IEEE P802.11
Wireless LANs

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|  |
| --- |
| Link Transmit Power Text |
| Date: 2016-12-23 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Matthew Fischer | Broadcom |  |  | Matthew.fischer@broadcom.com |
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Abstract

This submission proposes a resolution to LB 225 CID 8098 which looks for an increase in average throughput through use of higher MCS based on increased EVM.

**REVISION NOTES:**

**R0**:

initial

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGax Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGax Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGax Editor: Editing instructions preceded by “TGax Editor” are instructions to the TGax editor to modify existing material in the TGax draft. As a result of adopting the changes, the TGax editor will execute the instructions rather than copy them to the TGax Draft.***

**Proposed Changes**

3.4 Abbreviations and acronyms

**TGax Editor: *Add the following in the appropriate location within subclause 3.4 Abbreviations and acronyms of TGax D1.0:***

LTP Link Transmit Power

***TGax editor: to TGax D1.0, add the following row to each of the tables of frame body contents for each of the subclauses for frame formats for Beacon, Probe Request, Probe Response, Association Request, Association Response, Reassociation Request, Reassociation Response as shown, noting that the header row is shown for convenience:***

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| <ANA> | Link Transmit Power  | The Link Transmit Power element is optionally present if dot11LinkTransmitPowerActivated is true. |

**9.4.2 Elements**

**9.4.2.1 General**

***TGax editor: insert a new row into Table 9-77 - Element IDs in TGax D1.0 as shown, noting that the header row is shown only for convenience:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Element** | **Element ID** | **Element ID Extension** | **Extensible** |
| LTP (see 9.4.2.225a (LTP element)) | 255 | <ANA> | Yes |

**9.4.2.27 Extended Capabilities element**

***TGax editor: add a new row to Table 9-135 – Extended Capabilies field to TGax D1.0 as show, noting that the header row is shown only for convenience:***

|  |  |  |
| --- | --- | --- |
| **Bit** | **Information** | **Notes** |
| <ANA> | Link Transmit Power Support | A STA sets the Link Transmit Power Support field to 1 when dot11LinkTransmitPowerActivated is true, and sets it to 0 otherwise. See 11.46a |

***TGax editor: insert a new subclause 9.4.2.225a Link Transmit Power element into TGax D1.0 as shown:***

**9.4.2.225a Link Transmit Power element**

The LTP element is used to request and report transmit power values for one direction of a lnik between two STAs. The format of the LTP element is shown in Figure 9-325m LTP element format.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Element ID** | **Length** | **Element ID Extension** | **LTP Control** | **LTP Information** |
| Octets: | 1 | 1 | 1 | 4 | 0 - 250 |

**Figure 9-325m LTP element format**

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

The format of the LTP Control field is shown in Figure 9-325n LTP Control field format.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **B0** | **B1 B15** | **B16** | **B17** | **B18** | **B19** | **B20** | **B21 B23** | **B24 B31** |
|  | LTP Report | LTP MCI Bitmap | TXBF Present | NTXBF Present | SU Mode Support | OFDMA Mode Support | Absolute | Reserved | Transmit Power |
| **Bits:** | 1 | 15 | 1 | 1 | 1 | 1 | 1 | 3 | 8 |

**Figure 9-325n LTP Control field format**

The LTP Report subfield is set to 0 to indicate that the element contains an LTP Request. The LTP Report subfield is seto to 1 to indicate that the element contains an LTP Report. An LTP Request contains requested transmit powers. An LTP Response contains transmit powers that are used for transmissions by the transmitter of the LTP Report.

The LTP MCI Bitmap indicates which transmit power values are present in the element. A value of 1 in bit position B1 of the LTP Control field means that MCI TX Power value(s) are present in the element for MCI value 0. A value of 1 in bit position B2 of the LTP Control field means that MCI TX Power value(s) are present in the element for MCI value 1. Bit positions B13 through B15 are reserved. A value of all zeroes in this field is permitted.

The TXBF Present subfield indicates, for MCI TX Power values that are included in the element are present for beamformed PPDUs. When this subfield is set to 1, MCI TX Power values for beamformed PPDUs are present. When this subfield is set to 0, MCI TX Power values for beamformed PPDUs are not present.

The NTXBF Present subfield indicates, for MCI TX Power values that are included in the element are present for PPDUs that are not beamformed. When this subfield is set to 1, MCI TX Power values for PPDUs that are not beamformed are present. When this subfield is set to 0, MCI TX Power values for PPDUs that are not beamformed are not present.

The SU Mode Support and OFDMA Mode Support subfields are reserved when the LTP Report subfield is equal to 1.

When the LTP Report subfield is equal to 0, the SU Mode Support subfield indicates if the included MCI TX Power values are to be used for SU PPDU transmissions. When the SU Mode Support subfield is equal to 1, the included MCI TX Power values are to be used for SU PPDU transmissions. When the SU Mode Support subfield is equal to 0, the included MCI TX Power values are not to be used for SU PPDU transmissions

When the LTP Report subfield is equal to 0, the OFDMA Mode Support subfield indicates if the included MCI TX Power values are to be used for OFDMA PPDU transmissions. When the OFDMA Mode Support subfield is equal to 1, the included MCI TX Power values are to be used for OFDMA PPDU transmissions. When the OFDMA Mode Support subfield is equal to 0, the included MCI TX Power values are not to be used for OFDMA PPDU transmissions

When the Absolute subfield is set to 1, each MCI TX Power field is encoded with an absolute power value in dBm as described in the definition of the MCI TX Power subfield. When the Absolute subfield is set to 0, each MCI TX Power field is encoded with as a value of dB relative to the transmit power used for MCS0, as described in the definition of the MCI TX Power subfield.

The Transmit Power subfield is defined in 9.4.2.17 (TPC Report element).

The LTP Information field contains N octets, each of which is an MCI TX Power subfield. The value of N is equal to the number of bits that are set to 1 in the LTP MCI Bitmap multiplied by the sum of the number of bits that are set to 1 in the TXBF Present and NTXBF Present subfields. Each MCI TX Power subfield indicates a requested or reported maximum transmit power value for each MCS that employs the constellation and encoding values that correspond to the MCI of the MCI TX Power field as indicated in Table 9-bbb MCI Encoding. If only one of the TXBF Present and NTXBF Present subfields is equal to 1, then there is one MCI TX Power subfield for each MCI for which the LTP MCI Bitmap subfield has a value of 1. If both the TXBF Present and NTXBF Present subfields are equal to 1, then there is an adjacent pair of MCI TX Power subfields for each MCI. The first MCI TX Power field or pair of MCI TX Power fields in the LTP Information field corresponds to the MCI of the lowest numbered bit in the LTP MCI Bitmap that is equal to 1 and subsequent single or paired MCI TX Power fields correspond to the MCIs of successively higher numbered bit in the LTP MCI Bitmap that are equal to 1.

The format of the MCI TX Power subfield is shown in Figure 9-325p MCI TX Power subfield format.

|  |  |  |
| --- | --- | --- |
|  | **B0 B6** | **B7** |
|  | TX Power Value | Reserved |
| **Bits:** | 7 | 1 |

**Figure 9-325n MCI TX Power subfield format**

|  |  |
| --- | --- |
| **MCI Value** | **Constellation, Encoding** |
| 0 | BPSK, ½ |
| 1 | QPSK, ½ |
| 2 | QPSK, ¾ |
| 3 | 16QAM, ½ |
| 4 | 16QAM, ¾ |
| 5 | 64QAM, 2/3 |
| 6 | 64 QAM, ¾ |
| 7 | 64QAM, 5/6 |
| 8 | 256QAM, ¾ |
| 9 | 256QAM, 5/6 |
| 10 | 1024QAM, ¾ |
| 11 | 1024QAM, 5/6 |
| 12-14 | Reserved |

**Table 9-bbb MCI Encoding**

When the Absolute subfield of the LTP Control field is set to 1, the TX Power Value contains an unsigned integer that represents a Transmission Power value in dBm determined by equation 9-aaa.

Transmission Power = TX Power Value / 2 – 23 (9-aaa)

When the Absolute subfield of the LTP Control field is set to 0, the TX Power Value contains an unsigned integer that represents a Transmission Power value in dB relative to the transmission power for MCI with index 0, as determined by equation 9-bbb.

Transmission Power = TX Power Value for MCI0 – (TX Power Value / 2 – 23) (9-bbb)

***TGax editor: add a new row to Table 9-307 Public Action field values of TGax D1.0 as shown, noting that the header row is shown only for convenience:***

**9.6.8.1 Public Action frames**

|  |  |
| --- | --- |
| **Public Action field value** | **Description** |
| <ANA> | Link Transmit Power (LTP) Action |

***TGax editor: insert a new subclause 9.6.8.36a LTP Action into TGax D1.0 as shown:***

**9.6.8.36a LTP Action**

The LTP Action frame uses the Action frame format and is transmitted by an LTP Requester to an LTP Responder to request a modification to transmit powers used by the LTP Responder for transmissions to the LTP Requester. The LTP Action frame is transmitted by an LTP Responder to an LTP Requester to signal modifications to transmit power values used for transmissions to the LTP Requester. The format of the Action field of the LTP Action frame is shown in Figure 9-325q LTP Action field contents.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Category** | **Public Action** |  **LTP element** |
| Octets: | 1 | 1 | 7 - 257 |

**Figure 9-325q LTP Action field contents**

The Category field is defined in 9.4.1.11.

The Public Action field is defined in 9.6.8.1.

The LTP element is defined in 9.4.2.225a.

***TGax editor: insert a new subclause 9.6.11 Protected Dual of Public Action frames into TGax D1.0 as shown:***

**9.6.11 Protected Dual of Public Action frames**

***Add a new row to Table 9-332 – Public Action field values defined for Protected Dual of Public Action frames:***

|  |  |  |
| --- | --- | --- |
| **Public Action field value** | **Description** | **Defined in** |
| <ANA> | Protected Link Transmit Power | 9.6.8.36a |

***TGax editor: insert a new subclause 11.46a “Link Transmit Power” in TGax D1.0 as shown:***

**11.46a Link Transmit Power (LTP)**

**11.46a.1 Overview**

Improved throughput can be achieved when a STA implements a receiver function which can tolerate EVM values that exceed the minimum specification indicated in this standard provided that the STA that is the source of frames transmitted to such a receiver is aware of the enhanced cability of that receiver because the transmitter can employ a higher MCS and/or transmit power when transmitting to the enhanced receiver. The Link Transmit Power feature enables the exchange of information that allows two STA to create such an enhanced link.

**11.46a.2 LTP Capability Indication**

A STA with dot11LinkTransmitPowerActivated equal to true is an LTP STA. An LTP STA shall set the Link Transmit Power Support bit to 1 in transmitted Extended Capabilities elements.

**11.46a.3 LTP Requester behavior**

An MPDU that contains an LTP element with a value of 0 in the LTP Report subfield of the LTP Control field is an LTP Request.

An LTP STA may transmit an LTP Request to an LTP STA with which it is associated. A STA that transmits an LTP Request is an LTP Requester. A STA that receives an LTP Request addressed to it is an LTP Responder.

Before transmitting an LTP Request, an LTP Requester should determine the maximum transmit power for each MCS that produces an acceptable rate of error when received by the LTP Requester at a given SINR. The determination of such maximum transmit power values, an acceptable rate of error and given SINR are beyond the scope of this standard, but is assumed to require the reception of at least one PPDU from the LTP Responder. When the LTP Requester has determined the acceptable maximum transmit power for each MCS, it may transmit an LTP Request with one or more LTP Power Entry fields present. One bit of the LTP MCI Bitmap is set for each LTP Power Entry field or pair of LTP Power Entry fields that are present for each MCI, as per the definition of the LTP MCI Bitmap field in 9.4.2.xx. Each LTP Power Entry field contains a value of maximum transmit power that is requested to be used by the LTP Responder for each MCS that has a constellation and encoding that matches the constellation and encoding of the corresponding MCI and that is either beamformed or not beamformed, as indicated by the TXBF present and NTXBF present subfields. Up to two LTP Power Entry fields are present for each MCI that corresponds to a bit that is set to 1 in the LTP MCI Bitmap subfield. The LTP Requester shall set the TXBF Present subfield to 1 if LTP Power Entry fields are present that are intended to be used for beamformed PPDUs. The LTP Requester shall set the NTXBF Present subfield to 1 if LTP Power Entry fields are present that are intended to be used for non-beamformed PPDUs. LTP Power Entry field encoding is defined in 9.4.2.xx. An LTP STA is not required to include an LTP Power Entry field corresponding to each MCI that it is capable of receiving, but at least for those for which a change in transmit power is requested.

A STA transmitting an LTP Request shall set the SU subfield of the Supported Modes subfield to 1 if the indicated transmit power values are to be applied to SU transmissions. A STA transmitting an LTP Request shall set the OFDMA subfield of the Supported Modes subfield to 1 if the indicated transmit power values are to be applied to OFDMA transmissions in resource allocations units that are not also MU-MIMO resource allocation units. A STA transmitting an LTP Request may set both the OFDMA subfield and the SU subfield of the Supported Modes subfield to 1 within a single LTP Request.

A STA transmitting an LTP Request shall include the value of the transmit power used to transmit the PPDU containing the LTP Request in the Transmit Power subfield of the LTP element.

An LTP STA that is a not an AP may transmit one or more LTP elements in a Probe Request, (Re)Association Request or LTP Action.

An LTP STA that is an AP may transmit one or more LTP elements in a Beacon, Probe Response, (Re)Association Response or LTP Action.

**11.46a.4 LTP Responder behavior**

An MPDU that contains an LTP element with a value of 1 in the LTP Report subfield of the LTP Control field is an LTP Response.

The maximum transmit power value used by the LTP Responder for transmissions to an LTP Requester using MCSs corresponding to MCI values for which a modified maximum transmit power has not been indicated in any received LTP Request from the LTP Requester are chosen by the LTP Responder.

Whenever a maximum transmit power value used by an LTP Responder to transmit PPDUs to an LTP Requester is modified, the LTP Responder shall transmit an LTP Response the LTP Requester, indicating at least the changed maximum transmit power value(s).

An LTP Responder is not required to transmit an LTP Response to an LTP Requester following the receipt of an LTP Request if it does not modify any transmit power values in response to the LTP Request.

A STA transmitting an LTP Response shall include the value of the transmit power used to transmit the PPDU containing the LTP Response in the Transmit Power subfield of the LTP element.

An LTP Responder shall not exceed the most recently successfully acknowledged maximum transmit power indication per MCI for an LTP Requester when transmitting PPDUs to that LTP Requester.

The maximum transmit power values used for transmission of PPDUs to an LTP Requester by the LTP Responder for MCSs corresponding to MCI values that are not indicated in an LTP Request are chosen by the LTP Responder.

An LTP Responder may transmit an LTP Response to an LTP STA without having received an LTP Request from that STA.

An LTP STA that is an AP may transmit an LTP element with the Report subfield set to 1 in a Beacon or Probe Response. The maximum transmit power values included in an LTP element within a Beacon or Probe Response are the default maximum transmit power values that are used for a link with a STA that is not an LTP STA or with a STA that has not requested a change to the default maximum transmit power values.

An LTP STA that is an AP shall transmit at least one LTP element in a (Re)Association Response to an LTP STA. An LTP STA that is an AP may transmit more than one LTP element in an LTP Action frame.

An LTP STA that is an AP should transmit an NDP SIFS before the transmission of each DTIM Beacon. An LTP STA that is an AP should transmit an NDP SIFS after the transmission of the acknowledgement to the Association Request from an LTP STA. The NDP should use all transmit antennas and should have a value for the TXVECTOR parameter CH\_BANDWIDTH that corresponds to the currently adverstised maximum operating width of the AP.

A STA transmitting an LTP Response should use the same value for the following TXVECTOR parameters as was reported in the RXVECTOR of the LTP Request for which this is a response:

* FORMAT
* MCS
* NON\_HT\_MODULATION, if present
* STBC, if present
* CH\_BANDWIDTH, if present
* CH\_BANDWIDTH\_IN\_NON\_HT, if present

An LTP STA transmitting an LTP Response should use the maximum value supported for the TXVECTOR parameter N\_TX for the transmission of the LTP Response.

**11.46a.5 LTP Additional Considerations**

An MPDU may contain both an LTP Request and an LTP Response.

An LTP STA which has transmitted an LTP Request to a STA and has received an acknowledgement for the transmission shall not transmit another LTP Request to the same STA for 100 ms after receiving the acknowledgement if it has not received an LTP Response from the STA.

TX EVM requirements specified elsewhere in this standard may be ignored when an LTP Responder employs a transmit power value requested by an LTP Requester for the transmission of a PPDU to the LTP Requester.

**TGax Editor: *Add a new MIB variable in C.3 MIB Detail within the dot11StationConfigEntry group as shown:***

**C.3 MIB Detail**

dot11LinkTransmitPowerActivated OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This is a capability variable. Its value is determined by device capabilities.

This attribute, when true, indicates that the STA implementation is capable of transmitting and receiving Link Transmit Power capability information and acting in the role of both LTP Requester and LTP Responder. The capability is disabled, otherwise"

DEFVAL { false }

::= { dot11StationConfigEntry <XX>}

**End of proposed changes.**