IEEE P802.11
Wireless LANs

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| Proposed resolution to BF PHY related CIDs |
| Date: 2017-07-24 |
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Abstract

This submission proposes a resolution to several CIDs submitted on the 11ay draft text related to BF PHY.

The discussion is in reference to Draft IEEE P802.11ay/D0.3.

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| **CID** | **Clause** | **Page** | **Comment** | **Proposed change** |
| 102 | 30.9.2.2.3 | 155.36 | To have a more efficient mode, P=0, M=6, and N=3 should also be a mandatory TRN mode | As in comment |

**Proposed resolution**: Revised

*Discussion:* A motion approved in the July 2017 plenary (#252, based on the draft text proposed in 11-17-1042-01-00ay) defined various mandatory TRN-Unit configuration modes with P = 0, including the one suggested by the commenter.

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| **CID** | **Clause** | **Page** | **Comment** | **Proposed change** |
| 301 | 30.9.2.2.7 | 158.07 | P=0 is a valid value, if P=0, how to do channel measurement ? | Add more text to clarify the funtion of channel estimation and beamforming training, when p=0. |

**Proposed resolution**: Revised

*Discussion:* A motion approved in the July 2017 plenary (#252, based on the draft text proposed in 11-17-1042-01-00ay) added text to the spec draft that specifies that “(i)f the Channel Measurement Requested subfield in the DMG Beam Refinement element within a BRP frame is equal to 1, the TXVECTOR parameter EDMG\_TRN\_P shall not be set to 0.” In other words, a STA requesting transmit training shall not use a TRN-Unit configuration with P = 0 if channel measurements are requested. This configuration may be used if SNR measurements are requested.

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| **CID** | **Clause** | **Page** | **Comment** | **Proposed change** |
| 399 | 10.38.9.5.2 | 78.19 | How is the P TRN subfield is transmitted? They should be transmitted/received using the same awv as preamble and data, but the TRN subfields immediately follows uses a different antenna | Add a requirement that EDMG TRN-Unit P is set to 0 in BRP-TX packet in BRP TXSS, add mandatory capability of TP0 and RP0 |

**Proposed resolution**: Revised

*Discussion:* A motion approved in the July 2017 plenary (#252, based on the draft text proposed in 11-17-1042-01-00ay) addressed the transmission of CE TRN subfields in BRP TXSS when the data and TRN fields are transmitted with different antennas. As suggested by the commenter, TRN-Unit configuration modes with P = 0 were included in the specification draft. If CE TRN subfields are transmitted, an implementation chosen AWV may be used.

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| **CID** | **Clause** | **Page** | **Comment** | **Proposed change** |
| 292 | 30.4.1 | 127.12 | According to"All fields of an EDMG control mode PPDU except for the TRN field shall be transmitted using a single spatial stream. The TRN field of an EDMG control mode PPDU may be transmitted with multiple spatial streams, depending on the capability of the transmitter and receiver in supporting multiple streams. " ,the number of spatial stream for Data field and TRN subfields may be different. | add an indication for the Number of TRN spatial streams which may be different with the number of Data spatial streams |

**Proposed resolution**: Revised

*Discussion:* A motion approved in the July 2017 plenary (#245, based on the draft text proposed in 11-17-1040-00-00ay) added text to the spec draft that specifies that “(i)f an EDMG control mode PPDU is transmitted with multiple transmit chains, all fields of the EDMG control mode PPDU except for the TRN field shall be transmitted using the non-EDMG duplicate format and, as defined in 30.9, the TRN field shall consist of *N* orthogonal waveforms, where *N* is the number of transmit chains used in the transmission of the EDMG control mode PPDU.” In addition, a new 3 bit field labelled “Number of transmit chains” was defined in the EDMG-Header-A of EDMG Control Mode PPDUs that “indicates the number of transmit chains used in the transmission of the PPDU.”

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| **CID** | **Clause** | **Page** | **Comment** | **Proposed change** |
| 295 | 30.9.2.2 | 155.03 | This is not clear in an EDMG BRP-TX packet or EDMG BRP-RX/TX packet ,the transmitter should keep the same DMG antenna or may change DMG antenna intra or inter- TRN-Units. | please clarify it |

**Proposed resolution**: Revised

*Discussion:* In order for a STA switch DMG antennas during the transmission or reception of a PPDU, normative text that defines the procedure itself (e.g., transition interval) as well as the behaviour of the STAs involved in the training procedure must be defined. For example, for the BRP TXSS procedure, it is defined in 10.38.9.5.2 (DMG antenna and TRN-Unit configuration during BRP TXSS) that

“The first TRN-Unit in an EDMG BRP packet used in a BRP TXSS may be used for the initiator and responder to switch DMG antennas and shall not be processed by the responder… When transmitting an EDMG BRP-TX packet as part of a BRP TXSS, an EDMG STA may change the DMG antenna used in the transmission of its TRN field during the first TRN-Unit and shall not change DMG antenna during the remaining TRN-Units. When receiving EDMG BRP-TX packets as part of BRP TXSS, an EDMG STA may change the DMG antenna used in the reception of the TRN field during the first TRN-Unit and shall not change DMG antenna during the remaining TRN-Units.”

The only normative text present in D0.3/D0.35 that defines specification necessary to enable the switching of antennas is in 10.38.9.5.2 (DMG antenna and TRN-Unit configuration during BRP TXSS), which defines that antenna switching as part of BRP TXSS may happen during the transmission/reception of the first TRN-Unit of an EDMG BRP packet.

Also, please refer to the changes made in response to CID 297.

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| **CID** | **Clause** | **Page** | **Comment** | **Proposed change** |
| 297 | 30.9.2.2.6 | 157.15 | Not clear the number of spatial streams for the first P TRN subfields and the last M TRN subfields should be same or possible to be set differently | please clarify it. |

**Proposed resolution**: Revised

*Discussion:*

* A motion approved in the July 2017 plenary (#245, based on the draft text proposed in 11-17-1040-00-00ay) added text to the spec draft that specifies that “…all fields of the EDMG control mode PPDU except for the TRN field shall be transmitted using the non-EDMG duplicate format and, as defined in 30.9, the TRN field shall consist of *N* orthogonal waveforms, where *N* is the number of transmit chains used in the transmission of the EDMG control mode PPDU.”
* A motion approved in the July 2017 plenary (#246, based on the draft text proposed in 11-17-1043-00-00ay) added text to the spec draft that specifies that “(t)he total number of transmit chains *NTX* shall be constant over the different fields of EDMG SU PPDU” and “(t)he total number of transmit chains *NTX* shall be constant over the different fields of EDMG MU non-FDMA PPDU.”
* TRN field shall consist of *N* orthogonal waveforms, where *N* is the number of transmit chains used in the transmission of all fields of an EDMG PPDU.

*Modify 30.9.2.2.6 (TRN subfield definition) as follows*

The TRN field shall consist of *NTX* orthogonal waveforms, where *NTX* is the number of transmit chains used in the transmission of the EDMG PPDU. The basic TRN subfield for the waveform transmitted with the *i*th ~~spatial stream~~ transmit chain, TRNibasic, is composed of 6 Golay complementary sequences GaiN and GbiN as follows TRNibasic = [GaiN, -GbiN, GaiN, GbiN, GaiN, -GbiN], where:

* N is the Golay sequence length and is equal to TRN\_BL × NCB; and
* TRN\_BL represents the length of the Golay sequence used in the TRN subfield and depends on the value of the TRN Subfield Sequence Length field in EDMG-Header-A of the PPDU. If TRN Subfield Sequence Length field is 0, TRN\_BL is equal to 128. If TRN Subfield Sequence Length field is 1, TRN\_BL is equal to 256. If TRN Subfield Sequence Length field is 2, TRN\_BL is equal to 64.
* NCB represents the integer number of contiguous 2.16 GHz channels over which the TRN subfield is transmitted and 1 ≤ NCB ≤ 4.

An EDMG STA shall support Golay sequences of length 128 (i.e., TRN\_BL equal to 128). Other lengths are optional and support is indicated in the STA’s EDMG Capabilities element.

The sequences (GAi64, GBi64), (Gai128, Gbi128), (Gai256, Gbi256), (Gai384, Gbi384), (Gai512, Gbi512), (Gai768, Gbi768), and (Gai1024, Gbi1024) are defined in subclause 30.10. These sequences shall be transmitted using rotated π/2-BPSK modulation.

Table 42 defines the TRNi subfield that shall be used in the waveform transmitted with the *i*th transmit chain, where 1 ≤ *i* ≤ 8, for a given total number of transmit chains. ~~for given total number of spatial streams and spatial stream number~~ *~~i~~*~~, 1 ≤~~ *~~i~~* ~~≤ 8.~~

Table 42 —TRN subfield definition

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| Total number of ~~spatial streams~~ transmit chains | ~~Spatial stream~~ Transmit chain number | TRN subfield definition |
| 1, 2 | 1 | TRN1basic |
| 2 | TRN2basic |
| 3, 4 | 1 | [TRN1basic, TRN1basic] |
| 2 | [TRN2basic, TRN2basic] |
| 3 | [TRN3basic, -TRN3basic] |
| 4 | [TRN4basic, -TRN4basic] |
| 5, 6, 7, 8 | 1 | [TRN1basic, TRN1basic, TRN1basic, TRN1basic] |
| 2 | [TRN2basic, TRN2basic, TRN2basic, TRN2basic] |
| 3 | [TRN3basic, -TRN3basic, TRN3basic, -TRN3basic] |
| 4 | [TRN4basic, -TRN4basic, TRN4basic, -TRN4basic] |
| 5 | [TRN5basic, TRN5basic, -TRN5basic, -TRN5basic] |
| 6 | [TRN6basic, TRN6basic, -TRN6basic, -TRN6basic] |
| 7 | [TRN7basic, -TRN7basic, -TRN7basic, TRN7basic] |
| 8 | [TRN8basic, -TRN8basic, -TRN8basic, TRN8basic] |

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| 76 | 30.9.2.2.6 | 157.15 | TRN subfields definition: Throughtout this subclause, "spatial streams: are used. I think that since these fields are to be used for beamforming training without sptial expansion, TX chains should be used instead | Change spatial streams to transmit chains |

**Proposed resolution**: Revised

*Discussion:* The problem identified by the commenter is resolved with the solution proposed to CID 297.

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| **CID** | **Clause** | **Page** | **Comment** | **Proposed change** |
| 431 | 30.9.2.2.3 | 156.03 | Statement : "The total number of TRN-Units present in the TRN field of an EDMG PPDU is equal to the value of the EDMG TRN Length field." . Note the sentence is repeated verbatim in 30.9.2.2.5 where it is a better fit. | Delete entire paragraph as repeated verbatim in 30.9.2.2.5 |

**Proposed resolution**: Revised

*Delete the fourth paragraph of 30.9.2.2.3 (EDMG BRP packet header fields)*

“~~The total number of TRN-Units present in the TRN field of an EDMG PPDU is equal to the value of the EDMG TRN Length field. The value of the RX TRN-Units per Each TX TRN-Unit field indicates the number of consecutive TRN-Units for which the transmit AWV shall remain with the same AWV configuration.~~”

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| **CID** | **Clause** | **Page** | **Comment** | **Proposed change** |
| 332 | 30.9 | 152.10 | Considering dense operation scenario, spatial reuse could be a very imoprtant feature of 802.11ay. When we consider interference mitigation, the best sector could be different from the one measured at SSW frame exchanges. i.e., 2nd or 3rd best sector may enable conccurent transmission per spatial sharing. However, 802.11ad or 802.11ad draft does not specify or hint such possibility. In 802.11ad, as in 10.38.2.3.2 (Responder TXSS), 10.38.2.4 (Sector sweep (SSW) feedback), etc. -- 802.11-2016, the spec reads "The determination of which frame is received with best quality is implementation dependent and beyond the scope of this standard." Also, it seems that the sector selection is done in a completely different context from spatial sharing. | Please consider to insert a guideline to enable spatial sharing friendly sector selection method. |

**Proposed resolution**: Rejected

*Discussion:* Non actionable. Commenter is encouraged to bring a proposal to the Task Group to address the issue raised.

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| **CID** | **Clause** | **Page** | **Comment** | **Proposed change** |
| 74 | 30.9.2.2.2 | 115.21 | "If the PACKET-TYPE parameter in the RXVECTOR or TXVECTOR is equal to TRN-R-PACKET, then both BEAM\_TRACKING\_REQUEST and EDMG\_BEAM\_TRACKING\_REQUEST parameters in the corresponding" Only the TXVECTOR can be set, the RXVECTOR is received as is | Remove reference to RXVECTOR in this paragraph |

**Proposed resolution**: Revised

*Discussion:* The first paragraph of 20.10.2.2.2 (BRP packet structure) in 802.11-2016 reads

“The TRN-LEN parameter in the TVXVECTOR or RXVECTOR of a BRP packet shall be greater than zero. If the PACKET-TYPE parameter in the RXVECTOR or TXVECTOR is equal to TRN-R-PACKET, then the BEAM\_TRACKING\_REQUEST parameter in the corresponding RXVECTOR or TXVECTOR shall be set to Beam Tracking Not Requested.”

The second sentence of the paragraph above is ambiguous and not correct. Its intent is to specify that a packet with the Beam Tracking Request field in the PHY header equal to 1, the Packet Type field equal to 0, and the Training Length field greater than 0 shall not include a TRN field (that is, it is not a BRP packet).

The text indicated by the commenter is an extension of the 802.11-2016 text to the EDMG case, and as such it propagated its ambiguity.

*Modify the first paragraph of 30.9.2.2.2 (EDMG BRP packet structure) as follows*

“The EDMG\_TRN\_LEN parameter in the TVXVECTOR ~~or RXVECTOR~~ of an EDMG BRP packet shall be greater than zero. ~~If the PACKET-TYPE parameter in the RXVECTOR or TXVECTOR is equal to TRN-R-PACKET, then both BEAM\_TRACKING\_REQUEST and EDMG\_BEAM\_TRACKING\_REQUEST parameters in the corresponding RXVECTOR or TXVECTOR shall be set to Beam Tracking Not Requested.~~”

*Add the following paragraph at the end of 30.9.2.1 (General)*

“An EDMG PPDU with the Beam Tracking Request field in the L-Header equal to 0, the Packet Type field in the L-Header equal to 0, the EDMG Beam Tracking Request field in the EDMG-Header-A equal to 1, and the EDMG TRN Length field in the EDMG-Header-A greater than 0 shall not include a TRN field.”

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| **CID** | **Clause** | **Page** | **Comment** | **Proposed change** |
| 430 | 30.9.2.2.2 | 155.16 | statement "If the PACKET-TYPE parameter in the RXVECTOR or TXVECTOR is equal to TRN-R-PACKET, then both BEAM\_TRACKING\_REQUEST and EDMG\_BEAM\_TRACKING\_REQUEST parameters in the corresponding RXVECTOR or TXVECTOR shall be set to Beam Tracking Not Requested" contradicts statement in 10.38.7 "A beam tracking responder that receives a packet requesting beam tracking with the Beam Tracking Request field in the PHY header equal to 1 (corresponding to the BEAM\_TRACKING\_REQUEST or EDMG\_BEAM\_TRACKING\_REQUEST parameter in the RXVECTOR set to Beam Track Requested) and the Packet Type field in the PHY header equal to 0 (corresponding to PACKET-TYPE field in the RXVECTOR set to TRN-R-PACKET) shall.." | Harmonize statements. Remove statement in 30.9.2.2.2 |

**Proposed resolution**: Revised

*Discussion:* The problem identified by the commenter is resolved with the solution proposed to CID 74.

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| **CID** | **Clause** | **Page** | **Comment** | **Proposed change** |
| 77 | 30.9.2.2.7 | 158.07 | "first P TRN subfields of each TRN-Unit of the EDMG Not for each TRN units. " It should be only once in packet: only the first in each packet, or the second if the first is used for antenna switching | Change to the first valid P sequences in the packet (this is for BRP-TX packets, not clear what to do in BRP-TX-RX packets) |

**Proposed resolution**: Revised

*Discussion:*

* A motion approved in the July 2017 plenary (#252, based on the draft text proposed in 11-17-1042-01-00ay) added text to the spec draft that specifies that “(i)f the Channel Measurement Requested subfield in the DMG Beam Refinement element within a BRP frame is equal to 1, the TXVECTOR parameter EDMG\_TRN\_P shall not be set to 0.”
* The only normative text present in D0.3/D0.35 that defines specification necessary to enable the switching of antennas is in 10.38.9.5.2 (DMG antenna and TRN-Unit configuration during BRP TXSS). For BRP TXSS, channel measurements can’t be requested.

*Replace the only paragraph in 30.9.2.2.7 with the following*

The autocorrelation properties of the Golay sequence used in the TRN field allow for the estimation of the impulse response of the channel between transmitter and receiver. When the channel measurement is performed using an EDMG BRP-TX packet, the receiver should determine the channel tap with largest magnitude using the first *P* TRN subfields of the first TRN-Unit of the packet, where *P* is the number of TRN subfields indicated in the EDMG TRN-Unit P field within the EDMG-Header-A of the packet. The receiver then selects the set of taps that is measured around the tap with the largest magnitude, according to dot11ChanMeasFBCKNtaps. It can select a contiguous set of taps or select a noncontiguous set of taps. If a noncontiguous set of taps is selected, as defined in 9.4.2.136, the delays of the selected taps are included in the Tap Delay field of the Channel Measurement Feedback element. The receiver then measures the amplitude of the corresponding channel taps in each of the last *M* TRN subfields of all TRN-Units in the packet if *N* is equal to zero, where *M* and *N* are the number of TRN subfields indicated in the EDMG TRN-Unit M field and in the EDMG TRN-Unit N field within the EDMG-Header-A of the packet, respectively. If *N* is greater than zero, one set of amplitudes are obtained for each group of *N* consecutive TRN subfields that have the same AWV feedback ID, as defined in 30.9.2.2.5. The in-phase and quadrature components of the selected taps measured using the *k*th TRN subfield (if *N* is equal to zero) or *k*th group of *N* consecutive TRN subfields that have the same AWV feedback ID (if *N* is greater than zero) included in the Channel Measurement *k* subfield of the Channel Measurement field within the Channel Measurement Feedback element. As defined in 9.4.2.136, the in-phase and quadrature values in the Channel Measurement field are normalized with respect to the tap with largest magnitude over all measurements made using the TRN field of the EDMG BRP-TX packet.

**SP**: Do you agree to accept the resolutions given in 11-17/1175-01 to the following CIDs: 74, 76, 102, 292, 295, 297, 301, 332, 399, 430, and 431?