802.3cg D3.1 Comments 90 & 91:
Precision Time Protocol(PTP) and Half-Duplex

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Precision Time Protocol (PTP)

- Precision Time Protocol (PTP) is defined in IEEE 1588.
  - 802.1AS is "Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks"
    - 802.1AS is used with 802.1 AVB (Audio Visual Bridging), and 802.1 TSN.
  - In addition to 802.1AS, there are a large number of "PTP profiles" in use, e.g.,
    - IEEE 1588 default profile
    - Precision Time Protocol Industry Profile
    - IEC/IEEE 61850-9-3 PTP profile for substation automation
    - Parallel Redundancy Protocol use of PTP profiles (L2P2P and L3E2E)

Half-Duplex and Precision Time Protocol(PTP)

- 802.3cg is the first 802.3 half-duplex Physical Layer project for a very long time
  - 802.3cg half-duplex includes both point-to-point and multi-drop
- Clause 90 – "Ethernet support for time synchronization protocols"
  - Excludes half-duplex: "The TSSI is defined for the full-duplex mode of operation only."
  - Extends other RS's: "This subclause specifies services provided by an extension to the Reconciliation Sublayers specified elsewhere in this standard."
  - Is in scope for 802.3cg as "Physical Layer" includes the RS

802.3cg D3.1 comments #90 & #91

CommentID	CommenterNa	Clause	Subclau	Pa	Li	CommentTyp	Comment	SuggestedRemedy	Response	CommentStati	ResponseStatu	Topic
90	Jones, Peter	0	90.1	0	0	TR	802.3cg should support the TSSI. I don't believe that the TF discussed the pros/cons of supporting PTP or decided not to support PTP on 10BASE-T1S half-duplex point to point or multidrop. A significant portion of the applications for 10BASE-T1S will need precision time support.	Replace "The TSSI is defined for the full-duplex mode of operation only." with "The TSSI is defined for the full-duplex mode of operation, as well as clause 147 half-duplex point-to-point and multidrop." Add the following paragraph to the end of 90.4.3.1.1 Semantics "When using the half-duplex mode of operation, multiple TS_TZ indications may be produced for a single MA_DATA.request as a result of collisions on the media. The TimeSync Client should always use the last indication corresponding to a given MA_DATA.request."	PROPOSED REJECT. TFTD The CRG disagrees with the commenter. The comment is out of scope of the recirculation, bringing new text, unrelated to changed text into the draft on the recirculation. This change would introduce new functionality into the draft beyond the existing text or approved project objectives.	D	W	TSSI
91	Jones, Peter	148	148.4.2	235	10	TR	802.3cg should support the TSSI. I don't believe that the TF discussed the pros/cons of supporting PTP or decided not to support PTP on 10BASE-T1S half-duplex point to point or multidrop. A significant portion of the applications for 10BASE-T1S will need precision time support.	Modify "Figure 148-2--PLCA functions within the Reconciliation Sublayer (RS)" to add TS_TX.indication, TS_RX.indication, SFD DETECT TX and SFD DETECT RX as shown in D2.0 Figure 148-3. Insert the following paragraph before "148.4.3 Mapping of MII signals to PLS service primitives and PLCA functions" "Operation with TSSI When TSSI support is also specified in the actual RS, the SFD detection of transmitted frames shall be detected after the PLCA variable delay line, as shown in Figure 148-2. This ensures the network latency measurement is not affected by the synchronization latency added by PLCA. No special attention is required for SFD detection of received frames."	PROPOSED REJECT. Discuss with comment r01-90. TFTD The CRG disagrees with the commenter. The comment is out of scope of the recirculation, bringing new text, unrelated to changed text into the draft on the recirculation. This change would introduce new functionality into the draft beyond the existing text or approved project objectives.	X	W	TSSI

Precision Time Use Case Example

- Sequence-of-Event failure analysis and response (controllers need to be able to determine failure points vs secondary reactions to initial failure in order to respond correctly)
- Synchro-phasor measurements of phase, frequency and voltage In power automation
- IEC 61850(communication protocols for intelligent electronic devices at electrical substations) GOOSE (Generic Object Oriented Substation Event) and Sampled-Values (SV) messages
- Various TSN shapers require synchronized time across all devices
- Sensor Data Fusion (integrating data from several sensors, see https://ieeexplore.ieee.org/document/7247189). Example applications include spectrum analyzers, gas analyzers, temperature sensors flow sensors, etc.
- Sensor input to driver assistance systems (https://ieeexplore.ieee.org/document/6070146), including “target” tracking using multiple sensors
- Real time multiaxis motion control and feedback response/adjustments.

Sequence of Events in Industrial/Process Automation

Sequence of events (SOE) is a mechanism to record timestamped events from all over a plant in a common database (on-premise database.

Application defined events are e.g. changes of digital input signal values. Additional data may be provided together with the events, e.g. universal time sync state and grandmaster, working clock domain and value … SOE enables root-cause analysis of disruptions after multiple events have occurred. Therefore SOE can be used as diagnostics mechanism to minimize plant downtime. Plant-wide precisely synchronized time is a precondition for effective SOE application. SOE support may even be legally demanded e.g. for power generation applications.

Requirements:

- Plant wide high precision Universal Time synchronization;
- Maximum deviation to the grandmaster time in the range from 1 µs to 100 µs;
- Optional support of redundant sync masters and domains;
- Non-zero failover time in case of redundant universal time domains;

Useful 802.1 mechanisms: IEEE 802.1AS-Rev

Note: Use case taken from IEC/IEE 60802 (the TSN-Profile for Industrial Automation)

Comment #90 Suggested Remedy - Updated

Replace "The TSSI is defined for the full-duplex mode of operation only." with "The TSSI is defined for the full-duplex mode of operation ~~*only*~~*, as well as clause 147 half-duplex point-to-point and multidrop.*"

Add the following paragraph to the end of 90.4.3.1.1 Semantics

"When using the half-duplex mode of operation, multiple TS_TX indications may be produced for a single MA_DATA.request as a result of collisions on the media.

90. Ethernet support for time synchronization protocols

90.1 Introduction

This clause specifies the optional Time Synchronization Service Interface (TSSI). The TSSI can be used to support protocols that require knowledge of packet egress and ingress time.

The TSSI is defined for the full-duplex mode of operation***, as well as clause 147 half-duplex point-to-point and multidrop***. It supports MAC operation at various data rates. The MII (Clause 22), GMII (Clause 35), XGMII (Clause 46), 25GMII (Clause 106), XLGMII (Clause 81), GMII (Clause 81), 200GMII (Clause 117), and 400GMII (Clause 117) specifications are all compatible with the gRS sublayer defined in 90.5.

90.4.3.1.1 Semantics

The semantics of the primitive are as follows:

TS_TX.indication(SFD, MM)

The SFD parameter can take only one possible value, DETECTED. When asserted (SFD = DETECTED), the TimeSync Client is notified that a valid SFD was detected by the gRS sublayer TS_SFD_Detect_TX function (see 90.5.1) in the xMII transmit signals.

The MM parameter is mandatory when the MAC Merge sublayer (see Clause 99) is instantiated. The MM parameter, when present, can take one of two possible values, i.e., PMAC or EMAC. The value EMAC indicates the SMD-E (SFD) value has been detected at the xMII. The value PMAC indicates that an SMD-S value has been detected at the xMII (see Table 99–1). The MM parameter is not provided when MAC Merge sublayer is not instantiated.

When using the half-duplex mode of operation, multiple TS_TX indications may be produced for a single MA_DATA.request as a result of collisions on the media.

Comment #91 Suggested Remedy - Updated

Modify "Figure 148-2--PLCA functions within the Reconciliation Sublayer (RS)" to add *TS_TX.indication, TS_RX.indication, SFD DETECT TX and SFD DETECT RX as shown in D2.0 Figure 148-3*.

Insert the following subclause before "148.4.3 Mapping of MII signals to PLS service primitives and PLCA functions"

Operation with TSSI
When TSSI is supported, transmit SFD detection occurs after the PLCA variable delay line, as shown in Figure 148-2.
Clause 90 defines TS_TX.indication (90.4.3.1) and TS_RX.indication (90.4.3.2). Clause 90 also defines TS_SFD_Detect_TX (90.5.1) and TS_SFD_Detect_RX(90.5.2), these are shown in Figure 148-2 as SFD DETECT TX and SFD DETECT RX respectively.

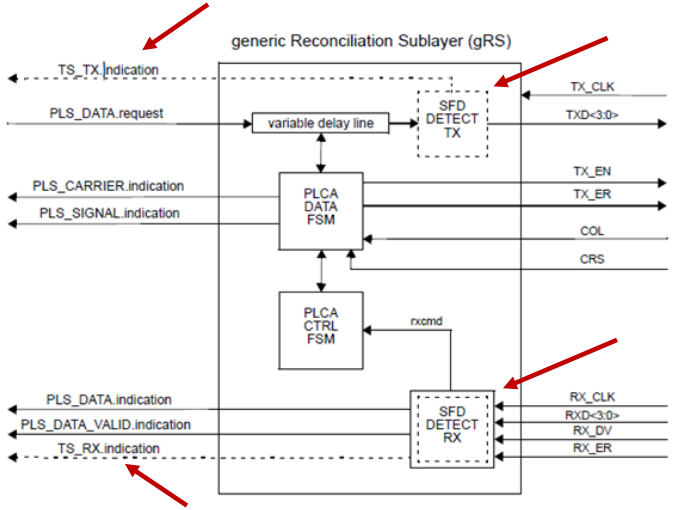

Figure 148–2—PLCA functions within the Reconciliation Sublayer (RS)

148.4.2.1 Operation with TSSI

When TSSI is supported, transmit SFD detection occurs after the PLCA variable delay line, as shown in Figure 148-2.

Clause 90 defines TS_TX.indication (90.4.3.1) and TS_RX.indication (90.4.3.2). Clause 90 also defines TS_SFD_Detect_TX (90.5.1) and TS_SFD_Detect_RX(90.5.2), these are shown in Figure 148-2 as SFD DETECT TX and SFD DETECT RX respectively.

148.4.3 Mapping of MII signals to PLS service primitives and PLCA functions

The RS maps the signals provided at the MII to the PLS service primitives defined in Clause 6 via the PLCA state diagrams, variables, and functions (see 148.4.5 and 148.4.6). The PLS service primitives provided by the RS behave in exactly the same manner as defined in Clause 6.

What about PICS for TSSI support?

- Don’t need PICS for TSSI with 10-BASET1S.
- TSSI only mentioned in Clause 1 and clause 90.
- If you have TSSI, clause 90 PICS is provided.
- None of the other RS’s include TSSI in their PICS. RS’s checked:
  - 22. Reconciliation Sublayer (RS) and Media Independent Interface (MII)
  - 35. Reconciliation Sublayer (RS) and Gigabit Media Independent Interface (GMII)
  - 46. Reconciliation Sublayer (RS) and 10 Gigabit Media Independent Interface (XGMII)
  - 65. Extensions of the Reconciliation Sublayer (RS) and Physical Coding Sublayer (PCS)/Physical Media Attachment (PMA) for 1000BASE-X for multipoint links and forward error correction
  - 66. Extensions of the 10 Gb/s Reconciliation Sublayer (RS), 100BASE-X PHY, and 1000BASE-X PHY for unidirectional transport
  - 76. Reconciliation Sublayer, Physical Coding Sublayer, and Physical Media Attachment for 10G-EPON
  - 81. Reconciliation Sublayer (RS) and Media Independent Interface for 40 Gb/s and 100 Gb/s operation (XLGMII and CGMII)
  - 101. Reconciliation Sublayer, Physical Coding Sublayer, and Physical Media Attachment for EPoC
  - 106. Reconciliation Sublayer (RS) and Media Independent Interface (25GMII) for 25 Gb/s operation
  - 117. Reconciliation Sublayer (RS) and Media Independent Interface for 200 Gb/s and 400 Gb/s operation (200GMII and 400GMII)

Why Now?

- 802.3cg is a “Physical Layer” project including half-duplex point-to-point and multidrop
  - RS is in scope for “Physical Layer” projects
- Clause 90 defines “an extension to the Reconciliation Sublayers specified elsewhere in this standard”
- Significant portion of target market requires PTP
- Adding to 802.3cg now avoids a 2+year wait
- Decouples the 802.3 & 802.1 work
- Changes are simple

Thank You!