IEEE P802.11
Wireless LANs

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| LMR Timestamps – Part II |
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Abstract

This document proposes resolutions to TGaz LB249 comments related to the LMR timestamps.

The TGaz LB249 CIDs addressed in this document are CIDs:

3277, 3278, and 3273.

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| --- | --- | --- | --- | --- | --- |
| **CID** | **P.L** | **Clause** | **Comment** | **Proposed change** | **Proposed resolution** |
| 3277 | 85.22 | 9.4.2.302 | The RSTA Passive Location LMR is likely transmitted with low MCS as it is used to broadcast LMR information. For this reason the 'RSTA Passive Location Measurement Report Element' should have a very small byte count. | Given that a STA doing passive locationing does only require the time difference of a TOA and TOD timestamp, the proposal is: Introduce another Type "time difference" in which case the time stamp field holds a time difference of TOA and subsequent TOD. The error field would need to be multiplied by 2 in this case, i.e. 2Emax. When implemented this saves signaling of N/2 time stamps. Also consider allowing fewer bits for this time of time stamp as it does not need to span as large a time interval. | Revised. TGaz editor, make the changes as shown below in document 11/20-1653r0. |
| 3278 | 85.22 | 9.4.2.302 | The ISTA Passive Location LMR is likely transmitted with low MCS as it is used to broadcast LMR information. For this reason the 'RSTA Passive Location Measurement Report Element' should have a very small byte count. | Given that a STA doing passive locationing does only require the time difference of a TOA and TOD timestamp, the proposal is: Introduce another Type "time difference" in which case the time stamp field holds a time difference of TOA and subsequent TOD. The error field would need to be multiplied by 2 in this case, i.e. 2Emax. When implemented this saves signaling of N/2 time stamps. Also consider allowing fewer bits for this time of time stamp as it does not need to span as large a time interval. | Revised. TGaz editor, make the changes as shown below in document 11/20-1653r0. |
| 3273 | 86.24 | 9.4.2.302 | The definition of the Time-Stamp Error subfield does not seem very efficient or appropriate. We should consider improving on this. | Revisit the definition of the Time-Stamp Error subfield and improve on it by making it use less bits. | Revised. TGaz editor, make the changes as shown below in document 11/20-1653r0. |

**Discussion for CIDs 3277 and 3278:**

Reporting only the time difference of a TOA and TOD timestamp is not the best way to reduce the number of bits used to report the timestamps for Passive TB Ranging. A reason for this is that in Passive TB Ranging we in general have multiple TOA timestamps for each reported TOA timestamp.

A better way to reduce the number of bits is to change the resolution from the current 1 ps to 128 ps (=3.84 cm propagation distance) and use only 16 bits to represent the timestamp, or to use a resolution of 32 ps (=0.96 cm propagation distance) and use 24 bits.

The max timestamp that can be represented before it wraps to zero now becomes 8.4 us or 0.54 ms, respectivelty. This corresponds to a propagation distance of about 2.5 km or 161 km, respectively. The distances involved in any practical Passive TB Ranging scenario much less than 2.5 km, or even half of 2.5 km = 1.25 km which is the range ambiguity that enters in the the differential range calculations.

In order to enable keeping track of timestamps between ranging opportunities, we propose to keep the 48 bit representation of the TOD timestamps, in units of 1 ps, while using the 16 or 24 bit representation for the possibly more numereous TOA timestamps.

By limiting the max distance between any of the STA’s involved in the exchange, the ISTA, the RSTA and the PSTA (that only receives) to 1.25 km or 161 km, respectively, minus some margin to account for errors, one can as shown in [2] resolve the ambiguities in the TOA timestamps.

Thus combined with the more easily performed resolution of the TOD timestamps, we can get non-ambigous timestamps for all TOD and TOA events.

We thus propose to make this change in the Time Stamp Measurement Report subfield both the ISTA Passive TB Ranging Measurement Report element and the RSTA Passive TB Ranging Measurement Report element.

In the resolution here we propose to use the option with 24 bits for the TOA timestamps.

**Discussion for CIDs 3873:** The Timestamp Error subfield in the ISTA/RSTA Passive TB Ranging Measurement Report element is 16 bits long but contains 11 reserved bits. We propose to reduce it to have only 3 reserved bits and a thus a total length of 8 bits. This also harmonizes this Timestamp Error subfield with the TOD/TOA Error fields in the Location Measurement Report frame.

Furthermore, we also add use of one of the reserved bit for a subfield named ‘TOD not continuous’ with the same definition as the corresponding field in the TOD Error field in the Location Measurement Report frame.

***TGaz Editor: Change the text in Subclause 9.4.2.304 (ISTA Passive TB Ranging Measurement Report element) as follows:***

**9.4.2.304 ISTA Passive TB Ranging Measurement Report element (#2340)**

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The Timestamp Measurement Reports field contains one or more Timestamp Measurement Report subfields defined as in Figure 9-788edz.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 B1 | B2 | B3 | B4 B11 | B12 B23 | B24 B47 or B71 |
|  | Type | Valid | Reserved | Timestamp Error | AID12/RSID12 | Timestamp |
| bits: | 2 | 1 | 1 | 8 | 12 | variable |

**Figure 9-788edz—Time Stamp Measurement Report subfield (#1515, #3277, #3278)**

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The Timestamp Error subfield indicates the absolute value of the estimated max error and for a TOD timestamp if the TOD value is with respect to a different underlying time base than the last transmitted TOD value.

The Time Stamp Error field is structured as shown in Figure 9-788ed1 (Format of Timestamp Error field).

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B4 | B5 B6 | B7 |
|  | Max Error Exponent | Reserved | TOD Not Continuous |
| Bits: | 5 | 2 | 1 |

**Figure 9-788ed1—Format of Timestamp Error field**

…

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*Emax* is the maximum timestamp error, respectively, in units of picoseconds

The TOD Not Continuous subfield indicates that the TOD value is with respect to a different underlying time base than the last transmitted TOD value. It is set to 1 when a discontinuity is present. Otherwise, it is set to 0. For a TOA or PSTOA timestamp this field is reserved.

The Timestamp subfield contains a TOD, TOA, or PSTOA timestamp. The TOD timestamps are represented with 48 bits in units of 1 ps. The TOA and PSTOA timestamps are represented with 24 bits in units of 32 ps. **(#3277, #3278)**

The TOD timestamp represents the time, with respect to the ISTA’s time base, at which the start of the preamble of the NDP in question appeared at the transmit antenna connector.

The TOA timestamp represents the time, with respect to the ISTA’s time base, at which the start of preamble of the NDP in question arrived at the receive antenna connector.

The PSTOA timestamp represents the time, with respect to the ISTA’s time base, at which the start of preamble of the NDP in question arrived at the receive antenna connector, calculated based on the average linear phase shift between two adjacent tones normalized by the tone spacing. An example of calculation of the phase shift is shown in Annex AD.

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**References:**

[1] Draft P802.11az\_D2.4

[2] ‘Wi-Fi FTM Timestamp Optimization”, Erik Lindskog, IEEE.11-20/1555.