



**IEEE Standard for Information Technology—
Telecommunications and Information Exchange between Systems
Local and Metropolitan Area Networks—
Specific Requirements**

Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications

Amendment 4: Enhancements for Positioning

IEEE Computer Society

Developed by the
LAN/MAN Standards Committee

IEEE Std 802.11az™-2022

(Amendment to IEEE Std 802.11™-2020
as amended by IEEE Std 802.11ax™-2021,
IEEE Std 802.11ay™-2021,
IEEE Std 802.11ba™-2021,
and IEEE Std 802.11™-2020/Cor 1-2022)

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Approved 3 December 2022

IEEE SA Standards Board

Abstract: This amendment defines modifications to both the IEEE 802.11 medium access control layer (MAC) and physical layers (PHY). Compared to IEEE Std 802.11™-2020 it enables absolute and relative position estimation with higher accuracy, and reduces wireless medium utilization and power consumption, is scalable to dense deployments, and includes security features.

Keywords: direction measurement, Fine Timing Measurement (FTM), IEEE 802.11™, IEEE 802.11az™, positioning, ranging

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Introduction

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This amendment defines modifications to both the IEEE 802.11 medium access control layer (MAC) and physical layers (PHY). It enables absolute and relative position estimation with higher accuracy executing on the same PHY-type. Further, it reduces existing wireless medium utilization and power consumption, is scalable to dense deployments, and includes security features.

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IEEE Standard for Information Technology— Telecommunications and Information Exchange between Systems Local and Metropolitan Area Networks— Specific Requirements

Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications

Amendment 4: Enhancements for Positioning

(This amendment is based on IEEE Std 802.11™-2020 as amended by IEEE Std 802.11ax™-2021, IEEE Std 802.3ay™-2021, IEEE Std 802.3ba™-2021, and IEEE Std 802.11™-2020/Cor 1-2022.)

NOTE—The editing instructions contained in this amendment define how to merge the material contained therein into the existing base standard and its amendments to form the comprehensive standard.

The editing instructions are shown in ***bold italic***. Four editing instructions are used: change, delete, insert, and replace. ***Change*** is used to make corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using ~~striking through~~ (to remove old material) and underscoring (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make changes in figures or equations by removing the existing figure or equation and replacing it with a new one. Editorial instructions, change markings and this NOTE will not be carried over into future editions because the changes will be incorporated into the base standard.⁶

⁶ Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

1. Overview

1.3 Supplementary information on purpose

Insert the following item at the end of the dashed list in 1.3:

- Defines mechanisms for the determination of absolute and relative position with secure measurement and measurement results exchange.

3. Definitions, acronyms, and abbreviations

3.2 Definitions specific to IEEE Std 802.11

Insert new definitions into 3.2 in alphabetical order as follows:

enhanced directional multi-gigabit (EDMG) secure ranging physical layer (PHY) protocol data unit (PPDU): An EDMG single user (SU) PPDU that contains secure training (TRN) subfields in the training (TRN) field to enable secure ranging with physical layer (PHY) level security.

HE-LTF repetitions: Multiple transmissions of HE-LTF symbols in an HE Ranging NDP or HE TB Ranging NDP, where an HE-LTF repetition value of 1 indicates no repetitions, and, for example, a value of 2 or 3 would indicate twice or three times as many HE-LTF symbols, respectively.

LMR frame: A Location Measurement Report frame.

non-TB ranging: A ranging measurement procedure that uses NDP, and is not initiated by a Ranging Trigger frame.

Null-SAC-HE-LTF: An HE-LTF present in an initiating STA (ISTA) to a responding STA (RSTA) null data PPDU (NDP), or RSTA to ISTA NDP in the ranging frame exchange, resulting from a mismatch of sequence authentication code (SAC) subfield in the STA Info field of a Ranging NDP Announcement frame, or the SAC subfield in the Trigger Dependent User Info field in the Ranging Secure Sounding Trigger frame, with either the value of the Validation SAC subfield in the Secure HE-LTF Parameters element in the last transmitted FTM frame, or the last transmitted Location Measurement Report frame to the ISTA, or is equal to 0. The TXVECTOR LTF_KEY and LTF_IV parameter corresponding to this LTF are set to generate any secure HE-LTF or null.

PASN Authentication frame: Authentication frame used in preassociation security negotiation.

Passive Sounding Ranging Trigger frame: A Ranging Trigger frame of Passive Sounding subvariant.

Poll Ranging Trigger frame: A Ranging Trigger frame of Poll subvariant.

preassociation security negotiation (PASN): A mechanism to establish security association and allow management frame protection prior to association.

preassociation security negotiation station (STA): A STA that implements preassociation security negotiation (PASN).

Report Ranging Trigger frame: A Ranging Trigger frame of Report subvariant.

robust Action No Ack frame: An Action No Ack frame with a category value specified in 9.4.1.11 (Table 9-51) of IEEE Std 802.11 with Yes in the Robust column.

Secure Sounding Ranging Trigger frame: A Ranging Trigger frame of Secure Sounding subvariant.

Sounding Ranging Trigger frame: A Ranging Trigger frame of Sounding subvariant.

unassociated range negotiation and measurement management frame protection required (URNM-MFPR): A security policy that specifies whether ranging frames are required to be protected without association.

unassociated range negotiation and measurement management frame protection required exempt 20 MHz (URNM-MFPR-X20): A security policy that specifies whether ranging frames are required to be protected without association if bandwidth greater than 20 MHz is used.

3.4 Acronyms and abbreviations

Insert new abbreviations into 3.4 in alphabetical order as follows:

FPBT	first path beamforming training
FTM	fine timing measurement
FTMR	fine timing measurement request
I2R	ISTA to RSTA
IFTM	initial fine timing measurement
IFTMR	initial fine timing measurement request
ISTA	initiating STA
LMR	Location Measurement Report
PSTA	passive STA
PSTOA	phase shift time of arrival
R2I	RSTA to ISTA
RSTA	responding STA
RSID	ranging session Identifier
SAC	sequence authentication code

Please note that instances of “initial fine timing measurement request” will be changed to “IFTMR” as appropriate in the next revision of IEEE Std 802.11.

Please note that instances of “fine timing measurement” will be changed to “FTM” as appropriate in the next revision of IEEE Std 802.11.

4. General description

4.3 Components of the IEEE 802.11 architecture

4.3.19 Wireless network management

Change the title and content of 4.3.19.19 as follows:

4.3.19.19 Fine timing measurement (FTM)

The Fine timing measurement FTM procedure allows a STA to accurately measure the round trip time (RTT) between it and another STA. If used with multiple peer STAs, the STA can track changes in its relative position with those peer STAs. If the absolute position of the peer STAs is known, then the STA can determine its absolute position. With the regular transfer of Fine Timing Measurement frames it is possible for the recipient STA to track changes in its relative location with other STAs in the environment. A STA executes the FTM procedure with multiple peers and uses the resulting relative location estimates along with the absolute position of each of the peers to determine its position in geospatial coordinates.

The STA can also estimate the direction of the transmission (angle of departure) of frames transmitted to and reception (angle of arrival) of frames received from a peer STA, allowing for estimating position using measurements obtained from frame exchanges with a single peer.

An FTM session is negotiated to determine range estimates by executing one of the measurement exchanges listed below:

- EDCA based exchange of FTM frames where location estimates are based on time of departure and time of arrival of the exchanged FTM frames and their corresponding acknowledgments. When the negotiated FTM session is over EDMG, security parameters can be negotiated to ensure that the measurement exchange is executed with the intended peer.
- Trigger-based (TB) measurement where location estimates are based on the execution of the trigger-based measurement exchange. This mode of operation allows for the execution of the measurement exchange between a responding STA (RSTA) and multiple initiating STAs (ISTAs) at the same time. Optionally, the TB measurement session can be negotiated to enable security parameters enabling mechanisms to ensure that the measurement exchange is executed with the intended peer.
- Non-Trigger-based (non-TB) measurement where location estimates are based on the execution of the non-TB measurement exchange. Optionally, the non-TB measurement session can be negotiated to enable security parameters enabling mechanisms to ensure that the measurement exchange is executed with the intended peer.
- A passive trigger-based (TB) Ranging measurement exchange is defined where a STA can determine its location based on periodic measurement reports from other STAs that execute the passive TB ranging measurement exchange amongst themselves.

The preassociation security negotiation protocol establishes a PTKSA for the exchange of protected frames without association, for example for establishing a secure FTM session and performing the corresponding secure measurement exchange between two unassociated peers.

4.5 Overview of the services

4.5.4 Access control and data confidentiality services

4.5.4.2 Authentication

Change the third and fourth paragraphs of 4.5.4.2 as follows:

IEEE Std 802.11-2020 defines ~~five-six~~ IEEE 802.11 authentication methods: Open System authentication, Shared Key authentication, FT authentication, (IEEE Std 802.11-2020) simultaneous authentication of equals (SAE), and FILS authentication (IEEE Std 802.11-2020) and preassociation security negotiation (PASN) authentication. Open System authentication admits any STA to the DS. Shared Key authentication relies on WEP to demonstrate knowledge of a WEP encryption key. FT authentication relies on keys derived during the initial mobility domain association to authenticate the stations as defined in Clause 13. SAE authentication uses finite field cryptography to prove knowledge of a shared password. FILS authentication allows for faster connection to the network for FILS non-AP STAs by providing authentication, association, and key confirmation information in an efficient number of frame exchanges (see 4.10.3.6). PASN authentication allows for the protection of Management frames without association by establishing a PTKSA using authentication frames. The IEEE 802.11 authentication mechanism also allows definition of new authentication methods, or any combination of these authentication methods.

An RSNA might support one or more of the following authentication methods: SAE authentication, FILS authentication, or both PASN authentication. An RSNA also supports authentication based on IEEE Std 802.1X-2010, or preshared keys (PSKs) after Open System authentication. IEEE 802.1X authentication utilizes the EAP to authenticate STAs and the AS with one another. This standard does not specify an EAP method that is mandatory to implement. See 12.6.5 for a description of the IEEE 802.1X authentication and PSK usage within an IEEE 802.11 IBSS.

Insert a new paragraph at the end of 4.5.4.2 as follows:

PASN authentication is used in an RSN for an infrastructure BSS when it is based on a PMKSA established by another RSN authentication protocol. Otherwise, it does not guarantee mutual authentication, and can be used as a non-RSN protocol in an infrastructure BSS.

6. Layer management

6.3 MLME SAP interface

6.3.5 Authenticate

6.3.5.2 MLME-AUTHENTICATE.request

6.3.5.2.2 Semantics of the service primitive

Change the text of 6.3.5.2.2 as follows:

The primitive parameters are as follows:

```
MLME-AUTHENTICATE.request(  
    PeerSTAAddress,  
    AuthenticationType,  
    AuthenticateFailureTimeout,  
    Content of FT Authentication elements,  
    Content of SAE Authentication frame,  
    Multi-band local,  
    Multi-band peer,  
    Content of FILS Authentication frame,  
    Content of PASN Authentication frame,  
    VendorSpecificInfo  
)
```

Insert a new row above the row for “VendorSpecificInfo” in the unnumbered table in 6.3.5.2.2 as follows (unchanged rows not shown):

Name	Type	Valid range	Description
...			
Content of PASN Authentication frame	Sequence of elements and fields	As defined in 12.13.3.2, 9.4.2.24, 9.4.2.241, 9.4.2.187, 9.4.2.303, 9.4.2.48	The set of elements and fields to be included in PASN Authentication frames. Present if AuthenticationType indicates PASN authentication and dot11PASNActivated is true, otherwise not present.
...			

6.3.5.3 MLME-AUTHENTICATE.confirm

6.3.5.3.2 Semantics of the service primitive

Change the text of 6.3.5.3.2 as follows:

The primitive parameters are as follows:

```
MLME-AUTHENTICATE.confirm(  
    PeerSTAAddress,  
    AuthenticationType,  
    ResultCode,  
    Content of FT Authentication elements,  
    Content of SAE Authentication frame,  
    Multi-band local,
```

Multi-band peer,
Content of FILS Authentication frame,
Content of PASN Authentication frame,
VendorSpecificInfo
)

Change the row for “AuthenticationType” and insert a new row above the row for “VendorSpecificInfo” in the unnumbered table in 6.3.5.3.2 as follows (unchanged rows not shown):

Name	Type	Valid range	Description
...			
AuthenticationType	Enumeration	OPEN_SYSTEM, SHARED_KEY FAST_BSS_TRANSITION, SAE, FILS_SHARED KEY_WITHOUT_PFS, FILS_SHARED_KEY_WI TH_PFS, FILS_PUBLIC_KEY_ PASN	Specifies the type of authentication algorithm that was used during the authentication process. This value matches the AuthenticationType parameter specified in the corresponding MLME-AUTHENTICATE.request primitive.
...			
Content of PASN Authentication frame	Sequence of elements and fields	As defined in 12.13.3.2, 9.4.2.241, 9.4.2.24, 9.4.2.187, 9.4.2.303, 9.4.2.48	The set of elements and fields to be included in PASN Authentication frames. Present if AuthenticationType indicates PASN authentication and dot11PASNActivated is true, otherwise not present.
...			

6.3.5.4 MLME-AUTHENTICATE.indication

6.3.5.4.2 Semantics of the service primitive

Change the text of 6.3.5.4.2 as follows:

The primitive parameters are as follows:

MLME-AUTHENTICATE.indication(
PeerSTAAddress,
AuthenticationType,
Content of FT Authentication elements,
Content of SAE Authentication frame,
Multi-band local,
Multi-band peer,
Content of FILS Authentication frame,
Content of PASN Authentication frame,
VendorSpecificInfo
)

Change the row for “AuthenticationType” and insert a new row above the row for “VendorSpecificInfo” in the unnumbered table in 6.3.5.4.2 as follows (unchanged rows not shown):

Name	Type	Valid range	Description
...			
AuthenticationType	Enumeration	OPEN_SYSTEM, SHARED_KEY, FAST_BSS_TRANSITION, SAE, FILS_SHARED_KEY_WITHOUT_PFS, FILS_SHARED_KEY_WITH_PFS, FILS_PUBLIC_KEY_PASN	Specifies the type of authentication algorithm that was used during the authentication process. <u>This value matches the AuthenticationType parameter specified in the corresponding MLME-AUTHENTICATE.request primitive.</u>
...			
Content of PASN Authentication frame	Sequence of elements and fields	As defined in 12.13.3.2, 9.4.2.24, 9.4.2.241, 9.4.2.187, 9.4.2.303, 9.4.2.48	The set of elements and fields to be included in PASN Authentication frames. Present if AuthenticationType indicates PASN authentication and dot11PASNAutivated is true, otherwise not present.
...			

6.3.5.5 MLME-AUTHENTICATE.response

6.3.5.5.2 Semantics of the service primitive

Change the text of 6.3.5.5.2 as follows:

The primitive parameters are as follows:

```
MLME-AUTHENTICATE.response(
    PeerSTAAddress,
    ResultCode,
    Content of FT Authentication elements,
    Content of SAE Authentication frame,
    Multi-band local,
    Multi-band peer,
    Content of FILS Authentication frame,
    Content of PASN Authentication frame,
    VendorSpecificInfo
)
```

Insert a new row above the row for “VendorSpecificInfo” in the unnumbered table in 6.3.5.5.2 as follows (unchanged rows not shown):

Name	Type	Valid range	Description
...			
Content of PASN Authentication frame	Sequence of elements and fields	As defined in 12.13.3.2, 9.4.2.24, 9.4.2.187, 9.4.2.303, 9.4.2.48	The set of elements and fields to be included in PASN Authentication frames. Present if AuthenticationType indicates PASN authentication and dot11PASNAutivated is true, otherwise not present.
...			

6.3.56 Fine timing measurement (FTM)

6.3.56.1 General

Change the first paragraph of 6.3.56.1 as follows:

The following set of primitives supports ~~triggering an FTM procedure or stopping an ongoing FTM procedure, and the exchange of FTM information from one SME to another, between two SMEs.~~ The informative diagram in Figure 6-17 depicts shows the use of these primitives and various points in time that are of interest to the FTM procedure.

Change the title of Figure 6-17 as follows:

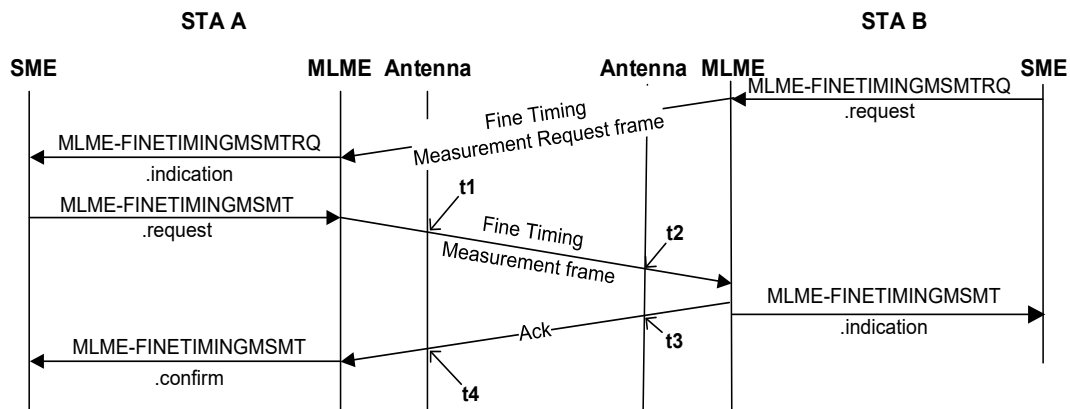


Figure 6-17—~~Fine timing measurement FTM primitives and timestamps capture for EDCA based ranging measurement exchange~~

Insert a new paragraph followed by Figure 6-17a, Figure 6-17b, and Figure 6-17c in 6.3.56.1 after Figure 6-17 as follows:

The structure of the FTM protocol and its relationship with the SME and MLME interface is shown in the three figures below: Figure 6-17a—FTM primitives and timestamps reporting capture for non-TB ranging measurement exchange; Figure 6-17b—FTM primitives and timestamps reporting capture for TB ranging measurement exchange; Figure 6-17c—FTM primitives and timestamps reporting capture for passive TB ranging measurement exchange.

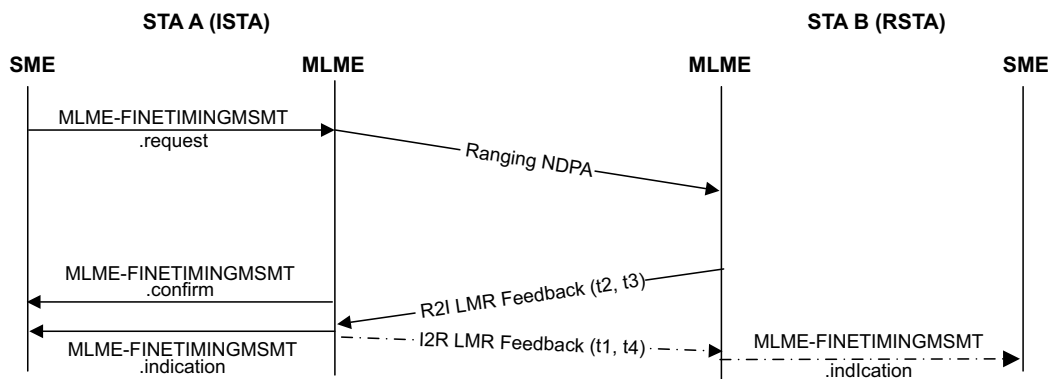


Figure 6-17a—FTM primitives and timestamps reporting capture for non-TB ranging measurement exchange

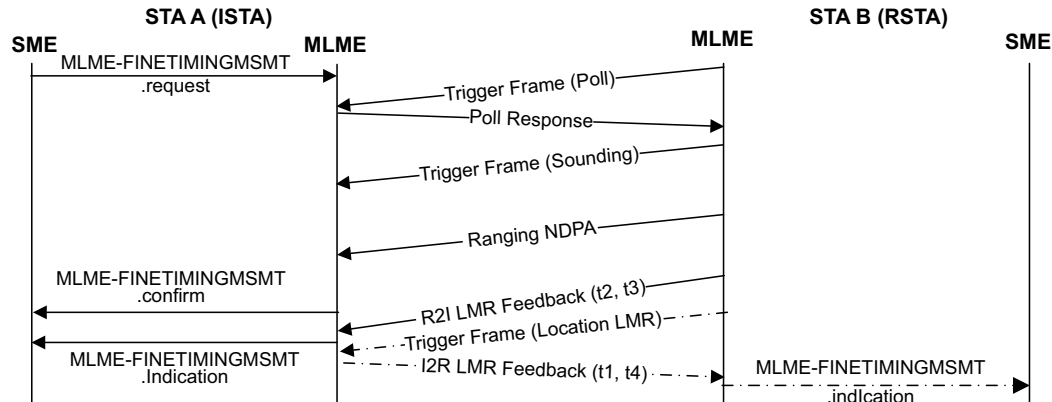


Figure 6-17b—FTM primitives and timestamps reporting capture for TB ranging measurement exchange

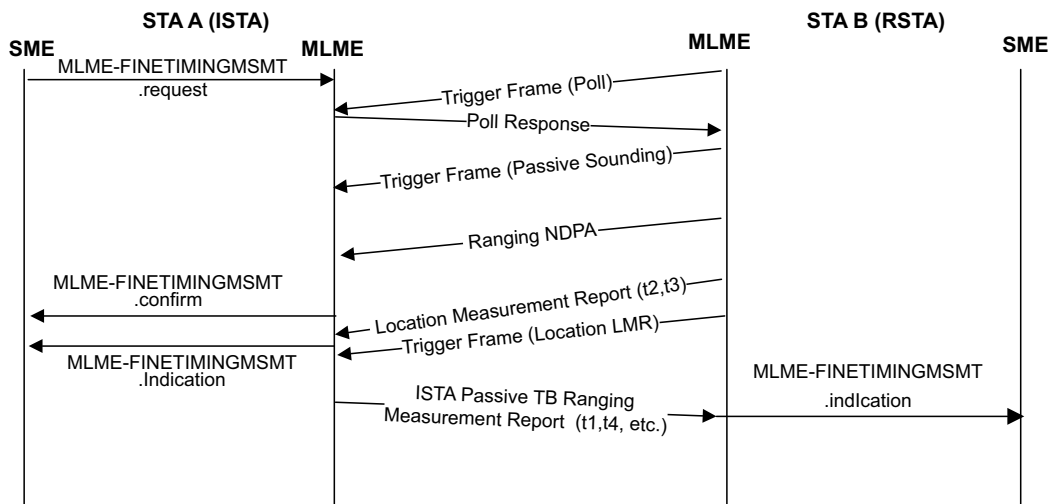


Figure 6-17c—FTM primitives and timestamps reporting capture for passive TB ranging measurement exchange

Change NOTE 1, NOTE 2, and NOTE 3 in 6.3.56.1 as follows:

NOTE 1—In Figure 6-17, t_1 and t_3 correspond to the point in time at which the start of the preamble for the transmitted frame appears at the transmit antenna connector. In Figure 6-17a, Figure 6-17b, and Figure 6-17c, t_1 and t_3 correspond to the point in time at which the transmitted HE TB Ranging NDP and/or HE Ranging NDP appears at the transmit antenna connector. The points where the timestamps are captured are therefore not shown for the non-TB, TB, and passive TB measurement exchanges. An implementation may capture a timestamp during the transmit processing earlier or later than the point at which it actually occurs and offset the value to compensate for the time difference.

NOTE 2—In Figure 6-17, t_2 and t_4 correspond to the point in time at which the start of the preamble for the incoming frame arrives at the receive antenna connector. In Figure 6-17a, Figure 6-17b, and Figure 6-17c, t_2 and t_4 correspond to the point in time at which the incoming HE TB Ranging NDP and/or HE Ranging NDP arrives at the receive antenna connector. The points where the timestamps are captured are therefore not shown for the non-TB and TB measurement exchanges. Because time is needed to detect the frame or the relevant LTF in the preamble and synchronize with its logical structure, an implementation determines when the start of the preamble or the relevant LTF in the preamble for the incoming frame arrived at the receive antenna connector by capturing a timestamp some time after it occurred and compensating for the delay by subtracting an offset from the captured value.

NOTE 3—In the MLME-FINETIMINGMSMT.request primitive corresponding to the message exchange described in Figure 6-17, the t1, Max t1 Error Exponent, t4, and Max t4 Error Exponent parameters are set to the values in the prior MLME-FINETIMINGMSMT.confirm primitive for that Peer MAC Address and with a Dialog Token parameter equal to the Follow Up Dialog Token parameter in the request, or 0 if there was none. In the MLME-FINETIMINGMSMT.confirm primitive the t1, Max t1 Error Exponent, t4, and Max t4 Error Exponent parameters are set to the values determined for the ~~Fine Timing Measurement FTM~~ frame and its acknowledgment. This primitive is not issued if no acknowledgment is received in response to the transmitted FTM frame (see Figure 6-17) or if the corresponding non-TB mode (see Figure 6-17a), or the TB mode (see Figure 6-17b), or the passive TB mode (see Figure 6-17c) Sounding Exchange did not complete. In the MLME-FINETIMINGMSMT.indication primitive the t1, Max t1 Error Exponent, t4, and Max t4 Error Exponent parameters are set to the values in the ~~Fine Timing Measurement FTM~~ frame and the t2, Max t2 Error Exponent, t3, and Max t3 Error Exponent parameters are set to the values determined for the ~~Fine Timing Measurement FTM~~ frame and its acknowledgment, Figure 6-17; or to the values in the corresponding LMR frame; see Figure 6-17a and Figure 6-17b. For passive TB ranging, the reported timestamps and parameters in the MLMEFINETIMINGMSMT.indication primitive are set to the values in the in the corresponding LMR and ISTA Passive TB Ranging Measurement Report frames in Figure 6-17c.

6.3.56.2 MLME-FINETIMINGMSMTRQ.request

6.3.56.2.2 Semantics of the service primitive

Change the text of 6.3.56.2.2 as follows:

The primitive parameters are as follows:

```
MLME-FINETIMINGMSMTRQ.request(
    Peer MAC Address,
    Trigger,
    LCI requested,
    LCI optional subelements,
    Location Civic requested,
    Civic Location Type,
    Location Civic optional subelements,
    Fine Timing Measurement FTM Parameters,
    Ranging Parameters,
    Minimum Required Secure HE-LTF Version,
    Vendor Specific
)
```

Insert two new rows above the row for “VendorSpecific” in the unnumbered table in 6.3.56.2.2 as follows (unchanged rows not shown):

Name	Type	Valid range	Description
...			
Ranging Parameters	As defined in 9.4.2.298	As defined in 9.4.2.298	Optional element containing the configuration for the requested ranging session.
Minimum Required Secure HE-LTF Version	As defined in 9.4.2.298	As defined in 9.4.2.298	The minimum version number for the secure LTF protocol required by the user or system.
...			

6.3.56.3 MLME-FINETIMINGMSMTRQ.indication

6.3.56.3.2 Semantics of the service primitive

Change the text of 6.3.56.3.2 as follows:

The primitive parameters are as follows:

MLME-FINETIMINGMSMTRQ.indication(
Peer MAC Address,
Trigger,
LCI requested,
LCI optional subelements,
Location Civic requested,
Civic Location Type,
Location Civic optional subelements,
~~Fine Timing Measurement~~ FTM Parameters,
Ranging Parameters,
Minimum Required Secure HE-LTF Version,
Vendor Specific
)

Insert two new rows above the row for “VendorSpecific” in the unnumbered table in 6.3.56.3.2 as follows (unchanged rows not shown):

Name	Type	Valid range	Description
...			
Ranging Parameters	As defined in 9.4.2.298	As defined in 9.4.2.298	Optional element containing the configuration for the requested ranging session.
Minimum Required Secure HE-LTF Version	As defined in 9.4.2.298	As defined in 9.4.2.298	Optional element. If the negotiation was successful, contains the secure LTF protocol version as assigned for the FTM session. If the negotiation failed, contains the minimum required protocol version allowed by the RSTA (Status Indication equals 2 or 3).
...			

6.3.56.4 MLME-FINETIMINGMSMT.request

6.3.56.4.1 Function

Change 6.3.56.4.1 as follows:

This primitive requests the transmission of a ~~Fine Timing Measurement~~ an FTM frame to a peer entity to initiate any of the following with the specified peer entity: 11.21.6.4.2, 11.21.6.4.3, 11.21.6.4.4, or 11.21.6.4.8.

6.3.56.4.2 Semantics of the service primitive

Change the text of 6.3.56.4.2 as follows:

The primitive parameters are as follows:

```
MLME-FINETIMINGMSMT.request(  
    Peer MAC Address,  
    Dialog Token,  
    Follow Up Dialog Token,  
    t1,  
    Max t1 Error Exponent,  
    t4,  
    Max t4 Error Exponent,  
    LCI Report,  
    Location Civic Report,  
    Fine Timing Measurement FTM Parameters,  
    Ranging Parameters,  
    VendorSpecific  
)
```

Change the unnumbered table in 6.3.56.4.2 as follows:

Name	Type	Valid range	Description	<u>Applies to both non-TB and TB ranging</u>
Peer MAC Address	MAC address	Any valid individual addressed MAC address	The address of the peer MAC entity ~~to which that acknowledges the receipt of the Fine Timing Measurement FTM frame is sent.~~	<u>Yes</u>
Dialog Token	Integer	0–255	The dialog token to identify the ~~Fine Timing Measurement FTM frame in 11.21.6.4.2.~~ A value of 0 indicates the end of the FTM session.	<u>No</u>
Follow Up Dialog Token	Integer	0–255	The dialog token of a ~~Fine Timing Measurement~~ an FTM frame ~~which that~~ the current frame follows, or 0 if there is no such frame. See ~~11.21.6~~ 11.21.6.4.2.	<u>No</u>
t1	Integer	$0-(2^{48}-1)$	For EDCA based ranging measurement exchange (11.21.6.4.2), the ~~The~~ value of t1 (see Figure 6-17) for the ~~Fine Timing Measurement FTM frame identified by the Follow Up Dialog Token, in units of picoseconds, or null if the Follow Up Dialog Token is 0.~~	<u>No</u>
Max t1 Error Exponent	Integer	0–31	The maximum error in the t1 value. ~~This is represented using a function of the Max t1 Error Exponent parameter as defined in Equation (9-4), or is null if the Follow Up Dialog Token is 0.~~	<u>No</u>
t4	Integer	$0-(2^{48}-1)$	For EDCA based ranging measurement exchange (11.21.6.4.2), the ~~The~~ value of t4 (see Figure 6-17) for the ~~Fine Timing Measurement FTM frame identified by the Follow Up Dialog Token, in units of picoseconds, or null if the Follow Up Dialog Token is 0.~~	<u>No</u>

Name	Type	Valid range	Description	<u>Applies to both non-TB and TB ranging</u>
Max t4 Error Exponent	Integer	0–31	The maximum error in the t4 value. This is represented using a function of the Max t4 Error Exponent parameter as defined in Equation (9-4), or is null if the Follow Up Dialog Token is 0.	<u>No</u>
LCI Report	As defined in 9.6.7.33	As defined in 9.6.7.33	Optional element to report LCI information of sender.	<u>Yes</u>
Location Civic Report	As defined in 9.6.7.33	As defined in 9.6.7.33	Optional element to report location civic information of sender.	<u>Yes</u>
~~Fine Timing Measurement~~ FTM Parameters	As defined in 9.4.2.167	As defined in 9.4.2.167	Optional element containing the proposed FTM configuration.	<u>No</u>
Ranging Parameters	As defined in 9.4.2.298	As defined in 9.4.2.298	Optional element containing the configuration for the proposed 802.11az session.	<u>Yes</u>
VendorSpecific	A set of elements	As defined in 9.4.2.25	Zero or more elements.	<u>Yes</u>

6.3.56.4.3 When generated

Change 6.3.56.4.3 as follows:

This primitive is generated by the SME ~~to request that a Fine Timing Measurement frame be sent to a peer entity.~~ in the context of an active FTM Session to initiate a measurement exchange. If the FTM session is:

- EDCA based ranging measurement exchange (11.21.6.4.2): the SME generates this primitive to request that an FTM frame be sent to a peer entity.
- non-TB ranging measurement exchange (11.21.6.4.4): the SME generates this primitive to request that a non-TB ranging measurement exchange be initiated with the specified peer entity.

NOTE—The sounding exchange initiation is constrained to the Min Time Between Measurements and Max Time Between Measurements thresholds that are defined when the corresponding FTM session was established.

- TB Sounding Exchange (11.21.6.4.3): the SME generates this primitive to request that a TB Sounding Exchange be initiated with the specified peer entity.

6.3.56.4.4 Effect of receipt

Change 6.3.56.4.4 as follows:

On receipt of this primitive, if the corresponding measurement exchange is:

- EDCA based ranging measurement exchange (11.21.6.4.2): the MLME constructs a Fine Timing Measurement ~~an FTM~~ frame with the specified parameters. This frame is then scheduled for transmission.
- non-TB ranging measurement exchange (11.21.6.4.4): the MLME generates a Ranging NDP Announcement frame with the specified parameters and transmits it to the specified peer entity.
- TB ranging measurement exchange (11.21.6.4.3): the MLME responds to the next Trigger frame of variant Ranging and subvariant Poll from the specified peer entity.

6.3.56.5 MLME-FINETIMINGMSMT.confirm

6.3.56.5.1 Function

Change 6.3.56.5.1 as follows:

This primitive indicates that a ~~Fine Timing Measurement~~ an FTM frame has been received by the peer STA to which it was sent.

For EDCA based ranging measurement exchange (11.21.6.4.2), this primitive indicates that an FTM frame has been received by the peer STA to which it was sent. For 11.21.6.4.3, or 11.21.6.4.4 this primitive indicates that the corresponding measurement exchange has completed successfully with the specified peer entity.

6.3.56.5.2 Semantics of the service primitive

Change the unnumbered table in 6.3.56.5.2 as follows:

Name	Type	Valid range	Description	<u>Applies to non-TB or TB ranging?</u>
Peer MAC Address	MAC address	Any valid individual addressed MAC address	The address of the peer MAC entity ~~to which that~~ acknowledges the receipt of the ~~Fine Timing Measurement~~ <u>FTM</u> frame.	<u>Yes</u>
Dialog Token	Integer	0–255	The dialog token to identify the ~~Fine Timing Measurement~~ <u>FTM</u> frame in EDCA based ranging measurement exchange (11.21.6.4.2). A value of 0 indicates the end of the FTM session.	<u>No</u>
t1	Integer	0–($2^{48}-1$)	<u>For EDCA based ranging measurement exchange (11.21.6.4.2), the</u> The value of t1 (see Figure 6-17) for the ~~Fine Timing Measurement~~ <u>FTM</u> frame identified by the Dialog Token, in units of picoseconds, or null if the Dialog Token is 0.	<u>No</u>
Max t1 Error Exponent	Integer	0–31	The maximum error in the t1 value. This is represented using a function of the Max t1 Error Exponent parameter as defined in Equation (9-4), or is null if the Dialog Token is 0.	<u>No</u>
t4	Integer	0–($2^{48}-1$)	<u>For EDCA based ranging measurement exchange (11.21.6.4.2), the</u> The value of t4 (see Figure 6-17) for the ~~Fine Timing Measurement~~ <u>FTM</u> frame identified by the Dialog Token, in units of picoseconds, or null if the Dialog Token is 0.	<u>No</u>
Max t4 Error Exponent	Integer	0–31	The maximum error in the t4 value. This is represented using a function of the Max t4 Error Exponent parameter as defined in Equation (9-4), or is null if the Dialog Token is 0.	<u>No</u>

6.3.56.5.3 When generated

Change 6.3.56.5.3 as follows:

This primitive is generated by the MLME when:

- a) ~~an An~~ Ack frame corresponding to the ~~Fine Timing Measurement-FTM~~ frame is received from the ~~peer STA-ISTA~~ when the ranging protocol is EDCA based ranging measurement exchange (11.21.6.4.2), or
- b) When the sounding exchange corresponding to the underlying non-TB (11.21.6.4.4) or TB (11.21.6.4.3) ranging measurement exchange is successfully completed at the ISTA.

6.3.56.6 MLME-FINETIMINGMSMT.indication

6.3.56.6.2 Semantics of the service primitive

Change the text of 6.3.56.4.2 as follows:

The primitive parameters are as follows:

MLME-FINETIMINGMSMT.indication(
Peer MAC Address,
Dialog Token,
Follow Up Dialog Token,
t1,
Max t1 Error Exponent,
t4,
Max t4 Error Exponent,
t2,
Max t2 Error Exponent
t3,
Max t3 Error Exponent,
LCI Report,
Location Civic Report,
~~Fine Timing Measurement-FTM~~ Parameters,
Ranging Parameters,
VendorSpecific
)

Insert a new row above the row for “VendorSpecific” in the unnumbered table in 6.3.56.6.2 as follows (unchanged rows not shown):

Name	Type	Valid range	Description
...			
Ranging Parameters	As defined in 9.4.2.298	As defined in 9.4.2.298	Optional element containing the configuration for the proposed NDP sounding based ranging session.
...			

8. PHY service specification

8.3 Detailed PHY service specifications

8.3.4 Basic service and options

8.3.4.2 PHY SAP inter-(sub)layer service primitives

Insert two new rows at the end of Table 8-2 as follows (unchanged rows not shown):

Table 8-2—PHY SAP inter-(sub)layer service primitives

Primitive	Request	Indication	Confirm
...			
PHY-RXLTFSEQUENCE	X		
PHY-RXTRNSEQUENCE	X		

8.3.4.3 PHY SAP service primitives parameters

Change the row for parameter “RXERROR” and insert a new row for parameter “LTFVECTOR” at the end of Table 8-3 as follows (unchanged rows not shown):

Table 8-3—PHY SAP service primitive parameters

Parameter	Associated primitive	Value
...		
RXERROR	PHY-RXEND.indication	NoError, FormatViolation, CarrierLost, UnsupportedRate, Filtered, <u>IntegrityCheckError</u>
...		
LTFVECTOR	PHY-RXLTFSEQUENCE.request	A set of parameters needed to receive and process the HE Ranging NDP and HE TB Ranging NDP (see Table 27-2a).

8.3.4.4 Vector descriptions

Insert a new row at the end of Table 8-4 as follows (unchanged rows not shown):

Table 8-4—Vector descriptions

Parameter	Associated vector	Value
...		
SECURE_TRN_SEQUENCE	TRNVECTOR	Indicates the Secure TRN bit sequences used in the EDMG secure ranging PPDU. The Secure TRN bit sequences generation is defined in 12.2.11.

8.3.5 PHY SAP detailed service specification

8.3.5.14 PHY-RXEND.indication

8.3.5.14.2 Semantics of the service primitive

Insert a new item at the end of the dashed list in 8.3.5.14.2 as follows:

- *IntegrityCheckError*. This value is used to indicate that during the reception of the HE Ranging NDP or HE TB Ranging NDP, an integrity check was performed and failed.

Insert 8.3.5.18 and 8.3.5.19 (and their subclauses) after 8.3.5.17.4 inserted by IEEE Std 802.11ay-2021, as follows:

8.3.5.18 PHY-RXLTFSEQUENCE.request

8.3.5.18.1 Function

This primitive is a request by the MAC sublayer to the local PHY entity to provide the parameters shown in Table 27-2a for the receipt of an HE Ranging NDP or HE TB Ranging NDP.

8.3.5.18.2 Semantics of the service primitive

The primitive provides the following parameter:

```
PHY-RXLTFSEQUENCE.request(
    LTFVECTOR
)
```

The LTFVECTOR represents a list of parameters needed to receive an HE Ranging NDP or HE TB Ranging NDP, including the HE-LTF configuration and information on how to generate the secure HE-LTF symbols as described in 27.3.18b.6.

8.3.5.18.3 When generated

This primitive is issued by the MAC sublayer to the PHY entity before receiving HE Ranging NDP and HE TB Ranging NDP.

8.3.5.18.4 Effect of receipt

The effect of receipt of this primitive by the PHY entity is to be aware of the number of spatial streams and HE-LTF repetitions that are not signaled in the HE SIG-A of the HE Ranging NDP and HE TB Ranging NDP, as well as to be able to generate the secure LTF symbols based on the parameters in the LTFVECTOR as described in 27.3.18b.6, if secure HE-LTF is used.

8.3.5.19 PHY-RXTRNSEQUENCE.request

8.3.5.19.1 Function

This primitive is a request by the MAC sublayer to the local PHY entity with a TRNVECTOR parameter to provide the Secure TRN bit sequences for the receipt of the EDMG secure ranging PPDU.

8.3.5.19.2 Semantics of the service primitive

The primitive provides the following parameter:

```
PHY-RXTRNSEQUENCE.request(  
    TRNVECTOR  
)
```

The TRNVECTOR represents the Secure TRN bit sequences used in the EDMG secure ranging PPDU.

8.3.5.19.3 When generated

This primitive is issued by the MAC sublayer to the PHY entity before receiving the secure TRN subfield of the EDMG secure ranging PPDU.

8.3.5.19.4 Effect of receipt

The effect of receipt of this primitive by the PHY entity is to make a secure ranging waveform based on the TRNVECTOR.

9. Frame formats

9.3 Format of individual frame types

9.3.1 Control frames

Change the title of 9.3.1.19 (as amended by IEEE Std 802.11ax-2021) as follows:

9.3.1.19 VHT/HE/Ranging NDP Announcement frame format

Change the first paragraph of 9.3.1.19 (as inserted by IEEE Std 802.11ax-2021) as follows:

The VHT/HE/Ranging NDP Announcement frame has ~~two-three~~ variants, the VHT NDP Announcement frame, ~~and the HE NDP Announcement frame, and the Ranging NDP Announcement frame.~~ The ~~two-three~~ formats are distinguished by the setting of the ~~HE subfield NDP Announcement Type subfield~~ in the Sounding Dialog Token field.

Change the now fourth and fifth paragraphs of 9.3.1.19 (as amended by IEEE Std 802.11ax-2021) as follows:

The VHT/HE/Ranging NDP Announcement frame contains at least one STA Info field. If the VHT/HE/Ranging NDP Announcement frame contains only one STA Info field with AID/RSID equal or less than 2007, then in the case of VHT or HE NDP Announcement frames the RA field is set to the address of the STA that can provide feedback (see 10.36.5.2), while in the case of Ranging NDP Announcement frames, the RA address is set to the address of the RSTA or ISTA that is the intended recipient of the frame. If the VHT/HE/Ranging NDP Announcement frame contains more than one STA Info field with AID/RSID equal or less than 2007, then the RA field is set to the broadcast address.

The TA field is set to the address of the STA transmitting the VHT/HE/Ranging NDP Announcement frame or the bandwidth signaling TA of the STA transmitting the VHT/HE/Ranging NDP Announcement frame. In a VHT/HE/Ranging NDP Announcement frame transmitted by a VHT or HE STA in a non-HT or non-HT duplicate format and where the scrambling sequence carries the TXVECTOR parameter CH_BANDWIDTH_IN_NON_HT, the TA field is set to a bandwidth signaling TA. If a Ranging NDP Announcement frame is addressed to a set of ISTAs in which at least two ISTAs have a TB ranging measurement exchange with a different BSSID in the Multiple BSSID set of the RSTA, then the TA field is the transmitted BSSID.

Replace Figure 9-59 with the following figure:

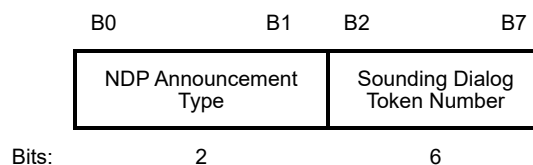


Figure 9-59—Sounding Dialog Token field format

Change the now seventh paragraph of 9.3.1.19 (as inserted by IEEE Std 802.11ax-2021) as follows:

~~The HE subfield in the Sounding Dialog Token field is set to 0 to identify the frame as a VHT NDP Announcement frame and set to 1 to identify the frame as an HE NDP Announcement frame. The NDP~~

Announcement Type field in the Sounding Dialog Token field identifies the NDP Announcement frame variant as defined in Table 9-28f.

Table 9-28f—NDP Announcement frame variant encoding

NDP Announcement Type subfield	NDP Announcement frame variant
0	VHT NDP Announcement frame
1	Ranging NDP Announcement frame
2	HE NDP Announcement frame
3	Reserved

Delete the second paragraph after Figure 9-61a (as inserted by IEEE Std 802.11ax-2021) with content: “The HE subfield in the Sounding Dialog Token field is set to 1 to identify the frame as an HE NDP Announcement frame.”

Insert the following text and Figure 9-61e through Figure 9-61h at the end of 9.3.1.19:

The Ranging NDP Announcement frame uses the same Frame Control subtype as the VHT NDP Announcement frame. The frame format of the Ranging NDP Announcement frame is the same as the HE NDP Announcement frame shown in Figure 9-61a.

The Duration, RA, and TA fields are set as in a VHT NDP Announcement frame.

The Sounding Dialog Token Number subfield in the Sounding Dialog Token (SDT) field contains a value in the range of 0 to 63, which identifies the Measurement Sounding phase of which this transmitted Ranging NDP Announcement frame is part; see 11.21.6.4.3 and 11.21.6.4.4.

The format of the STA Info field in a Ranging NDP Announcement frame, when the AID11 subfield is equal or less than 2007, is defined in Figure 9-61e.

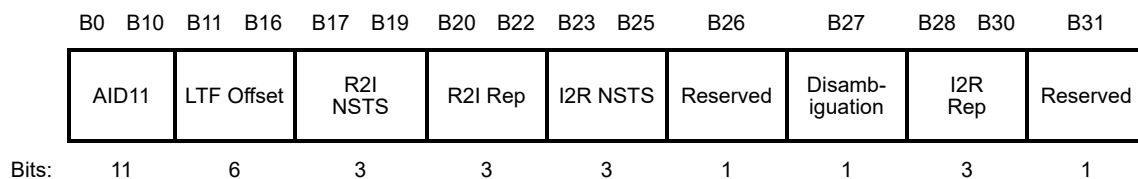


Figure 9-61e—STA Info field format in a Ranging NDP Announcement frame when the AID11 subfield is equal or less than 2007

A Ranging NDP Announcement frame contains one STA Info field with AID11 subfield equal or less than 2007 per STA that is intended to receive this frame.

In the case of the non-TB ranging measurement exchange (see 11.21.6.4.4), there is always only one intended receiver and the RA field is set to the address of that STA.

In the case of the TB ranging measurement exchange (see 11.21.6.4.3), the RA field is set to the broadcast address if more than one STA is intended to receive this frame; otherwise the RA field is set to the address of the STA that is intended to receive this frame.

If the AID11 subfield is equal or less than 2007, it identifies a STA that is intended to receive this frame and assigns the parameters within this STA Info field to this STA. In case of the TB ranging measurement exchange, see 11.21.6.4.3, the AID11 subfield contains the 11 least significant bits of the AID of an associated STA, or the RSID of an unassociated STA, when it is expected to process the following NDP. In case of the non-TB ranging measurement exchange (see 11.21.6.4.4), the intended receiver is identified by the RA field and the AID11 subfield is set to 0.

When used as part of the TB ranging measurement exchange (see 11.21.6.4.3), the LTF Offset, R2I NSTS, and R2I Rep subfields are used to indicate the following R2I NDP's HE-LTF configuration (see 27.3.18a.1); the I2R NSTS and the I2R Rep subfields are reserved.

When used as part of the non-TB ranging measurement exchange, the I2R NSTS and I2R Rep subfields are used to indicate the following I2R NDP's HE-LTF configuration, see 27.3.18a.1, while the R2I NSTS and R2I Rep subfields indicate the HE-LTF configuration of the R2I NDP sent in response by the RSTA, see 11.21.6.4.4.

The LTF Offset subfield is used in the TB ranging measurement exchange protocol with secure LTF see 11.21.6.4.5.2; it indicates the number of HE-LTF to skip when processing the following NDP. The LTF Offset subfield is set to 0 in all other cases.

The R2I NSTS and I2R NSTS subfields indicate the number of spatial streams of the corresponding NDP and is set to the number of spatial streams minus 1.

The R2I Rep and I2R Rep subfields are set to the number of HE-LTF repetitions of the corresponding HE Ranging NDP minus 1; see 27.3.18a.1. If the I2R and R2I Rep subfields have a value equal to 0, then there is no HE-LTF repetition in the I2R and R2I NDP respectively.

The Disambiguation subfield is set to 1 as in the STA Info field in an HE NDP Announcement frame regardless of the value of the AID11 subfield.

The format of the STA Info field in a Ranging NDP Announcement frame when the AID is equal to 2043 is shown in Figure 9-61f. It is used in the non-TB ranging measurement exchange with secure LTF to carry the sequence authentication code (SAC).

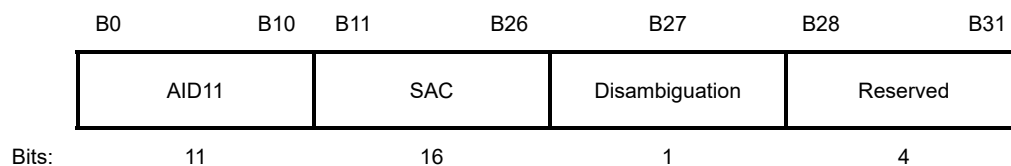


Figure 9-61f—STA Info field format in a Ranging NDP Announcement frame if the AID11 subfield is 2043

The SAC subfield contains the 16-bit SAC used in the non-TB ranging measurement exchange with secure LTF; see 11.21.6.4.5.3.

The format of the STA Info field in a Ranging NDP Announcement frame if the AID11 subfield is equal to 2044 as is shown in Figure 9-61g.

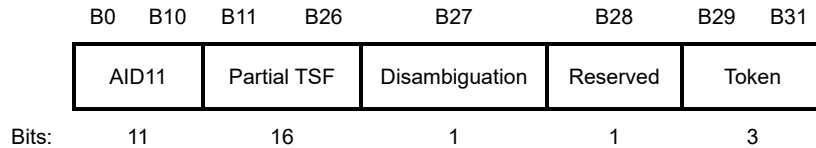


Figure 9-61g—STA Info field format in a Ranging NDP Announcement frame (if the AID11 subfield is equal to 2044)

The STA Info field, with AID11 subfield equal to 2044, is present in Ranging NDP Announcement frames when part of the TB ranging measurement exchange. It is used to carry the Partial TSF subfield. The Partial TSF subfield contains 16 bits of the RSTA's TSF time, TSF[21:6], when the RSTA transmitted the TF Ranging Poll that preceded the Ranging NDP Announcement frame, carrying this STA Info field with AID subfield equal to 2044.

The Token subfield is set to the value of the Token subfield of the TF Ranging Poll whose partial transmission TSF time is carried.

The format of the STA Info field with AID11 subfield equal to 2045 is shown in Figure 9-61h.

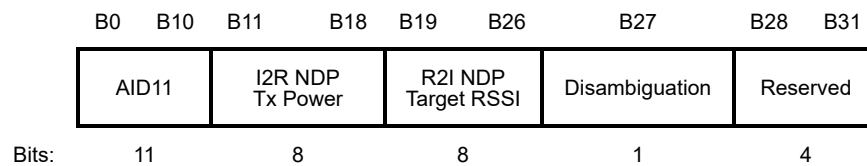


Figure 9-61h—STA Info field format in a Ranging NDP Announcement frame if the AID11 subfield is 2045

The STA Info field with AID11 subfield equal to 2045 is used in the non-TB ranging measurement exchange, see 11.21.6.4.4, to carry the I2R NDP Tx Power and R2I NDP Target RSSI subfields.

The I2R NDP Tx Power subfield indicates the combined average power per 20 MHz bandwidth referenced to the antenna connector, of all antennas used to transmit the following I2R NDP. The transmit power is reported with a resolution of 1 dB, with values in the range 0 to 60 representing –20 dBm to 40 dBm, respectively. Values above 60 are reserved.

The R2I NDP Target RSSI subfield indicates the preferred receive signal power, averaged over the ISTA's antenna connectors, for future R2I NDPs to be transmitted by the RSTA. The preferred receive signal power in units of dBm is $\text{TargetRSSI} = -110 + \text{FVal}$, where FVal is the value of the R2I NDP Target RSSI subfield, except that values above 90 indicate that the ISTA has no receive signal power preference for the R2I NDPs.

9.3.1.22 Trigger frame format

9.3.1.22.1 General

Insert a new row for subfield value “8” above the “Reserved” row and change the “Reserved” row in Table 9-29c (as inserted by IEEE Std 802.11ax-2021) as follows (unchanged rows not shown):

Table 9-29c—Trigger Type subfield encoding

Trigger Type subfield value	Trigger frame variant
...	
8	<u>Ranging</u>
~~8–15~~ <u>9–15</u>	Reserved

Change the second paragraph after Table 9-29c (as inserted by IEEE Std 802.11ax-2021) as follows:

The More TF subfield of the Common Info field indicates whether or not a subsequent Trigger frame is scheduled for transmission. The More TF subfield is set as defined in 26.8.2, ~~and~~ 26.8.3.2, and 11.21.6.4.3.

Change the paragraph above Figure 9-64d (as inserted by IEEE Std 802.11ax-2021) as follows:

The User Info field is defined in Figure 9-64d for all Trigger frame variants, except the NFRP Trigger frame, which is defined in 9.3.1.22.9 and the Ranging Trigger frame, which is defined in 9.3.1.22.10.

Change Table 9-29j (as inserted by IEEE Std 802.11ax-2021) as follows:

Table 9-29j—UL Target Receive Power subfield in Trigger frame

UL Target Receive Power subfield	Description
0–90	The expected receive signal power, in units of dBm, is $Target_{pwr} = -110 + F_{val}$, where F_{val} is the subfield value
91–126	Reserved
127	The STA transmits the HE TB PPDU at the STA’s maximum transmit power for the assigned HE-MCS. <u>If the Trigger frame is a Sounding or Passive Sounding Ranging Trigger frame that does not assign an HE-MCS, then the STA’s transmit power is that used for HE-MCS 0. If the Trigger frame is a Secured Sounding Ranging Trigger frame that does not assign an HE-MCS, the assigned HE-MCS is assumed to be HE-MCS 6 in terms of setting the STA’s transmit power.</u> <u>NOTE</u>—The expected receive signal power is then the STA’s maximum transmit power for the assigned HE-MCS minus the path loss.

Insert 9.3.1.22.10 and 9.3.1.22a (and its subclauses) after 9.3.1.22.9 (as inserted by IEEE Std 802.11ax-2021) as follows:

9.3.1.22.10 Ranging Trigger variant

The Ranging Trigger Subtype subfield value in the Trigger Dependent Common Info field of the Ranging Trigger frame, see Table 9-29l, signals the Ranging Trigger frame subvariants, which can be one of five frame types: Poll, Sounding, Secure Sounding, Report, and Passive Sounding Ranging Trigger frame.

The format of the Trigger Dependent Common Info subfield for the Poll, Sounding, Secure Sounding, and Report Ranging Trigger frame, is shown in Figure 9-64m. The Token field in the Trigger Dependent Common Info subfield is used in a Poll Ranging Trigger frame to match it with the partial TSF time in a following Ranging NDP Announcement frame. It is reserved in all other Ranging Trigger subvariants.

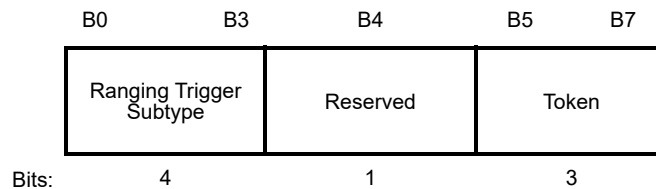


Figure 9-64m—Trigger Dependent Common Info subfield format for the Ranging Trigger subvariants Poll, Sounding, Secure Sounding, and Report

The format of the Trigger Dependent Common Info subfield of Ranging Trigger frame of subvariant Passive Sounding is shown in Figure 9-64n. The Sounding Dialog Token Number subfield contains a value in the range of 0 to 63 which identifies a Measurement Sounding phase (I2RNDP and R2I NDP announced by a Sounding Trigger frame and the Ranging NDP Announcement frame, respectively), and the same value is included in the Sounding Dialog Token field of the Ranging NDP Announcement frame transmitted within the same availability window; see 9.3.1.19.

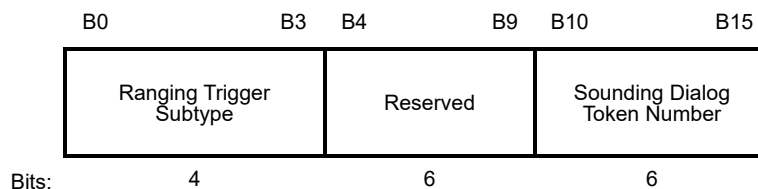


Figure 9-64n—Trigger Dependent Common Info subfield format of the Passive Sounding Ranging Trigger frame

The value of the Ranging Trigger Subtype subfield for the Ranging Trigger frame is defined in Table 9-291.

Table 9-291—Ranging Trigger Subtype subfield encoding

Ranging Trigger Subtype subfield value	Ranging Trigger frame subvariant
0	Poll
1	Sounding
2	Secure Sounding
3	Report
4	Passive Sounding
5–15	Reserved

The RA field, and the CS Required and UL BW subfields in the Common Info field of the Ranging Trigger frame are identical to the Basic Trigger frame described in 26.5.2 and 9.3.1.22, except that the RA field in Ranging Trigger frames with only one User Info field may be either unicast or broadcast.

The More TF subfield of the Common Info field of the Ranging Trigger frame indicates whether a subsequent Poll Ranging Trigger is scheduled for transmission within the availability window as defined in 11.21.6.4.3.

When a Ranging Trigger frame is addressed to ISTAs that all have a TB ranging measurement exchange, see 11.21.6.4.3, with the same RSTA's BSSID, the TA field of the Ranging Trigger frame is set to the RSTA's address. The TA field is set to the transmitted BSSID, if the Trigger frame is addressed to a set of ISTAs in which at least two ISTAs have a TB ranging measurement exchange with different BSSIDs in the Multiple BSSID set of the RSTA.

9.3.1.22a Subvariants of Ranging Trigger variant

9.3.1.22a.1 Poll subvariant

The format of the User Info field in the Poll Ranging Trigger frame is defined in Figure 9-64o.

The AID12/RSID12 subfield carries either the 12 LSBs of the AID for an associated ISTA or the 12 LSBs of the RSID for an unassociated ISTA. The RU Allocation, UL FEC Coding Type, UL HE-MCS, UL DCM, SS Allocation/RA-RU Information, UL Target Receive Power subfields are identical to the corresponding subfield in the Basic Trigger frame; see 9.3.1.22.

The Trigger Dependent User Info subfield is not present in the Poll Ranging Trigger frame.

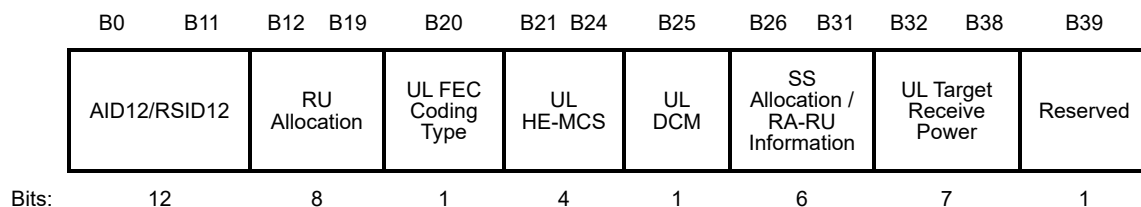


Figure 9-64o—User Info field format for the Poll and Report Ranging Trigger