IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Draft text for EDMG Capabilities | | | | |
| Date: 2016-12-15 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| C. Hansen | Peraso |  |  | chris@covariantcorp.com |
|  |  |  |  |  |

Abstract

Draft text for the EDMG Capabilities element is included

*Editor’s note. The Core Capabilities below includes capabilities copied from the DMG Capabilities element in 802.11. These may turn out to be redundant and removed in the future.*

**Information elements**

**EDMG Capabilities element**

**General**

The EDMG Capabilities element contains a fixed length Core Capabilities field which may be followed by one or more variable length Extended Capabilities elements. The element is present in Association Request, Association Response, Re-association Request, Re-association Response, Probe Request and Probe Response frames and can be present in EDMG Beacon, Information Request, and Information Response Frames.

The format of the EDMG Capabilities element is shown in Figure 1.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Element ID Extension | Core Capabilities | Extended Capabilities 1 | … | Extended Capabilities N |
| Octets: | 1 | 1 | 1 | TBD | Variable |  | Variable |

**—EDMG Capabilities element format**

The Core Capabilities field is shown in Figure 2.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | STA Address | AID | EDMG STA Core Capabilities | EDMG AP/PCP Capabilities | EDMG STA BeamTracking Time Limit | Maximum Number of Basic A-MSDU Subframes in A-MSDU | Maximum Number of Short A-MSDU Subframes in A-MSDU |
| Octets: | 6 | 1 | TBD | TBD | TBD | 1 | 1 |

**—Core Capabilities sub-field format**

The AID field contains the AID assigned to the STA by the AP or PCP The AID field is reserved in Association Request, Re-association Request, and Probe Request frames and when used in an IBSS.

The EDMG STA Core Capabilities field is shown in Figure 3.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Reverse Direction | Higher Layer Timer Synchronization | TPC | SPSH and Interference Mitigation | Number of RX DMG Antennas | Fast Link Adaptation | Total Number of Sectors |
| Bits: | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
|  |  |  |  |  |  |  |  |
|  | RXSS Length | EDMG Antenna Reciprocity | A-MPDU Parameters | BA with Flow Control | Support MCS Set | DTP Supported | A-PPDU Supported |
| Bits: | 6 | 1 | 6 | 1 | TBD | 1 | 1 |
|  |  |  |  |  |  |  |  |
|  | Heartbeat | Supports Other\_AID | Antenna Pattern Reciprocity | Heartbeat Elapsed Indictation | Grant ACK Supported | RXSS TX Rate Supported | Reserved |
| Bits: | 1 | 1 | 1 | 3 | 1 | 1 | TBD |

**—EDMG STA Core Capabilities field format**

The Reverse Direction (#3097)subfield is set to 1 if the STA supports RD as defined in 10.28 (Reverse direction protocol) and is set to 0 otherwise.

The Higher Layer Timer Synchronization (#3097)subfield is set to 1 if the STA supports Higher Layer Timer Synchronization as defined in 11.6 (Higher layer timer synchronization) (#3334)and is set to 0 otherwise.

The TPC (#3097)subfield is set to 1 if the STA supports the TPC as defined in 11.8 (TPC procedures) and is set to 0 otherwise.

The spatial sharing (SPSH) and Interference Mitigation (#3097)subfield is set to 1 if the STA is capable of performing the function of SPSH and Interference Mitigation and if dot11RadioMeasurementActivated is true and is set to 0 otherwise (see 11.32 (Spatial sharing and interference mitigation for DMG STAs)).

The Number of RX DMG Antennas (#3097)subfield indicates the total number of receive DMG antennas of the STA. The value of this (#3097)subfield is in the range of 1 to 4, with the value being equal to the bit representation plus 1.

The Fast Link Adaptation (#3097)subfield is set to 1 to indicate that the STA supports the fast link adaptation procedure described in 10.39.3 (Fast link adaptation). Otherwise, it is set to 0.

The Total Number of Sectors (#3097)subfield indicates the total number of transmit sectors the STA uses in a transmit sector sweep combined over all DMG antennas, including any LBIFS required for DMG antenna switching (see 10.38 (DMG beamforming)).(M34) The value of this (#3097)subfield is in the range of 1 to 128, with the value being equal to the bit representation plus 1.

The value represented by the RXSS Length (#3097)subfield specifies the total number of receive sectors combined over all receive DMG antennas of the STA, including any LBIFS required for DMG antenna switching (see 10.38 (DMG beamforming)).(M34)(#7363) The value represented by this (#3097)subfield is in the range of 2 to 128 and is given by (RXSS Length+1)×2.(M34)

The DMG Antenna Reciprocity (#3097)subfield is set to 1 to indicate that the best transmit DMG antenna of the STA is the same as the best receive DMG antenna of the STA and vice versa. Otherwise, this (#3097)subfield is set to 0.

The A‑MPDU Parameters (#3097)subfield is shown in Figure 9-505 (A-MPDU parameters subfield format).

|  |  |  |
| --- | --- | --- |
|  | B0 B2 | B3 B5 |
|  | Maximum A-MPDU  Length Exponent | Minimum MPDU  Start Spacing |
| Bits: | 3 | 3 |
| **Figure X A-MPDU parameters (#3097)subfield format(11ad)** | | |

The subfields of the A‑MPDU Parameters (#3097)subfield are defined in Table 9-229 (Subfields of the A-MPDU Parameters subfield).

|  |  |  |
| --- | --- | --- |
| * **Subfields of the A-MPDU Parameters (#3097)subfield(11ad)** | | |
| **Subfield** | **Definition** | **Encoding** |
| Maximum A-MPDU Length Exponent | Indicates the maximum length of A-MPDU that the STA can receive. | This (#3097)subfield is an integer in the range of 0 to 5.  The length defined by this (#3097)subfield is equal to  2(13 + Maximum A-MPDU Length Exponent) – 1 octets. |
| Minimum MPDU Start Spacing | Determines the minimum time between the start of adjacent MPDUs within an A-MPDU that the STA can receive, measured at the PHY (#7268)SAP. | Set to 0 for no restriction  Set to 1 for 16 ns  Set to 2 for 32 ns  Set to 3 for 64 ns  Set to 4 for 128 ns  Set to 5 for 256 ns  Set to 6 for 512 ns  Set to 7 for 1024 ns |

The BA with Flow Control (#3097)subfield is set to 1 if the STA supports BA with flow control as defined in 10.39 (DMG link adaptation) and is set to 0 otherwise.

The Supported MCS Set (#3097)subfield indicates which MCSs a(#2157) STA supports. An MCS is identified by an MCS index, which is represented by an integer in the range of 0 to 31 or by one of the values 9.1, 12.1, 12.2, 12.3, 12.4, 12.5 and 12.6.(#7138) The interpretation of the MCS index (i.e., the mapping from MCS to data rate) is PHY dependent. For the DMG PHY, see Clause 20 (Directional multi-gigabit (DMG) PHY specification). The structure of the Supported MCS Set (#3097)subfield is defined in Figure 9-506 (Supported MCS Set subfield format)

Supported MCS Capabilities field is TBD.

The DTP Supported (#3097)subfield is set to 1 to indicate that the STA supports DTP as described in 10.40 (DMG dynamic tone pairing (DTP)) and 20.5.3.2.4.6.3 (Dynamic tone pairing (DTP)). Otherwise, it is set to 0.

The A-PPDU Supported (#3097)subfield is set to 1 to indicate that the STA supports A-PPDU aggregation as described in 10.15 (DMG A-PPDU operation). Otherwise, it is set to 0.

The Supports Other\_AID (#3097)subfield is set to 1 to indicate that the STA sets its AWV configuration according to the Other\_AID subfield in the BRP Request field during the BRP procedure as described in 10.38.6.4.4 (Antenna configuration setting during a beam refinement transaction) and 20.10.2.2.6 (TRN field), if the value of the Other\_AID subfield is different from zero. Otherwise, this (#3097)subfield is set to 0.

The Heartbeat (#3097)subfield is set to 1 to indicate that the STA expects to receive a frame from the AP or PCP during the ATI (10.36.3 (ATI transmission rules)) and expects to receive a frame with the DMG Control modulation from a source DMG STA at the beginning of an SP (10.36.6.2 (Service period (SP) allocation)) or TXOP (10.22.2 (HCF contention based channel access (EDCA))). Otherwise, it is set to 0.

The Antenna Pattern Reciprocity (#3097)subfield is set to 1 to indicate that the transmit antenna pattern associated with an AWV is the same as the receive antenna pattern for the same AWV. Otherwise, this (#3097)subfield is set to 0.

The Heartbeat Elapsed Indication (#3097)subfield is used to calculate the value of the Heartbeat Elapsed Time. The Heartbeat Elapsed Time is computed with the following equation:

(Ed)



where

*THE* is the Heartbeat Elapsed Time (in milliseconds)

*FHE* is the value of the Heartbeat Elapsed Indication (#3097)subfield

The Grant (#1198)Ack Supported (#3097)subfield is set to 1 to indicate that the STA is capable of responding to a Grant frame with a Grant (#1198)Ack frame. Otherwise, this (#3097)subfield is set to 0.

The RXSSTxRate Supported (#3097)subfield is set to 1 to indicate that the STA can perform an RXSS with SSW frames transmitted at MCS 1 of the DMG SC modulation class. Otherwise, it is set to 0.

The EDMG AP/PCP Core Capabilities field is shown in Figure 4.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | TDDTI | Pseudo-static Allocations | PCP Handover | MAX Associated STA Number | Power Source |
| Bits: | 1 | 1 | 1 | 8 | 1 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Decentralized AP or PCP Clustering | PCP Forwarding | Centralized AP or PCP Clustering | EDMG AP/PCP Capabilities | EDMG STA BeamTracking Time Limit |
| Bits: | 1 | 1 | TBD | TBD | TBD |

**—EDMG AP/PCP Core Capabilities sub-field format**

Each Extended Capabilities sub-field is structured as defined in Figure 5. The Extended Capabilities field is identified by the contents of the Capabilities ID subfield. The Capabilities Length subfield specifies the number of octets in the Capabilities Payload subfield that follows the Capabilities Length subfield.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Capabilities ID | Capabilities Length | Capabilities Payload |
| Octets: | 1 | 1 | Variable |

**—Extended Capability sub-field format**

The set of valid extended capabilities is defined in Table 2. An Extended Capabilities sub-field shall only appear once in the EDMG Capabilities element. Extended Capabilities sub-fields may be transmitted in any order.

**—Capabilities IDs**

|  |  |
| --- | --- |
| **Capability** | **Capabilities ID** |
| Multi-BF | 0 |
| Antenna Polarization Capability | 1 |

**Multi-BF field**

The Multi-BF field indicates the capability of the STA to perform multi-beamforming.

**Antenna Polarization field**

The Antenna Polarization Capability field indicates the capability to share antenna polarization information and is defined in Figure 7.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Number of DMG Antennas | Polarization Capability 1 | … | Polarization Capability N |
| Octets: | 1 | 2 | … | 2 |

**—Antenna Polarization Capability field format**

The Number of DMG Antennas subfield defines the combined total number of RX and TX antennas of an EDMG STA.

A Polarization Capability subfield is present for as many DMG antennas as indicated by the value of the Number of DMG Antennas subfield. The Polarization Capability subfield is defined in Figure 8.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 B1 | B2 B3 | B4 B10 | B11 B15 |
|  | TX/RX | Polarization Configuration | Polarization Description | Reserved |
| Bits: | 2 | 2 | 7 | 5 |

**—Polarization Capability subfield format**

The TX/RX subfield is set to 1 to indicate that the antenna is for both transmission and reception, is set to 2 to indicate that the antenna is for transmission only, and is set to 3 to indicate that the antenna is for reception only. Value 0 is reserved.

The Polarization Configuration subfield is set to 0 to indicate single polarization, is set to 1 to indicate polarization switch, is set to 2 to indicate synthesizable polarization, and is set to 3 to indicate MIMO dual polarization.

The definition of the Polarization Description subfield depends on the setting of the Polarization Configuration subfield.

If the value of the Polarization Configuration subfield is equal to single polarization or MIMO dual polarization, the Polarization Description subfield is set to 0 to indicate linear polarization, is set to 1 to indicate circular polarization and is set to 2 for mixed polarization. Other values are reserved.

If the value of the Polarization Configuration subfield is equal to synthesizable polarization, the Polarization Description subfield is set to 0 to indicate linear polarization, is set to 1 to indicate circular polarization, is set to 2 for mixed polarization, and is set to 3 to indicate support for both linear and circular polarization. Other values are reserved.

If the value of the Polarization Configuration subfield is equal to polarization switch, the Polarization Description subfield is defined as shown in Figure 9.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B4 | B4 B6 | B7 B8 | B9 B10 |
|  | Number of Throws | Polarization for Throw 1 | Polarization for Throw 2 | Polarization for Throw 3 |
| Bits: | 1 | 2 | 2 | 2 |

**—Polarization Description subfield format**

The Number of Throws subfield is set to 0 to indicate 2 throws and is set to 1 to indicate 3 throws. If the Number of Throws subfield is set to indicate 2 throws, the Polarization for Throw 3 subfield is reserved.

Each of Polarization for Throw 1 subfield, Polarization for Throw 2 subfield and Polarization for Throw 3 subfield is set to set to 0 to indicate linear polarization, is set to 1 to indicate circular polarization and is set to 2 for mixed polarization. Value 0 is reserved.