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# A Proposal To Use 10 Gigabit Ethernet PHYs for RPR

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# Overview

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- Objectives
- 10 Gigabit Ethernet PHYs
  - Sublayers
  - MAC-PLS Interface
  - Proposal for RPR
- RPR MAC-PHY Mapping
- Summary



# Objectives

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- Preserve the MAC-PHY (“MAC-PLS”, or PHY SAP) interface specified by IEEE Std 802.3.
- Support the P802.3ae Ethernet Physical Layer (including the “Reconciliation Sublayer” and “PHY” sublayer) specifications with no changes.
- Support all seven LAN and WAN PHYs that P802.3ae is specifying.



# 10 GbE PHYs

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- P802.3ae (10 GbE) standard is scheduled for Mar 2002 completion.
- Standard is currently at Draft 3.2.
- Latest draft can be ordered at <http://standards.ieee.org/catalog/IEEE802.3.html>



# 10 GbE PHYs – SUBLAYERS

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- 10 GbE Physical Layer consists of the following sublayers:
  - Reconciliation Sublayer (RS).
  - 10 Gigabit Media Independent Interface (XGMII) – optional.
  - XGMII Extender Sublayer (XGXS) and 10 Gigabit Attachment Unit Interface (XAUI) - optional XGMII extender.
  - PHY [including Physical Coding Sublayer (PCS), optional WAN Interface Sublayer (WIS), Physical Medium Attachment (PMA) sublayer, and Physical Medium Dependent (PMD) Sublayer] – 7 variants specified.
  - Medium Dependent Interface (MDI) – not specifically defined.



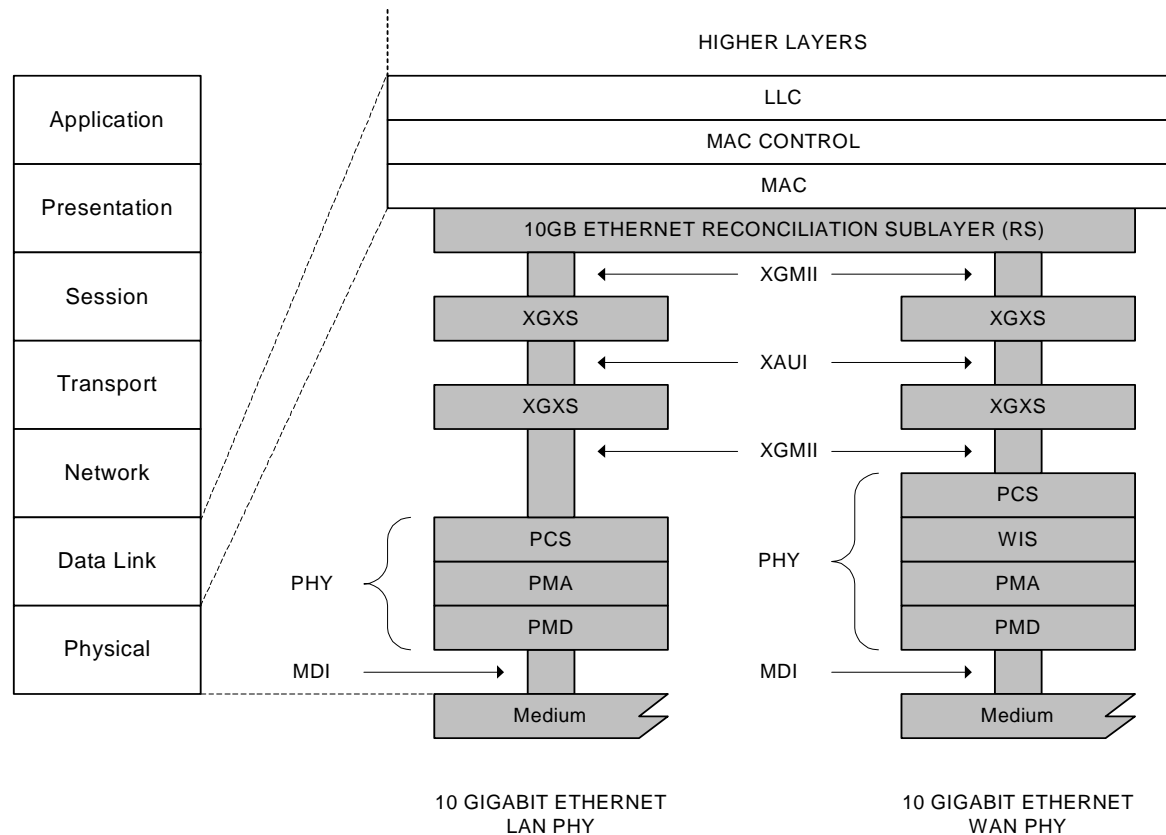
# 10 GbE PHYs – LAYER DIAGRAM



## 10 GbE Layer Diagram

OSI REFERENCE MODEL LAYERS

802.3ae LAYERS



LLC = LOGICAL LINK CONTROL  
 MAC = MEDIA ACCESS CONTROL  
 MDI = MEDIUM DEPENDENT INTERFACE  
 PCS = PHYSICAL CODING SUBLAYER  
 PHY = PHYSICAL LAYER ENTITY  
 PMA = PHYSICAL MEDIUM ATTACHMENT  
 PMD = PHYSICAL MEDIUM DEPENDENT  
 WIS = WAN INTERFACE SUBLAYER  
 XGMII = 10 GIGABIT MEDIA INDEPENDENT INTERFACE



# 10 GbE PHYs – MAC-PLS INTERFACE

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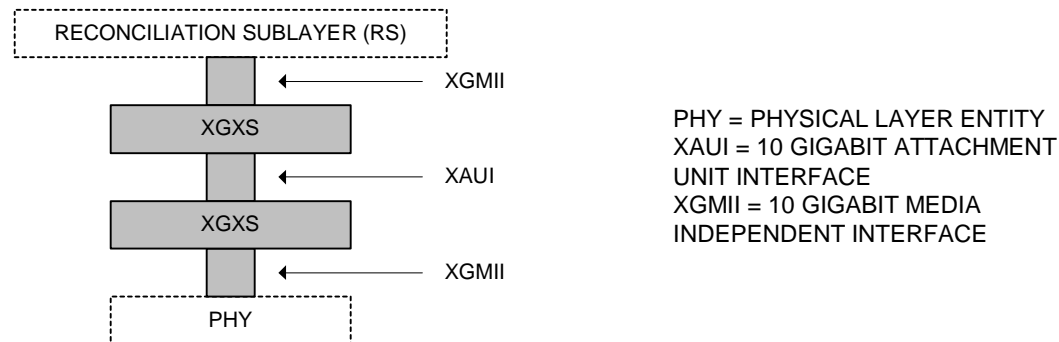
- Ethernet defines a logical MAC-PLS interface between the RS (PHY) and the MAC.
- The interface operates at a constant data rate (10 Gbps).
- The interface is defined as a set of service primitives:
  - PLS\_DATA.request
  - PLS\_DATA.indicate
  - PLS\_DATA\_VALID.indicate
  - PLS\_SIGNAL.indicate (not used for 10 GbE)
  - PLS\_CARRIER.indicate (not used for 10 GbE)



# 10 GbE PHYs – RS, XGMII, & XGXS/XAUI



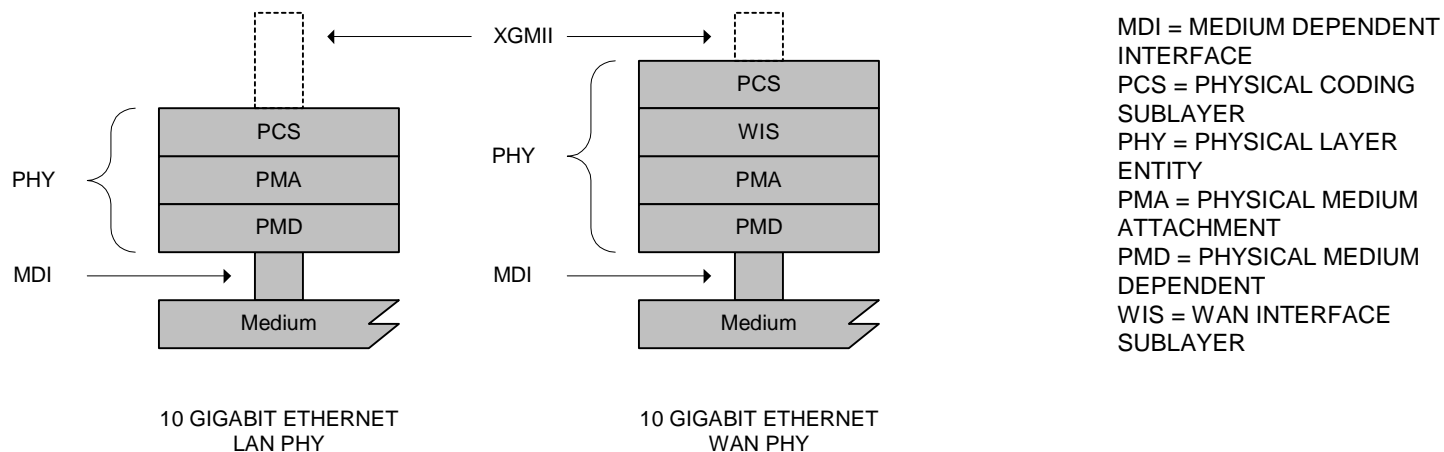
- P802.3ae/D3.2 Clause 46 defines a Reconciliation Sublayer and optional 10 Gigabit Media Independent Interface (XGMII).
  - Converts the logical MAC-PLS service primitives to electrical signals.
  - XGMII is optional, but used as the basis for specifications.
- Clause 47 defines an XGMII Extender Sublayer (XGXS) and 10 Gigabit Attachment Unit Interface(XAUI).





# 10 GbE PHYs – LAN/WAN PHYs

- P802.3ae/D3.2 Clauses 48-53 define the sublayers that implement two families of PHYs:
  - “LAN PHYs” operating at a data rate of 10.0 Gbps.
  - “WAN PHYs” operating at a data rate and format compatible with SONET STS-192c and SDH VC-4-64c.





# 10 GbE PHYs – PHY VARIANTS



- Seven PHY variants are defined:

Description	Reach/Fiber	10 GbE Designation	
		LAN PHY	WAN PHY
850 nm serial	~85 m/MMF	10GBASE-SR	10GBASE-SW
1310 nm serial	10 km/SMF	10GBASE-LR	10GBASE-LW
1550 nm serial	40 km/SMF	10GBASE-ER	10GBASE-EW
1310 nm WDM	10 km/SMF ~300 m/MMF	10GBASE-LX4	-



# 10 GbE PHYs – PROPOSAL

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- Include the 10 GbE Physical Layer in the RPR standard by reference to P802.3ae.
  - Support the RS and optional XGMII with no changes.
  - Support the optional XGXS/XAUI with no change.
  - Support all seven PHYs with their associated sublayers with no changes.
  - Maintain compliance with the “MAC-PLS” logical interface.



# 10 GbE PHYs – RPR IMPLICATIONS

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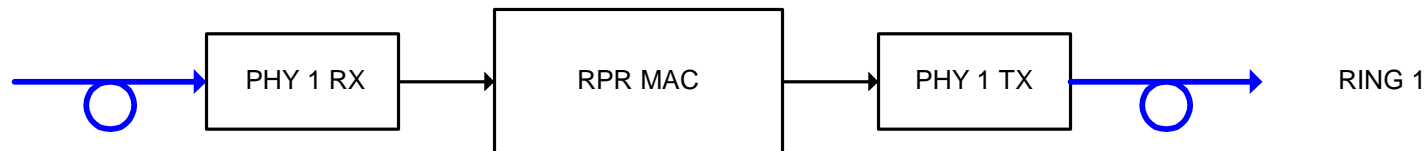
- RS treats the PHY RX and TX as a duplex medium.
  - As defined by 10 GbE, when a Local Fault condition is received by the RS, it stops sending MAC data and continuously generates Remote Fault status in the other direction.
  - Similarly, when a Remote Fault condition is received, the RS stops sending MAC data and generates continuous Idle in the other direction.
- MAC needs to include “open loop rate control”.
  - MAC mechanism defined by 802.3ae to adapt the 10 Gbps MAC-PLS signaling rate to the 9.29 Gbps effective data rate at the PHY.



# MAC-PHY Mapping – Direct Mapping



- RPR typically has more than one PHY connected to a MAC. Need to define a MAC to PHY (to media) mapping.
- MAC could be mapped directly to the corresponding PHY on a single RPR ringlet, but this isn't generally optimum for RPR applications...





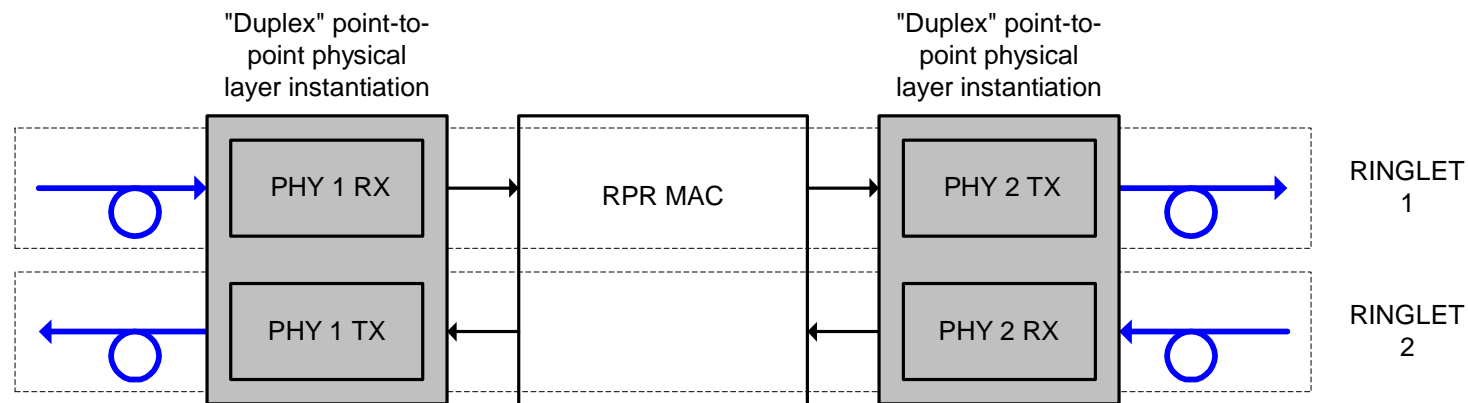
# Direct Mapping Problems

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- Direct mapping creates several significant issues for RPR applications:
  - Generally, this implies that the link to the preceding RPR station and the subsequent RPR station will use a single PHY type (same wavelength, same reach, etc). Extending this to the entire ringlet, all segments within a ringlet must use the same PHY type.
  - Most PHYs are intended for duplex operation—some include fault-processing and error-reporting capability that will be lost using direct mapping (ie, near-end and far-end status for the 10 GbE WAN PHY).
  - The 10 GbE RS Link Fault Signaling behavior stops transmitting MAC data if it receives a fault status, which would isolate a station on an RPR ringlet.

# RPR MAC-PHY Mapping

- Propose the following MAC-PHY mapping to resolve the direct-mapping problems:
  - Retains duplex behavior and duplex fault-detection capabilities.
  - Allows mixing PHY types (different reaches) on different links.
- Implies pairs of opposing ringlets.



PHY NUMBERING, RING NUMBERING, AND RING DIRECTIONS ARE SHOWN FOR REFERENCE ONLY



# Summary

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- Support the P802.3ae Physical Layer specifications for 10 Gbps LAN and WAN PHYs without changes.
- Assign an RPR MAC-PHY mapping such that a PHY is mapped to two ringlets of a single ring segment.