Contribution to 802.3cx: Clarifications on Timestamp Impact due to Codeword Marker Insertion/Deletions

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Agenda

- Problem statement
- Background
  - January meeting outcome regarding Codeword Markers
  - Previous discussions
    - ITU Liaison
- FEC operation
  - CWM marker insertion/deletion
  - transcoding
- Proposal
  - Text update

Problem statement

- Clarify Codeword marker impacts on timestamping

Background

January meeting minutes:

- Alignment markers were discussed and proposals made
  - Unconfirmed Meeting Minutes January 2020
- Codeword markers (CWM) were discussed. No agreed upon text updates. Therefore, there is a need for text update proposals for timestamp impact due to CWMs

January meeting minutes (below):

- Discussion about whether ITSA should use the term markers in general, rather than specially referring to alignment markers; there are also codeword markers (CWM) for FEC on a single lane interface
- Comment about case of a PCS that may not have to do idle deletion to make room for alignment marker; contrast with 25G RS-FEC CWM case where the implementation might have to perform idle deletion
- Discussion about the separable 100G RS-FEC sublayer and comment that it does not suffer from similar issues as the 25G RS-FEC CWM; the Clause 91 FEC simply swaps PCS AM's for FEC AM's
- It was noted that the AM's and CWM might need to be treated differently

Background - continued

- Codeword markers and its impact on the timestamps were covered by a Liaison from IEEE to ITU in 2018:
  - Liaison from ITU-T SG15
    - ITU_SG15-LS-72_to_IEEE_802d3.pdf (Oct 2017)
    - ITU requested advice on sources of timestamping error in PHYs with FEC, codeword markers, and alignment markers
  - Liaison response to ITU-T SG15
    - IEEE_802d3_to_SG15_timing_0118.pdf (Jan 2018)
    - Response from IEEE indicated that Ethernet FEC streams are bit transparent through the FEC layer such that the delay variation in the Tx path is matched by a complementary variation in the Rx path
    - Indicated that some implementation introduce no timestamping inaccuracy due to markers

Background - continued

- Liaison Text
  - …This synchronous operation means that the delay variation in the transmit path due to transcoding is matched by an opposite delay variation in the receive path due to reverse transcoding, yielding a constant total delay, as shown in Figure 2. …

Transcoding

  - … Another possible source of delay variability is the periodic insertion and deletion of markers by the PCS/FEC (e.g., codeword markers in Clause 108, or alignment markers in Clause 82). This functionality may introduce delay variability of up to 12.8 ns for the 100GBASE-R PCS, in both transmitter and receiver. However, we would like to note that there are compliant implementation methods that create no timestamping inaccuracy due to markers. …

Alignment markers/ Codeword markers

- Transcoding interworking has been resolved (Clause 90.7, 802.3-2018 updated text) + proposals on clarifications for AM operation have been submitted.
- Need to clarify text for CWM operation

RS-FEC operation

- RS-FEC needs information to determine the FEC codeword boundaries; a marker is used to determine FEC codeword boundaries
- Clause 91 (RS-FEC for 100GBASE-R PHYs): relies upon AMs for FEC codeword boundary determination – no need for CWMs
  - Clause 91.5.2.6 para 1: AMs are used to identify codeword boundaries
  - AMs and their impact on timestamping have been discussed in previous proposals
    - Gorshe gorshe_1_0119.pdf and later suggested further updates by Nicholl nicholl_nea_01_190416.pdf.
    - Text from `Timestamp Inaccuracy Due to Idle Insert/Delete for AMs' (Gorshe/Tse). Other proposals (Nicholl, Parkholm) have similar text.
      - If the insertion or removal of AMs and/or Idles in these PCSs affects the transmit or receive data path delay, this effect must be accounted for in the timestamp. In this way, the timestamp operation is performed as if alignment markers are present at the xMII (i.e., as if AM insertion and Idle insertion/removal is performed ahead of the Tx xMII and AM deletion and Idle insertion/removal is performed after the Rx xMII).
- Clause 108 (RS-FEC for 25GBASE-R PHYs) – rely upon CWM to determine FEC codeword boundaries
  - This proposal is to treat CWM in a way that is aligned with the previous Liaison and with current proposed text for AMs.

Proposal: New IEEE 802.3 draft

- Current text which deals with transcoding - IEEE 802.3-2018 clause 90.7, page 373:
  - For a PHY that includes an FEC function, the transmit and receive path data delays may show significant variation depending upon the position of the SFD within the FEC block. However, since the variation due to this effect in the transmit path is expected to be compensated by the inverse variation in the receive path, it is recommended that the transmit and receive path data delays be reported as if the SFD is at the start of the FEC block.

- The above text deals with transcoding impacts. Text should be added to clarify CWM impact on timestamping as discussed in the IEEE to ITU Liaison.

- Proposal: add the following text after existing 90.7 paragraph 2:

  - If the insertion or removal of CWMs in clause 108 affects the transmit or receive data path delay, this effect should be accounted for in the timestamp. In this way, the timestamp operation is performed as if CWMs are present at the xMII (i.e., as if CWM insertion and Idle insertion/removal is performed ahead of the Tx xMII and CWM deletion and Idle insertion/removal is performed after the Rx xMII)

Thank You

Backup: Other text proposals for CWM insertion/deletion

- CWM modifications added to Nicholl Clause 90.7 AM proposed text (added after existing 90.7 paragraph 2):
- For a PHY that inserts alignment markers, codeword markers or performs rate adaptation, the transmit path data delay measurement starting point (the beginning of the first symbol after the SFD at the xMII input) should be adjusted to account for alignment marker insertion, codeword marker insertion or rate adaptation that occurs in the PHY (between the xMII input and the MDI output) which impacts the relative location of the beginning of the first symbol after the SFD. Based on this adjustment, the result is a transmit path data delay measurement that appears as if the alignment marker insertion, codeword marker insertion or rate adaptation had been performed before the Tx xMII. Similarly, the receive path data delay measurement ending point (the beginning of the first symbol after the SFD at the xMII input) should be adjusted to account for any alignment markers, codeword markers or rate adaptation that occurred in the PHY (between the MDI input and xMII output) which impacts the relative location of the beginning of the first symbol after the SFD. Based on this adjustment, the result is a receive path data delay measurement that appears as if the alignment marker deletion, codeword marker deletion or rate adaptation had been performed after the xMII.