### IEEE P802.11 Wireless LANs

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| Proposed Resolutions to CIDs specified in 11-21/218r0 | | | | |
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Abstract

We propose draft text for resolving comments provided in 11-21/218r0.

Revisions:

* Rev 0: Initial version of the document. Finished until subclause 35.3.5. To be continued.

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the subsequent TGbe Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGbe Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGbe Editor: Editing instructions preceded by “TGbe Editor” are instructions to the TGbe editor to modify existing material in the TGbe draft. As a result of adopting the changes, the TGbe editor will execute the instructions rather than copy them to the TGbe Draft.***

**Discussion:**

**Propose:**

# 10.2.7 MAC data service

(#1809)An AP affiliated with an AP MLD that broadcasts an MPDU received from an associated non-AP MLD shall set the SA field of the broadcast group addressed MPDU to the MLD MAC address of the non-AP MLD.

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

# 10.3.2.9 CTS and DMG CTS procedure

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

* the STA is affiliated with an MLD that has at least one NSTR link pair
* the STA that has received the RTS frame is a member of one of the MLD’s NSTR link pairs
* another STA affiliated with the same MLD is a TXOP holder or TXOP responder on the other link of the same NSTR link pair as the STA

Otherwise, the STA is not NSTR limited.

A VHT STA that is addressed by an RTS frame in a non-HT or non-HT duplicate PPDU that has a bandwidth signaling TA and that has the RXVECTOR parameter DYN\_BANDWIDTH\_IN\_NON\_HT equal to Static behaves as follows:

* If the NAV indicates idle, the STA is not NSTR limited and CCA has been idle for all secondary channels (secondary 20 MHz channel, secondary 40 MHz channel, and secondary 80 MHz channel) in the channel width indicated by the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT for a PIFS prior to the start of the RTS frame, then the STA shall respond with a CTS frame carried in a non-HT or non-HT duplicate PPDU after a SIFS. The CTS frame’s TXVECTOR parameters CH\_BANDWIDTH and CH\_BANDWIDTH\_IN\_NON\_HT shall be set to the same value as the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT.
* If the NAV indicates idle, and the STA is NSTR limited, and CCA has been idle for all secondary channels (secondary 20 MHz channel, secondary 40 MHz channel, and secondary 80 MHz channel) in the channel width indicated by the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT for a PIFS prior to the start of the RTS frame, then the STA may respond with a CTS frame carried in a non-HT or non-HT duplicate PPDU after a SIFS. The CTS frame’s TXVECTOR parameters CH\_BANDWIDTH and CH\_BANDWIDTH\_IN\_NON\_HT shall be set to the same value as the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT.
* Otherwise, the STA shall not respond with a CTS frame.

A VHT STA that is addressed by an RTS frame in a non-HT or non-HT duplicate PPDU that has a bandwidth signaling TA and that has the RXVECTOR parameter DYN\_BANDWIDTH\_IN\_NON\_HT equal to Dynamic behaves as follows:

* If the NAV indicates idle, and the STA is not NSTR limited, then the STA shall respond with a CTS frame in a non-HT or non-HT duplicate PPDU after a SIFS. The CTS frame’s TXVECTOR parameters CH\_BANDWIDTH and CH\_BANDWIDTH\_IN\_NON\_HT shall be set to any channel width for which CCA on all secondary channels has been idle for a PIFS prior to the start of the RTS frame and that is less than or equal to the channel width indicated in the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT.
* If the NAV indicates idle, and the STA is NSTR limited, then the STA may respond with a CTS frame carried in a non-HT or non-HT duplicate PPDU after a SIFS. The CTS frame’s TXVECTOR parameters CH\_BANDWIDTH and CH\_BANDWIDTH\_IN\_NON\_HT shall be set to any channel width for which CCA on all secondary channels has been idle for a PIFS prior to the start of the RTS frame and that is less than or equal to the channel width indicated in the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT.
* Otherwise, the STA shall not respond with a CTS frame.

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

* If the NAV indicates idle, and the STA is not NSTR limited, then the STA shall respond with a CTS frame after a SIFS.
* If the NAV indicates idle, and the STA is NSTR limited, then the STA may respond with a CTS frame after a SIFS.
* Otherwise, the STA shall not respond with a CTS frame.

(#1936)An EHT STA that is addressed by an RTS frame in a non-HT or non-HT duplicate PPDU that has a bandwidth signaling TA and that has the RXVECTOR parameter DYN\_BANDWIDTH\_IN\_NON\_HT equal to Static behaves as follows:

* If the NAV indicates idle, the STA is not NSTR limited, and CCA has been idle for all nonpunctured nonprimary 20 MHz subchannels based on the rules defined in 36.3.20.6.4 (Per 20 MHz CCA sensi- tivity) in the channel width indicated by the RTS frame’s RXVECTOR parameter CH\_BAND- WIDTH\_IN\_NON\_HT for a PIFS prior to the start of the RTS frame, then the STA shall respond with a CTS frame carried in a non-HT or non-HT duplicate PPDU after a SIFS. The CTS frame’s TXVECTOR parameters CH\_BANDWIDTH and CH\_BANDWIDTH\_IN\_NON\_HT shall be set to the same value as the RTS frame’s RXVECTOR CH\_BANDWIDTH\_IN\_NON\_HT.
* If the NAV indicates idle, the STA is NSTR limited, and CCA has been idle for all nonpunctured nonprimary 20 MHz subchannels based on the rules defined in 36.3.20.6.4 (Per 20 MHz CCA sensi- tivity) in the channel width indicated by the RTS frame’s RXVECTOR parameter CH\_BAND- WIDTH\_IN\_NON\_HT for a PIFS prior to the start of the RTS frame, then the STA may respond with a CTS frame carried in a non-HT or non-HT duplicate PPDU after a SIFS. The CTS frame’s TXVECTOR parameters CH\_BANDWIDTH and CH\_BANDWIDTH\_IN\_NON\_HT shall be set to the same value as the RTS frame’s RXVECTOR CH\_BANDWIDTH\_IN\_NON\_HT.
* Otherwise, the STA shall not respond with a CTS frame.

An EHT STA that is addressed by an RTS frame in a non-HT or non-HT duplicate PPDU that has a band- width signaling TA and that has the RXVECTOR DYN\_BANDWIDTH\_IN\_NON\_HT equal to Dynamic behaves as follows:

* If the NAV indicates idle, and the STA is not NSTR limited, then the STA shall respond with a CTS frame in a non-HT or non-HT duplicate PPDU after a SIFS. The CTS frame’s TXVECTOR parame- ters CH\_BANDWIDTH and CH\_BANDWIDTH\_IN\_NOT\_HT shall be set to any channel width for which CCA on all nonpunctured secondary channels has been idle for a PIFS prior to the start of the RTS frame based on the rules defined in 36.3.20.6.4 (Per 20 MHz CCA sensitivity) and that is less than or equal to the channel width indicated in the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT.
* If the NAV indicates idle, and the STA is NSTR limited, then the STA may respond with a CTS frame in a non-HT or non-HT duplicate PPDU after a SIFS. The CTS frame’s TXVECTOR parame ters CH\_BANDWIDTH and CH\_BANDWIDTH\_IN\_NOT\_HT shall be set to any channel width for which CCA on all nonpunctured secondary channels has been idle for a PIFS prior to the start of the RTS frame based on the rules defined in 36.3.20.6.4 (Per 20 MHz CCA sensitivity) and that is less than or equal to the channel width indicated in the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT.
* Otherwise, the STA shall not respond with a CTS frame.

# 10.3.2.14.2 Transmitter requirements

A STA maintains one or more sequence number spaces that are used when transmitting a frame to determine

the sequence number for the frame. (#2751)An MLD maintains one or more sequence number spaces that are used when an STA affiliated with the MLD transmits an individually addressed QoS Data frame to an STA affiliated with another MLD to determine the sequence number for the frame. (#2496)An MLD with dot11QMFActivated equal to false maintains one sequence number space that is used when a STA affiliated with the MLD transmits an individually addressed Management frame (except the frames that are excluded in 35.3.13 (Multi-link device individually addressed Management frame delivery(#2496))) to a STA affili- ated with another MLD to determine the sequence number for the frame. When multiple sequence number spaces are supported, the appropriate sequence number space is determined by information from the MAC con- trol fields of the frame to be transmitted. Except as noted below, each sequence number space is represented by a modulo 4096 counter, starting at 0 and incrementing by 1, for each MSDU or MMPDU transmitted using that sequence number space. If dot11MACPrivacyActivated is true, the counter in each sequence number space shall be set to a random number modulo 4096 when the STA’s MAC address is changed.

A transmitting STA shall support the applicable sequence number spaces defined in [Table 10-5 (Transmitter](#bookmark2) [sequence number spaces)](#bookmark2). A transmitting MLD shall support the applicable sequence number spaces defined in [Table 10-5 (Transmitter sequence number spaces)](#bookmark2). (#2751)A transmitting STA affiliated with an MLD shall support SNS9 instead of SNS2 in [Table 10-5 (Transmitter sequence number spaces](#bookmark2)) to determine the sequence num- ber of an individually addressed QoS Data frame that is transmitted to a STA affiliated with another MLD. (#2496)A STA affiliated with an MLD shall support SNS10 instead of SNS1 in [Table 10-5 (Trans-](#bookmark2) [mitter sequence number spaces](#bookmark2)) to determine the sequence number of an individually addressed Manage- ment frame (except the frames that are excluded in 35.3.13 (Multi-link device individually addressed Management frame delivery(#2496))) that is transmitted to a STA affiliated with another MLD. Applicabil- ity is defined by the Applies to column. The Status column indicates the level of support that is required if the Applies to column matches the transmission. The Multiplicity column indicates whether the sequence number space contains a single counter, or multiple counters and in the latter case identifies any indexes.

The Transmitter requirements column identifies requirements for the operation of this sequence number space. The referenced requirements are defined at the end of the table.

# 10.25.2 Setup and modification of the block ack parameters

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

An EHT STA may include the ADDBA Additional Parameter Set element in a transmitted ADDBA Request frame and may set the Extended Buffer Size field of the ADDBA Additional Parameter Set element to a value greater than zero to indicate an extended buffer size. The extended buffer size in the ADDBA Request frame is advisory. When a block ack agreement is established between two MLDs, the originator may change the size of its transmission window if the value in the Extended Buffer Size field and the Buffer Size field of the ADDBA Response frame is larger than the value in the ADDBA Request frame. If the value in the Extended Buffer Size field and the Buffer Size field of the ADDBA Response frame is smaller than the value in the ADDBA Request frame, the originator shall change the size of its transmission window (*WinSizeO*) so that it meets the following condition:

— Not greater than 1024 if the sender and receiver of the ADDBA Response frame are EHT STA.

# 11.2.3.5.1 Power management with APSD procedures

If a STA is affiliated with a non-AP MLD, then the non-AP MLD shall have the same U-APSD Flag subfield value in the QoS Info field that its affiliated APs transmit for each AC across all setup links (see 35.3.5 (Multi-link (re)setup)).

# 11.3.1 State variables

An MLD (local) keeps an enumerated state variable for each MLD (remote) with which direct communication between two MLDs through affiliated STAs of the two MLDs(#2077) via the WM is needed. In this context, direct communication between two MLDs through affiliated STAs of the two MLDs(#2077) refers to the transmission of any Class 2 or Class 3 frame with an Address 1 field that matches the MAC address of a STA affiliated with the remote MLD and an Address 2 field that matches the MAC address of a STA affiliated with the local MLD.

# 11.3.2 Frame filtering based on STA or MLD state

The current state existing between the transmitter and receiver STAs determines the IEEE 802.11 frame types that may be exchanged between that pair of STAs (see Clause 9 (Frame formats)). The current state existing between MLDs determines the IEEE 802.11 frame types that may be exchanged on any of the links that are setup between that pair of MLDs, subject to additional constraints (see 35.3.6 (Link management)). A unique state exists for each pair of transmitter and receiver STAs and each pair of MLDs. The allowed frame types are grouped into classes and the classes correspond to the STA state and the MLD state. In State 1, only Class 1 frames are allowed. In State 2, only Class 1 or Class 2 frames are allowed. In State 3 and State 4, all frames are allowed (Classes 1, 2, and 3). In the definition of frame classes, the following terms are used:

1. Within an infrastructure BSS: both the transmitting STA and the recipient STA participate in the same infrastructure BSS
2. Within a PBSS: both the transmitting STA and the recipient STA participate in the same PBSS
3. Within an IBSS: both the transmitting STA and the recipient STA participate in the same IBSS
4. dot11RSNAActivated: reference to the setting of dot11RSNAActivated at the STA that needs to determine whether a transmission or reception is permitted.

# 11.3.5.1 General

Authentication is optional in an IBSS. In a non-DMG infrastructure BSS, authentication is required. The authentication is between two MLDs in an EHT BSS. In a DMG infrastructure BSS and PBSS, the Open System authentication algorithm is not used (see 12.3.3.1 (Overview(#2086)(#2283))). APs, AP MLDs, and PCPs do not initiate authentication.

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

The MLDME shall delete any PTKSA, GTKSA, IGTKSA, BIGTKSA and temporal keys held for communication with the AP MLD by using MLME-DELETEKEYS.request primitive (see 12.6.18 (RSNA security association termination)) before invoking MLME-ASSOCIATE.request primitive.

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

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

***…***

Upon receipt of an MLME-ASSOCIATE.request primitive, a non-AP, non-AP MLD, and non-PCP STA shall associate with an AP, AP MLD, or PCP, respectively, using the following procedure:

If the state for the AP, AP MLD, or PCP is State 1, the MLME shall inform the SME of the failure of the association by issuing an MLME-ASSOCIATE.confirm primitive, and this procedure ends.

All the states, agreements and allocations listed in both numbered lists in [11.3.6.4 (Non-AP, non-AP](#bookmark4) [MLD, and non-PCP STA reassociation initiation procedures)](#bookmark4) item c) are deleted or reset to initial values.

The MLME shall transmit an Association Request frame to the AP or PCP or the MLME shall transmit an Association Request frame with a Basic variant Multi-Link element in the Association Request frame that indicates the AP MLD to an AP affiliated with the AP MLD. The RSNE contained in the MLME-ASSOCIATE.request primitive shall be included in the Association Request frame. The RSNE shall specify exactly one pairwise cipher suite and exactly one AKM suite. If the MLME-ASSOCIATE.request primitive contained the EmergencyServices parameter equal to true, an Interworking element with the UESA field set to 1 shall be included in the Association Request frame.

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

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

The following procedure shall be used by an AP or PCP ~~U~~upon receipt of an Association Request frame from a STA ~~the AP or PCP shall use the following procedure~~ or by an AP MLD upon receipt from a non-AP STA affiliated with a non-AP MLD of an Association Request frame with a Basic variant Multi-Link element:

…

# 11.3.5.4 Non-AP, non-AP MLD, and non-PCP STA reassociation initiation procedures

Upon receipt of an MLME-REASSOCIATE.request primitive, a non-AP, non-AP MLD, and non-PCP STA shall reassociate with an AP, AP MLD, or PCP, respectively, using the following procedure:

If the STA (with respect to the AP or PCP) or non-AP MLD (with respect to the AP MLD) is not associated in the same ESS or the state for the new AP, AP MLD, or PCP is State 1, the MLME shall inform the SME of the failure of the reassociation by issuing an MLME-REASSOCIATE.confirm primitive, and this procedure ends.

The MLME shall transmit a Reassociation Request frame to the new AP or PCP or the MLME shall transmit a Reassociation Request frame with a Basic variant Multi-Link element in the Reassociation Request frame that indicates the new AP MLD to an AP affiliated with the new AP MLD. The RSNE contained in the MLME-ASSOCIATE.request primitive shall be included in the Reassociation Request frame. The RSNE shall specify exactly one pairwise cipher suite and exactly one AKM suite. If the MLME-REASSOCIATE.request primitive contained the EmergencyServices parameter equal to true, an Interworking element with the UESA field set to 1 shall be included in the Reassociation Request frame.

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

The following procedure shall be used by an AP or PCP u~~U~~pon receipt of a Reassociation Request frame from a STA ~~the AP or PCP shall use the following procedure~~ or by an AP MLD upon receipt from a non-AP STA affiliated with a non-AP MLD of a Reassociation Request frame with a Basic variant Multi-Link element:

The MLME shall issue an MLME-REASSOCIATE.indication primitive to inform the SME of the reassociation request. The SME shall issue an MLME-REASSOCIATE.response primitive addressed to the STA or the non-AP MLD identified by the PeerSTAAddress parameter of the MLME-REASSOCIATE.indication primitive. If the reassociation is not successful, the SME shall indicate a specific reason for the failure to reassociate in the ResultCode parameter. Upon receipt of the MLME-REASSOCIATE.response primitive, the MLME shall transmit a Reassociation Response frame.

If the state for the STA is 1 and the STA is a non-DMG STA or the state for the non-AP MLD is 1, the SME shall refuse the reassociation request by issuing an MLME REASSOCIATE.response primitive with ResultCode NOT\_AUTHENTICATED.

# 11.21.13 BSS max idle period management

If dot11BssMaxIdlePeriod is nonzero or dot11MldMaxIdlePeriod is nonzero, an AP shall include the BSS Max Idle Period element in the (Re)Association Response frame. Otherwise, the AP shall not include the BSS Max Idle Period element in the (Re)Association Response frame.

(#1027)When association is for a multi-link setup, the values carried in the BSS Max Idle Period element apply at the MLD level and the associated MLDs follow the MLD max idle period procedure (see 35.3.11.3 (MLD max idle period management). The rest of this subclause defines the procedure for the BSS max idle period when the association is not for a multi-link setup.

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

(#3321)A STA may send at least one protected or unprotected keepalive frame (such as Data frame, PS-Poll frame, or Management frame) per BSSMaxIdlePeriod, as indicated in the Idle Options field. ~~When a STA~~ ~~transmits an unprotected keepalive frame, it shall use a frame that has 48-bit TA and RA fields.~~

# 35.2.1 TXOP

# 35.2.1.1 Bandwidth signaling

An EHT STA transmitting a (#1476)Control frame in non-HT duplicate format with a bandwidth signaling TA addressed to an EHT STA shall set the TXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT according to Table 36-1 (TXVECTOR and RXVECTOR parameters).

# 35.2.1.2 Preamble puncturing

# 35.2.1.2.1 General

# 35.2.1.2.2 INACTIVE\_SUBCHANNELS

(#3151)(#3120)(#2180)(#1086)(#2541)An EHT STA shall not transmit on any 20 MHz subchannel that is punctured as indicated in the TXVECTOR parameter INACTIVE\_SUBCHANNELS (see Table 36-1 (TXVECTOR and RXVECTOR parameters)).

(#3151)(#3120)(#2180)(#1086)(#2147)The indication of which subchannels are punctured in a non-HT duplicate PPDU or EHT PPDU is conveyed from the MAC to the PHY through the TXVECTOR parameter INACTIVE\_SUBCHANNELS (see Table 36-1 (TXVECTOR and RXVECTOR parameters)). The parameter INACTIVE\_SUBCHANNELS may be present in the TXVECTOR of a non-HT duplicate PPDU or EHT PPDU.

# 35.1 Multilink operation

# 35.1.1 General

MLO enables a non-AP MLD to discover, authenticate, associate, and set up multiple links with an AP MLD. Channel access and frame exchanges between the non-AP MLD and the AP MLD is possible on each enabled link subject to the supported capabilities exchanged during association.

# 35.3.2 Advertisement of multi-link information in Multi-Link element(#2294)

# 35.3.2.1 General

NOTE—ML probe response is defined in 35.3.4.2 (Use of ML probe request and response).

(#2241)(#1154)(#2850)(#2450)(#3366)(#3152)(#1716)(#2898)(#1155)(#1414)(#2581)(#3367)(#3359)(#28

59)(#2295)An AP affiliated with an AP MLD shall follow the rules defined in [35.3.4.4 (Multi-Link element](#bookmark12) [usage rules in the context of discovery)](#bookmark12) for including a Basic variant Multi-Link element in a Beacon frame that it transmits or in a Probe Response frame, which is not an ML probe response, that it transmits.

(#2295)An AP affiliated with an AP MLD shall follow the rules in [35.3.5.4 (Usage and rules of Basic](#bookmark15) [variant Multi-Link element in the context of multi-link setup)](#bookmark15) for including a Basic variant Multi-Link element in (#1494)a (Re)Association Response frame and in an Authentication frame that it transmits.

(#1183)(#1777)(#1918)(#2414)(#2582)(#3211)(#3249)(#3368)(#2182)(#2295)A STA affiliated with a non-

AP MLD shall follow the rules in [35.3.4.2 (Use of ML probe request and response(#2583)(#3360))](#bookmark11) for including a Probe Request variant Multi-Link element in a Probe Request frame that it transmits.

(#2295)A STA affiliated with a non-AP MLD shall follow the rules in [35.3.5.4 (Usage and rules of Basic](#bookmark15) [variant Multi-Link element in the context of multi-link setup)](#bookmark15) for including a Basic variant Multi-Link element in (#1494)a (Re)Association Request frame and in an Authentication frame that it transmits.

(#1776)The Link ID subfield of the Per-STA Profile subelement carried in a Basic variant Multi-Link element is used in the context of multi-link discovery as described in [35.3.4.4 (Multi-Link element usage](#bookmark12) [rules in the context of discovery)](#bookmark12) and multi-link setup as described in [35.3.5.4 (Usage and rules of Basic](#bookmark15) [variant Multi-Link element in the context of multi-link setup)](#bookmark15).

(#3127)NOTE—The link ID of an AP affiliated with an AP MLD is a representation of the tuple consisting of Operating Class, Operating Channel, and BSSID of the AP affiliated with the AP MLD. The link ID is unique to every AP affiliated with an AP MLD.

(#1833)A STA affiliated with an MLD shall provide an indication of the presence of subfields carried in the Common Info field of the Multi-Link element via the subfields in the Multi-Link Control field.

(#1895)(#2295)A STA affiliated with an MLD may include Link Info field in the Basic variant Multi-Link element that it transmits to provide complete or partial information of another STA affiliated with its MLD as defined in [35.3.2.2 (Advertisement of complete or partial per-link](#bookmark6) [information(#1859))](#bookmark6)(#1034)(#2149)(#1861)(#1833)(#2831).

# 35.3.2.2 Advertisement of complete or partial per-link information(#1859)

…

(#1034)(#2149)(#1861)(#2831)An AP affiliated with an AP MLD shall not include the complete profile of a reported AP affiliated with the same AP MLD in the transmitted Beacon frame or a Probe Response frame that is not an ML probe response as defined in [35.3.4.4 (Multi-Link element usage rules in the context of](#bookmark12) [discovery)](#bookmark12) and [35.3.10 (Multi-link general procedures(#2324)(#2600))](#bookmark25).

(#1858)(#1010)(#1128)The Basic variant Multi-Link element when carried in the Neighbor Report element shall not include a Link Info field.

(#1034)(#1833)(#2149)(#1861)(#2831)An AP affiliated with an AP MLD may include either the complete profile or the partial profile of a reported AP affiliated with the same AP MLD in a transmitted Probe Response frame, which is an ML probe response frame, as defined in [35.3.4.2 (Use of ML probe request and](#bookmark11) [response(#2583)(#3360))](#bookmark11).

(#2585)(#3210)A STA affiliated with a non-AP MLD shall include, in a (Re)Association Request frame it transmits, the complete profile of all other STAs that are affiliated with its MLD and that are capable of operating on the links that it is requesting to be part of a multi-link setup (also see [35.3.5.4 (Usage and rules of Basic variant Multi-](#bookmark15) [Link element in the context of multi-link setup)](#bookmark15)).

(#2584)(#2295)An AP affiliated with an AP MLD shall include, in a (Re)Association Response frame it transmits, the complete profile of all other APs affiliated with its MLD and that are operating on the links that are accepted as part of a successful multi-link setup (also see [35.3.5.4 (Usage and rules of Basic variant Multi-Link element in](#bookmark15) [the context of multi-link setup)](#bookmark15)).

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# 35.3.2.3 Inheritance in a per-STA profile

(#2472)It is possible for STAs of an MLD to have similar capabilities and operational parameters on different links. As a result, some elements carried in the per-STA profile for a reported STA can be identical to same elements for the reporting STA. To reduce the frame size, when a per-STA profile carries complete information for a reported STA, it inherits the elements from the reporting STA.

NOTE—A per-STA profile that carries complete information is a complete profile (see 35.3.2.2).

(#1862)(#2167)The inheritance mechanism described in this subclause shall apply only when the Per-STA Profile subelement of the Basic variant Multi-Link element carries complete information of the reported STA (i.e., the Complete Profile subfield in the STA Control field of the subelement is set to 1).

(#3021)(#3212)(#3369)(#3370)A STA that transmits a Management frame carrying the Basic variant Multi- Link element shall include an element that is specific to the reported STA in the complete profile of the reported STA carried in the Basic variant Multi-Link element. An element is specific to a reported STA if any one of the following conditions is satisfied:

…

# 35.3.2.4 Multi-link device addressing

An MLD has an MLD MAC address that uniquelyidentifies the MLD.

(#1156)

(#2374)Each STA affiliated with an MLD shall have a different MAC address.

(#2759)NOTE—The MLD MAC address of an MLD might be the same as the MAC address of one affiliated STA or different from the MAC address of any affiliated STA.

(#1158)The value of the Address 2 (TA) field (if present) in the MAC header of a frame shall be the MAC address of the transmitting STA affiliated with the MLD corresponding to that link except for(#2474) the Individual/Group bit, which is set to 1 when the TA field value is a bandwidth signaling TA and set to 0 otherwise.

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

(#1670)The value of the Address 3 field and the Address 4 field (if present) in the MAC header of a data frame sent by a transmitting STA affiliated with the MLD shall be set based on Table 9- 30 (Address field contents), where the BSSID is the MAC address of the AP affiliated with the AP MLD corresponding to that link.

# 35.3.4 Discovery of an AP MLD

# 35.3.4.1 AP behavior

…

(#2589)(#2867)If a reporting AP is part of an AP MLD and is in the same co-located AP set as APs affiliated with another AP MLD for which there are no affiliated APs operating on the same channel as the reporting AP, each AP affiliated with the other AP MLD shall be reported in a TBTT Information field with the Neighbor AP TBTT Offset subfield, the BSSID subfield, the Short-BSSID subfield, the BSS Parameters subfield, the 20 MHz PSD subfield, and the MLD Parameters subfield in the Reduced Neighbor Report element that is included in the Beacon frames and broadcast Probe Response frames transmitted by the reporting AP if at least one AP affiliated with the other AP MLD is in the same multiple BSSID set as an AP affiliated with the AP MLD of the reporting AP, unless the APs affiliated with the other AP MLDs are already reported in Beacon frames and broadcast Probe Response frames transmitted by an AP in the same co-located AP set as the reporting AP and operating on the same link as the reporting AP.

…

# 35.3.4.2 Use of ML probe request and response

If an AP that is affiliated with an AP MLD receives an ML probe request from a non-AP STA requesting complete information, it shall respond with an ML probe response, subject to the rules defined in 11.1.4.3.4 (Criteria for sending a response)(#1048). An ML probe response is a Probe Response frame that includes a Basic variant Multi-Link element with a per-STA profile with complete information for each of the APs that are affiliated to the same AP MLD as the AP and that are requested by the ML probe request. If the AP receives an ML probe request from a non-AP STA requesting partial information, it shall respond with an ML probe response that includes a Basic variant Multi-Link element with (#2419)a per-STA profile with at least the elements requested from the (Extended) Request element for each of the APs that are affiliated to the same AP MLD as the AP and that are requested by the ML probe request, unless the elements requested are not part of the complete information for each of the APs and subject to the rules defined in 11.1.4.3.4 (Criteria for sending a response)(#1048).

(#2583)(#3360)(#1423)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 ML probe request requesting complete information and responds with an ML probe response (per 11.1.4.3.4 (Criteria for sending a response)), then the Address 1 field of the Probe Response frame may be set to the broadcast address unless the AP is not including its actual SSID in the SSID element of its Beacon frames in which case the Address 1 field of the Probe Response frame shall be set to the MAC address of the STA soliciting the Probe Response.

(#1049)(#1926)(#2421)(#2592)(#2858)NOTE—An AP operating in 6 GHz sets the Address 1 field of the Probe Response frame to broadcast address as defined in 26.17.2.3.2 (AP behavior for fast passive scanning).

(#1676)(#1042)(#1044)None of the non-AP STAs of a non-AP MLD shall send an ML probe request to an AP of the AP MLD in the corresponding link if any non-AP STA of the same non-AP MLD has already received a ML probe response including complete information from any of the AP of the AP MLD in any link, since the MLME-SCAN.request primitive with ScanType parameter indicating an active scan was issued.

# 35.3.5 Multi-link (re)setup

# 35.3.5.1 Multi-link (re)setup procedure

Before a non-AP MLD performs multi-link (re)setup with an AP MLD, the non-AP MLD and AP MLD shall follow MLD authentication procedure as described in 11.3 (STA authenticationAuthentication and association(#2277)).

For a non-AP MLD to perform multi-link (re)setup with an AP MLD, the non-AP MLD and the AP MLD shall exchange (Re)Association Request/Response frames and shall follow the MLD (re)association procedure as described in 11.3 (STA authenticationAuthentication and association(#2277)). (#1027)A (Re)Association Request/Response frame exchange that results in a successful association is for a multi-link setup if both the frames carried Basic variant Multi-Link element. Otherwise the association is not for a multi-link setup.

(#2063)In the (Re)Association Request frame, the non-AP MLD indicates the links that are requested for (re)setup (#1805)and the capabilities and operational parameters of the requested links as described in

[35.3.5.4 (Usage and rules of Basic variant Multi-Link element in the context of multi-link setup)](#bookmark15). (#2475)The non-AP MLD may request to (re)setup links with a subset of APs affiliated with the AP MLD.

In the (Re)Association Response frame, the AP MLD indicates the links that are accepted for (re)setup (#1805)and the capabilities and operational parameters of the accepted links as described in [35.3.5.4 (Usage](#bookmark15) [and rules of Basic variant Multi-Link element in the context of multi-link setup)](#bookmark15). (#2475)The AP MLD may

not accept all the links that are requested for (re)setup. (#2593)The (Re)Association Response frame shall be sent to the non-AP STA affiliated with the non-AP MLD that sent the (Re)Association Request frame.

(#1656)An MLD that requests or accepts multi-link (re)setup for any two links ensures that each link is located on different nonoverlapping channels.

After successful multi-link (re)setup between a non-AP MLD and an AP MLD, the non-AP MLD and the AP MLD setup links for multi-link operation (#1783)(see [35.3 (Multi-link operation)](#bookmark5) and the rest of the subclause [35.3 (Multi-link operation)](#bookmark5)), and the non-AP MLD is in associated state and is (re)associated with the AP MLD.

For each setup link, the corresponding non-AP STA affiliated with the non-AP MLD is in the same associated state as the non-AP MLD and is associated with the corresponding AP affiliated with the AP MLD, without providing the corresponding non-AP STA to the corresponding AP mapping to the DS, and enables the functionalities between a non-AP STA and its associated AP unless the functionalities have been extended to (#1442)the MLD level and specified otherwise.

An example of multi-link setup is shown in [Figure 35-5 (Example of multi-link setup(#2899))](#bookmark14).

**Figure 35-5—Example of multi-link setup(#2899)**

(#1052)In this example, (#2042)the AP MLD has three affiliated APs: AP 1 operates on 2.4 GHz band, AP 2 operates on 5 GHz band, and AP 3 operates on 6 GHz band. (#2899)Non-AP MLD initiates the multi-link setup procedure and non-AP STA 1 affiliated with the non-AP MLD sends an Association Request frame to AP 1 affiliated with the AP MLD, i.e., the TA field of the Association Request frame is set to the MAC address of the non-AP STA 1 and the RA field of the Association Request frame is set to the MAC address of the AP 1. The Association Request frame includes complete information of non-AP STA 1, non-AP STA 2, and non-AP STA 3 to request three links to be setup (one link between AP 1 and 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) and (#1053)a Basic variant Multi-Link element that indicates the MLD MAC address of the non-AP MLD. (#2899)AP MLD then responds to the requested multi-link setup, and AP 1 affiliated with the AP MLD sends an Association Response frame to non-AP STA 1 affiliated with the non-AP MLD, i.e., the TA field of the Association Response frame is set to the MAC address of the AP 1 and the RA field of the Association Response frame is set to the MAC address of the non-AP STA 1, to indicate successful multi-link setup. The Association Response frame includes complete information of AP 1, AP 2, and (#2043)AP 3 and a (#1785)Basic variant Multi-Link element that indicates the MLD MAC address of the AP MLD. After successful multi-link setup between the non-AP MLD and AP MLD, three links are setup (link 1 between AP 1 and non-AP STA 1, link 2 between AP 2 and non-AP STA 2, and link 3 between AP 3 and non-AP STA 3).

# Multi-link security

After a successful multi-link (re)setup between a non-AP MLD and an AP MLD, a PMK is established and a PTK is derived through a 4-way handshake between the non-AP MLD and the AP MLD (see 12.7.6 (4- way handshake)). The PMK, PTK, and the same PN space are used for all the setup links between the non-AP MLD and the AP MLD for the PTKSA. The non-AP MLD and the AP MLD use their respective MLD MAC addresses to derive the PMK under the SAE method and PTK.

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

# Multi-link tear down procedure

(#2377)For an MLD to tear down the setup links between the MLD and an associated peer MLD, one of the STAs affiliated with the MLD shall send Disassociation frame to the STA affiliated with the peer MLD on the corresponding link that is enabled (see [35.3.6.1.1 (General)](#bookmark18)), (#1055)and the MLD and the peer MLD shall follow the MLD disassociation procedure as described in 11.3 (STA authenticationAuthentication and association(#2277)).

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

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

A non-AP MLD may initiate a multi-link setup with an AP MLD to (#2478)set up more than one link with a subset of APs that are affiliated with the AP MLD. When a non-AP MLD initiates a multi-link setup with an AP MLD, a non-AP STA that is affiliated with the non-AP MLD shall transmit an (Re)Association Request frame on the link it is operating on. An AP that is affiliated with the AP MLD and that received the (Re)Association Request frame shall transmit an (Re)Association Response frame.

The non-AP STA shall include a Basic variant Multi-Link element in the (Re)Association Request frame it transmits.

The Basic variant Multi-Link element carried in the (Re)Association Request frame shall include the Common Info field and the Link Info field.

The Common Info field of the Basic variant Multi-Link element carried in the (Re)Association Request frame shall

1. include the MLD MAC address subfield for the non-AP MLD with which the non-AP STA is affiliated by setting the MLD MAC Address Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 1
2. not include the Link ID Info subfield by setting the Link ID Info Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 0
3. (#1068)not include the BSS Parameters Change Count subfield by setting the BSS Parameters Change Count Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 0.

The Link Info field of the Basic variant Multi-Link element carried in the (Re)Association Request frame shall include one or more Per-STA Profile subelement(s), each of which contains the complete information (such as capabilities) of a non-AP STA affiliated with the non-AP MLD and corresponding to a link that is requested for multi-link setup and shall set the Complete Profile subfield of the (#3251)Per-STA Control field of the Basic variant Multi-Link element to 1 and indicate SUCCESS in the Status Code subfield included in the Per-STA Profile subelement of the Basic variant Multi-Link element.

(#3251)The Link Info field of the Basic variant Multi-Link element carried in the (Re)Association Response frame shall include a Per-STA Profile subelement corresponding to a link that is not accepted by the AP MLD, is requested by the non-AP MLD and is not the link used to send (Re)Association Request frame, and shall set the Complete Profile subfield of the Per-STA Control field of the Basic variant Multi-Link element to 1 and indicate the failure cause of not accepting the link in the Status Code subfield included in the Per- STA Profile subelement of the Basic variant Multi-Link element.

(#1035)The Link ID subfield of the STA Control field of the Per-STA Profile subelement for the corresponding non-AP STA that requests a link for multi-link setup with the AP MLD is set to the link ID of an AP MLD that is operating on that link. The link ID is obtained during discovery.

The AP shall include a Basic variant Multi-Link element in (Re)Association Response frame that it transmits.

The Basic variant Multi-Link element carried in the (Re)Association Response frame shall include Common Info field and Link Info field.

The Common Info field of the Basic variant Multi-Link element carried in the (Re)Association Response frame shall

1. include the MLD MAC address subfield for the AP MLD with which the AP is affiliated by setting MLD MAC Address Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 1
2. include the Link ID Info subfield for the AP by setting the Link ID Info Present subfield of the Multi- Link Control field of the Basic variant Multi-Link element to 1
3. (#1068)include the BSS Parameters Change Count subfield for the AP by setting the BSS Parameters Change Count Present subfield of the Multi-Link Control field of the Basic variant Multi-Link element to 1.

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

(#1035)The Link ID subfield of the STA Control field of the Per-STA Profile subelement for the corresponding AP that accepts a link requested by an STA of non-AP MLD with a non-AP MLD is set to the link ID of the AP of the AP MLD that is operating on that link.

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

(#2044)A STA affiliated with an MLD shall include a Basic variant Multi-Link element containing the MLD MAC address of the MLD with which the STA is affiliated in the Authentication frame that it transmits.

(#2044)A STA, which is affiliated with an MLD, may select and manage its operating parameters independently from the other STA(s) affiliated with the same MLD, unless specified otherwise.

# Link management

# TID-to-link mapping

# General

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

By default, all TIDs shall be mapped to all setup links for (#2068)both DL and UL (see [35.3.6.1.2 (Default](#bookmark19) [mapping mode)](#bookmark19)). When both MLDs have explicitly negotiated a TID-to-link mapping by following the procedure defined in [35.3.6.1.3 (Negotiation of TID-to-link mapping)](#bookmark20), each TID can be mapped to the same or different link set(#2908).

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 are mapped to that link. At any point in time, a TID shall always be mapped to at least one setup link, unless admission control is used. By default, as TIDs are mapped to all setup links, all setup links shall be enabled (see [35.3.6.1.2 (Default mapping mode)](#bookmark19)).

(#1496)If a link is enabled, it may be used for frame exchange, subject to the power state of the non-AP STA operating on that link. Only MSDUs or A-MSDUs with TIDs mapped to an enabled link may be transmitted on that link. Management frames and Control frames may be sent only on enabled links.

If a link is disabled, it shall not be used for frame exchange, including Management frames both for DL and UL.

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

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

1. (#1226)The non-AP MLD can retrieve buffered BUs corresponding to that TID on any link within this set of enabled links.
2. The AP MLD can use any link within this set of enabled links to transmit frames carrying MSDUs or A-MSDUs with that TID, subject to existing restrictions for transmissions of frames that apply to those enabled links.

NOTE 1—An example of restriction is if the STA is in doze state.

(#1788)(#1680)NOTE 2—If the default mode is used, all TIDs are mapped to all setup links and all setup links are therefore enabled. The non-AP MLD can have the corresponding non-AP STA wake up on any link to receive BUs buffered by the AP MLD.

# Default mapping mode

(#1790)(#2427)(#2907)(#3377)(#3027)(#2908)Under this mode, all TIDs are mapped to all setup links for DL and UL, and all setup links are enabled. A non-AP MLD and an AP MLD that performed multi-link setup shall operate under this mode if a TID-to-link mapping negotiation for a different mapping did not occur or was unsuccessful or torn down.

# Negotiation of TID-to-link mapping

An MLD may support TID-to-link mapping negotiation. An MLD that supports TID-to-link mapping negotiation has dot11TIDtoLinkMappingActivated equal to true and shall set to a nonzero value the TID-to- link Mapping Negotiation Supported subfield in the MLD Capabilities field of the Basic variant Multi-Link

element that it transmits. Otherwise it shall set the TID-to-link Mapping Negotiation Supported subfield to

0. If the TID-to-link Mapping Negotiation Supported subfield value received from a peer MLD is equal to 2, the MLD shall send to the peer MLD only the TID-to-link Mapping element where all TIDs are mapped to the same link set.

In a multi-link (re)setup procedure, a non-AP MLD may initiate a TID-to-link mapping negotiation by including the TID-to-link Mapping element in the (Re)Association Request frame if an AP MLD has indicated a support of TID-to-link mapping negotiation.

After receiving the (Re)Association Request frame containing the TID-To-Link Mapping element, the AP MLD shall reply to the (Re)Association Request frame according to 11.3.5.3 (AP, AP MLD, or PCP association receipt procedures), 11.3.5.5 (AP, AP MLD, or PCP reassociation receipt procedures), and

* + - [(Multi-link (re)setup)](#bookmark13), with the following additional rules:
      * The AP MLD can accept the requested TID-to-link mapping in the TID-to-link Mapping element in the received (Re)Association Request frame only if it accepts the multi-link (re)setup for all links on which at least one TID is requested to be mapped. In this case, it shall not include in the (Re)Association Response frame the TID-to-link Mapping element.
      * Otherwise, it shall indicate rejection of the proposed TID-to-link mapping by including in the (Re)Association Response frame the TID-to-link Mapping element that suggests a preferred TID-to- link mapping.

After the multi-link (re)setup is successful, to negotiate a new TID-to-link mapping, an initiating MLD with dot11TIDtoLinkMappingActivated equal to true shall send an individually addressed TID-to-link Mapping Request frame to a responding MLD that has indicated support of TID-to-link mapping negotiation.

After receiving the individually addressed TID-to-link Mapping Request frame, the responding MLD shall send an individually addressed TID-to-link Mapping Response frame to the initiating MLD according to the following rules:

* + - * If the responding MLD accepts the requested TID-to-link mapping in the TID-to-link Mapping element in the received TID-to-link Mapping Request frame, it shall set to 0 (SUCCESS) the Status Code in the TID-to-link Mapping Response frame.
      * Otherwise, the responding MLD shall indicate rejection of the proposed TID-to-link mapping by setting to either <ANA> (DENIED\_TID\_TO\_LINK\_MAPPING) or

<ANA> (PREFERRED\_TID\_TO\_LINK\_MAPPING\_SUGGESTED) the Status Code in the TID- to-link Mapping Response frame. The responding MLD may suggest a preferred TID-to-link mapping by setting <ANA> (PREFERRED\_TID\_TO\_LINK\_MAPPING\_SUGGESTED) the Status Code in the TID-to-link Mapping Response frame and including the TID-to-link Mapping element in the TID-to-link Mapping Response frame.

An MLD may suggest a preferred TID-to-link mapping to a peer MLD by sending an unsolicited TID-to- link Mapping Response frame that includes the TID-to-link Mapping element and sets the Status Code to

<ANA> (PREFERRED\_TID\_TO\_LINK\_MAPPING\_SUGGESTED). An MLD shall not send an unsolicited TID-to-link Mapping Response frame that includes the TID-to-link Mapping element and sets the Status Code to 0 (SUCCESS).

If indicated by a peer MLD, an MLD should take into account the preferred TID-to-link mapping when it initiates a new TID-to-link mapping. In addition, an AP MLD should take into account the traffic flow(s) affiliated with the non-AP MLD and the capabilities and constraints (if any) of the non-AP MLD.

NOTE 1—A non-AP MLD can indicate its constraints (such as single radio) during multi-link setup.

A multi-link multi-radio (MLMR) non-AP MLD should accept a TID-to-link mapping initiated by its associated AP MLD.

When two MLDs have negotiated a TID-to-link mapping, either MLD may teardown the negotiated TID-to- link mapping by sending an individually addressed TID-to-link Mapping Teardown frame. After teardown, the MLDs shall operate in default mapping mode (see [35.3.6.1.2 (Default mapping mode)](#bookmark19)).

If an MLD has successfully negotiated the TID-to-link mapping with a peer MLD, both the MLD and the peer MLD shall update an uplink and/or downlink TID-to-link mapping information according to the negotiated the TID-to-link mapping. In case that a TID-to-link mapping of specific TID is missing in the negotiation, the most recent TID-to-link mapping of this TID remains unchanged and valid.

NOTE 2—If there is no successfully negotiated TID-to-link mapping for missing TID, the default mapping is applied to this TID.

When an MLD has successfully negotiated with a peer MLD an uplink and/or downlink TID-to-link mapping in which the bit position *i* of the Link Mapping Of TID field in the TID-to-link Mapping element is set to 0, the TID *n* shall not be mapped to the link associated with the link ID *i* in an uplink and/or downlink.

When an MLD has successfully negotiated with a peer MLD an uplink and/or downlink TID-to-link mapping in which the bit position *i* of the Link Mapping Of TID *n* field in the TID-to-link Mapping element is set to 1, the TID *n* shall be mapped to the link associated with the link ID *i* in an uplink and/or downlink.

# Power state after enablement

(#1791)When a link becomes enabled for a STA that is affiliated with a non-AP MLD after successful multi- link setup with (Re)Association Request/Response frames transmitted on that link, the initial power management mode of the STA, immediately after the acknowledgement of the (Re)Association Response frame, is active mode.

(#2340)(#1062)(#3028)(#2851)When a link transitions to being enabled for a STA that is affiliated with a non-AP MLD after successful multi-link setup with (Re)Association Request/Response frames transmitted on another link or after successful TID-to-link mapping negotiation with TID-To-Link Mapping Request/ Response frames transmitted on another link, the initial power management mode of the STA, immediately after the acknowledgement of the (Re)Association Response frame or of the TID-To-Link Mapping Response frame, is power save mode, and its power state is doze.

# Use of More Data subfield by an MLD

(#1195)(#1444)(#1882)An AP affiliated with an AP MLD uses the More Data subfield as defined in

9.2.4.1.8 (More Data subfield) to indicate to a non-AP STA in PS mode affiliated with the non-AP MLD that more individually addressed BUs are buffered for that non-AP MLD. The indicated buffered BUs (not including the BU currently being transmitted) are buffered at the AP MLD for the non-AP MLD and correspond to Data frames with TIDs that are mapped to this link by the most recent DL TID-to-link mapping (negotiated TID-to-link mapping or default mode mapping, see [35.3.6.1 (TID-to-link mapping)](#bookmark17)) or Management frames that are not measurement MMPDUs (see [35.3.11.4 (Traffic indication)](#bookmark30)).

An AP affiliated with an AP MLD shall follow the procedure defined in 11.2.3.6 (AP operation) for setting the More Data subfield and the EOSP subfield, except that in individually addressed frames the More Data subfield is used to indicate the presence of more BUs at the AP MLD for a non-AP MLD, as defined above.

When a STA is affiliated with a non-AP MLD operating with default mapping (see [35.3.6.1.2 (Default](#bookmark19) [mapping mode)](#bookmark19)) receives an individually addressed MPDU from its associated AP affiliated with the associated AP MLD with the More Data subfield set to 1, then at least one of any non-AP STA affiliated with the non-AP MLD shall follow the procedure defined in 11.2.3.7 (Receive operation for STAs in PS mode) and 11.2.3.8 (Receive operation using APSD) and may send PS-Poll frames or UAPSD trigger frames to retrieve buffered BUs buffered at the AP MLD.

When a STA that is affiliated with a non-AP MLD operating with a negotiated non-default TID-to-link mapping (see [35.3.6.1.3 (Negotiation of TID-to-link mapping)](#bookmark20)) receives an individually addressed MPDU from its associated AP with the More Data subfield set to 1, then at least one of any STA affiliated with the non-AP MLD that is operating on a link that is mapped to any of the TIDs that is also mapped to the link on which the individually addressed MPDU with the more data bit set to 1 is sent (as specified by the most recent DL TID-to-link mapping) shall follow the procedures defined in 11.2.3.7 (Receive operation for STAs in PS mode) and 11.2.3.8 (Receive operation using APSD) and may send PS-Poll frames or UAPSD trigger frames with any TID that is mapped to this operating link to retrieve the buffered BUs buffered at the AP MLD.

# Dynamic link transitions

A non-AP MLD may use the power states of its non-AP STAs to dynamically change the link(s) on which it operates. [Figure 35-6 (Example of operation of a single radio non-AP MLD with default mapping (all TIDs](#bookmark21) [mapped to all setup links), where the non-AP MLD transitions from operating on link 1 with STA 1 to](#bookmark21) [operating on link 2 with STA 2)](#bookmark21) provides an illustration of operation of a single radio non-AP MLD with default mapping (all 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.

**Figure 35-6—Example of operation of a single radio non-AP MLD with default mapping (all 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**

While operating on link 1:

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

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 retrieve BUs from the AP MLD and may use power save mode with doze state to save power.
2. STA 1 and STA 3 stay in doze state.

# Multi-link block ack

# Multi-link BlockAck procedure

# General

A block ack agreement between two MLDs shall apply to all links to which the TID corresponding to the block ack agreement, is mapped (i.e., there are no independent block ack agreements on a per-link basis).

(#1064)NOTE—Frame exchanges for a TID might be governed by TID-to-Link mapping rules (see [35.3.6.1 (TID-to-](#bookmark17) [link mapping)](#bookmark17)).

To setup a block ack agreement between two MLDs, a STA of the originator MLD sends an ADDBA Request frame, on any enabled link, indicating the TID for which the block ack agreement is being set up. The Buffer Size and Block Ack Timeout fields in the ADDBA Request frame are advisory. A STA of the recipient MLD shall respond with an ADDBA Response frame. The recipient MLD has the option of accepting or rejecting the request. If the recipient MLD accepts the request, then a block ack agreement exists between the originator MLD and recipient MLD for that TID as defined in 10.25.2 (Setup and modification of the block ack parameters).

If an MLD has established a block ack agreement with another MLD, then QoS Data frames for the TID associated with the block ack agreement may be exchanged between the two MLDs on any link to which the TID is mapped and subject to existing restrictions for transmissions of frames that apply to those enabled links, following the procedure described in [35.3.7.1 (Multi-link BlockAck procedure)](#bookmark22)(#1064).

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

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

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

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

A recipient MLD shall maintain a single common receive reordering buffer for each <peer MLD, TID> tuple under a block ack agreement, independently of the number of links that are setup. The receive reordering buffer shall be responsible for reordering MSDUs or A-MSDUs so that MSDUs or A-MSDUs are eventually passed up to the next MAC process in order of received sequence number. It shall also be responsible for identifying and discarding duplicate frames (i.e., frames that have the same sequence number as a currently buffered frame) that are part of this block ack agreement. It shall maintain its own state independent of the scoreboard context control to perform this reordering as specified in 10.25.6.6 (Receive reordering buffer control operation). Each received MPDU shall be analyzed by the scoreboard context control as well as by the receive reordering buffer control.

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

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

# EHT acknowledgment procedure

# Overview

The EHT acknowledgment procedure builds on the features defined for HT-immediate block ack (see

10.25.6 (HT-immediate block ack extensions)) and HE acknowledgement (see 26.4 (HE acknowledgment procedure)), with the following extensions:

— Support for BlockAck Bitmap field lengths of 512 and 1024

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

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

An EHT AP shall not transmit a Multi-STA BlockAck frame that contains a BlockAck Bitmap field with length equal to 512 or 1024 bits as a response to an HE TB PPDU generated by at least one HE STA.

# Negotiation of block ack bitmap lengths

Both the Compressed BlockAck frame and Multi-STA BlockAck frame allow different Block Ack Bitmap subfield lengths. The length of the Block Ack Bitmap subfield is indicated in the Fragment Number subfield of the Block Ack Starting Sequence Control field as defined in 9.3.1.8 (BlockAck frame format). The allowed Block Ack Bitmap lengths for each of the negotiated buffer sizes are defined in [Table 35-1](#bookmark23) [(Negotiated buffer size and Block Ack Bitmap subfield length)](#bookmark23).

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

|  |  |  |
| --- | --- | --- |
| **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 |
| 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. | | |

# Fragmentation in multi-link operation

A STA affiliated with an MLD shall not use the nondynamic fragmentation procedure described in

10.4 (MSDU, A-MSDU, and MMPDU fragmentation).

# BSS parameter critical update procedure

If an AP affiliated with an AP MLD is not in a multiple BSSID set or the AP corresponds to a transmitted BSSID in a multiple BSSID set, the AP shall

* + - * (#1083)(#1231)include in the Beacon and Probe Response frames it transmits a BSS Parameters Change Count subfield for each of all APs affiliated with the same AP MLD as the AP.
        + (#1070)(#1201)(#1202)The BSS Parameters Change Count subfield value for each AP is initial- ized to 0, and shall be incremented (modulo 256) when a critical update occurs to the operational parameters for that AP as defined in 11.2.3.15 (TIM Broadcast).
        + (#1068)The BSS Parameters Change Count subfield for each of other APs affiliated with the AP MLD shall be carried in the MLD Parameters subfield in the TBTT Information field of the Reduced Neighbor Report element corresponding to that AP.
        + (#1067)(#1068)(#1691)The BSS Parameters Change Count subfield for the AP shall be carried in the Common Info field of the Basic variant Multi-Link element.
      * (#1069)provide in the Critical Update Flag subfield of the Capability Information field (9.4.1.4 (Capability Information field)) of the Beacon and Probe Response frames it transmits an indication of an update to the value carried in the BSS Parameters Change Count subfield of the MLD Parameters field in the Reduced Neighbor Report element for any AP affiliated with the same AP MLD as the AP or the value carried in the BSS Parameters Change Count subfield in the Common Info field of the Basic variant Multi-Link element.
        + Set the Critical Update Flag subfield of the Capability Information field to 1 in the Beacon frame(s) until and including the next DTIM Beacon frame on the link on which the AP is operat- ing if there is a change to a value carried in the BSS Parameters Change Count subfield of the MLD Parameters field in the Reduced Neighbor Report element for any AP in the same AP MLD as the AP or a value carried in the BSS Parameters Change Count subfield in the Common Info field of the Basic variant Multi-Link element.
        + Otherwise set the Critical Update Flag subfield of the Capability Information field to 0.

If an AP affiliated with an AP MLD is a nontransmitted BSSID in a multiple BSSID set, then the AP that corresponds to the transmitted BSSID in the same multiple BSSID set shall

* + - * (#1231)include in the Beacon and Probe Response frames it transmits a BSS Parameters Change Count subfield for each of all APs affiliated with the same AP MLD as the AP corresponding to the non-transmitted BSSID
        + (#1070)(#1201)(#1202)The BSS Parameters Change Count subfield value for each AP is initial- ized to 0, and shall be incremented (modulo 256) when a critical update occurs to the operational parameters for that AP as defined in 11.2.3.15 (TIM Broadcast).
        + The BSS Parameters Change Count subfield for each of other APs affiliated with the AP MLD shall be carried in the MLD Parameters subfield in the TBTT Information field of the Reduced Neighbor Report element corresponding to that AP.
        + (#1067)(#1691)The BSS Parameters Change Count subfield for the nontransmitted BSSID shall be carried in the Common Info field of the Basic variant Multi-Link element carried in Nontrans- mitted BSSID Profile subelement of the Multiple BSSID element.
      * (#1069)provide in the Critical Update Flag subfield of the Nontransmitted BSSID Capability element (for that nontransmitted BSSID) an indication of an update to the value carried in the BSS Parameters Change Count subfield of the MLD Parameters field in the Reduced Neighbor Report element for any AP affiliated with the same AP MLD as the AP corresponding to the nontransmitted BSSID or a value carried in the BSS Parameters Change Count subfield in the Common Info field of the Basic variant Multi-Link element in the Nontransmitted BSSID Profile corresponding to the nontransmitted BSSID
        + Set the Critical Update Flag subfield of the Capability Information field to 1 in the Beacon frame(s) until and including the next DTIM Beacon frame of the nontransmitted BSSID if there is a change to a value carried in the BSS Parameters Change Count subfield of the MLD Param- eters field in the Reduced Neighbor Report element for any AP in the same AP MLD as the AP corresponding to the nontransmitted BSSID or a value carried in the BSS Parameters Change Count subfield in the Common Info field of the Basic variant Multi-Link element in the Non- transmitted BSSID Profile corresponding to the nontransmitted BSSID.
        + Otherwise, set the Critical Update Flag subfield of the Capability Information field to 0.

(#3225)(#1069)(#1070)(#3030)(#2131)(#3240)(#3319)(#1068)A non-AP MLD shall maintain a record of

the most recently received BSS Parameters Change Count subfield value for each AP in the AP MLD with which it has multi-link setup.

# Multi-link general procedures(#2324)(#2600)

# General

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

(#1693)NOTE 1—Management frames that would carry such information are the ones that carry Basic variant Multi- Link element.

(#3254)NOTE 2—The fields can be included in elements in the Management frame.

# Channel switching, extended channel switching, and channel quieting(#2749)

(#1429)(#1658)(#1694)(#1754)(#2874)If a first AP is affiliated to an AP MLD and in the Beacon frame or Probe Response frame either transmitted by the first AP, or transmitted by the transmitted BSSID in the same multiple BSSID set as the first AP if the first AP corresponds to a nontransmitted BSSID, any of the following elements is included for the first AP:

* + - * + Channel Switch Announcement element
        + (#2749)Extended Channel Switch Announcement element
        + Max Channel Switch Time element
        + (#2215)Quiet element corresponding to quiet intervals other than quiet intervals scheduled to protect restricted TWT service periods (see [35.7.4.2 (Quieting STAs during restricted TWT service](#bookmark55) [periods(#2215))](#bookmark55))
        + Quiet Channel element

(#2875)(#2911)(#1428)Then, for each of the other APs affiliated to the same AP MLD as the first AP, the following applies:

* + - * + in the Beacon frames and Probe Response frames transmitted by the other AP, or transmitted by the transmitted BSSID in the same multiple BSSID set as the other AP if the other AP corresponds to a nontransmitted BSSID, the same element(s) shall be included (#1203)explicitly or through inheritance ([35.3.2.3 (Inheritance in a per-STA profile)](#bookmark8)) in the per-STA profile corresponding to the first AP in the Basic variant Multi-Link element (#2912)(see 9.4.2.295b.2 (Basic variant Multi-Link element)) corresponding to the AP MLD,
        + the timing fields in the Channel Switch Announcement element, the (#2749)Extended Channel Switch Announcement element, the Quiet element, and the Quiet Channel element shall be applied in reference to the most recent TBTT and BI indicated in the corresponding element(s) of the first AP and not to the TBTT and BI of the other AP of the AP MLD.

NOTE 1—If the other AP corresponds to a nontransmitted BSSID, the same element(s) for the first AP is included in the per-STA profile corresponding to the first AP in the Basic variant Multi-Link element corresponding to the AP MLD in the nontransmitted BSSID profile corresponding to the other AP in the Multiple BSSID element in the Beacon and Probe Response frames transmitted by the transmitted BSSID.

NOTE 2—If an AP affiliated to an AP MLD is switching channel, the Channel Switch Announcement element, the (#2749)Extended Channel Switch Announcement element, and the Max Channel Switch Time elements will be included in every Beacon and Probe Response frames on all links of the AP MLD from right after the time the AP includes the elements in the Beacon frame it transmits until the intended channel switch time.

(#1754)(#2874)NOTE 3—The term, first AP, is used in this paragraph to differentiate this AP with the other APs that are part of the same AP MLD.

(#2295)When a first AP affiliated with an MLD is switching from an initial operating class/channel to a target operating class/channel at a target switch time using channel switch announcement procedure or extended channel switch announcement procedure, then:

* + - * + (#2295)another AP affiliated with the AP MLD shall set the (#1430)Operating Class and Channel Number fields corresponding to the first AP that is reported in the Reduced Neighbor Report element in Beacon and Probe Response frames it transmits (or that the transmitted BSSID in the same multiple BSSID set as the other AP transmits if the other AP corresponds to a nontransmitted BSSID) before the target switch time to the initial operating class/channel,
        + (#2295)another AP affiliated with the AP MLD shall set the (#1431)Operating Class and Channel Number fields corresponding to the first AP that is reported in the Reduced Neighbor Report element in Beacon and Probe Response frames it transmits (or that the transmitted BSSID in the same multiple BSSID set as the other AP transmits if the other AP corresponds to a nontransmitted BSSID) (#3320)at and after the target switch time to the target operating class/channel.

(#1074)If an AP (affected/reported AP) of an AP MLD is switching from an initial operating class/channel to a target operating class/channel at a target switch time using channel switch announcement or extended channel switch announcement procedure and includes a Max Channel Switch Time element in the Beacon and Probe Response frames it sends, and another AP (reporting AP) of the AP MLD receives a (Re)Association Request frame to perform multi-link setup with the AP MLD with the AP (affected/ reported AP) as a requested link, then the other AP (reporting AP) shall include the complete profile for the AP indicating the target operating class/channel and a Max Channel Switch Time element in the per-STA profile corresponding to the AP (affected/reported AP) in the Basic variant Multi-link element included in the (Re)Association Response frame it sends in response to indicate the time at which the AP (affected/ reported AP) will start beaconing, if the (Re)Association Response frame is sent between the last beacon on the initial operating class/channel and the first beacon on the target operating class/channel. Otherwise, the other AP (reporting AP) shall not include a Max Channel Switch Time element or (Extended) Channel Switch Announcement element in (Re)Association Response frames.

(#1074)When an AP (affected/reported AP) of an AP MLD has announced quiet intervals using Quiet element and optionally Quiet Channel element, and another AP (reporting AP) of the same AP MLD receives a (Re)Association Request frame to perform multi-link setup with the AP MLD with the AP (affected/reported AP) as a requested link, then the other AP (reporting AP) shall include the corresponding Quiet element and Quiet Channel element (if present) in the per-STA profile corresponding to the AP (affected/reported AP) in the Basic variant Multi-link element included in the (Re)Association Response frame it sends in response. Otherwise, the other AP (reporting AP) shall not include a Quiet element and Quiet Channel element in (Re)Association Response frames.

For the example shown in [Figure 35-7 (Example of an AP carrying a Quiet element to signal channel](#bookmark27) [quieting on another link (#1073))](#bookmark27), AP 1 and AP 2 are two APs affiliated with an AP MLD that operate on Link 1 and Link 2, respectively. The Beacon frame transmitted by AP 1 includes a Quiet element to indicate a scheduled quiet interval on Link 1 (the affected link). From this point onward and until the quiet interval begins on Link 1, AP 2, which operates on Link 2 (the reporting link), includes a Quiet element in the Per- STA Profile subelement corresponding to AP 1 in the Basic variant Multi-Link element carried in its Beacon frames. Although not shown in the figure, Quiet element will also be included in the Per-STA Profile subelement of the Basic variant Multi-Link element corresponding to AP 1 carried in the Probe Response frames transmitted by AP 2. The values of the Quiet Count field, Quiet Offset field, and the Quiet Duration field of the Quiet element carried on Link 2 are set by AP 2 with reference to Link 1. As the value of the Beacon Interval for AP 2 is greater than the value of beacon interval for AP 1, the Quiet Count field of the Quiet element is decremented at a faster rate (i.e., 2 in this example) in every subsequent beacon transmitted by AP1. In [Figure 35-7 (Example of an AP carrying a Quiet element to signal channel quieting on another](#bookmark27) [link (#1073))](#bookmark27), a STA affiliated with a non-AP MLD, which is capable of operating on Link 2, transmits a (Re-)Association Request frame to AP 2, in order to perform multi-link setup. The multi-link setup includes Link 1 as one of the links. Since the (Re)Association Response frame is transmitted by AP 2 after the quiet

interval has started on Link 1, AP 2 includes the Quiet element in the per-STA profile corresponding to AP 1 in the (Re)Association Response frame it transmits. The value of the Quiet Count field of the Quiet element carried in the (Re )Association Response frame is set to 129 to indicate that the quiet interval on Link 1 started in the beacon interval that occurred 2 TBTTs in the past on Link 1.

**Figure 35-7—Example of an AP carrying a Quiet element to signal channel quieting on another link (#1073)**

For the example shown in [Figure 35-8 (Example of an AP carrying a Channel Switch Announcement](#bookmark28) [element to signal channel switching on another link (#1073))](#bookmark28), AP 1 and AP 2 are two APs affiliated with an AP MLD that operate on Link 1 and Link 2, respectively. The Beacon frame transmitted by AP 1 includes a Channel Switch Announcement element to indicate that the channel on Link 1 (the affected link) will be switched. From this point onward and until the channel on Link 1 switches, AP 2, which operates on Link 2 (the reporting link), includes a Channel Switch Announcement element in the per-STA profile corresponding to AP 1 in the Basic variant Multi-Link element carried in the Beacon frame it transmits. When AP 1 begins to include the Channel Switch Announcement element in its Beacon frames, the Change Sequence subfield in the TBTT Information field corresponding to AP 1 in the Reduced Neighbor Report element carried in AP 2’s Beacon frames is incremented by 1. The values of the Channel Switch Count field of the Channel Switch Announcement element carried on Link 2 are set by AP 2 with reference to Link 1. As the value of the beacon interval for AP 2 is twice the value of beacon interval for AP 1, the Channel Switch Count field of the Channel Switch Announcement element is decremented by 2 in every subsequent beacon transmitted by AP 1. If AP 1 carries the Extended Channel Switch Announcement element and the Max Channel Switch Time element in the Beacon frame its transmits, AP 2 also includes the Extended Channel Switch Announcement element and the Max Channel Switch Time element in the per-STA profile corresponding to AP 1 in the Basic variant Multi-Link element in the Beacon frames it transmits. Although not shown in the figure, the Channel Switch Announcement element, Extended Channel Switch Announcement element (if included by AP 1), and Max Channel Switch Time element (if included by AP 1) will also be included in the Per-STA Profile subelement of the Basic variant Multi-Link element corresponding to AP 1 carried in the Probe Response frames transmitted by AP 2. In [Figure 35-8 (Example](#bookmark28) [of an AP carrying a Channel Switch Announcement element to signal channel switching on another link](#bookmark28) [(#1073))](#bookmark28), a STA affiliated with a non-AP MLD, that operates on Link 2, transmits a (Re)Association Request frame to AP 2 requesting Link 1 as one of the links for multi-link setup. Since the (Re)Association Response frame is transmitted by AP 2 after the last Beacon frame on the initial operating class/channel on Link 1 and before the first beacon on the initial operating class/channel is transmitted, AP 2 includes the Max Channel Switch Time element in the per-STA profile corresponding to AP 1 in the (Re)Association Response frame it transmits. The value carried in Max Channel Switch Time element provides an estimate

of time until the first TBTT on the new channel on Link 1. The STA affiliated with the non-AP MLD operating on Link 1 does not transmit a frame until it hears the first Beacon frame from AP 1 on Link 1.

**Figure 35-8—Example of an AP carrying a Channel Switch Announcement element to signal channel switching on another link (#1073)**

# Multi-link power management

# General

Each STA of a non-AP MLD that is operating on an enabled link shall maintain its own power management mode and power states as defined in 11.2 (Power management) and 10.47 (Target wake time (TWT)). Frame exchanges on an enabled link are possible when the STA of the non-AP MLD operating on that link is in the awake state (see 11.2.3 (Power management in a non-DMG infrastructure network))(#3255).

(#2325)[Figure 35-9 (Each STA affiliated with a non-AP MLD maintains its own power state(#2325))](#bookmark29) illustrates the power save operation for each STA affiliated with a non-AP MLD during multi-link operation. As depicted in the figure, during the initial portion of the illustration, both STAs affiliated with the non-AP MLD are in active mode and involved in frame exchange. At some point in time, STA 2 affiliated with non- AP MLD operating on link 2 signals to AP 2 that it has entered power save mode (i.e., PM = 1) and transitions to doze state. It remains in doze state for the rest of the illustration. A little later, STA 1 enters power save mode (i.e., signals PM = 1). While operating in this mode, it signals awake state to AP 1 by transmitting a frame (such as PS-Poll frame) on link 1. STA 1 participates in frame exchange with AP 1 while in awake state.

**Figure 35-9—Each STA affiliated with a non-AP MLD maintains its own power state(#2325)**

# Basic BSS operation

(#1167)A non-AP MLD shall be able to perform basic operations (such as receiving a traffic indication, time synchronization, receiving BSS parameter updates) by monitoring Beacon frames on one or more enabled link. This is in addition to mechanisms such as individual TWT agreement(#2601). With these mechanisms, a non-AP MLD can receive basic information about the AP MLD and one or more APs of the AP MLD on a single link while the other STA(s) of the non-AP MLD are in doze state.

(#1695)(#3031)(#1168)(#2252)(#3032)An AP MLD shall assign a single AID to a non-AP MLD during multi-link setup (see [35.3.11.4 (Traffic indication)](#bookmark30)) and the traffic indication for the non-AP MLD shall be consistent across the Beacon frames transmitted by the APs affiliated with the AP MLD, that are operating on the links that are part of the multi-link setup.

(#1695)(#3031)(#2295)NOTE—Each AP affiliated with an MLD provides a critical updates indication when there is an update to the BSS parameters for another AP affiliated with the AP MLD (see [35.3.9 (BSS parameter critical update](#bookmark24) [procedure)](#bookmark24)).

# MLD max idle period management

(#1027)(#1818)(#1696)(#3203)(#2295)During multi-link setup, if the AP affiliated with an MLD includes a BSS Max Idle Period element in the (Re)Association Response frame, then the value carried in the Max Idle Period field is applied at the MLD level. The AP MLD shall use this timeout value for making disassociation decisions. An AP MLD may provide different BSS Max Idle Period values for different non-AP MLDs.

(#3321)(#1635)At least one STA affiliated with a non-AP MLD may send at least one keepalive frame (such as Data frame, PS-Poll frame, or Management frame) per BSS Max Idle Period if the non-AP MLD wants to avoid getting disassociated from the AP MLD due to nonreceipt of frames. A keepalive frame shall be protected or unprotected as indicated in the Idle Options subfield.

(#3203)A non-AP MLD is considered inactive if the AP MLD has not received a Data frame, PS-Poll frame, or Management frame (protected or unprotected as specified in this paragraph) or a frame exchange sequence initiated by the non-AP MLD on any setup link for a time period greater than or equal to the time specified by the Max Idle Period subfield of the BSS Max Idle Period element. If the Idle Options subfield of the BSS Max Idle Period element requires protected keepalive frames, (#2090)(#1108)then the AP MLD may disassociate the non-AP MLD if no protected frames are received from any STA of the non-AP MLD for a duration of BSS Max Idle Period. If the Idle Options subfield allows unprotected or protected keepalive frames, (#2090)(#1108)then the AP MLD may disassociate the non-AP MLD if no protected or unprotected frames are received from any STA of the non-AP MLD for a duration of BSS Max Idle Period.

(#2090)(#1108)NOTE—The AP MLD can disassociate or deauthenticate the non-AP MLD at any time for other reasons even if the non-AP MLD satisfies the keepalive frame transmission requirements.

# Traffic indication

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

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

An AP MLD may recommend a non-AP MLD to use one or more enabled links to retrieve individually addressed buffered BU(s)(#3256)(#3322). The AP’s indication may be carried in a broadcast or a unicast frame(#1697)(#2153).

(#2302)An AP MLD shall buffer a BU with a TID at the AP MLD if the TID is not mapped to any link on which the corresponding STA of a non-AP MLD is in active mode, and it shall set the bit in the partial virtual bitmap of the TIM element that corresponds to the AID of the non-AP MLD to 1.

TPC Request and Link Measurement Request frames are Measurement MMPDUs.

(#2302)An AP MLD buffers an MMPDU that is not a Measurement MMPDU and intended for receipt by a STA affiliated with a non-AP MLD in the AP MLD when all STAs affiliated with the non-AP MLD are in power save mode. In this case, the bit in the partial virtual bitmap of the TIM element that corresponds to the AID of the non-AP MLD shall be set to 1.

(#1432)(#1697)(#2136)(#2153)(#2341)(#2342)(#3149)An AP affiliated with an AP MLD shall include the Multi-Link Traffic element (see 9.4.2.295e (Multi-Link Traffic element(#2341))) in a Beacon frame it transmits if at least one of the associated non-AP MLD has successfully negotiated a TID-to-link mapping (see [35.3.6.1.3 (Negotiation of TID-to-link mapping)](#bookmark20)) with the AP MLD and the AP MLD has buffered BU(s) for the non-AP MLD. The Multi-Link Traffic element includes Per-Link Traffic Indication Bitmap subfield(s) that corresponds to the AID(s) of the non-AP MLD(s), starting from the bit number *k* of the traffic indication virtual bitmap, in the Per-Link Traffic Indication Bitmap List field. The AID Offset subfield of the Multi-Link Traffic Control field of the Multi-Link Traffic element contains the value *k*. The order of the Per-Link Traffic Indication Bitmap subfield(s) follows the order of the bits that are set to 1 in the Partial Virtual Bitmap subfield of the TIM element that corresponds to the AID(s) of the non-AP MLD(s). If a non-AP MLD has successfully negotiated a TID-to-link mapping with an AP MLD with a nondefault mapping, the bit position *i* of the Per-Link Traffic Indication Bitmap subfield that corresponds to the link with the link ID equals to *i* on which a STA of the non-AP MLD is operating shall be set to 1 if the AP MLD has buffered BU(s) with TID(s) that are mapped to that link or MMPDU(s) for that non-AP MLD, otherwise the bit shall be set to 0. If a non-AP MLD is in the default mapping mode (see [35.3.6.1.2 (Default mapping](#bookmark19) [mode)](#bookmark19)), the bit position *i* of the Per-Link Traffic Indication Bitmap subfield that corresponds to the link with the link ID equal to *i* on which a STA affiliated with the non-AP MLD is operating may be set to 1 to indicate to the non-AP MLD a link on which buffered BU(s) should be retrieved. An example of the construction of the Multi-Link Traffic element is shown in [Figure 35-10 (Example of Multi-Link Traffic](#bookmark31) [element construction)](#bookmark31).

**Figure 35-10—Example of Multi-Link Traffic element construction**

When a non-AP MLD that is in the default mapping mode (see [35.3.6.1.2 (Default mapping mode)](#bookmark19)) detects that the bit corresponding to its AID is 1 in the TIM element, any STA affiliated with the non-AP MLD may issue a PS-Poll frame, or a U-APSD trigger frame if the STA is using U-APSD and all ACs are delivery enabled, to retrieve buffered BU(s) in the AP MLD.

When a non-AP MLD that is in the default mapping mode (see [35.3.6.1.2 (Default mapping mode)](#bookmark19)) detects that the bit corresponding to its AID is 1 in the TIM element and the Multi-Link Traffic element is present in a Beacon frame, any STA affiliated with the non-AP MLD that operates on the link(s) indicated in the Multi- Link Traffic element should issue a PS-Poll frame, or a U-APSD trigger frame if the STA is using U-APSD and all ACs are delivery enabled, to retrieve buffered BU(s) in the AP MLD.

When a non-AP MLD that has successfully negotiated TID-to-link mapping (see [35.3.6.1.3 (Negotiation of](#bookmark20) [TID-to-link mapping)](#bookmark20)) detects that the bit corresponding to its AID is equal to 1 in the TIM element and any bit of the Per-Link Traffic Indication Bitmap subfield that corresponds to a link on which a STA affiliated with the non-AP MLD is operating is equal to 1 in the Multi-Link Traffic element, the STA affiliated with the non-AP MLD that operates on that link may issue a PS-Poll frame, or a U-APSD trigger frame if the STA is using U-APSD and all ACs are delivery enabled, to retrieve buffered BU(s) from the AP MLD.

When an AP affiliated with an AP MLD receives a PS-Poll frame or a U-APSD trigger frame from a STA affiliated with an associated non-AP MLD that is in power save mode, it shall transmit buffered BU(s) to the STA, if one is available and not discarded for implementation dependent reasons, otherwise it may transmit a QoS Null frame.

If a buffered BU is an MMPDU that is intended for one STA affiliated with a non-AP MLD and that is not a Measurement MMPDU, and if it is transmitted on a link where another STA affiliated with the same non-AP MLD is operating on, following the procedure above, the frame shall carry information to determine the intended destination STA affiliated with the non-AP MLD.

# WNM sleep mode in multi-link operation

An MLD that implements WNM sleep mode shall indicate its capability by setting the WNM Sleep Mode field to 1 in the Extended Capabilities element that is transmitted by its affiliated STAs.

A STA affiliated with a non-AP MLD may transmit a WNM Sleep Mode Request frame (see

9.6.13.19 (WNM Sleep Mode Request frame format)) to an AP affiliated with an AP MLD that has indicated support for WNM sleep mode capability.

(#2295)All STAs affiliated with an MLD shall advertise the same WNM Sleep Mode capability.

(#2295)An AP affiliated with an MLD shall send a WNM Sleep Mode Response frame in response to a WNM Sleep Mode Request frame received from a STA of a non-AP MLD. An AP affiliated with an MLD may send this frame without solicitation upon the AP MLD’s deletion of all traffic filter sets established according to the traffic filtering agreement between the AP MLD and the non-AP MLD (see 9.6.13.20 (WNM Sleep Mode Response frame format)).

The WNM sleep state is maintained at the MLD level and WNM sleep mode procedures defined in 11.2.3 (Power management in a non-DMG infrastructure network) and 11.2.3.16 (WNM sleep mode) are performed at the MLD level and apply to all the STAs affiliated with the MLD.

# 35.3.11.6 Operation for MLD listen interval

During multi-link (re)setup, the value carried in Listen Interval field in the (Re)Association Request frame sent by a non-AP STA affiliated with a non-AP MLD to an AP affiliated with an AP MLD is requested at the MLD level. The AP affiliated AP MLD may reject the multi-link setup because the listen interval requested

by the non-AP MLD is too large. After successful multi-link (re)setup, the AP MLD shall use the listen interval in determining the lifetime of frames that it buffers for the non-AP MLD.

The AP MLD may delete buffered BUs for the implementation dependent reasons (subject to 11.2.3.10 (AP and AP MLD aging function)), including the use of an aging function and availability of buffers where the aging function is based on the listen interval indicated by the non-AP MLD in its (Re)Association Request frame or the WNM sleep interval specified by the non-AP MLD in the WNM Sleep Mode Request frame.

If all STAs operating on enabled links and affiliated with the non-AP MLD that is associated with the multi- link (re)setup are in power save mode, at least one of these STAs shall wake up to receive at least one Beacon frame scheduled for transmission within the interval of duration equal to the listen interval indicated by the non-AP MLD in its (Re)Association Request frame, starting from the last TBTT for which another STA or the same STA affiliated with the MLD was awake.

An example of operation for MLD listen interval is shown in [Figure 35-11 (Example of operation for MLD](#bookmark32) [listen interval)](#bookmark32).

**Figure 35-11—Example of operation for MLD listen interval**

In this example, AP MLD has three affiliated APs: AP 1 operates on link 1, AP 2 operates on link 2, and AP 3 operates on link 3. The beacon intervals of link 1, link 2, and link 3 are 300 ms, 200 ms, and 70 ms, respectively. Non-AP STA 1 affiliated with the non-AP MLD sends an Association Request frame to AP 1 affiliated with the AP MLD. The non-AP STA 1 requests three links to be setup (link 1 between AP 1 and non-AP STA 1, link 2 between AP 2 and non-AP STA 2, and link 3 between AP 3 and non-AP STA 3) and set the value of Listen Interval field carried in the Association Request frame to 1. Therefore, the listen interval requested by the non-AP MLD is 300 ms. AP 1 affiliated with the AP MLD accepts the three links for this multi-link setup (link 1 between AP 1 and non-AP STA 1, link 2 between AP 2 and non-AP STA 2, and link 3 between AP 3 and non-AP STA 3) by sending an Association Response frame to non-AP STA 1 affiliated with the non-AP MLD. After the successful multi-link setup, non-AP STA 1, non-AP STA 2, and non-AP STA 3 enter in power save mode. In this case, the AP MLD shall buffer the DL BUs to the non-AP MLD at least for 300 ms. At T1, the non-AP STA 1 receives a Beacon frame on link 1, then a non-AP STA

affiliated the non-AP MLD is required to wake up to receive at least one Beacon frame before T2 where T2 = T1 + 300 ms, for example, the non-STA 1 receives the second Beacon frame on link 1 (at T1 + 300 ms), or the non-AP STA 2 receives the second Beacon frame on link 2 (at T1 + 200 ms), or the non-AP STA 3 receives the fourth Beacon frame on link 3 (at T1 + 280 ms). The figure was simplified to show the first Beacon frames on all links as aligned. In real deployment, the first TBTTs on all links may not be aligned.

Another example of operation for MLD listen interval is shown in [Figure 35-12 (Another example of](#bookmark33) [operation for MLD listen interval)](#bookmark33).

**Figure 35-12—Another example of operation for MLD listen interval**

In this example, AP MLD has three affiliated APs: AP 1 operates on link 1, AP 2 operates on link 2, and AP 3 operates on link 3. The beacon intervals of link 1, link 2, and link 3 are 300 ms, 200 ms, and 70 ms, respectively. Non-AP STA 1 affiliated with the non-AP MLD sends an Association Request frame to AP 1 affiliated with the AP MLD. The non-AP STA 1 requests three links to be setup (link 1 between AP 1 and non-AP STA 1, link 2 between AP 2 and non-AP STA 2, and link 3 between AP 3 and non-AP STA 3) and sets the value of Listen Interval field carried in the Association Request frame to 1. AP 1 affiliated with the AP MLD accepts the two links for this multi-link setup (link 2 between AP 2 and non-AP STA 2, and link 3 between AP 3 and non-AP STA 3) by sending an Association Response frame to non-AP STA 1 affiliated with the non-AP MLD, the listen interval requested by the non-AP MLD is still 300 ms and it is not changed along with the accepted links in the multi-link setup procedure. After the successful multi-link setup, non- AP STA 2 and non-AP STA 3 enter in power save mode. In this case, the AP MLD shall buffer the DL BUs to the non-AP MLD at least for 300 ms. At T1, the non-AP STA 2 receives a Beacon frame on link 2, then either non-AP STA 2 or non-AP STA 3 is required to wake up to receive at least one Beacon frame before T2 where T2 = T1 + 300 ms, for example, the non-AP STA 2 receives the second Beacon frame on link 2 (which occurs at T1 + 200 ms in this example) or the non-AP STA 3 receives the fourth Beacon frame on link 3 (which occurs at T1 + 280 ms). The figure was simplified to show the first Beacon frames on all links as aligned. In real deployment, the first TBTTs on all links may not be aligned.

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

An MLD may deliver individually addressed QoS Data frames belonging to a TID without block ack negotiation to an associated MLD on the setup links subject to additional constraints in [35.3.6 (Link](#bookmark16) [management)](#bookmark16).

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

An MLD shall follow the rules as described in 10.3.2.14.3 (Receiver requirements) to discard duplicate individually addressed QoS Data frames belonging to a TID without block ack negotiation that are delivered from the associated MLD.

(#2328)An MLD shall maintain a transmit MSDU timer for each MSDU passed to the MAC. The transmit MSDU timer shall be started when the MSDU is passed to the MAC. STAs affiliated with an MLD shall have the same dot11EDCATableMSDULifetime.

(#2328)An MLD shall continue to deliver the failed individually addressed QoS Data frame belonging to a TID without block ack negotiation to an associated MLD on the setup links subject to additional constraints (see [35.3.6 (Link management)](#bookmark16)) until any of the following conditions occur:

1. The retry limit is met.
2. The transmit MSDU timer for the MSDU exceeds dot11EDCATableMSDULifetime.
3. The individually addressed QoS Data frame is successfully delivered.

(#1174)A STA affiliated with the MLD shall not transmit other individually addressed QoS Data frames belonging to the TID without block ack negotiation to another STA affiliated with the associated MLD while the current individually addressed QoS Data frame belonging to the TID without block ack negotiation has not yet completed to the point of success, retry fail, or other MAC discard (e.g., lifetime expiration).

# Multi-link device individually addressed Management frame delivery(#2496)

The following individually addressed Management frames are excluded from the rules defined in this subclause.

* + - * CSI frame
      * Noncompressed Beamforming frame
      * Compressed Beamforming frame
      * VHT Compressed Beamforming frame
      * HE Compressed Beamforming/CQI frame
      * EHT Compressed Beamforming/CQI frame
      * Probe Response frame
      * LMR frame
      * FTM frame

An MLD with dot11QMFActivated equal to false shall follow the rules described in 10.3.2.14.2 (Transmitter requirements) to determine the sequence number of an individually addressed Management frame (except the frames that are excluded above) that is delivered to the associated MLD.

An MLD with dot11QMFActivated equal to false shall follow the rules as described in 10.3.2.14.3 (Receiver requirements) to discard duplicate individually addressed Management frames (except the frames that are excluded above) that are delivered from the associated MLD.

An MLD with dot11QMFActivated equal to false shall maintain a transmit MMPDU timer for each MMPDU (except the frames that are excluded above). The transmit MMPDU timer shall be started when the MMPDU is passed to the MAC.

An MLD with dot11QMFActivated equal to false shall continue to deliver the failed individually addressed Management frame (except the frames that are excluded above) to an associated MLD on the setup links subject to additional constraints (see [35.3.6 (Link management)](#bookmark16))) until any of the following conditions occur:

* + - * The retry limit is met.
      * The transmit MMPDU timer for the MMPDU exceeds dot11EDCATableMSDULifetime.
      * The individually addressed Management frame is successfully delivered.

A STA affiliated with the MLD with dot11QMFActivated equal to false shall not transmit other individually addressed Management frames (except the frames that are excluded above) to another STA affiliated with the associated MLD while the current individually addressed Management frame (except the frames that are excluded above) has not yet completed to the point of success, retry fail, or other MAC discard (e.g., lifetime expiration).

# Multi-link group addressed frame delivery and reception

# Group addressed frame delivery

Each AP affiliated with an AP MLD shall schedule for transmission buffered group addressed frames immediately after every DTIM beacon except that a TWT scheduling AP affiliated with that AP MLD shall schedule for transmission the buffered group addressed frames during the broadcast TWT SPs located within the beacon interval during which the DTIM Beacon frame is transmitted (see 26.8.3.2 (Rules for TWT scheduling AP)).

Each AP affiliated with an AP MLD shall schedule:

* + - * + the transmission of the buffered group addressed Management frames independently from the transmission of buffered group addressed Management frames of other AP(s) affiliated with the same AP MLD.
        + the transmission of the buffered group addressed data frames that are expected to be received by a non-AP MLD in all the links setup with the non-AP MLD.

If an AP affiliated with an AP MLD is not part of a multiple BSSID set or the AP corresponds to a transmitted BSSID in a multiple BSSID set, then the AP shall indicate if each of the other AP(s) in the same AP MLD has buffered group addressed frames by using a bit in the Partial Virtual Bitmap field of the TIM element after the last bit corresponding to a nontransmitted BSSID (if any) (maximum possible number of BSSIDs – 1) which is in the same multiple BSSID as the AP.

* + - * + The indication is in the DTIM beacon sent by the AP and is based on the latest information about the other APs that the AP has when the AP schedules the DTIM beacon.
        + These bits in the Partial Virtual Bitmap field of the TIM element for the other AP(s) in the same AP MLD shall be contiguous.

NOTE—The AP indicates the presence of its buffered group addressed frames following 11.2.3.6 (AP operation).

If an AP affiliated with an AP MLD is a nontransmitted BSSID in a multiple BSSID set, then the AP that corresponds to the transmitted BSSID in the same multiple BSSID set shall indicate if each of the other AP(s) in the same AP MLD as the nontrasnmitted BSSID has buffered group addressed frames by using a bit in the Partial Virtual Bitmap field of the TIM element after the last bit corresponding to the nontransmitted BSSID (if any) (maximum possible number of BSSIDs – 1) which is in the same multiple BSSID as the AP.

* + - * + The indication is in the DTIM beacon corresponding to that nontransmitted BSSID sent by the transmitted BSSID of the same multiple BSSID set as the nontransmitted BSSID and is based on the latest information about the other APs of the AP MLD that the transmitted BSSID has when it schedules the DTIM beacon.
        + These bits in the Partial Virtual Bitmap field of the TIM element for the other AP(s) in the same AP MLD shall be contiguous.

# Group addressed frame reception

A non-AP STA affiliated with a non-AP MLD shall follow the item (e) defined in 11.2.3.7 (Receive operation for STAs in PS mode) to receive the group addressed BUs sent by the AP affiliated with the associated AP MLD on the corresponding link.

If an indication of buffered group addressed frames in the TIM element about an AP in an AP MLD is received by any STA affiliated with a non-AP MLD, the STA affiliated with the non-AP MLD that is associated with the AP and that stays awake to receive group addressed BUs shall elect to receive all group addressed frames that are scheduled for delivery in that link.

# Multi-link channel access

# General

An STA, which is affiliated with an MLD, is allowed to contend for the WM on its link independently from the other STA(s) affiliated with the same MLD, unless explicitly stated otherwise in the subclause below.

# Simultaneous transmit and receive (STR) operation

(#1215)(#1433)(#2748)When a pair of links on which an MLD operates is an STR link pair, a STA that is affiliated with the MLD and that is operating on a link in that STR link pair shall access the WM on that link by following the rules defined in 10.3 (DCF) and 10.23.2 (HCF contention based channel access (EDCA)) regardless of any activity occurring on the other link within that STR link pair, except as specified in

* + - * [(Nonsimultaneous transmit and receive (NSTR) operation)](#bookmark36).

(#1698)(#1794)All pairs of links where an AP MLD that is not an NSTR soft AP MLD operates shall be STR link pairs.

(#1699)(#1794)(#1083)A non-AP MLD shall announce whether each pair of links where the MLD operates is the STR link pair or the NSTR link pair if there exists at least on NSTR link pair as defined in [35.3.15.4](#bookmark37) [(Capability signaling)](#bookmark37).

(#2138)(#2553)(#1175)[Figure 35-13 (Channel access of two MLDs over an STR link pair(#2553)(#1175))](#bookmark35) shows an example of an AP MLD and a non-AP MLD that are operating over an STR link pair and that are contending for access to the WM and subsequent frame exchanges between two MLDs on those links. After the AP MLD has set up link 1 and link 2 with the non-AP MLD and the links are enabled, then AP 2 may

receive data frames from STA 2 on link 2, while AP 1 contends for the WM and then transmits data frames to STA 1 on link 1.

**Figure 35-13—Channel access of two MLDs over an STR link pair(#2553)(#1175)**

# Nonsimultaneous transmit and receive (NSTR) operation

(#1700)(#1701)A pair of links that is not indicated as an NSTR pair is an STR pair.

(#2100)(#2101)(#3147)An AP of an MLD that has gained the right to initiate transmission of a frame of an AC on a link through the rules for EDCA backoff in 10.23.2.4 (Obtaining an EDCA TXOP) may elect to not transmit any frame from the transmission queue for that AC due to expected NSTR based interference at the intended recipient and lack of availability of an alternative frame in the queue that would not cause such interference.

A non-AP STA of an MLD that has gained the right to initiate transmission of a frame of an AC on a link through the rules for EDCA backoff in 10.23.2.4 (Obtaining an EDCA TXOP) may elect to not transmit any frame from the transmission queue for that AC due to expected NSTR based interference at another STA within the MLD and lack of availability of an alternative frame in the queue that would not cause such interference.

An AP or non-AP STA that gains a TXOP through 10.23.2.4 (Obtaining an EDCA TXOP) for an AC but does not transmit any frame from the queue for that AC for the reasons stated above may:

1. perform an NSTR deferral for the EDCAF associated with that AC by invoking backoff per item h) of 10.23.2.2 (EDCA backoff procedure)
2. consider the TX queue for that AC as empty until any frame exists in the queue which the transmitter determines will not cause an unacceptable level of NSTR interference, at which time the queue is considered to have become nonempty and the procedure described in item a) of 10.23.2.2 (EDCA backoff procedure) is followed if the medium is busy as described in item a), otherwise, transmission proceeds immediately as per 10.23.2.4 (Obtaining an EDCA TXOP).

An AP MLD should not transmit a frame that solicits an immediate response to a STA that is affiliated with 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 immediate response is expected to overlap in time with group addressed MPDUs scheduled in another link of any of those NSTR link pairs and the non-AP MLD is expected to be receiving those group addressed MPDUs.

If a STA that is affiliated with a non-AP MLD successfully obtains a TXOP on one link of one of its NSTR link pairs before the TBTT of the other link of the NSTR link pair, then it should end its TXOP before the TBTT of the other link if it intends to receive Beacon frames on the other link.

NOTE—The STA might not do so if it is not aware of the TSF of the other link.

# Capability signaling

(#2139)(#1465)(#1796)An AP MLD shall set the Maximum Number Of Simultaneous Links subfield value to be greater than or equal to that of the number of per-STA profiles included in the Basic variant Multi-Link element in transmitted (Re)Association Response frames.

(#2139)(#1465)(#1796)A single radio non-AP MLD shall set the Maximum Number Of Simultaneous Links subfield in the Basic variant Multi-Link element to 0 in transmitted (Re)Association Request frames.

(#2139)(#1465)(#1796)A multi-radio non-AP MLD shall set the Maximum Number Of Simultaneous Links subfield in the Basic variant Multi-Link element to a value equal to or larger than 1 in transmitted (Re)Association Request frames.

A multi-radio non-AP MLD shall announce each pair of links formed by links that requested for multi-link setup is STR or NSTR in transmitted (Re)Association Request frame(#1466)(#1656).

NOTE 1—If an MLD supports transmission on link 1 concurrent with reception on link 2, but cannot support transmission on link 2 concurrent with reception on link 1, this pair of links is NSTR.

(#1078)(#1475)(#2981)An MLD shall set the MLD Capabilities Present subfield in the Multi-Link Control field of the Basic variant Multi-Link element to 1 when carried in a (Re)Association Request frame or (Re)Association Response frame.

An MLD shall set the MLD Capabilities Present subfield in the Multi-Link Control field of the Basic variant Multi-Link element to 0 when carried in an Authentication frame.

An MLD shall set the NSTR Link Pair Present subfield value to 1 in a STA Control field that corresponds to link ID *i* (where 0  *i*  15 ) only if it is a multi-radio MLD and contains at least one NSTR link pair formed by the link with link ID *i*; otherwise it shall set the subfield value to 0. An AP MLD that is not an NSTR soft AP MLD shall set the NSTR Link Pair Present subfield value in each STA Control field to 0.

An MLD shall set to 0 every bit in the NSTR Indication Bitmap subfield that corresponds to a link pair where one of the STAs in the link pair operates in the 2.4 GHz band and the other STA operates in the 5 GHz or 6 GHz band.

A non-AP MLD may set the Frequency Separation For STR subfield to a nonzero value if it intends to indicate the minimum frequency separation that is recommended between two links for the non-AP MLD to be able to perform STR operation; otherwise the non-AP MLD shall set the Frequency Separation For STR subfield to 0.

An AP MLD might take into account the information provided by associated non-AP MLDs in the Frequency Separation For STR subfield in their transmitted Multi-Link elements when the AP MLD intends to set up BSSs or switch the BSS operating channel of one or more of the setup links with those non-AP MLDs.

NOTE 2—The non-AP MLD ensures that the minimum frequency separation indicated in the Frequency Separation For STR subfield starts from the frequency edge of the maximum supported bandwidth indicated in the EHT Capabilities element of each link.

The ability of a non-AP MLD to perform STR on a pair of setup links may change after multi-link setup. The non-AP MLD may use a Management frame on any enabled link to inform the AP MLD about the ability change to perform STR.

NOTE 3—The ability might change due to an AP switching BSS operating channels of one or more of the setup links with the non-AP MLD.

If dot11EHTBaselineFeaturesImplementedOnly equals to true,

1. An NSTR soft AP MLD shall set the Maximum Number Of Simultaneous Links subfield in the Basic variant Multi-Link element to a value equals to 1.
2. (#1035)An NSTR soft AP MLD shall set the NSTR Link Pair Present subfield value to 1 in a STA Control field that corresponds to link ID *i,* where 0  *i*  15 .

# PPDU end time alignment

In this subclause “simultaneously transmit” means more than one PPDU is transmitted on more than one link, where each PPDU is transmitted over one link, and those transmissions overlap in time. Likewise, “simultaneously trigger” means more than one HE or EHT TB PPDU is triggered on more than one link, where each PPDU is triggered over one link, and those transmissions overlap in time. If a NSTR MLD that is receiving a PPDU on a first link simultaneously transmits another PPDU on a second link, then the NSTR MLD might fail to receive the PPDU on the first link because of the interference caused by its transmission on the second link. This subclause specifies a mechanism to align the end time of PPDUs that are simultaneously transmitted to the same NSTR non-AP MLD, which helps reduce the chances of the occurrence of such self-interference among STAs affiliated to the same NSTR MLD.

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

* + - * + 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.

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

When an AP MLD is required to align the end time of simultaneously transmitted PPDUs, it shall satisfy the following conditions:

* + - * + The AP MLD shall ensure that the difference between the end times of simultaneously transmitted PPDUs is less than or equal to 8 μs (see NOTE 2), where the end time of the PPDU is the time of the end of the last OFDM symbol or the time of the end of the packet extension if present, whichever is later.
        + The AP MLD shall ensure that the end time of one or more PPDUs that carries a frame soliciting an immediate response frame is at most 4 μs (see NOTE 3) earlier than the end time of any of PPDUs containing a Trigger frame with the CS Required subfield set to 1.

NOTE 2—The difference between the end times of transmitting PPDUs needs to be less than SIFS minus a timing margin, so that the response PPDU to any of the PPDUs transmitted by the AP will not overlap with any of these PPDUs. To balance the implementation complexity at a transmitter side and a receiver side, the timing margin is set to half of SIFS.

NOTE 3—The value of 4 μs is derived from aRxTxTurnaroundTime being equal to 4 μs for the purpose of this requirement.

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

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

* + - * + An AP affiliated to the AP MLD shall not transmit a Trigger frame with the CS Required subfield set to 1 to a STA affiliated to a NSTR non-AP MLD, when at least one PPDU from other STAs affiliated to the same NSTR non-AP MLD is scheduled for transmission before a timer with a value of 12 μs (see NOTE 4) has expired after the PPDU containing the Trigger frame.
        + If the AP MLD allows the frames in the TB PPDUs to solicit control response frames from the AP MLD, then the UL Length subfield values in the soliciting Basic Trigger frames shall be set to the same value.

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

The relationship between the end times of DL PPDUs sent over link 1, link 2, and link 3 between an AP MLD and a STA MLD is shown in [Figure 35-14 (PPDU end time alignment timing relationships)](#bookmark38). An AP in the AP MLD operating on link 1 solicits an HE or EHT TB PPDU requiring the carrier sense from a STA in the STA MLD. In this case the difference between the end time of the soliciting DL PPDU sent on link 1 and the starting time of the first solicited PPDU (in the figure, Ack frame on link 2) that is sent from any STA in the same STA MLD immediately after the soliciting DL PPDU is greater than or equal to 12 μs. Accordingly, the end time of the soliciting PPDU sent on link 2 cannot be more than 4 μs earlier than the end time of the soliciting PPDU sent on link 1. To avoid overlapping in time between any of the DL PPDUs and the response PPDU to any of the DL PPDUs, the difference between the end times of the DL PPDUs on link 2 and link 3 cannot be greater than 8 μs.

**Figure 35-14—PPDU end time alignment timing relationships**

An AP that is affiliated with an AP MLD shall set the SRS Support subfield in the Common Info field of the Basic variant Multi-Link element it transmits to 1 if its dot11SRSOptionImplemented is true; otherwise the AP shall set it to 0.

A non-AP STA shall not transmit a PPDU carrying one or more MPDUs with SRS Control subfield to an AP unless it has received from the AP a Basic variant Multi-Link element with the SRS Support subfield equal to 1.

An AP shall not transmit a PPDU carrying one or more MPDUs with SRS Control subfield to a STA.

NOTE 5—If the received SRS Support subfield from an AP is equal to 0, a non-AP STA might not be able to perform multiple frame transmission in a TXOP over NSTR link pair(s) with the AP, unless the expected duration of solicited PPDU transmitted on NSTR link pair(s) are the same.

When more than one STA that are affiliated with the same NSTR non-AP MLD simultaneously transmit a PPDU to their peer APs that are affiliated with the same AP MLD that sets the SRS Support subfield in the Basic variant Multi-Link element it transmits to 1 solicit a control response frame on more than one link and the NSTR non-AP MLD intends to align the PPDU end time of PPDUs carrying the control response frames from the peer APs, then PPDU soliciting the control response frame shall carry one or more MPDUs with SRS Control subfield. The STA shall set the PPDU Response Duration subfield of the SRS Control subfield to a value that is equal to or longer than the maximum of the expected duration of the response PPDUs on all links, where the expected duration of the response PPDU is calculated based on the following parameters:

* + - * + PPDU format that includes HE SU PPDU, or EHT MU PPDU,
        + Bandwidth that is equal to the bandwidth of the soliciting PPDU,
        + NSS and number of LTFs that are equal to one,
        + GI that is equal to the longest mandatory GI value (3.2 µs),
        + MCS that is selected following the rate selection rules defined in 10.6.6.5 (Rate selection for control response frames), 26.17.1 (Basic HE BSS operation), 26.15.3 (MCS, NSS, BW and DCM selection), and [35.11 (EHT BSS operation)](#bookmark60),
        + A PSDU length that is equal to or greater than the length of a Multi-STA BlockAck frame with the negotiated BlockAck bitmap size(s).

An EHT AP affiliated with an AP MLD that transmits a PPDU in response to a frame containing an SRS Control subfield shall:

* + - * + Have the duration of the PPDU to be equal to the duration that is specified in the PPDU Response Duration subfield of the soliciting SRS Control subfield.
        + Use at least the HE SU PPDU format or the EHT MU PPDU format addressed to a single STA for the PPDU transmission. If the PSDU carried in the response PPDU contains an A-MPDU then the contents of the A-MPDU shall be as defined in Table 9-533 (A-MPDU contents in the control response context).

NOTE 6—If the PPDU carrying the response is an HE SU PPDU or an EHT MU PPDU addressed to one non-AP STA, then the AP might use any type of padding to ensure that the duration of the PPDU is equal to the duration that is specified in the PPDU Response Duration subfield of the soliciting SRS Control subfield.

# Start time sync PPDUs medium access

(#1797)(#3323)(#2142)(#2434)(#2718)(#1772)(#3141)Each STA of an MLD operating on a pair of NSTR

links for that MLD that aligns the start times of the PPDUs scheduled for transmission on more than one link shall ensure that the EDCA rules on each link permit access to the medium on all the links at the time of issuance of the PHY-TXSTART.request for each link.

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

(#3398)(#2435)(#2718)(#1772)A STA of an MLD operating on a link that is part of an NSTR link pair for that MLD shall follow the channel access procedure described below:

1. (#1510)The STA may initiate transmission on a link when the medium is idle as indicated by the physical and virtual CS mechanism and one of the following conditions is met:
   * (#1757)The STA obtained an EDCA TXOP following the procedure in

10.23.2.4 (Obtaining an EDCA TXOP).

* + (#1757)The backoff counter of the STA is already zero, and the STA operating on the other link of NSTR link pair of the affiliated MLD obtains an EDCA TXOP following the procedure in 10.23.2.4 (Obtaining an EDCA TXOP).

1. When the backoff counter of the STA reaches zero, it may choose to not transmit and keep its backoff counter at zero.
2. (#1349)(#1509)If the backoff counter of the STA has already reached zero, it may perform a new backoff procedure following deferral procedures as described in 10.23.2.4 (Obtaining an EDCA TXOP) and 10.3.4.3 (Backoff procedure for DCF). CW[AC] and QSRC[AC] are left unchanged.

(#3399)NOTE 2—A STA with backoff counter that has already reached zero and there is a frame available for transmission performs a new backoff procedure before being allowed to initiate a link following condition a).

(#1501)(#1502)(#1512)(#2211)A STA that chooses not to transmit after the backoff counter reached zero on a link of NSTR link pair may have one or more EDCAF backoff counters with value zero on that link. The

STA that initiates transmission on that link following condition a) or b), and has one or more EDCAF backoff counters that already reached zero shall choose only one implementation specific EDCAF for the transmission.

(#1511)(#3205)A STA with backoff counter that has already reached zero on a link and has a frame available for transmission shall follow channel access procedures described in 10.23.2.4 (Obtaining an EDCA TXOP).

(#2211)(#2741)The STA with backoff counter that has already reached zero and is initiating transmission following condition b) is not mandated to initiate transmission on a slot boundary of the link on which the STA operates. The STA that is initiating transmission following condition b) shall commence the transmission no later than 4 µs following slot boundary of the link on which the other STA whose backoff counter reaches zero operates.

# Medium access recovery procedure

# 35.3.15.7.1 General

A STA affiliated with a non-AP MLD that belongs to a NSTR link pair is considered to have lost medium synchronization (due to UL interference) when the other STA, which is affiliated with the same MLD and belongs to that link pair, transmits a PPDU, except under the following condition:

* + - * + Both STAs ended a transmission at the same time.

A STA that has lost medium synchronization due to transmission by another STA affiliated with the same MLD shall start a MediumSyncDelay timer at the end of that transmission event if that transmission event is longer than aMediumSyncThreshold. The STA may not start the MediumSyncDelay timer if the transmission event is shorter than or equal to aMediumSyncThreshold.

***Editor’s Note: The value of aMediumSyncThreshold needs to be specified.***

The MediumSyncDelay timer is a single timer, shared by all EDCAFs within a non-AP STA, which is initialized to aPPDUMaxTime defined in Table 36-69 (EHT PHY characteristics). The STA shall update its MediumSyncDelay timer with the one contained in the Medium Synchronization field, if present, of the Basic variant Multi-Link element in the most recent frame received from its associated AP MLD. In addition, the timer resets to zero when any of the following events occur:

* + - * + The STA receives a PPDU with a valid MPDU.
        + The STA receives a PPDU whose corresponding RXVECTOR parameter TXOP\_DURATION is not UNSPECIFIED.

A non-AP STA affiliated with non-AP MLD that has a nonzero MediumSyncDelay timer that supports to obtain a TXOP:

* + - * + Shall transmit an RTS frame as the first frame of any attempt to obtain a TXOP.
        + Shall not attempt to initiate more than MSD\_TXOP\_MAX TXOPs.
        + Shall use CCA\_ED threshold that is equal to dot11MSDOFDMEDthreshold.

An AP affiliated with an AP MLD may include the Medium Synchronization Delay Information field in a Basic variant Multi-Link element carried in an Association Response, Beacon, or Probe Response frame. An AP affiliated with an AP MLD shall not include the Medium Synchronization Delay Information field in a Basic variant Multi-Link element carried in an Authentication frame. A STA affiliated with a non-AP MLD shall not include the Medium Synchronization Delay Information field in any Basic variant Multi-Link element it transmits.

A non-AP STA shall initialize dot11MSDOFDMEDthreshold to –72 dBm and MSD\_TXOP\_MAX to 1, respectively. The non-AP STA affiliated with the non-AP MLD shall set MSD\_TXOP\_MAX and dot11MSDOFDMEDthreshold to the most recent values in the Medium Synchronization Maximum Number Of TXOPs and Medium Synchronization OFDM ED Threshold subfields, respectively, if they are present in a Basic variant Multi-Link element received from its associated AP MLD.

NOTE—If either the intra-BSS NAV or the inter-BSS NAV is nonzero in the non-AP STA affiliated with the non-AP MLD when it starts the MediumSyncDelay timer, the non-AP STA does not initiate any TXOP and follow the same rules as an HE STA to respond to any RTS or MU-RTS frame until both NAVs expire.

During the aCCAtime (see 36.3.20.6.3 (CCA sensitivity for occupying the primary 20 MHz channel)) immediately following the end of the transmission event that caused loss of medium synchronization and subsequent initiation of the MediumSyncDelay timer at the non-AP STA, if the received signal strength exceeds the CCA-ED threshold as given by dot11OFDMEDThreshold for the primary 20 MHz channel and no start of a PPDU is detected, the non-AP STA should defer for EIFS beginning when the received signal strength falls below the CCA-ED threshold.

# 35.3.15.7.2 AP assisted medium synchronization recovery procedure

An EHT STA with dot11AAROptionImplemented equals to true shall set the AAR Support subfield in the EHT MAC Capabilities Information field in the EHT Capabilities element it transmits to 1; otherwise the EHT STA shall set the AAR Support subfield to 0.

A non-AP STA with dot11AAROptionImplemented equals to true and affiliated with a non-AP MLD that belongs to a NSTR link pair may transmit the AAR Control subfield in a frame to its associated AP affiliated with an AP MLD, which indicates the link identifier of another AP affiliated with the same AP MLD to solicit the other AP to transmit a Trigger frame to the other non-AP STA affiliated with the same non-AP MLD that belongs to the same NSTR link pair. The non-AP STA shall not transmit a frame containing an AAR Control subfield to its associated AP from which it has not received an EHT Capabilities element with the AAR Support subfield of the EHT MAC Capabilities Information field equal to 1.

The other AP affiliated with the AP MLD should transmit a Trigger frame to the other non-AP STA affiliated with the non-AP MLD to solicit an UL PPDU if the AP MLD supports reception of the AAR Control subfield and the other AP does not have frame exchanges already scheduled with another STA.

A non-AP STA with dot11AAROptionImplemented equals to false shall not transmit a frame containing an AAR Control subfield to its associated AP.

# 35.3.15.8 Multi-link retransmit procedures(#1064)(#2714)(#2598)(#2761)(#3381)

(#2909)If an MLD has a established block ack agreement with another MLD for a TID, and the transmission of a QoS Data frame of the TID on a link is unsuccessful, and if the frame is not a fragment, the MLD may attempt retransmissions of the frame on any link that has the TID mapped to it, subject to the applicable lifetime limit for that frame and subject to any other restrictions that apply to the link where the retransmission is scheduled(#2714)(#2761).

(#3381)If an MLD does not have a block ack agreement with another MLD for a TID, then the frames for that TID with failed transmission attempts are delivered following the rules defined in [35.3.12 (Multi-link](#bookmark34) [device individually addressed data delivery without block ack negotiation)](#bookmark34).

(#2598)NOTE—A retransmitted frame is not encapsulated with a new PN when retransmitted on another link.

# Enhanced multi-link single radio operation

A non-AP MLD may operate in the EMLSR mode on the enabled links between the non-AP MLD and its associated AP MLD(#2332).

(#2143)(#3206)An MLD with dot11EHTEMLSROptionImplemented equal to true shall set the EML Capabilities Present subfield to 1 and shall set the EMLSR Support subfield of the Common Info field of the Basic variant Multi-Link element (9.4.2.295b.2 (Basic variant Multi-Link element)) to 1(#2915); otherwise, the MLD shall set the EMLSR Support subfield to 0.

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

1. 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.
2. The initial Control frame of a frame exchange sequence shall be sent in the OFDM PPDU or non-HT 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. (#1582)Reception of MU-RTS and BSRP Trigger frames is mandatory for a non-AP MLD that is in the EMLSR mode. The number of spatial streams for the response to the BSRP Trigger frame shall be limited to one.
4. (#2916)(#1773)(#3206)The non-AP MLD shall indicate the delay time duration in the EMLSR Delay subfield of the EML Capabilities subfield in the Common Info field of the Basic variant Multi- Link element.
5. The AP MLD shall initiate a frame exchange sequence with the non-AP MLD on one of the enabled links by transmitting an initial Control frame to the non-AP MLD with the limitations specified above.
6. After receiving the initial Control frame of a frame exchange sequence, the non-AP MLD shall be able to transmit or receive frames on the link in which the initial Control frame was received and shall not transmit or receive on the other link(s) until the end of the frame exchange sequence, and subject to its spatial stream capabilities, operation mode, and link switch delay, the non-AP MLD shall be capable of receiving a PPDU that is sent using more than one spatial stream a SIFS after the end of its response frame transmission solicited by the initial Control frame. During the frame exchange sequence, the AP MLD shall not transmit frames to the non-AP MLD on the other link(s). The non-AP MLD switches back to the listening operation on the enabled links immediately after the end of the frame exchange sequence.

(#2346)(#3400)NOTE—A sounding sequence also follows the rules above.

(#2346)(#3400)An example of an EHT non-TB sounding sequence with a single beamformee in the EMLSR operation is shown in [Figure 35-15 (An example of EHT non-TB sounding in the EMLSR operation)](#bookmark40). An example of an EHT TB sounding sequence with a beamformee operating in the EMLSR mode (beamformee 1) and the other beamformees (beaformees 2, …, *n*) not operating in the ELMSR mode is shown in [Figure 35-16 (An example of EHT TB sounding in the EMLSR operation (beamformee 1 is in the EMLSR](#bookmark41) [mode, the other beamformees are not in the EMLSR mode))](#bookmark41). An example of an EHT TB sounding sequence

with beamformees operating in the EMLSR mode is shown in [Figure 35-17 (An example of EHT TB](#bookmark42) [sounding in the EMLSR operation (BSRP is used as the initial Control frame))](#bookmark42).

**Figure 35-15—An example of EHT non-TB sounding in the EMLSR operation**

**Figure 35-16—An example of EHT TB sounding in the EMLSR operation (beamformee 1 is in the EMLSR mode, the other beamformees are not in the EMLSR mode)**

**Figure 35-17—An example of EHT TB sounding in the EMLSR operation (BSRP is used as the initial Control frame)**

# Enhanced multi-link multi-radio operation

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

An MLD with dot11EHTEMLMROptionImplemented equal to true shall set the EML Capabilities Present subfield to 1 and shall set the EMLMR Support subfield of the Common Info field of transmitted Basic variant Multi-Link elements to 1; otherwise, the MLD shall set the EMLMR Support subfield to 0.

A non-AP MLD with dot11EHTEMLMROptionImplemented equal to true shall set the EMLMR Rx NSS subfield of the Common Info field of transmitted Basic variant Multi-Link element to dot11SupportedEMLMRRxNSS and the EMLMR Tx NSS subfield of the Common Info field of transmitted

Basic variant Multi-Link element to dot11SupportedEMLMRTxNSS, which indicate MLD level capabilities.

If a non-AP MLD with dot11EHTEMLMROptionImplemented equal to true intends to switch EMLMR mode after multi-link setup, then a non-AP STA affiliated with the non-AP MLD shall transmit an EML Operating Mode Notification frame with EMLMR Mode subfield equal to 1 or 0 to enable or disable EMLMR mode, respectively.

After successful transmission of the EML Operating Mode Notification frame from the non-AP STA affiliated with the non-AP MLD to an AP affiliated with an AP MLD, the non-AP STA and the AP initialize the transition timeout timer with the Transition Timeout subfield value in the EML Capabilities subfield of the Basic variant Multi-Link element received from the AP. The transition timeout timer begins counting down from the end of the PPDU containing the immediate response to the EML Operating Mode Notification frame. The AP should send an EML Operating Mode Notification frame to the non-AP STA with EML Control field set to the same value as EML Control field in the received EML Operating Mode Notification frame from the non-AP STA before the transition timeout expires.

The non-AP MLD shall transition to the indicated mode immediately after successfully receiving the EML Operating Mode Notification frame from the AP or immediately after the transition timeout timer expires, whichever comes first.

A non-AP MLD with dot11EHTEMLMROptionImplemented equal to true shall indicate the minimum padding duration required for the non-AP MLD for EMLMR link switch in the EMLMR Delay subfield in the Common Info field of transmitted Basic variant Multi-Link elements.

NOTE—The link switching can happen during the transmission time of the initial response frame. However, the duration of initial response frame can be different depending on the initial frame. The non-AP MLD might determine the minimum padding duration such that it can be satisfied even when the shortest initial response frame is used on EMLMR links (e.g., a CTS frame in non-HT PPDU with the highest rate in the BSSBasicRateSet parameters).

When an AP of an AP MLD transmits a PPDU that initiates a frame exchange with a non-AP MLD operating in EMLMR mode, the AP shall ensure that the padding duration of the PPDU is longer than or equal to the minimum padding duration value indicated by the EMLMR Delay field of the Basic variant Multi-Link element received from the non-AP MLD.

When a non-AP MLD operates in the EMLMR mode, after initial frame exchange subject to its per-link spatial stream capabilities and operating mode on one of the EMLMR links, the non-AP MLD shall be able to support the following until the end of the frame exchange sequence initiated by the initial frame exchange:

1. Receive PPDUs with the number of spatial streams up to the value as indicated in the EMLMR Rx NSS subfield of the Common Info field of transmitted Basic variant Multi-Link element at a time on the link for which the initial frame exchange was made.
2. Transmit PPDUs with the number of spatial streams up to the value as indicated in the EMLMR Tx NSS subfield of the Common Info field of transmitted Basic variant Multi-Link element at a time on the link for which the initial frame exchange was made.

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

# NSTR soft AP MLD operation

# General

An NSTR soft AP MLD is an AP MLD which sets dot11SoftAPMLDImplemented to true and has one NSTR pair of links with the following restrictions:

* + - * + Each AP affiliated with a soft AP MLD is not required to support all the EHT AP mandatory features

Support of MU operation is optional for the APs affiliated with a soft AP MLD

Support of two or more spatial streams is optional for the APs affiliated with a soft AP MLD

* + - * + Only one AP of the affiliated APs operating in an NSTR pair of links sends Beacon and Probe Response frames
        + The soft AP MLD is in a mobile device that is typically battery powered
        + Each AP affiliated to a soft AP MLD has different MAC address

An NSTR soft AP MLD shall designate one link of an NSTR link pair as the primary link to transmit Beacon and Probe Response frames. The other link of the NSTR link pair is the nonprimary link.

STAs affiliated with a non-AP MLD that is associated with an NSTR soft AP MLD and APs affiliated with an NSTR soft AP MLD shall follow the procedure defined in [35.3.15.6 (Start time sync PPDUs medium](#bookmark39) [access)](#bookmark39) when intending to transmit in the nonprimary link with the following additional constraints.

* + - * + A STA affiliated with the non-AP MLD may initiate a PPDU transmission to its associated AP affiliated with the NSTR soft AP MLD in the nonprimary link only if the STA affiliated with the same MLD in the primary link is also initiating the PPDU as a TXOP holder with the same start time.
        + An AP affiliated with the NSTR soft AP MLD may initiate a PPDU transmission to its associated non-AP STA in the nonprimary link only if the AP affiliated with the same NSTR soft AP MLD in the primary link is also initiating the PPDU as a TXOP holder with the same start time.

# Multi-link operation in a multiple BSSID set or co-hosted BSSID set

# General

(#1096)(#2275)An AP MLD shall not have more than one affiliated AP amongst APs that are members of the same multiple BSSID set.

(#1095)(#2292)(#2540)An AP MLD shall not have more than one affiliated AP amongst APs that are members of the same co-hosted BSSID set.

(#1819)(#2295)Each AP affiliated with an MLD shall be independently configured to operate a BSS and each AP shall:

* Correspond to a transmitted BSSID or a nontransmitted BSSID in a multiple BSSID set, or
* Belong to a co-hosted BSSID set, or
* Be part of neither a multiple BSSID set nor a co-hosted BSSID set.

NOTE--Annex AA provides some examples of BSS configurations for an AP MLD.

(#3212)An AP corresponding to the transmitted BSSID shall not include a Basic variant Multi-Link element in the Nontransmitted BSSID Profile subelement of a Multiple BSSID element unless the corresponding nontransmitted BSSID is affiliated with an AP MLD.

# Inheritance in the per-STA profile of Basic variant Multi-Link element for an AP in a multiple BSSID set(#3021)(#3212)

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

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

[Figure 35-18 (Example of inheritance in a complete per-STA profile for a multiple BSSID scenario)](#bookmark44) illustrates inheritance when a per-STA profile carries complete information in a Basic variant Multi-Link element that is contained in a nontransmitted BSSID profile of a Multiple BSSID element. The example shows a Management frame transmitted by an AP corresponding to the transmitted BSSID. The Management frame carries several elements with their corresponding element IDs shown in parenthesis. The frame also carries a Multiple BSSID element that includes profile for nontransmitted BSSID N. The nontransmitted BSSID profile contains a Basic variant Multi-Link element carrying complete profile for AP x. The BSSID N is inheriting elements with IDs B, C, and E. Elements with ID D and ID F are specific to BSSID N and appear in its nontransmitted BSSID profile. Further, the BSSID N does not inherit element with ID A and the ID is listed in the Non-Inheritance element. Since the value of element F for BSSID N is not the same as that advertised by the transmitted BSSID, the element is carried in the profile for BSSID N. An element with ID Y is specific to the BSSID N and is included in its profile. AP x inherits elements with IDs D and F directly from the BSSID N and element with ID C indirectly from the transmitted BSSID (via the BSSID N’s inheritance). AP x does not inherit element A (same as nontransmitted BSSID). The elements with IDs B and Y are specific to AP x and appear in its profile. Furthermore, AP x does not inherit element E from the transmitted BSSID and the ID is listed in the Non-Inheritance element present in its profile.

**Figure 35-18—Example of inheritance in a complete per-STA profile for a multiple BSSID scenario**

* 1. **EHT BSS operation**
     1. **EHT BSS 6 GHz operation**

(#2852)A 6 GHz EHT AP may announce to 6 GHz non-EHT non-AP STAs a BSS operating channel width that is different from the BSS operating channel width that it announces to 6 GHz non-AP EHT STAs if the EHT BSS operating channel width includes at least one disallowed 20 MHz channel (see 35.11.2 (Preamble puncturing operation) and/or if the announced EHT BSS operating channel width is not supported by the HE BSS.

A 6 GHz EHT AP shall announce the BSS operating channel width in the HE Operation element with the following restrictions:

* The announced BSS operating channel width in the HE Operation element is the widest channel width that does not overlap with any of the disallowed 20 MHz channels.
* The announced BSS operating channel width in HE Operation element is no more than the BSS operating channel width in the EHT Operation element.