IEEE P802.11
Wireless LANs

|  |
| --- |
| **11bk Spec Text for IFTM Expansion** |
| **Date:** 2023-07-26 |
| **Author(s):** |
| **Name** | **Affiliation** | **Address** | **Phone** | **Email** |
| Yanjun Sun | Qualcomm |  |  |  |
| Ali Raissinia |  |  |  |  |
| Steve Shellhammer |  |  |  |  |
| George Cherian |  |  |  |  |
|  |  |  |  |  |

Abstract

We propose the draft specification skeleton for NDP Announcement to help the creation of TGbk draft.

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Uploaded the same version to get around a system glitch
* Rev 2: Added format of the Ranging Parameters element in the discussion; Unified format of the discussion
* Rev 3: Added underscore for next text and strikethrough for deleted baseline text; use Nss instead of STS for 320 MHz to match 11be; added text to match the entry in 23/1253r1.
* Rev 4: Propagated changes on STS/Nss and 320 MHz to 11.21.6.3.3 and 11.21.6.4.8.3

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 TGbk Draft. This introduction is not part of the adopted material.

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

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

***Discussion:***

*The text is prepared for the following motion:*

*Extends the IFTMR and IFTM frames with a new subelement to indicate information on the transmit power envelope of the BSS.*

*(11-23-48: 202301-15)*

*The use-case the group discussed during the motion is to help an*

 *unassociated ISTA learn an updated transmit power envelop using a new subelement in the Ranging Parameters element.*

*Although the Ranging Parameters element is present in both IFTMR and IFTM frames, the use-case only requires the transmit power envelop in an IFTM frame. So, this PDT leaves out IFTMR frame and focus only on IFTM frame.*

*In addition, new text has been added according to the new entry for 320 MHz introduced in 23/1253r1*

**Proposed spec text:**

***TGbk editor: Please note Baseline is REVme\_D3.0, 11az D7.0 and 11bk D0.2***

**9. Frame formats**

**9.4.2.298 Ranging Parameters element**

… …

***Discussion:***

*Similar to discussions in 11bf, 320 MHz may have a STS value different from that for 160 MHz, so we propose to rename* *Max R2I STS > 80 MHz subfield to Max R2I STS = 160 MHz subfield, and Max I2R STS > 80 MHz subfield to Max I2R STS = 160 MHz subfield.*

*We’ll also need new values for 320 MHz. As a reference, 11be D3.0 has the following to allow a different NSS for 320 MHz*





*As the Ranging Parameters field is not extensible based on the figure above and these new values are not expected to be transmitted frequently, we propose to add them as an optional subelement in the current draft, similar to transmit power envelop.*

The format of the Ranging Parameters field is shown in Figure [9-788edh](#F09o788edh) (Ranging Parameters field format)

***TGbk editor: Please rename the Max R2I STS > 80 MHz and Max I2R STS > 80 MHz subfields as follows (track change enabled):***

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 B1 | B2 B6 | B7 | B8 B9 | B10 B11 | B12 |  B13 | B14 |  B15 |
|  | StatusIndication | Value | I2R LMR Feedback | Reserved | RangingPriority | R2I TOA Type | I2R TOA Type | R2I AOA Request | I2R AOA Request |
| Bits: | 2 | 5 | 1 | 2 | 2 | 1 | 1 | 1 | 1 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B16 B21 | B22  | B23 | B24 B26 | B27 B29 | B30 B31 | B32 B34 | B35 B37 |
|  | Formatand Bandwidth | Immediate R2IFeedback | Immediate I2RFeedback | Max I2R Repetition | Max R2I Repetition | Reserved | Max R2ISTS ≤ 80 MHz | Max R2ISTS ~~> 80~~=160 MHz |
| Bits: | 6 | 1 | 1 | 3 | 3 | 2 | 3 | 3 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B38 B39  | B40 B41 | B42 B44 | B45 B47 | B48 B55 |
|  | Max R2I LTF Total | Max I2R LTF Total | Max I2RSTS ≤ 80 MHz | Max I2RSTS ~~> 80~~=160 MHz | BSS ColorInformation |
| Bits: | 2 | 2 | 3 | 3 | 8 |

**Figure 9-788edh—Ranging Parameters field format**

***TGbk editor: Please insert one new subelment id for transmit power envelop and another new subelement id for the Max R2I STS =320 MHz and Max I2R STS = 320 MHz values as follows (track change enabled):***

**Table 9-322h23fd—Ranging Subelement IDs for Ranging Parameters**

|  |  |  |
| --- | --- | --- |
| Subelement ID | Name | Extensible |
| 0 | Non-TB Specific subelement | Yes |
| 1 | TB-specific subelement | Yes |
| 2 | Secure HE-LTF subelement | Yes |
| 3 | Transmit Power Envelop subelement | Yes |
| 4 | Max Nss subelement | Yes |
| 5-220 | Reserved |  |
| 221 | Vendor Specific |  |
| 222-255 | Reserved |  |

… …

***TGbk editor: Please insert the following definitions for the two new sublements to the end of this subclause (track change enabled):***

The Transmit Power Envelop subelement has the same definition as the Transmit Power Envelop element (see 9.4.2.161 (Transmit Power Envelope element))

The format of the Max Nss subelement is as shown in Figure 9-7xx (Max STS subelement format).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 B7 | B8 B15 | B16 B18 | B19 B21 |
|  | Subelement ID | Length | Max R2INss =320 MHz | Max I2RNss =320 MHz |
| Bits: | 8 | 8 | 3 | 3 |

**Figure 9-7xx—Max Nss subelement format**

The Subelement ID and Length fields are defined in 9.4.3 (Subelements).

The Max R2I Nss = 320 MHz field indicates the maximum number of spatial streams to be used in R2I NDP in the session for 320 MHz bandwidth.

The Max I2R Nss = 320 MHz field indicates the maximum number of spatial streams to be used in I2R NDP in the session for 320 MHz bandwidth.

***TGbk editor: Please update subclause 11.21.6.3.3 as follows (track change enabled):***

**11.21.6.3.3 Negotiation for TB and non-TB ranging measurement exchange**

… …

When a Ranging Parameters element is included in the IFTMR frame, the ISTA shall indicate the following parameters in the Ranging Parameters field:

* … …
* Maximum number of space-time streams it is capable of receiving in the R2I NDP for 160 MHz bandwidth~~s greater than 80 MHz~~, in the Max R2I STS ~~> 80~~=160 MHz subfield.
* Maximum number of space-time streams it is capable of transmitting in the I2R NDP for bandwidths less than or equal to 80 MHz, in the Max I2R STS ≤ 80 MHz subfield.
* Maximum number of space-time streams it is capable of transmitting in the I2R NDP for 160 MHz bandwidth~~s greater than 80 MHz~~, in the Max I2R STS ~~> 80~~=160 MHz subfield.
* … …

If the Format and Bandwidth subfield is set to a value of 6, the ISTA shall include a Max Nss subelement together with the Ranging Parameters element in the IFTMR frame. In the subelement:

* The Max R2I Nss =320 MHz field is set to the maximum number of spatial streams the ISTA is capable of receiving in the R2I NDP for 320 MHz bandwidth minus 1.
* The Max I2R Nss =320 MHz field is set to the maximum number of spatial streams the ISTA is capable of transmitting in the I2R NDP for 320 MHz bandwidth minus 1.

The ISTA shall not include a Transmit Power Envelop subelement in the IFTMR frame.

… …

When the negotiation is successful for TB ranging and non-TB ranging, the corresponding IFTM frame from the RSTA shall include a Ranging Parameters element with the parameters that defines the negotiated range measurement session. The RSTA shall indicate the following parameters in the Ranging Parameters field:

* … …
* In the Max R2I STS ~~> 80~~=160 MHz subfield, either the maximum number of space-time streams it is capable of transmitting in the R2I NDP for 160 MHz bandwidth~~s greater than 80 MHz~~, or the value in the corresponding IFTMR frame, whichever is smaller (referred to as RSTA Assigned R2I STS ~~> 80~~=160 MHz).
* In the Max I2R STS ~~> 80~~=160 MHz subfield, either the maximum number of space-time streams it is capable of receiving in the I2R NDP for 160 MHz bandwidth~~s greater than 80 MHz~~, or the value in the corresponding IFTMR frame, whichever is smaller (referred to as RSTA Assigned I2R STS ~~> 80~~=160 MHz).
* … …

If the Format and Bandwidth subfield is set to a value of 6, in the same IFTM frame, the RSTA shall include a Max Nss subelement together with the Ranging Parameters element. In the Max Nss subelement:

* The Max R2I Nss =320 MHz field is set to either the maximum number of spatial streams it is capable of transmitting in the R2I NDP for 320 MHz bandwidth minus 1, or the value in the corresponding IFTMR frame, whichever is smaller (referred to as RSTA Assigned R2I Nss =320 MHz).
* The Max I2R Nss =320 MHz field is set to either the maximum number of spatial streams it is capable of receiving in the I2R NDP for 320 MHz bandwidth minus 1, or the value in the corresponding IFTMR frame, whichever is smaller (referred to as RSTA Assigned I2R Nss =320 MHz).

The RSTA shall include a Transmit Power Envelop subelement in the IFTM frame if the IFTM frame contains a Max Nss subelement and is addressed to an unassociated ISTA.

***TGbk editor: Please update subclause 11.21.6.4.3.3 as follows (track change enabled):***

**11.21.6.4.3.3 Measurement sounding phase of TB ranging**

… …

 In the TF Ranging Sounding, the RSTA shall set the SS Allocation subfield and the I2R Rep subfield of the User Info fields corresponding to each of the ISTAs triggered by the Trigger frame in the following way:

— The Number of Spatial Streams in each SS Allocation subfield shall not exceed:

* ~~t~~The RSTA Assigned I2R STS ≤ 80 MHz for the corresponding ISTA, if the UL BW subfield in the Common Info field indicated a bandwidth less than or equal to 80 MHz~~,~~.
* ~~and not exceed t~~The RSTA Assigned I2R STS ~~> 80~~=160 MHz for the corresponding ISTA if the bandwidth is 160 MHz~~,~~.
* The RSTA Assigned I2R Nss =320 MHz for the corresponding ISTA if the bandwidth is 320 MHz.

… …

After transmission of the TF Ranging Sounding, the RSTA’s MAC sublayer shall issue a PHY-RXLTFSEQUENCE.request primitive with an LTFVECTOR containing the following parameters:

— … …

— The R2I NSTS subfield value shall not exceed:

* ~~t~~The RSTA assigned R2I STS ≤ 80 MHz for the corresponding ISTA, if the TXVECTOR parameter CH\_BANDWIDTH for this Ranging NDP Announcement frame is less than or equal to 80 MH~~,~~.
* ~~and not exceed~~ The RSTA ~~a~~Assigned R2I STS ~~> 80~~=160 MHz for the corresponding ISTA if the CH\_BANDWIDTH is equal to 160 MHz~~,~~.
* The RSTA Assigned R2I Nss =320 MHz for the corresponding ISTA if the CH\_BANDWIDTH is equal to 320 MHz ~~otherwise~~.

***TGbk editor: Please update subclause 11.21.6.4.4.2 as follows (track change enabled):***

**11.21.6.4.4.2 Measurement sounding phase of non-TB ranging**

… …

If the bandwidth is less than or equal to 80 MHz, the ISTA shall set the I2R NSTS subfield and the R2I NSTS subfield in the STA Info field of the Ranging NDP Announcement frame each to a value not to exceed the RSTA assigned I2R STS ≤ 80 MHz and RSTA assigned R2I STS ≤ 80 MHz respectively. If the bandwidth is ~~greater than 80~~160 MHz, the ISTA shall set these same subfields to values not to exceed the RSTA assigned I2R STS ~~> 80~~=160 MHz and RSTA assigned R2I STS ~~> 80~~=160 MHz respectively. If the bandwidth is 320 MHz, the ISTA shall set these same subfields to values not to exceed the RSTA assigned I2R Nss =320 MHz and RSTA assigned R2I Nss =320 MHz respectively.

***TGbk editor: Please update subclause 11.21.6.3.3 as follows (track change enabled):***

**11.21.6.3.3 Negotiation for TB and non-TB ranging measurement exchange**

For TB and non-TB ranging Measurement exchange the IFTMR frame shall have:

— the Trigger field set to 1,

— a set of scheduling parameters in a Ranging Parameters element that describe the ISTA’s availability for measurement exchange.

For TB and non-TB ranging measurement exchange, the IFTM frame shall include a Ranging Parameters element containing either the non-TB specific subelement, or the TB specific subelement.

The ISTA shall include one ISTA Availability Window element in the TB specific subelement in the IFTMR frame indicating its availability for TB ranging as well as the requested periodicity. The periodicity of the availability windows requested by the ISTA is expressed in units of 10 TUs in the Count subfield in the ISTA Availability Information field of the ISTA Availability Window element. The value of the Count subfield in the ISTA Availability Information field of the ISTA Availability Window element shall be a multiple of the Beacon Interval of the RSTA in units of 10 TUs.

When the RSTA sets the Status Indication field in an IFTM frame to 1 (Successful), it shall not include a Non-TB Specific subelement or TB-specific subelement, if the same subelement was not also included in the IFTMR frame by the ISTA.

When the RSTA includes a TB-specific subelement in an IFTM frame and the Status Indication field in the IFTM frame is equal to 1, then the RSTA shall include an RSTA Availability Window element in the IFTM frame. The RSTA Availability Information field in the RSTA Availability Window element shall contain exactly one Availability Window Information field. The Availability Window Information field represents the availability window assigned by the RSTA to the ISTA. The Availability Window Broadcast Format subfield in the Header subfield in the RSTA Availability Information field in this RSTA Availability Window element is set to 0.

When the RSTA includes a TB-specific subelement in an IFTM frame and the Status Indication field in the IFTM frame is equal to 1, the subelement contains an AID/RSID field assignment to the ISTA. The RSID and the AID are derived from the same ID number space and are non-conflicting.

When the RSTA includes a TB-specific subelement in an IFTM frame and the Status Indication field in the IFTM frame is equal to 1, the RSTA shall assign the value of the **Max Session Exp** field in the TB Ranging Specific subelement in the Ranging Parameters element in the initial FTM frame. The value of this field shall be larger than the assigned periodicity signaled in the Periodicity subfield in the Availability Window Information field in the TB ranging Specific subelement.

When a Ranging Parameters element is included in the IFTMR frame, the ISTA shall indicate the following parameters in the Ranging Parameters field:

* Maximum supported bandwidth in the Format and Bandwidth subfield.
* Maximum number of LTF repetitions it is capable of receiving in the preamble of the R2I NDP, in the Max R2I Repetition subfield.
* Maximum number of LTF repetitions it is capable of transmitting in the preamble of the I2R NDP, in the Max I2R Repetition subfield.
* Maximum number of space-time streams it is capable of receiving in the R2I NDP for bandwidths less than or equal to 80 MHz, in the Max R2I STS ≤ 80 MHz subfield.
* Maximum number of space-time streams it is capable of receiving in the R2I NDP for the bandwidth~~s greater than 80~~ of 160 MHz, in the Max R2I STS ~~> 80~~=160 MHz subfield.
* Maximum number of spatial streams it is capable of receiving in the R2I NDP for the bandwidth of 320 MHz, in the Max R2I Nss = 320 MHz field of the Max Nss subelement, if the Format and Bandwidth subfield is set to a value of 6.
* Maximum number of space-time streams it is capable of transmitting in the I2R NDP for bandwidths less than or equal to 80 MHz, in the Max I2R STS ≤ 80 MHz subfield.
* Maximum number of space-time streams it is capable of transmitting in the I2R NDP for the bandwidth~~s greater than 80~~of 160 MHz, in the Max I2R STS ~~> 80~~= 160 MHz subfield.
* Maximum number of spatial streams it is capable of transmitting in the I2R NDP for the bandwidth of 320 MHz, in the Max I2R Nss = 320 MHz field of the Max Nss subelement, if the Format and Bandwidth subfield is set to a value of 6.
* Maximum number of LTFs in total it is capable of receiving, including all repetitions, in the R2I NDP, in the Max R2I LTF Total subfield.
* Maximum number of LTFs in total it is capable of transmitting, including all repetitions, in the I2R NDP, in the Max I2R LTF Total subfield.
* Immediate or delayed feedback capability in the I2R LMR by setting the Immediate I2R Feedback subfield to 1 or 0, respectively.

When based on the policy at the ISTA, the ISTA does not share measurement results with the RSTA,the ISTA shall set the I2R LMR Feedback subfield in the Ranging Parameters field, in the IFTMR frame, to 0. Otherwise the ISTA shall set the I2R LMR Feedback subfield to 1.

When the I2R LMR Feedback subfield in the IFTMR frame is equal to 0, and the I2R LMR Feedback Policy field in the Extended Capabilities element is set to 1 by the RSTA, then the RSTA shall not reject the request because the I2R LMR Feedback subfield in the Ranging Parameters field was set to 0, and shall set the I2R LMR Feedback in the IFTM frame to 0.

When the I2R LMR Feedback subfield in the IFTMR frame is equal to 0, and the I2R LMR Feedback Policy field in the Extended Capabilities element is set to 0 by the RSTA, then the RSTA shall set the I2R LMR Feedback subfield to 1 to indicate it requests the ISTA to transmit the I2R LMR or to 0 otherwise. In the former case, the ISTA may either proceed with measurement exchange; see [11.21.6.4.3](#H11o21o6o4o3) (TB ranging measurement exchange) and [11.21.6.4.4](#H11o21o6o4o4) (Non-TB ranging measurement exchange), or terminate the FTM session (see [11.21.6.6](#H11o21o6o6) (FTM termination)).

When the I2R LMR Feedback subfield in the IFTMR frame is equal to 1, then the RSTA shall set the I2R LMR Feedback subfield to 1 to indicate it requests the ISTA to transmit the I2R LMR or to 0 otherwise.

NOTE 1—**The setting of the I2R LMR Feedback subfield to 1 in the Ranging Parameters field in the Ranging Parameters element contained in the IFTMR frame and IFTM frame respectively is based on higher layer agreements.**

NOTE 2—**Because the FTM procedure executes at the PHY/MAC layer, an RSTA accepting a ranging request despite the ISTA having set the I2R LMR Feedback subfield in the Ranging Parameters field in the IFTMR frame to 0 enables use cases where the ISTA might share its location information at a higher layer.**

When the ISTA sets the I2R AOA Requested subfield to 1 in the IFTMR frame, the RSTA may set the I2R AOA Requested subfield in the corresponding IFTM frame to 1 to confirm that the ISTA shall deliver the I2R AOA measurement result in any transmitted I2R LMR and set to 0 otherwise.

When the ISTA sets the R2I AOA Requested subfield to 1 in the IFTMR frame, the RSTA may set R2I AOA Requested subfield in the corresponding IFTM frame to 1 to confirm that the RSTA shall deliver R2I AOA measurement results in the R2I LMR and set to 0 otherwise.

When the ISTA indicated support to announce the TX power of its I2R NDPs by setting the I2R Tx Power field in the Non-TB specific subelement of the Ranging Parameters element in the IFTMR frame to 1, the RSTA may set the corresponding field in the IFTM frame to 1 to request the ISTA to announce the TX power of its I2R NDs, and 0 otherwise.

When the ISTA requested the RSTA to announce the TX power of its R2I NDPs by setting the R2I Tx Power field in the Non-TB Specific subelement to 1, the RSTA may set the corresponding field in the IFTM frame to 1. Otherwise, the RSTA shall set the R2I Tx Power field to 0.

For TB ranging and non-TB ranging, the ISTA shall indicate, in the Ranging Priority subfield of the Ranging Parameters field of the Ranging Parameters element in the IFTMR frame, its Ranging Priority according to Table [9-280c](#T09o280c) (Definition of the EDMG Ranging Priority subfield when included in the IFTMR frame).

For TB ranging, the RSTA shall indicate, in the Ranging Priority subfield of the Ranging Parameters field of the Ranging Parameters element in the IFTM frame, whether it accommodates the ranging priority request transmitted by the ISTA according to Table [9-280d](#T09o280d) (Definition of the EDMG Ranging Priority subfield when included in the IFTM frame.

 When the negotiation is successful for TB ranging and non-TB ranging, the corresponding IFTM frame from the RSTA shall include a Ranging Parameters element with the parameters that defines the negotiated range measurement session. The RSTA shall indicate the following parameters in the Ranging Parameters field:

* In the Format and Bandwidth subfield, it assigns the maximum allowed bandwidth used during measurement exchanges (referred to as RSTA Assigned Max Bandwidth). This value shall not be greater than the value in the corresponding IFTMR frame.
* In the Max R2I Repetition subfield, it assigns the maximum number of HE-LTF repetitions in the preamble of the R2I NDP for this session (referred to as RSTA Assigned R2I Rep). This value shall not be greater than the value in the corresponding IFTMR frame.
* In the Max I2R Repetition subfield, it assigns the maximum number of HE-LTF repetitions in the preamble of the I2R NDP for this session (referred to as RSTA Assigned I2R Rep). This value shall not be greater than the value in the corresponding IFTMR frame.
* In the Max R2I STS ≤ 80 MHz subfield, either the maximum number of space-time streams it is capable of transmitting in the R2I NDP for bandwidths less than or equal to 80 MHz, or the value in the corresponding IFTMR frame, whichever is smaller (referred to as RSTA Assigned R2I STS ≤ 80 MHz).
* In the Max R2I STS ~~> 80~~=160 MHz subfield, either the maximum number of space-time streams it is capable of transmitting in the R2I NDP for the bandwidth~~s greater than 80~~ of 160 MHz, or the value in the corresponding IFTMR frame, whichever is smaller (referred to as RSTA Assigned R2I STS ~~> 80~~ = 160 MHz).
* In the Max R2I Nss = 320 MHz field of the Max Nss subelement, either the maximum number of spatial streams it is capable of transmitting in the R2I NDP for the bandwidth of 320 MHz, or the value in the corresponding IFTMR frame, whichever is smaller (referred to as RSTA Assigned R2I Nss = 320 MHz).
* In the Max I2R STS ≤ 80 MHz subfield, either the maximum number of space-time streams it is capable of receiving in the I2R NDP for bandwidths less than or equal to 80 MHz, or the value in the corresponding IFTMR frame, whichever is smaller (referred to as RSTA Assigned I2R STS ≤ 80 MHz).
* In the Max I2R STS ~~> 80~~ = 160 MHz subfield, either the maximum number of space-time streams it is capable of receiving in the I2R NDP for the bandwidth~~s greater than 80~~ of 160 MHz, or the value in the corresponding IFTMR frame, whichever is smaller (referred to as RSTA Assigned I2R STS > 80 = 160 MHz).
* In the Max I2R Nss = 320 MHz field of the Max Nss subelement, either the maximum number of spatial streams it is capable of receiving in the I2R NDP for the bandwidth of 320 MHz, or the value in the corresponding IFTMR frame, whichever is smaller (referred to as RSTA Assigned I2R Nss = 320 MHz).
* In the Max R2I LTF Total subfield, either the maximum number of LTFs in total it is capable of transmitting to this ISTA, including HE-LTF repetitions, in the R2I NDP, or the value in the corresponding IFTMR frame, whichever is smaller (referred to as RSTA Assigned R2I LTF Total).
* In the Max I2R LTF Total subfield, either the maximum number of LTFs in total it is capable of receiving, including HE-LTF repetitions, in the I2R NDP, or the value in the corresponding IFTMR frame, whichever is smaller (referred to as RSTA Assigned I2R LTF Total).
* Immediate or delayed feedback in the R2I LMR by setting the Immediate R2I Feedback subfield to 1 or 0 respectively.

An ISTA and an RSTA may negotiate a phase shift feedback mode of the non-TB ranging and TB ranging measurement exchange ([11.21.6.4.3](#H11o21o6o4o3)), for either the R2I LMR and/or I2R LMR. In this case, instead of the TOA t2 of the I2R NDP, the R2I LMR carries the phase shift tp2 of I2R NDP and instead of the TOA t4 of the R2I NDP, the I2R LMR carries phase shift tp4 of R2I NDP. The ISTA and RSTA can use Equations [(11-6e)](#E11o6e) and [(11-6f)](#E11o6f) to derive the RTT.

NOTE—tp2 and tp4 are reported in the same units of time (not angle) as the TOA; see 9.6.7.48 (LMR frame format).

If an RSTA has set the Phase Shift TOA Feedback Support field to 1 in the Extended Capabilities element, then to request phase shift TOA feedback in the R2I LMR, an ISTA shall set the R2I TOA Type subfield in the Ranging Parameter field in an IFTMR frame to 1. To assign phase shift TOA feedback in the R2I LMR the RSTA shall set the R2I TOA subfield in the Ranging Parameter field in an IFTM frame to 1, otherwise it shall set it to 0. If the RSTA sets the R2I TOA Type subfield in the Ranging Parameter field in an IFTM frame to 1, the RSTA shall report the phase shift TOA feedback (tp2 of the I2R NDP) in the R2I LMR.

An ISTA that has set the I2R LMR feedback subfield in the Ranging Parameters field in an IFTMR frame to 1, shall set the I2R TOA Type subfield to 1 to indicate that it supports phase shift TOA feedback in the I2R LMR, and set it to 0 otherwise. When the ISTA indicates that it does not support phase shift TOA feedback in the I2R LMR, then the RSTA shall set the I2R Type subfield to 0 in the IFTM frame. When the ISTA indicates support for phase shift TOA feedback in the I2R LMR, the RSTA shall set the I2R TOA Type subfield in the Ranging Parameters field of an IFTM frame to 1 to assign phase shift TOA feedback in the I2R LMR, otherwise it shall set it to 0. If the RSTA sets the I2R TOA Type subfield in the Ranging Parameters field of an IFTM frame to 1, the ISTA shall report phase shift TOA feedback (tp4 of the R2I NDP) in the I2R LMR.

An RSTA shall reject a request for TB ranging from an ISTA if the RSTA cannot assign the ISTA to an availability window that overlaps with a 10 TU interval in which the ISTA is available (as signaled by the ISTA Availability Window element in the IFTMR frame).

When an RSTA sets the Status Indication field in an IFTM frame to 1 (Successful), it shall include an FTM Synchronization Information element in this IFTM frame.

When the RSTA includes a TB-specific subelement in an IFTM frame and the Status Indication field in the IFTM frame is equal to 2 (Request incapable) or 3 (Request failed), then the RSTA may include an RSTA Availability Window element in the IFTM frame. The RSTA Availability Information field in the RSTA Availability Window element shall contain one or more Availability Window Information fields. Each Availability Window Information field represents an availability window that the RSTA can assign to that ISTA if requested by the ISTA in future. The passive TB ranging availability window bit in this Availability Window Information subfield is set to 0.

When Management Frame Protection is negotiated for TB and non-TB ranging, a STA shall

* use Protected Fine Timing Action frames for FTMR frames, FTM frames, and LMR frames for ranging negotiation and measurement
* discard unprotected variants of these frames upon reception

An RSTA shall reject a request, unless the request is for passive TB ranging, if it has set the URNM-MFPR field of the RSNXE to 1, and the ISTA has not successfully set up a PTKSA to protect IFTMR, IFTM and LMR frames exchanged between the RSTA and the ISTA.

Upon reception of an IFTMR frame with the Format and Bandwidth subfield set to a value of 3, 4 or 5 representing the ISTA’s support for one of the 160 MHz BW options, the RSTA shall respond with the same requested value in the Format and Bandwidth subfield in the IFTM frame, if it supports the requested 160 MHz BW option, otherwise respond with a value less than 3. Upon reception of an IFTMR frame with the Format and Bandwidth subfield set to a value of 6 representing the ISTA’s support for the 320 MHz BW option, the RSTA shall respond with the same requested value in the Format and Bandwidth subfield in the IFTM frame, if it supports the requested 320 MHz BW option.

***TGbk editor: Please update subclause 11.21.6.4.8.3 as follows (track change enabled):***

**11.21.6.4.8.3 Passive TB ranging measurement sounding phase**

The passive TB ranging measurement sounding follows the same rules and procedures for the measurement sounding for TB ranging described in [11.21.6.4.3.3](#H11o21o6o4o3o3) (TB ranging Measurement Sounding phase), unless explicitly stated otherwise.

The second phase of the passive TB ranging measurement sequence, after the passive TB ranging Polling phase, is called the passive TB ranging measurement sounding phase. The passive TB ranging measurement sounding phase may include one or more Passive Sounding Ranging Trigger frames and HE/EHT Ranging NDP exchanges, a Ranging NDP Announcement frame, and an HE/EHT Ranging NDP transmission; see Figure [11-37v](#F11o37v) (Passive TB ranging polling, Measurement Sounding, and Measurement Reporting phases).



**Figure 11-37v—Passive TB ranging polling, measurement sounding, and measurement reporting phases.**

In passive TB ranging, for each ISTA, the RSTA shall transmit a Passive Sounding Ranging Trigger frame, which includes a single User Info field.

An RSTA shall transmit one or more Passive Sounding Ranging Trigger frames, each of which is addressed to a single ISTA, the first one coming a SIFS time after the TB Polling phase.

An ISTA addressed by the AID/RSID in the Passive Sounding Ranging Trigger frame shall transmit an HE/EHT Ranging NDP a SIFS time after the reception of the Passive TB Ranging Ranging Trigger frame.

An RSTA transmitting a Passive Sounding Ranging Trigger frame shall not use a bandwidth wider than that indicated in the IFTM frame sent to the ISTA.~~, and~~ If the Passive Sounding Ranging Trigger frame is soliciting an HE Ranging NDP, the RSTA shall set the TXVECTOR parameter CH\_BANDWIDTH to be the same value as the UL BW subfield of the Common Info field in the Passive Sounding Ranging Trigger frame. Otherwise, the RSTA shall set the TXVECTOR parameter CH\_BANDWIDTH of the Passive Sounding Ranging Trigger frame to CBW320.

NOTE—Generally a PSTA benefits from consistent ranging measurement performance when an RSTA initiates a passive TB ranging sequence with the nominal advertised bandwidth in every TXOP.

An RSTA transmitting a Ranging NDP Announcement frame and an HE/EHT Ranging NDP after receiving an HE/EHT Ranging NDP as a response to a Passive Sounding Ranging Trigger frame shall set the TXVECTOR parameter CH\_BANDWIDTH to be the same value as the BW subfield of the Common Info field in the Passive Sounding Ranging Trigger frame whose bandwidth is less than or equal to 160 MHz. If the bandwidth of the Passive Sounding Ranging Trigger frame is equal to 320 MHz, the RSTA shall set the TXVECTOR parameter CH\_BANDWIDTH to CBW320.

An ISTA transmitting an HE/EHT Ranging NDP as a response to a Passive Sounding Ranging Trigger frame shall set the TXVECTOR parameter CH\_BANDWIDTH to be the same value as the UL BW subfield of the Common Info field in the Passive Sounding Ranging Trigger frame whose bandwidth is less than or equal to 160 MHz. If the bandwidth of the Passive Sounding Ranging Trigger frame is equal to 320 MHz, the ISTA shall set the TXVECTOR parameter CH\_BANDWIDTH to CBW320..

If the CH\_BANDWIDTH of the Ranging NDP, either the I2R NDP or the R2I NDP, is equal to 320 MHz, the corresponding NDP shall be an EHT Ranging NDP and the R2I LMR in the corresponding measurement exchange sequence shall be transmitted in an EHT MU PPDU. Otherwise, the corresponding NDP shall be an HE Ranging NDP and the R2I LMR shall be transmitted in an HE MU PPDU.

As in TB ranging, an ISTA participating in a passive TB ranging exchange shall measure the TOD of its own HE/EHT Ranging NDP and either the TOAs, or both the TOAs and the phase shift feedback TOAs (PSTOAs), when it receives the RSTA’s HE/EHT Ranging NDP. In addition, optionally the ISTA may also measure and report either the TOAs, or both the TOAs and the PSTOAs, when it receives the HE/EHT Ranging NDPs transmitted by the other ISTAs participating in the passive TB ranging exchange. By reporting the timestamps for when it received the other ISTAs NDP transmissions, the quality of the location estimate for a PSTA listening in to the passive TB ranging exchanges can be improved.

The number of NSTS/Nss used in the passive TB ranging exchanges shall be less than or equal to 4.

When phase shift feedback is negotiated between an ISTA and an RSTA in passive TB ranging, the protocol for the measurement sounding phase differs from passive TB ranging with TOA feedback on the following points:

* The RSTA shall measure phase shift feedback TOA (PSTOA), in addition to measuring the TOA, on the I2R NPD it receives from the ISTA.
* The ISTA shall measure:

	+ the phase shift TOA (PSTOA), in addition to measuring the TOA, for the R2I NDP it receives from the RSTA.
	+ and may also measure phase shift TOA(s) (PSTOAs), in addition to measuring the TOA(s), for the I2R NDP(s) it receives from other ISTA(s).

See Figure [11-37w](#F11o37w) (Example Timing diagram of a Measurement Sounding phase in passive TB ranging) for an example of timestamps measured by the RSTA, ISTA and a PSTA in a passive TB ranging measurement exchange. The timestamp values t1, t2, t3 and t4 are analogous to the corresponding labeled timestamps in [11.21.6.4.3.3](#H11o21o6o4o3o3) (Measurement Sounding phase of TB ranging). The timestamps t5 and t6 are the times at which the I2R NDP and R2I NDPs arrive at the PSTA, respectively.



**Figure 11-37w—Example timing diagram of a measurement sounding phase in passive TB ranging**

The PSTA may use the ISTA’s and RSTA’s timestamps, together with its own measured TOAs of the ranging NDPs, t5 and t6, to calculate its differential time of flight to the RSTA and the ISTA.

The differential time-of-flight (DToF) from PSTA to RSTA and ISTA (DToF\_PRI) is defined by Equation [(11-6g)](#E11o6g).

DToF\_PRI = ToF\_PR – ToF\_PI, (11-6g)

Where, ToF\_PR is the time of flight between the PSTA and the RSTA, and ToF\_PI is the time of flight between the PSTA and the ISTA. The differential time of flight DToF\_PRI can be computed as per Equation [(11-6h)](#E11o6h):

DToF\_PRI = t6 – t5 – 0.5 × t3’ + 0.5 × t2’ – 0.5 × t4’ + 0.5 × t1’, (11-6h)

where,

t1’ and t4’ are the time at which the I2R NDP was transmitted from the ISTA and the time at which the R2I NDP was received by the ISTA, respectively, converted by the PSTA from the ISTA’s time basis to the PSTA’s time basis.

t2’ and t3’ are the time at which the I2R NDP was received by the RSTA and the time at which the R2I NDP was transmitted by the RSTA, respectively, converted by the PSTA from the RSTA’s time basis to the PSTA’s time basis.

At the PSTA, the mechanism by which t1’ and t4’ is derived from t1, t4, the ISTA’s reported CFO, and the PSTA’s CFO measured with respect to the RSTA, is implementation dependent.

At the PSTA, the mechanism by which t2’ and t3’ is derived from t2, t3, and the PSTA’s CFO measured with respect to the RSTA, is implementation dependent.

By multiplying the differential time of flight, DToF\_PRI, with the speed of light, the differential distance from PSTA to RSTA and ISTA can be computed.

See [11.21.6.4.8.5](#H11o21o6o4o8o5) (Passive TB ranging differential time-of-flight calculations using phase shift TOA timestamps) for how the PSTA’s differential distance to the RSTA and the ISTA can be computed using PSTOAs measured by the RSTA and the ISTA.