IEEE P802.3bf and synchronization for EPoC

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and siepon_1002_hajduczenia.pdf

Outline

- IEEE P802.3bf overview
  - Background information
  - Objectives (formal and informal)
  - Additional information
  - Applications
  - Architecture
  - Downstream and upstream transmission directions
  - Objects, registers and their relationships
- TimeSync for EPoC

IEEE Std 802.3bf™-2011 overview

IEEE P802.3bf Background (I)

- Before 802.3bf TF was formed …
  - Work on Ethernet time synchronization started in 2004 within the Residential Ethernet Study Group (RESG SG) in IEEE 802.3 WG
  - RESG determined that the project was best suited for IEEE 802.1Higher Layer LAN Protocols WG
  - IEEE 802.1 WG created the Audio-Video Bridging Group (802.1 AVB)
  - At the time, it was understood that there would be an 802.3 component to support the 802.1 AVB work

IEEE P802.3bf Background (II)

- and where IEEE 802.3 is now…
  - Ethernet Support for the IEEE P802.1AS Time Synchronization Protocol Task Force (IEEE 802.3bf) started work in January 2010
  - Work within IEEE P802.3bf was completed successfully in March 2011, with the standard published on the 15th of July 2012 as IEEE Std 802.3bf™-2011
  - Project materials were achieved and are available at http://www.ieee802.org/3/bf/index.html
  - Clause 90 of the base document 802.3-2012
    - Optional feature

IEEE P802.3bf Objectives

- **Formal objectives:**
  - Provide an accurate indication of the transmission and reception initiation times of certain packets as required to support IEEE P802.1AS.
- **Additional goals:**
  - Restrict changes to IEEE 802.3 base document (i.e. don't change the PHY clauses)
  - Provide PHY agnostic solution, capable of supporting existing and future 802.3 PHYs
  - Provide open architecture, which can be scaled to higher data rate PHYs

IEEE 802.3bf project information

- **Primary website**
  - http://www.ieee802.org/3/bf/
- **Public folder**
  - http://www.ieee802.org/3/bf/public/index.html
- **Private folder (including the draft)**
  - http://www.ieee802.org/3/bf/private/
- **IEEE 802.3bf PAR**
  - http://www.ieee802.org/3/bf/P802.3bf.pdf
- **IEEE 802.3bf 5 Criteria**
  - http://www.ieee802.org/3/time_adhoc/P802_3bf_5Criteria_802_3_approved_1109.pdf
- **IEEE 802.3bf Objectives**
  - http://www.ieee802.org/3/time_adhoc/P802_3bf_objective_802_3_approved_1109.pdf
- **Email reflector**
  - http://www.ieee802.org/3/bf/reflector.html

IEEE 802.3bf applications

- Provides an accurate indication of the transmission and reception times of all packets
  - direct use case in IEEE 802.1AS
  - there is nothing preventing other use cases as well
    - TSSI is defined in an abstract manner and it is not bound to a specific PHY / PHY class
    - For example, IEEE 1588v2 can use 802.3bf TSSI interface for support of transparent clocks
    - Any custom protocol that requires 802.3bf functionality may also use the 802.3bf TSSI

Abstract Service Interface

- Clause 2 MAC Service Interface example

  MA_DATA.request (destination_address, source_address, mac_service_data_unit, frame_check_sequence)

  This primitive defines the transfer of data from a MAC client entity to a single peer entity or multiple peer entities in the case of group addresses.

MAC Client output
MA_DATA.request
(MAC Service
interface)

- Clause 6 Physical Signaling (PLS) service Interface example

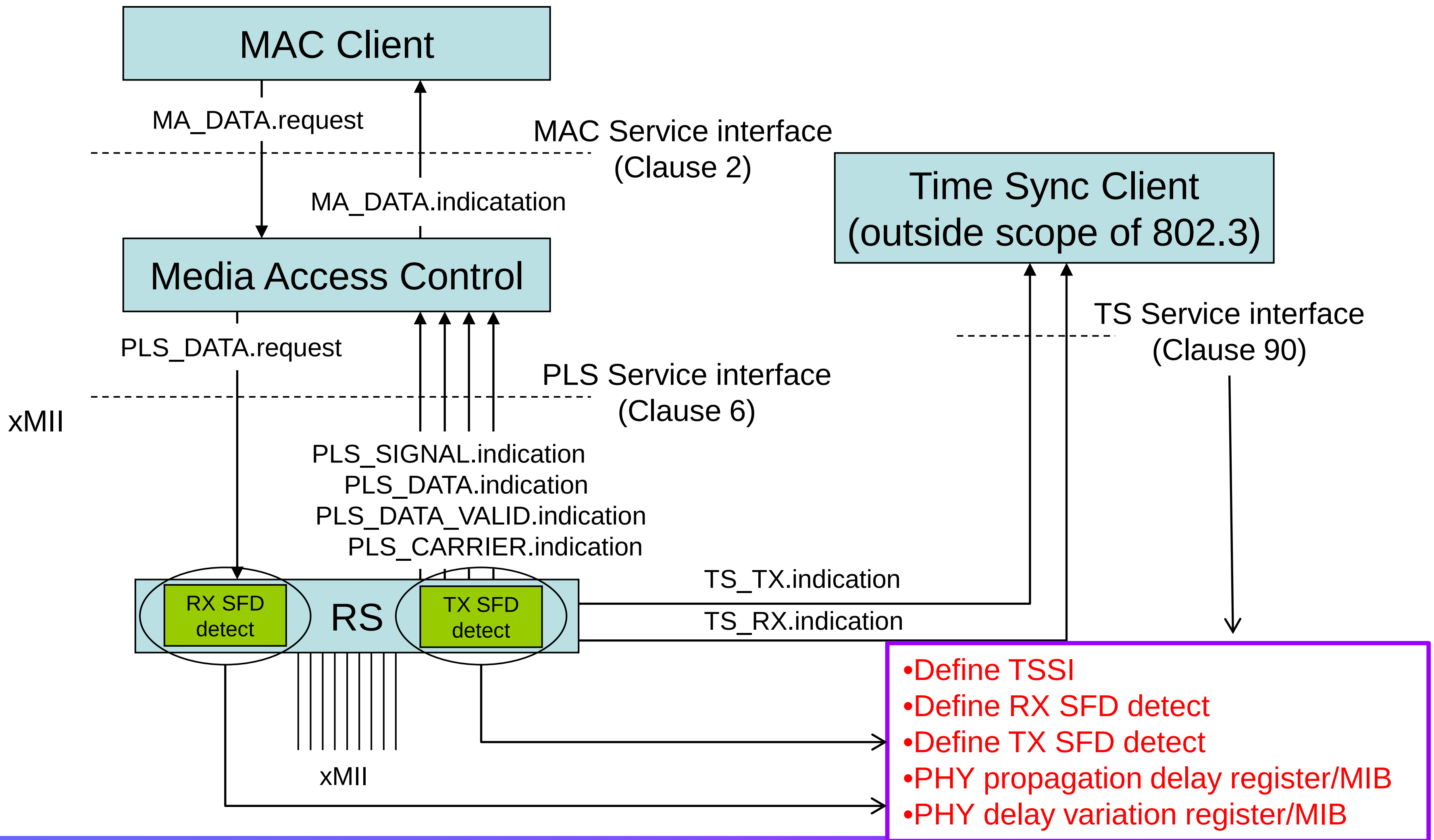
  PLS_DATA.request (OUTPUT_UNIT)

  The OUTPUT_UNIT parameter can take on one of three values: ONE, ZERO, or DATA_COMPLETE and represent a single data bit. The DATA_COMPLETE value signifies that the Media Access Control sublayer has no more data to output.

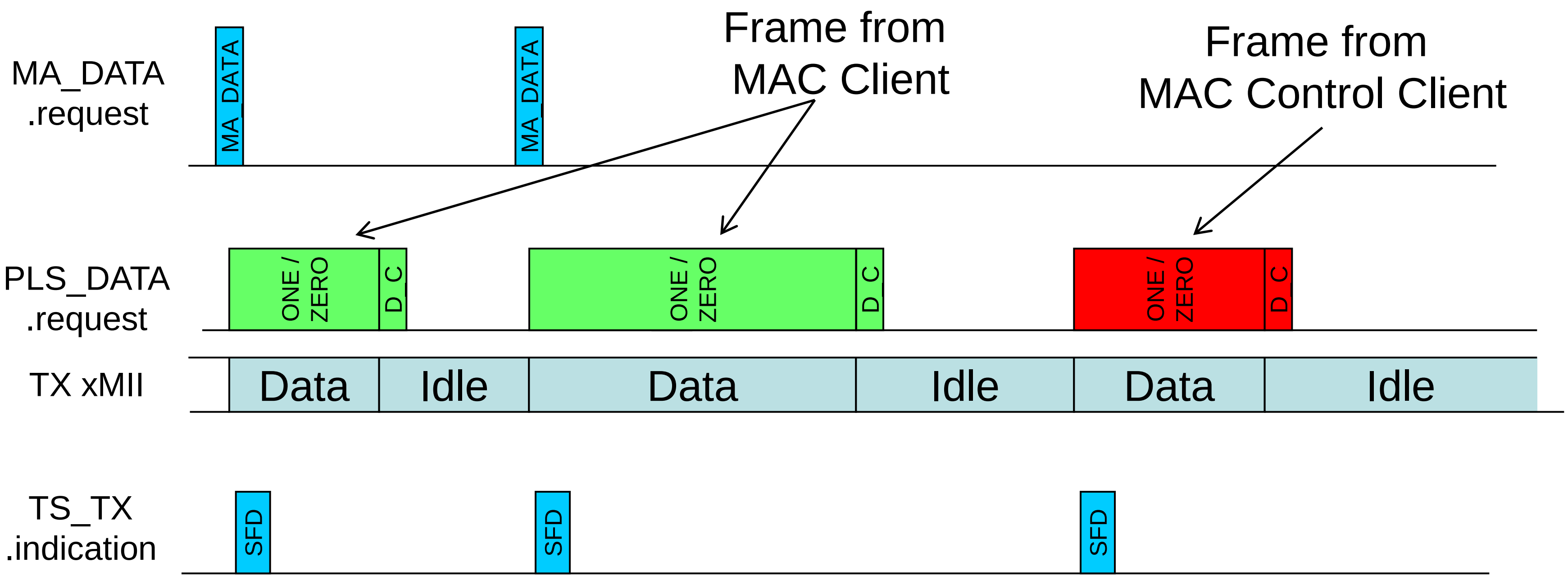
MAC output
PLS_DATA.request
(PLS Service
interface)

NOTE – The above is only an **illustration** of the abstract messages passing interface – messages are instantaneous

IEEE P802.3bf Architecture

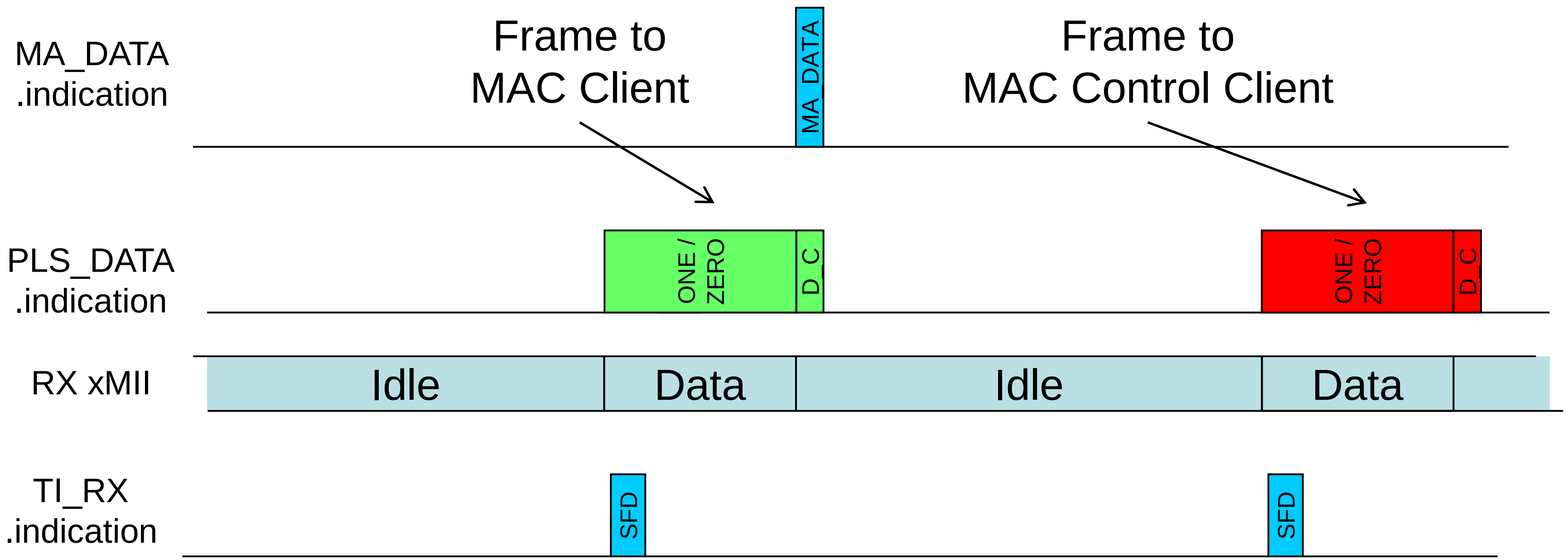


Service primitive generation – downstream
(simplification)



- Frames may be generated by MAC Control Client and not by MAC Client
  - In that case, MA_DATA.request is not generated (nothing is passed through the MAC Service Interface)
  - TS_TX.indication will be generated nonetheless (there is a frame passed through the xMII)

Service primitive generation – upstream
(simplification)



- Frames may be addressed to MAC Control Client and not to MAC Client
  - In that case, MA_DATA.indication is not generated (nothing is passed through the MAC Service Interface)
  - TS_RX.indication will be generated nonetheless (there is a frame passed through the xMII)

Interlayer service interfaces

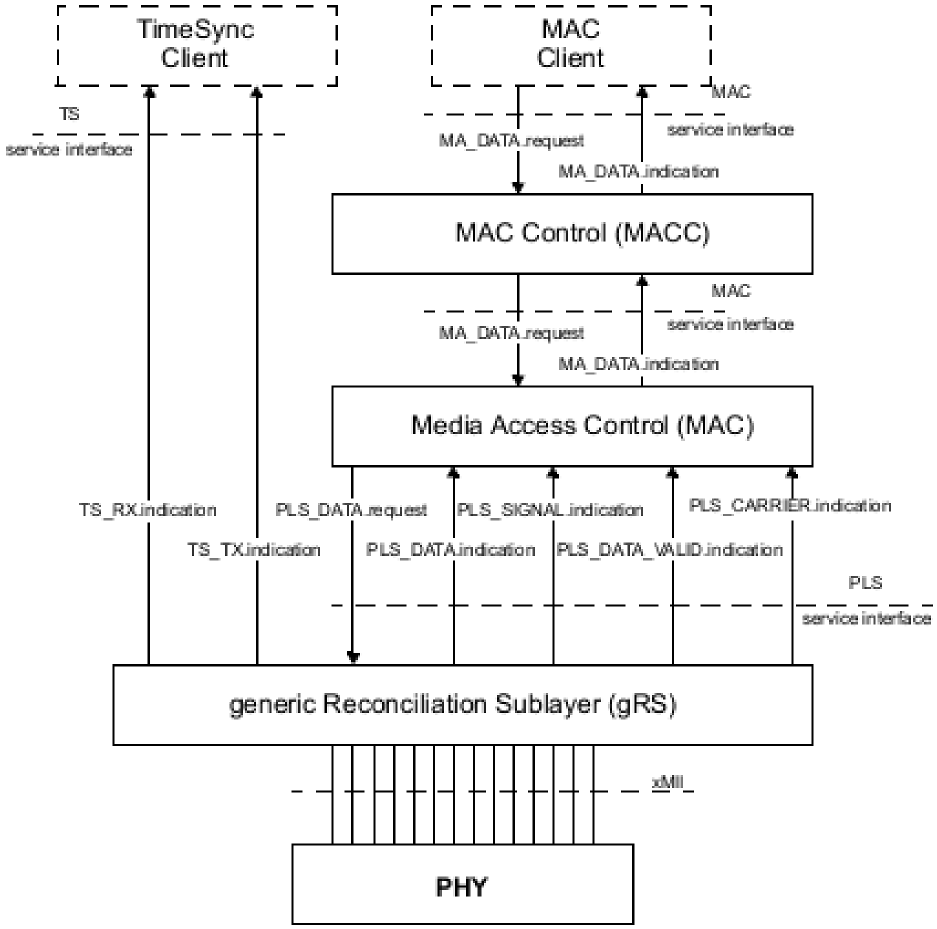


Figure 90–1—Relationship of the TimeSync Client, TSSI, and gRS sublayer relative to MAC and MAC Client and associated interfaces

- Shows source / destination for TS_RX and TS_TX indication primitives
- Reuses the parallel data path model to dedicated MAC Client introduced in EEE (802.3az)
- Detection functions are embedded in the generic RS (gRS) sublayer, and applicable to any Ethernet PHY that needs TimeSync capability

TimeSync SFD detection functions

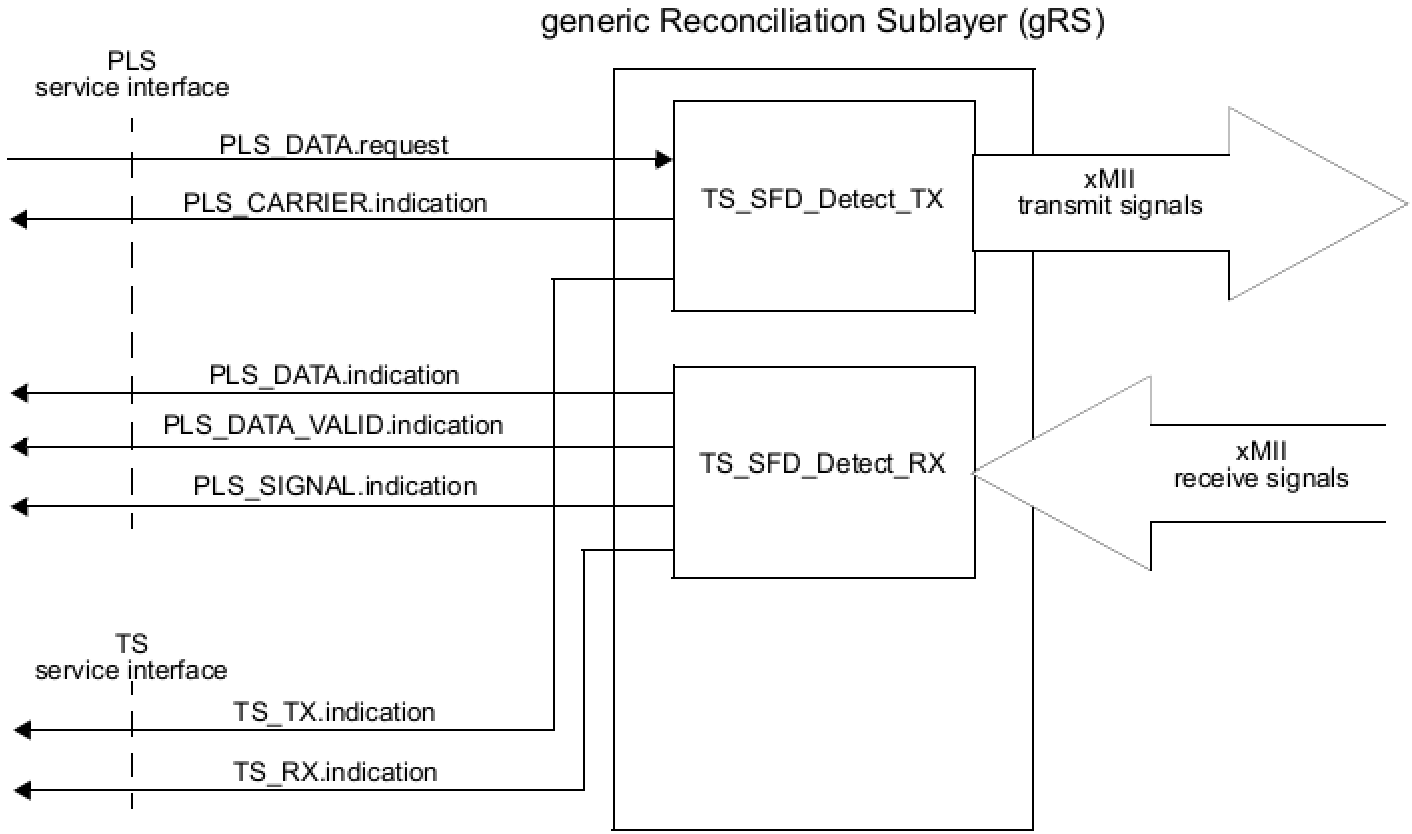


Figure 90–2—TS_SFD_Detect_TX and TS_SFD_Detect_RX functions within the generic Reconciliation Sublayer (gRS)

Clause 30 objects

- Added oTimeSync entity in subclause 30.13 (optional), containing a series of object class attributes
  - aTimeSyncCapabilityTX / aTimeSyncCapabilityRX : true if the TimeSync capability is supported in the transmit / receive path and false otherwise. Calculated based on the status of TimeSync support for instantiated MDIO registers in existing sublayers
  - aTimeSyncDelayTXmax / aTimeSyncDelayTXmin: the maximum / minimum transmit data delay as specified in 90.7, expressed in units of ns. Corresponds to the total maximum / minimum for transmit path delay for PMA/PMD, WIS, PCS, PHY XS, DTE XS and/or TC sublayers, when present.
  - aTimeSyncDelayRXmax / aTimeSyncDelayRXmin: the maximum / minimum receive data delay as specified in 90.7, expressed in units of ns. Corresponds to the total maximum / minimum for receive path delay for PMA/PMD, WIS, PCS, PHY XS, DTE XS and/or TC sublayers, when present
- These objects will be part of revised 802.3.1-2011 (added under P802.3.1a project under way)

Clause 45 registers

- Implemented in all PMD sublayers i.e. PMA/PMD, WIS, PCS, PHY XS, DTE XS and/or TC, to which Clause 45 MDIO interface is implemented to
- Register set for each sublayer is composed of the following elements:
  - X represents the register group for the given sublayer e.g. 1 for PMA/PMD, 2 for WIS, 3 for PCS etc.
  - Capability register X.1800 (2 octets), with independent indication for receive and transmit data path
  - Transmit path data delay register X.1801 – X.1804 (2 x 4 octets), which stores 4 octets representing maximum and 4 octets representing minimum transmit path data delay for the given sublayer
  - Receive path data delay register X.1805 – X.1808 (2 x 4 octets), which stores 4 octets representing maximum and 4 octets representing minimum receive path data delay for the given sublayer
- Clause 45 registers and Clause 30 objects map into each other as defined in Clause 30 object definitions

Summary of TimeSync features

Table 90–1—Summary of TimeSync features in Clause 45

Register	Name	Reference
1.1800	TimeSync PMA/PMD capability register	45.2.1.100
1.1801 through 1.1804	TimeSync PMA/PMD transmit path data delay	45.2.1.101
1.1805 through 1.1808	TimeSync PMA/PMD receive path data delay	45.2.1.102
2.1800	TimeSync WIS capability register	45.2.2.20
2.1801 through 2.1804	TimeSync WIS transmit path data delay	45.2.2.21
2.1805 through 2.1808	TimeSync WIS receive path data delay	45.2.2.22
3.1800	TimeSync PCS capability register	45.2.3.40
3.1801 through 3.1804	TimeSync PCS transmit path data delay	45.2.3.41
3.1805 through 3.1808	TimeSync PCS receive path data delay	45.2.3.42
4.1800	TimeSync PHY XS capability register	45.2.4.10
4.1801 through 4.1804	TimeSync PHY XS transmit path data delay	45.2.4.11
4.1805 through 4.1808	TimeSync PHY XS receive path data delay	45.2.4.12
5.1800	TimeSync DTE XS capability register	45.2.5.10
5.1801 through 5.1804	TimeSync DTE XS transmit path data delay	45.2.5.11
5.1805 through 5.1808	TimeSync DTE XS receive path data delay	45.2.5.12
6.1800	TimeSync TC capability register	45.2.6.14
6.1801 through 6.1804	TimeSync TC transmit path data delay	45.2.6.15
6.1805 through 6.1808	TimeSync TC receive path data delay	45.2.6.16

- NOTE — Register location in Clause 45 as shown is based on IEEE Std 802.3bf™-2011
- Location in IEEE Std 802.3-2012 (when published) may be different due to merging of various amendments
- Clause 30 objects will be relocated to 802.3.1-201X, when published.

Delay measurement

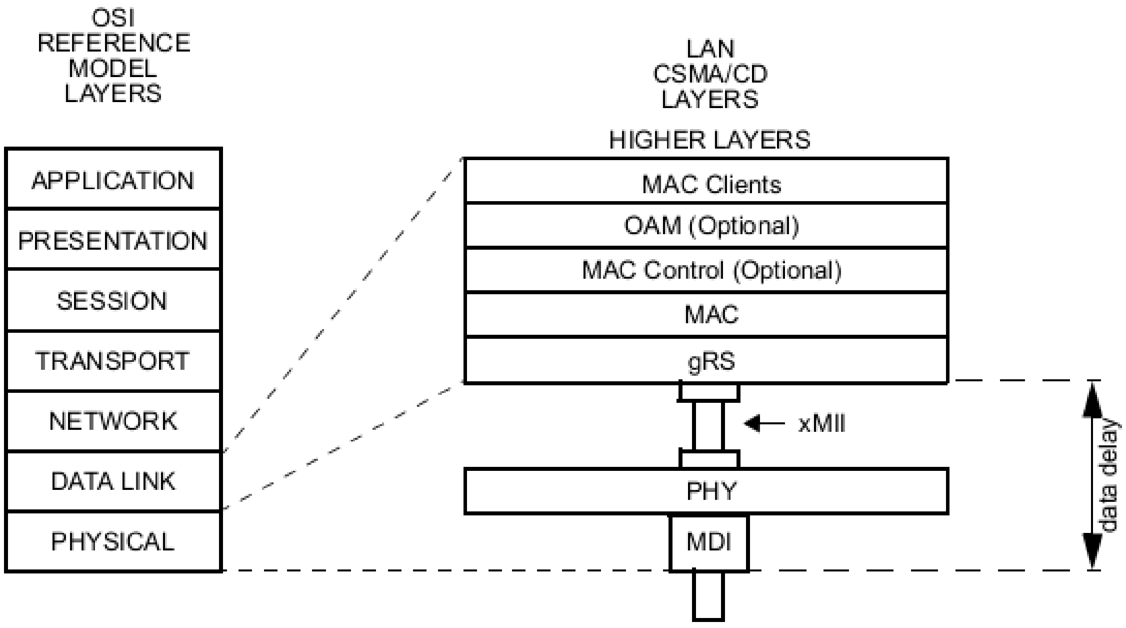


Figure 90–3—Data delay measurement

- Performed between the bottom of MDI and top of xMII
- Covers the absolute min/max delay in transmit/receive path for:
  - Whole path (managed objects in clause 30), representing the total of delays for all instantiated sublayers (registers in Clause 45)
  - Individual instantiated sublayers (registers in Clause 45)

TimeSync for EPoC

the need …

- The SG should clearly indicate the need to provide native support for any IEEE 1588v2 profile in future EPoC specifications
  - Any IEEE 1588v2 profile, or any other synchronization mechanism can take advantage of TimeSync interfaces.
  - There are no restrictions imposed by TimeSync specifications
- Once the need is identified, support for TimeSync in EPoC is straightforward …

the means …

- List of potential future requirements for EPoC specifications to support TimeSync:
  - Make sure that the support for oTimeSync entity is mandatory in EPoC package
  - Mandate support for Clause 45 registers associated with TimeSync in all sublayers mandatory and optional for implementation in EPoC
  - Make sure that RS defined in EPoC references to SFD detect functions defined in Clause 90 and that TSSI (TimeSync Service Interface) is also listed as mandatory for implementation
- All remaining requirements and definitions are already part of respective TimeSync related subclauses created under P802.3bf project

Questions?