IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DMG Measurement Setup frames | | | | |
| Date: 2022-01-25 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Assaf Kasher | Qualcomm |  |  | akasher@qti.qualcomm.com |
|  |  |  |  |  |

Abstract

This document presents draft text for a The DMG part of the Sensing Measurement setup frame

Rev 4: convert LUTs from subelements to elements. Add option to request Image Direction report. Various grammatical and editorial fixes.

**Discussion**

(Motion 48, 21/1865r1) In an DMG/EDMG bistatic and multistatic measurement setup exchange (at least) the following parameters may be exchanged:

* set of beam directions in TX (sets of TX AWV settings to be used in the measurements)
* set of beam directions in RX (sets of RX AWV settings to be used in the measurements)
* beamforming TRN field information such as TRN-P, TRN-M, TRN-N
* location and orientation of each of the STAs
* coordinates can be local or earth coordinates
* relative locations orientation may be estimated using TGaz based exchanges or available from management layer
* Scheduling

***TGbf Editor: insert the following text as a new clause 9.4.2.x***

***Editor: insert the following new subclause:***

**9.4.2.x3** **DMG Sensing Measurement Setup element**

The DMG Sensing Measurement Setup element carries information needed for a setup of a DMG sensing measurement. The DMG Sensing Measurement Setup element is contained in Sensing Setup frames.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element Id | Length | Element Id Extension | Measurement Setup Control | Measurement Id | Report  Type | Num Tx Beams | Num Rx Beams |
| octets: | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | TRN-M | TRN-P | TRN-N | LCI | Peer Orientation | Optional subelements |
| octets: | 1 | 1 | 1 | 0 or 16 | 0-5 | variable |

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

The Measurement Setup Control field is shown in Figure 1.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B0 B1 | B2 | B3 | B4 | B5 B7 |
|  | Sensing Type | Rx Initiator | LCI Present | Orientation Present | Reserved |
| bits: | 2 | 1 | 1 | 1 | 1 |

Figure 1 - DMG Measurement Setup Element

The Sensing Type subfield is set according to the following table:

Table 1 - Sensing Type Subfield

|  |  |
| --- | --- |
| value | Sensing Type |
| 0 | Reserved |
| 1 | Coordinated Monostatic |
| 2 | Bi-Static |
| 3 | Multi-Static |

The Rx Initiator subfield is set to 1 if the initiator is the receiver in bi-static sensing and to 0 if the initiator is the transmitter in bi-static sensing. This field is reserved if the Sensing Type subfield is not set to 2 (Bi-Static).

The LCI Present subfield is set to 1 if the LCI field is present in the DMG Sensing Measurement Setup element, it is set to 0 otherwise.

The Orientation Present subfield is set to 1 if the Peer Orientation is present in the DMG Sensing Measurement Setup element, it is set to 0 otherwise.

The Measurement Id field is set by the initiator to a unique value.

The Report Type field indicates which type of report the initiator expects from the responder. Possible values for this field are listed in Table 2

Table 2 - Values for Report Type field

|  |  |
| --- | --- |
| Value | Type of report |
| 0 | No Report |
| 1 | CSI |
| 2 | DMG Sensing Image Direction |
| 3 | DMG Sensing Image Range-Doppler |
| 4 | DMG Sensing Image Range-Direction |
| 5 | DMG Sensing Image Doppler-Direction |
| 6 | DMG Sensing Image Range-Doppler-Direction |
| 7 | Target |

The Num Tx Beams field and the Num Rx Beams field indicate the number of Tx AWVs and Rx AWVs that are listed in the Beam List subelements.

The TRN-M, TRN-P, TRN-N are used to indicate the values of EDMG-TRN-M, EDMG-TRN-P and EDMG-TRN-N that will be used in EDMG Bi-Static and EDMG Multi-Static sensing. If the addressed STA is a non-EDMG STA, TRN-M and TRN-P are reserved and set to 0 and TRN-N indicate the number of repetitions for each receive pattern (see DMG Bi-static sounding instance)

The LCI field is defined in 9.4.2.21.10.

The peer orientation field is shown in Figure 2.

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B11 | B12 B23 | B24 B39 |
|  | Azimuth | Elevation | Range |
| bits: | 12 | 12 | 16 |

Figure 2 - Peer Orientation field

The Azimuth subfield contains the azimuth orientation of the addressed STA as measured by the transmitting STA in 360º/4096 units with values from 0 to 4095.

The Elevation subfield contains the elevation orientation of the addressed STA as measured by the transmitting STA in 180º/4096 units with values from -2048 to 2047.

The Range subfield contains the range from the transmitting STA to the addressed STA as measured by the addressed STA in millimeter units.

The Optional Subelements field contains zero or more subelements. The subelement format and ordering of subelements are defined in 9.4.3 (Subelements). The Subelement ID field values for the defined subelements are shown in Table 3.

Table 3 - Subelements of DMG Sensing Measurement Setup

|  |  |  |
| --- | --- | --- |
| Subelement Id | Subelement Name | Extensible |
| 1 | Tx Beam List | Yes |
| 2 | Rx Beam List | Yes |
| 3 | DMG Sensing Scheduling | Yes |
|  |  |  |
|  |  |  |

**9.4.2.x3.1 Tx Beam List subelement**

The Tx Beam List subelement contains a list of Tx beam indices. The beam indices represent indices in the Beam Descriptors sent with DMG Sensing Capabilities Element.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Subelement Id | Length | Num Beam Indices | Beam Index Field 1 | … | Beam Index Field N | Pad to Multiple of 8 bits |
| octets: | 1 | 1 | 1 |  | … |  |  |

Figure 3 - Tx Beam List subelement format

Each Beam Index Field is 12bit long.

**9.4.2.x3.2 Rx Beam List subelement**

The Rx Beam List subelement contains a list of Rx beam indices. The beam indices represent indices in the Beam Descriptors sent with DMG Sensing Capabilities Element.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Subelement Id | Length | Num Beam Indices | Beam Index Field 1 | … | Beam Index Field N | Pad to Multiple of 8 bits |
| octets: | 1 | 1 | 1 |  | … |  |  |

Figure 4 - Rx Beam List subelement format

Each Beam Index Field is 12bit long.

**9.4.2.x3.3 DMG Sensing Scheduling subelement**

The Scheduling subelement contains scheduling information for the measurement defined in the measurement setup.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Subelement Id | Length | Start Of Burst | Inter Burst Time | Intra Burst Time | Num Tx Beams Per Instance | Repeat per Instance | Num Bursts |
| octets: | 1 | 1 | 4 | 2 | 1 | 1 | 1 |  |

Figure 5 - DMG Sensing Scheduling subelement format

The Start of Burst field contains the time for the start of the first burst in TSF units.

The Inter Burst Time Field contains the time between the start of successive instances in a burst. This field is in TSF field units.

The Intra Burst Time contains the time between the start of successive bursts of TSF Units.

The Num Tx Beams Per Instance field contain the number of TX beams to be used in one instance. The use of this field is described in 11.21.18.3.5

The Repeat per Instance field indicates the number of times to repeat the transmission.

The Num Bursts field contains the number of times to repeat the Burst. A value of 0 indicates repeat until another measurement setup or tear down.

**9.4.2.x4DMG Sensing Image Range Axis LUT element**

The DMG Sensing Image Range Axis LUT element carries the LUT for the Range Axis used in DMG Sensing Image Report Data element. The format of the DMG Sensing Image Range Axis LUT element is shown in Figure 9-n (DMG Sensing Image Range Axis LUT element format)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Element Id | Length | Element Id Extension | Total number of LUT entries |
| Octets: | 1 | 1 | 1 | 2 |

|  |  |
| --- | --- |
|  | LUT entries |
| Octets: | 2xK |

**Figure 9-n—** **DMG Sensing Image Range Axis LUT element format**

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

The Total number of LUT entries subelements field contains the total number of LUT entries that the sender STA sends in one or multiple DMG Sensing Image Range Axis LUT IE.

The LUT entries field contains the Range values for each entry. Each value is 16 bits representing the Range in 1mm units.

**9.4.2.x5DMG Sensing Image Doppler Axis LUT element**

The DMG Sensing Image Doppler Axis LUT element carries the LUT for the Doppler Axis used in DMG Sensing Image Report Data element. The format of the DMG Sensing Image Doppler Axis LUT element is shown in Figure 9-o (DMG Sensing Image Doppler Axis LUT element format)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Element Id | Length | Element Id Extension | Total number of LUT entries |
| Octets: | 1 | 1 |  | 2 |

|  |  |
| --- | --- |
|  | LUT entries |
| Octets: | 2xK |

**Figure 9-o—** **DMG Sensing Image Doppler Axis LUT element format**

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

The Total number of LUT entries subelements field contains the total number of LUT entries that the sender STA sends in one or multiple DMG Sensing Image Doppler Axis LUT IE.

The LUT entries Subelement field contains the Doppler values for each entry. Each value is 16 bits representing the Doppler in 1mm/sec units.

***TGbf Editor: insert the new text as follows***

**9.6.19.1 DMG Action frame details**

***Editor: Add the following lines to Table 9-540—DMG Action field values***

|  |  |
| --- | --- |
| **DMG Action field value** | **Meaning** |
| 21 | Protected Sensing Measurement Setup Request. The format of the frame after the action field is identical to the format of the Sensing Measurement Setup Request (9.6.21.8) |
| 22 | Protected Sensing Measurement Setup Response. The format of the frame after the action field is identical to the format of the Sensing Measurement Setup Response (9.6.21.9). |

**9.6.21.1 Unprotected DMG Action field**

**Editor: change table 9-569 as follows**

**Table 9-569—Unprotected DMG Action field values**

|  |  |
| --- | --- |
| **Unprotected DMG Action field value** | **Meaning** |
| 6 | Sensing Measurement Setup Request |
| 7 | Sensing Measurement Setup Response |
| 8 | Sensing Measurement Report |

***TGbf Editor: Add the following line to table 9-xxx Sensing Measurement Setup frame Action field format:***

|  |  |
| --- | --- |
| 7 | DMG Sensing Measurement Setup element |

**9.6.21.10** Sensing Measurement Report frame format

TBD

**9.6.X.1 Protected Sensing Action field**

***TGbf Editor: insert the following line to the Protected Sensing action field table:***

|  |  |
| --- | --- |
| **Protected Sensing Action field** | **Meaning** |
| TBD | Sensing Measurement Report - The format of the frame after the action field is identical to the format of the Sensing Measurement Report unprotected DMG Action frame. It is carried in a Management Action frame. |

***TGaz Editor: insert the following text at the end of 11.21.18.3.3.1***

A DMG Sensing Measurement setup starts with the initiator STA sending a Sensing Measurement Setup Request frame containing a DMG Sensing Measurement Setup element to the responder.

The initiator shall set the Measurement Id field in the DMG Sensing Measurement Setup element to a unique value identifying the measurement.

In the DMG Sensing Measurement Setup element the initiator shall set Sensing Type subfield to the sensing that will be used in the measurement. The initiator shall not request a sensing type that the responder has not indicated it is capable of. For sensing type of Bi-Static the Rx Initiator subfield is set to 1 to indicate that the initiator is the receiver in the Bi-Static measurements. It is set to 0 if the initiator is the transmitter in the Bi-Static measurements.

The initiator shall set the Num Tx Beams field to the number of Tx beams that will be used by the transmitter in each measurement burst. The Num Tx Beams shall be equal to the number of beams indices in the Tx Beam List subelement. The initiator shall set the Num Rx Beams field to the number of receiver beam per each transmit beam in the Bi-Static and Multi-Static measurements. The Num Rx Beams shall be equal to the number of beams indices in the Rx Beam List subelement. Each beam index in the Tx Beam List and Rx Beam List is an index into the list of beams the transmitting and receiving STA published in their Sensing Beam Descriptor elements for Tx and Rx respectively.

If present the Peer Orientation field contains the azimuth and elevation of the responder as measured by initiator. If present the LCI field contains the location of the initiator.

The Schedule subelement contains the scheduling of the measurement as proposed by the initiator.

After receiving a Sensing Measurement Setup frame with a DMG Sensing Measurement Setup element a DMG STA responds with a Sensing Measurement Response Request frame containing a DMG Measurement Setup Element.

The Responder shall set the Measurement Id field in the DMG Sensing Measurement Setup element to the value set in this field in the DMG Sensing Measurement Setup element sent the initiator.

In the DMG Sensing Measurement Setup element the responder shall the set the Status Code field to 1 if it agrees to SUCCESS if it accepts the Measurement Setup Request. It shall set the Status Code to REJECT\_WITH\_SCHEDULE if it rejects the request but will accept with the schedule that is included in Scheduling subelement included in the DMG Sensing Measurement Setup element. It shall set the Status Code field to REFUSED, REFUSED\_REASON\_UNSPECIFIED if it rejects the request.

The responder shall set Sensing Type Rx Initiator subfield to the same value that was in the Sensing Measurement Setup frame. If present, the Peer Orientation field contains the azimuth and elevation of the initiator as measured by responder. If present the LCI field contains the location of the initiator.

If the responder indicated REJECT\_WITH\_SCHEDULE, the Scheduling subelement indicates the proposed schedule from the responder.

***TGbf Editor: insert the following text at 9.4.2.1***

***Editor: Insert the following lines to table 9-128 Elements IDs as last lines***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Element** | **Element ID** | **Element ID Extension** | **Extensible** | **Fragmentable** |
| DMG Sensing Measurement Setup element | 255 | <ANA> | Yes | Yes |
| DMG Sensing Image Range Axis LUT | 255 | <ANA> | Yes | Yes |
| DMG Sensing Image Doppler Axis LUT | 255 | <ANA> | Yes | Yes |

**References:**

<https://mentor.ieee.org/802.11/dcn/21/11-21-0504-07-00bf-specification-framework-for-tgbf.docx>