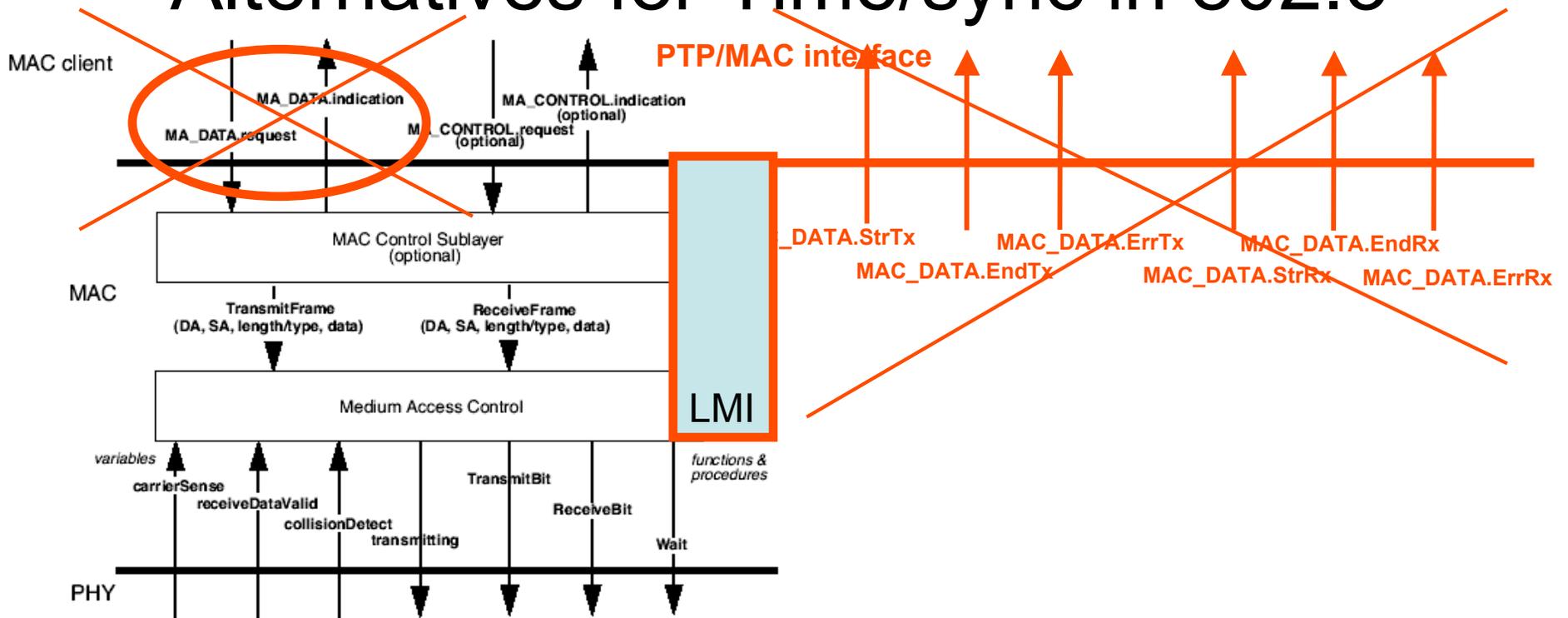


Time Synchronization and 802 models

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Kevin Stanton
Dirceu Cavendish

Alternatives for Time/sync in 802.3



PTP requirements to MAC layer:

- 1- Signal events for start of frame TX/RX
- 2- Signal events for end of TX/RX or error.

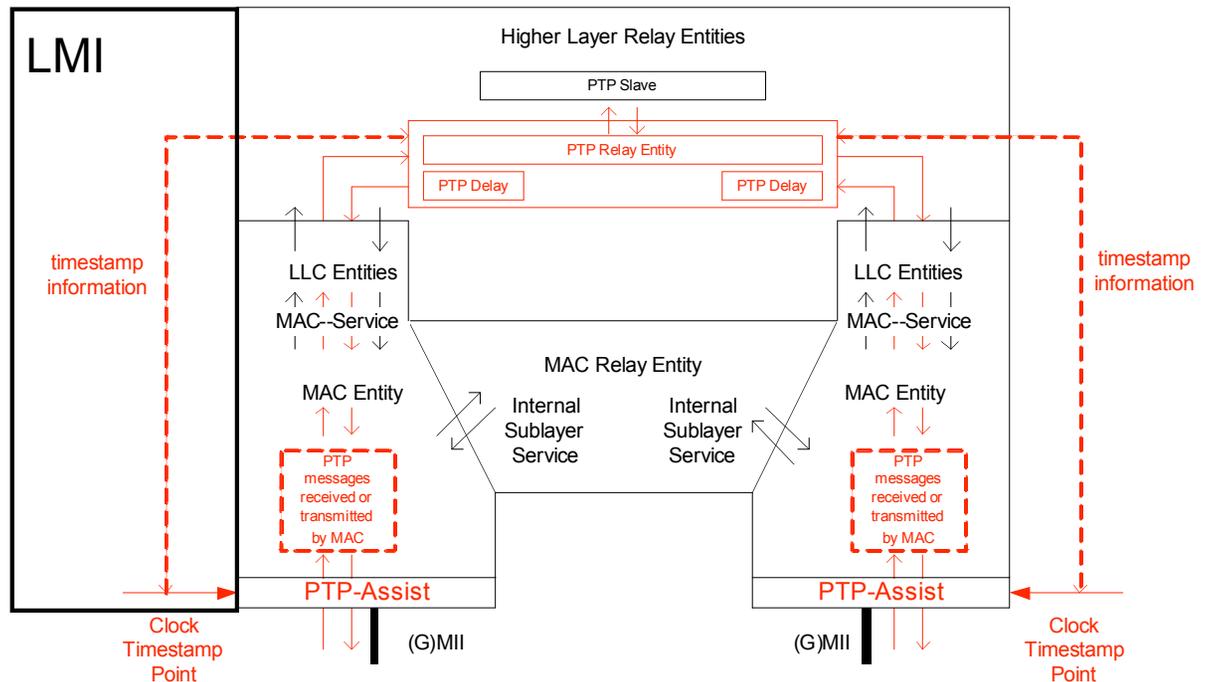
Definitions needed within MAC layer:

- 1- Definition of frame position where those events should be reported
- 2- Definition on where within PHY the start of TX/RX should be detected
- 3- Delay bounds on these events, relative to the definitions of clauses 1 and 2.

July 2006 Plenary output:

- 1- LMI interface is preferable
- 2- MAC client should not rely on MA_DATA.request return parameters of 802.3

802 Baggy Pants Model



LMI TS support

- PHY generates TX_Event, RX_Event within X uSec accuracy
- PTP correlates LMI events with timestamps

Issues

- Does PHY generate TX/RX events for every frame?
 - Bit in frame signals TS requirement @ PHY
- If non-PTP entities (MAC clients) also use TS, PTP is not able to accurately generate TS from PHY events

Receive side

Comments:

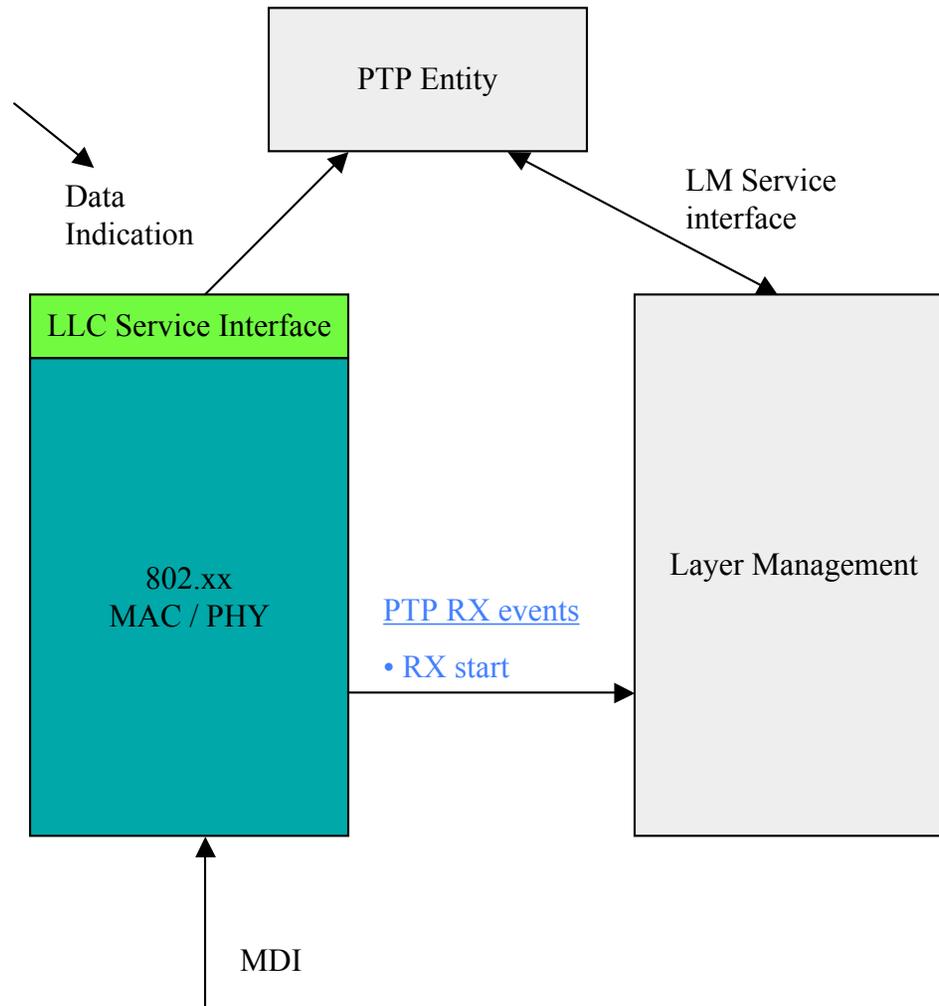
- 1- PTP layer must poll RX_start event, to produce an accurate timestamp
- 2- MA_DATA.indication validates TS produced by latest RX_Event only under the assumption that from RX_Event generation to MA_DATA.indication no other RX_Event is generated. There could be a problem if PTP frames are generated too fast.

From 802.3-2005 section 2.3.2.1

```
MA_DATA.indication (
    destination_address,
    source_address,
    mac_service_data_unit,
    frame_check_sequence,
    reception_status
)
```

Discussion:

Frames are received into the 802.xx MAC / PHY, and at the start of the frame, an RX start is posted to indicate that the front of the frame has passed a predefined location in the stack. The PTP Entity collects the event, and associates a timestamp with it. If a Data Indication is presented later, the time information becomes associated with the frame. If there is another RX start before a Data Indication, previous time information is discarded by the PTP Entity. Location of where the RX start occurs in the 802.xx stack is TBD, but a maximum figure may be specified in 802.1AS.



Transmit side

Comments:

- 1- PTP exclusive parameter may violate GENERIC MAC service interface
- 2- PTP needs to poll TX_Start to generate accurate timestamp

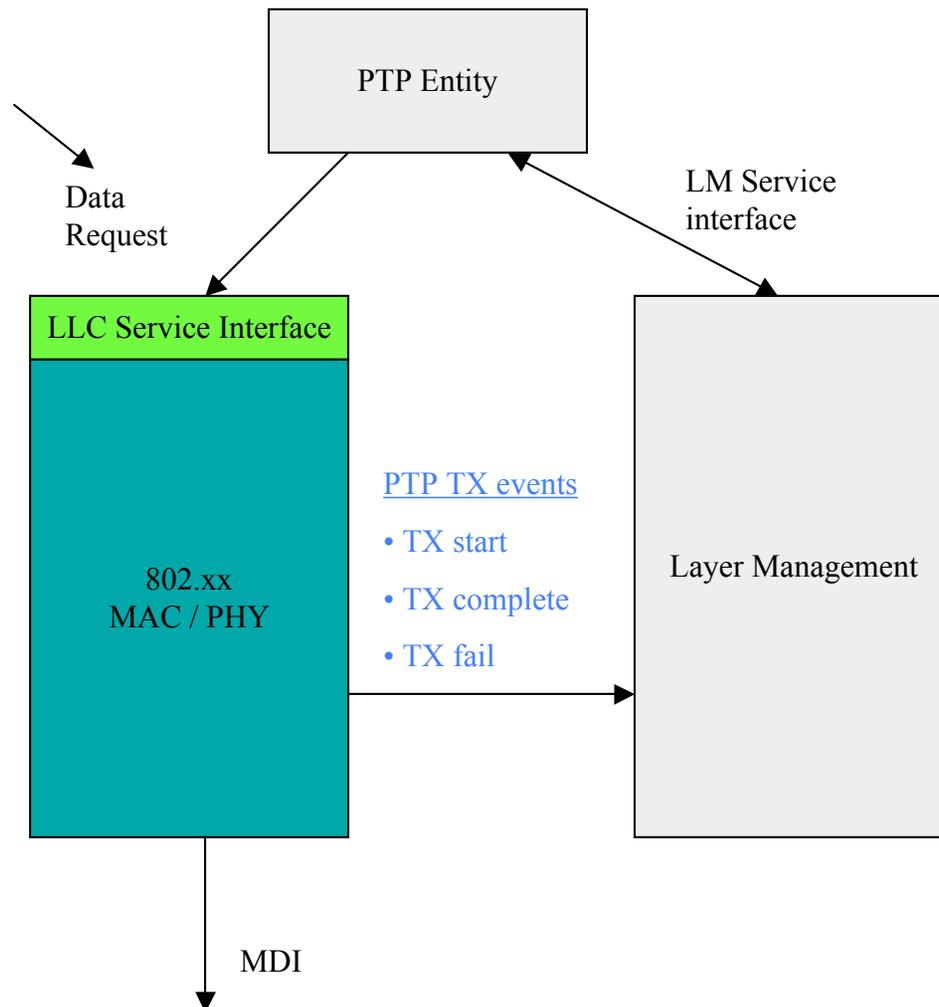
From 802.3-2005 section 2.3.1.2 (modified to include event request)

```
MA_DATA.request    (  
    destination_address,  
    source_address,  
    mac_service_data_unit,  
    frame_check_sequence,  
    Post PTP TX Events  
    )
```

Discussion:

Data Requests are received at the LLC Service Interface for frame transmission. When needed, the PTP Entity requests posting of PTP TX Events that occur lower in the 802.xx stack. Such events are specific to the PTP Entity in order to differentiate from other requestors. The TX start event is posted at the beginning of the frame, and TX complete / fail serve to indicate completion status. Location of where the TX start occurs in the 802.xx stack is TBD, but a maximum figure may be specified in 802.1AS.

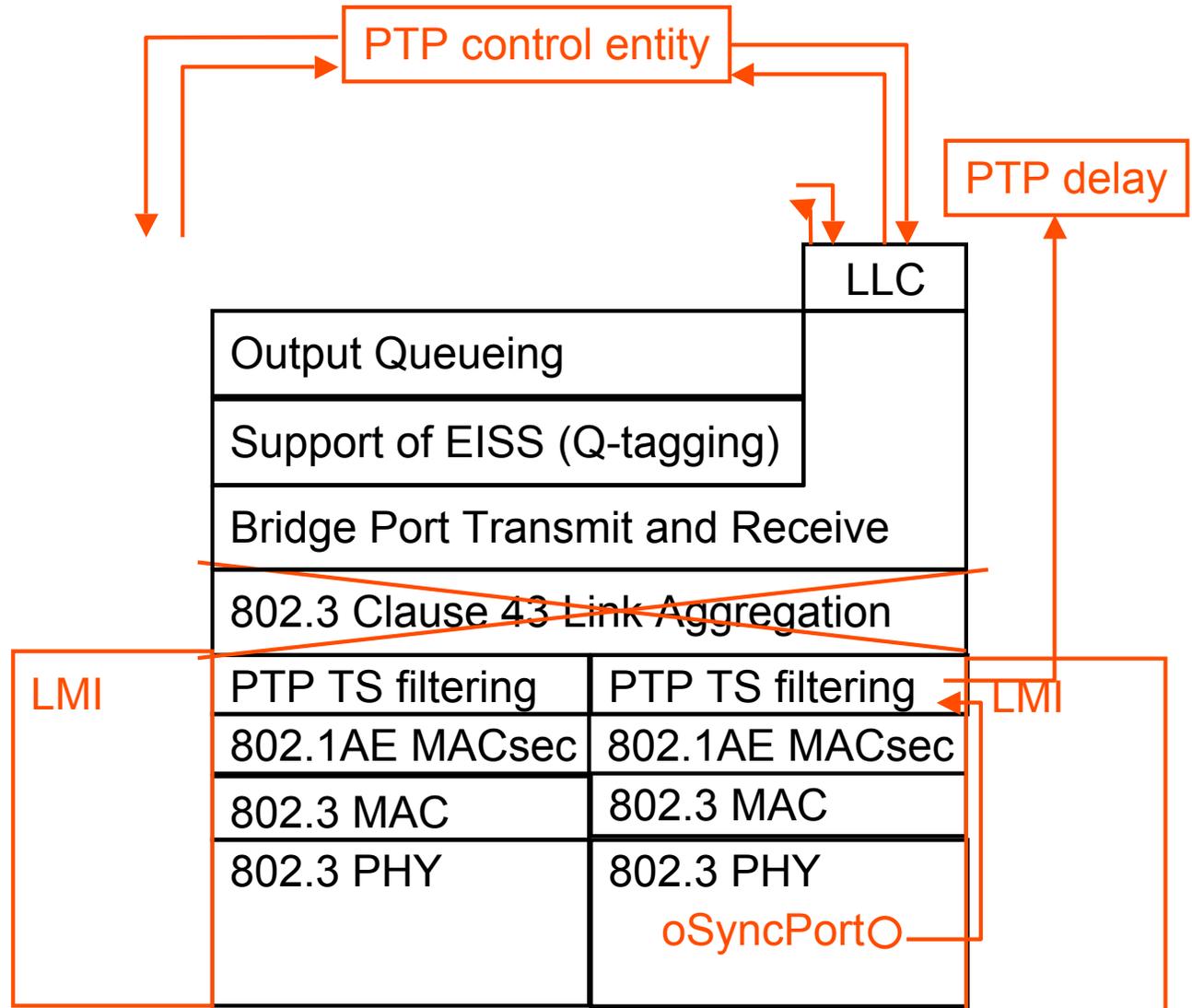
Note: An addition to the Data Request unit would be required to operate event actions associated with the request.



802.1/3 Layering

Comments:

- 1- No link aggregation for now
- 2- No per VLAN timing distribution



BackUp Slides

MAC delays

Clause 21.8 – Table 21-2 specifies for 100BASE-T between MAC-MII for exposed MII

4 bits BT for TX; 8 bits BT for RX
Clause 23 – I didn't find info on MII-MDI delays for 100BASE-T!

Clause 24.6 – Table 24-2 specifies for 100BASE-X between MII-MDI for exposed MII
Half duplex - 14 bits BT for TX; 24 bits BT for RX(MDI input to COL de-assert)
Full-duplex – 14 bits BT for TX; 32 bits BT for RX(MDI input to RX_DV de-assert)

Clause 40.11 specifies for 1000BASE-T half duplex between GMII-MDI
Table 40-13 half duplex : 84 bits BT for TX; 244 bits TU for RX(MDI input to COL de-assert)
Table 40-14 full-duplex – 84 bits BT for TX; 244 bits TU for RX(MDI input to RX_DV de-assert)

Clause 46.1 specifies for XGMII 8192 bits BT for round-trip (TX + RX) of MAC, RS, and MAC control

Clause 48.5 specifies for 10GBASE-X 2048 BT for round-trip PCS

Clause 49.2.15 specifies for 10GBASE-R 3584 BT for TX and RX PCS

Clause 52.2 specifies for 10GBASE-S/L/E 512 BT for TX and RX PMA + PMD

Clause 53.2 specifies for 10GBASE-LX4 512 BT for TX and RX PMD

Clause 54.3 specifies for 10GBASE-CX4 512 BT for TX and RX PMD

OUR NUMBERS

100BASE-T – MAC-MDI delays: TX 4+?; RX 8 + ?

100BASE-X – MAC-MDI delays: half TX 4+14=18BT; RX 8 + 24=32BT

100BASE-X – MAC-MDI delays: full TX 4+14=18BT; RX 8 + 32=40BT

1000 BASE-T – MAC-MDI delays: half/full TX 8?+84=92BT; RX 8 + 244=232BT

XGMII 10GBASE-X – MAC-MDI delays: TX + RX = 8192 + 2048 = 10240BT

Time measurements at MII and 802.3

GMI Reconciliation sublayer (Std 802.3-2005 35.2.1)

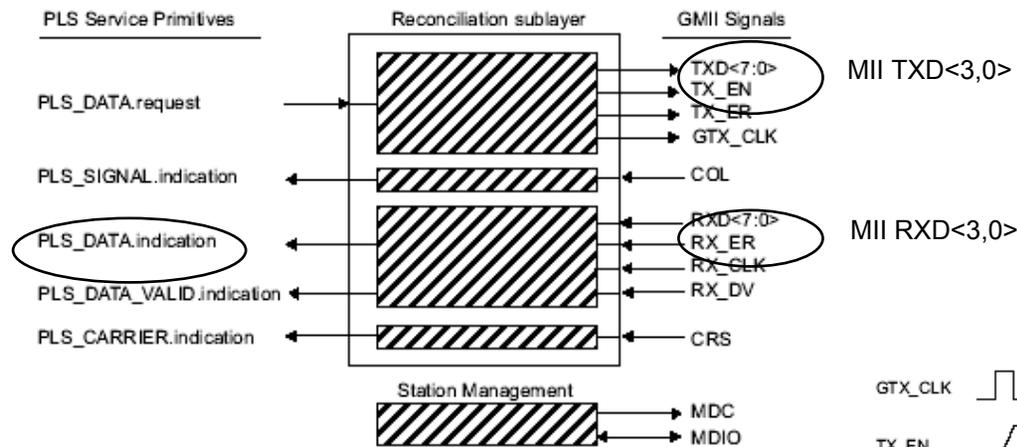


Figure 35-2—Reconciliation Sublayer (RS) inputs and outputs and STA connections to GMI

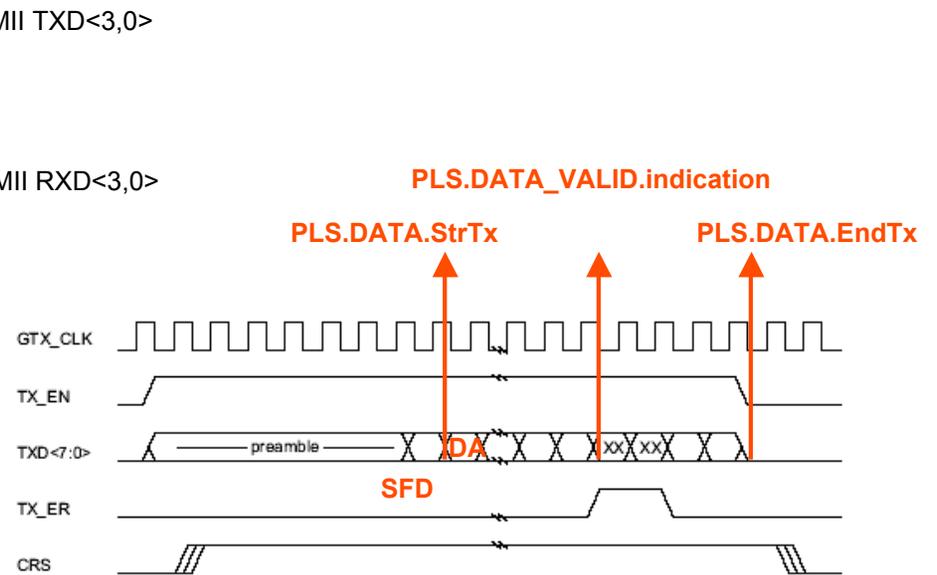


Figure 35-4—Propagating an error within a frame

Issue:

- 1- 1588 assumes timestamp epoch at MII
- 2- RS is not aware of byte semantics

802.3 architecture and timestamps

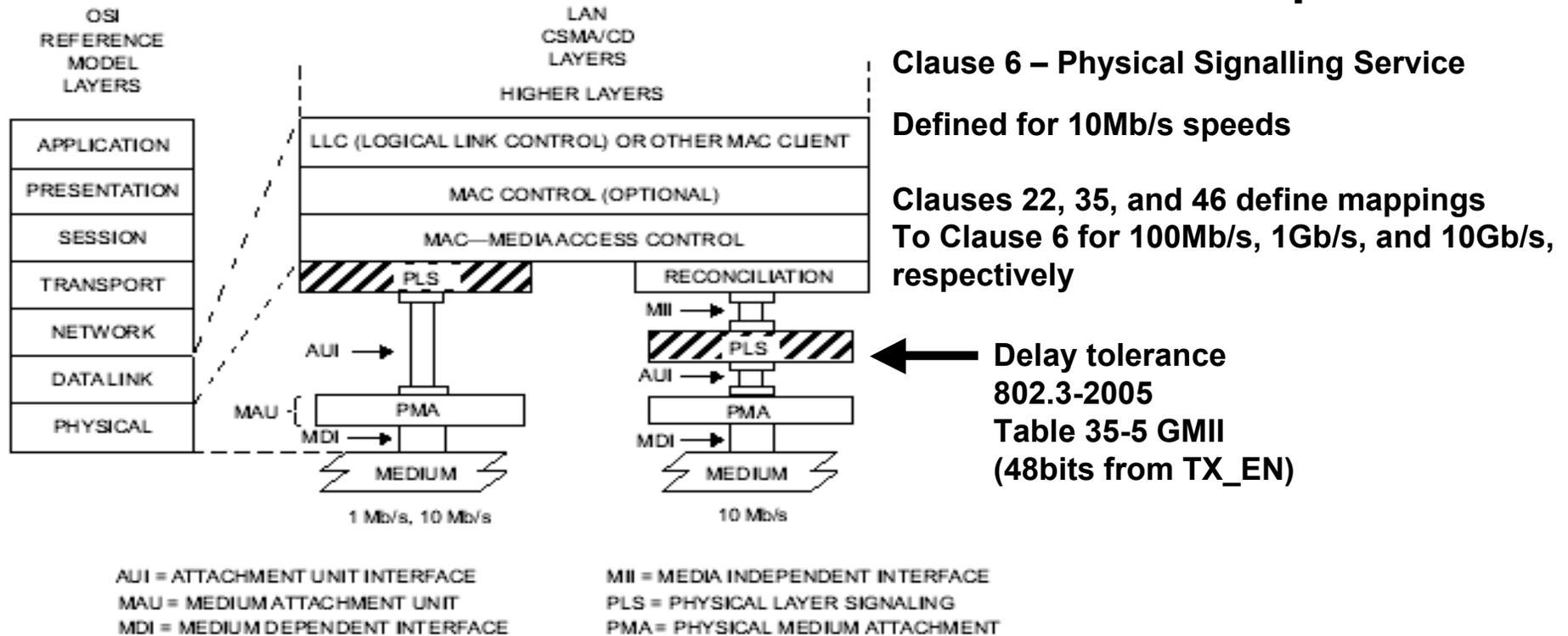


Figure 6–1—PLS service specification relationship to the ISO/IEC Open Systems Interconnection (OSI) reference model and the IEEE 802.3 CSMA/CD LAN model