### **IEEE P802.11 Wireless LANs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Miscellaneous Comment Resolutions | | | | |
| Date: 2023-07-11 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | Email |
| Brian Hart | Cisco Systems |  |  | brianh@cisco.com |
|  |  |  |  |  |
|  |  |  |  |  |

**Abstract**

CIDs 4013, 4023, 4014

**Revisions:**

* Rev 0: Initial version of the document.
* Rev 1: Some clean up around HE MMPDUs dropping between Table 9-34 and 9.3.3.1; also addressing other offline feedback items to maintain existing limits as much as possible.
* Rev 2: Converted 4013 from accept to revised.
* Rev 3: Added discussion and options for 4023
* Rev 4: Under CID 4023, changed last line of MIB variable to “Not used by APs.”
* Rev 5: Under CID 4014, reworked table 9-23 changes; reused 9.3.3.1.
* Rev 6: Under CID 4014, changed CMMG “information” to “field” x2

***TGme editor: Please note Baseline is 11me D3.0. Edits are expressed via Word track changes:***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 4013 | Table 9-34expresses units in the title of the table, which is non-traditional (i.e., easy to miss) and not as precise as could be | 621 | 9.2.4.8.1 | 1 | Dete "(octets)" and "in microseconds" from table header, and instead add these as labels to each row (i.e. all rows are octets except the last which is microseconds) | Revised. See changes in 23/831<motioned Rev> that substantially align with the commenter’s resolution. |

***Note to editor: append “(octets) in all rows in Table 9-34 except that last row where “(microseconds)” is appended as per below***

**Table 9-34—Maximum data unit sizes and durations**

|  |  |  |
| --- | --- | --- |
|  | Non-HT non-VHT non-HE(11ax) non-S1G non-DMG PPDU and non-HT duplicate PPDU | … |
| … | … | … |
| PSDU size (octets) | xx | … |
| PPDU duration (microseconds) | xx | … |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 4023 | 12.2.10 lays out the opportunities and requirements for non-AP STAs seeking privacy (i.e., with dot11MACPrivacyActivated equal to true) including some minimal behaviors to assure expected/usual ESS behavior. In reality, these minimal behaviors apply equally to non-AP STAs not seeking privacy. This second class of STAs will naturally tend to follow the same minimal behaviors yet this is not required since the associated language is omitted via the current narrow text: "MAC privacy enhancements are enabled on a non-AP STA when dot11MACPrivacyActivated is set to true ... The STA ...". The current language on minimal behaviors should be generalized to include clients not seeking privacy. | 2790 | 12.2.10 | 58 | Change "The" to "A" at P2790L58. Change "The" to "A" at P2790L60.5. | Revised. Changes substantially in line with the comment are made in 23/0831r<motionedRev> |

***Discussion***

If dot11MACPrivacyActivated is true, a STA is subject to “The non-AP STA connecting to an infrastructure BSS shall retain a single MAC address for the duration of its connection across an ESS.” This requirement is not present if dot11MACPrivacyActivated is false, as some kind of omission based on the historical behavior that client MAC addresses don’t change. However, given we need a “shall” statement to prevent clients from unhelpful/non-interoperable behavior if dot11MACPrivacyActivated is true, then presumably we also need a “shall” statement to prevent clients from unhelpful/non-interoperable behavior if dot11MACPrivacyActivated is false too.

There is a point of view that if dot11MACPrivacyActivated is false then the STA MAC address never changes, and so no “shall” statement is required for this case. The basis for this point of view is generally one or more of the following:

1. Convention
   1. … but this would not be normative
2. Lack of implementer action
   1. … but this would not be normative
3. Self-interest: there are implicit incentives to keep an unchanged MAC address:
   1. To maintain network connectivity (i.e. above layer 2) when it is connecting to a LAN and transitioning between APs in an ESS.
   2. To maintain security state when connecting to APs in an ESS.
   3. … however, this argument applies whether dot11MACPrivacyActivated is true or false. Yet if dot11MACPrivacyActivated is true, we explicitly call out “The non-AP STA connecting to an infrastructure BSS shall retain a single MAC address for the duration of its connection across an ESS.” … so we infer that 11aq didn’t find the self-interest argument compelling.
4. A defined requirement from 802
   1. 802 certainly has some related content:
      1. 8.1 of IEEE 802-2014 defines a MAC address as follows: "In this standard, the term MAC address is used to refer to a 48-bit or 64-bit number that is used to identify the source and destination MAC entities. A MAC address may also be used to identify a MAC SAP." This is not a “shall” requirement but it is the basis for addressing in IEEE 802. All 802 standards comply with this definition.
      2. 8.2.1 of IEEE 802-2014 states, with respect to Universal Addressing: "The concept of universal addressing is based on the idea that **all potential members of a network need to  
         have a unique identifier**. The advantage of a universal address is that a station with such a MAC address can be attached to any IEEE 802 network in the world **with an assurance that the MAC address is unique, if all stations adhere to the rules** and the security of the network prevents malicious spoofing of MAC addresses."
   2. However, these requirements don’t seem to bind 802.11 non-AP STAs very tightly since simply setting dot11MACPrivacyActivated to true allows a STA to ignore any such 802 (or 802.11) requirement and randomly and regularly change its MAC address .
5. dot11MACPrivacyActivated is the only permitted mechanism permitted to change MAC addresses
   1. The first sentence in 12.2.10 “MAC privacy enhancements are enabled on a non-AP STA when dot11MACPrivacyActivated is set to true” says something close to that, and the MIB variable definition is a little stronger (“This attribute when true, indicates that the STA enables MAC privacy considerations. The capability is disabled otherwise.")
   2. However, what if the implementer wants something else: e.g., they want a lucky MAC address and their definition of a lucky MAC address changes every second or minute or hour? Such an implementer might change its MAC address yet still have dot11MACPrivacyActivated set to false.

Thus the counter-arguments against clarifying the expectations on non-AP STAs are not strong, and so it is desirable to clarify the conventions under which existing systems are built, ready for any evolution defined by 11bh/11bi.

***Proposed changes***

***Option A: clarify the MIB variable:***

***TGme editor, make the following changes under CID 4023***

dot11MACPrivacyActivated OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-write

output-type = final

STATUS current

DESCRIPTION

"This is a control variable.

It is written by an external management entity or the SME. Changes take effect as soon as practical in the implementation. This attribute when true, indicates that the non-AP STA enables MAC privacy considerations. Otherwise, the capability is disabled, and the STA’s MAC address is unchanging.Not used by APs.”

DEFVAL {false}

::= { dot11StationConfigEntry 184 }

***Option B: split 12.2.10 into two subsections; one general and one related to privacy:***

***TGme editor, make the following changes under CID 4023***

12.2.10 Requirements pertaining to MAC privacy enhancements

12.2.10.1 Constraints

A non-AP STA shall not change its MAC address during a transactional exchange, for example, transmitting Public Action frames for preassociation discovery, or during the creation of state on an AP using preassociation capabilities, for example, RSN preauthentication or FT over-the-DS.

If a non-AP STA that changes it MAC address starts any transaction that establishes state bound to a MAC address and might elect to establish an association or establish transaction state with a discovered BSS, the STA shall check the value of dot11LocallyAdministeredMACConfig and shall configure its MAC address according to the rules of the local address space prior to the start of the transaction. State created with an AP using a prior MAC address, for instance, RSN preauthentication state or FT state established over-the-DS, is bound to the MAC address used when that state was created. Prior to establishing an association to the AP, the STA shall change its MAC address to the MAC address used when the state was created.

A non-AP STA connecting to an infrastructure BSS shall retain a single MAC address for the duration of its connection across an ESS. A PMKSA created as part of an RSNA will contain the MAC address used to create the PMKSA. A non-AP STA that supports PMKSA caching shall use the same MAC address when attempting a subsequent association to an ESS using PMKSA caching.

When dot11MACAddressPolicyActiviated is true, an AP shall set the Local MAC Address Policy field in the Extended Capabilities field to 1, indicating the existence of a MAC address policy. When dot11MACAddressPolicyActivated is false, an AP shall set the Local MAC Address Policy field in the Extended Capabilities field to 0, indicating that local MAC addresses are not restricted.

A non-AP STA that changes it MAC address and that receives from an AP an Extended Capabilities field with the Local MAC Address Policy subfield set to 1 should, unless the STA has previously stored the MAC address policy for the ESS, discover that policy, using the MAC Address Policy ANQP-element, before sending any Association Request frame to that AP using a local MAC address as the TA.

12.2.10.2 Requirements for support of MAC privacy enhancements

MAC privacy enhancements are enabled on a non-AP STA when dot11MACPrivacyActivated is set to true. MAC privacy behaviors are subject to 12.2.10.1 (Constraints). The STA shall periodically change its MAC address to a random value while not associated to a BSS. The STA shall construct the randomized MAC address from the locally administered address space as defined in IEEE Std 802-2014 and IEEE Std 802c™-2017. The smaller the period of MAC address change, down to a single transmitted frame per MAC address, the greater the privacy these enhancements afford. The actual period used when changing a MAC address is implementation dependent and outside the scope of this standard.

The SME of the non-AP STA may change the MAC address by generating an MLME-UPDATEMACADDRESS.request primitive containing the new MAC address. On receipt of an MLME-UPDATEMACADDRESS.request primitive, the MLME shall attempt to update the MAC address that is to be used by the MAC entity and shall generate an MLME-UPDATEMACADDRESS.confirm primitive to notify the SME whether the MAC address has been changed to the new value.

Every time a MAC address is changed to a new random value, counters in (#270)all sequence number spaces used to identify each MSDU, A-MSDU or MMPDU shall be reset (see 10.3.2.14.2 (Transmitter requirements)) and the STA shall set the TXVECTOR parameter SCRAMBLER\_RESET to RESET\_SCRAMBLER on the next transmitted PPDU.

To construct a random MAC address, the STA shall select a randomized MAC address according to IEEE Std 802-2014 and IEEE Std 802c-2017.

To avoid leakage of possibly sensitive network identifying information, STAs should refrain from transmitting Probe Request frames containing preferred SSID values and, instead, use passive scanning or transmit Probe Request frames containing the wildcard SSID.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 4014 | The definition of the VHT Maximum MPDU Length field has been used and abused, and is not actually the max MPDU length for HE compressed feedback. HE has a workaround in 26.7.1, but it is weak since it leaves the text here as an invalid and misleading definition. | 1223 | 9.4.2.156.2 | 10 | Change to "Indicates the maximum MPDU length that the STA is capable of receiving (see 10.11 (A-MSDU operation)) \*, excluding an HE compressed beamforming/CQI Report frame (see 26.7.1 (General))\* Note that this change also addresses the Maximum MPDU Length field defined in Figure 9-901, since that is defined by xref back to this table. | Revised. Changes substantially in line with the comment are made in 23/0831r<motionedRev> |

***Discussion***

This comment resolution blew up to address all sounding feedback, and associated terms. We make changes in three Parts (each with its own change-text)

***Part A: get the terms correct:***

We have five somewhat related, defined terms:

|  |
| --- |
| * In 9.4.1.47 VHT Compressed Beamforming Report field:   **VHT Compressed Beamforming Report information** (Table 9-103)   * In 9.4.1.60 CMMG Compressed Beamforming Report field   **CMMG Compressed Beamforming Report** field   * In 9.4.1.63 HE Compressed Beamforming Report field   **HE Compressed Beamforming Report information** (Table 9-121)   * In 10.35.5.2 Rules for VHT sounding protocol sequences:   **VHT compressed beamforming feedback** comprises the VHT Compressed Beamforming Report information (see Table 9-103 (VHT Compressed Beamforming Report information)) and the MU Exclusive Beamforming Report information (see Table 9-106 (MU Exclusive Beamforming Report information)). Subclause 9.6.22.2 (VHT Compressed Beamforming frame format) specifies how VHT compressed beamforming feedback is converted into a VHT Compressed Beamforming frame, and it also specifies the rules for the presence or absence of the two fields listed here.   * In 26.7.1 General:   The HE beamformee returns an estimate of the channel state in an **HE compressed beamforming/CQI report** carried in one or more HE Compressed Beamforming/CQI frames. There are three types of HE compressed beamforming/CQI report:   * SU feedback: The HE compressed beamforming/CQI report consists of an HE Compressed Beamforming Report field. * MU feedback: The HE compressed beamforming/CQI report consists of an HE Compressed Beamforming Report field and HE MU Exclusive Beamforming Report field. * CQI feedback: The HE compressed beamforming/CQI report consists of an HE CQI Report field. |

Editorial comment CID317 changed “VHT/CMMG Compressed Beamforming report" to “VHT/CMMG Compressed Beamforming report information" but, since this relates to segments, this should be changed to “VHT/CMMG compressed beamforming feedback” instead. In general, we find that undefined terms (using similar words) are used and should be replaced by defined terms:

***TGme editor: change the following under CID 4014:***

***P661L12:***

The Feedback Segment Retransmission Bitmap field indicates the requested feedback segments of VHT compressed beamforming feedback

***P671L27:***

The Feedback Segment Retransmission Bitmap subfield indicates the requested feedback segments of an HE compressed beamforming/CQI report.

***P820L1***

The CMMG Compressed Beamforming Report field has the structure defined in Table 9-116 (CMMG Compressed Beamforming Report field), where Na is the number of angles used for the CMMG compressed beamforming feedback matrix.

Table 9-116—CMMG Compressed Beamforming Report field

***P820L37:***

Ns is the number of subcarriers for which the CMMG compressed beamforming feedback matrix is sent back to the CMMG beamformer. Ns is a function of the Channel Width and Grouping subfields in the CMMG MIMO Control field. Table 9-117 (Subcarrier indices for which a compressed beamforming feedback matrix is sent back) lists Ns, the exact subcarrier indices and their order for which the CMMG compressed beamforming feedback matrix is sent back. No padding is present between angles in the CMMG Compressed Beamforming Report field, even if they correspond to different subcarriers. If the length of the CMMG Compressed Beamforming Report field is not an integral multiple of 8 bits, up to 7 0s are appended to the end of the field to make its size an integral multiple of 8 bits.

***P823L39/50:***

Table 9-119—Subfield values of the CMMG Operating Mode field

|  |  |
| --- | --- |
| Subfield | Description |
| RX NSS | If the RX NSS Type subfield is 0, indicates the maximum number of spatial streams that the STA can receive. If the RX NSS Type subfield is 1, indicates the maximum number of spatial streams that the STA can receive as a beamformee in an SU PPDU using a beamforming steering matrix derived from a CMMG Compressed Beamforming Report field(#317) with the Feedback Type subfield indicating SU in the corresponding CMMG Compressed Beamforming frame sent by the STA. Set to 0 for NSS = 1 Set to 1 for NSS = 2 … Set to 3 for NSS = 4 |
| RX NSS Type | Set to 0 to indicate that the RX NSS subfield carries the maximum number of spatial streams that the STA can receive. Set to 1 to indicate that the RX NSS subfield carries the maximum number of spatial streams that the STA can receive in an SU PPDU using a beamforming steering matrix derived from a CMMG Compressed Beamforming Report field(#317) with the Feedback Type subfield indicating SU in the corresponding CMMG Compressed Beamforming frame sent by the STA. NOTE—An AP always sets this field to 0. |

***P834L51:***

the Average SNR of Space-Time Stream i field of the HE Compressed Beamforming Report information

***P2044L4:***

NOTE 2—The feedback segments of VHT compressed beamforming feedback(#317) are not MSDU/MMPDU fragments.***P3667L3:***

The Feedback Segment Retransmission Bitmap field indicates the feedback segments to be polled in VHT compressed beamforming feedback(#317)

***P3895L47***

The HE compressed beamforming/CQI report is carried in a single HE Compressed Beamforming/CQI frame if the resulting frame is less than or equal to 11 454 octets in length (see 26.7.3 (Rules for HE sounding protocol sequences)). Otherwise, the HE compressed beamforming/CQI report is segmented, and each segment is carried in an HE Compressed Beamforming/CQI frame.

***P3904L1:***

An HE beamformee that transmits HE compressed beamforming/CQI report shall include neither the HE Compressed Beamforming Report information nor the HE MU Exclusive Beamforming Report information if the transmission duration of the PPDU carrying the HE Compressed Beamforming Report information and any HE MU Exclusive Beamforming Report information would exceed the maximum PPDU duration.

***Part B: clarify that segments are part of an MMPDU.***

***(TGme editor: change-text from Part A has been Word-change-accepted in the following for clarity, but these kind of changes are not intended to change or override whatever Word-changes are agreed in Part A)***

***P2043L52:***

10.35.5.3 Rules for fragmented feedback in VHT sounding protocol sequences

If VHT compressed beamforming feedback would result in a VHT Compressed Beamforming frame that exceeds the VHT beamformer’s maximum MPDU length capability, the VHT compressed beamforming feedback shall be split into up to 8 feedback segments, with each feedback segment sent in a different VHT Compressed Beamforming frame and containing successive portions of the VHT compressed beamforming feedback consisting of the VHT Compressed Beamforming Report information followed by any MU Exclusive Beamforming Report information. Each of the feedback segments except the last shall be transmitted in a frame that contains the maximum number of octets allowed by the VHT beamformer’s maximum MPDU length capability. The last feedback segment may be transmitted in a smaller frame. Each feedback segment is identified by the value of the Remaining Feedback Segments subfield and the First Feedback Segment subfield in the VHT MIMO Control field as defined in 9.4.1.46 (VHT MIMO Control field); the other nonreserved subfields of the VHT MIMO Control field shall be the same for all feedback segments. All feedback segments shall be sent in a single A-MPDU and shall be included in the A-MPDU in the descending order of the Remaining Feedback Segments subfield values.

NOTE 2—The feedback segment of VHT compressed beamforming feedback(#317) are not MSDU/MMPDU fragments, rather each feedback segment, together with the other fields in the Frame Body field of the VHT Compressed Beamforming frame (see Figure 9-120 (Management frame format) and 9.6.22.2 (VHT Compressed Beamforming frame format)), constitutes a single unfragmented MMPDU.

26.7.1 General

An HE beamformer shall support a maximum MPDU length for a frame containing the HE compressed beamforming/CQI report that is the minimum of 11 454 octets and the maximum length of the frame containing the HE compressed beamforming/CQI report that the HE beamformer intends to solicit from its HE beamformees.

26.7.4 Rules for generating segmented feedback

If the HE compressed beamforming/CQI report solicited by the HE beamformer would result in an HE Compressed Beamforming/CQI frame that exceeds 11 454 octets in length, then the HE compressed beamforming/CQI report shall be split into up to 8 feedback segments. Each feedback segment shall be included in a separate HE Compressed Beamforming/CQI frame and shall contain successive segments of the HE compressed beamforming/CQI report. Each feedback segment shall be of equal length, except the last feedback segment that may be smaller. Each HE Compressed Beamforming/CQI frame that includes a feedback segment that is not the last feedback segment shall have a length of 11 454 octets. Each feedback segment is identified by the value of the Remaining Feedback Segments subfield and the First Feedback Segment subfield in the HE MIMO Control field as defined in 9.4.1.62 (HE MIMO Control field(11ax)); the other nonreserved subfields of the HE MIMO Control field shall be the same for all feedback segments. All feedback segments shall be sent in a single A-MPDU contained in a PPDU and shall be included in the A-MPDU in the descending order of the Remaining Feedback Segments subfield values.

***TGbe editor: immediately following this para, insert the following NOTE and renumber all notes in this section accordingly***

NOTE 0—A feedback segment of the HE compressed beamforming/CQI report together with the other fields in the Frame Body field of the HE Compressed Beamforming/CQI frame (see Figure 9-120 (Management frame format) and Table 9-618(HE Compressed Beamforming/CQI frame Action field format), constitutes a single unfragmented MMPDU.

***Part C: update Table 9-34 (Maximum data unit sizes (in octets) and durations (in microseconds) and clarify role of Maximum MPDU Length in VHT Capabilities element***

|  |
| --- |
| ***Part C discussion***  Reviewing all the sounding feedback   * 10.33, 10.35: HT sounding feedback (CSI/compressed/non-compressed) feedback can reach:   + PPDU     - Implicit sounding: “The procedures for HT transmit beamforming with implicit feedback use only HT and non-HT PPDU”     - Explicit sounding: “The procedures in this subclause apply only to HT and non-HT PPDUs”   + MMPDU     - CSI/uncompressed: Category + HT Action + MIMO Control + CSI = 1 + 1 + 6 + 4\*1 + ceil(114\*(3+2\*4\*4\*8)/8) = 3703 octets.     - Compressed: Category + HT Action + MIMO Control + Compressed = 24 + 4 + 1 + 1 + 6 + 4\*1 + ceil(114\*(12\*(4+6)/2)/8) = 895 octets (a non-factor)     - But, from Table 9-34, Non-HT and HT MMPDUs are limited to 2304 octets, so we propose to make it explicit that sounding feedback in a frame that exceeds 2304 octets is still disallowed - compressed or low accuracy CSI would be allowed but not max-accuracy CSI.   + MPDU:     - MAC header + ?HT Control + Category + HT Action + MIMO Control + CSI + FCS = 24 + 4 + 1 + 1 + 6 + 4\*1 + ceil(114\*(3+2\*4\*4\*8)/8) + 4 = 3735 octets.     - Table 9-34, Note 5 says “No direct constraint on the maximum MPDU size; indirectly constrained by the maximum A-MSDU size” but HT sounding feedback is not contained in an A-MSDU. Need to clarify that it is also constrained by max MMPDU size * 10.33.4, 10.35.5/6: VHT sounding feedback is large but, especially after Part B changes, segmented each segment is limited to the maximum number of octets allowed by the VHT beamformer’s maximum MPDU length capability from 10.35.5.3 (Rules for fragmented feedback in VHT sounding protocol sequences). Also Note 1 in Table 9-34 says “NOTE 1—No direct constraint on the maximum MMPDU size; indirectly constrained by the maximum MPDU size (see 9.3.3.1 (Format of (PV0) Management frames)).” Assume that the payload of each segment is an MMPDU, now made explicit.   + PPDU     - From 10.35.5.3, unsegmented or segmented, segments are sent in an A-MPDU, which means a HT or VHT or HE PPDU. The language “allowed by the VHT beamformer’s maximum MPDU length capability” works quite well for each PPDU format (undeclared for <=HT but *indirectly* constrained by the 2304 octet MMPDU limit, declared for VHT and HE), although this “capability” is based on different sub-capabilites (for HT, VHT, etc). Note: AFAIK there is nothing to stop VHT sounding feedback from being sent (unsegmented or segmented) in an HT or HE PPDU – but that seems to be fine, as long as we are not violating pre-existing MMPDU.MPDU limits. Adding a clarifying note.   + MMPDU and MMPDU     - So MPDU length is fine, and MMPDU length is fine given VHT and HE are covered by “Table 9-34/NOTE 1—No direct constraint on the maximum MMPDU size; indirectly constrained by the maximum MPDU size (see 9.3.3.1 (Format of (PV0) Management frames)).” * 26.7: HE sounding feedback is segmented again, but now MPDUs up to 11454 octets could be required, and commensurately large MMPDUs.   + PPDU     - Non-TB sounding: same as VHT – unsegmented or segmented; segments are sent in an A-MPDU, which means HT, VHT or HE … Assume this is possible, as long as pre-existing limitations on MMPDU/MPDU are not violated. Reusing the clarifying note.     - TB- sounding – uses HE TB PPDU   + MMPDU     - Fine – same as VHT   + MPDU     - Up to 11454 octets, if needed |

Table 9-34—Maximum data unit sizes (in octets) and durations (in microseconds)(#1327)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Non-HT non-VHT non-HE(11ax) non-S1G non-DMG PPDU and non-HT duplicate PPDU | HT PPDU | VHT PPDU | HE PPDU(11ax) |
| MMPDU size | 2304  See NOTE 10 | 2304  See NOTE 10 | See NOTE 1 | 2.4 GHz: see NOTE 11  Otherwise: see NOTE 1 |
| A-MSDU size | 3839 or 4065 (see NOTE 2) (HT STA, see also Table 9-222 (Subfields of the HT Capability Information field)), or N/A (non-HT STA, see also 10.11 (A-MSDU operation)) | 3839 (#1435)or 4065 (see NOTE 9) or 7935 (see also Table 9-222 (Subfields of the HT Capability Information field)) | See NOTE 3 | 2.4 GHz band: 3839 or 7935 (see also Table 9-222 (Subfields of the HT Capability Information field))  Otherwise: see NOTE 3 |
| MPDU size | See NOTE 4 | See NOTE 5 | 3895 or 7991 or 11 454 (see also Table 9-311 (Subfields of the VHT Capabilities Information field) and NOTE 10) | 2.4 GHz band: see NOTE 5.  Otherwise: 3895 or 7991 or 11 454 (see Table 9-311 (Subfields of the VHT Capabilities Information field)and NOTE 7) |
| NOTE 1—No direct constraint on the maximum MMPDU size; indirectly constrained by the maximum MPDU size (see 9.3.3.1 (Format of (PV0) Management frames)).  NOTE 3—No direct constraint on the maximum A-MSDU size; indirectly constrained by the maximum MPDU size.  NOTE 4—No direct constraint on the maximum MPDU size; indirectly constrained by the maximum MSDU, MMPDU or (for HT STAs only) A-MSDU size.  NOTE 5—No direct constraint on the maximum MPDU size; indirectly constrained by the maximum A-MSDU/MMPDU size.  NOTE 7—The maximum MPDU size might be greater than the size declared as supported by the recipient if the MPDU is an HE Compressed Beamforming/CQI frame.(11ax)  NOTE 10—The maximum MMPDU or MPDU size can preclude the use of the corresponding PPDU format for certain sounding feedback configurations. See 10.33 (Transmit beamforming), 10.35 (Null data PPDU (NDP) sounding) and 26.7 (HE sounding operation).  NOTE 11—The maximum MMPDU size is: - if there is one recipient, then the size of the MPDU that contains an A-MSDU with size equal to the maximum size supported by the recipient less the shortest Management frame MAC header and FCS, or  - if there is more than one recipient, then the size of the MPDU that contains an A-MSDU with size equal to the smallest among the maximum sizes supported by the recipients less the shortest Management frame MAC header and FCS. | | | | |

**Table 9-311—Subfields of the VHT Capabilities Information field**

|  |  |  |
| --- | --- | --- |
| **Subfield** | **Definition** | **Encoding** |
| Maximum MPDU Length | Indicates the maximum MPDU length that the STA is capable of receiving (see 10.11 (A-MSDU operation)), excepting that a higher maximum MPDU length might be required for the frames listed in NOTE 7 in Table 9-34 (Maximum data unit sizes (in octets) and durations (in microseconds)). | Set to 0 for 3895 octets.  Set to 1 for 7991 octets.  Set to 2 for 11 454 octets.  The value 3 is reserved |

|  |
| --- |
| ***Note to reader: no change is needed to the draft for 6 GHz since this is defined by xref to the table modified above:***  **9.4.2.262 HE 6 GHz Band Capabilities element**  The Maximum A-MPDU Length Exponent subfield and Maximum MPDU Length subfield are defined in (#2317)Table 9-311 (Subfields of the VHT Capabilities Information field) |

9.3.3.1 Format of (PV0) Management frames

The format of a Management frame is defined in Figure 9-118 (Management frame format). The Frame Control, Duration, Address 1, Address 2, Address 3, and Sequence Control fields are present in all management frame subtypes. (#564)The maximum size of an MMPDU that is not carried in a VHT or S1G PPDU or an HE PPDU not sent at 2.4 GHz is defined in Table 9-34 (Maximum data unit sizes and durations(#1327)(#4013)). The presence of the HT Control field is determined by the setting of the +HTC subfield of the Frame Control field (see 9.2.4.1.10 (+HTC subfield). (#564)The maximum size of an MMPDU that is carried in one or more VHT or S1G PPDUs, or an HE PPDU not sent at 2.4 GHz (in whole or in part) is:

- if there is one recipient, then the maximum MPDU size supported by the recipient less the shortest Management frame MAC header and FCS, or

- if there is more than one recipient, then the smallest of the maximum MPDU sizes supported by the recipients less the shortest Management frame MAC header and FCS.

10.35.5.1 General

***Since this definition is widely used and before where it was defined, insert the following as a new last paragraph (copied exactly from the old para in 10.35.5.2***

VHT compressed beamforming feedback comprises the VHT Compressed Beamforming Report information (see Table 9-103 (VHT Compressed Beamforming Report information)) and the MU Exclusive Beamforming Report information (see Table 9-106 (MU Exclusive Beamforming Report information)). Subclause 9.6.22.2 (VHT Compressed Beamforming frame format) specifies how VHT compressed beamforming feedback is converted into a VHT Compressed Beamforming frame, and it also specifies the rules for the presence or absence of the two fields listed here.

10.35.5.2 Rules for VHT sounding protocol sequences