#600)

|  |
| --- |
| * Regulatory Info subfield interpretation by STAs with dot11ExtendedRegInfoSupport set to false(#600)
 |
| Value | Description |
| 0 or 8 | Indoor APAn AP whose operation does not require control from an external system such as an Automated Frequency Coordination (AFC) system but operates under regulatory rules requiring indoor operation, and is subject to additional regulatory requirements intended to prohibit outdoor operation. |
| 1 or 9 | Standard power APAn AP whose operation requires control from an external system such as an AFC system. |
| 2 or 10 | Very low power APAn AP whose operation does not require control from an external system such as an AFC system, is not subject to additional regulatory requirements intended to prohibit outdoor operation, and is restricted to very low transmit power.NOTE – A STA 6G conformant with a previous revision of this standard might not be able to interpret these values.  |
| 3 or 11 | Indoor enabled APAn AP whose operation relies on being able to successfully receive an enabling signal (as defined by the regulatory rules) from an indoor AP or an indoor standard power AP.NOTE – A STA 6G conformant with a previous revision of this standard might not be able to interpret these values. |
| 4 or 12 | Indoor standard power AP (deprecated)An AP whose operation requires control from an external system such as an AFC system and that is subject to additional regulatory requirements intended to prohibit outdoor operation.NOTE – A STA 6G conformant with a previous revision of this standard might not be able to interpret these values. |
| 5 or 13(#4020) | Reserved |
| 6 or 14 | Reserved |
| 7 or 15(#4020) | AP role not relevant.An AP whose operation does not affect the regulated behavior of associated or enabled devices.NOTE—For instance, the transmission of Transmit Power Envelope elements by the AP might suffice.NOTE – A STA 6G conformant with a previous revision of this standard might not be able to interpret these values. |

﻿

|  |
| --- |
| Table E12bis - Regulatory Info subfield interpretation by STAs with dot11ExtendedRegInfoSupport set to true |
| Value | Description |
| 0 | Indoor APAn AP whose operation does not require control from an external system such as an Automated Frequency Coordination (AFC) system but operates under regulatory rules requiring indoor operation, and is subject to additional regulatory requirements intended to prohibit outdoor operation. |
| 1 | Standard power APAn AP whose operation requires control from an external system such as an AFC system. |
| 2 | Very low power APAn AP whose operation does not require control from an external system such as an AFC system, is not subject to additional regulatory requirements intended to prohibit outdoor operation, and is restricted to very low transmit power. |
| 3 | Indoor enabled APAn AP whose operation relies on being able to successfully receive an enabling signal (as defined by the regulatory rules) from an indoor AP or an indoor standard power AP. |
| 4 | Reserved |
| 5 | Subordinate DeviceAn AP that operates under the control of an indoor AP or an indoor standard power AP, and that is subject to additional regulatory requirements intended to prohibit outdoor operation. |
| 6 | Reserved |
| 7(#4020) | AP role not relevant.An AP whose operation does not affect the regulated behavior of associated or enabled devices.NOTE—For instance, the transmission of Transmit Power Envelope elements by the AP might suffice. |
| 8 | Indoor standard power APAn AP whose operation requires control from an external system such as an AFC system and also operates under regulatory rules requiring indoor operation, and is subject to additional regulatory requirements intended to prohibit outdoor operation.  |
| 9-15 | Reserved |

In Table E-12 (Regulatory Info subfield encoding(#600)) and Table E-12bis, a WLAN STA is not an external system.

NOTE 2—For example, an indoor enabled AP is not a standard power AP because the indoor AP or the indoor standard power AP (from which the indoor enabled AP receives the enabling signal) are not external systems.(#600)

(#600)The value 8 (indoor standard power AP) for the Regulatory Info subfield is used instead of the value 0 (indoor AP) when the transmit power for all or part of the indoor AP’s BSS bandwidth is controlled by an external system such as an AFC system.

The Maximum Transmit Power Category subfield in the Transmit Power Information field of the Transmit Power Envelope element is interpreted as shown in Table E-13 (Maximum Transmit Power Category subfield encoding(#600)) when operating in the 6 GHz band. This table describes the non-AP STAs for which a Transmit Power Envelope element with a given Maximum Transmit Power Category value is applicable. Each regulatory domain might have additional regulations for each Maximum Transmit Power Category subfield value. Operation in such regulatory domains is subject to the additional regulations. Some values defined in Table E-13 (Maximum Transmit Power Category subfield encoding(#600)) might not be valid in all regulatory domains. If a certain Maximum Transmit Power Category subfield encoding value is not valid in a regulatory domain, then the value is not used when operating in that regulatory domain.

|  |
| --- |
| * Maximum Transmit Power Category subfield encoding(#600)
 |
| Value | Description |
| 0 | Default |
| 1 | Subordinate deviceA device that operates under the control of an indoor AP with additional requirements specified by the regulatory domain in which the AP is operating.(#600) |
| 2–3 | Reserved |

(#600)

(#600)An AP operating in the 6 GHz band shall send at least one Transmit Power Envelope element in Beacon and Probe Response frames as follows:

* Maximum Transmit Power Category subfield = Default; Unit interpretation = (#3452)Regulatory client EIRP PSD

(#600)When operating in the 6 GHz band in a regulatory domain in which a subordinate device (see Table E-13 (Maximum Transmit Power Category subfield encoding(#600))) is supported, an AP that is an indoor AP or indoor standard power AP per regulatory rules shall also send the following Transmit Power Envelope element in Beacon and Probe Response frames:

* Maximum Transmit Power Category subfield = Subordinate device; Unit interpretation = Regulatory client EIRP PSD

A regulatory client EIRP PSD value advertised by an AP that is a standard power AP or indoor standard power AP shall be set to the highest value that meets the authorized client transmit power limits for the corresponding category obtained from the external system required by the regulatory rules, such as an AFC system, and any other client PSD regulatory rules for the corresponding 20 MHz channel.(#600)

If the regulatory client EIRP PSD values advertised by an AP that is a (#600)standard power AP or indoor standard power AP are insufficient to ensure that regulatory client limits on total EIRP are always met for all transmission bandwidths within the bandwidth of the AP’s BSS, the AP shall also send a Transmit Power Envelope element in Beacon and Probe Response frames as follows:

* Maximum Transmit Power Category subfield = Default; Unit interpretation = Regulatory client EIRP

NOTE 3—In the case of regulatory rules where the maximum transmit power for client devices is lower than the maximum transmit power for APs(#600), the regulatory client maximum transmit power advertised by the AP for client devices might be lower than the regulatory client maximum transmit power the AP is authorized to use for its own transmissions.

If a non-AP STA receives a Transmit Power Envelope element with Maximum Transmit Power Category subfield that is not applicable to that STA, the STA may ignore that element.

NOTE 4—For example, if the non-AP STA is a (#600)subordinate device per regulatory rules and receives a Transmit Power Envelope element with Maximum Transmit Power Category subfield indicating (#600)a subordinate device, it may ignore any other received Transmit Power Envelope elements that indicate other values in the Maximum Transmit Power Category subfield.(#600)

NOTE 5--For example, if the non-AP STA is a device that, per regulatory rules, determines its regulatory client transmit power entirely using sources other than the AP (see 11.7.5 (Specification of regulatory and local maximum transmit power levels), it can ignore all received Transmit Power Envelope elements with unit interpretation of Regulatory Client EIRP PSD or Regulatory Client EIRP from that AP.

**Annex C**

﻿**ASN.1 encoding of the MAC and PHY MIB
C.3 MIB detail**

﻿Dot11StationConfigEntry ::= SEQUENCE

{

<snip>

 Dot11NoAuthPASNActivated TruthValue,

 Dot11ExtendedReginfoSupport TruthValue

}

dot11ExtendedReginfoSupport OBJECT-TYPE

 SYNTAX TruthValue

 MAX-ACCESS read-only

 STATUS current

 DESCRIPTION

 “This is a capability variable.

 Its value is determined by STA capabilities.

 This attribute, when true, indicates the station implementation interprets the Regulatory info subfield of 6 GHz Operation Information field of HE Capability element per Table E12bis. Otherwise, the station implementation interprets the subfield per Table E12.”

 ::= { dot11StationConfigEntry <REVme editor to populate> }