IEEE 802.3
"Time Sync"

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siepon_1002_hajduczenia.pdf

"Time Sync" Background /1

- ## 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 802.1 WG

  - Effectively, 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

"Time Sync" Background /2

- 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 and had its completed standard published in 2011
  - IEEE P802.3bf is also commonly referenced to as "Time Sync" for short
  - Updates to Clause 90 were made over time to address support for multi-lane systems
    - Maintenance Request 1286 triggered by liaison letter exchange with ITU-T SG15
   - IEEE Std 802.3br-2016

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.

- **Informal objectives:**

  - Restrict changes to IEEE 802.3 base document

  - 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

"Time Sync" Architecture
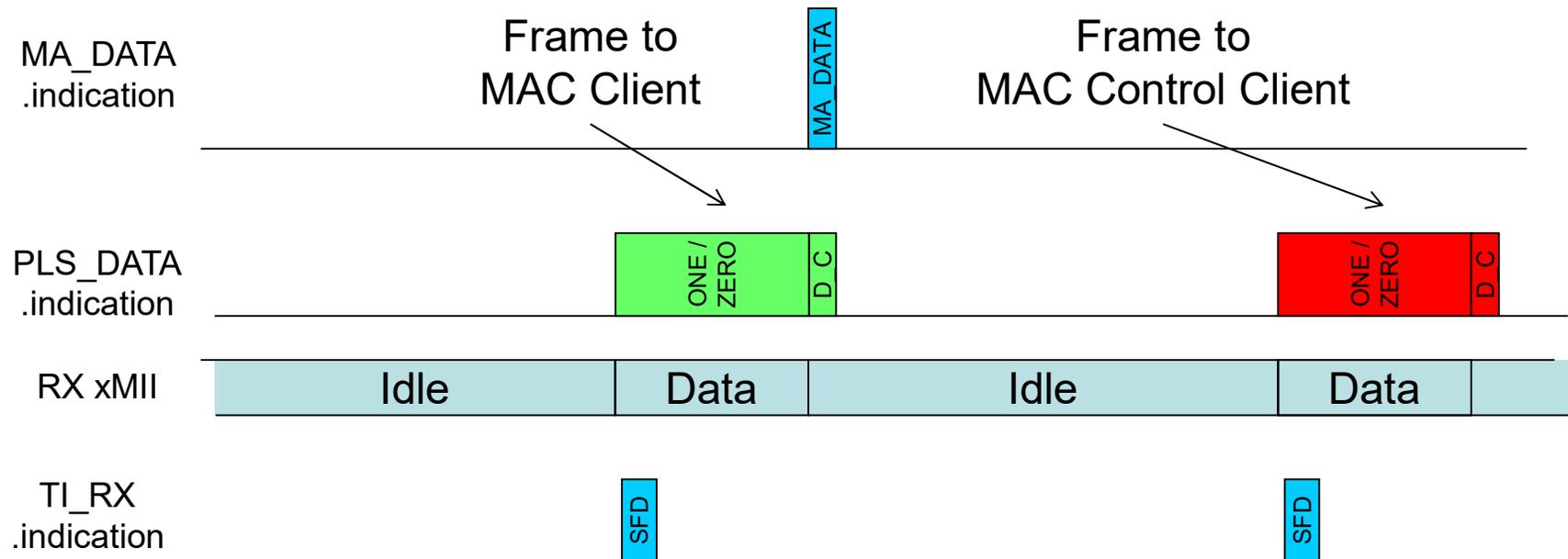
IEEE 802.3 "Time Sync"
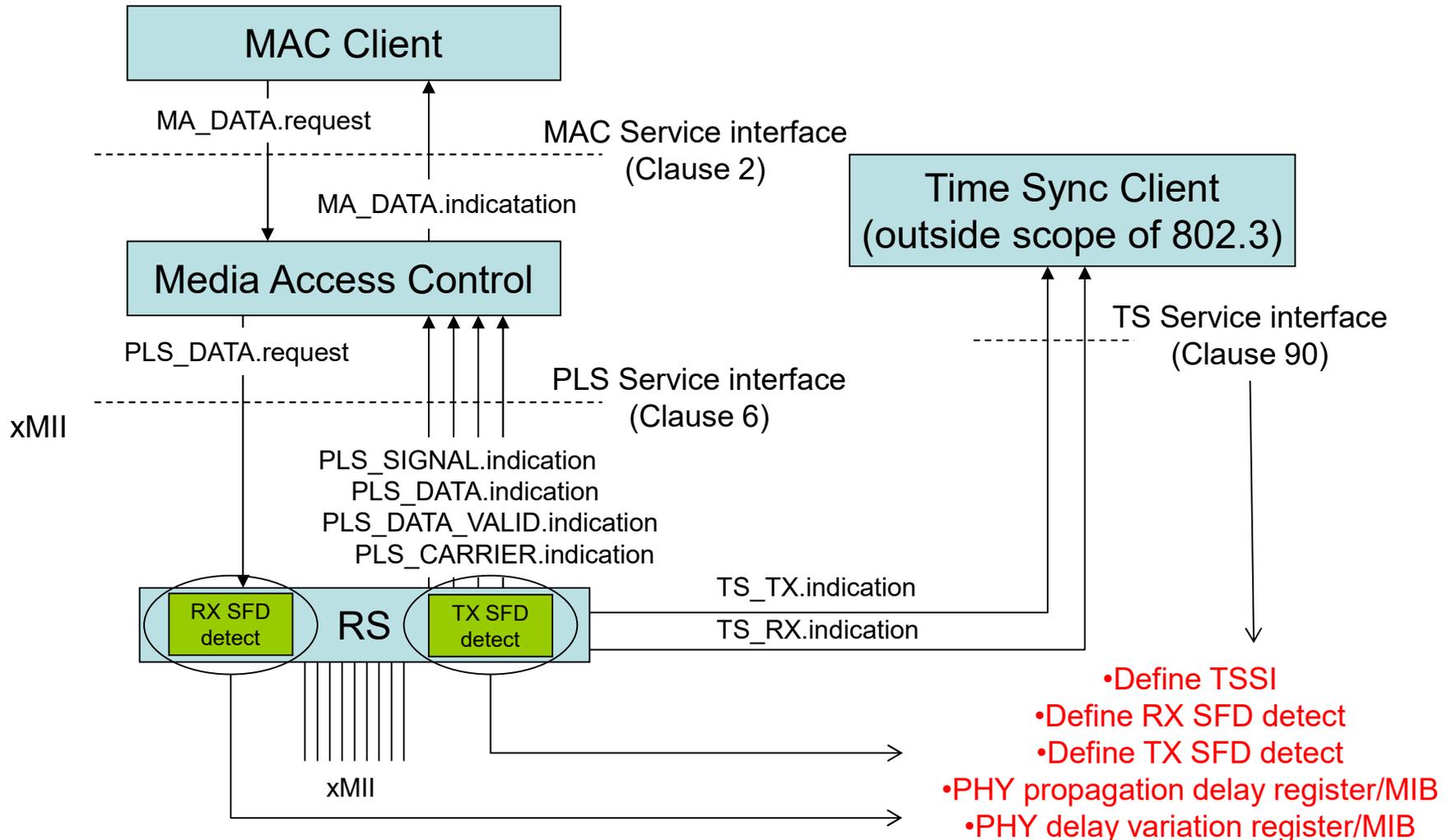
Service primitive generation - downstream
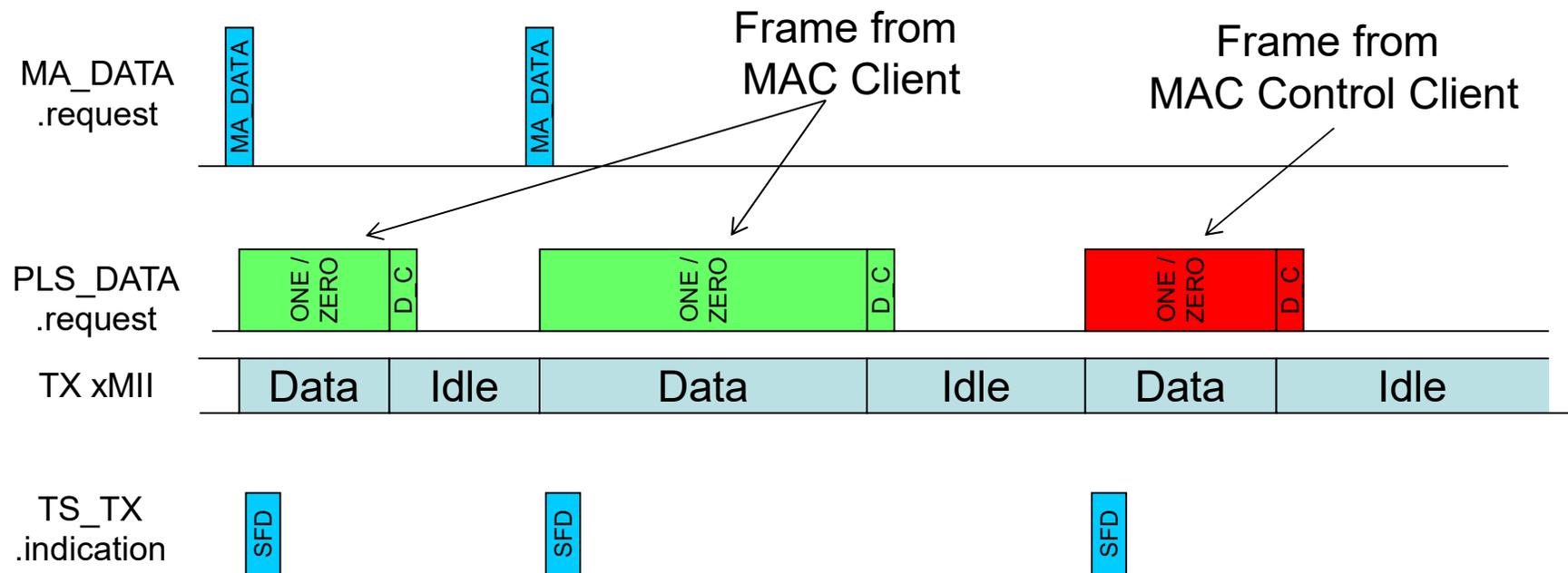
- Frames may be generated by MAC Control Client and not by MAC Client
  - In that case, MA_DATA.request is not generated (nothing is passed through the MAC Service Interface)
  - TS_TX.indication will be generated nonetheless (there is a frame passed through the xMII)

# Service primitive generation - upstream

- 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)

"Time Sync" applications

- Provides an accurate indication of the transmission and reception times of all packets
  - direct use case in IEEE 802.3AS
  - 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
    - IEEE 1588v2 can also use P802.3bf TSSI interface for support of transparent clocks

"Time Sync" and Multi-Lane PHYs

(Figure 1)

(Figure 2)
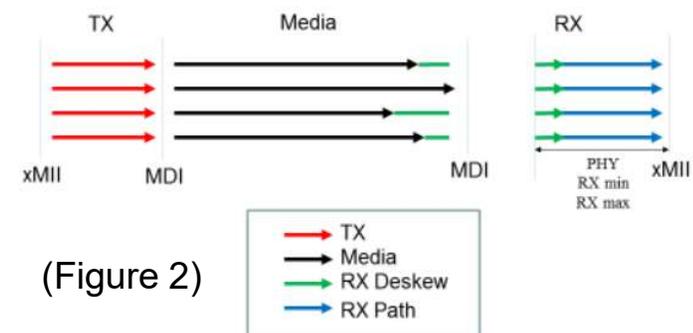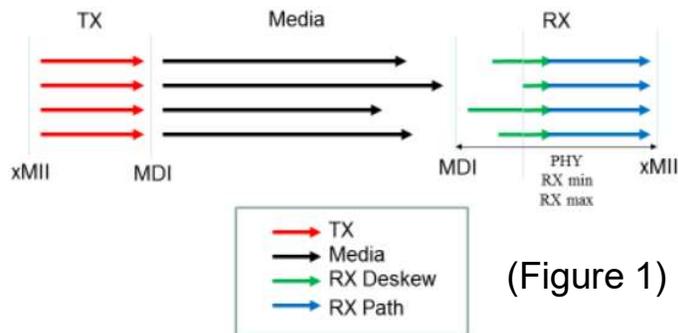
- In multi-lane PHYs, each lane (media) may have different delay due to variations in media length, different propagation speed, etc. PCS lane deskew function compensates for these different media lane delays by removing inter-lane skew.

- Without a definition of which lane of the MDI is used as the timing reference point, the entire inter-lane skew may need to be accounted for in the receive minimum and receive maximum path data delay register values (Figure 1).

- Updates to Clause 90 clarified that the arrival of the SFD on the slowest lane of the MDI is used as the receive path reference point. This will have the effect of associating the alignment delay in excess of the slowest lane on the other lanes to the media, and reducing the delay uncertainly to that of the maximum skew variation (Figure 2).

"Time Sync" current work

- ## IEEE P802.3cx project in flight

  – Define optional enhancements to Ethernet support for time synchronization protocols to provide improved timestamp accuracy in support of ITU-T Recommendation G.8273.2 'Class C' and 'Class D' system time error performance requirements.

  – Align time stamp reference point with other standards

  – Add support for higher precision (sub-ns) delay reporting

IEEE 802.3 "Time Sync"

Questions?

Backup Slides

IEEE 802.3 "Time Sync"

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**
  - 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 802.3cx project information

- **Primary website**
  - http://www.ieee802.org/3/cx/
- **Public folder**
  - https://www.ieee802.org/3/cx/public/index.html
- **Private folder**
  - https://www.ieee802.org/3/cx/private/index.html
- **IEEE 802.3bf PAR**
  - https://mentor.ieee.org/802-ec/...p802-3cx-draft-par-response.pdf
- **IEEE 802.3bf CSD**
  - https://mentor.ieee.org/802-ec/...-p802-3cx-draft-csd-response.pdf
- **IEEE 802.3bf Objectives**
  - https://www.ieee802.org/3/ITSA/P802_3cx_Objectives_190912.pdf
- **Email reflector**
  - https://www.ieee802.org/3/ITSA/email/thrd1.html

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.
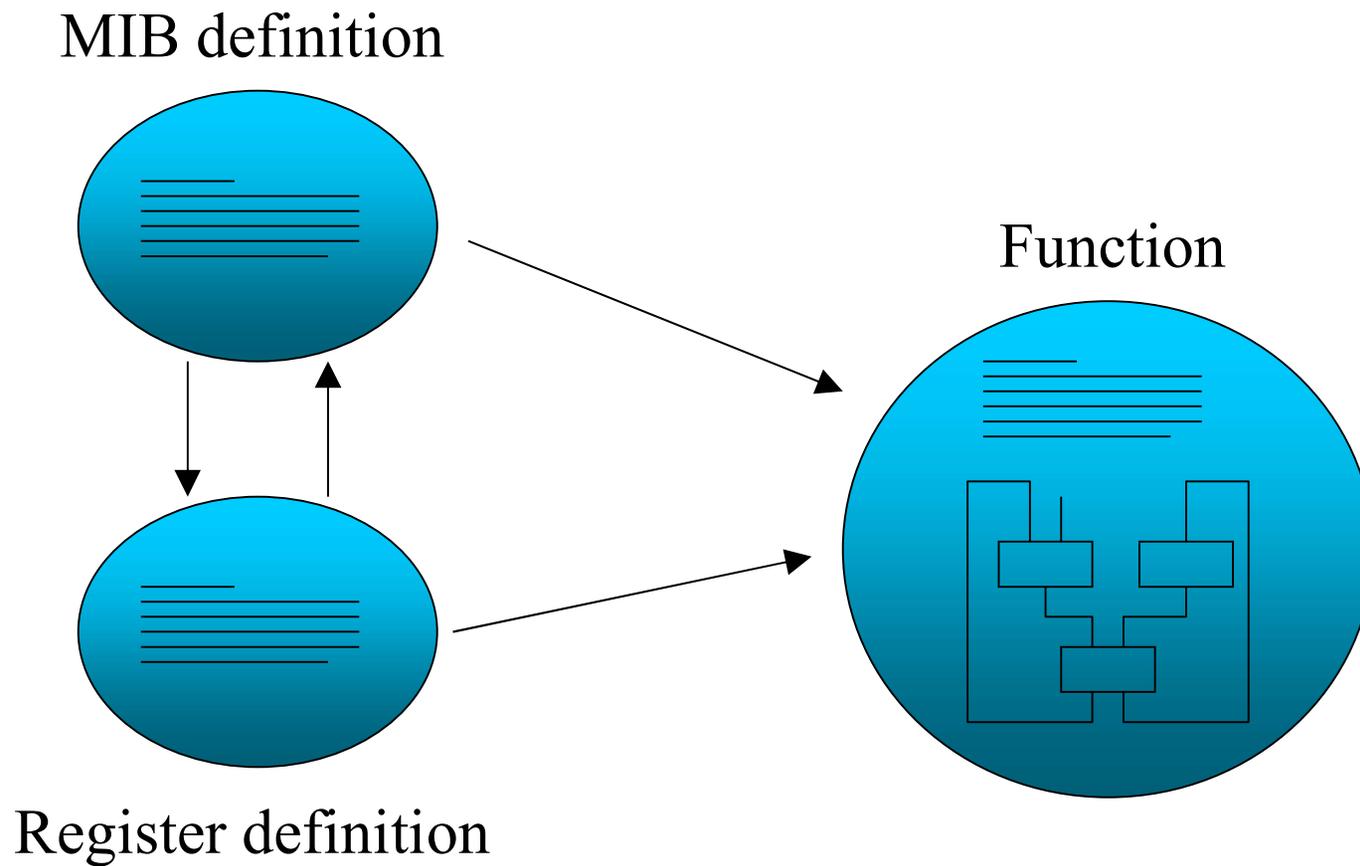
MAC output
PLS_DATA.request
(PLS Service
interface)
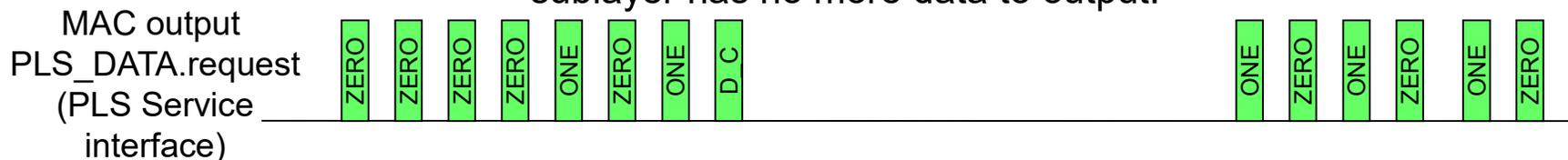
NOTE – The above is only an **illustration** of the abstract messages passing interface – messages are instantaneous

Review of management architecture
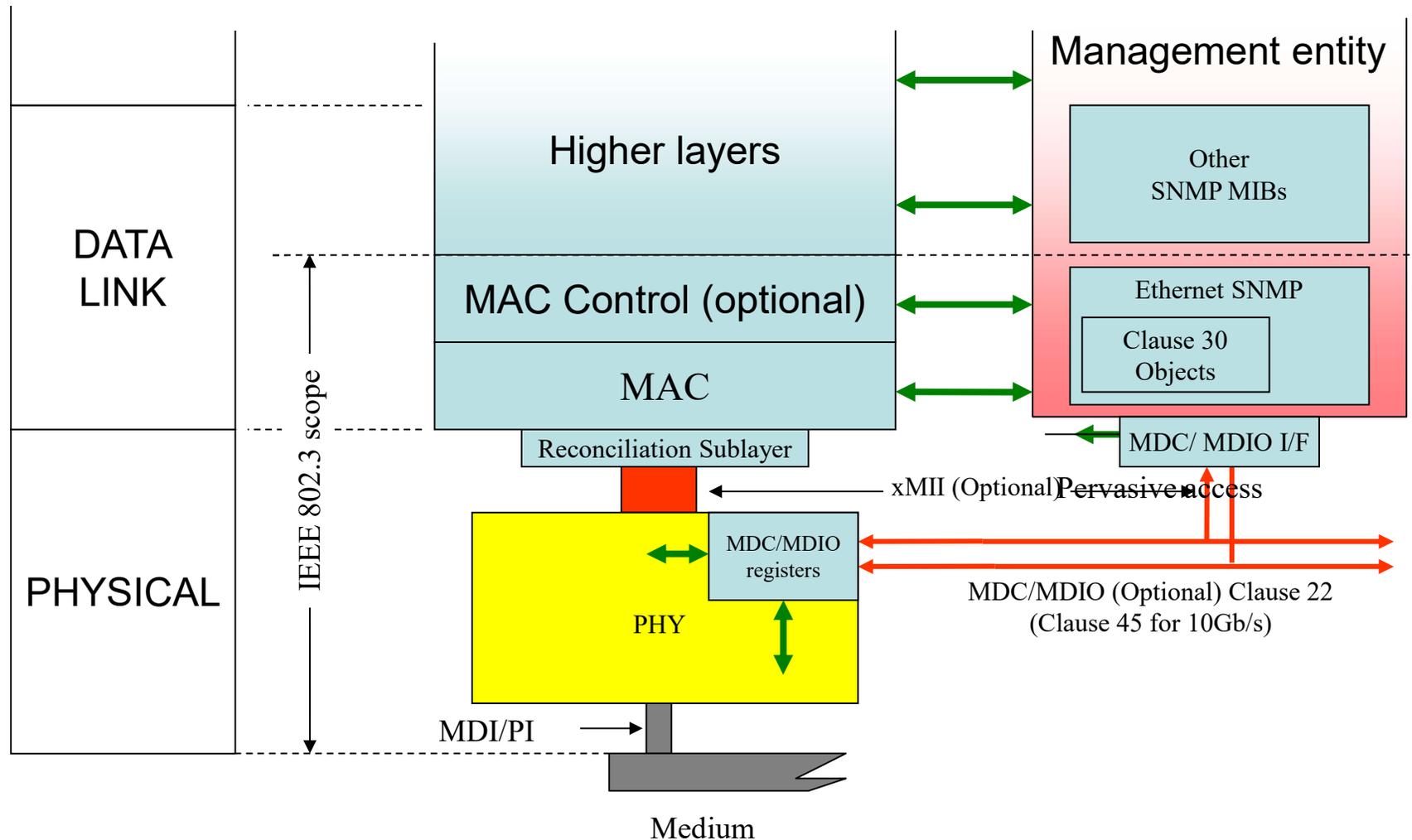
MIB, Registers and Function

Function in PHY needs register access to make it manageable

MIB definition

Function

Register definition

Review of sublayers and interfaces

MAC Client

MA_DATA.request

MA_Control.request

MA_DATA.indicate

MA_Control.indicate

Clause 2

MAC Control

MA_DATA.request

Clause

MA_DATA.indicate

Media Access Control

PLS_DATA.request

Claus

PLS_SIGNAL.indication
PLS_DATA.indication
PLS_DATA_VALID.indication
PLS_CARRIER.indication

RS

Clause 22/35/46

xMII