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IEEE P802.11  
Wireless LANs

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| Review of P802.11be/D0.3 for CC34 | | | | |
| Date: 2021-02-03 | | | | |
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|  |  |  |  |  |

Abstract

Review of P802.11be/D0.3 for CC34.

10. MAC sublayer functional description

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# 4 10.2 MAC architecture

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### 7 10.2.7 MAC data service

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1. ***Insert the following two paragraphs after the fifth paragraph (“Unless the MPDU is delivered***
2. ***via DMS ... ”):***

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1. An AP MLD that broadcasts the group addressed MPDU received from a non-AP MLD with which it has
2. done multi-link setup shall set the SA field of the broadcast group addressed MPDU to the MLD MAC
3. address of the non-AP MLD.

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1. A non-AP MLD shall filter out the group addressed MPDU with the SA field set to the MLD MAC address
2. of the non-AP MLD.

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22 **10.3 DCF**

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### 24 10.3.2 Procedures common to the DCF and EDCAF

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### 27 10.3.2.9 CTS and DMG CTS procedure

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## 29 Change the first paragraph as follows:

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1. A STA that receives an RTS frame addressed to it considers the NAV and NSTR limits in determining
2. whether to respond with CTS, unless the NAV was set by a frame originating from the STA sending the
3. RTS frame (see 10.24.2.2 (EDCA backoff procedure)). In this subclause for a non-S1G STA, “NAV

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1. indicates idle” means that the NAV count is 0 or that the NAV count is nonzero but the nonbandwidth
2. signaling TA obtained from the TA field of the RTS frame matches the saved TXOP holder address. In an
3. S1G STA, “NAV indicates idle” means that both NAV and RID counters are 0 or that either NAV or RID
4. counter is nonzero but the TA field of the RTS frame matches the saved TXOP holder address.

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## 42 Insert the following two paragraphs as the second and third paragraph of the subclause:

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44 In this subclause, a STA is NSTR limited if all of the following conditions are true:

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1. — the STA is affiliated with an MLD that has at least one NSTR link pair
2. — the STA has received the RTS on a link that is a member of one or more of the MLD’s NSTR link
3. pairs

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1. — a STA of the MLD is a TXOP holder or TXOP responder on one of the other links that is a member
2. of at least one of the NSTR link pairs of which the link on which the RTS was received is a member

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54 If at least one of the above conditions is not true, then the STA is not NSTR limited.

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## 56 Change the now-shifted fourth and fifth paragraphs as follows:

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58 A VHT STA that is addressed by an RTS frame in a non-HT or non-HT duplicate PPDU that has a

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1. bandwidth signaling TA and that has the RXVECTOR parameter DYN\_BANDWIDTH\_IN\_NON\_HT
2. equal to Static behaves as follows:
3. — If the NAV indicates idle, the STA is not NSTR limited and CCA has been idle for all secondary
4. channels (secondary 20 MHz channel, secondary 40 MHz channel, and secondary 80 MHz channel)

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65 in the channel width indicated by the RTS frame’s RXVECTOR parameter

1. CH\_BANDWIDTH\_IN\_NON\_HT for a PIFS prior to the start of the RTS frame, then the STA shall
2. respond with a CTS frame carried in a non-HT or non-HT duplicate PPDU after a SIFS. The CTS
3. frame’s TXVECTOR parameters CH\_BANDWIDTH and CH\_BANDWIDTH\_IN\_NON\_HT shall
4. be set to the same value as the RTS frame’s RXVECTOR parameter

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1. CH\_BANDWIDTH\_IN\_NON\_HT.
2. • If all of the conditions in the previous paragraph are met, except for the condition “the STA is not
3. NSTR limited”, then the STA may respond with the CTS frame as described in that paragraph.

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10 — Otherwise, the STA shall not respond with a CTS frame.

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1. A VHT STA that is addressed by an RTS frame in a non-HT or non-HT duplicate PPDU that has a
2. bandwidth signaling TA and that has the RXVECTOR parameter DYN\_BANDWIDTH\_IN\_NON\_HT
3. equal to Dynamic behaves as follows:
4. — If the NAV indicates idle, and the STA is not NSTR limited, then the STA shall respond with a CTS

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1. frame in a non-HT or non-HT duplicate PPDU after a SIFS. The CTS frame’s TXVECTOR
2. parameters CH\_BANDWIDTH and CH\_BANDWIDTH\_IN\_NON\_HT shall be set to any channel
3. width for which CCA on all secondary channels has been idle for a PIFS prior to the start of the RTS
4. frame and that is less than or equal to the channel width indicated in the RTS frame’s RXVECTOR
5. parameter CH\_BANDWIDTH\_IN\_NON\_HT.

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1. • If all of the conditions in the previous paragraph are met, except for the condition “the STA is not
2. NSTR limited”, then the STA may respond with the CTS frame as described in that paragraph.

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27 — Otherwise, the STA shall not respond with a CTS frame.

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## 29 Change the now-shifted ninth paragraph as follows:

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1. A non-VHT and non-S1G STA that is addressed by an RTS frame or a VHT STA that is addressed by an
2. RTS frame carried in a non-HT or non-HT duplicate PPDU that has a nonbandwidth signaling TA or a VHT
3. STA that is addressed by an RTS frame in a format other than non-HT or non-HT duplicate behaves as
4. follows:

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1. — If the NAV indicates idle, and the STA is not NSTR limited, the STA shall respond with a CTS
2. frame after a SIFS.

39

1. • If all of the conditions in the previous paragraph are met, except for the condition “the STA is not
2. NSTR limited”, then the STA may respond with the CTS frame as described in that paragraph.

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43 — Otherwise, the STA shall not respond with a CTS frame.

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### 45 10.3.2.14 Duplicate detection and recovery

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### 48 10.3.2.14.2 Transmitter requirements

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## 50 Change the first paragraph as follows:

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1. A STA maintains one or more sequence number spaces that are used when transmitting a frame to determine
2. the sequence number for the frame. An MLD maintains one or more sequence number spaces that are used
3. when delivering an individually addressed QoS data frame to an associated MLD to determine the sequence
4. number for the frame. When multiple sequence number spaces are supported, the appropriate sequence number
5. space is determined by information from the MAC control fields of the frame to be transmitted. Except as

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1. noted below, each sequence number space is represented by a modulo 4096 counter, starting at 0 and incre-
2. menting by 1, for each MSDU or MMPDU transmitted using that sequence number space. If dot11MACPriva-
3. cyActivated is true, the counter in each sequence number space shall be set to a random number modulo
4. 4096 when the STA’s MAC address is changed.

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64

## 65 Change the fourth paragraph as follows:

1. A transmitting STA shall support the applicable sequence number spaces defined in [Table 10-5 (Transmitter](#bookmark0)
2. [sequence number spaces)](#bookmark0). An MLD shall support the applicable sequence number spaces defined in
3. [Table 10-5 (Transmitter sequence number spaces)](#bookmark0). A STA affiliated with an MLD shall support MSNS1
4. instead of SNS2 in [Table 10-5 (Transmitter sequence number spaces](#bookmark0)) to determine the sequence number of

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1. an individually addressed QoS Data frame that is delivered to the associated MLD. Applicability is defined
2. by the Applies to column. The Status column indicates the level of support that is required if the Applies to
3. column matches the transmission. The Multiplicity column indicates whether the sequence number space
4. contains a single counter, or multiple counters and in the latter case identifies any indexes. The Transmitter
5. requirements column identifies requirements for the operation of this sequence number space. The refer-

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12 enced requirements are defined at the end of the table.

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## 14 Insert a new row to [Table 10-5 (Transmitter sequence number spaces)](#bookmark0):.

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### 18 Table 10-5—Transmitter sequence number spaces

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| --- | --- | --- | --- | --- | --- |
| **Sequence number space identifier** | **Sequence number space** | **Applies to** | **Status** | **Multiplicity** | **Transmitter requirements** |
| MSNS1 | Individually addressed | Any STA affiliated with an MLD transmitting an | Mandatory | Indexed by  <MLD MAC |  |
|  | QoS Data | individually addressed QoS |  | Address that |
|  |  | Data frame |  | the STA  identified by |
|  |  |  |  | Address 1 is |
|  |  |  |  | affiliated with, |
|  |  |  |  | TID> per |
|  |  |  |  | MLD |

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### 37 10.3.2.14.3 Receiver requirements

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## 40 Change the first paragraph as follows:

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1. A STA maintains one or more duplicate detection caches. An MLD maintains one or more duplicate detection
2. caches. [Table 10-6 (Receiver caches)](#bookmark1) defines the conditions under which a duplication detection cache is sup-
3. ported and the rules followed by the receiver for the cache. When a Data, Management or Extension frame is
4. received, a record of that frame is inserted in an appropriate cache. That record is identified by a sequence num-
5. ber and possibly other information from the MAC control fields of the frame. When a Data, Management or

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1. Extension frame is received in which the Retry subfield of the Frame Control field is equal to 1, the appropriate
2. cache, if any, is searched for a matching frame. In DMG, when a group addressed frame is received the appro-
3. priate cache is searched for a matching frame. When a PV1 Data frame or PV1 Management frame is
4. received, the appropriate cache is searched for a matching frame, regardless of the presence of the Retry sub-
5. field of the Frame Control field. If the search is successful, the frame is considered to be a duplicate. Duplicate

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55 frames are discarded.

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## 57 Change the third paragraph as follows:

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1. A receiving STA shall implement the applicable receiver requirements defined in [Table 10-6 (Receiver caches)](#bookmark1)
2. with Status indicated as Mandatory. An MLD shall implement the applicable receiver requirements defined in
3. [Table 10-6 (Receiver caches](#bookmark1)) with Status indicated as Mandatory. All STAs affiliated with an MLD shall
4. implement MRC1 instead of RC2 in [Table 10-6 (Receiver caches](#bookmark1)) to discard duplicate individually addressed

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65 QoS Data frames belonging to a TID without BA negotiation that are delivered from the associated MLD. A

1. receiving STA should implement the applicable receiver requirements defined in [Table 10-6 (Receiver caches)](#bookmark1)
2. with Status indicated as Recommended. A receiving STA may implement the applicable receiver requirements
3. defined in [Table 10-6 (Receiver caches)](#bookmark1) with Status indicated as Optional. Applicability is defined by the
4. Applies to column. The Status column indicates the level of support that is required if the Applies to column

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1. matches the received frame. The Multiplicity / Cache size column indicates the indexes that identify a cache
2. entry and the number of entries that shall be supported. The Receiver requirements column identifies
3. requirements for the operation of this cache. The referenced requirements are defined at the end of the table.
4. The requirements relate to caching information that identifies a cache entry and discarding duplicate MPDUs.

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## 12 Insert a new row and a new footnote after RR6 to [Table 10-6 (Receiver caches)](#bookmark1):

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14

### 15 Table 10-6—Receiver caches

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|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Receiver cache identifier** | **Cache name** | **Applies to** | **Status** | **Multiplicity / Cache size** | **Receiver requirements** |
| MRC1 | Individu ally addresse d QoS Data | Any STA affiliated with an MLD receiving an individually addressed QoS Data frame | Mandatory | Indexed by <MLD MAC Address that the STA identified by Address 2 is affiliated with, TID, sequence number> per MLD.  At least the most recent cache entry per <MLD MAC Address that the STA identified by Address 2 is affiliated with, TID> pair in this cache. | MRR1 |
| MRR1: The MLD shall discard the frame if the Retry subfield of the Frame Control field is 1 and it matches an entry in the cache. | | | | | |

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# 42 10.6 Multirate support

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### 44 10.6.6 Rate selection for Control frames

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### 47 10.6.6.1 General rules for rate selection for Control frames

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49 ***Change the last paragraph as follows:***

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1. An HE STA that transmits a Trigger frame, Multi-STA BlockAck frame or ~~HE/~~VHT/HE/EHT NDP
2. Announcement frame addressed to more than one STA shall use a rate, HT-MCS, <VHT-MCS, NSS> tuple
3. or <HE-MCS, NSS> tuple that is supported by all recipient STAs.

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# 1 10.25 Block acknowledgment (block ack)

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### 3 10.25.2 Setup and modification of the block ack parameters

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1. ***Insert the following paragraph after the eleventh paragraph (“When a block ack agreement is***
2. ***established ...”):***

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9 The extended buffer size in the ADDBA Request frame is advisory. When a block ack agreement is estab-

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1. lished between two MLDs, the originator may change the size of its transmission window if the value in the
2. Extended Buffer Size field and the Buffer Size field of the ADDBA Response frame is larger than the value
3. in the ADDBA Request frame. If the value in the Extended Buffer Size field and the Buffer Size field of the
4. ADDBA Response frame is smaller than the value in the ADDBA Request frame, the originator shall
5. change the size of its transmission window (WinSizeO) so that it meets the following condition:

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17 — Not greater than 1024 if the sender of the ADDBA Response frame is an EHT STA.

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1 11. MLME

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# 4 11.1 Synchronization

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# 21 11.2 Power management

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### 23 11.2.3 Power management in a non-DMG infrastructure network

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### 26 11.2.3.5 Power management with APSD

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### 28 11.2.3.5.1 Power management with APSD procedures

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30 ***Insert the following paragraph after the tenth paragraph (“A STA may set an AC ...”):***

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1. If a STA is affiliated with a non-AP MLD, the non-AP MLD shall have the same U-APSD Flag value for each
2. AC across all setup links (see 35.3.5 (Multi-link (re)setup)).

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## 37 Change the title of the subclause 11.3 as follows:

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# 40 11.3 STA/MLD authentication and association

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### 42 11.3.1 State variables

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45 ***Insert the following two paragraphs as the first two paragraphs of the subclause:***

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1. In [11.3 (STA/MLD authentication and association)](#bookmark0), the reference of a “STA” means that the “STA” is not
2. affiliated with an MLD unless specified otherwise.

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1. In [11.3 (STA/MLD authentication and association)](#bookmark0), when referring to MLD authentication, MLD
2. deauthentication, MLD (re)association, MLD disassociation, or MLD 4-way handshake, the reference of
3. “SME” means the entity that manages the MLD.

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## 55 Insert the following paragraph after the now-shifted third paragraph (“A STA (local) for which

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57 ***dot11OCBAActiviated ...”):***

58

1. An MLD (local) keeps an enumerated state variable for each MLD (remote) with which direct
2. communication via the WM is needed. In this context, direct communication refers to the transmission of
3. any Class 2 or Class 3 frame with an Address 1 field that matches the MAC address of the STA affiliated

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1. with the remote MLD and an Address 2 field that matches the MAC address of the STA affiliated with the
2. local MLD.

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## Insert the following paragraph after the now-shifted seventh paragraph (“For nonmesh STAs,

1. ***this state variable ...”):***

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4 For MLDs, this state variable expresses the relationship between the local MLD and the remote MLD. It

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1. takes on the following values:
2. — *State 1*: Initial start state for MLDs that perform IEEE 802.11 authentication. Unauthenticated and
3. unassociated.

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1. — *State 2*: Authenticated but unassociated.
2. — *State 3*: Authenticated and associated (Pending RSNA Authentication). The IEEE 802.1X Controlled

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1. Port is blocked.
2. — *State 4*: Authenticated and associated (RSNA Established or Not Required). The IEEE 802.1X
3. Controlled Port is unblocked, or not present.

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## 54 Change the title of the subclause 11.3.3 as follows:

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### 57 11.3.3 Frame filtering based on STA or MLD state

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## 59 Change the first paragraph as follows:

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1. The current state existing between the transmitter and receiver STAs determines the IEEE 802.11 frame
2. types that may be exchanged between that pair of STAs (see Clause 9 (Frame formats)). The current state
3. existing between MLDs determines the IEEE 802.11 frame types that may be exchanged on any setup links

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1. between that pair of MLDs subject to additional constraints (see 35.3.6 (Link management)). A unique state
2. exists for each pair of transmitter and receiver STAs or each pair of MLDs. The allowed frame types are
3. grouped into classes and the classes correspond to the STA state or the MLD state. In State 1, only Class 1
4. frames are allowed. In State 2, only Class 1 or Class 2 frames are allowed. In State 3 and State 4, all frames

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1. are allowed (Classes 1, 2, and 3). In the definition of frame classes, the following terms are used:
2. — Within an infrastructure BSS: both the transmitting STA and the recipient STA participate in the
3. same infrastructure BSS

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1. — Within a PBSS: both the transmitting STA and the recipient STA participate in the same PBSS
2. — Within an IBSS: both the transmitting STA and the recipient STA participate in the same IBSS

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1. — dot11RSNAActivated: reference to the setting of dot11RSNAActivated at the STA or the MLD that
2. needs to determine whether a transmission or reception is permitted.

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## 16 Change the description of the Data frames and Management frames of Class 3 frame in the

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18 ***sixth paragraph as follows:***

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20 The frame classes are defined as follows:

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1. c) Class 3 frames
2. 1) Data frames

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1. i) Data frames between STAs in an infrastructure BSS or in an MBSS
2. ii) Data frames between an AP MLD and a non-AP MLD associated with the AP MLD

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1. 2) Management frames
2. i) In an infrastructure BSS, an MBSS, or a PBSS, all Action and Action No Ack frames
3. except those that are declared to be Class 1 or Class 2 frames

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1. ii) Between an AP MLD and a non-AP MLD associated with the AP MLD, all Action and
2. Action No Ack frames except those that are declared to be Class 1 or Class 2 frames

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## 35 Insert the following paragraph after the eighth paragraph (“A STA shall not transmit Class 2

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37 ***...”):***

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1. A STA affiliated with an MLD shall not transmit Class 2 frames unless the MLD is in State 2 or State 3 or
2. State 4.

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## Insert the following paragraphs after the now-shifted tenth paragraph (“A STA shall not

1. ***transmit Class 3 ...”):***

45

46 A STA affiliated with an MLD shall not transmit Class 3 frames unless the MLD is in State 3 or State 4.

47

1. NOTE—Frames transmissions on a link between an AP MLD and a non-AP MLD associated with the AP MLD is
2. subject to additional constraints (see 35.3.6 (Link management)). 50

### 51 11.3.4 Authentication and deauthentication

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### 54 11.3.4.1 General

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## 56 Change the second and third paragraphs as follows:

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1. Successful authentication sets the state for a STA or an MLD to State 2, if it was in State 1. Unsuccessful
2. authentication leaves the state for the STA or the MLD unchanged.

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1. Deauthentication notification sets the state for a STA or an MLD to State 1. Deauthentication notification when
2. in State 3 or 4 implies disassociation as well. A STA or an MLD may deauthenticate a peer STA or a peer
3. MLD, respectively, at any time, for any reason.

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## 6 Change the fifth paragraph as follows:

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1. Authentication is optional in an IBSS. Between an AP MLD and a non-AP MLD, authentication is required. In
2. a non-DMG infrastructure BSS, authentication is required. In a DMG infrastructure BSS and PBSS, the Open
3. System authentication algorithm is not used (see 12.3.3.1 (Overview)). APs, AP MLDs, and PCPs do not

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12 initiate authentication.

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## 14 Change the title of the subclause 11.3.4.2 as follows:

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### 17 11.3.4.2 Authentication—originating STA or MLD

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## 19 Change the second paragraph as follows:

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1. Upon receipt of an MLME-AUTHENTICATE.request primitive, the originating STA or MLD shall
2. authenticate with the indicated STA or MLD, respectively, using the following procedure:
3. a) If the STA is in an IBSS, the SME shall delete any PTKSA, GTKSA, IGTKSA and temporal keys
4. held for communication with the indicated STA by using the MLME-DELETEKEYS.request

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1. primitive (see 12.6.18 (RSNA security association termination)).
2. b) The STA or the MLD shall execute one of the following:

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1. 1) For the Open System or Shared Key authentication algorithm, the authentication mechanism
2. described in 12.3.3.2 (Open System authentication) or 12.3.3.3 (Shared Key authentication),
3. respectively.

33

1. 2) For the fast BSS/ML transition (FT) authentication algorithm in an ESS, the authentication
2. mechanism described in 13.5 (FT protocol), or, if resource requests are included, 13.6 (FT
3. resource request protocol).
4. 3) For SAE authentication between an AP MLD and a non-AP MLD or in an infrastructure BSS,

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1. IBSS, or MBSS, the authentication mechanism described in 12.4 (Authentication using a
2. password).
3. 4) For FILS authentication, the authentication mechanism described in 12.11 (Authentication for

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1. FILS). An AP or PCP may provide estimated association response latency to a non-AP and
2. non-PCP STA using the Association Delay Info field in the Association Delay Info element
3. (9.4.2.174 (Future Channel Guidance element)). The value of the Association Delay Info field
4. shall be larger than dot11HLPWaitTime.

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1. c) If the authentication was successful within the AuthenticateFailureTimeout, the state for the
2. indicated STA or MLD shall be set to State 2 if it was State 1; the state shall remain unchanged if it
3. was other than State 1.

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1. d) The MLME shall issue an MLME-AUTHENTICATE.confirm primitive to inform the SME of the
2. result of the authentication.

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## 49 Change the title of the subclause 11.3.4.4 as follows:

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### 51 11.3.4.4 Deauthentication—originating STA or MLD

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## 53 Change as follows:

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1. f1) If the MLD is an AP MLD, its MLDME, upon receipt of an MLME-DEAUTHENTICATE.confirm
2. primitive, shall release the AID assigned for the indicated non-AP MLD, if the state for the indicated
3. MLD was State 3 or State 4.

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1. g) If the STA is contained within an AP, its SME shall inform the DS of the disassociation, if the state
2. for the indicated STA was State 3 or State 4.
3. g1) If the MLD is an AP MLD, its MLDME shall inform the DS of the disassociation, if the state for the

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1. indicated non-AP MLD was State 3 or State 4.
2. h) If the STA is a mesh STA, its SME shall inform the mesh peering instance controller (see
3. 14.3.4 (Mesh peering instance controller)) of the deauthentication.

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### 7 11.3.5 Association, reassociation, and disassociation

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## 49 Change the title of the subclause 11.3.5.2 as follows:

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### 52 11.3.5.2 Non-AP STA, non-AP MLD, and non-PCP STA association initiation procedures

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## 54 Insert the following paragraph after the first paragraph (“The SME shall delete ...”):

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56 The MLDME shall delete any PTKSA, GTKSA, IGTKSA, BIGTKSA and temporal keys held for

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1. communication with the AP MLD by using MLME-DELETEKEYS.request primitive (see 12.6.18 (RSNA
2. security association termination)) before invoking MLME-ASSOCIATE.request primitive.

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## 61 Insert the following two paragraphs after the now-shifted fifth paragraph (“Upon receipt of an

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63 ***MLME-ASSOCIATE.request primitive that is ...”):***

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65

1. For a non-AP MLD associated with an AP MLD, a non-AP STA affiliated with the non-AP MLD shall not
2. send an Association Request frame without Multi-Link element.

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1. NOTE—A non-AP MLD can disassociate with the associated AP MLD to allow a non-AP STA that was affiliated with
2. the non-AP MLD to allow to send an Association Request frame without Multi-Link element to perform regular STA
3. association, i.e., non-MLD association. 7

## 8 Change the now-shifted eighth paragraph as follows:

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10 Upon receipt of an MLME-ASSOCIATE.request primitive, a non-AP, non-AP MLD, and non-PCP STA shall

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1. associate with an AP, AP MLD, or PCP, respectively, using the following procedure:
2. a) If the state for the AP, AP MLD, or PCP is State 1, the MLME shall inform the SME of the failure of
3. the association by issuing an MLME-ASSOCIATE.confirm primitive, and this procedure ends.

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1. b) All the states, agreements and allocations listed in both numbered lists in [11.3.5.4 (Non-AP, non-AP](#bookmark2)
2. [MLD, and non-PCP STA reassociation initiation procedures)](#bookmark2) item c) are deleted or reset to initial
3. values.

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1. c) The MLME shall transmit an Association Request frame to the AP or PCP or the MLME shall
2. transmit an Association Request frame with Basic variant Multi-Link element in the Association
3. Request frame that indicates the AP MLD to an AP affiliated with the AP MLD. The RSNE
4. contained in the MLME-ASSOCIATE.request primitive shall be included in the Association

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1. Request frame. The RSNE shall specify exactly one pairwise cipher suite and exactly one AKM
2. suite. If the MLME-ASSOCIATE.request primitive contained the EmergencyServices parameter
3. equal to true, an Interworking element with the UESA field set to 1 shall be included in the
4. Association Request frame.

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## 34 Change the title of the subclause 11.3.5.3 as follows:

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### 36 11.3.5.3 AP, AP MLD, or PCP association receipt procedures

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## 39 Insert the following paragraph as the first paragraph of the subclause:

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41 For a non-AP MLD associated with an AP MLD, if an AP affiliated with the AP MLD receives an

42

1. Association Request frame without Multi-Link element from a non-AP STA affiliated with the non-AP
2. MLD, then the AP shall reject the association request with a status code of
3. DENIED\_STA\_AFFILIATED\_WITH\_MLD\_WITH\_EXISTING\_MLD\_ASSOCIATION.

46

## 47 Change the remaining paragraphs of the subclause as follows:

48

49

1. h) The SME shall refuse an association request from a VHT STA or a non-AP MLD that does not
2. support all of the <VHT-MCS, NSS> tuples indicated by the Basic VHT-MCS And NSS Set field of
3. the VHT Operation parameter of the AP or the corresponding AP in each setup link, respectively, in
4. the MLME-START.request primitive.

5

## 1 Change the title of the subclause 11.3.5.5 as follows:

2

### 3 11.3.5.5 AP, AP MLD, or PCP reassociation receipt procedures

4

5

## 6 Insert the following paragraph as the first paragraph of the subclause:

7

8 For a non-AP MLD associated with an AP MLD, if an AP affiliated with the AP MLD receives an

9

1. Reassociation Request frame without Multi-Link element from a non-AP STA that is affiliated with the
2. non-AP MLD and has MAC address not equal to the MLD MAC address of the non-AP MLD, then the AP
3. shall reject the reassociation request with a status code of
4. DENIED\_STA\_AFFILIATED\_WITH\_MLD\_WITH\_EXISTING\_MLD\_ASSOCIATION.

14

15

## 16 Change the remaining paragraphs of the subclause as follows:

17

1. The following procedure shall be used by an AP or PCP u~~U~~pon receipt of a Reassociation Request frame from
2. a STA ~~the AP or PCP shall use the following procedure~~ or by an AP MLD upon receipt of a Reassociation

20

1. Request frame with Basic variant Multi-Link element indicates the AP MLD from a non-AP STA affiliated
2. with a non-AP MLD:

62

30

31

# 22 11.21 Wireless network management procedures

23

24

### 25 11.21.13 BSS max idle period management

26

27 ***Change the first paragraph, including splitting it into the four paragraphs as follows:***

28

29 If dot11BssMaxIdlePeriod is nonzero or dot11MldMaxIdlePeriod is nonzero, an AP shall include the BSS

30

1. Max Idle Period element in the (Re)Association Response frame. Otherwise, the AP shall not include the BSS
2. Max Idle Period element in the (Re)Association Response frame.

33

1. When the AP is affiliated with an AP MLD and the Association Request frame or Reassociation Request
2. frame is received from a STA that is affiliated with an non-AP MLD, then the values carried in the BSS Max

36

1. Idle Period element apply at the MLD level. The MLD max idle period procedure is as defined in 35.3.10.3
2. (MLD max idle period management). The rest of this subclause defines the procedure for BSS max idle
3. period when either the AP or the non-AP STA or both are not affiliated with an MLD.

40

1. NOTE – An AP of an AP MLD would know that a (Re-)Association Request frame was transmitted by a STA that is not
2. affiliated with a non-AP MLD if the frame does not include Basic variant Multi-Link element. 43

44 A non-S1G STA may send protected or unprotected keepalive frames, as indicated in the Idle Options field.

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# 1

1 12. Security

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# 4 12.3 Pre-RSNA security methods

5

6

### 7 12.3.3 Pre-RSNA authentication

8

### 9 12.3.3.1 Overview

10

11 ***Insert the following two paragraphs as the first two paragraphs of the subclause:***

12

13

1. In [12.3.3 (Pre-RSNA authentication),](#bookmark0) the reference of a “STA” means that the “STA” is not affiliated with an
2. MLD unless specified otherwise.

16

17

1. In [12.3.3 (Pre-RSNA authentication)](#bookmark0), when referring to MLD authentication, “SME” is the entity that manages
2. the MLD.

20

## 21 Change the now-shifted third and fourth paragraphs as follows:

22

23

1. In an infrastructure BSS, a non-DMG STA shall complete an IEEE 802.11 authentication exchange prior to
2. association. A non-AP MLD shall complete an IEEE 802.11 authentication exchange with an AP MLD prior
3. to association with the AP MLD. A DMG STA not in an IBSS shall complete an IEEE 802.11 authentication

27

1. exchange prior to association when an authentication algorithm other than the Open System authentication
2. algorithm is requested. A DMG STA shall not perform an IEEE 802.11 authentication exchange using the
3. Open System authentication algorithm. An IEEE 802.11 authentication exchange is optional in an IBSS.

31

32 All Authentication frames shall be individually addressed, as IEEE 802.11 authentication is performed

33

1. between pairs of STAs or MLDs, i.e., group addressed authentication is not allowed. Deauthentication frames
2. are advisory and may be sent as group addressed frames.

36

### 37 12.3.3.2 Open System authentication

38

39

### 40 12.3.3.2.1 General

41

## 42 Change the second, third, and fourth paragraphs as follows:

43

44 Any non-DMG STA or MLD requesting Open System authentication can be authenticated if

45

1. dot11AuthenticationAlgorithmsTable at the peer STA or MLD, respectively, includes an entry with
2. dot11AuthenticationAlgorithm equal to openSystem and dot11AuthenticationAlgorithmActivated equal to
3. true.

49

50 A STA or an MLD may decline to authenticate with another requesting STA or requesting MLD, respectively.

51

52 Open System authentication is the default authentication algorithm for a pre-RSNA STA or MLD.

53

1. Open System authentication utilizes a two-message authentication transaction sequence. The first message
2. asserts identity and requests authentication. The second message returns the authentication result. If the result is
3. “successful,” the STAs or MLDs shall be declared mutually authenticated.

57

58

## Change the fifth paragraph, including the addition of a note and the split of the paragraph into

1. ***two as follows:***

61

62 In the description in 12.3.3.2.2 (Open System authentication (first frame)) and 12.3.3.2.3 (Open System

63

64 authentication (final frame)), the STA or MLD initiating the authentication exchange is referred to as the

65

1. *requester*, and the STA or the MLD, respectively, to which the initial frame in the exchange is addressed is
2. referred to as the *responder*.

3

1. NOTE—Open system authentication between MLDs is done before multi-link (re)setup (see 35.3.5.1 (Multi-link (re)setup
2. procedure) and 11.3 (STA/MLD authentication and association)). 6
3. The specific items in each of the messages described in the following subclauses are defined in 9.3.3.11
4. (Authentication frame format), Table 9-40 (Authentication frame body), and Table 9-41 (Presence of fields
5. and elements in Authentication frames).

10

11

# 12 12.4 Authentication using a password

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### 15 12.4.1 SAE overview

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17 ***Insert the following two paragraphs as the first two paragraphs of the subclause:***

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19

1. In [12.4 (Authentication using a password)](#bookmark1), the reference of a “STA” means that the “STA” is not affiliated with
2. an MLD unless specified otherwise.

22

23

1. In [12.4 (Authentication using a password)](#bookmark1), when referring to MLD authentication, the reference of “SME”
2. means the entity that manages the MLD.

26

## 27 Change the now-shifted third paragraph and split it into two paragraphs as follows:

28

29

1. STAs, both AP STAs and non-AP STAs, may authenticate each other by proving possession of a password.
2. MLDs, both AP MLDs and non-AP MLDs, may authenticate each other by proving possession of a password.

32

33 Authentication protocols that employ passwords need to be resistant to off-line dictionary attacks.

34

35

## 36 Change the now-shifted fifth paragraph as follows:

37

1. Simultaneous authentication of equals (SAE) is a variant of *Dragonfly*, a password-authenticated key exchange
2. based on a zero-knowledge proof. SAE is used by STAs or MLDs to authenticate with a password; it has the
3. following security properties:

41

1. — The successful termination of the protocol results in a PMK shared between the two STAs or the two
2. MLDs.

44

1. — An attacker is unable to determine either the password or the resulting PMK by passively observing
2. an exchange or by interposing itself into the exchange by faithfully relaying messages between the
3. two STAs or the two MLDs.

48

1. — An attacker is unable to determine either the password or the resulting shared key by modifying,
2. forging, or replaying frames to an honest, uncorrupted STA or MLD.
3. — An attacker is unable to make more than one guess at the password per attack. This implies that the
4. attacker cannot make one attack and then go offline and make repeated guesses at the password until

53

1. successful. In other words, SAE is resistant to dictionary attack.
2. — Compromise of a PMK from a previous run of the protocol does not provide any advantage to an
3. adversary attempting to determine the password or the shared key from any other instance.

57

1. — Compromise of the password does not provide any advantage to an adversary in attempting to
2. determine the PMK from the previous instance.

60

## 61 Change the now-shifted seventh paragraph as follows:

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64

65

1. The parties involved are called *STA-A* and *STA-B* between two STAs or called *MLD-A and MLD-B* between
2. two MLDs. They are identified by their MAC addresses, STA-A-MAC and STA-B-MAC, respectively,
3. between two STAs or by their MLD MAC addresses MLD-A-MAC and MLD-B-MAC, respectively, between
4. two MLDs. STAs or MLDs begin the protocol when they discover a peer by receiving Beacon or Probe

5

6 Response frame(s), or when they receive an Authentication frame indicating SAE authentication from a peer.

7

### 8 12.4.3 Representation of a password

9

## 10 Change as follows:

11

12

1. Passwords are used in SAE to deterministically compute a secret element in the negotiated group, called a
2. password element. The input to this process needs to be in the form of a binary string. For the protocol to
3. successfully terminate, it is necessary for each side to produce identical binary strings for a given password,

16

1. even if that password is in character format. There is no canonical binary representation of a character and
2. ambiguity exists when the password is a character string. To eliminate this ambiguity, a STA or an MLD shall
3. represent a character-based password as a UTF-8 string that is processed according to the OpaqueString profile
4. of IETF RFC 8265, the output of which is an octet string. The octet string representation of the password, after
5. being processed, is stored in the dot11RSNAConfigPasswordValueTable. When a “password” is called for in

22

23 the description of SAE that follows the credential from the dot11RSNAConfigPasswordValueTable is used.

24

1. Similarly, to address ambiguity when identifying passwords, a STA or an MLD shall represent a password
2. identifier as a UTF-8 string that is processed according to the UsernameCasePreserved profile of
3. IETF RFC 8265, the output of which is an octet string that is stored in the

28

1. dot11RSNAConfigPasswordValueTable. When a “password identifier” is called for in the description of SAE
2. that follows, the identifier from the dot11RSNAConfigPasswordValueTable is used.

31

1. In an infrastructure BSS or an AP MLD for which an SAE AKM is indicated, the AP or APs affiliated with the
2. AP MLD, respectively, shall set the SAE Password Identifiers In Use subfield of the Extended Capabilities

34

1. field of the Extended Capabilities element to 1 if any entry in the dot11RSNAConfigPasswordValueTable has
2. a non-NULL dot11RSNAConfigPasswordIdentifier, and shall set it to 0 otherwise. Similarly, an AP or APs
3. affiliated with the AP MLD, respectively, shall set the SAE Password Identifiers Used Exclusively subfield of
4. the Extended Capabilities field of the Extended Capabilities element to 1 if every entry in the
5. dot11RSNAConfigPasswordValueTable has a non-NULL dot11RSNAConfigPasswordIdentifier and shall set

40

41 it to 0 otherwise.

42

### 43

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### 45 12.4.5 SAE protocol

46

47

### 48 12.4.5.2 PWE and secret generation

49

## 50 Change the second paragraph as follows:

51

52

1. When a STA or an MLD supports directly hashing to a group element (according to [12.4.4.2.3 (Hash-to-curve](#bookmark2)
2. [generation of the password element with ECC groups)](#bookmark2) or [12.4.4.3.3 (Direct Generation of the password](#bookmark3)
3. [element with FFC groups)](#bookmark3)) it computes a secret element, PT, offline at provisioning time for all groups it
4. wishes to support with that password. Prior to initiating SAE to a STA or an MLD which also supports the
5. direct form of hashing to a group element, or upon receipt of an SAE Commit message indicating it was

58

1. generated using a direct form of hashing to a group element, it shall generate the PWE by hashing the two peer
2. MAC addresses to produce a digest, reducing the digest modulo the order of the particular group, *r*, interpreting
3. the reduced digest as an integer and using it with the secret element to generate the PWE:

62

1. *val = H(0n, MAX(STA-A-MAC, STA-B-MAC) || MIN(STA-A-MAC, STA-B-MAC)) between*
2. *two STAs or MLD-A-MAC and MLD-B-MAC shall be used in the computation of val*

65

1. *between two MLDs*
2. *val = val* modulo *(r – 1) + 1*

3

1. *PWE = scalar-op(val, PT)*
2. where 0n is a salt of all zeros whose length equals the length of the digest from the hash function used to
3. instantiate H() (see Table 12-1 (Hash algorithm based on length of prime)).

7

8

## 9 Change the fourth paragraph as follows:

10

1. After generation of the ***PWE***, each STA or each MLD shall generate a secret value, *rand*, and a temporary
2. secret value, *mask*, each of which shall be chosen randomly such that 1 < *rand* < *r* and 1 < *mask* < *r* and (*rand*

13 *+ mask*) mod *r* is greater than 1, where *r* is the (prime) order of the group. If their sum modulo r is not greater

14

1. than 1, they shall both be irretrievably deleted and new values shall be randomly generated. The values *rand*
2. and *mask* shall be random numbers produced from a quality random number drawn from a uniform distribution
3. generator. These values shall never be reused on distinct protocol runs.

18

# 21 12.6 RSNA security association management

22

### 23 12.6.1 Security associations

24

25

### 26 12.6.1.1 Security association definitions

27

### 28 12.6.1.1.2 PMKSA

29

30 ***Change the third paragraph as follows:***

31

32

1. A PMKSA association is bidirectional. In other words, both parties use the information in the security
2. association for both sending and receiving. The PMKSA is used to create the PTKSA. PMKSAs have a certain
3. lifetime. For a non-AP MLD that is associated with an AP MLD, the PMKSA association is between the AP

36

1. MLD and the non-AP MLD. The PMKSA consists of the following:
2. — PMKID, as defined in [12.7.1.3 (Pairwise key hierarchy)](#bookmark5) or 12.7.1.6.3 (PMK-R0). The PMKID
3. identifies the security association.

40

1. — Authenticator’s or peer’s MAC address. For multi-band RSNA, the MAC address is associated with
2. the operating band in use when the PMKSA is established. For MLD, the Authenticator’s MAC
3. address is the MLD MAC address of the AP MLD and the peer’s (Supplicant’s) MAC address is the
4. MLD MAC address of the non-AP MLD.

45

1. — PMK; or if the PMKSA was established with an AKM suite type for which the Authentication type
2. column includes FT authentication (see Table 9-151 (AKM suite selectors)), MPMK (see

48 12.7.1.6.3 (PMK-R0)).

49

1. — Lifetime, as defined in [12.7.1.3 (Pairwise key hierarchy)](#bookmark5) or 12.7.1.6 (FT key hierarchy).
2. — AKMP.

52

1. — All authorization parameters specified by the AS or local configuration. This might include
2. parameters such as the STA’s authorized SSID.
3. — Cache Identifier, if advertised by the AP in FILS Indication element.

56

57

### 58 12.6.1.1.6 PTKSA

59

## 60 Change the first paragraph as follows:

61

62

1. The PTKSA results from a successful 4-way handshake, FT 4-way handshake, FT protocol, FT resource
2. request protocol, or FILS authentication. This security association is also bidirectional. PTKSAs have the same

65

1. lifetime as the PMKSA or PMK-R1 security Association, whichever comes first. Because the PTKSA is tied to
2. the PMKSA or to a PMK-R1 security association, it only has the additional information from the 4-way
3. handshake, or FT Protocol authentication, or FILS authentication. For the PTKSA derived as a result of the 4-
4. way handshake, there shall be only one PTKSA per band (see 12.6.19 (Protection of robust Management

5

1. frames)) or per MLD setup (see 35.3.5 (Multi-link (re)setup)) with the same Supplicant and Authenticator
2. MAC addresses. For the PTKSA derived as a result of an initial mobility domain association or fast BSS
3. transition, there shall be only one PTKSA with the same STA’s MAC address and BSSID.

9

## 10 Change the last paragraph as follows:

11

12

1. The PTKSA consists of the following:
2. — PTK, where the PTK includes the KDK when WUR frame protection is negotiated

15

1. — Pairwise cipher suite selector, and when WUR frame protection is negotiated, the cipher suite
2. selector 00-0F-AC:6 (BIP-CMAC-128) for individually addressed WUR Wake-up frames

18

1. — Supplicant MAC address or STA’s MAC address or MLD MAC address of the non-AP MLD
2. — Authenticator MAC address or BSSID or MLD MAC address of the AP MLD

21

1. — Key ID
2. — If FT key hierarchy is used,

24

1. — R1KH-ID
2. — S1KH-ID

27

1. — PTKName
2. — If WUR frame protection is negotiated

30

31 — WTK

32

33

# 34 12.7 Keys and key distribution

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### 36 12.7.1 Key hierarchy

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### 38

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### 1 12.7.1.3 Pairwise key hierarchy

2

## 3 Insert the following paragraph after the first paragraph (“Except when preauthentication or

4

5 ***FILS authentication ...”):***

6

1. For a non-AP MLD associated with an AP MLD, the Supplicant is the non-AP MLD and the Authenticator is
2. the AP MLD. For the rest of this clause and within the context of protecting individually addressed

9

1. communications between the two MLDs, AA shall be set to the AP MLD MAC address and SPA shall be set
2. to the non-AP MLD MAC address.

12

### 13 12.7.2 EAPOL-Key frames

14

15

## Insert the following news rows to [Table 12-9 (KDE selectors)](#bookmark7) while maintaining the numerical

1. ***order and updating the reserved range:***

18

### 19 Table 12-9—KDE selectors

20

21

|  |  |  |
| --- | --- | --- |
| **OUI** | **Data type** | **Meaning** |
| 00-0F-AC | 16 | MLO GTK KDE |
| 00-0F-AC | 17 | MLO IGTK KDE |
| 00-0F-AC | 18 | MLO BIGTK KDE |
| 00-0F-AC | 1~~5~~9–255 | Reserved |

22

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## 32 Insert the following figure and paragraphs after the description on Figure 12-36 (GTK KDE

33

34 ***format) in the fifth paragraph:***

35

36 The format of the MLO GTK KDE is shown in [Figure 12-36a (MLO GTK KDE format)](#bookmark8).

37

38

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Key ID | Tx | Reserved | Reserved | LinkID | Key RSC | GTK |

39

40

Bits: 2 1 5 8 – *k*

41

(value of *k*

42 is TBD)

43

*k* (TBD) 48 (Length – 12) **×** 8

### 44 Figure 12-36a—MLO GTK KDE format

45

46

1. If the value of the Tx field is 1, then the IEEE 802.1X component shall configure the temporal key derived
2. from this KDE into its IEEE 802.11 MAC for both transmission and reception.

49

1. If the value of the Tx field is 0, then the IEEE 802.1X component shall configure the temporal key derived
2. from this KDE into its IEEE 802.11 MAC for reception only.

52

53

54 The LinkID field contains the link identifier that corresponds to the link this GTK applies.

55

1. The KeyRSC field contains the Key RSC field that corresponds to the link for which this GTK applies (see
2. [Table 12-9 (KDE selectors)](#bookmark7)).

58

59

### 37

1 ***Insert new Clauses 35 and 36 following Clause 34 as follows:***

2

3

4 35. Extremely high throughput (EHT) MAC specification

5

6

7

# 8 35.1 Introduction

9

1. An EHT STA supports the MAC and MLME functions defined in [Clause 35 (Extremely high throughput](#bookmark0)
2. [(EHT) MAC specification)](#bookmark0) in addition to the MAC functions defined in Clause 26 (High efficiency (HE)

12

1. MAC specification) and Clause 10 (MAC sublayer functional description), the MLME functions defined in
2. Clause 11 (MLME), and the security functions defined in Clause 12 (Security) except when the functions in
3. Clause 35 (Extremely High Throughput (EHT) MAC specification) supersede the functions in Clause 10
4. (MAC sublayer functional description), Clause 11 (MLME), Clause 12 (Security), or Clause 26 (High
5. efficiency (HE) MAC specification).

18

19

# 20 35.2 Channel access

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22

23 **35.2.1 TXOP**

24

### 25 35.2.1.1 Bandwidth signaling

26

27

1. An EHT STA transmitting a control frame in non-HT duplicate format with a bandwidth signaling TA
2. addressed to an EHT STA shall set the TXVECTOR parameters CH\_BANDWIDTH\_IN\_NON\_HT
3. according to Table 36-1 (TXVECTOR and RXVECTOR parameters).

31

### 32 35.2.1.2 Preamble puncturing

33

34

### 35 35.2.1.2.1 General

36

### 37 35.2.1.2.2 INACTIVE\_SUBCHANNELS

38

39

1. When an EHT STA transmits an RTS, MU-RTS Trigger, or CTS frame in a non-HT duplicate PPDU, the
2. STA shall not transmit on any 20 MHz subchannel that is punctured.

42

1. The indication of which subchannels are punctured in an RTS, MU-RTS Trigger, or CTS frame that is
2. carried in a non-HT duplicate PPDU is conveyed from the MAC to the PHY through the TXVECTOR

45

1. parameter INACTIVE\_SUBCHANNELS (see Table 36-1 (TXVECTOR and RXVECTOR parameters)).
2. The parameter INACTIVE\_SUBCHANNELS may be present in the TXVECTOR of a non-HT duplicate
3. PPDU that carries an RTS, MU-RTS Trigger, or CTS frame.

49

50

# 51 35.3 Multi-link operation

52

53

### 54 35.3.1 General

55

1. Multi-link operation (MLO) enables a non-AP MLD to discover, authenticate, associate, and set up multiple
2. links with an AP MLD. Each link enables channel access and frame exchanges between the non-AP MLD
3. and the AP MLD based on the supported capabilities exchanged during association.

59

60

#### Editor’s Note: Editor will check the frequency of the abbreviation “MLO” prior to the publication of D1.0

1. ***and see whether it is sufficient to define MLO as a new abbreviation in clause 3.***

63

64

65

### 1 35.3.2 Container for multi-link information

2

### 3 35.3.2.1 General

4

5

1. A STA of an MLD shall advertise multi-link capabilities and information of other STA of the MLD it is
2. affiliated with by including a Basic variant Multi-Link element in certain Management frames that it
3. transmits.

9

10 An AP of an AP MLD shall follow the rules defined in [35.3.4.3 (Multi-link element usage rules in the](#bookmark4)

11

1. [context of discovery)](#bookmark4) for including a Basic variant Multi-Link element in the Beacon frames and non-ML
2. Probe Response frames that it transmits.

14

1. An AP of an AP MLD shall follow the rules in [35.3.4.2 (Use of MLD probe request)](#bookmark3) for including a Basic
2. variant Multi-Link element in the Probe Response frame that it transmits.

17

18

1. An AP of an AP MLD shall follow the rules in [35.3.5.4 (Usage and rules of Basic variant Multi-link element](#bookmark7)
2. [in the context of multi-link setup)](#bookmark7) for including a Basic variant Multi-Link element in the (Re-)Association
3. Response frame that it transmits.

22

23

1. A STA of a non-AP MLD shall follow the rules in [35.3.4.2 (Use of MLD probe request)](#bookmark3) for including a
2. Basic variant Multi-Link element in the Probe Request frame that it transmits.

26

1. A STA of a non-AP MLD shall follow the rules in [35.3.5.4 (Usage and rules of Basic variant Multi-link](#bookmark7)
2. [element in the context of multi-link setup)](#bookmark7) for including a Basic variant Multi-Link element in the

29

30 (Re-)Association Request frame that it transmits.

31

1. A STA of an MLD shall follow the rules in [35.3.5.4 (Usage and rules of Basic variant Multi-link element in](#bookmark7)
2. [the context of multi-link setup)](#bookmark7) for including a Basic variant Multi-Link element in the Authentication frame
3. that it transmits.

35

36

1. In order to prevent duplication of information, an AP of an AP MLD shall not include a Reduced Neighbor
2. Report element or a Multiple BSSID element or another Basic variant Multi-Link element in the Per-STA
3. Profile subelement of the Basic variant Multi-Link element for a reported AP.

40

41

### 42 35.3.2.2 Complete or partial per-STA profile

43

1. A STA of an MLD may provide complete or partial information of another STA of its MLD in the Per-STA
2. Profile subelement of the Basic variant Multi-Link element that it transmits. The exact set of

46

47 elements/fields that constitute partial information is TBD.

48

1. A STA of an MLD shall set the Complete Profile subfield of the Per-STA Control field in the Per-STA
2. Profile subelement to 1 if the Per-STA Profile subelement carries all the elements (subject to the inheritance
3. rules as defined in [35.3.2.3 (Inheritance in a per-STA profile)](#bookmark1)) that would be included if the reported STA

52

1. were to transmit the frame that carried the Basic variant Multi-Link element. Otherwise the STA shall set the
2. subfield to 0.

55

1. An AP of an AP MLD shall follow the rules defined in [35.3.4.2 (Use of MLD probe request)](#bookmark3) to include
2. complete or partial profile of another AP of its MLD in ML Probe Response frame.

58

59

1. An AP of an AP MLD shall include complete profile of another AP of its MLD in its (Re-)Association
2. Response frame by following the rules defined in [35.3.5.4 (Usage and rules of Basic variant Multi-link](#bookmark7)
3. [element in the context of multi-link setup)](#bookmark7).

63

64

65

1. A STA of a non-AP MLD shall include complete profile of another STA of its MLD in its (Re-)Association
2. Request frame by following the rules defined in [35.3.5.4 (Usage and rules of Basic variant Multi-link](#bookmark7)
3. [element in the context of multi-link setup)](#bookmark7).

4

5

### 6 35.3.2.3 Inheritance in a per-STA profile

7

1. STAs of an MLD are expected to have similar capabilities and operational parameters on different links.
2. Therefore, some of the elements that could be carried in the per-STA profile for a reported STA would have
3. the same value as the reporting STA. In order to reduce frame bloating, when a per-STA profile carries

11

12 complete information for a reported STA, it would inherit the elements from the reporting STA.

13

1. An element is considered to be specific to a reported STA if its value is different from the corresponding
2. element advertised by the reporting STA or if the reported STA satisfies the condition as specified in the
3. Table 9-32 (Beacon frame body) if the reporting STA is an AP or Table 9-34 (Association Request frame

17

1. body) if the reporting STA is a non-AP for that element to be present while the reporting STA does not
2. satisfy the corresponding condition. If any of the elements carried in the frame of the reporting STA are not
3. present in a per-STA profile, the values to use for the reported STA are the values of the corresponding
4. element of the reporting STA unless the element is listed in the Non-Inheritance element (if included) in the
5. per-STA profile for that STA.

23

24

1. When carried in a Management frame transmitted by a STA of an MLD, each Per-STA Profile subelement in
2. a Basic variant Multi-Link element that is a complete profile shall contain a list of elements as follows:

27

1. — The Per-STA Control field is the first field
2. — TBD fields in fixed order

30

1. — TBD elements in fixed order
2. — If the reporting STA is an AP, a variable number of elements that provide the capabilities and
3. operation parameters of the reported AP in the order defined in Table 9-32 (Beacon frame body)

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1. — If the reporting STA is a non-AP, a variable number of elements that provide capability information
2. of the reported STA in the order defined in Table 9-34 (Association Request frame body)
3. — Any element specific to the reported STA or with content that is not inherited from the reporting

38

1. STA.
2. — When included in the Per-STA Profile subelement for the reported STA, the Non-Inheritance
3. element appears as the last element in the profile and carries a list of elements that are not inherited

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43 by the reported STA from the reporting STA.

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1. An example of a Basic variant Multi-Link element containing a complete per-STA profile is shown in
2. [Figure 35-1 (Illustration of Basic variant Multi-Link element carrying a complete per-STA profile)](#bookmark2).

3

4

Per‐STA Profile x

Field k

5 Optional subelements

Per‐STA Profile y (if present)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Element ID (=255) | Length | Element ID Extension | Multi‐Link Control | Field 1 |

6

7 ...

8

9

10

11

12

|  |  |  |
| --- | --- | --- |
| Subelement ID (=0) | Length | Data |

13

Element 2

Per‐STA Control field

...

Complete Profile (=1)

Link ID

Element Y

Element L

14

15

16

17

18

19

20

Element n+1

Element n

Non‐Inheritance element

(if present)

21 ...

22

23

...

...

...

1. Fixed order for certain Fields / IEs
2. (1 or more)

Element order as defined in Beacon frame or Association Request frame

Last element

### Figure 35-1—Illustration of Basic variant Multi-Link element carrying a complete per-STA

27

28 **profile**

29

30 An AP corresponding to the transmitted BSSID may include a Basic variant Multi-Link element in the

31

1. Nontransmitted BSSID Profile subelement of a Multiple BSSID element when the corresponding
2. nontransmitted BSSID is affiliated with an AP MLD. See [35.3.17 (Multi-BSSID)](#bookmark20) for inheritance rules when
3. the Basic variant Multi-Link element is carried in a Multiple BSSID element.

35

### 36 35.3.3 Multi-link device addressing

37

38

39 An MLD has an MLD MAC address that singly identifies the MLD.

40

1. The MAC address of each AP affiliated with an AP MLD shall be different from each other unless the
2. affiliated APs cannot perform simultaneous TX/RX operation (e.g., due to near band in-device interference),

43

44 in which case the MAC address properties are TBD.

45

1. If each AP affiliated with an AP MLD has different MAC addresses, then when a non-AP MLD is associated
2. with the AP MLD, each non-AP STA affiliated with the non-AP MLD shall have different MAC addresses.

48

49

1. The value of the Address 2 field (TA) field in the MAC header of a frame sent over-the-air shall be the MAC
2. address of the transmitting STA affiliated with the MLD corresponding to that link except the
3. Individual/Group bit, which is set to 1 when the TA field value is a bandwidth signaling TA and set to 0
4. otherwise.

54

55

1. The value of the Address 1 (RA) field in the MAC header of an individually addressed frame sent
2. over-the-air shall be the MAC address of the receiving STA affiliated with the MLD corresponding to that
3. link.

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### 1 35.3.4 Discovery of an AP MLD

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### 3 35.3.4.1 AP behavior

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1. If neither of these conditions is met:
2. — the transmitted Probe Response frame is individually addressed to a STA that has signaled that it
3. does not support operating in a given band (see 9.4.2.53 (Supported Operating Classes element))

9

10 — the APs affiliated to the AP MLD do not intend to be discovered by STAs

11

12 then the following applies:

13

1. — If an AP is affiliated to an AP MLD then the Beacon and Probe Response frames transmitted by the
2. AP or by the AP corresponding to the transmitted BSSID of the same multiple BSSID set as the AP
3. shall include a TBTT Information field in a Reduced Neighbor Report element with the Neighbor AP
4. TBTT Offset subfield, the BSSID subfield, the Short-SSID subfield, the BSS Parameters subfield,

18

1. and the MLD Parameters subfield, for each of the other APs affiliated to the same AP MLD.
2. — If a reporting AP is part of an AP MLD and is in the same collocated set as APs affiliated with
3. another AP MLD for which there are no affiliated APs operating on the same channel as the
4. reporting AP, each AP of the other AP MLD shall be reported in the Reduced Neighbor Report

23

1. element that is included in the Beacon frames and broadcast Probe Response frames transmitted by
2. the reporting AP if at least one AP of the other AP MLD is in the same multiple BSSID set as an AP
3. affiliated with the AP MLD of the reporting AP, unless the APs of the other AP MLDs are already
4. reported in Beacon frames and broadcast Probe Response frames transmitted by an AP in the same
5. collocated set as the reporting AP.

29

30

1. If an AP of an AP MLD is reported in an Reduced Neighbor Report element with the MLD Parameters
2. subfield present in the TBTT Information field for that AP:

33

1. — If the reported AP is affiliated to the same MLD as the reporting AP, the MLD ID subfield shall be
2. set to 0. If the reported AP is affiliated to the same AP MLD as a nontransmitted BSSID that is in the
3. same multiple BSSID set as the reporting AP, the MLD ID subfield shall be set to the same value as
4. in the BSSID Index field in the Multiple BSSID-Index element in the nontransmitted BSSID profile
5. corresponding to the nontransmitted BSSID in the Multiple BSSID element transmitted in frames

39

1. sent by the reporting AP. If the reported AP is affiliated to another AP MLD and the reporting AP
2. intends to carry MLD information for that AP, the MLD ID for this AP MLD shall be unique in the
3. frame that carries the Reduced Neighbor Report element and shall be selected with additional TBD
4. rules. Otherwise, the MLD ID subfield shall be set to TBD if the reported AP is not part of an AP
5. MLD, or if the reporting AP does not have that information.

45

1. — If the reported AP is affiliated to the same MLD as the reporting AP or as a nontransmitted BSSID in
2. the same multiple BSSID set as the reporting AP, the Link ID subfield in the TBTT Information field
3. for the reported AP shall be set to the same value as in the Link ID field in the per-STA profile
4. corresponding to the reported AP in the Basic variant Multi-Link element transmitted in frames sent

50

1. by all APs affiliated to the same AP MLD. The Link ID subfield shall be set to TBD if the reported
2. AP is not part of an AP MLD, or if the reporting AP does not have that information.

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### 54 35.3.4.2 Use of MLD probe request

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1. An MLD probe request is a Probe Request frame:
2. — with the Address 1 field set to the broadcast address and the Address 3 field set to the BSSID of an
3. AP, or with the Address 1 and Address 3 fields set to the BSSID of an AP, or other addressing TBD

60

1. — and that includes a Probe Request variant Multi-Link element to identify that the Probe Request
2. frame is an MLD probe request and to identify from which APs of the AP MLD the information is
3. requested.

64

65

1 NOTE—If and how the transmitting AP info can be explicitly requested or not requested is TBD. 2

1. An MLD probe request allows a non-AP STA to request an AP to include the complete set of capabilities,
2. parameters and operation elements of other APs affiliated to the same AP MLD as the AP. The information
3. of an AP affiliated to the same AP MLD as the AP identified in the Address 1 or Address 3 field of the Probe

6

1. Request frame is requested if one of the following conditions is met:
2. — the Multi-Link element in the Probe Request frame does not include any per-STA profile.

9

1. — the Link ID of the AP corresponds to the Link ID field in a per-STA profile in the Multi-Link
2. element in the Probe Request frame.

12

1. The complete information of a requested AP sent by a reporting AP is defined as all elements that would be
2. provided if the requested AP was transmitting the Probe Response frame, except the following elements, if

15

1. present: the Reduced Neighbor Report element, the Multiple BSSID element, the Multi-Link element, other
2. exceptions TBD.

18

1. If an AP that is part of an AP MLD receives an MLD probe request from a non-AP STA requesting complete
2. information, it shall respond with an MLD probe response, which is a Probe Response frame that includes a

21

1. Basic variant Multi-Link element with a STA profile with complete information for each of the APs that are
2. affiliated to the same AP MLD as the AP and that are requested by the MLD probe request. If it receives an
3. MLD probe request from a non-AP STA requesting partial information, it shall respond with an MLD probe
4. response that includes a Basic variant Multi-Link element with a STA profile with at least the elements
5. requested for each of the APs that are affiliated to the same AP MLD as the AP and that are requested by the

27

1. MLD probe request, unless the elements requested are not part of the complete information for each of the
2. APs.

30

1. If an AP that is operating in the 2.4 GHz band or the 5 GHz band that is part of an AP MLD receives an
2. MLD probe request frame requesting complete information and responds with an MLD probe response

33

1. frame (per 11.1.4.3.4 (Criteria for sending a response)), the Address 1 field of the Probe Response frame
2. may be set to the broadcast address unless the AP is not including its actual SSID in the SSID element of its
3. Beacon frames.

37

### 38 35.3.4.3 Multi-link element usage rules in the context of discovery

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40

41 A Probe Request frame that is a non-ML probe request shall not include a Multi-Link element.

42

43 A Probe Request frame shall not include a Basic variant Multi-Link element.

44

45

### 46 35.3.5 Multi-link (re)setup

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### 48 35.3.5.1 Multi-link (re)setup procedure

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50 Before a non-AP MLD performs multi-link (re)setup with an AP MLD, the non-AP MLD and AP MLD

51

52 shall follow MLD authentication procedure as described in 11.3 (STA/MLD authentication and association).

53

1. For a non-AP MLD to perform multi-link (re)setup with an AP MLD, the non-AP MLD and the AP MLD
2. shall exchange (Re)Association Request/Response frames and shall follow MLD (re)association procedure
3. as described in 11.3 (STA/MLD authentication and association).

57

58

1. In the (Re)Association Requeust frame, the non-AP MLD indicates the links that are requested for (re)setup
2. as described in [35.3.5.4 (Usage and rules of Basic variant Multi-link element in the context of multi-link](#bookmark7)
3. [setup)](#bookmark7)

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1. In the (Re)Association Response frame, the AP MLD indicates the links that are accepted for (re)setup as
2. described in [35.3.5.4 (Usage and rules of Basic variant Multi-link element in the context of multi-link](#bookmark7)
3. [setup)](#bookmark7).

4

5

1. After successful multi-link (re)setup between a non-AP MLD and an AP MLD, the non-AP MLD and the
2. AP MLD setup links for multi-link operation, and the non-AP MLD is in associated state and is
3. (re)associated with the AP MLD.

9

10 For each setup link, the corresponding non-AP STA affiliated with the non-AP MLD is in the same

11

1. associated state as the non-AP MLD and is associated with the corresponding AP affiliated with the AP
2. MLD, without providing the corresponding non-AP STA to the corresponding AP mapping to the DS, and
3. enables the functionalities between a non-AP STA and its associated AP unless the functionalities have been
4. extended to MLD level and specified otherwise.

16

17

18 An example of multi-link setup is shown in [Figure 35-2 (Example of multi-link setup)](#bookmark6).

19

20

AP 3

6 GHz

AP 2

5 GHz

AP 1

2.4 GHz

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | | | AP 2 AP 3  5 GHz 6 GHz |
|  | AP 1  2.4 GHz | | |
|  | |  |  | |
| me | |  | Association Response frame | |
|  | |  |  | |
|  | Non-AP STA 1 | | | Non-AP Non-AP  STA 2 STA 3 |
|  |  | | |

21 AP MLD

22

23

24

25 Association Request fra

26

27

28 Non-AP MLD

29

30

Successful multi- link setup

AP MLD

Link 1

Link 2

Link 3

Non-AP MLD

Non-AP STA 3

Non-AP STA 2

Non-AP STA 1

### 31 Figure 35-2—Example of multi-link setup

32

33

34 In this example, AP MLD has three affiliated APs: AP 1 operates on 2.4 GHz band, AP 2 operates on 5 GHz

35

1. band, and AP 3 operates on 6 GHz band. Non-AP STA 1 affiliated with the non-AP MLD sends an
2. Association Request frame to AP 1 affiliated with the AP MLD, i.e., the TA of the Association Request
3. frame is set to the MAC address of the non-AP STA 1 and the RA of the Association Request frame is set to
4. the MAC address of the AP 1. The Association Request frame includes complete information of non-AP
5. STA 1, non-AP STA 2, and non-AP STA 3 to request three links to be setup (one link between AP 1 and

41

1. non-AP STA 1, one link between AP 2 and non-AP STA 2, and one link between AP 3 and non-AP STA 3)
2. and an ML element that indicates the MLD MAC address of the non-AP MLD. AP 1 affiliated with the AP
3. MLD sends an Association Response frame to non-AP STA 1 affiliated with the non-AP MLD, i.e., the TA
4. of the Association Response frame is set to the MAC address of the AP 1 and the RA of the Association
5. Response frame is set to the MAC address of the non-AP STA 1, to indicate successful multi-link setup. The

47

1. Association Response frame includes complete information of AP 1, AP 2, and AP 3 and an Multi-Link
2. element that indicates the MLD MAC address of the AP MLD. After successful multi-link setup between
3. the non-AP MLD and AP MLD, three links are setup (link 1 between AP 1 and non-AP STA 1, link 2
4. between AP 2 and non-AP STA 2, and link 3 between AP 3 and non-AP STA 3).

52

53

### 54 35.3.5.2 Multi-link security

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1. After a successful multi-link (re)setup between a non-AP MLD and an AP MLD, a PMK is established and
2. a PTK is derived through a 4-way handshake between the non-AP MLD and the AP MLD (see 12.7.6 (4-
3. way handshake)). The PMK, PTK, and the same PN space are used for all the setup links between the

59

1. non-AP MLD and the AP MLD for the PTKSA. The non-AP MLD and the AP MLD use their respective
2. MLD MAC addresses to derive the PMK under the SAE method and PTK.

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1. Different links use different GTK/IGTK/BIGTK and each link has its own PN space. The
2. GTK/IGTK/BIGTK of each setup links are delivered to the non-AP MLD using a single 4-way handshake as
3. defined in 12.7.6 (4-way handshake).

4

5

### 6 35.3.5.3 Multi-link tear down procedure

7

1. To tear down the setup links between a non-AP MLD and an AP MLD, one of the non-AP STAs affiliated
2. with the non-AP MLD shall send disassociation frame to the AP affiliated with the AP MLD on the
3. corresponding link that is enabled, and the non-AP MLD and the AP MLD shall follow MLD disassociation

11

12 procedure as described in 11.3 (STA/MLD authentication and association).

13

1. To tear down the setup links between a non-AP MLD and an AP MLD, one of the APs affiliated with the AP
2. MLD, respectively, shall send disassociation frame to the non-AP STA affiliated with the non-AP MLD on
3. the corresponding link that is enabled, and the non-AP MLD and the AP MLD shall follow MLD

17

18 disassociation procedure as described in 11.3 (STA/MLD authentication and association).

19

1. After multi-link teardown, all the non-AP STAs affiliated with the non-AP MLD are in the same
2. unassociated state as the non-AP MLD.

22

23

### 35.3.5.4 Usage and rules of Basic variant Multi-link element in the context of multi-link

1. **setup**

26

1. A non-AP MLD may initiate a multi-link setup with an AP MLD to setup more than one link with a subset
2. of APs that are affiliated with the AP MLD. When a non-AP MLD initiates a multi-link setup with an AP

29

1. MLD, a non-AP STA that is affiliated with the non-AP MLD shall transmit an (Re-)Association Request
2. frame on the link it is operating on. An AP that is affiliated with the AP MLD and that received the
3. (Re-)Association Request frame shall transmit an (Re-)Association Response frame.

33

34 The Basic variant Multi-Link element carried in the (Re-)Association Request frame shall include MLD

35

1. level information that is common to all non-AP STAs affiliated with the non-AP MLD. MLD level
2. information shall include at least the MLD MAC address.

38

1. The Basic variant Multi-Link element carried in the (Re-)Association Request frame shall include one or
2. more STA profile subelement(s), each of which contains the complete information (such as capabilities) of a

41

1. non-AP STA affiliated with the non-AP MLD and corresponding to a link that is requested for multi-link
2. setup.

44

1. The Basic variant Multi-Link element carried in the (Re-)Association Response frame shall include MLD
2. level information that is common to all APs affiliated with the AP MLD. MLD level information shall

47

48 include at least the MLD MAC address.

49

1. The Basic variant Multi-Link element carried in the (Re-)Association Response frame shall include one or
2. more STA profile subelement(s), each of which contains the complete information (such as capabilities and
3. operational parameters) of an AP affiliated with the AP MLD and corresponding to a link that is accepted by

53

54 the AP MLD and requested by the non-AP MLD.

55

1. Each STA profile subelement included in the Basic variant Multi-Link element carried in the
2. (Re-)Association Request frame and the (Re-)Association Response frame shall not include another Basic
3. variant Multi-Link element.

59

60

1. An STA affiliated with an MLD shall include a Basic variant Multi-Link element containing the MLD MAC
2. address of the MLD with which the STA is affiliated in the Authentication frame that it transmits.

63

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1. An STA, which is affiliated with an MLD, may select and manage its operating parameters independently
2. from the other STA(s) affiliated with the same MLD, unless specified otherwise.

3

### 4 35.3.6 Link management

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### 7 35.3.6.1 TID-to-link mapping

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### 9 35.3.6.1.1 General

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11

1. The TID-to-link mapping mechanism allows an AP MLD and a non-AP MLD that performed multi-link
2. setup to determine how TIDs are mapped to the setup links in DL and in UL.

14

1. By default, all TIDs shall be mapped to all setup links for both UL and DL (see [35.3.6.1.2 (Default mapping](#bookmark11)
2. [mode)](#bookmark11)).

17

1. NOTE 1—It is TBD whether the negotiation for TID-to-link mapping other than default mapping is optional or
2. mandatory. 20

21 A setup link is defined as enabled if at least one TID is mapped to that link and is defined as disabled if no

22

1. TIDs are mapped to that link. At any point in time, a TID shall always be mapped to at least one setup link,
2. unless admission control is used. By default, as TIDs are mapped to all setup links, all setup links shall be
3. enabled (see [35.3.6.1.2 (Default mapping mode)](#bookmark11)).

26

27 If a link is enabled, it may be used for frame exchange, subject to the power state of the non-AP STA

28

1. operating on that link. Frames carrying MSDUs or A-MSDUs with TIDs mapped to an enabled link may be
2. transmitted on that link. Frames carrying MSDUs or A-MSDUs with TIDs not mapped to a link shall not be
3. transmitted on that link. Management frames may be sent on enabled links, following baseline.

32

#### 33 Editor’s Note: “following baseline” is not precise. Please update it with an appropriate reference of IEEE

34

35 ***P802.11REVmd D4.0.***

36

37 If a link is disabled, it shall not be used for frame exchange, including Management frames.

38

39 If a TID is mapped in UL to a set of enabled links for a non-AP MLD, then the non-AP MLD can use any

40

41 link within this set of enabled links to transmit frames carrying MSDUs or A-MSDUs with that TID.

42

43 If a TID is mapped in DL to a set of enabled links for a non-AP MLD, then:

44

1. — The non-AP MLD can retrieve buffered BUs corresponding to that TID on any links within this set
2. of enabled links.
3. — The AP MLD can use any link within this set of enabled links to transmit frames carrying MSDUs or
4. A-MSDUs with that TID, subject to existing restrictions for transmissions of frames that apply to

49

1. those enabled links.
2. NOTE 2—An example of restriction is if the STA is in doze state. 53

52

1. NOTE 3—If the default mode is used, all TIDs are mapped to all links and all links are therefore enabled. The non-AP
2. MLD can have the corresponding non-AP STA wake up on any link to receive BUs buffered by the AP MLD. The
3. non-AP MLD can therefore use the power state of its non-AP STAs to dynamically change the links it wants to operate
4. on.

58

### 59 35.3.6.1.2 Default mapping mode

60

1. This mode refers to the default mapping described in [35.3.6.1.1 (General)](#bookmark10). Under this mode, all TIDs are
2. mapped to all links for DL and UL, and all setup links are enabled. A non-AP MLD and an AP MLD that

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64

65

1. performed multi-link setup shall operate under this mode if a TID-to-link mapping negotiation for a different
2. mapping did not occur or was not successful or was torn down.

3

4 NOTE—It is TBD if support for TID-to-link mapping negotiation is mandatory or optional. 5

### 6 35.3.6.1.3 Negotiation of TID-to-link mapping

7

### 8 35.3.6.1.4 Power state after enablement

9

10

1. When a link becomes enabled for a STA that is part of a non-AP MLD through multi-link setup sent on that
2. link, the initial power management mode of the STA, immediately after the signaling exchange, is active
3. mode.

14

15

1. When a link is enabled for a STA that is part of a non-AP MLD through signaling (multi-link setup or TID to
2. link mapping update) send on another link, the initial power management mode of the STA, immediately
3. after the exchange, is power save mode, and its power state is doze, unless TBD.

19

### 20 35.3.6.1.5 Use of More Data subfield by an MLD

21

22

1. When an AP MLD transmits a PPDU carrying a BU in one enabled link to a non-AP MLD, if there is, at the
2. AP MLD, at least one additional buffered BU of any TID that is mapped to this link by the TID-to-link
3. mapping function (including default mapping) or a Management frame for the same non-AP MLD that is not
4. carried in the PPDU, the More Data subfield shall be set to 1, otherwise the More Data subfield shall be set

27

28 to 0.

29

### 30 35.3.6.2 Dynamic link transitions

31

32 A non-AP MLD may use the power states of its non-AP STAs to dynamically change the link(s) on which it

33

1. operates. [Figure 35-3 (Example of operation of a single radio non-AP MLD with default mapping (all TIDs](#bookmark12)
2. [mapped to all setup links), where the non-AP MLD transitions from operating on link 1 with STA 1 to](#bookmark12)
3. [operating on link 2 with STA 2)](#bookmark12) provides an illustration of operation of a single radio non-AP MLD with
4. default mapping (all TIDs mapped to all setup links), where the non-AP MLD transitions from operating on
5. link 1 with STA 1 to operating on link 2 with STA 2.

39

40



AP MLD

AP1

AP2

AP3



Non‐AP MLD

STA1

STA2

STA3

41

PPDU transmission carrying BUs from the AP MLD to the non‐AP MLD

42

STA1 awake STA1 awake

STA1 awake

43

44 Link1

45

STA2 awake

STA2 awake

STA2 awake

46

47 Link2

48

49 Link3

50

51

### 52 Figure 35-3—Example of operation of a single radio non-AP MLD with default mapping (all

53

1. **TIDs mapped to all setup links), where the non-AP MLD transitions from operating on link 1**

### with STA 1 to operating on link 2 with STA 2

56

57

58 While operating on link 1:

59

1. — STA 1 of the non-AP MLD may use active mode or power save mode with the awake state to
2. retrieve BUs from the AP MLD and may use power save mode with doze state to save power.
3. — STA 2 and STA 3 stay in doze state.

63

64

65 While operating on link 2:

1. — STA 2 of the non-AP MLD may use active mode or power save mode with the awake state to
2. retrieve BUs from the AP MLD and may use power save mode with doze state to save power.

3

4 — STA 1 and STA 3 stay in doze state.

5

### 6 35.3.6.3 Multi-link retransmit procedures

7

8 If an MLD has established block ack agreement with another MLD for a TID, and the transmission of a QoS

9

1. Data frame of the TID in a link is unsuccessful, and if the frame is not a fragment, the MLD may attempt
2. retransmissions of the frame on any link that has the TID mapped to it.

12

### 13 35.3.7 Multi-link block ack

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15

### 16 35.3.7.1 Multi-link BlockAck procedure

17

### 18 35.3.7.1.1 General

19

20 A block ack agreement between two MLDs shall apply to all links to which the TID corresponding to the

21

1. block ack agreement, is mapped (i.e., there are no independent block ack agreements on a per-link basis).
2. NOTE 1—Frame exchanges for a TID might be governed by TID-to-Link mapping rules (see [35.3.6.1 (TID-to-link](#bookmark9)
3. [mapping)](#bookmark9)).

25

26

1. To setup a block ack agreement between two MLDs, a STA of the originator MLD sends an ADDBA
2. Request frame, on any enabled link, indicating the TID for which the block ack agreement is being set up.
3. The Buffer Size and Block Ack Timeout fields in the ADDBA Request frame are advisory. A STA of the
4. recipient MLD shall respond with an ADDBA Response frame. The recipient MLD has the option of
5. accepting or rejecting the request. If the recipient MLD accepts the request, then a block ack agreement

32

1. exists between the originator MLD and recipient MLD for that TID as defined in 10.25.2 (Setup and
2. modification of the block ack parameters).

35

1. If an MLD has established a block ack agreement with another MLD, then QoS Data frames for the TID
2. associated with the block ack agreement may be exchanged between the two MLDs on any link to which the

38

1. TID is mapped and subject to existing restrictions for transmissions of frames that apply to those enabled
2. links, following the procedure described in [35.3.7.1 (Multi-link BlockAck procedure)](#bookmark13).

41

1. NOTE 2—QoS Data frames that are not fragments might be (re)transmitted on any link(s) where the corresponding TID
2. is mapped to.

44

1. A STA of a recipient MLD shall provide the receive status on the link where the STA is operating on for any
2. MPDU with ACK policy equal to any value other than No Ack that is received on the link where the STA is
3. operating on.

48

49

1. A STA of a recipient MLD may provide (if available) information on successful reception of any MPDU
2. with ACK policy equal to any value other than No Ack that is received by another STA of that MLD.

52

1. An originator MLD shall update the receive status for an MPDU corresponding to a block ack agreement if
2. the received status indicates successful reception.

55

56

1. An originator MLD shall not update the receive status for an MPDU corresponding to a block ack agreement
2. that has already been positively acknowledged.

59

60 A recipient MLD shall maintain a single common receive reordering buffer for each <peer MLD, TID>

61

1. tuple under a block ack agreement, independently of the number of links that are setup. The receive
2. reordering buffer shall be responsible for reordering MSDUs or A-MSDUs so that MSDUs or A-MSDUs are
3. eventually passed up to the next MAC process in order of received sequence number. It shall also be

65

1. responsible for identifying and discarding duplicate frames (i.e., frames that have the same sequence number
2. as a currently buffered frame) that are part of this block ack agreement. It shall maintain its own state
3. independent of the scoreboard context control to perform this reordering as specified in 10.25.6.6 (Receive
4. reordering buffer control operation). Each received MPDU shall be analyzed by the scoreboard context

5

6 control as well as by the receive reordering buffer control.

7

1. An EHT STA shall send Control frames following the rules defined in 10.6.6 (Rate selection for Control
2. frames) and 26.15.2 (PPDU format selection) with the following additional exception:

10

1. — An EHT STA may transmit a BlockAck frame in an HE SU PPDU or EHT SU PPDU if the transmit
2. time of HE SU PPDU or EHT SU PPDU (respectively) is less than the PPDU duration of a non-HT
3. PPDU containing the Control frame sent at the primary rate (see 10.6.6.5.2 (Selection of a rate or
4. MCS)).

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### 17 35.3.7.2 EHT acknowledgment procedure

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### 19 35.3.7.2.1 Overview

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1. The EHT acknowledgment procedure builds on the features defined for HT-immediate block ack (see
2. 10.25.6 (HT-immediate block ack extensions)) and HE acknowledgement (see 26.4 (HE acknowledgment
3. procedure)), with the following extensions:
4. — Support for BlockAck Bitmap field lengths of 512 and 1024

26

27

1. An initiating MLD shall maintain a single sequence number space for the MSDUs/A-MSDUs belonging to
2. each TID that may be transmitted to a peer responding MLD over one or more links subject to TID to link
3. mapping negotiated between the initiating MLD and the peer responding MLD.

31

32

1. An initiating MLD shall maintain a single transmission window for each block ack agreement negotiated
2. with the responding MLD to submit MPDUs for transmission across links subjected to the TID to link
3. mapping negotiated between the initiating MLD and the responding MLD.

36

37 An EHT AP shall not transmit a Multi-STA BlockAck frame that contains a BlockAck Bitmap field with

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39 length equal to 512 or 1024 bits as a response to an HE TB PPDU generated by at least one HE STA.

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### 41 35.3.7.2.2 Negotiation of block ack bitmap lengths

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43 Both the Compressed BlockAck frame and Multi-STA BlockAck frame allow different Block Ack Bitmap

44

1. subfield lengths. The length of the Block Ack Bitmap subfield is indicated in the Fragment Number subfield
2. of the Block Ack Starting Sequence Control field as defined in 9.3.1.8 (BlockAck frame format). The
3. allowed Block Ack Bitmap lengths for each of the negotiated buffer sizes are defined in [Table 35-1](#bookmark14)
4. [(Negotiated buffer size and Block Ack Bitmap subfield length)](#bookmark14).

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### 52 Table 35-1—Negotiated buffer size and Block Ack Bitmap subfield length

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|  |  |  |
| --- | --- | --- |
| **Negotiated buffer size** | **Block Ack Bitmap subfield length (bits) in a Compressed BlockAck frame** | **Block Ack Bitmap subfield length (bits) in a Multi-STA BlockAck frame** |
| 1–64 | 64 | 32 or 64 |
| 65–128 | 64 or 256 | 32, 64, or 128 |
| 129–256 | 64 or 256 | 32, 64, 128, or 256 |
| 257–512 | 64, 256, or 512 | 32, 64, 128, 256, or 512 |

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### 1 Table 35-1—Negotiated buffer size and Block Ack Bitmap subfield length

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|  |  |  |
| --- | --- | --- |
| **Negotiated buffer size** | **Block Ack Bitmap subfield length (bits) in a Compressed BlockAck frame** | **Block Ack Bitmap subfield length (bits) in a Multi-STA BlockAck frame** |
| 513–1024 | 64, 256, 512, or 1024 | 32, 64, 128, 256, 512, or 1024 |
| NOTE—A 32-bit Block Ack Bitmap subfield length is not allowed unless the originator has set the 32-bit BA Bitmap Support field in the HE MAC Capabilities Information field in the HE Capabilities element to 1. | | |

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### 15 35.3.8 BSS parameter critical update procpedure

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1. An AP within an AP MLD shall include in the Beacon and Probe Response frames it transmits a Change
2. Sequence field for each of all APs in the same AP MLD.

19

1. — The Change Sequence field for each of other APs of the MLD shall be carried in the MLD
2. Parameters subfield in the TBTT Information field of the Reduced Neighbor Report element
3. corresponding to that AP.

23

24 — The Change Sequence field for the AP shall be carried in the TBD field.

25

1. If an AP within an AP MLD is transmitted BSSID in a multiple BSSID set, then the AP shall include in the
2. Beacon and Probe Response frames it transmits a Change Sequence field for each of nontransmitted BSSIDs

28

1. in the same multiple BSSID set.
2. — The Change Sequence field for each of the nontransmitted BSSIDs shall be carried in the TBD field.

31

32 An AP within an AP MLD shall increase the value (modulo TBD maximum value) of the Change Sequence

33

1. field for the AP when a critical update occurs to any of the elements for the AP. An AP within an AP MLD
2. shall increase the value (modulo TBD maximum value) of the Change Sequence field for another AP in the
3. same AP MLD when a critical update occurs to any of the elements for that AP. An AP within an AP MLD
4. that is transmitted BSSID shall increase the value (modulo TBD maximum value) of the Change Sequence
5. field for a nontransmitted BSSID in the same multiple BSSID set when a critical update occurs to any of the

39

1. elements for the nontrasnmitted BSSID.The critical updates are defined in 11.2.3.15 (TIM Broadcast) and
2. the TBD additional update can be added. The name and format of the Change Sequence field are TBD.

42

43 NOTE—The Change Sequence field is at most 1 octet in length.

44

1. An AP within an AP MLD shall provide in the Critical Update Flag subfield of the Capability Information
2. field (9.4.1.4 (Capability Information field)) of the Beacon and Probe Response frames it transmits an
3. indication of an update to the value carried in the Change Sequence subfield of the MLD Parameters field in

48

1. the Reduced Neighbor Report element for any AP in the same AP MLD. An AP shall provide this indication
2. in the Beacon frame(s) until (and including) the next DTIM Beacon frame on the link that the AP is
3. operating on.

52

53 A non-AP STA within a non-AP MLD may decode the Critical Update Flag subfield in the Capability

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55 Information field.

56

1. A non-AP MLD shall maintain a record of the most recently received Change Sequence field value for each
2. AP in the AP MLD with which it has multi-link setup.

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### 1 35.3.9 General procedures

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### 3 35.3.9.1 General

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1. If a STA of a non-AP MLD receives a Management frame with a field corresponding to a reported AP of the
2. AP MLD, then an affiliated STA (if any) of the non-AP MLD that operates on the link of the reported AP
3. shall follow the procedure (if any) corresponding to receiving such field from the reported AP, as if that field
4. was received by the affiliated STA from the reported AP.

10

1. NOTE—Management frames that would carry such information include Beacon, Probe Response, and (Re)Association
2. Response frames.

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### 14 35.3.9.2 Channel switching, enhanced channel switching, and channel quieting

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1. If the Beacon frame or Probe Response frame transmitted by a first AP affiliated to an AP MLD, or
2. transmitted by the transmitted BSSID in the same multiple BSSID set as the first AP if the first AP
3. corresponds to a nontransmitted BSSID, any of the following elements is included for the first AP:

20

1. — Channel Switch Announcement element
2. — Enhanced Channel Switch Announcement element

23

1. — Max Channel Switch Time element
2. — Quiet element

26

27 — Quiet Channel element

28

1. Then, if another AP is affiliated to the same AP MLD:
2. — in the Beacon frames and Probe Response frames transmitted by the other AP, or transmitted by the

31

1. transmitted BSSID in the same multiple BSSID set as the other AP if the other AP corresponds to a
2. nontransmitted BSSID, the same element(s) shall be included in the per-STA profile corresponding
3. to the first AP in the Basic variant Multi-Link element corresponding to the AP MLD,

35

1. — the timing fields in the Channel Switch Announcement element, the Enhanced Channel Switch
2. Announcement element, the Quiet element, and the Quiet Channel element shall be applied in
3. reference to the most recent TBTT and BI indicated in the corresponding element(s) of the first AP
4. and not to the TBTT and BI of the other AP of the AP MLD.

40

1. NOTE 1—If the other AP corresponds to a nontransmitted BSSID, the same element(s) for the first AP is included in the
2. per-STA profile corresponding to the first AP in the Basic variant Multi-Link element corresponding to the AP MLD in
3. the nontransmitted BSSID profile corresponding to the other AP in the Multiple BSSID element in the Beacon and Probe
4. Response frames transmitted by the transmitted BSSID. 45
5. NOTE 2—If an AP affiliated to an AP MLD is switching channel, the Channel Switch Announcement element, the
6. Enhanced Channel Switch Announcement element, and the Max Channel Switch Time elements will be included in
7. every Beacon and Probe Response frames on all links of the AP MLD from right after the time the AP includes the
8. elements in the Beacon frame it transmits until the intended channel switch time. 50

51 When a first AP of an AP MLD is switching from an initial operating class/channel to a target operating

52

1. class/channel at a target switch time using channel switch announcement procedure or extended channel
2. switch announcement procedure, then:
3. — another affiliated AP of the AP MLD shall set the fields corresponding to the first AP that is reported
4. in the Reduced Neighbor Report element in Beacon and Probe Response frames it transmits (or that

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1. the transmitted BSSID in the same multiple BSSID set as the other AP transmits if the other AP
2. corresponds to a nontransmitted BSSID) before the target switch time to the initial operating
3. class/channel,

61

1. — another affiliated AP of the AP MLD shall set the fields corresponding to the first AP that is reported
2. in the Reduced Neighbor Report element in Beacon and Probe Response frames it transmits (or that
3. the transmitted BSSID in the same multiple BSSID set as the other AP transmits if the other AP

65

1. corresponds to a nontransmitted BSSID) after the target switch time to the target operating
2. class/channel.

3

### 4 35.3.10 Multi-link power management

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### 7 35.3.10.1 General

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1. Each STA of a non-AP MLD that is operating on an enabled link shall maintain its own power management
2. mode and power states as defined in 11.2 (Power management) and 10.47 (Target wake time (TWT)). Frame

11

1. exchanges on an enabled link are possible when the STA of the non-AP MLD operating on that link is in the
2. awake state (see 11.2.3 (Power management in a non-DMG infrastructure network)).

14

1. NOTE—A setup link is defined as enabled if at least one TID is mapped to that link and is defined as disabled if no TIDs
2. are mapped to that link (see [35.3.6.1 (TID-to-link mapping)](#bookmark9)).

17

1. [Figure 35-4 (Each STA of a non-AP MLD maintains its own power state)](#bookmark16) illustrates the power save
2. operation for multi-link. As depicted in the figure, during the initial portion of the illustration, both STAs of
3. the non-AP MLD are in active mode and involved in frame exchange. At a later point in time, STA 2 of
4. non-AP MLD operating on link 2 signals PM = 1 to AP 2 to enter power save mode and transitions to doze

22

1. state. It remains in doze state for the rest of the illustration. STA 1 of non-AP MLD continues to remaining
2. active mode and participates in frame exchanges with AP 1 of AP MLD operating on link 1. When STA 1
3. enters power save mode, it provides an indication (i.e., PM = 1) to AP 1. While in power save mode, STA 1
4. signals awake state to AP 1 by transmitting a frame (such as PS-Poll) on link 1. STA 1 participates in frame
5. exchange with AP 1 while in awake state.

28

29

30 PM=0

AP 1

AP 2

31

32

Active mode

... ...

PM=1

...



PS‐POLL

Doze state

...

Doze state

PM=0

Active mode

STA 1

STA 2

...

33

34

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37

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40 AP‐MLD

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Link 1

PM=0

...

Link 2

Active mode

...

Active mode

PM=1

...

Doze state

Awake state

Power Save Mode

Doze state

... Data frame exchange

Link 1

Link 2

Non AP‐MLD

### 42 Figure 35-4—Each STA of a non-AP MLD maintains its own power state

43

44

45

### 46 35.3.10.2 Basic BSS operation

47

1. A non-AP MLD may perform basic operations (such as receiving a traffic indication, time synchronization,
2. receiving BSS parameter updates) by monitoring Beacon frames on one or more links. Not every STA

50

1. operating in PS mode in a non-AP MLD is required to receive the Beacon frames periodically. This is in
2. addition to mechanisms such as individual TWT agreement, WNM sleep mode and non-TIM mode. With
3. these mechanisms, a non-AP MLD can receive basic information about the AP MLD and one or more APs
4. of the AP MLD on a single link while the other STA(s) of the non-AP MLD are in doze state.

55

1. NOTE 1—A single AID is assigned to a non-AP MLD during multi-link setup (see [35.3.5 (Multi-link (re)setup)](#bookmark5)).
2. Therefore, the traffic indication for the non-AP MLD is consistent across Beacon frames transmitted by different APs of
3. the same AP MLD. 59
4. NOTE 2—Each AP of an AP MLD provides a critical updates indication when there is an update to the BSS parameters
5. for another AP of the AP MLD (see [35.3.8 (BSS parameter critical update procedure)](#bookmark15)). 62

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### 1 35.3.10.3 MLD max idle period management

2

1. A STA of a non-AP MLD may send at least one protected or unprotected keepalive frame per
2. BSSMaxIdlePeriod, as indicated in the Idle Options subfield. When a STA of a non-AP MLD transmits an

5

6 unprotected keepalive frame, it shall use a frame that has 48-bit TA and RA fields.

7

1. The Max Idle Period subfield of the BSS Max Idle Period element indicates the time period during which a
2. non-AP MLD can refrain from transmitting frames on any setup link to the AP MLD, with whom it has
3. performed multi-link setup, without causing a tear down of the multi-link setup. A non-AP MLD is

11

1. considered inactive if the AP MLD has not received a Data frame, PS-Poll frame, or Management frame
2. (protected or unprotected as specified in this paragraph) of a frame exchange sequence initiated by the
3. non-AP MLD on any setup link for a time period greater than or equal to the time specified by the Max Idle
4. Period subfield. If the Idle Options subfield requires protected keepalive frames, then the AP MLD may tear
5. down the multi-link setup with the non-AP MLD if no protected frames are received from any STA of the

17

1. non-AP MLD for a duration of BSSMaxIdlePeriod. If the Idle Options subfield allows unprotected or
2. protected keepalive frames, then the AP MLD may tear down the multi-link setup with the non-AP MLD if
3. no protected or unprotected frames with 48-bit TA and RA fields are received from any STA of the non-AP
4. MLD for a duration of BSSMaxIdlePeriod.

22

1. NOTE—The AP MLD can tear down or deauthenticate the non-AP MLD at any time for other reasons even if the
2. non-AP MLD satisfies the keepalive frame transmission requirements. 25

### 26 35.3.10.4 Traffic indication

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28

1. An AP MLD shall assign a single AID to a non-AP MLD upon successful multi-link setup. All the STAs of the
2. non-AP MLD shall have the same AID as the one assigned to the non-AP MLD during multi-link setup.

31

1. An AP MLD shall indicate pending buffered traffic for non-AP MLDs using partial virtual bitmap of TIM
2. element in a Beacon frame as described in 9.4.2.5 (TIM element).

34

35

1. An AP MLD may recommend a non-AP MLD to use one or more enabled links. The AP’s indication may be
2. carried in a broadcast or a unicast frame. The format of the indication is TBD.

38

### 39 35.3.11 Multi-link device individually addressed data delivery without block ack negotiation

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41

1. An MLD may deliver individually addressed QoS Data frames belonging to a TID without block ack
2. negotiation to an associated MLD on the setup links subject to additional constraints in [35.3.6 (Link](#bookmark8)
3. [management)](#bookmark8).

45

46

1. An MLD shall follow the rules described in 10.3.2.14.2 (Transmitter requirements) to determine the
2. sequence number of an individually addressed QoS Data frame belonging to a TID that is delivered to the
3. associated MLD.

50

51 An MLD shall follow the rules as described in 10.3.2.14.3 (Receiver requirements) to discard duplicate

52

1. individually addressed QoS Data frames belonging to a TID without block ack negotiation that are delivered
2. from the associated MLD.

55

1. An MLD shall continue to deliver the failed individually addressed QoS Data frame belonging to a TID
2. without block ack negotiation to an associated MLD on the setup links subject to additional constraints (see

58

1. [35.3.6 (Link management)](#bookmark8)) until the retry limit is met or the individually addressed QoS Data frame is
2. successfully delivered whichever occurs first. A STA affiliated with the MLD shall not transmit other
3. individually addressed QoS Data frames belonging to the TID without block ack negotiation to another STA
4. affiliated with the associated MLD on the corresponding link until the current individually addressed QoS
5. Data frame belonging to the TID without block ack negotiation finishes transmission or is dropped.

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### 18 35.3.13 Multi-link channel access

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### 20 35.3.13.1 General

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22 An STA, which is affiliated with an MLD, is allowed to contend for the WM on its link independently from

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24 the other STA(s) affiliated with the same MLD, unless explicitly stated otherwise in the subclause below.

25

### 26 35.3.13.2 Simultaneous transmit and receive (STR) operation

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28 An STA that is affiliated with an MLD capable of STR over a pair of links and that is operating on a link in

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1. that pair of links may contend for access to WM or transmit a frame to an STA of another MLD capable of
2. STR over that pair of links on that link regardless of any activity occurring on the other link within that pair
3. of links.

33

34 An MLD shall announce whether the MLD is capable of STR over a pair of links as defined in [35.3.13.4](#bookmark18)

35

36 [(Capability signaling)](#bookmark18).

37

1. [Figure 35-5 (Channel access of two MLDs operating as STR over a pair of links)](#bookmark17) shows an example of an
2. AP MLD and a non-AP MLD that are operating as STR over a pair of links and that are contenting for
3. access to the WM and subsequent frame exchanges between two MLDs on those links. After the AP MLD

41

1. has set up link 1 and link 2 with the non-AP MLD, then AP 2 may receive data frames from STA 2 on link 2,
2. while AP 1 contends for the WM and then transmits data frames to STA 1 on link 1.

44

45

**Non‐AP MLD**

STA 2

STA 1

**AP MLD**

AP 2

AP 1

46

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| AP 1 | Data |  | | |
| STA 1 | | | ACK |  |

47 **Link 1 **

48

49

50

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| AP 2 | | | | ACK |  |
| STA 2 |  | Data |  | | |

51

52 **Link 2**

53 

54

55

### 56 Figure 35-5—Channel access of two MLDs operating as STR over a pair of links

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### 60 35.3.13.3 Nonsimultaneous transmit and receive (NSTR) operation

61

#### 62 Editor’s Note: As per the author of 20/1395r14, the following two paragraphs are TBD.

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64

65

1. An MLD may indicate a pair of links as STR by setting the TBD field in the TBD elements that it transmits
2. if the receiver requirements specified in Clause 36 (Extremely high throughput (EHT) PHY specification)
3. on one link are met whenever it is transmitting on the other link.

4

5

6 A pair of links that is not indicated as STR shall be indicated as NSTR.

7

1. An AP that is affiliated with an MLD should not transmit to a STA affiliated with a non-AP MLD, a frame
2. on a link of an NSTR link pair of the non-AP MLD at the same time that the non-AP MLD is transmitting a
3. frame on the other link of the NSTR link pair.

11

12

1. A STA that is affiliated with a non-AP MLD should not transmit a frame on a link of one of its NSTR link
2. pairs at the same time that another STA that is affiliated with the same non-AP MLD is receiving a frame
3. addressed to that receiving STA on the other link of the NSTR link pair.

16

17

1. An AP MLD should not transmit a frame that solicits an immediate response to a STA that is affiliated with
2. a non-AP MLD on a link that is a member of one or more NSTR link pairs for that non-AP MLD, if the
3. immediate response is expected to overlap in time with group addressed MPDUs scheduled in another link
4. of any of those NSTR link pairs and the non-AP MLD is expected to be receiving those group addressed
5. MPDUs.

23

24

### 25 35.3.13.4 Capability signaling

26

1. An MLD can indicate capability to support exchanging frames simultaneously by affiliated STAs on a set of
2. links to another MLD in TBD capability field/element. The capability field/element indicates the MLD is a

29

1. multi-radio MLD or other types of MLD. A multi-radio MLD operating on multiple links can announce
2. whether it supports transmission on one link concurrent with reception on the other link for each pair of
3. links, in which case the pair of link is STR or NSTR. The two links of each link pair are on different
4. channels.

34

1. NOTE—If an MLD supports transmission on link 1 concurrent with reception on link 2, but cannot support transmission
2. on link 2 concurrent with reception on link 1, this pair of links is NSTR. 37
3. The ability of a non-AP MLD to perform STR on a pair of setup links may change after multi-link setup.
4. The non-AP MLD may use TBD signaling on any enabled link to inform the AP MLD about the ability

40

41 change to perform STR.

42

43 The limitation of updating frequency of the ability to perform STR as well as the switching delay is TBD.

44

### 45 35.3.13.5 PPDU end time alignment

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47

1. In this subclause “simultaneously transmit” means more than one PPDU is transmitted on more than one
2. link, where each PPDU is transmitted over one link, and those transmissions overlap in time. Likewise,
3. “simultaneously trigger” means more than one HE or EHT TB PPDU is triggered on more than one link,
4. where each PPDU is triggered over one link, and those transmissions overlap in time. If a NSTR MLD that

52

1. is receiving a PPDU on a first link simultaneously transmits another PPDU on a second link, then the NSTR
2. MLD might fail to receive the PPDU on the first link because of the interference caused by its transmission
3. on the second link. This subclause specifies a mechanism to align the end time of PPDUs that are
4. simultaneously transmitted to the same NSTR non-AP MLD, which helps reduce the chances of the
5. occurrence of such self-interference among STAs affiliated to the same NSTR MLD.

58

59

1. When an AP MLD simultaneously transmits more than one PPDU to the same NSTR non-AP MLD and at
2. least one of the PPDUs carries a frame that is a QoS data soliciting an immediate response, then

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63

64

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* + — The AP shall align the end time of the PPDUs soliciting an immediate response per the rules defined
  + in this subclause, except if the PPDU carries a high priority frame (the definition of the high priority
  + frame is TBD).

4

5 — The end time of the PPDU that does not solicit an immediate response shall meet the TBD condition.

6

1. NOTE 1— In this way the response PPDU to any of the PPDUs transmitted by the AP will not overlap with any of these
2. PPDUs.

9

1. When an AP MLD is required to align the end time of simultaneously transmitted PPDUs, it shall satisfy the
2. following conditions:
3. — The AP MLD shall ensure that the difference between the end times of simultaneously transmitted

13

1. PPDUs is less than or equal to 8 μs (see NOTE 2), where the end time of the PPDU is the time of the
2. end of the last OFDM symbol or the time of the end of the packet extension if present, whichever is
3. later.

17

1. — The AP MLD shall ensure that the end time of one or more PPDUs that carries a frame soliciting an
2. immediate response frame is at most 4 μs (see NOTE 3) earlier than the end time of any of PPDUs
3. containing a Trigger frame with the CS Required subfield set to 1.

21

1. NOTE 2—The difference between the end times of transmitting PPDUs needs to be less than SIFS minus a timing
2. margin, so that the response PPDU to any of the PPDUs transmitted by the AP will not overlap with any of these PPDUs.
3. To balance the implementation complexity at a transmitter side and a receiver side, the timing margin is set to half of
4. SIFS. 26
5. NOTE 3—The value of 4 μs is derived from aRxTxTurnaroundTime being equal to 4 μs for the purpose of this
6. requirement.

29

1. An AP MLD may use any type of padding to align the end time of transmitted PPDUs, such as using the
2. Padding field in a Trigger frame, post-EOF A-MPDU padding, aggregating other MPDUs in the A-MPDU,

32

33 or a packet extension.

34

1. When an AP MLD simultaneously solicits one or more HE or EHT TB PPDUs from the same NSTR
2. non-AP MLD, each AP affiliated to the AP MLD shall independently solicit an HE or EHT TB PPDU
3. following the mechanisms defined in 26.5.2 (UL MU operation) with the following exceptions:

38

1. — An AP affiliated to the AP MLD shall not transmit a Trigger frame with the CS Required subfield set
2. to 1 to a STA affiliated to a NSTR non-AP MLD, when at least one PPDU from other STAs
3. affiliated to the same NSTR non-AP MLD is scheduled for transmission before a timer with a value
4. of 12 μs (see NOTE 4) has expired after the PPDU containing the Trigger frame.

43

1. — If the AP MLD allows the frames in the TB PPDUs to solicit control response frames from the AP
2. MLD, then the UL Length subfield values in the soliciting Basic Trigger frames shall be set to the
3. same value.

47

1. NOTE 4—12 μs is derived from aSIFSTime + aSignalExtension – aRxTxTurnaroundTime, where
2. aRxTxTurnaroundTime is equal to 4 μs for the purpose of this calculation. 50

51 The relationship between the end times of DL PPDUs sent over link 1, link 2, and link 3 between an AP

52

1. MLD and a STA MLD is shown in [Figure 35-6 (PPDU end time alignment timing relationships)](#bookmark19). An AP in
2. the AP MLD operating on link 1 solicits an HE or EHT TB PPDU requiring the carrier sense from a STA in
3. the STA MLD. In this case the difference between the end time of the soliciting DL PPDU sent on link 1 and
4. the starting time of the first solicited PPDU (in the figure, Ack frame on link 2) that is sent from any STA in
5. the same STA MLD immediately after the soliciting DL PPDU is greater than or equal to 12 μs.

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1. Accordingly, the end time of the soliciting PPDU sent on link 2 cannot be more than 4 μs earlier than the end
2. time of the soliciting PPDU sent on link 1. To avoid overlapping in time between any of the DL PPDUs and

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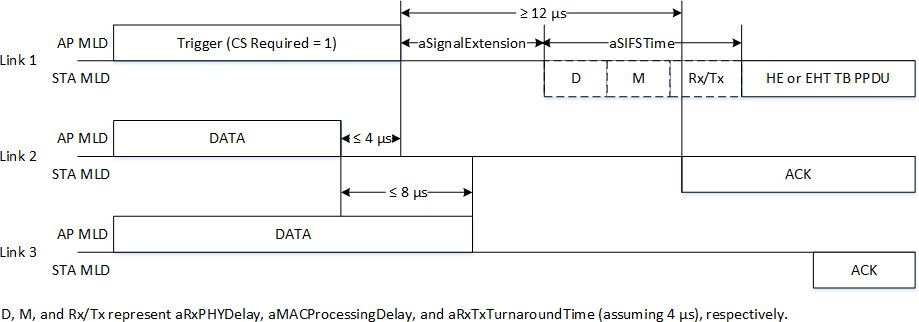
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1. the response PPDU to any of the DL PPDUs, the difference between the end times of the DL PPDUs on
2. link 2 and link 3 cannot be greater than 8 μs.

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### 20 Figure 35-6—PPDU end time alignment timing relationships

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### 24 35.3.13.6 Start time sync PPDUs medium access

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1. A non-STR MLD contending for the WM to become a TXOP holder and that aligns the start times of the
2. PPDUs scheduled for transmission on more than one link shall ensure that the EDCA count down procedure
3. is completed in all the links.

29

30 NOTE 1—The backoff counters for each link count down as specified in 10.23.2.4 (Obtaining an EDCA TXOP). 31

32 NOTE 2—Whether to extend this mechanism to STR MLD is TBD. 34

33

1. A STA that is affiliated with a non-STR MLD shall follow the channel access procedure described below:
2. — The STA may initiate transmission on a link when the medium is idle and one of the following
3. conditions is met:

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1. • The backoff counter of the STA reaches zero on a slot boundary of that link.
2. • The backoff counter of the STA is already zero, and the backoff counter of another STA of the
3. affiliated MLD reaches zero on a slot boundary of the link that the other STA operates.

42

1. — When the backoff counter of the STA reaches zero, it may choose to not transmit and keep its
2. backoff counter at zero.
3. — If the backoff counter of the STA has already reached zero, it may perform a new backoff procedure.

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47 CW[AC] and QSRC[AC] are left unchanged.

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### 49 35.3.14 Enhanced multi-link single radio operation

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51 A non-AP MLD may operate in the EMLSR mode on the enabled links between the non-AP MLD and its

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53 associated AP MLD.

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#### 55 Editor’s Note: Per the authors of 20/1291r12, the name of the EMLSR mode is TBD.

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57 An MLD with dot11EHTEMLSROptionImplemented equal to true shall set the EMLSR mode subfield of

58

1. the Common Info field of the Basic variant Multi-Link element to 1; otherwise, the MLD shall set the
2. EMLSR mode subfield to 0.

61

1. When a non-AP MLD is operating in the EMLSR mode with an AP MLD supporting the EMLSR mode the
2. following applies:

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* + — The non-AP MLD shall be able to listen on the enabled links, by having its affiliated STA(s)
  + corresponding to those links in the awake state. The listening operation includes CCA and receiving
  + the initial Control frame of a frame exchange sequence that is initiated by an AP MLD.

4

1. — The initial Control frame of a frame exchange sequence shall be sent in the OFDM PPDU or non-HT
2. duplicate PPDU format using a rate of 6 Mbps, 12 Mbps, or 24 Mbps.
3. — The initial Control frame shall be an MU-RTS Trigger frame or a BSRP Trigger frame.

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1. NOTE 1—Mandatory or optional support for the non-AP MLD of reception of MU-RTS and BSRP Trigger frames is
2. TBD. 11

12 NOTE 2—Optional support for the non-AP MLD of reception of Basic Trigger frame is TBD. 14

13

1. — The non-AP MLD shall indicate the delay time needed by the non-AP MLD in the EMLSR Delay
2. field in the Common Info field of the Basic variant Multi-Link element. The value in the EMLSR
3. Delay field indicates the MAC padding duration of the Padding field of the initial Control field. The
4. EMLSR Delay field is 3 bits and set to 0 for 0 µs, set to 1 for 32 µs, set to 2 for 64 µs, set to 3 for
5. 128 µs, set to 4 for 256 µs, and the values 5 to 7 are reserved.

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1. — The AP MLD shall initiate a frame exchange sequence with the non-AP MLD on one of the enabled
2. links by transmitting an initial Control frame to the non-AP MLD with the limitations specified
3. above.

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1. — After receiving the initial Control frame of a frame exchange sequence, the non-AP MLD shall be
2. able to transmit or receive frames on the link in which the initial Control frame was received and
3. shall not transmit or receive on the other link(s) until the end of the frame exchange sequence, and
4. subject to its spatial stream capabilities, operation mode, and link switch delay, the non-AP MLD

29

1. shall be capable of receiving a PPDU that is sent using more than one spatial stream a SIFS after the
2. end of its response frame transmission solicited by the initial Control frame. During the frame
3. exchange sequence, the AP MLD shall not transmit frames to the non-AP MLD on the other link(s).
4. The non-AP MLD switches back to the listening operation on the enabled links immediately after the
5. end of the frame exchange sequence.

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### 37 35.3.15 Enhanced multi-link multi-radio operation

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1. A non-AP MLD may operate in the EMLMR mode on a specified set of the enabled links between the
2. non-AP MLD and its associated AP MLD. The specified set of the enabled links in which the EMLMR

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42 mode is applied is called EMLMR links.

43

#### 44 Editor’s Note: Per the authors of 20/1440r7, the name of the EMLMR mode is TBD.

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46 An MLD with dot11EHTEMLMROptionImplemented equal to true shall set the EMLMR Support subfield

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1. of the TBD Capabilities element, which indicates MLD level capabilities, to 1; otherwise, the MLD shall set
2. the EMLMR Support subfield to 0.

50

1. A non-AP MLD with dot11EHTEMLMROptionImplemented equal to true shall set the EMLMR Rx NSS
2. subfield of TBD element to dot11SupportedEMLMRRxNSS and the EMLMR Tx NSS subfield of TBD

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54 element to dot11SupportedEMLMRTxNSS, which indicate MLD level capabilities.

55

1. A non-AP MLD with dot11EHTEMLMROptionImplemented equal to true operates in the EMLMR mode
2. by TBD signaling.

58

59

1. A non-AP MLD with dot11EHTEMLMROptionImplemented equal to true may indicate its link switch
2. delay in a TBD management frame.

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1. When a non-AP MLD operates in the EMLMR mode, after initial frame exchange subject to its per-link
2. spatial stream capabilities and operating mode on one of the EMLMR links, the non-AP MLD shall be able

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1. to support the following until the end of the frame exchange sequence initiated by the initial frame
2. exchange:

3

1. — Receive PPDUs with the number of spatial streams up to the value as indicated in the EMLMR Rx
2. NSS subfield of TBD element at a time on the link for which the initial frame exchange was made.
3. — Transmit PPDUs with the number of spatial streams up to the value as indicated in the EMLMR Tx
4. NSS subfield of TBD element at a time on the link for which the initial frame exchange was made.

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9

1. After the end of the frame exchange sequence, each STA of the non-AP MLD in the EMLMR mode shall be
2. able to transmit or receive PPDU, subject to its per-link spatial stream capabilities and operating mode and
3. any switching delay indicated by the non-AP MLD.

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### 15 35.3.16 NSTR soft AP MLD operation

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### 17 35.3.16.1 General

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#### 19 Editor’s Note: It is a placeholder subclause.

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### 22 35.3.17 Multi-BSSID

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1. Each AP of an AP MLD shall be independently configured to operate as a transmitted or nontransmitted
2. BSSID of a multiple BSSID set, or as an AP belonging to a co-hosted BSSID set, or as a standalone AP that

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1. is not part of either a multiple BSSID set or co-hosted BSSID set. Annex AA provides example
2. configurations.

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1. When Basic variant Multi-Link element is carried in a Nontransmitted BSSID Profile subelement in a
2. Multiple BSSID element, the value of an element, that is not present in the Per-STA Profile subelement of

32

1. the Basic variant Multi-Link element for a reported AP, shall be the same as the corresponding element
2. value as that of the nontransmitted BSSID profile that carried the Basic variant Multi-Link element or as the
3. element of the transmitted BSSID, present elsewhere in the frame, which is inherited by the nontransmitted
4. BSSID. The hierarchy of inheritance is from transmitted BSSID to the nontransmitted BSSID that carried
5. the Basic variant Multi-Link element and from the nontransmitted BSSID to the AP reported in the per-STA

38

39 profile.

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# 42 35.9 EHT BSS operation

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### 44 35.9.1 EHT BSS 6 GHz operation

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1. In 6 GHz band, a 6 GHz EHT AP may announce to 6 GHz non-EHT STAs a BSS operating channel width
2. that is different from the BSS operating channel width that it announces to 6 GHz EHT non-AP STAs if the
3. EHT BSS operating channel width includes at least one disallowed 20 MHz channel and/or if the announced
4. EHT BSS operating channel width is not supported by an HE BSS.

51

52

1. A 6 GHz EHT AP shall announce the BSS operating channel width in the HE Operation element with the
2. following restriction:

55

1. — The announced BSS operating channel width in the HE Operation element is the widest width
2. without covering the disallowed 20 MHz channels.

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1. The announced BSS operating channel width in HE Operation element is no more than the BSS operating
2. channel width in the EHT Operation element.

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# 1 35.10 NSEP priority access

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### 3 35.10.1 General

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1. A STA with a value of true for dot11EHTNSEPPriorityAccessActivated shall set to 1 the NSEP Priority
2. Access Supported subfield of the EHT Capabilities element that it transmits and is capable of invoking
3. NSEP priority access. A STA with a value of false for dot11EHTNSEPPriorityAccessActivated shall set to 0
4. the NSEP Priority Access Supported subfield of the EHT Capabilities element that it transmits and is not

10

11 capable of invoking NSEP priority access.

12

1. During the (re)association process, the AP obtains information required to verify the authority of the non-AP
2. STA to use NSEP priority access. An AP that has dot11SSPNInterfaceActivated equal to true may use the
3. interworking procedures described in 11.22.5 (Interworking procedures: interactions with SSPN) to retrieve

16

1. permission for a non-AP STA to use the NSEP priority access from an NSEP service provider via the SSPN
2. interface during association by the non-AP STA. To support this exchange, a non-AP STA with
3. dot11EHTNSEPPriorityAccessActivated equal to true shall provide the home realm information of the
4. NSEP provider and necessary authentication parameters as described in 11.22.5 (Interworking procedures:
5. interactions with SSPN). An AP with dot11SSPNInterfaceActivated equal to true that successfully obtains

22

1. permission for a non-AP STA to use NSEP priority access for the non-AP STA shall update the
2. dot11NonAPStationAuthNSEPPriorityAccesstype for the non-AP STA in the dot11InterworkingEntry. The
3. authorization information included in the dot11InterworkingEntry is passed from the prior AP to the new AP
4. in the same ESS during reassociation as described in 11.22.5.3 (Reporting and session control with SSPN).
5. Other methods of obtaining this authorization information are vendor specific and thus out of scope.

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29

# 1 Annex AA

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3

4 (informative)

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# 7 Multiple BSSID configuration examples

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## 12

### 51 Insert a new subclause AA.3 following subclause AA.2:

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## 55 AA.3 Example illustrating the relationship between multi-link operation and

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57 **multiple BSSID set**

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1. Each AP of an AP MLD can correspond to a transmitted or a nontransmitted BSSID in a multiple BSSID
2. set, or to an AP belonging to a co-hosted BSSID set, or to an AP that is not part of either a multiple BSSID
3. set or a co-hosted BSSID set.

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64

65 The links shown in the figures are assumed to be operating on different channels.

1. The first example illustrates the case where APs on each link belong to a multiple BSSID set. By definition,
2. since APs affiliated with an AP MLD have the same properties (such as security), APs in a multiple BSSID
3. set on a link are not part of the same AP MLD. [Figure AA-6 (Example of APs from multiple BSSID set on](#bookmark0)
4. [all links in a multi-link setup)](#bookmark0) shows an example where APs affiliated with an MLD belong to a multiple

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1. BSSID set on their respective link. Further, APs within the same MLD may correspond to a transmitted or
2. nontransmitted BSSID.

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**MLD 2**

(L2, L3)

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13 **Link 1**

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18 **Link 2**

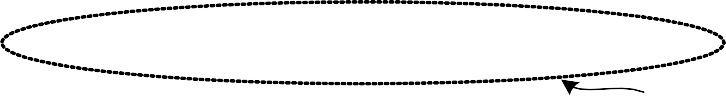
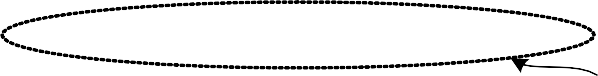
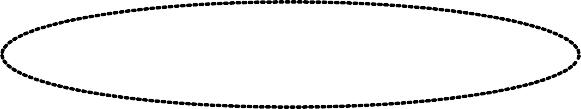
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**MLD 1**

(L1, L2, L3)



**BSSID‐x**

o

**BSSID‐p**

o

**BSSID‐q [T**

**]**

o

**MLD 3**

(L1, L2)

**BSSID‐y [T]**

o

**BSSID‐r**

o

Multiple BSSID set on L1

Multiple BSSID set on L2

22

23 **Link 3**

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25

26

1. **BSSID‐a [T]**
2. **BSSID‐b**

**BSSID‐c**

o

Multiple BSSID set on L3

#### 27 Figure AA-6—Example of APs from multiple BSSID set on all links in a multi-link setup

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1. [Figure AA-6 (Example of APs from multiple BSSID set on all links in a multi-link setup)](#bookmark0) illustrates that
2. APs corresponding to BSSID-x and BSSID-y are part of the multiple BSSID set on link 1 and belong to dif-

33

1. ferent MLDs (MLD 1 and MLD 3, respectively). On link 1, AP-y, affiliated with MLD 3, corresponds to the
2. transmitted BSSID for the multiple BSSID set on link 1. On link 2, there are three APs that are part of the
3. same multiple BSSID set and each belongs to a different MLD. AP-q, affiliated with MLD 2, corresponds to
4. the transmitted BSSID for the multiple BSSID set on link 2. On link 3, there are three APs which are part of
5. the same multiple BSSID set and two of the APs belongs to two different MLDs. AP-a, affiliated with

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1. MLD 1, corresponds to the transmitted BSSID for the multiple BSSID set on link 3. AP-c is a not affiliated
2. with any MLD.

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1. The second example illustrates the case where APs affiliated with an MLD belong to a mix of multiple
2. BSSID set and a co-hosted BSSID set or is a standalone AP. By definition, since APs affiliated with an AP

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1. MLD have same properties (such as security), APs in a co-hosted BSSID set on a link are not part of the
2. same AP MLD. [Figure AA-7 (Example of mix of multiple BSSID set, co-hosted set and standalone AP in a](#bookmark1)