IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| LMR Timestamps – Part II | | | | |
| Date: 2020-11-04 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | Email |
| Erik Lindskog | Samsung | 3655 N 1st St, San Jose, CA 95134 |  | e.lindskog@samsung.com |
| Ali Raissinia | Qualcomm | 1700 Technology Dr, San Jose, CA 95110 |  | alirezar@qca.qualcomm.com |
| Roy Want | Google Inc | 1541 Morton Ave, Los Altos, CA 94024 |  | roywant@google.com |

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.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **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 https://mentor.ieee.org/802.11/dcn/20/11-20-1653-04-00az-lmr-timestamps-part-ii.docx. |
| 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 https://mentor.ieee.org/802.11/dcn/20/11-20-1653-04-00az-lmr-timestamps-part-ii.docx. |
| 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 https://mentor.ieee.org/802.11/dcn/20/11-20-1653-04-00az-lmr-timestamps-part-ii.docx. |

**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, due to the cross-reporting between the ISTA’s. Thus at most, we would save only the TOD timestamps while keeping the more numereous TOA timestamps. Also, in some usecases, there is a desire to be able to represent timestamps in a continuous manner across subsequent ranging availability windows. Thus there is a need for at least some timestamps that can cover a long time period without wrapping for this purpose.

A better way is to reduce the number of bits used to represent the TOA timestamps. We propose to change the resolution from the current 1 ps to 16 ps (=0.48 cm propagation distance) and use only 32 bits to represent the timestamp.

The max TOA timestamp that can be represented before it wraps to zero now becomes 68.7 ms. Since 68.7 ms is much longer than than the duration of any one Passive TB Ranging exchange sequence, resolving any ambiguities in these timestamps due to possible wrapping within the ranging exchange sequence becomes very simple.

To fill the need of having timestamps that can be continuous across subsequent Passive TB Ranging availability windows, which may be separated by a time on the order of 1 second, we propose to keep the TOD timestamps represented with the current 48 bits in units of 1 ps.

If we as a group cannot agree on saving bits in the signaling of the more numereous TOA timestamps, we would have to stick to using the less efficient representation with also 48 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.

We also propose to:

* Add use of one of the remaining reserved bit for a subfield named ‘Invalid measurement’ with a definition similar to the definition of the field with the same name in the TOA Error field in the Location Measurement Report frame.
* Add use of one of the other remaining reserved bit for a subfield named ‘TOD not continuous’ with a definition corresponding to the definition of the field with the same name in the TOD Error field in the Location Measurement Report frame.

This makes the Timestamp Error subfield for Passive TB Ranging mimic the formats of the TOA/TOA Error fields 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)**

…

<Scroll to P87L12>

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 B1 | B2 B13 | B14 B15 | B16 B23 |  | B24 B55 or B71 |
|  | Type | AID12/RSID12 | Reserved | Timestamp Error | **<DELETE COLUMN>** | Timestamp |
| bits: | 2 | 12 | 2 | 8 |  | 32 or 48 |

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

…

<Scroll to P88L2>

The AID12/RSID12 subfield contains the 12 LSBs of the AID, for an associated ISTA, or the 12 LSBs of the RSID, for an unassociated ISTA, of the STA that transmitted the NDP in question. When the STA that transmitted the NDP is the RSTA, the value zero is reported in the AID12/RSID12 subfield. **(#1518, #3045)**

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

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

**Figure 9-788ed1—Format of Timestamp Error subfield (#3273)**

The Max Error Exponent subfield contains the exponent *F* which via equation (9-x) represents the absolute value of the estimated maximum timestamp error, *E*max, in units of picoseconds. **(#3273)**

…

<Scroll to P88L26>

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

The Invalid Measurement field is set to 1 to indicate that the timestamp invalid, or set 0 to indicate that the timestamp valid.

For a timestamp of type TOD, 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 other timestamp types, this field is reserved.

The Timestamp subfield contains a TOD, TOA, or a PSTOA timestamp. The TOD timestamps are represented with 48 bits in units of 1 ps. The TOA and PSTOA timestamps are represented with 32 bits in units of 16 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.

**----------------------------------------------------------------- X -----------------------------------------------------------**

**References:**

[1] Draft P802.11az\_D2.5

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