IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| LB236 C/DMG Beamtracking CIDs | | | | |
| Date: 2019-06-10 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Assaf Kasher | Qualcomm |  |  | akasher@qti.qualcomm.com |
|  |  |  |  |  |

Abstract

This document proposes resolutions to CIDs on DMG beamtracking and CMDG enhanced beam tracking.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2071 | 1277.00 | 44 | 9.4.2.127.4 | "Beam Tracking is unsupported" - in another place (10.43.1) it is stated as mandatory | reconcile - if it is optional - write text in 10.43.7 to say that request cannot be sent to a STA that does not support, if is mandatory, delete the option to set Beam Tracking Time Limit to 0 | **Revise** |
| 2070 | 1277.00 | 40 | 9.4.2.127.4 | "BeamTrackingTimeLimit" - Beam Tracking may be joined to a single word - but "Time" and Limit should be separated by spaces. Also add "field" after the name, because otherwise there is a mix between the field and the MIB variable | as in comment - separate the field name by spaces and and "field" | **Revised** |
| 2066 | 1277.00 | 27 | 9.4.2.127.4 | ":The BeamTrackingTimeLimit subfield contains the value of dot11BeamTrackingTimeLimit. The resulting value of dot11BeamTrackingTimeLimit ..." - it is not clear whether the MIB variable is the result of the exchange or the input to the exchange. I don't think it should be both. | Separate the input( the mib variable ) from the SME with the result of calculation (may be another MIB variable) | **Revise** |

**Discussion:**

In the January 2019 meeting, the TGaz task group, which are the E/DMG experts, held the following strawpoll:

* 1. Presentation by Assaf Kasher (Qualcomm), Beam tracking mandatory?, Doc. IEEE 11-19/0007r0.
     1. Opened floor for discussion.
     2. Straw poll: Do you support:

Option1: Beam Tracking Fully optional

Option2: Beam Tracking Mandatory for RX BT and optional for TX BT

Option3: Beam Tracking Fully Mandatory

* + 1. Result: Option 1: 1; Option 2: 2; Option 3: 11; Abstain: 4.

Following this guidance, we propose to remove the option of defining beamtracking as unsupported. This means that the variable dot11BeamTrackingTimeLimit can’t take the value of zero. I also propose to move the behavioral aspects (what is the resulting value of the limit) to clause 10, to avoid comparing using the same name for a MIB variable and a field received from the peer STA.

***Editor: Change clause 9.4.2.127.4 as follows:***

**9.4.2.127.4 DMG STA Beam Tracking Time Limit field**



The DMG STA BeamTrackingTimeLimit field contains the value of dot11BeamTrackingTimeLimit. This field indicates the maximum time a beam tracking initiator waits for feedback for transmit beamtracking. This use of this field is discussed in 10.43.7 (Beam Tracking)

***Editor: Change the last pargraphs of 10.43.7 (P2041L21-46 D2.2) as follows:***

— The time duration since the last PPDU it transmitted to the beam tracking responder that requested transmit beam tracking is greater than the beam tracking time limit plus BRPIFS.

— A BRP frame with the channel measurement feedback from the beam tracking responder has been

received.

If the beam tracking initiator does not receive the expected feedback from the beam tracking responder within a time period that is less than the beam tracking time limit of the last request, the beam tracking request has failed. If the initiator receives the expected feedback from the responder within time that is greater than or equal to a beam tracking time limit of the last request, the beam tracking initiator should ignore it.

The time of arrival of the beam tracking responder’s feedback is indicated by the PHY-RXEND.indication primitive of PPDU that contains the BRP MMPDU.

The time of transmit completion of the beam tracking initiator’s PPDU is indicated by the PHYTXEND.

confirm primitive.

The beam tracking responder shall not transmit a BRP frame with feedback to the beam tracking initiator if the time period between PHY-RXEND.indication primitive of the PPDU that contains the beam tracking request and of PHY-TXEND.confirm primitive of the response BRP frame is longer than

the beam tracking time limit.

The beam tracking time limit is based on the values of the DMG STA BeamTrackingTimeLimit field received from the peer STA in the DMG Capabilities element and the dot11BeamTrackignTimeLimit from the SME. The setting of the beam tracking time limit is according to table 9-xyz:

**Table xyz - beam tracking time limit negotiation**

|  |  |  |  |
| --- | --- | --- | --- |
| DMG STA BeamTrackingTimeLimit field from peer STA – denoted A | dot11BeamTrackingTimeLimit from SME – denoted B | A vs. B | beam tracking time limit |
| >0 and < 65535 | >0 and < 65535 | A ≥ B | A |
| >0 and < 65535 | >0 and < 65535 | A < B | B |
| 65535 | >0 and < 65535 | NA | B |
| >0 and < 65535 | 65535 | NA | A |
| 65535 | 65535 | NA | Default dot11BeamTrackingTimeLimit  value |

Note: if the beam tracking responder has not included the BeamTrackingTimeLimit field in the DMG Capabilities element, the beam tracking initiator cannot tell whether the procedure failed. Retransmission is therefore implementation dependent.

***TGaz Editor: Modify the MIB entry at P4198L27-29 (D2.2)***

dot11BeamTrackingTimeLimit OBJECT-TYPE

SYNTAX Unsigned32 (1..65535)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2063 | 2028.00 | 59 | 10.43.7 | "Beam Tracking Request field in the PHY header equal to 1" No header field references in clause 9 | Replace all header field references in the subclause with the appropriate RXVECTOR parameters - submission will be provided | **Revise** |

***Editor: Modify the text in P2039L60-64 as follows:***

A beam tracking responder that receives a PPDU(#1379) with the BEAM\_TRACKING\_REQUEST parameter in the RXVECTOR set to Beam Track Requested and the PPDU-TYPE(#1379) field in the RXVECTOR set to TRN-R-PACKET shall follow the rules described in

***Editor: Modify the text in P2040L22-34 as follows:***

A beam tracking initiator may also request a beam tracking responder to perform receive beam tracking by setting the TXVECTOR parameter BEAM\_TRACKING\_REQUEST to beam tracking not requested, the TRN-LEN parameter to a non zero value, the PPDU-TYPE parameter to TRN-R-PACKET, and append an AGC field and TRN-R subfields to the transmitted PPDU(#1379).

A beam tracking responder that receives a PPDU(#1379) with the BEAM\_TRACKING\_REQUEST parameter in the RXVECTOR equal to beam tracking not requested, the TRN-LEN parameter in RXVECTOR having a nonzero value and the PPDU-TYPE(#1379) parameter in the RXVECTOR equal to TRN-R-PACKET, shall follow the rules described in 20.9.2.2 (Beam refinement) and may use the beam refinement AGC field and TRN-R subfields appended to the received PPDU(#1379) to perform receive beam training.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2064 | 2029.00 | 11 | 10.43.7 | "The beam tracking responder may append the feedback to any PPDU(#1379) from the responder to the initiator" - The feedback is BRP frame and cannot be appended to PPDUs | Specify that the feedback may be aggregated inside an A-MPDU with frames sent from the responder to the initiator according to rules specified in 10.43.6.4.1 | **Revise** |

***Editor: Modify the text in P2040L12-13 as follows:***

append an AGC field and TRN-T subfields to the PPDU(#1379). The beam tracking responder may aggregate the feedback inside an A-MPDU in a frame sent from the responder to the initiator according to the rules specified in 10.43.6.4.1. The initiator may allocate time for the

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2061 | 2032.00 | 60 | 10.43.9 | "The enhanced beam tracking responder may append the feedback to any PPDUs" The feedback is a MAC entity (BRP frame). It cannot be appended with any frame. It can be aggregated inside an A-MPDU under the rules in 10.43.7 | Specify that the feedback may be aggregated inside an A-MPDU with frames sent from the responder to the initiator | **Revise** |

***Editor:***

subfields, an STF, and a CE field to the PPDU(#1379). The enhanced beam tracking responder may aggregate the feedback inside an A-MPDU in a frame sent from the responder to the initiator according to the rules specified in 10.43.6.4.1. The initiator may allocate

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2060 | 2033.00 | 14 | 10.43.9 | Use TXVECTOR parameters not header fields | Repalce header fields with TXVECTOR setting |  |

***Editor: Modify the text in P2044L14-24 (D2.2) as follows:***

An enhanced beam tracking initiator may also request a beam tracking responder to perform receive beam

tracking by setting, in the TXVECTOR of a transmitted PPDU(#1379), the

ENHANCED\_BEAM\_TRACKING\_REQUEST parameter to Enhanced beam tracking requested, the TRN-LEN parameter to a nonzero value, and the PPDU-TYPE(#1379) parameter to TRN-R-PACKET and appending an AGC field, TRN-R subfields, an STF, and a CE field to the transmitted PPDU(#1379).

A beam tracking responder that receives a PPDU(#1379) with the RXVECTOR parameter ENHANCED\_BEAM\_TRACKING\_REQUEST equal to Enhanced beam tracking requested, the TRN-LEN parameter having a nonzero value, and the PPDU-TYPE(#1379) parameter equal to TRN-R-PACKET, shall follow the rules described in 24.9.2.2 (Beam refinement) and may use the beam refinement AGC field, TRN-R subfields, STF, and CE field appended to the received PPDU(#1379) to

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2094 | 1295.00 | 43 | 9.4.2.136 | "The delay values in the Tap Delay subfield, when present, correspond to the strongest taps and are unsigned integers, in increments of Tc, starting from 0."  Discussion: Tap delays selected are common to all channel measurements taken over different training fields. So "strongest" is ill-defined (strongest tap for one channel can be zero for another channel). It seems defining strongest taps over different channels becomes implementation-dependent, unless there is a clear formula given to select those taps. | Either include language to indicate deciding strongest taps for a set of channels is implementation-dependent, or introduce a metric for strongest tap.  The first approach is not preferred for interoperability. Metric could be average power across included channels or similar. | **Revise** |

**Discussion:**

The channel measurement feedback, when providing feedback on TRN subfields, consists of set of Nmeas channel impulse responses. Each channel impulse response consists of Ntaps taps, with delay specified to be relative to the earliest arriving path. The text specifies that the selected taps should correspond to the Ntaps strongest taps. It is also a commont set over all measurements. It is not specified how these to requirements can be reconciled. There are several ways to select the set taps to be used. One of them is to select the set of taps based on the strongest set of taps measured on the CE field of the PPDU (or the CE field preceding the TNR subfields. This method is relatively easy to implement. Another method is to select the set of taps with the highest Energy when measured over all TRN subfields. This require complex computations and a large memory. Anyway, setting a clear requirement now will have issues with implementations currently in the field. I therefore propose to add text that the selection of the set of strongest taps is implementation dependant.

***Editor: Modify the the tex in P1304L41-44 as follows:***

present, then the *Ntaps* channel taps is interpreted as consecutive time samples, separated by *Tc*. The delay

values in the Tap Delay subfield, when present, correspond to the strongest taps and are unsigned integers,

in increments of *Tc*, starting from 0. Selection of which taps are sent is implementation dependent. Each channel tap is reported as an in-phase and quadrature component

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2106 | 1294.00 | 50 | 9.4.2.136 | Sector ID Order field in Channel Measurement element does not seem to be applicable to transmit training using TRN-T fields (applicable to a previous SLS/TXSS only). Clarify in the field definition. | If Sector ID Order is applicable to TRN-T training, please specify its usage, and if not, please define restrictions, both here and in the definition of "Sector ID Order Requested" field in the DMG Beam Refinement field. | **Revise** |

**Discussion:**

It is fairly clear that sector ID should not be used for feedback on TRN-T training. The feedback on TRN-T training contains the feedback for all TRN-T subfields, so no ordering is needed. The correct restriction on the use the FBCK-REQ shall be presented in clause 10. The text in 9.4.2.136 only needs a clarification.

***Editor: Change the text in P1304L54-55 as follows:***

TX sector IDs ranked in the decreasing order of link quality, as measured on a preceding sector sweep, MID, or BC phase, determined in an implementation dependent

***Editor: Change the text in P2036L47-51***

A STA requests transmit beam refinement training by sending a BRP frame as follows. In the BRP Request

field, the TX-TRN-REQ field is set to 1, and the FBCK-REQ field indicates the feedback type. The Sector ID Order Requested subfield in the FBCK-REQ field shall be set to 0. In the TXVECTOR, the PPDU- TYPE(#1379) parameter is set to TRN-T-PACKET, and the TRN-LEN parameter indicates the number of AGC and TRN-T subfields(#1025) appended to the PPDU(#1379).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2058 | 2032.00 | 45 | 10.43.9 | "Enhanced Beam Tracking Request field in the PHY header set to 1" - MAC is not aware of header bits | Repalce with RXVECTOR parameters | **Revise** |

*Change the text in P2057L45-52* ***(RevMD D2.4)*** *as follows*

An enhanced beam tracking responder that receives a PPDU(#1379) with ~~the Enhanced Beam Tracking Request field in the PHY header set to 1 (corresponding to the~~ ENHANCED\_BEAM\_TRACKING\_REQUEST parameter in the RXVECTOR equal to enhanced beam tracking requested~~)~~ and the ~~PPDU Type(#1379) field in the PHY header set to 0 (corresponding to the~~ PPDU\_TYPE(#1379)(#2016) parameter in the RXVECTOR ~~set~~ equal to TRN-R(#2016)~~)~~ shall follow the rules described in

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2060 | 2033.00 | 14 | 10.43.9 | Use TXVECTOR parameters not header fields | Repalce header fields with TXVECTOR setting | **Revise** |

*Change the text in P2058L17-26* ***(RevMD D2.4)*** *as follows:*

An enhanced beam tracking initiator may also request a beam tracking responder to perform receive beam tracking by setting, in ~~the PHY header of~~ a transmitted PPDU(#1379), the ENHANCED\_BEAM\_TRACKING\_REQUEST parameter in the TXVECTOR to enhanced beam tracking requested ~~Enhanced Beam Tracking Request field to 1~~, the ~~Training Length field~~ TRN-LEN parameter to a nonzero value, and the PPDU\_~~Type~~TYPE(#1379) ~~field~~ parameter to 0 and appending an AGC field, TRN-R subfields, an STF, and a CE field to the transmitted PPDU(#1379).

A beam tracking responder that receives a PPDU(#1379) with the ~~Enhanced Beam Tracking Request field in the PHY header set to 1~~ ENHANCED\_BEAM\_TRACKING\_REQUEST parameter in the RXVECTOR equal to enhanced beam tracking requested, the ~~Training Length field in the PHY header~~ TRN-LEN parameter equal to a nonzero value, and the PPDU\_ TYPE~~Type~~(#1379) ~~field in the PHY header~~ parameter ~~set~~ equal to 0 shall follow the rules described in 24.9.2.2 (Beam refinement) and may use

**References:**

**[1]** [**Draft P802.11REVmd\_D2.2**](http://www.ieee802.org/11/private/Draft_Standards/11md/Draft%20P802.11REVmd_D2.2.pdf)

**[2]** [**11-19-0225-00-00ay-tg-ay-january-2019-st-louis-meeting-minutes**](https://mentor.ieee.org/802.11/dcn/19/11-19-0225-00-00ay-tg-ay-january-2019-st-louis-meeting-minutes.docx)