IEEE P802.11
Wireless LANs

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| LB240 CID Resolutions - Phase Shift TOA in Passive Location – Amendment text |
| Date: 2019-07-16 |
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|  |  |  |  |  |

Abstract

This document proposes resolutions to comments related Phase Shift TOA in Passive Location Ranging.

The changes here are in relation to [1].

TGaz LB240 CIDs addressed: 1515

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **P.L** | **Clause** | **Comment** | **Proposed change** | **Resoluion** |
| 1515 | 125.16 | 11.22.6.4.10.3 | In the current draft phase shift TOA reporting is specifed for TB Ranging. As Passive Location Ranging is a sub-variant of TB Ranging it is natural that we also should be allowed do use phase shift TOA reporting also there. Thus we should explicitly allow this and make the necessary additions the the LMR reporting formats for Passive Location Ranging. | Explicitly allow phase shift TOA reporting in Passive Location Ranging, make the necessary additions the the LMR reporting formats for Passive Location Ranging, and add description for how phase shift TOA reporting works in Passive Location Ranging. | Revise. See changes to amendment text in 11/1043r0. |

***TGaz Editor: Change the text in subclause 3.4 (“Abbreviations and acronyms”) as follows:***

…

***Change the text in Subclause 3.4 (“Abbreviations and acronyms”) as follows:***

**Insert the following abbreviations into 3.4 in alphabetic order:**

**FPBT first path beamforming training**

**…**

**SAC sequence authentication code**

**PSTA passive STA.**

***TGaz Editor: Change the text in Section 9.4.2.286 (*ISTA Passive Location Measurement Report element*) as follows:***

**9.4.2.286 ISTA Passive Location Measurement Report element**

…

The Timestamp Measurement Reports field contains one or more Timestamp Measurement Report fields defined as in Figure 9-1024.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 B1  | B2  | B3 B50 | B51 B66 | B67 B82 | B83 B87 |
|  | Type | Valid | Time-Stamp | Time-Stamp Error | RID | Reserved |
| bits: | 2 | 1 | 48 | 16 | 16 | 5 |

**Figure 9-1024 – Time Stamp Measurement Report field**

The Type subfield is set according to the Table in Figure 9-1024b..

|  |  |  |  |
| --- | --- | --- | --- |
|  | Field value | Time-Stamp Type | Description |
|  | 00 | TOD | Time of departure time stamp. |
|  | 01 | TOA | Time of arrival time stamp. |
|  | 10 | PS-TOA | Phase Shift TOA |
|  | 11 | PS-Corr | Correction to Phase Shift TOA |

**Figure 9-1024b – Time Stamp Measurement Report field**

***TGaz Editor: Change the text in Section 9.4.2.287 (*RSTA Passive Location LMR element*) as follows:***

**9.4.2.287 RSTA Passive Location LMR element**

…

Time Stamp Measurement Reports field contains one or more Time Stamp Measurement Report

25 fields defined as in Figure 9-1027 (Format of Timestamp Error field).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 B1  | B2  | B3 B50 | B51 B66 | B67 B82 | B83 B87 |
|  | Type | Valid | Time-Stamp | Time-Stamp Error | RID | Reserved |
| bits: | 2 | 1 | 48 | 16 | 16 | 5 |

**Figure 9-1027 – Time Stamp Measurement Report field**

The Type subfield is set according to the Table in Figure 9-1027b..

|  |  |  |  |
| --- | --- | --- | --- |
|  | Field value | Time-Stamp Type | Description |
|  | 00 | TOD | Time of departure time stamp. |
|  | 01 | TOA | Time of arrival time stamp. |
|  | 10 | PS-TOA | Phase Shift TOA |
|  | 11 | PS-Corr | Correction to Phase Shift TOA |

**Figure 9-1027b – Time Stamp Measurement Report field**

***TGaz Editor: Change the text in Section 11.22.6.2 as follows:***

**11.22.6.2 FTM capabilities**

**…**

If the STA in which dot11TriggerBasedRangingRespImplemented, dot11NonTriggerBasedRangingRespImplemented, dot11PassiveLocationRangingInitiatorActivated, or dot11PassiveLocationRangingResponderActivated is true supports

(g) Phase Shift Feedback, it shall set the Phase Shift Feedback Support field in the Extended 1 Capabilities element to 1. Otherwise it shall set the Phase Shift Feedback Support field in 2 the Extended Capabilities element to 0.

***TGaz Editor: Change the text in Section 11.22.6.3.3 as follows:***

**In Section 11.22.6.3.3 (Trigger-based and non-Trigger-based Ranging Measurement Negotiation)**

An ISTA and an RSTA may negotiate a phase shift feedback mode of the non-TB ranging and TB ranging measurement exchange, for either the RSTA-to-ISTA LMR and/or ISTA-to-RSTA LMR. For the Passive Location Ranging case the ISTA to RSTA LMR is carried in the ISTA Passive Location Measurement Report frame and the broadcast LMRs are carried in the Primus and Secundus RSTA Broadcast Passive Location Measurement Report frames. In this case, instead of the TOA t2 of the UL NDP, the RSTA-to-ISTA LMR carries the phase shift tp2 (PS-TOA t2) of UL NDP. For the ISTA-to-RSTA LMR, instead of the TOA t4 of the DL NDP, the ISTA-to-RSTA LMR carries phase shift tp4 (PS-Corr to t2) of DL NDP. For the case of Passive Location Ranging, the ISTA Passive Location Measurement Report frame carries tp4 (PS-Corr to t2) and TOD t1. The ISTA and RSTA can use Equations (11-xx) and (11-yy) to derive the RTT.

An RSTA in which dot11PhaseShiftFeedbackImplemented is true shall set the Phase Shift Feedback Support field in the Extended Capabilities element to 1 to indicate RSTA’s capability.

— When an RSTA has set the Phase Shift Feedback Support field to 1 in the Extended Capabilities element, an ISTA may set the RSTA-to-ISTA Phase Shift Feedback subfield in the Ranging Parameter field in an initial Fine Timing Measurement

Request frame to to activate a RSTA-to-ISTA phase shift feedback mode between the ISTA and the RSTA. The RSTA may set the RSTA-to-ISTA Phase Shift Feedback subfield in the Ranging Parameter field in an initial Fine Timing Measurement frame to 1 to confirm a RSTA-to-ISTA phase shift feedback. When the RSTA sets the RSTA-to-ISTA Phase Shift Feedback subfield in the Ranging Parameter field in an initial Fine Timing Measurement frame to 1, the RSTA shall carry the phase shift tp2 (PS-TOA t2) of UL NDP in the RSTA-to-ISTA LMR.

An ISTA which has set the ISTA-to-RSTA LMR feedback field to 1 and which is capable to send LMR carrying phase shift feedback shall set the ISTA-to-RSTA Phase Shift Feedback field to 1 in the Ranging Parameter field in an initial Fine Timing Measurement Request frame to indicate the ISTA’s capability.

— When an ISTA has set the ISTA-to-RSTA LMR feedback field to 1 and has set the ISTA-to-RSTA Phase Shift Feedback subfield to 1 in the Ranging Parameter field in an initial Fine Timing Measurement Request frame, an RSTA may set the ISTA-to-RSTA Phase Shift Feedback subfield to 1 in the Ranging Parameter field in an initial Fine Timing Measurement frame to activate a ISTA-to-RSTA phase shift feedback mode between the ISTA and the RSTA. Otherwise, RSTA shall set ISTA-to-RSTA Phase Shift Feedback subfield in the ranging parameter field of an initial Fine Timing Measurement frame to 0. When RSTA sets ISTA-to-RSTA Phase Shift Feedback subfield in the ranging parameter field of an initial Fine Timing Measurement frame to 1, the ISTA shall carry the phase shift tp4 (PS-TOA t4) of DL NDP in the ISTA-to-RSTA LMR. In the case of Passive Location Ranging, the ISTA shall here send tp4 (PS-TOA t4) and TOD t1 to the RSTA in the ISTA Passive Location Measurement Report frame.

For Passive Location Ranging we have two main cases involving phase shift feedback:

Case 1 – ISTA PS-TOA reporting: The ISTA measures and reports phase shift TOAs, PS-TOAs.

Case 2 – RSTA PS-TOA reporting: The RSTA measures and reports phase shift TOAs, PS-TOAs.

Behavior in case 1 – ISTA PS-TOA reporting:

* The ISTA(s) in question measures and reports phase shift TOAs, PS-TOAs, for all ranging NDPs it receives during the ranging measurement phase.
* The above ISTA(s) do this reporting by setting the ‘Type’ subfield in the Time Stamp Measurement Report field of the ISTA Passive Location Measurement Report element , see Section 9.4.2.286 (ISTA Passive Location Measurement Report element), to the value 10.
* The RSTA also measure the corrections to the PS-TOAs received from the PS-TOA reporting ISTA(s).
* The ISTAs that are measuring regular TOA time-stamps may also measure the corrections to the PS-TOAs received from the PS-TOA reporting ISTA(s).
* Assuming ISTA to RSTA LMR reporting is enabled, the ISTAs that meaure the corrections to the PS-TOAs, report them by setting the ‘Type’ subfield in the Time Stamp Measurement Report field of the ISTA Passive Location Measurement Report element , see Section 9.4.2.286 (ISTA Passive Location Measurement Report element), to the value 11.
* For the measurement broadcasting, the RSTA can either:
	+ Alt. I:
		- Broadcast the corrections to the PS-TOAs, in the Primus RSTA Broadcast Passive Location Measurement Report frame by setting the ‘Type’ subfield in the Time Stamp Measurement Report field of the RSTA Passive Location LMR element , see Section 9.4.2.287 (RSTA Passive Location LMR element), to the value 11, and
		- Re-broadcast the PS-TOA values measured by the ISTA(s) in the Secundus RSTA Broadcast Passive Location Measurement Report frame by setting the ‘Type’ subfield in the Time Stamp Measurement Report field of the RSTA Passive Location LMR element , see Section 9.4.2.287 (RSTA Passive Location LMR element), to the value 10, or it can
	+ Alt II:
		- Use the corrections to the PS-TOAs it measures to correct the PS-TOAs reported by the ISTA(s) and in the Secundus RSTA Broadcast Passive Location Measurement Report frame broadcast them by setting the ‘Type’ subfield in the Time Stamp Measurement Report field of the RSTA Passive Location LMR element , see Section 9.4.2.287 (RSTA Passive Location LMR element), to the value 01.

Behavior in case 2 – RSTA PS-TOA reporting:

* The RSTA measures and reports phase shift TOAs, PS-TOAs, for all ranging NDPs it receives during the ranging measurement phase.
* The above RSTA does this reporting by setting the ‘ToA Type’ subfield in the TOA Error Field of Location Measurement Report frame, see Section 9.6.7.48 (Location Measurement Report frame format), to 1.
* The ISTA calculates the correction to the RSTA PS-TOA by measuring on the NDP sent by the RSTA.
* If the ISTA is sending LMR reports to the RSTA, then the ISTA, in addition to reporting its TODs, it reports the corrections to the RSTA’s reported PS-TOAs.
* The ISTA reports the corrections to the RSTA’s PS-TOAs by setting the ‘Type’ subfield in the Time Stamp Measurement Report field of the ISTA Passive Location Measurement Report element , see Section 9.4.2.286 (ISTA Passive Location Measurement Report element), to the value 11.
* For the measurement broadcasting, the RSTA can either:
	+ Alt. I:
		- Broadcast its measured PS-TOAs in the Primus RSTA Broadcast Passive Location Measurement Report frame by setting the ‘Type’ subfield in the Time Stamp Measurement Report field of the RSTA Passive Location LMR element , see Section 9.4.2.287 (RSTA Passive Location LMR element), to the value 10, and
		- Re-broadcast the corrections to the PS-TOA values measured by the ISTA(s) in the Secundus RSTA Broadcast Passive Location Measurement Report frame by setting the ‘Type’ subfield in the Time Stamp Measurement Report field of the RSTA Passive Location LMR element , see Section 9.4.2.287 (RSTA Passive Location LMR element), to the value 11, or it can
	+ Alt II:
		- Use the corrections to the PS-TOAs measured by the ISTA to correct its own PS-TOA(s) and broadcast them in the Secundus RSTA Broadcast Passive Location Measurement Report frame by setting the ‘Type’ subfield in the Time Stamp Measurement Report field of the RSTA Passive Location LMR element , see Section 9.4.2.287 (RSTA Passive Location LMR element), to the value 01.

***TGaz Editor: Change the text in Section 11.22.6.4.3.4 (*TB Ranging Measurement Reporting Phase*) as follows:***

**11.22.6.4.3.4 TB Ranging Measurement Reporting Phase**

**…**

In TB ranging measurement reporting phase, if RSTA-to-ISTA LMR reporting or ISTA-to-RSTA LMR reporting carries phase shift feedback, then the RSTA-to-ISTA LMR reporting or the ISTA-to-RSTA LMR reporting shall be immediate feedback.

Correspondingly, in the case of the Passive Location Ranging variant of TB Ranging, all phase shift feedback signaling shall be immediate feedback.

***TGaz Editor: Change the text in Section 11.22.6.4.6a as follows:***

**11.22.6.4.6a Time of Arrival estimation using Phase Shift Feedback**

Based on the Figure 11-35d and Equation (xx), to enable the ISTA to derive the RTT, the RSTA needs to compute TOA t2 and feed t2 and t3 back to ISTA using RSTA-to-ISTA LMR. Instead of utilizing TOA t2 for RTT computation, a phase shift feedback can be prepared by RSTA and fed back to ISTA for deriving RTT.



**Figure 11-36r Timing diagram of a Measurement Sounding phase in TB Ranging based on phase shift of UL NDP and DL NDP**

As shown in Figure 11-36r, in the phase shift (PS) feedback method, the ISTA transmits an UL NDP at ToD t1, and the RSTA determines the phase shift tp2 (PS-TOA t2) of the UL NDP. The RSTA transmits a DL NDP at ToD t3, and the ISTA determines the phase shift tp4 (PS-Corr to t2) and ToA t4 of the DL NDP. tp2 (PS-TOA t2) and tp4 (PS-Corr to t2) are determined from the phase slope of the frequency domain channel estimation of the corresponding NDP. An example of calculation of the phase shift is shown in Annex Z.

The RSTA sends the DL NDP at ToD t3, and after receiving the DL NDP, the ISTA calculate the phase shift tp4 (PS-Corr to tp2) and TOA t4 of DL NDP. The value of tp2 (PS-TOA t2) and tp4 (PS-Corr to t2) are calculated utilizing the frequency domain channel estimation of UL NDP and DL NDP.

The phase shift (PS) is defined as the average linear phase shift between two adjacent tones normalized by the tone spacing. To enable the ISTA calculate the RTT, the RSTA should feed phase shift tp2 (PS-TOA t2) and ToD t3 back to the ISTA using RSTA-to-ISTA LMR, and the ISTA can calculate the RTT as

RTT = (t4 – t1) – (t3 – t2’’), with t2’’ = tp2 – (tp4 – t4) (11-xx)

When the ISTA-to-RSTA LMR with phase shift feedback is negotiated between ISTA and RSTA, ISTA-to-RSTA LMR carries phase shift tp4 (PS-Corr to t2) and ToD t1, then RSTA can calculate the RTT as

RTT = (t4’’ – t1) – (t3 – t2), with t4’’ = tp4 – (tp2 – t2) (11-yy)

In the case of Passive Location Ranging the ISTA sends the tp4 (PS-Corr to t2) and TOD t1 back to the ISTA using the ISTA Passive Location Measurement Report frame**.**

**References:**

**[1] Draft P802.11az\_D1.2**