TX/RX_num_unit_change Signals

Richard Tse, Microchip Technology
David Law, Hewlett Packard Enterprise

IEEE 802.3cx Plenary, July 21, 2021

Outline

1. Issue with TX/RX_num_unit_change
2. Solution Considerations
3. Solution Concepts
4. Proposed Changes

Issue with TX/RX_num_unit_change

An issue in the existing TX/RX_num_unit_change concept was identified at the P802.3cx meeting on June 22, 2021

- The generic Reconcilliation sublayer (gRS) does not have the information to generate the TX/RX_num_unit_change primitives
  - This information is known by the PHY (the PCS performs AM, CWM, and Idle insertion/removal)
- TX/RX_num_unit_change was connected only to the gRS because it was originally envisioned that alteration of the xMII would not be accepted by 802.3 members

Solution Considerations

- TX/RX_num_unit_change should accompany xMII signals to form a standardized interface for high accuracy timestamping
  - Enables PHY IP and MAC IP to interact through standardized interface for high accuracy timestamping applications
  - TX/RX_num_unit_change are only needed for high accuracy timestamping with PHYs that perform AM, CWM, and/or Idle insertion/removal
  - TX/RX_num_unit_change primitives need to be changed into signals

- TX/RX_num_unit_change signals are for use with intra-chip xMIIs
  - 25GMII and onwards are defined as logical interconnections intended for use as intra-chip interfaces (see IEEE Std 802.3-2018 subclause 1.1.3.2)
  - Electrical and timing specifications are not needed for intra-chip interfaces
  - Logical specifications are needed for intra-chip interfaces

Solution Concepts (1/4)

- TX/RX_num_unit_change signals are generated by the Tx/Rx PHY
  - TX/RX_num_unit_change_support register is already located alongside other PCS registers
- TX/RX_num_unit_change signals are aligned to TXD/RXD signals on the xMII
- The new lines (in blue) connecting the PHY to the gRS and TimeSync Client are shown in the updated Figure 90-1 and Figure 90-2

Figure 90–1 depicts the TimeSync Client and the RS interlayer service interfaces.

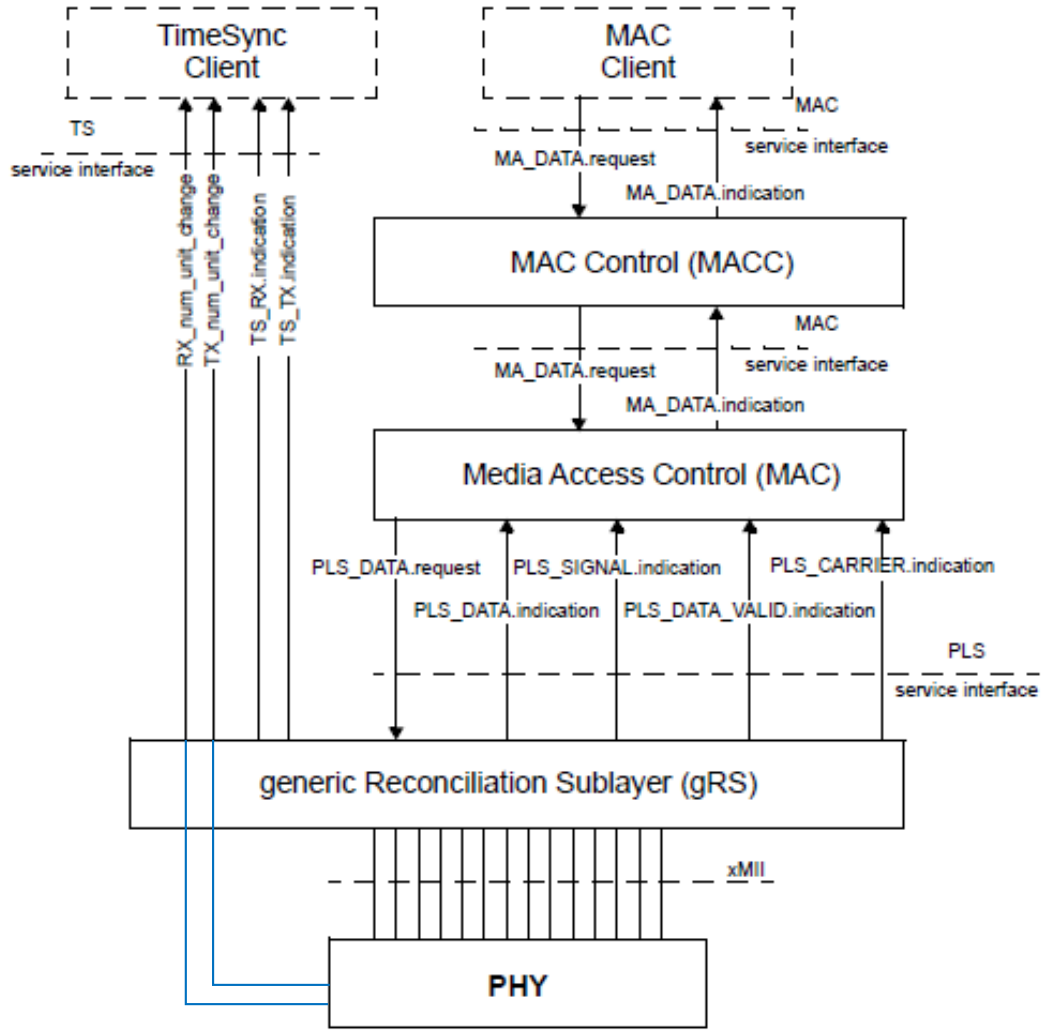


Figure 90–1—Relationship of the TimeSync Client, TSSI and gRS sublayer relative to MAC and MAC Client and associated interfaces

Solution Concepts (2/4)

Also note that this arrow is pointing in the wrong direction and should be fixed

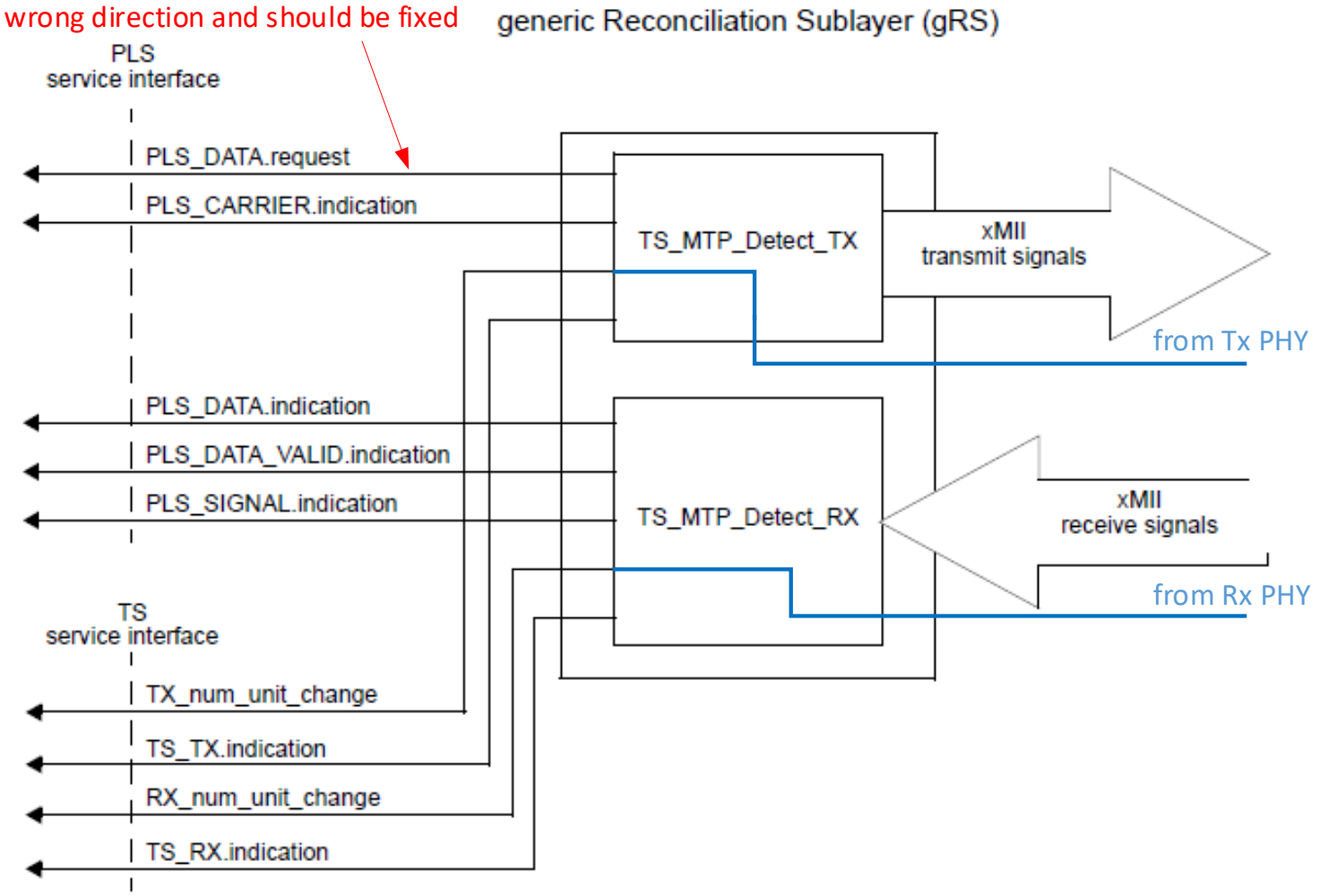
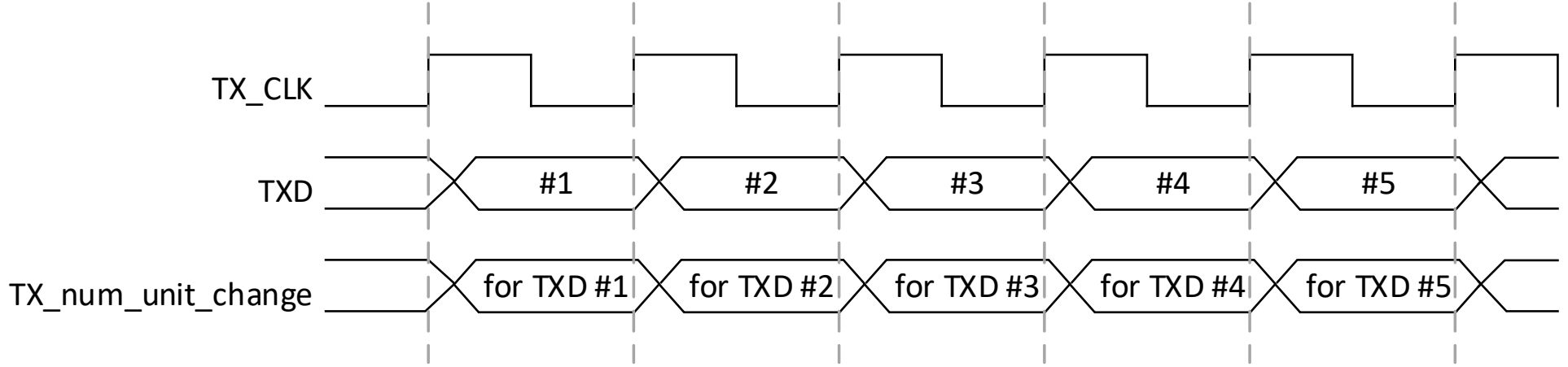


Figure 90–2—TS_MTP_Detect_TX and TS_MTP_Detect_RX functions within the generic Reconciliation Sublayer (gRS)

Solution Concepts (3/4)

TX_num_unit_change gives advanced notification of Tx PHY path data delay changes (from upcoming AM, CWM, and Idle insertion/removal) for the TXD on the xMII

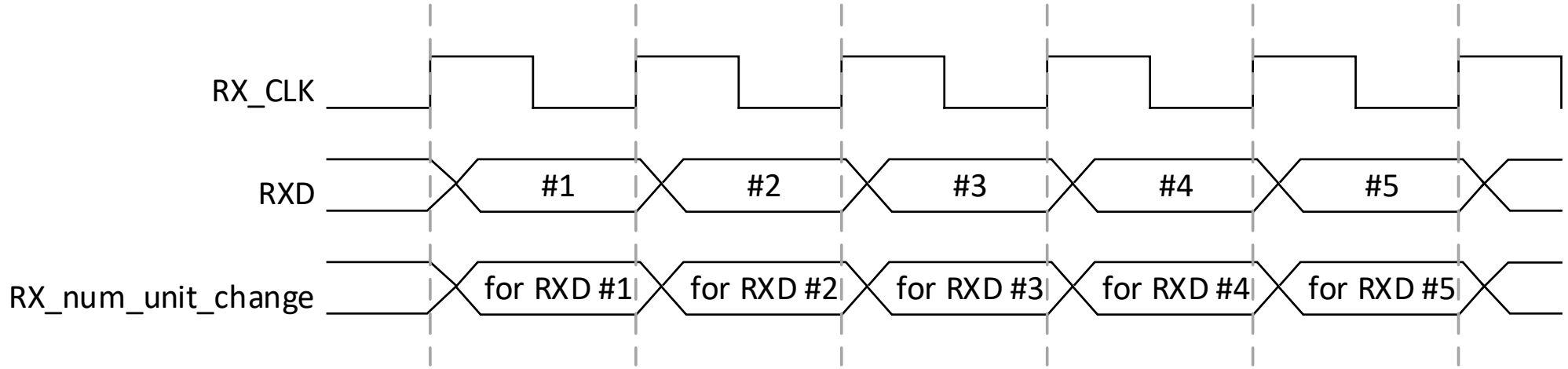
- Since AM, CWM, and Idle insertion/removal are controlled by the PHY, the PHY can generate advanced notification of these events
- TX_num_unit_change is updated by the Tx PHY on the active edge of TX_CLK before TXD is sampled by the Tx PHY



Solution Concepts (4/4)

RX_num_unit_change gives the change in Rx PHY path data delay (due to AM, CWM, and Idle insertion/removal) experienced by the RXD on the xMII

- RX_num_unit_change accompanies each valid RXD on the xMII
- RX_num_unit_change is updated by the Rx PHY on the active edge of RX_CLK in the manner as RXD



Proposed Changes (1/7)

- Update **Figure 90-1** and **Figure 90-2** as shown earlier in this presentation
- Rename **Figure 90-2** to **Figure 90-4** (two new figures are to be inserted)
- Change **90.4.2 TSSI** as follows:

  The following specifies the service interface provided by the RS and the path data delay change signaling by the PHY to the TimeSync Client. The~~se~~ services provided by the primitives are described in an abstract manner and do not imply any particular implementation. The model used in the~~is~~ service specification is identical to that used in 1.2.2.

  The following primitives are defined:

  — TS_TX.indication

  — TS_RX.indication

  The following signals are generated by the PHY to indicate path data delay changes:

  — TX_num_unit_change

  — RX_num_unit_change

Proposed Changes (2/7)

90.4.4 Path data delay change signals

90.4.4.1~~3.3~~ TX_num_unit_change<15:0> ~~primitive~~signal

This ~~primitive~~signal defines the transfer of Tx PHY path data delay variation information from the TX PHY through the gRS to the TimeSync Client for support of high accuracy timestamping.

90.4.4.1.1~~3.3.1~~ Semantics

~~The semantics of the primitive are as follows:~~

~~TX_num_unit_change(UNIT_CNT)~~

TX_num_unit_change<15:0> contains a value ranging from -32768 to +32767 in two's complement format. The ~~UNIT_CNT parameter~~value indicates how many units of delay change are to be performed in the Tx PHY (e.g., for AM insertion, CWM insertion, or Idle rate adaptation insertion/removal), where one unit is equivalent to one bit at the xMII.

Proposed Changes (3/7)

90.4.4.1.2~~3.3.2~~ Condition for generation

Tx_num_unit_change is generated by the Tx PHY for every Tx xMII word that it receives. Tx_num_unit_change indicates the change in the Tx PHY's path data delay due to AM insertion, CWM insertion, and/or Idle rate adaptation insertion/removal for the corresponding Tx xMII word. If a Tx PHY does not perform these changes to its path data delay, then this ~~primitive~~signal is fixed to the value zero.

~~TX_num_unit_change is a 16-bit signed integer, with the value ranging from -32768 to +32767.~~

An example usage of TX_num_unit_change is described in 90A.5.1.

90.4.4.1.3~~3.3.3~~ Effect of receipt

The receipt of this ~~primitive~~signal by the TimeSync Client is undefined.

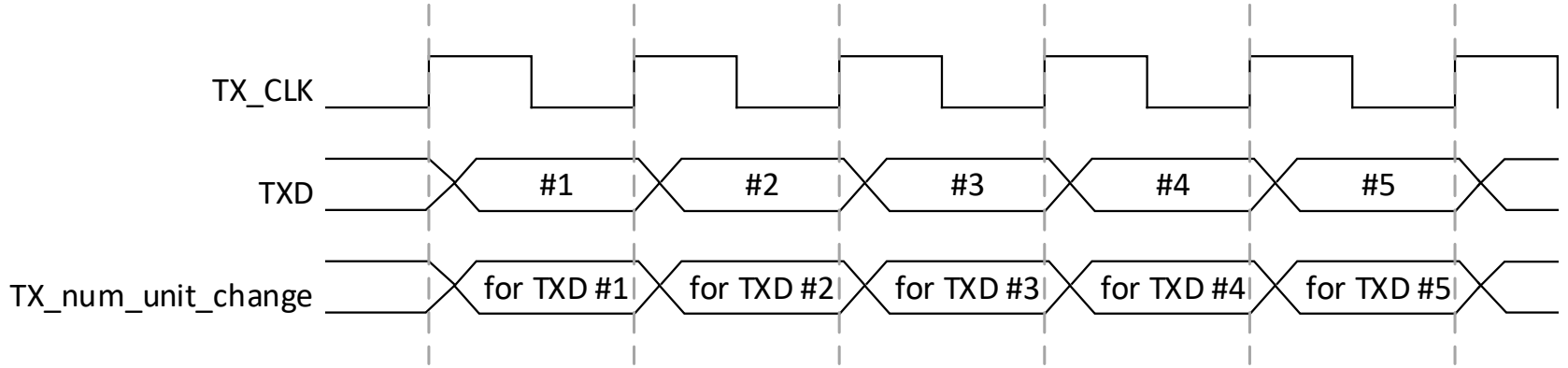


Figure 90-2 — Relationship between TXD and Tx_num_unit_change

Proposed Changes (4/7)

90.4.4.2~~3.4~~ RX_num_unit_change<15:0> ~~primitive~~signal

This ~~primitive~~signal defines the transfer of Rx PHY path data delay variation information from the RX PHY through the gRS to the TimeSync Client for support of high accuracy timestamping.

90.4.4.2.1~~3.4.1~~ Semantics

~~The semantics of the primitive are as follows:~~

~~RX_num_unit_change(UNIT_CNT)~~

RX_num_unit_change<15:0> contains a value ranging from -32768 to +32767 in two's complement format. The ~~UNIT_CNT parameter~~value indicates how many units of delay change ~~are to be~~were performed in the Rx PHY (e.g., for AM removal, CWM removal, or Idle rate adaptation insertion/removal), where one unit is equivalent to one bit at the xMII.

90.4.4.2.2~~3.4.2~~ Condition for generation

Rx_num_unit_change is generated by the Rx PHY for every Rx xMII word. Rx_num_unit_change indicates the change in the Rx PHY's path data delay due to AM removal, CWM removal, and/or Idle rate adaptation insertion/removal for the corresponding Rx xMII word. If a Rx PHY does not perform these changes to its path data delay, then this ~~primitive~~signal is fixed to the value zero.

~~RX_num_unit_change is a 16-bit signed integer, with the value ranging from -32768 to +32767.~~

An example usage of RX_num_unit_change is described in 90A.5.2.

Proposed Changes (5/7)

90.4.4.2.3~~3.4.3~~ Effect of receipt

The receipt of this ~~primitive~~signal by the TimeSync Client is undefined.

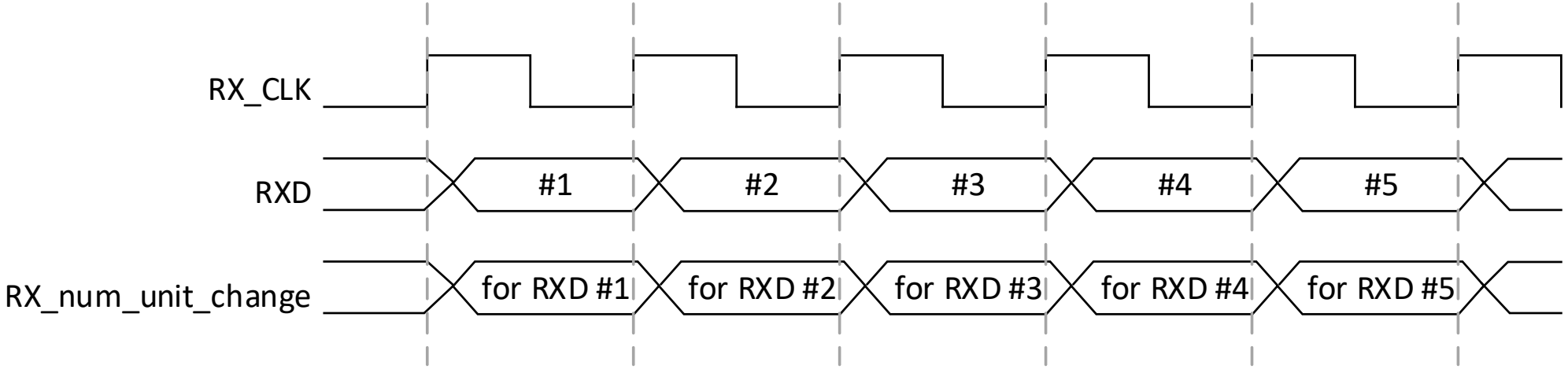


Figure 90-3 — Relationship between RXD and Rx_num_unit_change

Proposed Changes (6/7)

90.7 Data delay measurement

The dynamic delay variance of AM, CWM, or Idle insertion or removal is not to be included in the TimeSync PCS transmit path data delay or the TimeSync PCS receive path data delay registers. The dynamic delay variance is reported by the TX_num_unit_change and RX_num_unit_change ~~primitives~~signals.

90A.3 Considerations for Use of Different Message Timestamp Points

The effect of AM or CWM insertion is accounted for, using the TX_num_unit_change and RX_num_unit_change ~~primitives~~signals (see 90.4.4.1~~3.3~~, 90.4.4.2~~3.4~~, and 90A.5)

90A.5 Considerations for AM/CWM and Idle Functions

Each of these path data delay variations may be accounted for by using the TX_num_unit_change and RX_num_unit_change ~~primitives~~signals (see 90.4. 4.1~~3.3~~ and 90.4. 4.2~~3.4~~). These ~~primitives~~signals allow the TimeSync Client to compensate for the instant change in the path data delay. Because the ~~primitives~~signals compensate for the instant path data delay changes, the TimeSync PCS transmit path data delay register and TimeSync PCS receive path data delay register can operate as static values, even when AM, CWM, or Idle insertion/removal operations are present.

Proposed Changes (7/7)

90A.5.3 Considerations for Implementations without Tx num_unit_change and RX_num_unit_change

For an implementation that does not compensate for the path data delay variation resulting from AM, CWM, or Idle insertion/deletion removal events (e.g., without the TX_num_unit_change and RX_num_unit_change ~~primitives~~signals), the effect of the timestamp accuracy impairments that result from these events can be evaluated to determine if they cause significant degradation in the TimeSync system's performance. Some observations that might help this evaluation are given below:

.

.

.

If a PHY does not perform AM, CWM, or Idle insertion/removal, then the TX/RX num_unit_change ~~primitives~~signals are not needed and are fixed to the value zero.

Thank you!

Any questions or comments?