IEEE P802.11
Wireless LANs

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| Solomon text to cover SFD 3.8 Multirate support  |
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Abstract

Text to cover following sections of SFD

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| **Section** | **Page** | **Line** | **Topic** |
| 3.8 | 16 | 11 | Multirate support  |

Discussion:

Terminology that should be introduced in some place:

1. EDMG STA – STA that asserted EDMG Supported field to 1 in DMG Parameters field or/and a non-AP or non-PCP STA declares that it is an EDMG STA by transmitting the EDMG Capabilities element.
2. EDMG STA is a DMG STA by default, it means that EDMG STA supports all relevant DMG features when communicating with DMG STA
3. EDMG STA that communicates with DMG STA is referred as DMG STA
4. EDMG rules are not applicable for DMG STA. Many of DMG rules are fully applicable for EDMG STA. Some of DMG rules are not applicable for EDMG STA. It should be carefully threated what is notation that makes the differences clear. In this submission DMG and EDMG notation is used to indicate DMG rules that are applicable for EDMG STAs communication.
5. Non-EDMG STA actually means DMG STA that is not capable of (1)
* CH\_BANDWIDTH\_IN\_NON\_EDMG in TXVECTOR, if present, indicates the channel width of the PPDU transmitted with DMG control modulation class in duplicated mode, which is signaled via the scrambling sequence or in the control trailer. In RXVECTOR, if valid, indicates the channel width of the received PPDU, which is signaled via the scrambling sequence or in the control trailer. Enumerated type: 2.16 GHz, 4.32 GHz, 6.48 GHz, 8.64 GHz and 2.16+2.16 GHz or 4.32+4.32 GHz.
1. CH\_BANDWIDTH
* FORMAT is EDMG (Indicates the channel width of the transmitted PPDU: Enumerated type: 2.16 GHz, 4.32 GHz, 6.48 GHz, 8.64 GHz, and 2.16+2.16 GHz or 4.32+4.32 GHz.
* FORMAT is non-EDMG (indicated the channel width of PPDU transmitted in SC duplicated mode): Enumerated type: 2.16 GHz, 4.32 GHz, 6.48 GHz, 8.64 GHz, and 2.16+2.16 GHz or 4.32+4.32 GHz.

**10.7.7 Multirate support for DMG and EDMG STAs**

**10.7.7.1 Usage of DMG Control modulation class**

*Discussion: rule “The DMG Control modulation class has only one MCS, which is DMG MCS 0 defined in Clause 20 (Directional multi-gigabit (DMG) PHY specification). The DMG Beacon, SSW-Feedback, SSW-Ack, RTS, DMG CTS, DMG CTS-to-self, DMG DTS, CF-End, Grant, SPR, Poll” is compliant with EDMG.*

*TBD changes in relation to EDMG SSSW frames*

**10.7.7.2 Rate selection rules for Control frames transmitted by DMG and EDMG STAs**

This subclause describes the rate selection rules for Control frames transmitted by DMG and EDMG STAs. The rate selection rules apply only for MCSs defined in Clause 20 (Directional multi-gigabit (DMG) PHY specification) and in Clause 2X (Extended Directional multi-gigabit (EDMG) PHY specification.

A Control frame that does not have an MCS defined in 10.7.7.1 (Usage of DMG Control modulation class) and that is not a control response frame shall be transmitted using an MCS from the mandatory MCS set of the DMG SC modulation class or DMG Control modulation class.

A STA transmitting an Ack or a BlockAck frame that is a response to a frame sent using the DMG lowpower SC modulation class shall use an MCS from the DMG low-power SC Supported MCS set of the Stat hat transmitted the frame that elicited the response as long as (a) the selected MCS has a Data Rate that does not exceed the Data Rate of the frame that elicited the response, and (b) no other MCS satisfying condition (a) results in a shorter frame transmission time.

A STA transmitting a Grant Ack frame shall use the DMG Control modulation class or any MCS from the mandatory MCS set of the DMG SC modulation class.

A STA transmitting an Ack or a BlockAck frame that is a response to a frame sent using the DMG Control modulation class shall use the DMG Control modulation class.

A STA transmitting an Ack frame or a BlockAck frame in response to a frame sent using the DMG SC modulation class or DMG OFDM modulation class shall use an MCS from the mandatory MCS set of the DMG SC modulation class as long as (a) the selected MCS has a Data Rate that does not exceed the Data Rate of the frame that elicited the response, and (b) no other MCS satisfying condition (a) results in a shorter frame transmission time.

An EDMG STA transmitting an Ack frame or a BlockAck frame in response to a frame sent using the DMG SC modulation class, EDMG SC modulation class or EDMG OFDM modulation class shall:

* apply to the DMG STA rules when an ACK or BA sent in DMG PPDU (channel width 2.16 GHz)
* use MCS1 when an ACK or BA frame sent in a non-EDMG duplicate PPDU (channel width 4.32 GHz or wider)
* use an MCS from the mandatory MCS set of the DMG SC modulation class when an ACK or BA is sent in a EDMG PPDU as long as (a) the selected MCS has a Data Rate that does not exceed the Data Rate of the frame that elicited the response, and (b) no other MCS satisfying condition (a) results in a shorter frame transmission time.

Rules for Channel Width selection of Control frames for EDMG STA are presented in 10.7.7.6 Channel Width selection for Control frames transmitted by EDMG STAs.

NOTE—A control response frame is a Control frame that is transmitted within an MPDU as a response to a reception SIFS after the PPDU containing the frame that elicits the response, e.g., a DMG CTS frame in response to an RTS frame reception, an Ack frame in response to a Data frame reception, a BlockAck frame in response to a BlockAckReq frame reception. In some situations, the transmission of some of these Control frames is not a control response transmission, such as when a DMG CTS frame is used to initiate a TXOP.

Except in an A-MPDU consisting of one of the combinations listed below, the rules in this subclause do not apply to Control frames that are contained in A-MPDUs that also include at least one MPDU with the Type subfield equal to Data or Management. In the following cases, the rate selection rules are the same as those for a standalone Ack or BlockAck frame:

— An Ack frame and a QoS Null frame

— A BlockAck frame and a QoS Null frame

— A BlockAckReq frame and a QoS Null frame

— A BlockAck frame, a BlockAckReq frame, and a QoS Null frame

**10.7.7.3 Rate selection for group addressed Data and Management frames transmitted by**

**DMG and EDMG STAs**

This subclause describes the rate selection rules for group addressed Data and Management frames transmitted by DMG STAs. The rate selection rules apply only for MCSs defined in Clause 20 (Directional multi-gigabit (DMG) PHY specification), and in Clause 2X (Extended Directional multi-gigabit (EDMG) PHY specification.

If the transmit antenna pattern of a single transmission of a group addressed frame covers more than one receiver and the supported MCS set of each of the receivers is known to the sender, then the MCS used for the transmission shall be an MCS common to the supported MCS sets of all of the receivers. If such an MCS is not known, the frame shall be transmitted using an MCS from the mandatory MCS set of the DMG control or SC mode.

If the transmit antenna pattern of a single transmission of a group addressed frame covers only one receiver, the frame shall be transmitted following the rate selection rules of individually addressed frames as described in 10.7.7.4 (Rate selection for individually addressed Data and Management frames transmitted by DMG STAs and EDMG STAs).

**10.7.7.4 Rate selection for individually addressed Data and Management frames transmitted by DMG and EDMG STAs**

*Discussion: MCS/Channel\_width relationship is not covered and should be resolved later.*

This subclause describes the rate selection rules for individually addressed Data and Management frames as transmitted by DMG STAs and EDMG STAs. The rate selection rules apply only for MCSs defined in Clause 20 (Directional multi-gigabit (DMG) PHY specification), and in Clause 2X (Extended Directional multi-gigabit (EDMG) PHY specification.

An individually addressed Data or Management frame transmitted to DMG STA shall be sent using an MCS supported by the receiver STA, as reported in the maximum receive MCS subfields in the Supported MCS Set field of the DMG STA Capability Information field and in the Extended

SC MCS Capabilities field of the DMG Capabilities elementin Management frames transmitted by the receiver STA.

An individually addressed Data or Management frame transmitted to EDMG STA shall be sent using an MCS supported by the receiver STA, as reported in the maximum receive MCS subfields in the Supported MCS Set field of the DMG STA Capability Information field and in the Extended

SC MCS Capabilities field of the DMG Capabilities element, and in the EDMG Capabilities element (TBD more details)in Management frames transmitted by the receiver STA.

When the Supported MCS set of the receiving STA is not known, the transmitting STA shall transmit using an MCS from the mandatory MCS set of the DMG control or SC mode.

A DMG STA and EDMG STA shall transmit a TPA Request frame and a TPA Response frame using MCS 1.

The rules in this subclause also apply to A-MPDUs that contain at least one MPDU with Type subfield equal to Control and at least one MPDU with Type subfield equal to Data or Management.

**10.7.7.5 Rate selection for BRP packets**

*Discussion: EDMG BRP is not covered in this document - TBD*

*Editor add new sub clause after 10.7.7.5*

**10.7.7.6 Channel Width selection for Control frames transmitted by EDMG STAs**

*Discussion: Channel width selection rules for RTS/DMG CTS/DTS frames are described in TBD (EDMG RTS procedure).*

The rules in this subclause, combined with the rules in 10.7.7.2 (Rate selection rules for Control frames transmitted by DMG and EDMG STAs), determine the format of control response frames.

If a EDMG STA transmits to another EDMG STA a Control frame that is not an RTS frame, DMG CTS frame, DTS frame, or a CF-End frame, if that Control frame elicits a control response frame, and

— if the Control frame is transmitted in a non-EDMG duplicate PPDU (channel width 4.32 GHz or wider) and in DMG Control modulation class the transmitting DMG STA shall set the TXVECTOR parameters CH\_BANDWIDTH\_IN\_NON\_EDMG and CH\_BANDWIDTH to the same value.

— If the Control frame is transmitted in a non-EDMG PPDU (channel width 2.16 GHz) and in DMG Control modulation class the transmitting DMG STA may set the TXVECTOR parameters CH\_BANDWIDTH\_IN\_NON\_EDMG and CH\_BANDWIDTH to the same value.

NOTE 1—Such Control frames are Grant, Grant-Ack, SPR, Poll frames

— If the Control frame is transmitted in a non-EDMG duplicate PPDU (channel width 4.32 GHz or wider) and in SC modulation class the transmitting DMG STA shall not set the TXVECTOR parameters CH\_BANDWIDTH\_IN\_NON\_EDMG.

An EDMG STA that transmits a CF-End frame in a non-EDMG duplicate PPDU (channel width 4.32 GHz or wider) shall set the TXVECTOR parameters CH\_BANDWIDTH\_IN\_NON\_EDMG and CH\_BANDWIDTH to the same value.

An EDMG STA that transmits a CF-End frame in a non-EDMG PPDU (channel width 2.16GHz) may set the TXVECTOR parameters CH\_BANDWIDTH\_IN\_NON\_EDMG and CH\_BANDWIDTH to the same value.

An EDMG STA that sends a Control frame in a non-EDMG duplicate PPDU in DMG Control modulation class in response to a frame carried in an EDMG PPDU shall set the TXVECTOR parameter CH\_BANDWIDTH to indicate a channel width that is the same as the channel width indicated by the RXVECTOR parameter CH\_BANDWIDTH of the frame eliciting the response.

An EDMG STA that sends a Control frame in response to a frame carried in a non-EDMG duplicate PPDU that does not provide channel width information

— Should set the TXVECTOR parameter CH\_BANDWIDTH to the same value as the RXVECTOR parameter CH\_BANDWIDTH for the frame eliciting the response.

— Shall not set the TXVECTOR parameter CH\_BANDWIDTH to a value greater than the

RXVECTOR parameter CH\_BANDWIDTH for the last EDMG PPDU or non-EDMG duplicate PPDU frame successfully transmitted by the STA in the current sequence.

NOTE 2—According to this rule, a STA can respond with a 2.16 GHz PPDU if it receives a non-EDMG duplicate PPDU (SC modulation class with no channel width indication) and can also respond with 4.32 GHz PPDU if the last frame it sent in the sequence and responded in SIFS time was of EDMG PPDU with channel width 4.32 GHz.

A EDMG STA that sends a Control frame that is in response to a non-EDMG duplicate format frame in DMG Control modulation class and that is not a DMG CTS shall set the channel width indicated by the TXVECTOR parameter CH\_BANDWIDTH to the same value as the channel width indicated by the RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_EDMG for the frame eliciting the response.

For the channel width selection rules for CTS sent in response see TBD (EDMG CTS procedure).

A frame that is intended to provide protection is transmitted using a channel width selected by the rules defined in 10.26 (Protection mechanisms).

An EDMG STA that uses a non-EDMG duplicate frame to establish protection of its TXOP shall send any CF-End frame using a non-EDMG duplicate frame The TXOP holder should set the TXVECTOR parameter CH\_BANDWIDTH of a CF-End frame to the maximum bandwidth allowed by the rules in TBD (Multiple frame transmission in an EDCA TXOP).

NOTE 3—A CF-End frame transmitted a SIFS duration after receiving a CF-End frame is considered a control response frame.

**10.7.7.7 Channel Width selection for group addressed Data and Management frames transmitted by EDMG STAs**

TBD

**10.7.7.8 Channel width for individually addressed Data and Management frames transmitted by EDMG STAs**

TBD

**10.7.9 Modulation classes**

Table 10-6 (Modulation classes) defines modulation classes for the rules for response frames in 10.7

**Table 10-6—Modulation classes**

Editor modify the table as follows:

|  |  |
| --- | --- |
| Description ofmodulation | Condition that selects this modulation class |
| Clause 15 (DSSS PHYspecification for the2.4 GHz banddesignated for ISMapplications) toClause 18 (ExtendedRate PHY (ERP)specification) PHYs orClause 20 (Directionalmulti-gigabit (DMG)PHY specification)PHY or Clause 2X (Extended DMG PHY specification)PHY | Clause 19 (High Throughput (HT)PHY specification) PHY | Clause 21 (Very HighThroughput (VHT) PHYspecification) PHY |
|  |  |  |  |
| EDMG Control | Clause 2X (Extended DMG PHY specification) transmissionIndication TBD | NA | NA |
| EDMG SC | Clause 2X (Extended DMG PHY specification) transmissionIndication TBD | NA | NA |
| EDMG OFDM | Clause 2X (Extended DMG PHY specification) transmissionIndication TBD | NA | NA |

**References:**

1. 11-15-1358-15-00ay-11ay Spec Framework.pdf
2. IEEE P802.11-REVmc/D8.0, Aug 2016