Sampling error of gPTP timestamp

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- The granularity of the counter is the timestamping precision. Legacy implementation uses 125MHz (8ns precision), and new implementations could use 500 MHz clock (2 ns precision)
- The legacy implementations detects the byte of gPTP message to generate timestamp, and the variable delay is bounded by the byte border
- Newer implementations could detect the bit to generate the timestamp, and in this case the variable delay is bounded by 1-bit uncertainty

The timestamp is the value of Time Counter at the rising edge of the local clock. The unit of the local clock is timestamp precision.

Variable delay of the timestamp event

The required timestamping point should be the start of gPTP, but the timestamp event is not always aligned with this. Then this uncertain sampling, causes a variable delay to gPTP timestamp.
PHY speeds

The timestamp error due to sampling error will be different based on the PHY speeds (reference from 1.4.468 of IEEE 802.3-2018)

- For 1GE, the delay of one bit is 0.8ns, and one byte is 6.4ns;
- For 1000BASE-T, the delay of one bit is 8ns, and one byte is 64ns;
- For 100BASE-X, the delay of one bit is 8ns, and one byte is 64ns;
- For 100BASE-T1, the delay of one bit is 15ns, and one byte is 120ns;
- For 100BASE-T2, IEEE 802.3 specification for a 100 Mb/s CSMA/CD local area network over two pairs -> the delay of one bit is 40ns, and one byte is 320ns;
- For 100BASE-T4, IEEE 802.3 specification for a 100 Mb/s CSMA/CD local area network over four pairs -> the delay of one bit is 40ns, and one byte is 320ns;
Summary

• The sampling error of gPTP timestamp can affect the performance
  • It could be an issue for lower rate PHYs
  • It is less of an issue for higher rate PHYs
• This needs to be considered depending on the required performance on each clock in the chain