IEEE P802.11
Wireless LANs

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| 11bi D2.0 Some editorial comments in Clause 10 |
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Abstract

This submission resolves the following CIDs:

2025, 2132, 2188, 2210, 2190, 2211, 2191, 2388, 2028, 2402,

2155, 2245, 2069, 2410, 2418, 2419, 2431, 2432, 2434, 2435,

2437

Revisions:

* Rev 0: Initial version of the document.

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 TGbi D2.0 Draft. This introduction is not part of the adopted material.

Editing instructions formatted like this are intended to be copied into the TGbi D2.0 Draft. (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents). TGbi Editor: Editing instructions preceded by “TGbi Editor” are instructions to the TGbi editor to modify existing material in the TGbi draft. As a result of adopting the changes, the TGbi editor will execute the instructions rather than copy them to the TGbi Draft.

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| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 2025 | 10.71.1 | 93.35 | "...mechanisms:" In front of colon need ", as follows:" | In front of colon add ", as follows" | Accepted - |
| 2132 | 10.71.1 | 93.53 | Clarify sentence | Change: "then the AP MLD only permits associating non-AP MLDs that have BPE FA enabled." to "then the AP MLD only permits associations by non-AP MLDs with BPE FA enabled." | Accepted - |
| 2188 | 10.71.1 | 94.39 | Text: "If an AP MLD that has FA mechanisms enabled, then the AP MLD shall advertise" can be better worded as "An AP MLD with FA mechanisms enabled, shall advertise.." | As per comment | Accepted - |
| 2210 | 10.71.1 | 94.46 | To keey consistent, use the word "FA mechanisms" | Change to:The AP MLD allows non-AP STAs and non-AP MLDs that do not have FA mechanisms enabled to associate. FA mechanisms shall not be applied to individually addressed frames transmitted to or received from an associated non-AP STA or an associated non-AP MLD that does not have FA mechanisms enabled. | Accepted - |
| 2190 | 10.71.1 | 94.53 | "NOTE 1--In this case, the AP MLD ignores the BPE Frame Anonymization Supported field of the Extended RSN Capabilities field of the RSNXE element." should indicate the RSNXE of whom. | Change phrase to: "NOTE 1--In this case, the AP MLD ignores the BPE Frame Anonymization Supported field of the Extended RSN Capabilities field of the RSNXE element advertised by the non-AP MLD. | Accepted - |
| 2211 | 10.71.1 | 94.54 | Add to the end of the note "in a frame received from a non-AP MLD", assuming the AP does not ignore the field sent by itself. | As in comment | Revised – Agree in principle.TGbi editor to make the changes shown in this document under all headings that include CID 2190 |
| 2191 | 10.71.1 | 94.61 | Phrase "Only non-AP MLD that advertises that BPE FA mechanisms are enabled may associate with the AP MLD.", may be better worded as "Only non-AP MLDs advertising enablement of BPE FA mechanisms may associate with the AP MLD." | As per comment | Revised – Agree in principle.TGbi editor to make the changes shown in this document under all headings that include CID 2191 |
| 2388 | 10.71.1 | 95.01 | The text at page 95 lines 1 to 8 (advertizing for a non-AP MLD with FA enabled) make more sense immediately following the text at page 95 lines 39-42 (advertizing for an AP MLD with FA enabled) | Move the text currently at page 95 lines 1 to 8, to p94 line 43. | Revised – Agree in principle.TGbi editor to make the changes shown in this document under all headings that include CID 2388 |
| 2028 | 10.71.1 | 95.13 | "NOTE 2--In the remainder of 10.71 (Frame anonymization) the following rules explain how the prefixes for the terms MLD, AP MLD or non-AP MLD are related to the FA mechanisms enabled." Does not read right. | Replace cited text with "NOTE 2--In the remainder of 10.71 (Frame anonymization) the prefixes for the terms MLD, AP MLD or non-AP MLD are related to the FA enabled mechanisms, as follows:" | Revised – Agree in principle.TGbi editor to make the changes shown in this document under all headings that include CID 2028 |
| 2402 | 10.71.3 | 101.59 | Within this section, "non-AP MLD" and "AL MLD" are used without a "CPE" prefix, except for "CPE non-AP MLD" in this sentence. These text should be consisstent. | Replace "CPE non-AP MLD" with "non-AP MLD" | Accepted - |
| 2155 | 10.71.3 | 102.02 | Editorial changes needed | Change "For each EPP epoch of the EPP group, to which a non-AP MLD is assigned" to "For each EPP epoch of an EPP group to which a non-AP MLD is assigned". | Accepted - |
| 2245 | 10.71.3 | 102.07 | Since clause 10.71.2.5 has used q to denote the non-AP MLD Specific Collision Epoch Offset field value, it is better to use the q instead of p in the formula. | As in comment | Revised – Agree in principle.TGbi editor to make the changes shown in this document under all headings that include CID 2245 |
| 2069 | 10.71.3 | 102.12 | EpochInterval is not described | please add description for EpochInterval after "where" | Revised – Agree in principle.TGbi editor to make the changes shown in this document under all headings that include CID 2069 |
| 2410 | 10.71.3 | 103.32 | Regading "The generation of the full48-bit EPP\_STA\_address is defined in 10.71.5.4 (Addressing)." This is correct for the transmitter, but the generation at the receiver is defined in 10.71.6.1 (General) | Replace the identifier text with:"The generation of the full 48-bit EPP\_STA\_address at a transmitter is defined in 10.71.5.4 (Addressing). The generation of the full 48-bit EPP\_STA\_address at a receiver is defined in 10.71.6.1 (General)." | Accepted - |
| 2418 | 10.71.5.2 | 108.13 | Regarding the text "If the AP MLD has BPE enabled":The document typically uses "If the AP MLD has BPE FA mechanisms enabledd". Align with the typical usage. | Replace the identified text with:"If the AP MLD has BPE FA mechanisms enabled" | Accepted - |
| 2419 | 10.71.5.4 | 109.52 | This clause is missing the note at the start of clauses 10.71.5.2, 10.71.5.3 and 10.71.5.5 include references to 10.71.5.1 regarding determining the applicable CPE MHA parameter set and (when relevant) the applicable BPE MHA parameter set. | Insert the following note:"NOTE--The applicable CPE MHA parameter set is determined in 10.71.5.1 (MAC header anonymization parameter set selection). If dot11FrameAnonymizationMechanismsActivated is equal to bpe(2), then the applicable BPE MHA parameter set is determined in 10.71.5.1 (MAC header anonymization parameter set selection). | Accepted - |
| 2431 | 10.71.6.2 | 113.51 | Regarding the text "BPE MHA parameter set selectedfor the frame":Other subclauses of 10.71.6 use the language "applicable BPE MHA parameter set". Align this text with other clauses. | Replace the identified text with:"the applicable BPE MHA parameter set". | Accepted - |
| 2432 | 10.71.6.2 | 113.63 | Regarding the text "10.71.6.4 (Sequence number deanonymization)" which occurs twice in this note:These occurences should refer to 10.71.6.1.4 (MAC header anonymization parameter set selection) | Replace the two occurrences of the identified text in this note with:"10.71.6.1.4 (MAC header anonymization parameter set selection)" | Accepted - |
| 2434 | 10.71.6.4 | 114.43 | Regarding the text "If the AP MLD has BPE enabled":The document typically uses "If the AP MLD has BPE FA mechanisms enabledd". Align with the typical usage. | Replace the identified text with:"If the AP MLD has BPE FA mechanisms enabled" | Accepted - |
| 2435 | 10.71.6.4 | 114.53 | Regarding the text "OSN = (SN + EPP\_SN\_offset) ...":This is an obvious cut and past error which was not corrected to show SN being computed from OSN. | Replace the identified text with:"SN = (OSN - EPP\_SN\_offset) ..." | Accepted - |
| 2437 | 10.71.6.5 | 115.16 | Regarding the text "the BPE MHA parameter setselected for the frame":Other subclauses of 10.71.6 use the language "applicable BPE MHA parameter set". Align this text with other clauses. | Replace the identified text with:"the applicable BPE MHA parameter set". | Accepted - |

***Discussion:***

***Proposal:***

**TGbi Editor: *Instruction: Modify 10.71 as follows***

* Frame anonymization
* General

Frame anonymization (FA) is an optional EPP feature available during an association in which MLO is enabled. The objective of FA is to mitigate the privacy threat posed by values that (when FA is disabled) are (a) assigned to an MLD, (b) remain static or predictable, and (c) transmitted in unencrypted fields and elements. FA encrypts some such values, e.g., transmitting MSDU(s) in an A-MSDU to protect SA and DA. FA transforms other values into “over-the-air” values that remain static or predictable only within configurable periods called EPP Epochs, e.g., using temporary MAC addresses. The over-the-air values can be transmitted in the clear while maintaining anonymity.

FA operations comprise client privacy enhancement frame anonymization (CPE FA) mechanisms and BSS privacy enhancement frame anonymization (BPE FA) mechanisms as follows(#2025):

* The CPE FA mechanisms mitigate detection of a non-AP MLD. The CPE FA mechanisms are the “baseline” FA operations. The CPE FA mechanisms comprise:
* the non-AP MLD and AP MLD agreeing on timing for EPP epochs, as described in 10.71.2 (EPP epoch operation).
* the AP MLD assigning the non-AP MLD a temporary, per-EPP-Epoch AID (see 10.71.7 (Frame anonymization and AID)) that is then used in AID fields and in fields and elements derived from the AID.
* the non-AP MLD and AP MLD applying CPE MAC header anonymization (CPE MHA) to individually addressed frames, as described in 10.71.5 (MAC header anonymization and transmitting functions) and 10.71.6 (MAC header anonymization and receiving functions), using CPE MHA parameter sets established as described in 10.71.3 (Establishing CPE MAC header anonymization parameter sets).
* The BPE FA mechanisms mitigate detection of an AP MLD and its associated non-AP MLDs . If an AP MLD has BPE FA operations enabled, then the AP MLD only permits associations by non-AP MLDs with(#2132) BPE FA enabled. BPE FA is continuously applied by the BPE AP MLD. BPE FA mechanisms include all CPE FA mechanisms, with the additional BPE FA mechanisms comprising:
* the non-AP MLD and AP MLD applying BPE MAC header anonymization (BPE MHA) to individually addressed frames, group addressed frames and Privacy Beacons, as described in in 10.71.5 (MAC header anonymization and transmitting functions) and 10.71.6 (MAC header anonymization and receiving functions), using BPE MHA parameter sets established as described in 10.71.4 (Establishing BPE MAC header anonymization parameter sets).
* Confidentiality of SA and DA (optional for CPE FA and mandatory for BPE FA) is provided by transmitting an MSDU in an A-MSDU, noting that an A-MSDU can contain a single MSDU.

The following list clarifies the scope of attacks that FA mitigates:

* FA mitigates the ability for third parties determining the presence of an MLD across multiple FA epochs.
* FA does not mitigate the ability for third parties determining the presence of an MLD within a single FA epoch.
* FA does not mitigate the ability for third parties determining the presence of an MLD across multiple FA epochs via traffic analysis using known transmission behavior of upper layer protocols for presence monitoring.

Table 10-40a (Advertising FA mechanisms enabled by an MLD) describes the values of the CPE Frame Anonymization Supported field and BPE Frame Anonymization Supported field of the Extended RSN Capabilities field of the RSNXE used to advertise to the FA mechanisms enabled by an MLD.

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| --- |
| * Advertising FA mechanisms enabled by an MLD
 |
| Field of the Extended RSN Capabilities field of the RSNXE | FA is not enabled | CPE FA mechanisms are enabled, BPE FA mechanisms are not enabled | CPE FA mechanisms are enabled, BPE FA mechanisms are enabled |
| CPE Frame Anonymization Supported | 0 | 1 | 1 |
| BPE Frame Anonymization Supported | 0 | 0 | 1 |

Only MLDs may implement FA mechanisms.

An AP MLD with FA mechanisms enabled(#2188) shall advertise the enabled FA mechanisms in Beacon and Probe Response frames using the CPE Frame Anonymization Enabled field and BPE Frame Anonymization Enabled field of the Extended RSN Capabilities field of the RSNXE, using the values specified in Table Table 10-40a (Advertising FA mechanisms enabled by an MLD).

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* (#2388)

If an AP MLD has CPE FA mechanisms enabled and does not have BPE FA mechanisms enabled, then:

* The AP MLD allows non-AP STAs and non-AP MLDs that do not have FA mechanisms(#2210) enabled to associate. FA mechanisms(#2210) shall not be applied to individually addressed frames transmitted to or received from an associated non-AP STA or an associated non-AP MLD that does not have FA mechanisms(#2210) enabled.
* The AP MLD shall apply CPE FA mechanisms to individually addressed frames transmitted to or received from an associated non-AP MLD that advertises that CPE FA mechanisms are enabled.

NOTE 1—In this case, the AP MLD ignores the BPE Frame Anonymization Supported field of the Extended RSN Capabilities field of the RSNXE element advertised by the non-AP MLD.(#2190)

If an AP MLD has BPE FA mechanisms enabled (which implies that CPE FA mechanisms are enabled), then:

* The AP MLD shall apply BPE FA mechanisms to all frames.
* Only non-AP MLD advertising(#2191) that BPE FA mechanisms are enabled may associate with the AP MLD.
* The AP MLD shall apply CPE FA mechanisms to individually addressed frames transmitted to or received from an associated non-AP MLD.
* (#2388)

For all operations described in 10.71 (Frame anonymization), an MLD has CPE FA mechanisms enabled, unless otherwise noted.

NOTE 2—In the remainder of 10.71 (Frame anonymization) the prefixes for the terms MLD, AP MLD or non-AP MLD are related to the FA mechanisms enabled as follows:(#2028)

* If no prefix is present, then CPE FA mechanisms are enabled and BPE FA mechanisms may or may not be enabled.
* If a “BPE” prefix is present, then both CPE FA mechanisms and BPE FA mechanisms are enabled.

An MLD applying CPE FA mechanisms should transmit an MSDU in an A-MSDU.

An MLD applying BPE FA mechanisms shall transmit an MSDU in an A-MSDU.

* Establishing CPE MAC header anonymization parameter sets

This subclause describes how an AP MLD and associated non-AP MLD establish the CPE MHA parameter set for each EPP epoch for the non-AP MLD(#2402). The creation of the BPE MHA parameter sets is described in 10.71.4 (Establishing BPE MAC header anonymization parameter sets).

The non-AP MLD and AP MLD establish the EPP epochs used for frame anonymization as described in 10.71.2 (EPP epoch operation).

For each EPP epoch of an EPP group(#2155) to which a non-AP MLD is assigned, the non-AP MLD and the AP MLD shall generate a CPE\_MHA\_block as:

CPE\_MHA\_block =*KDF*-*Hash*-*Length*( KDK, “CPE\_MHA\_block”,

Seed *+* ((*n* + *q(#2245)*) × EpochInterval)

where

CPE\_MHA\_block is the block of bits that is partitioned into the sets of all possible

 values for each CPE MHA parameter

KDF-*Hash*-*Length* is the key derivation function as defined in 12.7.1.6.2 (Key derivation

 function (KDF)) using the hash algorithm identified by the AKM suite

 selector (see Table 9-190 (AKM suite selectors))

KDK is the Key Derivation Key

*n* is the current number of the EPP epoch in the EPP epoch sequence as

 defined in 10.71.2.4 (EPP Epoch Start Time Computation)

*Length* is the total number of bits to derive. A total of 1728 bits are derived for a

 CPE\_MHA\_block.

*q(#2245)* is the value of the latest exchanged non-AP MLD Specific Collision Epoch

 Offset field if received and if n is greater or equal to colliding epoch number *c*

 (see 10.71.2.5 (OTA MAC address collision avoidance); otherwise, *q(#2245)* equals 0.

Seed is the value of the Group Epoch Seed field of the received EPP Epoch Settings

 field.

EpochInterval is the value in TU corresponding to the Epoch Interval

 field of the EPP Epoch Settings field(#2069)

The non-AP MLD and the AP MLD shall extract the CPE MHA parameters from CPE\_MHA\_block as shown in the following tables:

* Table 10-40b (Extracting EPP\_PN\_offset values from the CPE\_MHA\_block).
* Table 10-40c (Extracting EPP\_STA\_address values from CPE\_MHA\_block).
* Table 10-40d (Extracting EPP\_SN\_offset values for SNS1 and SNS 10 from the CPE\_MHA\_block).
* Table 10-40e (Extracting EPP\_SN\_offset values for SNS3 from the CPE\_MHA\_block).
* Table 10-40f (Extracting EPP\_SN\_offset values for SNS9 from the CPE\_MHA\_block).
* Table 10-40g (Extracting EPP\_SN\_offset values for SNS12 from the CPE\_MHA\_block).

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| * Extracting EPP\_PN\_offset values from the CPE\_MHA\_block
 |
| 48-bit sub-block of the CPE\_MHA\_block | Value |
| 0:47 | EPP\_PN\_offset for frames transmitted by non-AP MLD |
| 48:95 | EPP\_PN\_offset for frames transmitted by AP MLD |
| * Extracting EPP\_STA\_address values from CPE\_MHA\_block
 |
| 48-bit sub-block of the CPE\_MHA\_block | Sub-block Bits [0:45] | Sub-block Bits [46:47] |
| 96:143 | EPP\_STA\_address [0:45] for link ID 0  | Not used |
| 144:191 | EPP\_STA\_address [0:45] for link ID 1  | Not used |
| 192:239 | EPP\_STA\_address [0:45] for Link ID 2  | Not used |
| 240:287 | EPP\_STA\_address [0:45] for link ID 3  | Not used |
| 288:335 | EPP\_STA\_address [0:45] for link ID 4  | Not used |
| 336:383 | EPP\_STA\_address [0:45] for link ID 5  | Not used |
| 384:431 | EPP\_STA\_address [0:45] for link ID 6  | Not used |
| 432:479 | EPP\_STA\_address [0:45] for link ID 7  | Not used |
| 480:527 | EPP\_STA\_address [0:45] for link ID 8  | Not used |
| 528:575 | EPP\_STA\_address [0:45] for link ID 9  | Not used |
| 576:623 | EPP\_STA\_address [0:45] for link ID 10  | Not used |
| 624:671 | EPP\_STA\_address [0:45] for link ID 11  | Not used |
| 672:719 | EPP\_STA\_address [0:45] for link ID 12  | Not used |
| 720:767 | EPP\_STA\_address [0:45] for link ID 13  | Not used |
| 768:815 | EPP\_STA\_address [0:45] for link ID 14  | Not used |

NOTE—Only 46 bits of each EPP\_STA\_address are extracted from the CPE\_MHA\_block. The generation of the full 48-bit EPP\_STA\_address at a transmitter is defined in 10.71.5.4 (Addressing). The generation of the full 48-bit EPP\_STA\_address at a receiver is defined in 10.71.6.1 (General).(#2410)

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| * Extracting EPP\_SN\_offset values for SNS1 and SNS 10 from the CPE\_MHA\_block
 |
| 48-bit sub-block of the CPE\_MHA\_block | Sub-block Bits [0:11] | Sub-block Bits [12:23] | Sub-block Bits [24:35] | Sub-block Bits [36:47] |
| 816:863 | EPP\_SN\_offset value for SNS1 in frames transmitted by non-AP MLD | Not used | EPP\_SN\_offset value for SNS10 in frames transmitted by non-AP MLD | EPP\_SN\_offset value for SNS10 in frames transmitted by AP MLD |
| * Extracting EPP\_SN\_offset values for SNS3 from the CPE\_MHA\_block
 |
| 48-bit sub-block of the CPE\_MHA\_block | Sub-block Bits [0:11] | Sub-block Bits [12:23] | Sub-block Bits [24:35] | Sub-block Bits [36:47] |
| EPP\_SN\_offset values for SNS3 for frames transmitted by the non-AP MLD |
| 864:911 | Value for TID 0 | Value for TID 1 | Value for TID 2 | Value for TID3 |
| 912:959 | Value for TID 4 | Value for TID 5 | Value for TID 6 | Value for TID 7 |
| 960:1007 | Value for TID 8 | Value for TID 9 | Value for TID 10 | Value for TID 11 |
| 1008:1055 | Value for TID 12 | Value for TID 13 | Value for TID 14 | Value for TID 15 |
| EPP\_SN\_offset values for SNS3 for frames transmitted by the AP MLD |
| 1056:1103 | Value for TID 0 | Value for TID 1 | Value for TID 2 | Value for TID3 |
| 1104:1151 | Value for TID 4 | Value for TID 5 | Value for TID 6 | Value for TID 7 |
| 1152:1199 | Value for TID 8 | Value for TID 9 | Value for TID 10 | Value for TID 11 |
| 1200:1247 | Value for TID 12 | Value for TID 13 | Value for TID 14 | Value for TID 15 |
| * Extracting EPP\_SN\_offset values for SNS9 from the CPE\_MHA\_block
 |
| 48-bit sub-block of the CPE\_MHA\_block | Sub-block Bits [0:11] | Sub-block Bits [12:23] | Sub-block Bits [24:35] | Sub-block Bits [36:47] |
| EPP\_SN\_offset values for SNS9 for frames transmitted by the non-AP MLD |
| 1248:1295 | Value for TID 0 | Value for TID 1 | Value for TID 2 | Value for TID3 |
| 1296:1343 | Value for TID 4 | Value for TID 5 | Value for TID 6 | Value for TID 7 |
| 1344:1391 | Value for TID 8 | Value for TID 9 | Value for TID 10 | Value for TID 11 |
| 1392:1439 | Value for TID 12 | Value for TID 13 | Value for TID 14 | Value for TID 15 |
| EPP\_SN\_offset values for SNS9 for frames transmitted by the AP MLD |
| 1440:1487 | Value for TID 0 | Value for TID 1 | Value for TID 2 | Value for TID3 |
| 1488:1535 | Value for TID 4 | Value for TID 5 | Value for TID 6 | Value for TID 7 |
| 1536:1583 | Value for TID 8 | Value for TID 9 | Value for TID 10 | Value for TID 11 |
| 1584:1631 | Value for TID 12 | Value for TID 13 | Value for TID 14 | Value for TID 15 |
| * Extracting EPP\_SN\_offset values for SNS12 from the CPE\_MHA\_block
 |
| 48-bit sub-block of the CPE\_MHA\_block | Sub-block Bits [0:11] | Sub-block Bits [12:23] | Sub-block Bits [24:35] | Sub-block Bits [36:47] |
| 0:9 | 10:11 | 12:21 | 22:23 | 24:33 | 34:35 | 36:45 | 46:47 |
| EPP\_SN\_offset values for SNS12 for frames transmitted by the non-AP MLD |  |
| 1632:1679 | Value for ACI 0 | Not used | Value for ACI 1 | Not used | Value for ACI 2 | Not used | Value for ACI 3 | Not used |
| EPP\_SN\_offset values for SNS12 for frames transmitted by the AP MLD |  |
| 1680:1727 | Value for ACI 0 | Not used | Value for ACI 1 | Not used | Value for ACI 2 | Not used | Value for ACI 3 | Not used |

* Sequence number anonymization

NOTE 1—The sequence number spaces are defined in Table 10-5 (Transmitter sequence number spaces).

NOTE 2—The applicable CPE MHA parameter set is determined in 10.71.5.1 (MAC header anonymization parameter set selection). If the AP MLD has BPE FA mechanisms(#2418) enabled, then the applicable BPE MHA parameter set is determined in 10.71.5.1 (MAC header anonymization parameter set selection).

If the MAC header of the frame includes a Sequence Control field using:

* sequence number space SNS1 when the frame is transmitted by a non-AP MLD, or
* sequence number space SNS3 (Time Priority Management), or
* sequence number space SNS9 (MLD Individually addressed QoS Data frame), or
* sequence number space SNS10 (MLD Individually addressed Management frame),

then the transmitter shall compute an over-the-air SN (OSN) value from the sequence number SN assigned to the MPDU as follows:

 OSN = (SN + EPP\_SN\_offset) mod 212,

where EPP\_SN\_offset is selected from the applicable CPE MAC header anonymization parameter set for the frame, according to the following mechanisms specific to the sequence number space:

* In the case of SNS1 when the frame is transmitted by a non-AP MLD, the transmitter shall select the single defined EPP\_SN\_offset value for SNS1.
* In the case of SNS3, the transmitter shall select an EPP\_SN\_offset value for SNS3 according to the transmitting MLD (non-AP MLD or AP MLD) and the TID.
* In the case of SNS9, the transmitter shall select an EPP\_SN\_offset value for SNS9 according to the transmitting MLD (non-AP MLD or AP MLD) and the TID.
* In the case of SNS10, the transmitter shall select an EPP\_SN\_offset value for SNS10 according to and the transmitting MLD (non-AP MLD or AP MLD).

If the MAC header of the frame includes a Sequence Control field using sequence number space SNS12 (IQMF) ), then the transmitter shall compute an OSN value from the sequence number SN assigned to the MPDU (defined in Figure-9-9 (Sequence Number field format in QMFs)) as follows:

 OSN[10:11] = SN[10:11], and

 OSN[0:9] = (SN[0:9] + EPP\_SN\_offset) mod 210,

where EPP\_SN\_offset is an EPP\_SN\_offset value for SNS12 selected from the applicable CPE MAC header anonymization parameter set for the frame according to the transmitting MLD (non-AP MLD or AP MLD) and the Access Class Index field (SN[10:11]).

If the AP MLD has BPE FA mechanisms enabled, and if the MAC header of a frame transmitted by the AP MLD includes a Sequence Control field using:

* sequence number space SNS1 or
* sequence number space SNS11 (Group addressed data),

then the transmitter shall compute an over-the-air SN (OSN) value from the sequence number SN assigned to the MPDU as follows:

 OSN = (SN + EPP\_SN\_offset) mod 212,

where EPP\_SN\_offset is selected, from the applicable BPE MAC header anonymization parameter set for the frame, according to mechanisms specific to the sequence number space.

* In the case of SNS1, the transmitter shall select the single EPP\_SN\_offset value for SNS1.
* In the case of SNS11, the transmitter shall select an EPP\_SN\_offset value for SNS11 according to the transmitting MLD (non-AP MLD or AP MLD).

The transmitter shall transmit frames over the air using the OSN value in the Sequence Number field of the Sequence Control field (see 9.2.4.4 (Sequence Control field)).

* Addressing

NOTE--The applicable CPE MHA parameter set is determined in 10.71.5.1 (MAC header anonymization parameter set selection). If dot11FrameAnonymizationMechanismsActivated is equal to bpe(2), then the applicable BPE MHA parameter set is determined in 10.71.5.1 (MAC header anonymization parameter set selection).

MLD addressing shall be applied per 35.3.2 (MLD addressing) with the following addressing clarification.

Within the scope of this clause:

* A link-specific EPP\_STA\_address assigned to an affiliated STA on a given link is the MAC address defined as follows:
* The Local/Global bit shall be set to value 1, local address.
* The Individual/Group bit shall be set to value 0, individual address.
* EPP\_STA\_address[0:45] shall be extracted from CPE\_MHA\_block as described in Table 10-40c (Extracting EPP\_STA\_address values from CPE\_MHA\_block), according to the link ID of the link, where the CPE\_MHA\_block is generated for the current EPP epoch.
* If the AP MLD has the BPE FA mechanisms enabled, then a link-specific EPP\_AP\_address assigned to an affiliated STA on a given link is the MAC address defined as follows:
* The Local/Global bit shall be set to value 1, local address.
* The Individual/Group bit shall be set to value 0, individual address.
* EPP\_AP\_address[0:45] shall be extracted from BPE\_MHA\_block as described in Table 10-40i (Extracting EPP\_AP\_address values from the BPE\_MHA\_block), according to the link ID of the link, where the BPE\_MHA\_block is generated for the current EPP epoch.

For individually addressed frames transmitted to or from a non-AP MLD:

* If the frame is transmitted by an AP MLD to the non-AP MLD, then AP MLD shall set the Address 1 field to the link-specific EPP\_STA\_address value.
* If the frame is transmitted by the non-AP MLD to an AP MLD, then non-AP MLD shall set the Address 2 field to the link-specific EPP\_STA\_address value.

If the AP MLD has BPE FA mechanisms enabled, then:

* The AP MLD shall set the Address 2 field to the link-specific EPP\_AP\_address value in all frames transmitted by the AP MLD.
* A non-AP MLD shall set the Address 1 field to the link-specific EPP\_AP\_address value in all frames transmitted by the non-AP MLD to the AP MLD.
* The AP MLD shall set the Address 1 field value of a group addressed frame to:

 OTAGroupAddress = (group address + EPP\_Group\_Anonymization\_Offset) mod 246,

where group address is 46 bits of the group address excluding the local/global and individual/group bits and where EPP\_Group\_Anonymization\_Offset is the single EPP\_Group\_Anonymization\_Offset value obtained from the BPE MHA parameter set, selected for the frame as per 10.71.5.1 (MAC header anonymization parameter set selection).

* Block ack scoreboarding

Block ack scoreboarding shall be applied per 35.3.8 (Block ack procedures in MLO), with the following clarifications:

* The values in the Address 1 field and Address 2 field of the (per-link) Block Ack frame shall be the values in the Address 2 field and Address 1 field (respectively) of MPDUs of the corresponding A-MPDU.
* The (per-link) Block Ack frame shall report the OSN values received in the Sequence Number field of the MPDU header within the MPDUs of the corresponding A-MPDU (rather than reporting the SN values recovered after SN deanonymization).
* Packet number deanonymization

NOTE—The applicable CPE MHA parameter set and applicable BPE MHA parameter set (when the AP MLD enables BPE FA mechanisms) are determined in 10.71.6.1.4 (MAC header anonymization parameter set selection).

For encrypted individually addressed frames, the receiver shall obtain the original PN value (assigned by the transmitter) from the OPN value encoded in the fields PN0, PN1, PN2, PN3, PN4, PN5 of the CCMP header or GCMP header as follows:

 PN = (OPN – EPP\_PN\_offset) mod 248,

where EPP\_PN\_offset is selected from the applicable CPE MHA parameter set for the frame according to the transmitting MLD (non-AP MLD or AP MLD).

If the AP MLD has BPE FA mechanisms enabled, then for encrypted group addressed frames, the receiver shall obtain the PN value from the OPN value encoded in the fields PN0, PN1, PN2, PN3, PN4, PN5 of the CCMP header or GCMP header as follows:

 PN = (OPN – EPP\_Group\_PN\_offset) mod 248,

where EPP\_Group\_PN\_offset is the single EPP\_Group\_PN\_offset in the applicable(#2431) BPE MHA parameter set selected for the frame.

The PN value (nominally the PN value assigned by the transmitter) shall replace the OPN value in subsequent processing of the frame in the receiving MLD.

* Sequence number deanonymization

NOTE 1—The sequence number spaces are defined in Table 10-5 (Transmitter sequence number spaces).

NOTE 2—The applicable CPE MHA parameter set is determined in 10.71.6.1.4 (MAC header anonymization parameter set selection). If the AP MLD has BPE FA mechanisms enabled, then the applicable BPE MHA parameter set is determined in 10.71.6.1.4 (MAC header anonymization parameter set selection).(#2432)

If the MAC header of the frame includes a Sequence Control field using:

* sequence number space SNS1 when the frame is received by an AP MLD, or
* sequence number space SNS3 (Time Priority Management), or
* sequence number space SNS9 (MLD Individually addressed QoS Data frame), or
* sequence number space SNS10 (MLD Individually addressed Management frame),

then the receiver shall compute the SN value from the over-the-air value in the sequence number field, OSN, as follows:

 SN = (OSN – EPP\_SN\_offset) mod 212,

where EPP\_SN\_offset is selected from the applicable CPE MAC header anonymization parameter set for the frame, according to mechanisms specific to the sequence number space.

* In the case of SNS1 when the frame is received by an AP MLD, the receiver shall select the single defined EPP\_SN\_offset value for SNS1.
* In the case of SNS3 and SNS9, the receiver shall select an EPP\_SN\_offset value according to the transmitting MLD (non-AP MLD or AP MLD) and the TID.
* In the case of SNS10, the receiver shall select an EPP\_SN\_offset value for in Table 10-40d (Extracting EPP\_SN\_offset values for SNS1 and SNS 10 from the CPE\_MHA\_block) according to the transmitting MLD (non-AP MLD or AP MLD).

If the MAC header of the frames includes a Sequence Control field using sequence number space SNS12 (IQMF), then the receiver shall compute the original SN value from the over-the-air value in the Sequence Number field, OSN, (defined in Figure 9-9 (Sequence Number field format in QMFs)) as follows:

 SN[10:11] = OSN[10:11], and

 SN[0:9] = (OSN[0:9] - EPP\_SN\_offset) mod 210,

where EPP\_SN\_offset is an EPP\_SN\_offset value for SNS12 selected from the applicable CPE MAC header anonymization parameter set for the frame according to the transmitting MLD (non-AP MLD or AP MLD) and the Access Class Index field (SN[10:11]).

If the AP MLD has BPE FA mechanisms(#2434) enabled, and if the MAC header of a frame received by a non-AP MLD includes a Sequence Control field using:

* sequence number space SNS1 or
* sequence number space SNS11 (Group addressed data),

then the receiver shall compute the SN value from the over-the-air value in the sequence number field, OSN, as follows:

SN = (OSN - EPP\_SN\_offset) mod 212, (#2435)

where EPP\_SN\_offset is selected from the applicable CPE MAC header anonymization parameter set for the frame, according to mechanisms specific to the sequence number space.

* In the case of SNS1, the receiver shall select the single EPP\_SN\_offset value for SNS1.
* In the case of SNS11, the receiver shall select an EPP\_SN\_offset value for SNS11according to the transmitting MLD (non-AP MLD or AP MLD).

The SN value (nominally the SN value assigned by the transmitter) shall replace the OSN value in subsequent processing of the frame in the receiving MLD.

NOTE 3—If BPE FA mechanisms are not enabled, and a frame received by a non-AP MLD includes a Sequence Control field using sequence number space SNS1, then the sequence number is not deanonymized in that frame.

* Timestamp deanonymization

NOTE—If the AP MLD has BPE FA mechanisms enabled, then the applicable BPE MHA parameter set is determined in 10.71.6.1.4 (MAC header anonymization parameter set selection).

For Privacy Beacon frames, the receiver shall recover the original Timestamp value (assigned by the transmitter) from the OTA\_Timestamp value encoded in the Timestamp fields as follows:

 Timestamp = (OTA\_Timestamp - EPP\_Timestamp\_offset) mod 264,

where EPP\_Timestamp\_offset is the single EPP\_Timestamp\_offset value in the applicable(#2437) BPE MHA parameter set selected for the frame.

The Timestamp value (nominally the Timestamp value assigned by the transmitter) shall replace the OTA\_Timestamp value in subsequent processing of the Privacy Beacon frame in the receiving MLD.