IEEE P802.11
Wireless LANs

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| LB240 CID Resolutions - Phase Shift TOA in Passive Location – Amendment text |
| Date: 2019-09-06 |
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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 11/1043r3. |

***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.**

**PS-TOA phase shift TOA**

***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 subfields defined as in Figure 9-1024.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 B1  | B2  | B3 B50 | B51 B66 | B67 B78 | B79  |
|  | Type | Valid | Time-Stamp | Time-Stamp Error | AID12/RID12 | Reserved |
| bits: | 2 | 1 | 48 | 16 | 12 | 1 |

**Figure 9-1024 – Time Stamp Measurement Report field (#1515)**

The Type subfield is set according to the Table in Figure 9-1024b.. **(#1515)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | 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 | Reserved | Reserved |

**Figure 9-1024b – Type subfield (#1515)**

***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 **(#1515)**

(a) Phase Shift Feedback, it shall set the Phase Shift Feedback Support field in the Extended 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 RSTA2ISTA LMR and/or ISTA2RSTA LMR. In this case, instead of the TOA t2 of the UL NDP, the RSTA2ISTA LMR carries the phase shift tp2 (PS-TOA t2) of UL NDP. For the ISTA2RSTA LMR, instead of the TOA t4 of the DL NDP, the ISTA2RSTA LMR carries phase shift tp4 (PS-TOA t4) of DL NDP. The ISTA and RSTA can use Equations (11-xx) and (11-yy) to derive the RTT.

For Passive Location Ranging, when phase shift feedback is negotiated either by the ISTA or the RSTA, LMR feedback from the ISTA to the RSTA has to be used.

For the Passive Location Ranging case, the ISTA2RSTA 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 the ISTA Passive Location Measurement Report frame and the Primus and Secundus RSTA Broadcast Passive Location Measurement Report frames, the time stamps reported can be of the types TOD, TOA, OR phase shift TOAs (PS-TOAs). See the Timestamp Measurement Report field and it’s Type subfield detailed in Figure 9-1024 and 9-1024b which are contained in the ISTA Passive Location Measurement Report element, see Subclause 9.4.2.286, and the RSTA Passive Location LMR element, see Subclause 9.4.2.287. **(#1515)**

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 RSTA2ISTA Phase Shift Feedback subfield in the Ranging Parameter field in an initial Fine Timing Measurement

Request frame to to activate a RSTA2ISTA phase shift feedback mode between the ISTA and the RSTA. The RSTA may set the RSTA2ISTA Phase Shift Feedback subfield in the Ranging Parameter field in an initial Fine Timing Measurement frame to 1 to confirm a RSTA2ISTA phase shift feedback. When the RSTA sets the RSTA2ISTA 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 RSTA2ISTA LMR.

An ISTA which has set the ISTA2RSTA LMR feedback field to 1 and which is capable to send LMR carrying phase shift feedback shall set the ISTA2RSTA 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 ISTA2RSTA LMR feedback field to 1 and has set the ISTA2RSTA Phase Shift Feedback subfield to 1 in the Ranging Parameter field in an initial Fine Timing Measurement Request frame, an RSTA may set the ISTA2RSTA Phase Shift Feedback subfield to 1 in the Ranging Parameter field in an initial Fine Timing Measurement frame to activate a ISTA2RSTA phase shift feedback mode between the ISTA and the RSTA. Otherwise, RSTA shall set ISTA2RSTA Phase Shift Feedback subfield in the ranging parameter field of an initial Fine Timing Measurement frame to 0. When RSTA sets ISTA2RSTA 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 ISTA2RSTA 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 – One or more ISTA(s) has negotiated to measures and report phase shift TOAs, PS-TOAs.
* Case 2: RSTA PS-TOA reporting - The RSTA has negotiated to measures and reports phase shift TOAs, PS-TOAs.

Case 1 – ISTA PS-TOA measurement and reporting:

* The ISTA(s) that has negotiated phase shift feedback measures and reports its TOD and the phase shift TOA (PS-TOA) for the R2I NDP it receives from the RSTA.
* The ISTA(s) that has negotiated phase shift feedback, may also measure and report the phase shift TOA(s) (PS-TOAs) for the I2R NDP(s) it receives from other ISTA(s).
	+ In this case, the ISTA(s) from which the ISTA(s) in question measures PS-TOA(s) for, should themselves measure and report PS-TOA for the I2R NDP they receive from the ISTA in question. The ISTA(s) can learn about other ISTAs reporting PS-TOAs from them from the Secondus RSTA Broadcast Passive Location Measurement Report frames.
* The above ISTA(s) do this reporting by setting the ‘Type’ subfield in the Timestamp 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 (PS-TOA).
* The RSTA measures the PS-TOA on the I2R NDP(s) transmitted by the ISTA(s) that have negotiated ISTA phase shift TOA feedback.
* In the Primus RSTA Broadcast Passive Location Measurement Report frame, the RSTA broadcasts its R2I TOD and its measured PS-TOA(s).
* In the Secundus Primus RSTA Broadcast Passive Location Measurement Report frame, the RSTA re-broadcasts the time-stamps the ISTA(s) have reported to the RSTA.

Case 2 - RSTA PS-TOA measurement and reporting:

* The RSTA measures and reports, its TOD and the phase shift TOAs (PS-TOAs) for the I2R NDPs it receives that are transmitted by ISTAs that has negotiated ISTA phase shift feedback.
* The RSTA reports its PS-TOAs by setting the ‘Type’ subfield in the Timestamp Measurement Report field RSTA Passive Location LMR element , see Section 9.4.2.287 (RSTA Passive Location LMR element), to the value 10 (PS-TOA).
* The ISTA measures its PS-TOA on the R2I NDP it receives from the RSTA.
* The ISTA reports its TOD and the PS-TOA it has measured on the R2I NDP.
* The ISTAs may also measure the PS-TOA(s) of the I2R NDP(s) it receives from for other ISTA(s).
	+ In this case, the ISTA(s) from which the ISTA in question measures PS-TOA(s) for, should themselves measure and report PS-TOA for the I2R NDP they receive from the ISTA in question. The ISTA(s) can learn about other ISTAs reporting PS-TOAs from them from the Secondus RSTA Broadcast Passive Location Measurement Report frames.
* The ISTA reports its measured PS-TOA 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 (PS-TOA).
* The RSTA:
	+ Broadcasts its TOD and 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 (PS-TOA), and

Re-broadcasts the TODs and the PS-TOAs reported by ISTAs in the Secundus RSTA Broadcast Passive Location Measurement Report frame. **(#1515)**

***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 Measurement Reporting Phase of TB Ranging (#2158)**

**…**

In TB ranging measurement reporting phase, if RSTA2ISTA LMR reporting or ISTA2RSTA LMR reporting carries phase shift feedback, then the RSTA2ISTA LMR reporting or the ISTA2RSTA 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. **(#1515)**

When phase shift feedback is used in Passive Location Ranging, the reporting of PS-TOAs and associated TODs by both the RSTA and the ISTA(s) shall be immediate. Furthermore the broadcasting of TODs and PS-TOAs in the Primus and Secundus RSTA Broadcast Passive Location Measurement Report frames shall also be immediate. That is the TODs and PS-TOAs measured by the RSTA shall be broadcast in the Primus RSTA Broadcast Passive Location Measurement Report frame following the measurement phase in which they were measured. Correspondingly, the TODs and PS-TOAs reported by the phase shift TOA reporting ISTA(s) shall be re-broadcast in the Secundus RSTA Broadcast Passive Location Measurement Report frame following the reporting from the ISTA(s). **(#1515)**

***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 11-36f Timing diagram of a Measurement Sounding Phase in TB Ranging and Equation (11-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 RSTA2ISTA 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 transmitsa DL NDP at ToD t3, and the ISTA determines the phase shift tp4 (PS-TOA t2) and ToA t4 of the DL NDP. tp2 (PS-TOA t2) and tp4 (PS-TOA 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-TOA tp4) and TOA t4 of DL NDP. The value of tp2 (PS-TOA t2) and tp4 (PS-TOA t4) 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 RSTA2ISTA LMR, and the ISTA can calculate the RTT as

(11-xx)

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

When the ISTA2RSTA LMR with phase shift feedback is negotiated between ISTA and RSTA, ISTA2RSTA LMR carries phase shift tp4 (PS-TOA t4) and ToD t1, then RSTA can calculate the RTT as

(11-yy)

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

**References:**

**[1] Draft P802.11az\_D1.3**