###  **IEEE P802.11Wireless LANs**

|  |
| --- |
| 6 GHz Indoor SP AP TPE and Connectivity Signalling |
| Date: 2023-11-13 |
| Author(s): |
| Name | Affiliation | Address | Phone | Email |
| Brian Hart | Cisco Systems |  |  | brianh@cisco.com |
| Binita Gupta | Cisco Systems |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

**Abstract**

CID 6076

**Revisions:**

* Rev 0: Initial version of the document.
* Rev 1: Fixes editorials identified in the chat during the first presentation on 2023-11-06.
* Rev 2: Fixes further editorials identified offline.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6076 | E.2.7 | 5544 | 27 | 1) Depending on circumstances, APs might get more power as an Indoor AP (IAP) or as a SP AP (SPAP). Therefore, APs are motivated to be FCC-certified as both SPAPs and IAPs. 2) Although arguably Part 15.407 as written does not prohibit an AP being both at the same time, this was not initially anticipated and adjustments with FCC Labs (OET) may be required, yet may not pan out of may be unrealistically onerous. 3) For the AP, if it has to choose between SPAP xor IAP mode, maximizing power is secondary to maximizing client connectivity. 4) Although there is no such thing in Part 15.407 as an indoor client or a SP client, only a client operating under the control of an indoor/SP AP, still some clients in the field can only operate under the control of an indoor access point. 5) Then, in order for an AP to make the IAP/SPAP choice that maximizes client connectivity, it is important for the AP to know each client’s 6 GHz capabilities and really to know them before assoc (e.g., else a SPAP never knows if it should be operating as an IAP). | Add client capability signaling: can the client operate under the control of an IAP or under the control of an SPAP? This can positively indicate that the client is a "modern" client. (The absence of such signaling indicates that the client probably can only operate under the control of an IAP.) Include such signaling in probe req and (re)assoc req, Two bits in the Extended Capabilities element is a reasonable choice. | RevisedGenerally, in agreement with commenter. See changes under CID 6076 (Parts I, II and III) in doc 23/104 <motionedRevision> |

# Motivation

In communication systems, two devices that wish to communicate may have different capabilities. Maximum interoperability is achieved if features are cumulative:

* Better: device A supports feature X and Y; device B supports features X, Y and Z; so they can use both features X and Y between themselves
* Worse: device A supports feature X and Y; device B supports features X and Z; so they can only use feature X between themselves
* Worst: device A supports feature X; device B supports feature Y; so they *cannot* communicate among themselves

We regard cumulative capability as interoperability best practice.

Ignoring subordinate devices and fixed clients, FCC regulations refer only to clients operating in different modes (under the control of a LPI AP or under the control of a SP AP), still FCC KBDs and tests define different client classes. Worse, the AP and client device classes don’t align well with interoperability best practice: we have indoor only clients, SP only clients and dual clients (etc), and LPI APs and SP APs such that:

* LPI only clients cannot interoperate with (indoor) SP APs
* SP only clients cannot interoperate with LPI APs



Perfect client-side mitigation does not seem to be possible:

* Many LPI only clients have already been certified (may more LPI only clients than dual clients)
* Despite discussions, FCC testing continues to allow indoor only clients to be certified.
* Despite discussions, some products continue to be certified as indoor only clients.

That is, a customer could have acquired a 6 GHz-capable AP and a 6 GHz capable client, but they are unable to actually use 6 GHz. This might lead to frustration and support calls, and it is desirable to proactively minimize the likelihood of this situation, and provide troubleshootability in the corner cases where this is not possible.

Therefore, a potential mitigation is the composite AP:

A composite AP is simultaneously an LPI AP and a SP AP. It has one BSSID.

|  |
| --- |
| Since an SP AP cannot operate on spectrum that does not permit SP operation, a composite AP cannot operate on spectrum that does not permit SP operation (still, composite APs can operate on approx. 2/3rd of the 6 GHz spectrum allocated by the FCC).Since an LPI AP must operate indoors, a composite AP cannot operate outdoors. Therefore, the only interoperability limitation of a composite AP is that it cannot solve the case of an LPI only client that wishes to connect to an outdoor AP.We recommend that clients, if possible, be dual certified. This offers them:* The option to use higher UL power with a SP AP or composite AP
* The option to connect to an outdoor AP at 6 GHz
 |

Since a composite AP can support LPI only, SP only and dual clients, each with different regulatory limits, the current Transmit Power Envelope signaling is not sufficient and we propose two options for the path forwards, with changes in the subfields of the Transmit Power Information field in the TPEe.



Importantly, since no SP only clients have been certified to date, legacy SP only clients require little consideration.

As part of this CID, we also clarify how the EIRP PSD fields (with 20 MHz resolution) in TPEe are populated given an AFC frequency response (with 1 MHz resolution).

As part of this CID, we also add client connectivity signaling.

# Proposal

This document addresses three sub-topics:

* Part I: TPE signaling for all of LPI, SP and dual clients
	+ Options B and D
	+ We propose option B unless interop issues are identified; and then we propose option D as a fallback. **Feedback is solicited. We need to down-select to a single option.**
* Part II: Clarification of TPE signaling when the AP obtains an AFC frequency response.
* Part III Client connectivity signaling, to assist with troubleshooting connectivity.

# Part I: TPE signaling for all of LPI, SP and dual clients

## Part I: Overview of Options

Option B:

* Composite AP uses legacy signaling to indicate itself as an LPI only AP then new signaling to indicate itself as a composite AP.
* Composite AP uses legacy TPEe signaling to indicate a max power limit equal to **max(LPI only client power limit, SP only client power limit)** then further, new TPEe signaling to indicate the max power limit for SP only clients. **LPI only clients follow the known regulations.**

Option D:

* Composite AP uses legacy signaling to indicate itself as an LPI only AP then new signaling to indicate itself as a composite AP.
* Composite AP uses legacy TPEe signaling to indicate the max power limit **for LPI only** clients then further, new TPEe signaling to indicate the max power limit for SP only clients. **Dual clients consume both elements according to the regulations.**

## Part I: Pros and Cons of the Options

Option B:

* Pros:
	+ For a typical LPI or dual client implementation, no client TPEe processing changes are required.
	+ Thus, we propose this as the preferred option.
* Cons
	+ Small potential for a backwards compatibility issue: if there exist any legacy clients that respond erratically when presented with what is apparently an LPI only AP that populates the regulatory TPEe with a higher-than-expected value.
	+ Small potential for a backwards compatibility issue: if AFC SP power < LPI power, a legacy SP client could transmit at too high a power (however, no such SP only clients are certified to date)

Option D

* Cons:
	+ For a typical dual client implementation, client TPEe processing changes are required.
	+ Adds to productization and eco-system enablement timeline, especially for dual clients.
* Pros:
	+ No potential for backwards compatibility issues.
	+ No potential for legacy SP clients to transmit at too high a power
	+ Thus, we propose this as fall-back option if any backwards compatibility issues with option B are discovered.

## Part I: Changes for Option B (Composite APs send TPE at max(SP,LPI) for LPI clients then an Additional TPE for SP clients)

***TGme editor, please make the following changes under CID 6076 (Part I, option B).***

9.4.2.160 Transmit Power Envelope element

Table 9-316—Maximum Transmit Power Interpretation subfield encoding(11ax)

|  |  |
| --- | --- |
| Value | Interpretation of the Maximum Transmit Power field |
| 0 | Local EIRP |
| 1 | Local EIRP PSD (power spectral density) |
| 2 | Regulatory client EIRP |
| 3 | Regulatory client EIRP PSD |
| 4 | Additional regulatory client EIRP |
| 5 | Additional regulatory client EIRP PSD |
| 6–7 | Reserved |
| NOTE—This table is expected to be updated only if regulatory domains mandate the use of transmit power control with limits that cannot be converted into one of the currently defined interpretations. |

(11ax)If the Maximum Transmit Power Interpretation subfield is 0, 2 or 4 (EIRP), the Maximum Transmit Power Count subfield indicates the number of Maximum Transmit Power For X MHz subfields (where X = 20, 40, 80, or 160/80+80) minus 1 in the Maximum Transmit Power field of the Transmit Power Envelope element, as shown in Table 9-317 (Meaning of Maximum Transmit Power Count subfield if the Maximum Transmit Power Interpretation subfield is 0, 2 or 4(11ax)).

Table 9-317—Meaning of Maximum Transmit Power Count subfield if the Maximum Transmit Power Interpretation subfield is 0, 2 or 4(11ax)

(11ax)If the Maximum Transmit Power Interpretation subfield is 0, 2 or 4 (EIRP), the format of the Maximum Transmit Power field is defined in Figure 9-688 (Maximum Transmit Power field format if the Maximum Transmit Power Interpretation subfield is 0, 2 or 4(11ax)).

11ax)If the Maximum Transmit Power Interpretation subfield is 1, 3 or 5 (EIRP PSD), the format of the Maximum Transmit Power field is shown in Figure 9-689 (Maximum Transmit Power field format if Maximum Transmit Power Interpretation subfield is 1, 3 or 5(11ax)).

Table 9-318 (Meaning of Maximum Transmit Power Count subfield if Maximum Transmit Power Interpretation subfield is 1, 3 or 5(11ax)) which specifies the format and interpretation of the Maximum Transmit Power field as described below.

Figure 9-689—Maximum Transmit Power field format if Maximum Transmit Power Interpretation subfield is 1, 3 or 5(11ax)

Table 9-318—Meaning of Maximum Transmit Power Count subfield if Maximum Transmit Power Interpretation subfield is 1, 3 or 5(11ax)

E.2.7 6 GHz band

(#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; Maximum Transmit Power Interpretation subfield = (#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; Maximum Transmit Power Interpretation subfield = Regulatory client EIRP PSD

An AP that transmits a Regulatory Information field indicating Indoor standard power AP shall send at least one Transmit Power Envelope element in Beacon and Probe Response frames as follows:

* Maximum Transmit Power Category subfield = Default; Maximum Transmit Power Interpretation subfield = Additional regulatory client EIRP PSD

An *SP only client* is a non-AP STA that is capable of operating under the control of a standard power AP and is incapable of operating under the control of an indoor AP per regulatory rules. An *LPI only client* is a non-AP STA that is capable of operating under the control of an indoor AP and is incapable of operating under the control of a standard power AP per regulatory rules.

A regulatory client EIRP PSD value advertised by an AP that is a 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)

A regulatory client EIRP PSD value advertised by an AP that is an indoor standard power AP shall be set to the higher of the following two values:

* 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.
* The highest value that meets the LPI only client transmit power limits authorized by the regulatory rules for the corresponding category for the corresponding 20 MHz channel.

An additional regulatory client EIRP PSD value advertised by an AP that is an 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.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; Maximum Transmit Power Interpretation subfield = 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 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 that is a (#600)subordinate device per regulatory rules receives Transmit Power Envelope elements with Maximum Transmit Power Category subfields 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)

An SP only client that is associated to an indoor standard power AP that receives, from the AP, one Transmit Power Envelope element with the Maximum Transmit Power Category subfield indicating Default and with the Maximum Transmit Power Interpretation subfield indicating Regulatory client EIRP and another Transmit Power Envelope element with the Maximum Transmit Power Category subfield also indicating Default yet with the Maximum Transmit Power Interpretation subfield indicating Additional regulatory client EIRP shall comply with both elements.

An SP only client that is associated to an indoor standard power AP that receives, from the AP, one Transmit Power Envelope element with the Maximum Transmit Power Category subfield indicating Default and with the Maximum Transmit Power Interpretation subfield indicating Regulatory client EIRP PSD and another Transmit Power Envelope element with the Maximum Transmit Power Category subfield also indicating Default yet with the Maximum Transmit Power Interpretation subfield indicating Additional regulatory client EIRP PSD shall comply with both elements.

NOTE – The Transmit Power Envelope elements sent by an indoor standard power AP are insufficient for a client that is not an SP only client to determine its regulatory maximum power level; rather the client uses the regulatory maximum transmit power for the channel in the current regulatory domain known by the STA from other sources following 11.7.5 (Specification of regulatory and local maximum transmit power levels) and 11.7.6 (Transmit power selection).

## Part I: Changes for Option D (Composite APs send TPE at LPI for LPI clients then an Additional TPE for SP clients)

***TGme editor, please make the following changes under CID 6076 (Part I, option D)***

9.4.2.160 Transmit Power Envelope element

Table 9-316—Maximum Transmit Power Interpretation subfield encoding(11ax)

|  |  |
| --- | --- |
| Value | Interpretation of the Maximum Transmit Power field |
| 0 | Local EIRP |
| 1 | Local EIRP PSD (power spectral density) |
| 2 | Regulatory client EIRP |
| 3 | Regulatory client EIRP PSD |
| 4 | Additional regulatory client EIRP |
| 5 | Additional regulatory client EIRP PSD |
| 6–7 | Reserved |
| NOTE—This table is expected to be updated only if regulatory domains mandate the use of transmit power control with limits that cannot be converted into one of the currently defined interpretations. |

(11ax)If the Maximum Transmit Power Interpretation subfield is 0, 2 or 4 (EIRP), the Maximum Transmit Power Count subfield indicates the number of Maximum Transmit Power For X MHz subfields (where X = 20, 40, 80, or 160/80+80) minus 1 in the Maximum Transmit Power field of the Transmit Power Envelope element, as shown in Table 9-317 (Meaning of Maximum Transmit Power Count subfield if the Maximum Transmit Power Interpretation subfield is 0, 2 or 4(11ax)).

Table 9-317—Meaning of Maximum Transmit Power Count subfield if the Maximum Transmit Power Interpretation subfield is 0, 2 or 4(11ax)

(11ax)If the Maximum Transmit Power Interpretation subfield is 0, 2 or 4 (EIRP), the format of the Maximum Transmit Power field is defined in Figure 9-688 (Maximum Transmit Power field format if the Maximum Transmit Power Interpretation subfield is 0, 2 or 4(11ax)).

11ax)If the Maximum Transmit Power Interpretation subfield is 1, 3 or 5 (EIRP PSD), the format of the Maximum Transmit Power field is shown in Figure 9-689 (Maximum Transmit Power field format if Maximum Transmit Power Interpretation subfield is 1, 3 or 5(11ax)).

Table 9-318 (Meaning of Maximum Transmit Power Count subfield if Maximum Transmit Power Interpretation subfield is 1, 3 or 5(11ax)) which specifies the format and interpretation of the Maximum Transmit Power field as described below.

Figure 9-689—Maximum Transmit Power field format if Maximum Transmit Power Interpretation subfield is 1, 3 or 5(11ax)

Table 9-318—Meaning of Maximum Transmit Power Count subfield if Maximum Transmit Power Interpretation subfield is 1, 3 or 5(11ax)

11.7.5 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 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 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 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)

E.2.7 6 GHz band

(#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; Maximum Transmit Power nIterpretation = (#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; Maximum Transmit Power Interpretation subfield = Regulatory client EIRP PSD

An AP that transmits a Regulatory Information field indicating Indoor standard power AP shall send at least one Transmit Power Envelope element in Beacon and Probe Response frames as follows:

* Maximum Transmit Power Category subfield = Default; Maximum Transmit Power Interpretation subfield = Additional regulatory client EIRP PSD

An *SP only client* is a non-AP STA that is capable of operating under the control of a standard power AP and is incapable of operating under the control of an indoor AP per regulatory rules. An *LPI only client* is a non-AP STA that is capable of operating under the control of an indoor AP and is incapable of operating under the control of a standard power AP per regulatory rules.

A regulatory client EIRP PSD value advertised by an AP that is a 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)

A regulatory client EIRP PSD value advertised by an AP that is an indoor standard power AP shall be set to the highest value that meets the LPI only client transmit power limits authorized by the regulatory rules for the corresponding category for the corresponding 20 MHz channel.

An Additional regulatory client EIRP PSD value advertised by an AP that is an 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.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; Maximum Transmit Power Interpretation subfield = 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 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 that is a (#600)subordinate device per regulatory rules receives Transmit Power Envelope elements with Maximum Transmit Power Category subfields 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)

An SP only client that is associated to an indoor standard power AP that receives, from the AP, one Transmit Power Envelope element with the Maximum Transmit Power Category subfield indicating Default and with the Maximum Transmit Power Interpretation subfield indicating Regulatory client EIRP and another Transmit Power Envelope element with the Maximum Transmit Power Category subfield also indicating Default yet with the Maximum Transmit Power Interpretation subfield indicating Additional regulatory client EIRP shall ignore the element that has its Maximum Transmit Power Interpretation subfield indicating Regulatory client EIRP.

An SP only client that is associated to an indoor standard power AP that receives, from the AP, one Transmit Power Envelope element with the Maximum Transmit Power Category subfield indicating Default and with the Maximum Transmit Power Interpretation subfield indicating Regulatory client EIRP PSD and another Transmit Power Envelope element with the Maximum Transmit Power Category subfield also indicating Default yet with the Maximum Transmit Power Interpretation subfield indicating Additional regulatory client EIRP PSD shall ignore the element that has its Maximum Transmit Power Interpretation subfield indicating Regulatory client EIRP PSD.

A client that is capable of operating under the control of either an indoor AP or a standard power AP per regulatory rules shall process each of the following pairs of elements from the AP according to the regulations known to the client:

* one Transmit Power Envelope element with the Maximum Transmit Power Category subfield indicating Default and with the Maximum Transmit Power Interpretation subfield indicating Regulatory client EIRP and another Transmit Power Envelope element with the Maximum Transmit Power Category subfield also indicating Default yet with the Maximum Transmit Power Interpretation subfield indicating Additional regulatory client EIRP
* one Transmit Power Envelope element with the Maximum Transmit Power Category subfield indicating Default and with the Maximum Transmit Power Interpretation subfield indicating Regulatory client EIRP PSD and another Transmit Power Envelope element with the Maximum Transmit Power Category subfield also indicating Default yet with the Maximum Transmit Power Interpretation subfield indicating Additional regulatory client EIRP PSD

NOTE – Given two corresponding subfields from the Maximum Transmit Power field, one from each element in the pair of elements, the regulations might allow the client to use the higher of the two values, or some other processing.

# Part II: TPE for AFC frequency response (especially with puncturing)

***TGme editor, please make the following changes under CID 6076 (Part II)***

9.4.2.160 Transmit Power Envelope element

(11ax)The Maximum Transmit PSD X subfield is encoded as an 8-bit 2s complement signed integer. The value of –128 indicates that the corresponding 20 MHz channel cannot be used for transmission. The value of +127 indicates that no maximum PSD limit is specified for the corresponding 20 MHz channel. For all other values Y of the subfield (i.e., –127 to +126, inclusive), the maximum transmit PSD in the corresponding 20 MHz channel is Y/2 dBm/MHz (i.e., ranging from –63.5 to +63 dBm/MHz). If an allowed PSD for the Xth 20 MHz channel is known with finer resolution than 20 MHz, the Maximum Transmit PSD X subfield is set to the lowest allowed PSD within the Xth 20 MHz channel.

# Part III Client connectivity signaling (to assist with troubleshooting connectivity).

## Part III: Motivation

Normally the infrastructure learns a client’s connectivity characteristics through the Supported Operating Classes element. In days gone by, we could/would have defined LPI as one operating class and SP as a different operating class, and thereby the Supported Operating Classes element would provide a complete set of connectivity information to the infrastructure. However, in the modern era, in the days of the *global* operating class and the multitude of bandwidths (20+40+80+160+320 MHz), an operating-class-based solution will just consume too many values.

Meanwhile, ther are many use cases where it is important and helpful if the infrastructure has this connectivity information:

* Not all spectrum allows composite APs, and not all clients are dual-certified. It is important to have a solution whereby the infrastructure can know which APs have more dual clients associated and then ensure with much higher probability that these APs be assigned UNII5 & UNII7 channels.
* LPI only clients still can’t connect to outdoor SP APs. It is important to have a solution whereby the infrastructure can optimize neighbor reports and BTM frames to steer LPI only clients towards viable APs and avoid pushing such clients to unusable APs
* LPI clients have lower power (12 dBm) than typical clients (15-18 dBm). If mission-critical clients at a venue happen to be LPI only, then the venue may choose to deploy at 2x or 4x AP density in order to achieve the usual level of coverage; conversely, if no/few mission-critical clients at a venue happen to be LPI only then the venue may choose a traditional AP density. In this way, understanding the client mix can massively lower the venue’s installation costs.
* Troubleshooting / avoiding support calls. If a customer buys a 6 GHz-enabled AP and a 6 GHz-enabled client and they can’t connect, with client connectivity capability signaling, the issues can be automatically diagnosed and reported, thereby saving the client vendor or AP vendor a support case.

We propose a new element to convey the client connectivity capability, instead of defining 15 further global Operating Classes for 20, 40, 80, 160 nad 320 MHz bandwidths for each of LPI only, SP only and /dual clients.

## Part III: Changes

***TGme editor, please make the following changes under CID 6076 (Part III) (which assume that the MIB variable in 23/1903 has been accepted)***

***TGbe editor: Add the following row to each of tables Table 9-63 (Association Response frame body), Table 9-65 (Reassociation Response frame body) and 9-67 (Probe Response frame body):***

|  |  |  |
| --- | --- | --- |
| Order | Information | Notes |
| <Last assigned + <11beEditorToAssign>> | Non-AP STA Regulatory Connectivity | The Non-AP STA Regulatory Connectivity element is optionally present if dot11ExtendedRegInfoSupport is true. |

9.4.2.1 General

Table 9-128—Element IDs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Element | Element ID | Element ID Extension | Extensible | Fragmentable |
| Non-AP STA Regulatory Connectivity (see 9.4.2.3xx (Non-AP STA Regulatory Connectivity)) | 255 | <ANA> | No | Yes |

9.4.2.3xx Non-AP STA Regulatory Connectivity element

The format of the Non-AP STA Regulatory Connectivity element is defined in Figure 9-xx1.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Element ID | Length | Element ID Extension | Regulatory Connectivity |
| Octets | 1 | 1 | 1 | variable |

Figure 9-xx1 – Non-AP STA Regulatory Connectivity element format

The Element ID, Length, and Element ID Extension fields are defined in 9.4.2.1 (General).

The Regulatory Connectivity field is a concatenation of subfields indicating certain regulatory capabilities of the non-AP STA transmitting the element. The length of the Regulatory Connectivity field is variable and is liable to increase as additional connectivity capabilities are defined. The Regulatory Connectivity field is defined in Table 99-xx3 (Regulatory Connectivity field).

Table 9-xx3 –Regulatory Connectivity field

|  |  |  |
| --- | --- | --- |
| Subfield bit or bits | Subfield name | Interpretation |
| 0 | Connectivity With Indoor AP Valid | Indicates whether the Connectivity With Indoor AP subfield is reserved or not:Set to 0 if the Connectivity With Indoor AP subfield is reserved.Set to 1 if the Connectivity With Indoor AP subfield is valid.  |
| 1 | Connectivity With Indoor AP  | Indicates whether operating under the control of an indoor AP is implemented (see Annex E.2.7). For a non-AP STA: Set to 0 if not implemented.Set to 1 if implemented.Reserved for a non-AP STA that is incapable of operating as a STA 6G in the current regulatory domain and for an AP.Reserved if the Connectivity With Indoor AP Valid subfield is set to 0.See NOTE 1.  |
| 2 | Connectivity With SP AP Valid | Indicates whether the Connectivity With SP AP subfield is reserved or not:Set to 0 if the Connectivity With SP AP subfield is reserved.Set to 1 if the Connectivity With SP AP subfield is valid. |
| 3  | Connectivity With SP AP  | Indicates whether at least one of the following is implemented: operating under the control of an SP AP and operating as a fixed client device (see Annex E.2.7). For a non-AP STA: Set to 0 if not implemented.Set to 1 if implemented.Reserved for a non-AP STA that is incapable of operating as a STA 6G in the current regulatory domain and for an AP.Reserved if the Connectivity With SP AP Valid subfield is set to 0.See NOTE 1. |
| 4 to 8×(Length-1)-1 | Pad | Reserved |
| NOTE 1 – This field is informative (e.g., for troubleshooting), has no regulatory purpose, and does not imply a need for any action by a peer STA. |

E.2.7 6 GHz band(11ax)(#600)

***TGme editor: please add the following material in section E2.7 immediately before the para beginning “The Maximum Transmit Power Category subfield in the Transmit Power Information field of the Transmit …”***

A fixed client device is a non-AP STA that operates only on channels provided by an external system for the regulatory domain in which the non-AP STA is operating such as an AFC system with additional requirements specified by the regulatory domain.

A non-AP STA shall transmit a Non-AP STA Regulatory Connectivity element (see 9.4.2.3xx (Non-AP STA Regulatory Connectivity)) in Probe Request and (Re)Association Request frames if the STA has dot11ExtendedRegInfoSupport equal to true and the Regulatory Connectivity field in the Non-AP STA Regulatory Connectivity element is non-zero.