

The 400 GbE Project Ahead

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Agenda

- Multi-Rate Support
- Architecture
- Reach
- "400 GbE"

Multi-Rate Support

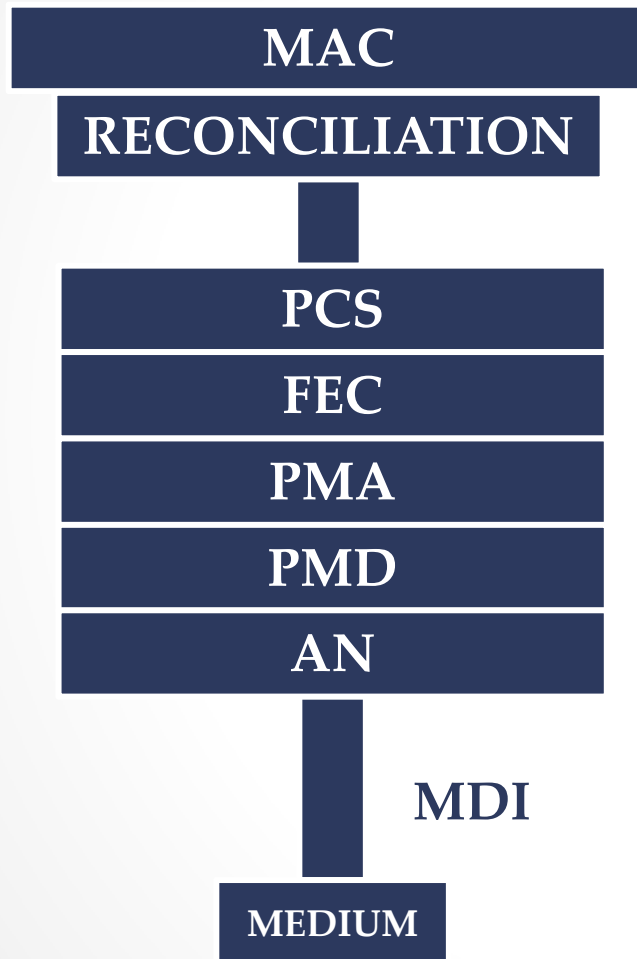


QSFP Cable Breakout to SFP+:
40GbE Speed or 10GbE Density?

Picture: Courtesy of
Kapil Shrikhande

- Technology Evolution:
 - Multiple Generation Rates
 - Multi-Lane Solutions anticipated for some time...
- Simple Illustration:
 - $400 \text{ GbE} = 25 \text{ Gb/s} * 16$
 - $400 \text{ GbE} = 50 \text{ Gb/s} * 8$
 - $400 \text{ GbE} = 100 \text{ Gb/s} * 4$
- Next Generation I/O Modules
 - Multi-functional: high speed or high density
 - Leverage investment across applications
- Multi-rate / # of links support between
 - 40 GbE
 - 100 GbE
 - 400 GbE

Defining an Architecture



- Multiple physical layer specifications will be developed
- Everything works together
- The architecture must be flexible and scalable
- Signaling technologies will evolve
- Medium changes?

Objectives

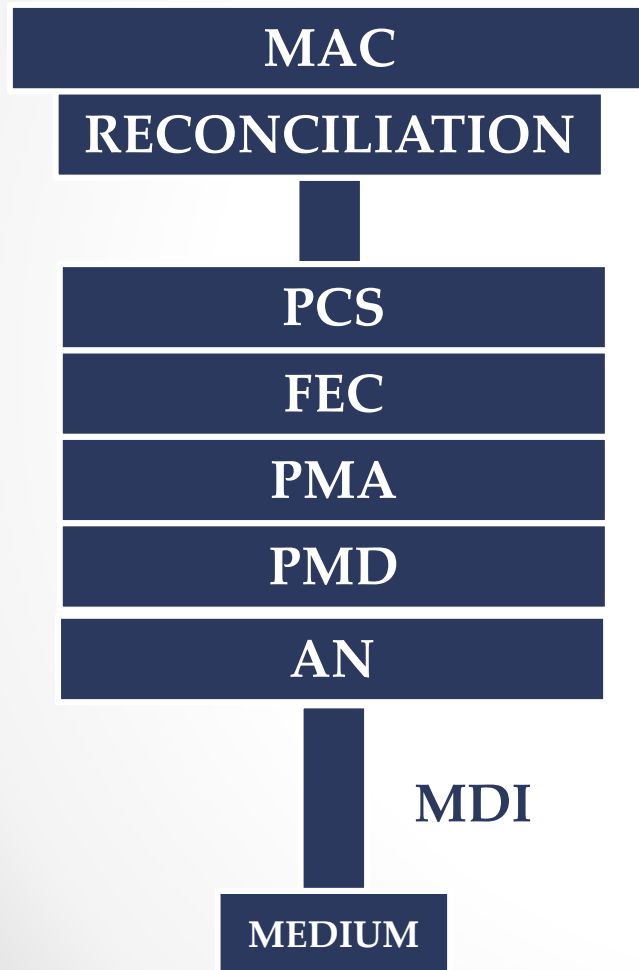
Historical Perspective

(gustlin_400_01_0513)

Objective	.3ba	.3bg	.3bj	.3bm
Support full-duplex operation only	✓	✓	✓	✓
Preserve the 802.3 / Ethernet frame format utilizing the 802.3 MAC	✓	✓	✓	✓
Preserve minimum and maximum FrameSize of current 802.3 standard	✓	✓	✓	✓
Support a BER better than or equal to 10^{-12} at the MAC/PLS service interface	✓	✓	✓	✓
Provide appropriate support for OTN	✓			✓
Support a MAC data rate of x Gb/s	✓	✓		
To define optional Energy-Efficient Ethernet operation for xxx PMD or interface	*	*	✓	✓

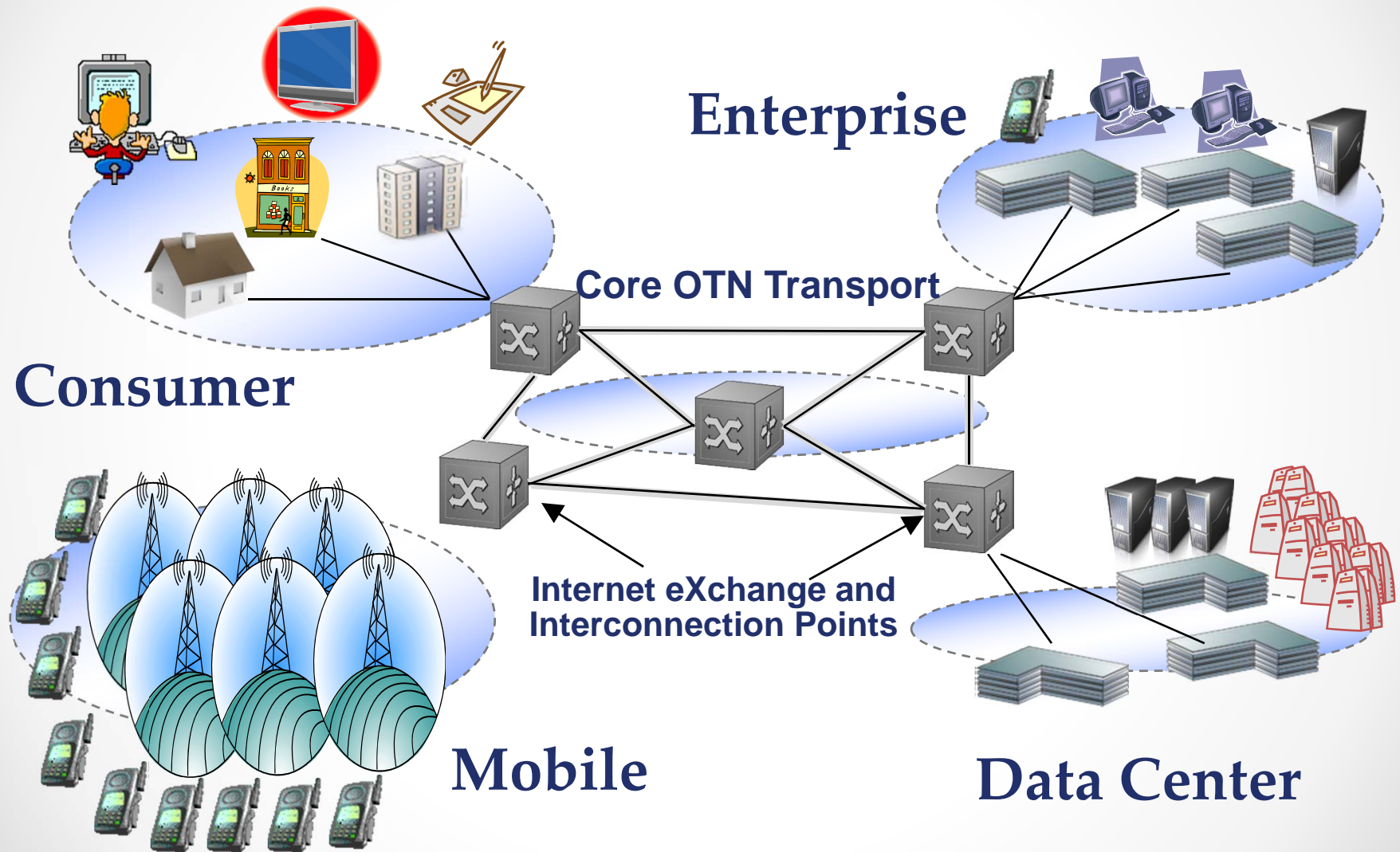
* Optional EEE support added by 802.3bj and .3bm for these PMDs

Defining an Architecture – Other Requirements?

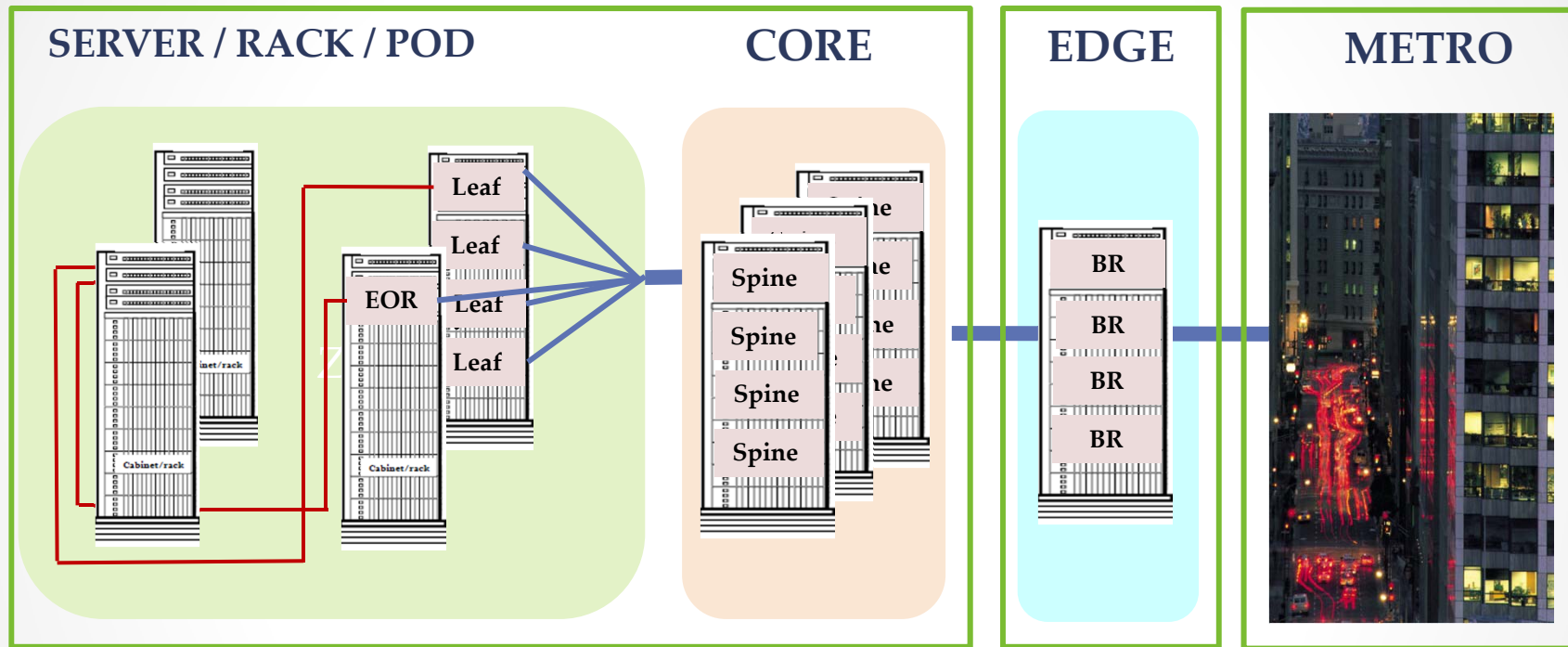


- FEC – how much coding gain?
- Energy Efficiency Ethernet
- OTN Compatibility
- AN / Capabilities Exchange via LLDP
- Low latency
- Flexibility
- Time-synchronization

The Ethernet Ecosystem

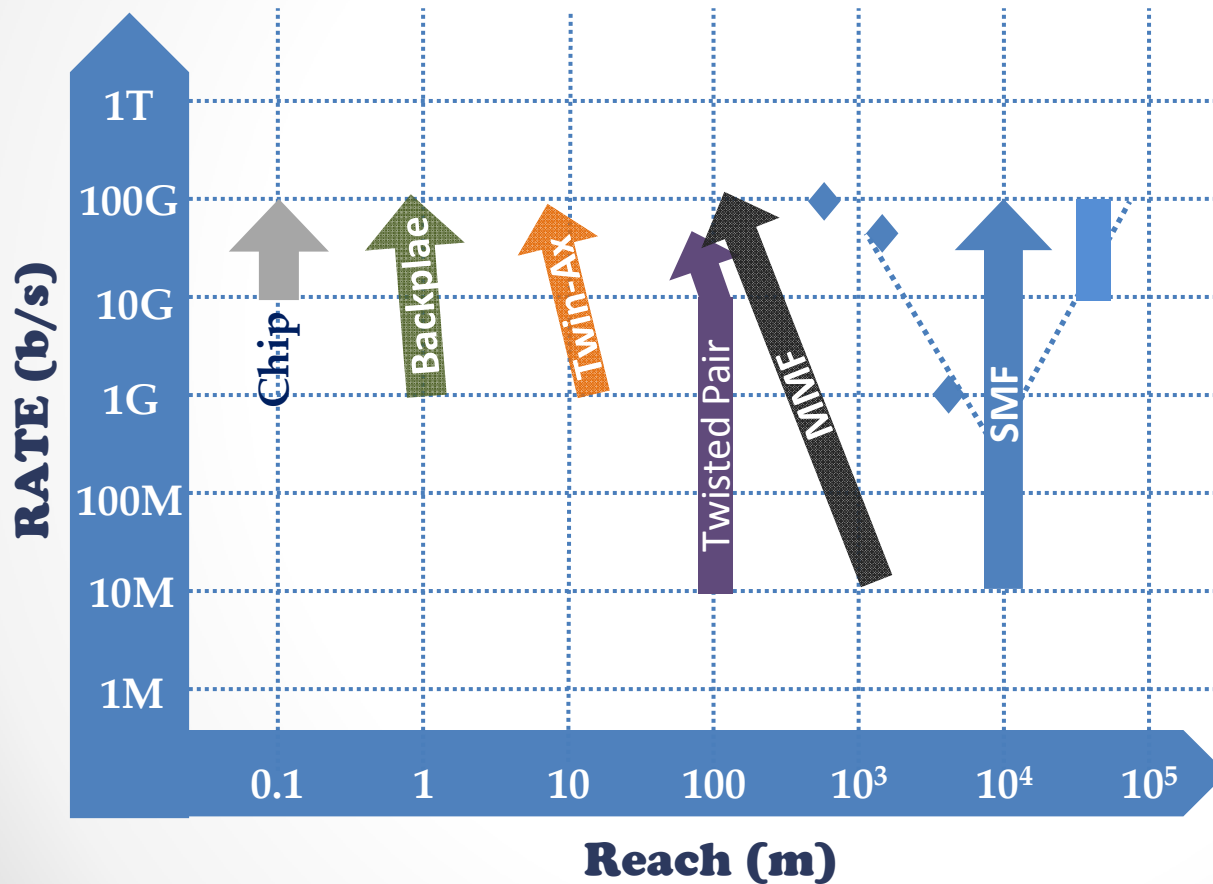


Potential Box-Box Interconnects



Intra-Rack, ToR, EoR	To Core	Campus	Metro
Cu / MMF	MMF, SMF	SMF	SMF
5 – 30m	≤ 500m	2 – 10km	> kms

General Trends of the Ethernet Family



- Many PHYs are facing shrinking reaches!
- Multiple applications for SMF PHYs

Reach Objectives – 40G/100G Historical Perspective

Objective	.3ba	.3bg	.3bj	.3bm	.3bq
XLAUI / CAUI (n X 10 Gb/s)	✓				
CAUI (4 x 25 Gb/s)				✓	
Backplane – 40 Gb/s	✓				
Backplane – 100 Gb/s			✓		
TwinAx – 40 / 100 Gb/s (nx10 Gb/s), 7m	✓				
TwinAx – 100 Gb/s (4x25 Gb/s) , 5m			✓		
Twisted pair – 40 Gb/s, 30m					✓
MMF 40/100 Gb/s (nx10 Gb/s) , 100/150m	✓				
MMF 100 Gb/s (4x25Gb/s), 20/100m				✓	
SMF 100 Gb/s, 500m				✓	
SMF 40 Gb/s, serial 2km		✓			
SMF 40 Gb/s (4x10 CWDM), 10km	✓				
SMF 100 Gb/s, (4x25 WDM), 10km	✓				
SMF 40 Gb/s (4x10 CWDM) , 40km				✓	
SMF 100 Gb/s (4x25 WDM), 40km	✓				

Changing Our Perspective

House of 400 GbE

**Future Effort -
PMD(s)**

**Future Effort -
PMD(s)**

**This Effort -
PMD(s)?**

**This Effort -
Architecture!**

BMP?

**Technical
Feasibility?**

**Economic
Feasibility?**

Foundation

Summary

- **Getting the architecture right is key!**
 - Architecture Features / Requirements
 - Backwards rate compatibility
- **Selecting PMDs**
 - Evolution will happen
 - There will be follow-on projects