802.3cg 10SPE AdHoc

Half-duplex and Precision Time Protocol(PTP)

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- 802.3cg is the first 802.3 half-duplex PHY for a very long time
  - Half-duplex point-to-point and multi-drop
- Precision Time Protocol (PTP) is defined in IEEE 1588.
  - 802.1AS is "Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks"
  - 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)
- Clause 90 – "Ethernet support for time synchronization protocols" excludes half-duplex
    - "The TSSI is defined for the full-duplex mode of operation only."

802.3cg D3.1 comments #90 & #91

Comment ID	Commenter Name	CommenterCo	Clause	Subclause	Page	Line	Comment Type	Comment	SuggestedRemedy
90	Jones, Peter	Cisco Systems, Inc.	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."
91	Jones, Peter	Cisco Systems, Inc.	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."

Examples needing Precision Time

- 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 SO 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

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."

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 only***, 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), CGMII (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_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.

Comment #91 Suggested Remedy

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.

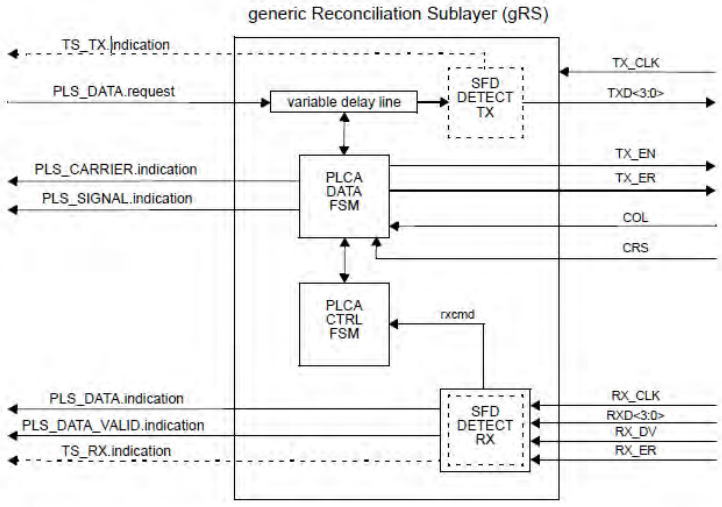

Figure 148–2—PLCA functions within the Reconciliation Sublayer (RS)

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

148.4.2.1 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

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

Why Now?

- We missed it before.
- 802.3ch is a “Physical Layer” project, and we added a half-duplex PHY.
- Clause 90 defines “an extension to the Reconciliation Sublayers specified elsewhere in this standard”

  FYI - 802.3br modified clause 90 when defining the MAC Merge sublayers without calling it out in PAR, CSD or objectives
- It’s required for a significant portion of our target market
- Adding this to 802.3cg now avoids a 2+year wait
- Decouples the 802.3 vs 802.1 work
- Changes are simple

Thank You!