IEEE 802.3
Beyond 400 Gb/s Ethernet Study Group

Beyond 400 Gb/s Ethernet – The Road Ahead

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Foreword

- My responsibility as chair:
  - to produce a draft standard, recommended practice, or guideline in a reasonable amount of time for review and approval by the WG.

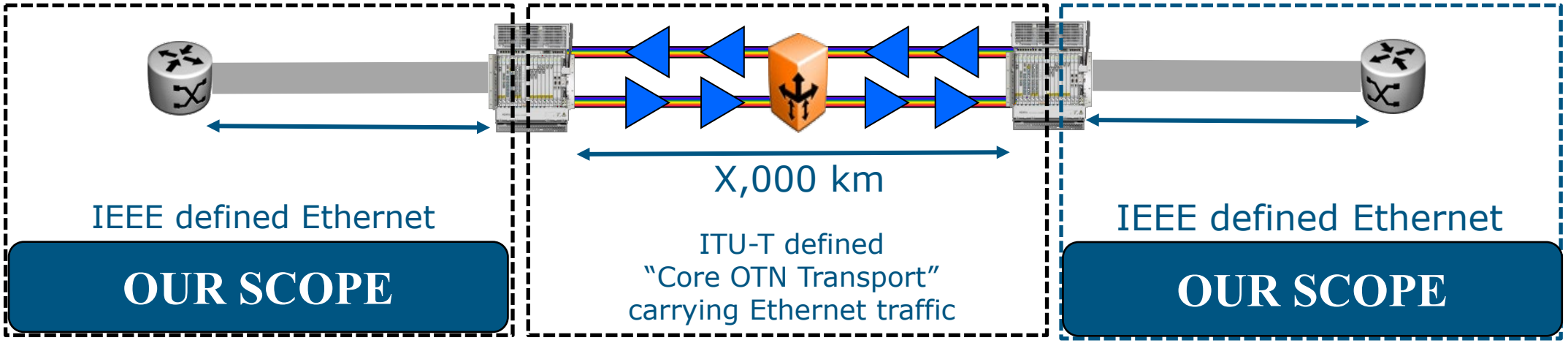
- Nothing in this presentation should be interpreted as an endorsement by its mention

Study Group Charter

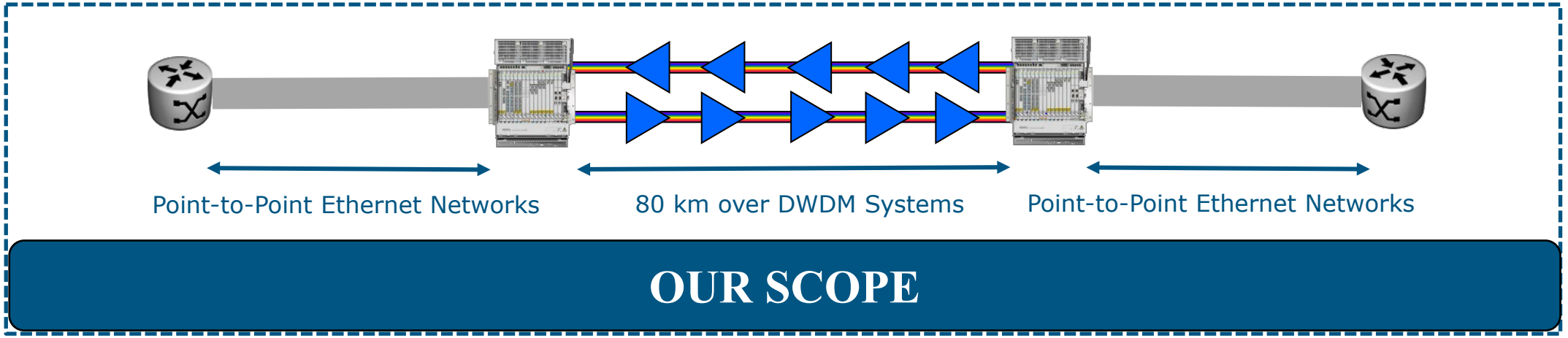
- The IEEE 802 LMSC Executive Committee has chartered a Study Group under the IEEE 802.3 Ethernet Working Group to develop a Project Authorization Request (PAR) and Criteria for Standards Development (CSD) responses for:
  (1) Beyond 400 Gb/s Ethernet
  (2) Physical Layer specifications for existing Ethernet rates based on Physical Layer specifications for beyond 400 Gb/s Ethernet.

THE SCOPE OF ETHERNET TODAY

Scenario #1



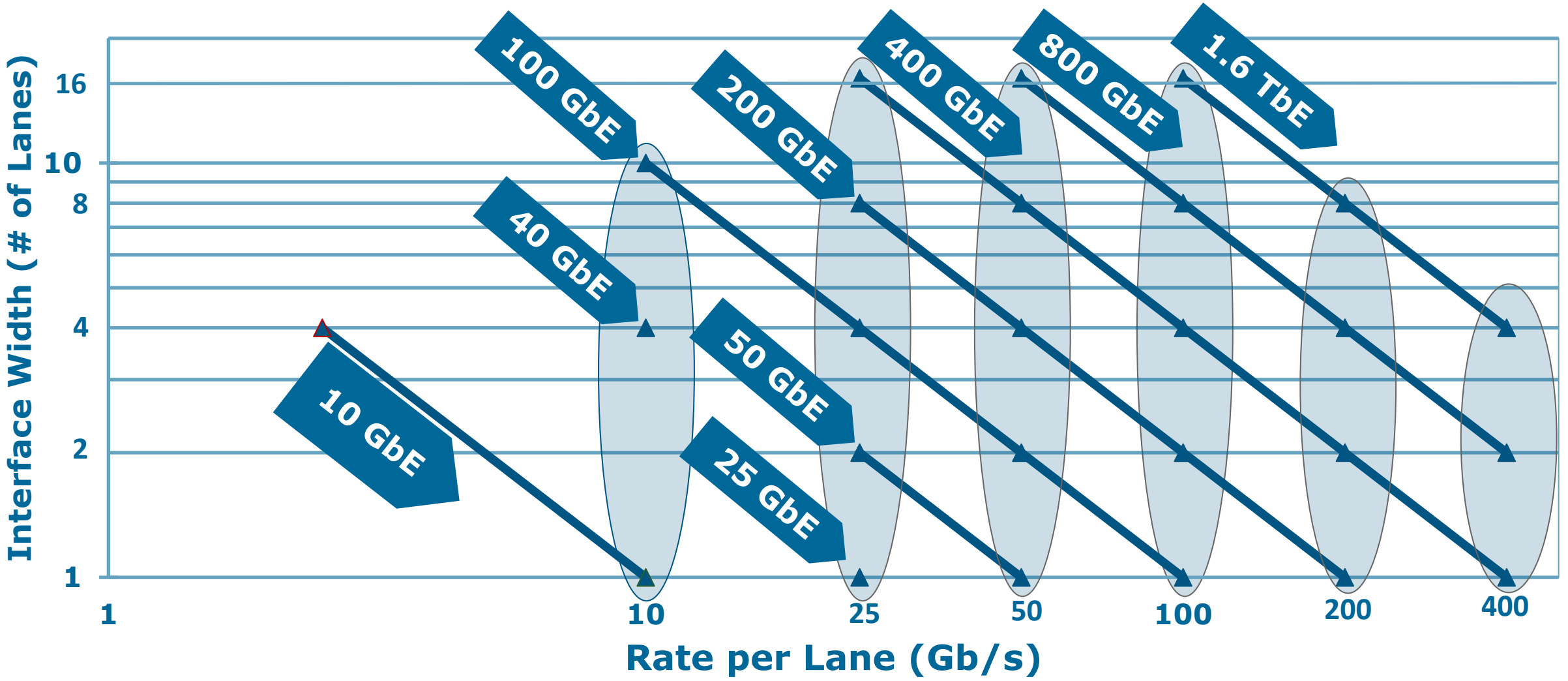
Scenario #2



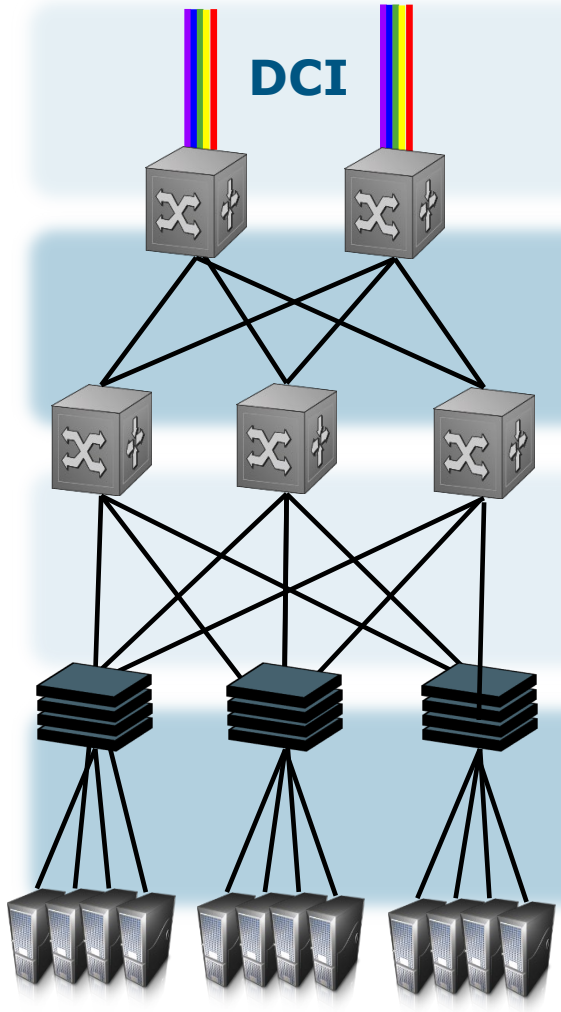
Key Questions

- What Ethernet rate or rates does this SG want to target?
- What signaling rate technologies should we leverage? Do we need to examine on a case-by-case basis?
  - 50 Gb/s?
  - 100 Gb/s?
  - 200 Gb/s?
  - Other?
- What objectives does this group wish to target?
  - Can they be justified via the CSD?

The Relationship Between Ethernet & Signaling Rates



The Entire Ethernet Family Needs Consideration



	Next Speed?	Reach	Medium
Router	> 400 GbE	80 km	DWDM SMF
Leaf/Spine	> 400 GbE	500 m to 40 km	Duplex SMF
TOR / MOR / Leaf	> 400 GbE	50 m to 500 m	MMF / SMF (duplex or parallel)
Server	> 100 GbE	< 30 m	MMF Twin Axial

Coherent

?

Direct Detect

Potential for Technology Reuse

TODAY

Reuse of signaling rate technologies developed for higher Ethernet rates enables existing lower speed Ethernet rate specifications (AUI, -KR, -CR, -SR, - DR, -FR, -LR, -ER)

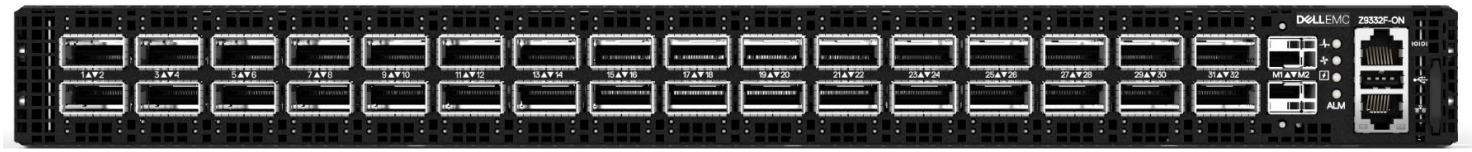


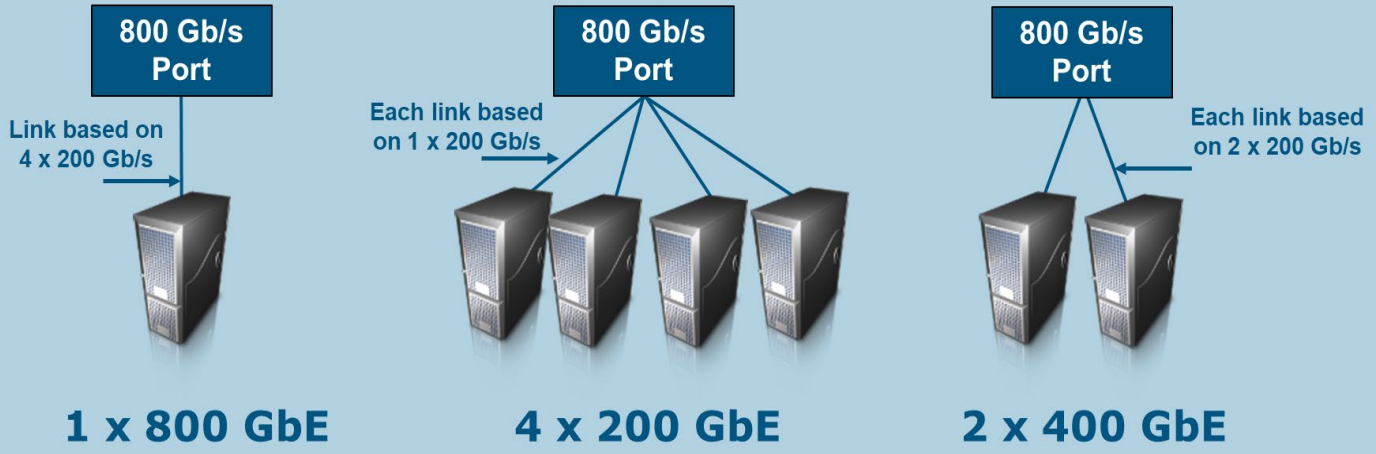
Image courtesy of David Piehler, Dell Technologies

- 32 - 400 Gb/s capacity ports
- Can be configured to support 32 - 400 GbE ports
- Can be configured to support 128 - 100 GbE ports

A POSSIBLE FUTURE

Possible Scenario – 800 GbE is developed based on 4 x 200 Gb/s

The 200 Gb/s signaling rate technology could be reused to support development of 200 GbE and 400 GbE physical layer specifications

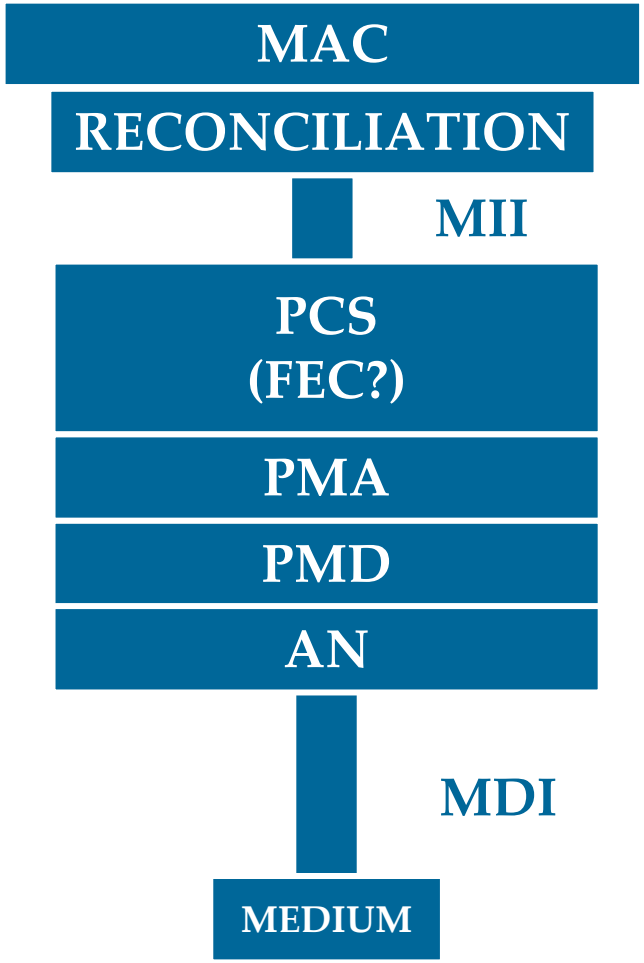


Reuse of 200 Gb/s signaling rate technology could be applicable to: AUIs, -KR, -CR, -SR, -DR, -FR, -LR, -ER, others?

"It has been my experience at Google that we have used optical and copper modules to support different configurations of a given port, including applications that require the maximum capacity of the single port."

Cedric Lam, Google

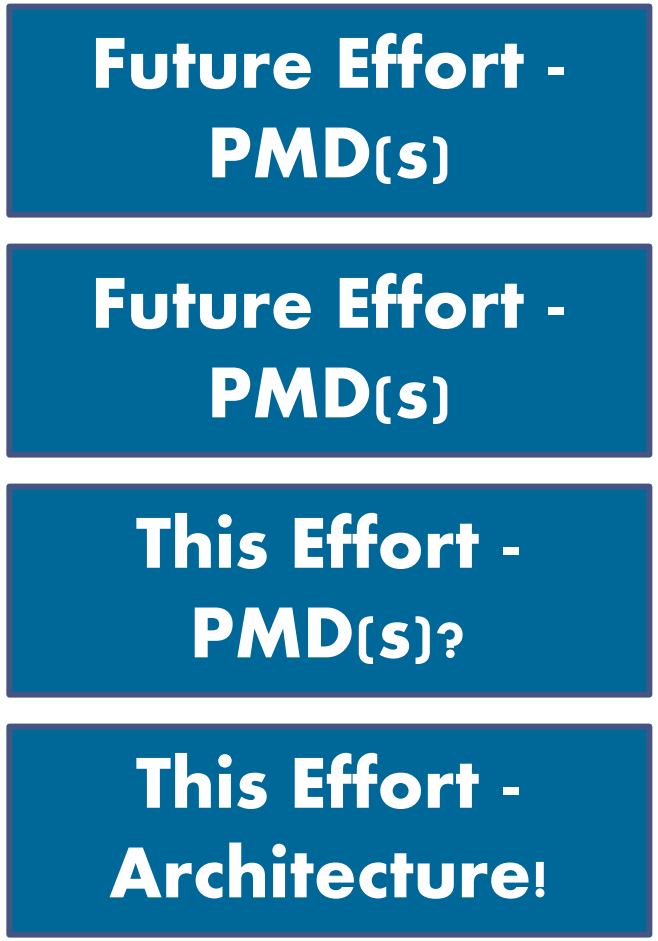
Defining an Architecture



- Everything works together
- The architecture must be flexible and scalable
- Multiple physical layer specifications will be developed
- Extender Sublayer?
- FEC Strategy
  - End-to-end?
  - Segment-by-segment?
  - Encapsulate?
- Signaling technologies will evolve
- Medium changes?

My Perspective

House of Beyond 400 Gb/s Ethernet



BMP?

Technical Feasibility?

Economic Feasibility?

Foundation

The Projects of 100 Gb/s Ethernet (2006 to Present)

Objective	.3ba	.3bj	.3bm	.3cd	.3ck	.3ct	.3cu	.3db
CAUI - 10 X 10 Gb/s	✓							
CAUI - 4 x 25 Gb/s			✓					
CAUI – 2 x 50 Gb/s				✓				
CAUI – 1 x 100 Gb/s					✓			
Backplane – 4 x 25 Gb/s		✓						
Backplane – 2 x 50 Gb/s				✓				
Backplane – 1 x 100 Gb/s					✓			
TwinAx – 10 x 10 Gb/s, 7m	✓							
TwinAx – 4 x 25 Gb/s, 5m		✓						
Twin-Ax – 2 x 50 Gb/s, 3m				✓				
Twin-Ax – 1 x 100 Gb/s, 2m					✓			
MMF – 10 x 10 Gb/s, 100/150m	✓							
MMF – 4 x 25 Gb/s, 100m			✓					
MMF – 2 x 50 Gb/s, 100m				✓				
MMF – 1 x 100 Gb/s, 50/100m								✓
SMF – 1 x 100 Gb/s, 500m				✓				
SMF – 1 x 100 Gb/s, 2km							✓	
SMF – 4 x 25 Gb/s WDM, 10km	✓							
SMF – 1 x 100 Gb/s, 6km							✓	
SMF – 4 x 25 Gb/s WDM, 40km	✓							
DWDM Systems, 1 x 100 Gb/s, 80km						✓		

Observations

- Electrical Interfaces
  - Chip-to-chip
  - Chip-to-module
- PMD Types
  - Backplane
  - Twin-Ax
  - MMF (current trend up to 100m)
  - SMF - parallel fiber approach (current trend up to 500m)
  - SMF –duplex fiber approach (2km to 40km)
  - DWDM Systems
- PMD Lane counts
  - Backplane / Twin-ax / MMF – 1, 2, 4 lane variants
  - SMF – 1 and 4 lane variants
  - Development of 200 Gb/s signaling would then be applicable to 200 GbE / 400 GbE electrical interfaces and various PMDs

Summary

- We are just starting a long journey….
- This is just the first of many projects to whatever new speed(s) we select
- Development of the underlying architecture is critical

THANK YOU!