Silicon Photonics enables next-generation cloud computing, data center and HPC connectivity

Arlon Martin

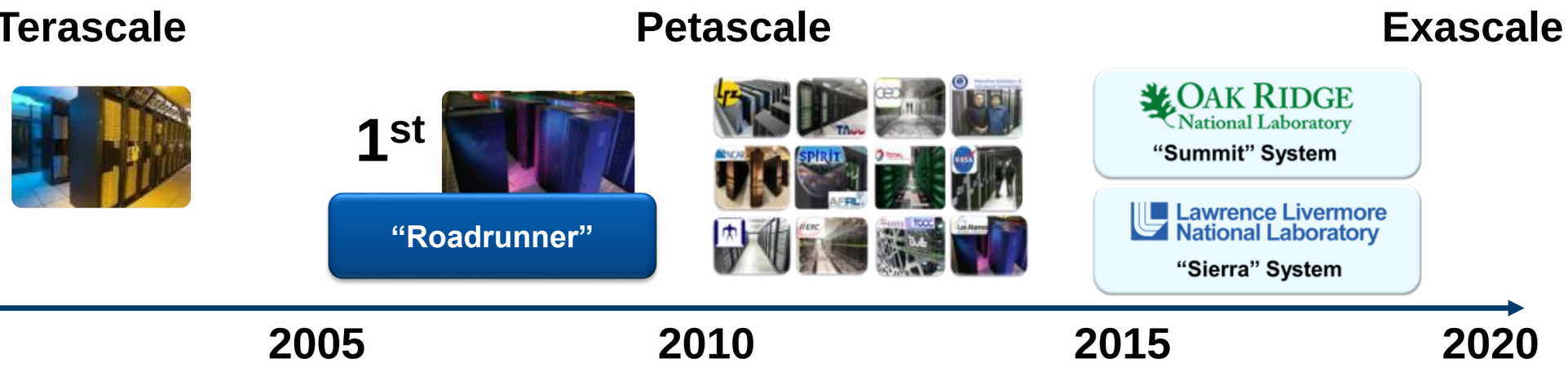
PIC International Conference, March 2016

Mellanox TECHNOLOGIES

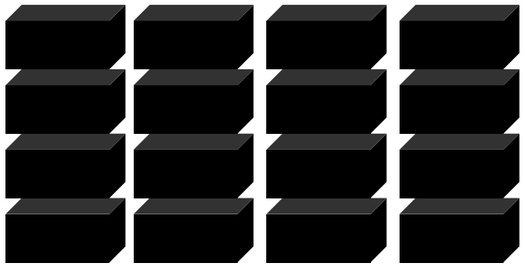
Connect. Accelerate. Outperform.™

The Ever Growing Demand for Higher Performance

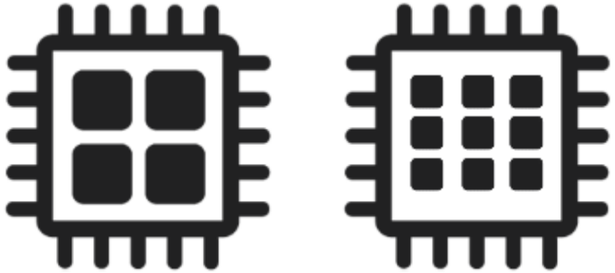
Performance Development



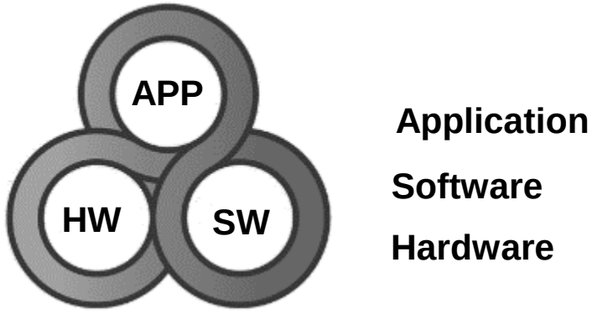
The Interconnect is the Enabling Technology



SMP to Clusters



Single-Core to Many-Core



Co-Design

High-Performance Designed 100Gb/s Interconnect Solutions

Adapters

ConnectX®-4

100Gb/s Adapter, 0.7us latency

150 million messages per second

(10 / 25 / 40 / 50 / 56 / 100Gb/s)

ConnectX-4 Lx

ConnectX-4 Lx Programmable

Switch

SwitchIB™-2

36 EDR (100Gb/s) Ports, <90ns Latency

Throughput of 7.2Tb/s

7.02 Billion msg/sec (195M msg/sec/port)

Switch

Spectrum™

32 100GbE Ports, 64 25/50GbE Ports

(10 / 25 / 40 / 50 / 100GbE)

Throughput of 6.4Tb/s

Interconnect

LinkX™

Transceivers

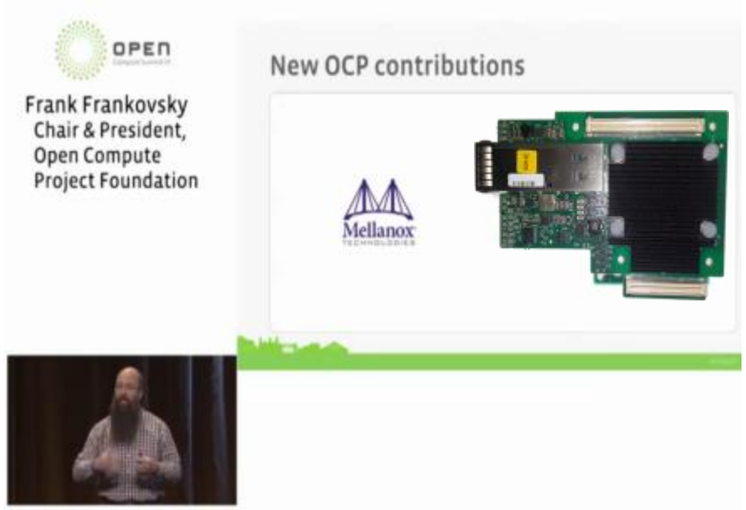
Active Optical and Copper Cables

(10 / 25 / 40 / 50 / 56 / 100Gb/s)

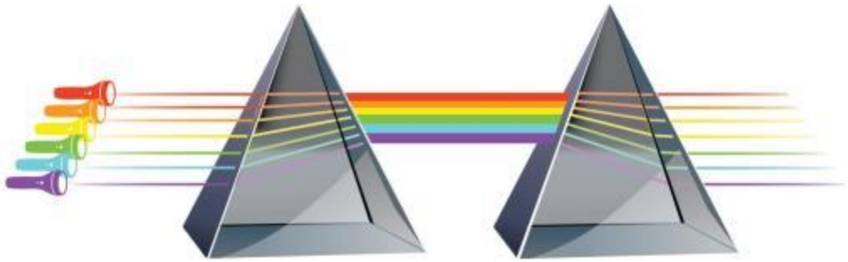
VCSELs, Silicon Photonics and Copper

Three Major 2015 OCP Summit Contributions

ConnectX-4 Multi-Host Technology



Open Optics MSA



ciena

Mellanox TECHNOLOGIES
Connect. Accelerate. Outperform.™

CoAdna

ORACLE

Ghiasi Quantum

RANOVUS™

MultiPhy

VERTILAS

Yenista OPTICS

SAI
Switch Abstraction Interface

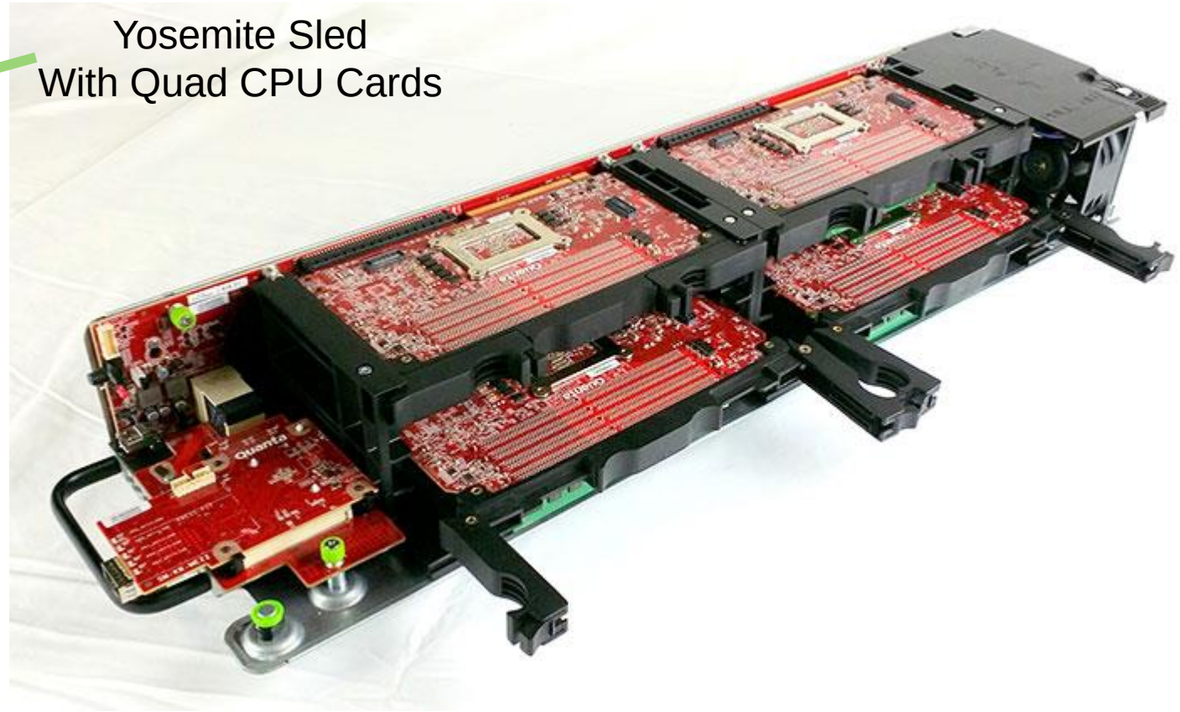
OPEN Compute Project

Microsoft

The Generation of OPEN ETHERNET™

onie

Facebook Yosemite: First Ever Disaggregated Multi-Host Server



Yosemite Sled
With Quad CPU Cards

100Gb/s
Copper
Cable

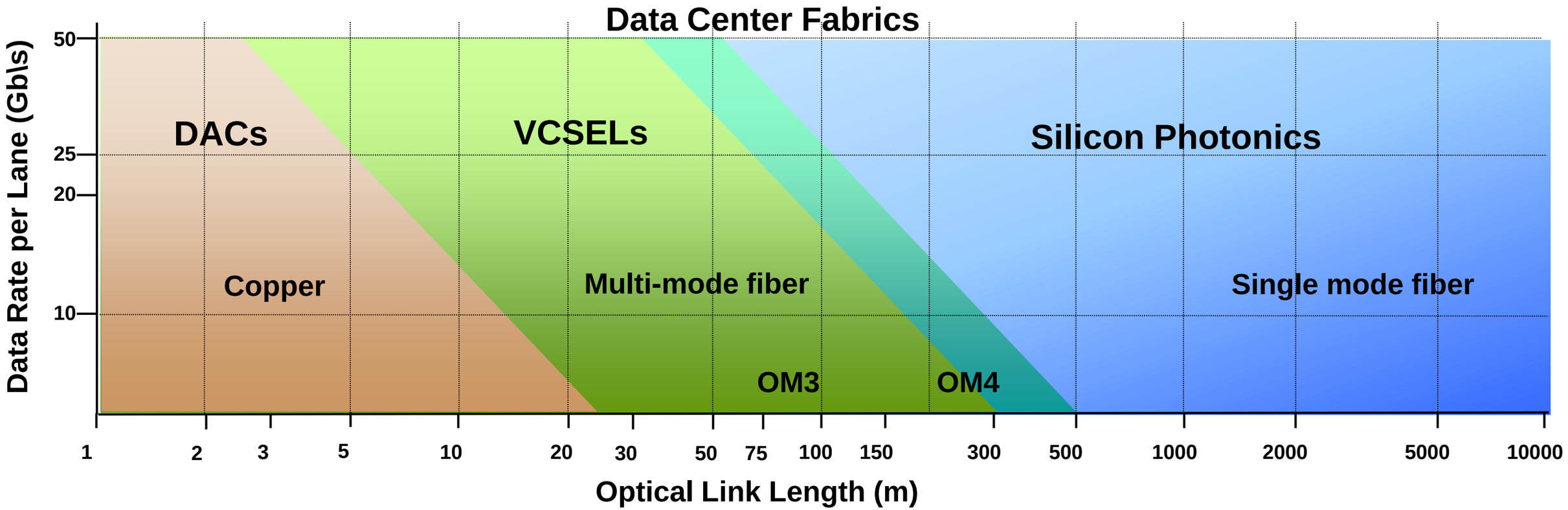
100Gb/E
QSFP

Multi-Host
PCI-Express
Host Connections

ConnectX-4
OCP2.0 100Gb/s
Multi-Core Adapter

Facebook Yosemite Quad Core Multi-Host Platform

Mellanox View of Data Center Fabrics



Direct Attach Copper
- Zero power
- Demo'd 8m at 100G
- Best fit 3m

Active Optical Cables
- VCELs or SiP
- Reaches to 200m
- Best fit for 5-20m

VCSEL Transceivers
- Reaches to 100m
- Best fit for MMF

SiP Transceivers
- Reaches to 2km
- Best fit for SMF
- Parallel or WDM

Where Silicon Photonics Fits in Data Center Fabrics Today

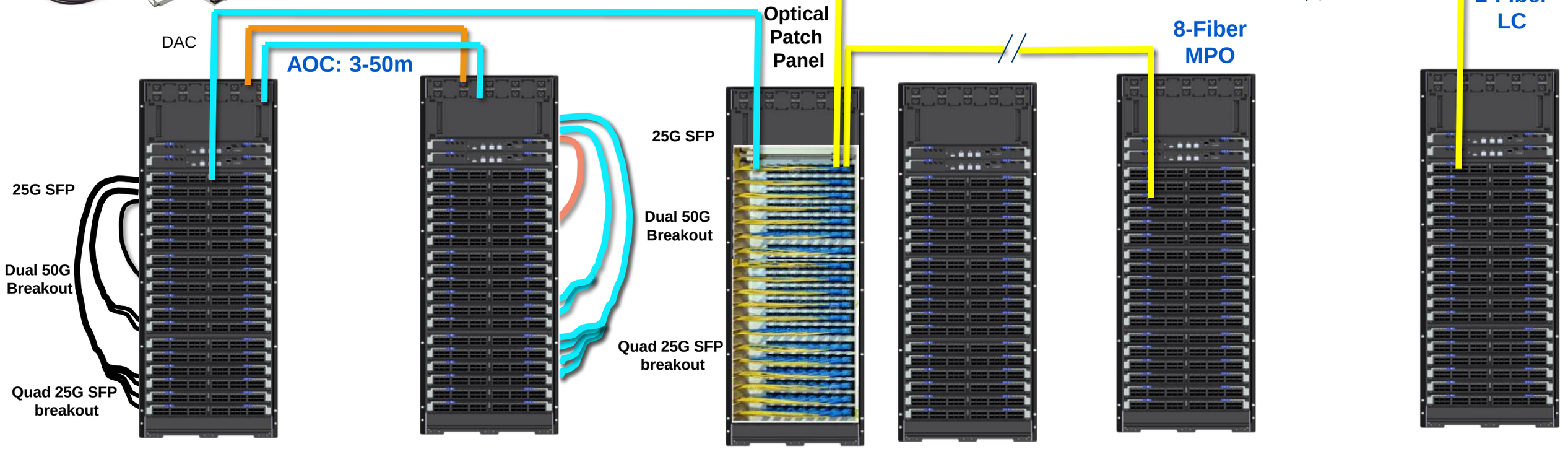
DAC
Server/ToR-to-ToR

AOC
ToR-Leaf/Spine

SR4
For structured cabling
***Short* Reaches**

PSM4

WDM4
For Structured Cabling
***Long* Reaches**



"DAC In the Rack"
3m

Multi-Mode Optics
3m-100m

Single-Mode Optics
Up to 2Km

LinkX™ Silicon Photonics: Designed for Data Center Economics

Mellanox silicon photonics chips, drivers and TIAs, QSFP modules, Integrated WDM

No WDM specific lasers, No laser sub-assembly, No hermetic packages
No active laser alignment, No detector sub assembly

Mellanox Delivers!

- Innovation
- Integration
- Low power

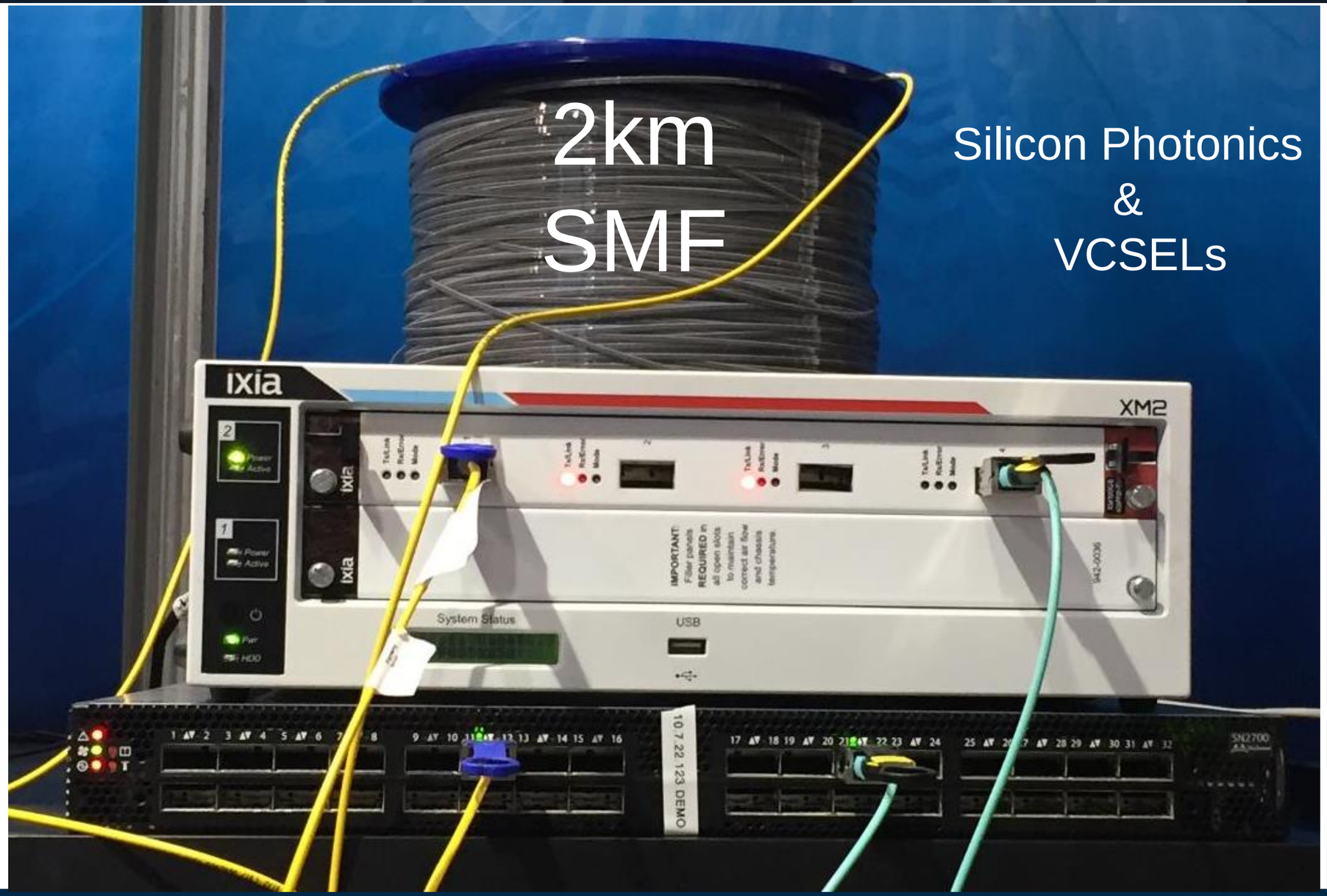
Making 100Gb/s Deployments as Easy as 10Gb/s

Mellanox and Ixia Confirm 100Gb/s Ethernet Interoperability

ixia

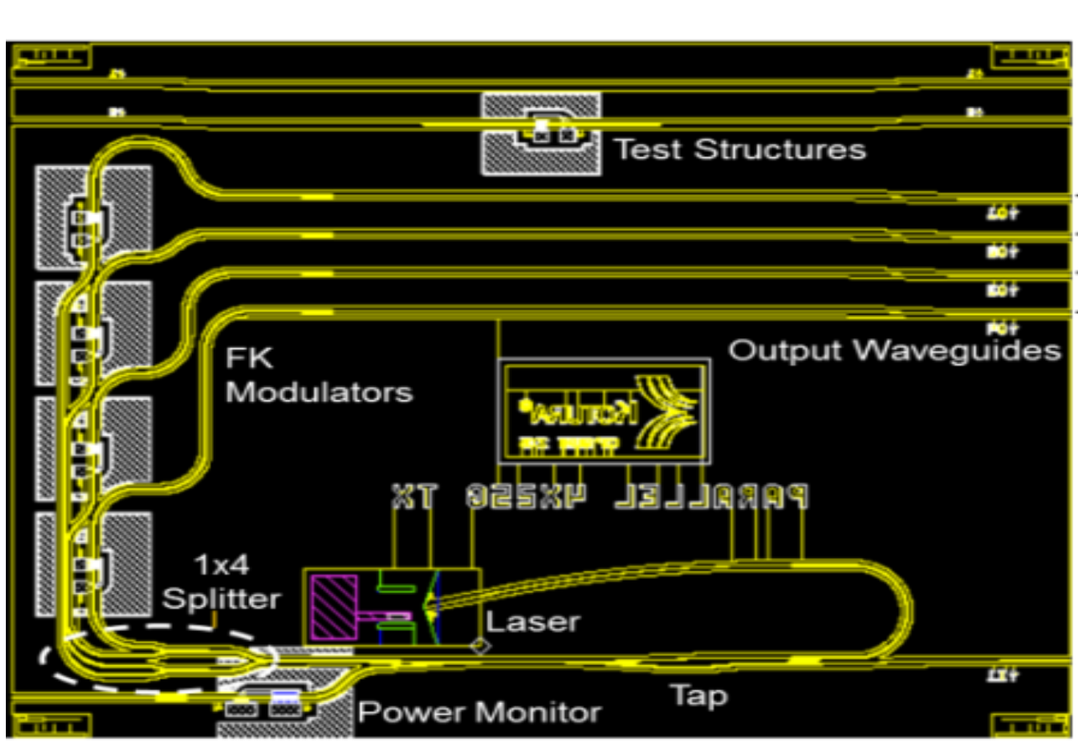
100G PSM4 & SR4 Transceivers

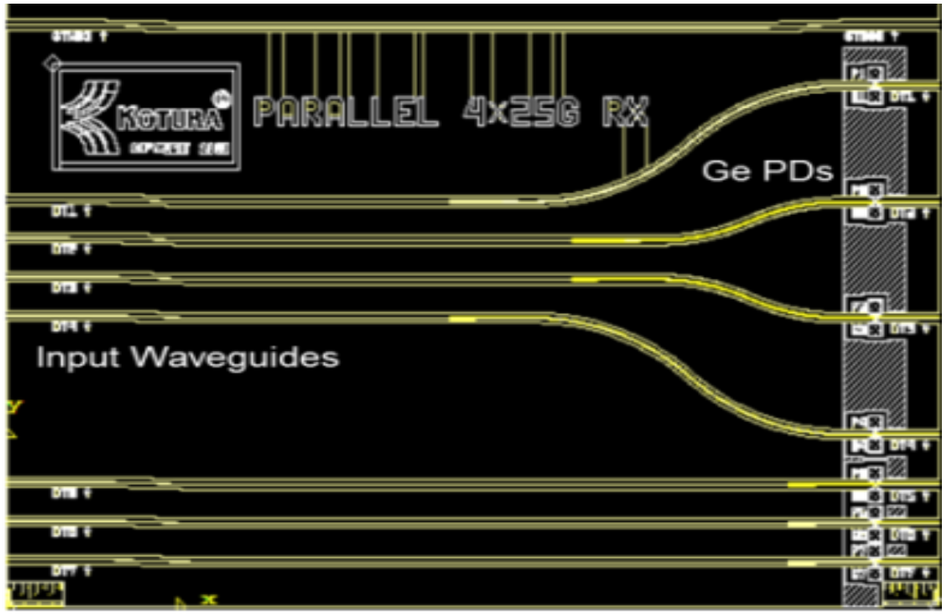
Spectrum™



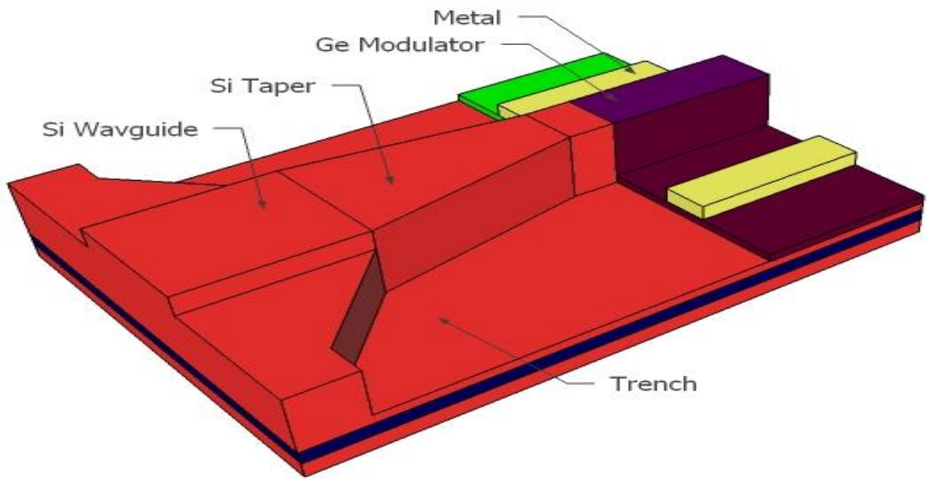
Silicon Photonics Solutions at Mellanox: 100 Gb/s Transceivers

- QSFP28
- Low power
- Integration



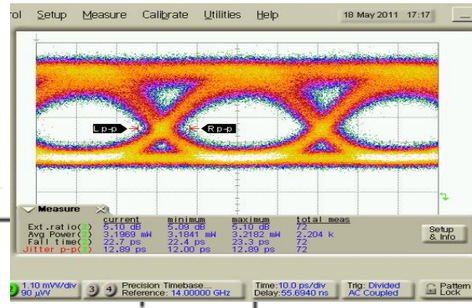


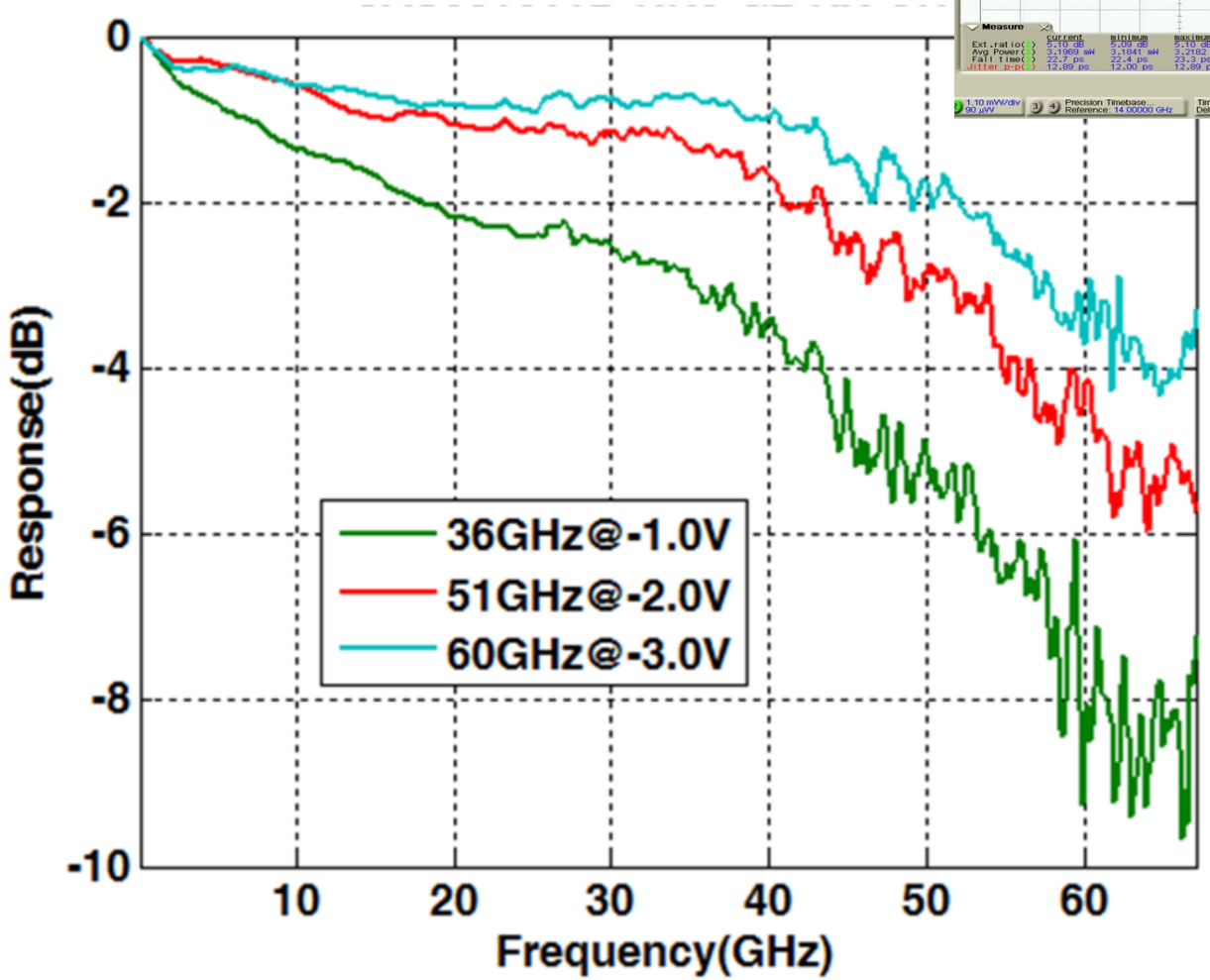
Density: Tiny FK Modulator Scales to >50 GHz



- **Franz-Keldysh modulator is >>10x smaller than MZI**
- **Only 40 um long**
- **Provides 5dB ER**
- **Integrates well w/WDM section**

25Gb/s Eye





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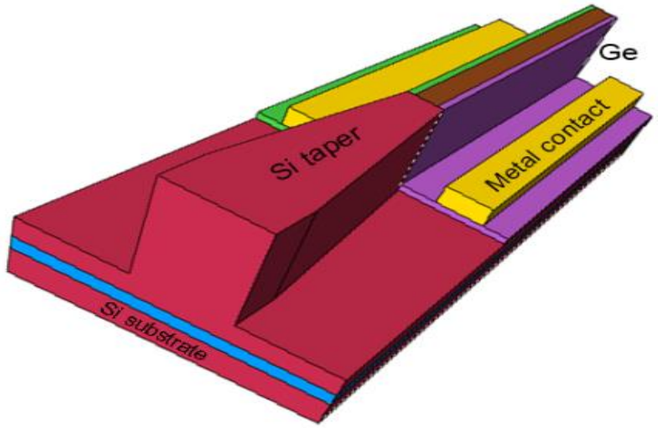
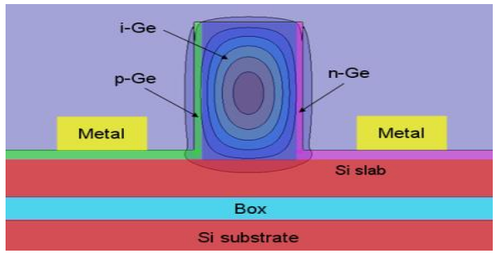
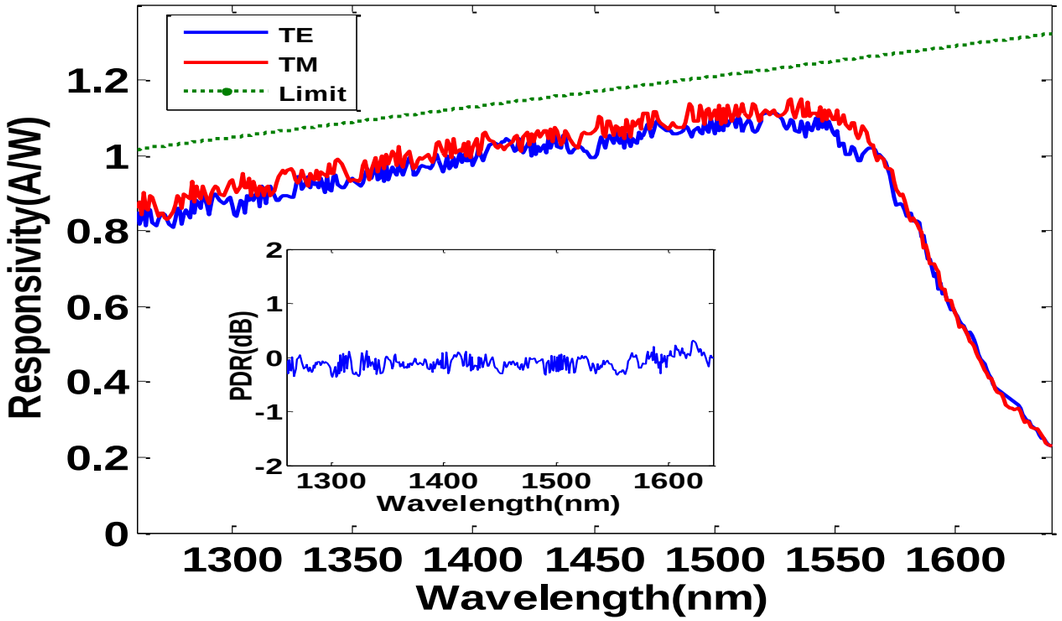
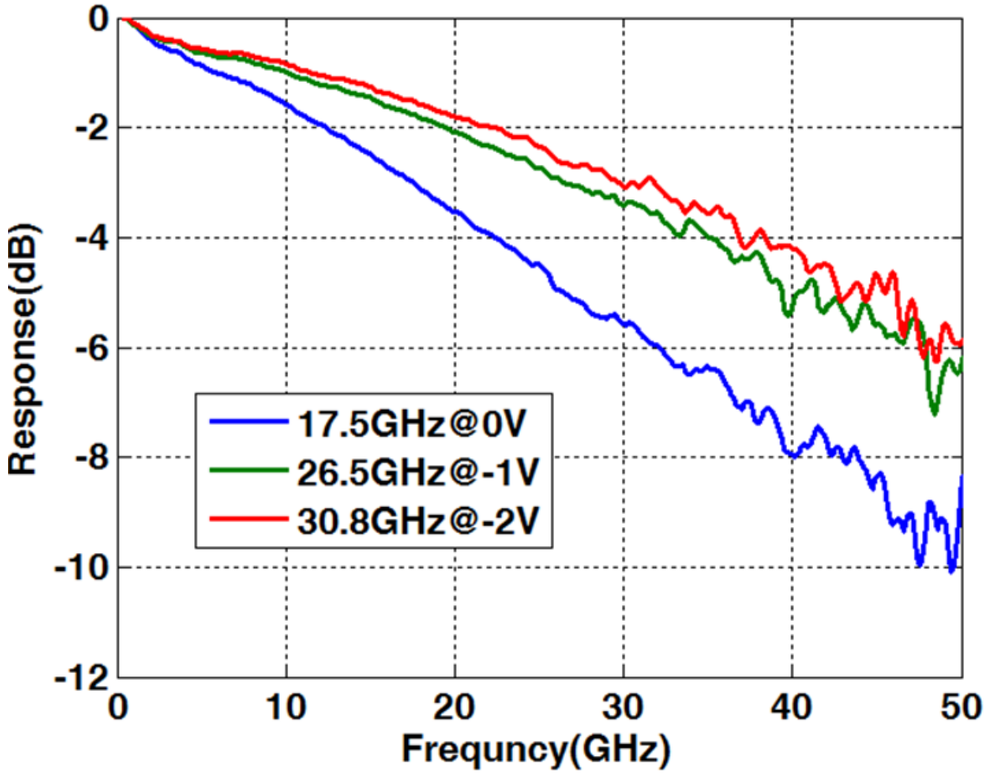
Density: 25 GHz Germanium Detectors Also Scale to >50 Gb/s



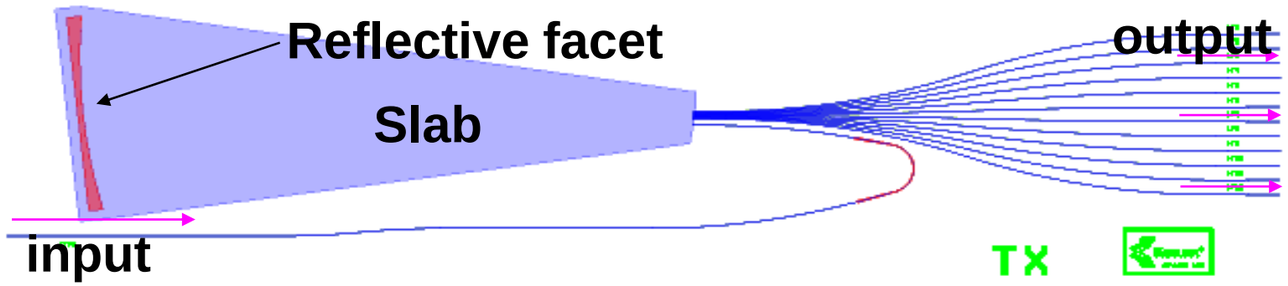


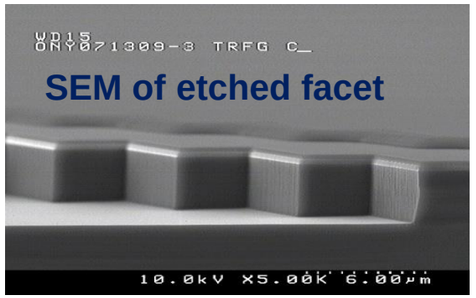


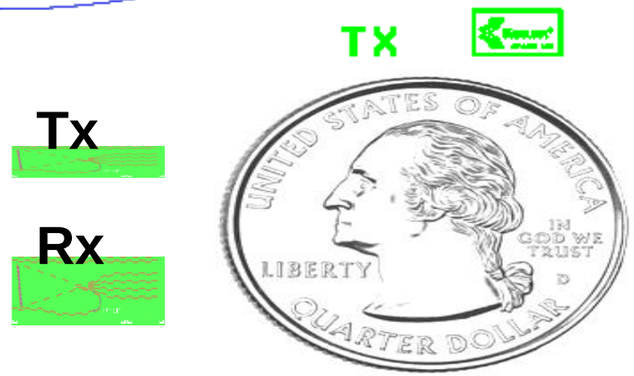


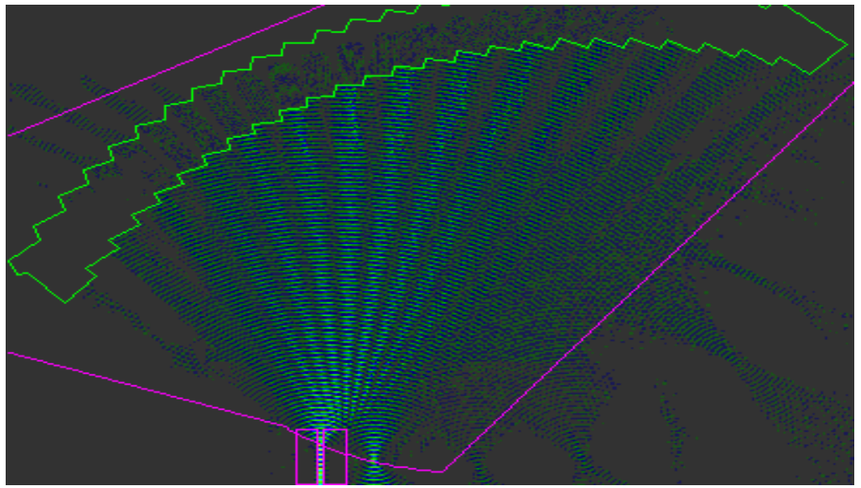
Density & Scalability: Echelle Gratings as Mux/Demux

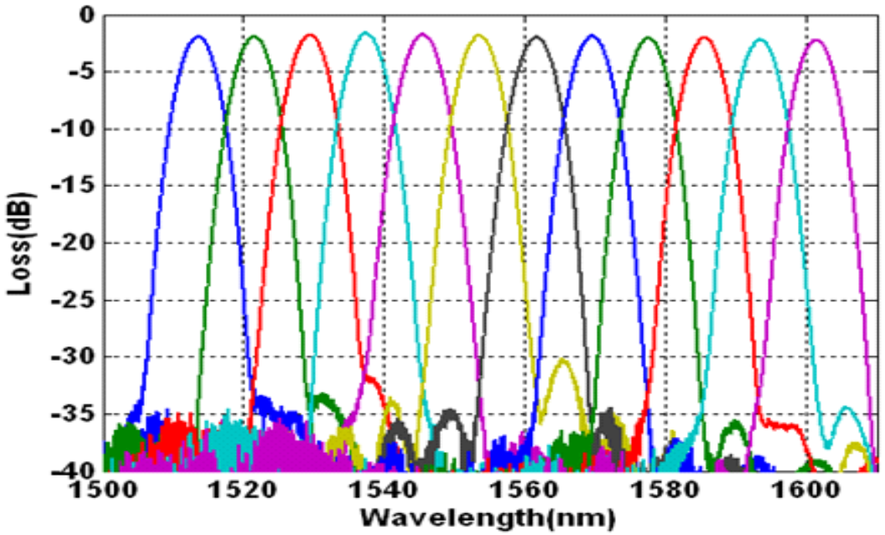
- **Echelle gratings scale from 4 to 40+ channels**
- **10x smaller than AWGs**
- **Provide excellent wavelength registration**
- **Very low cross talk**





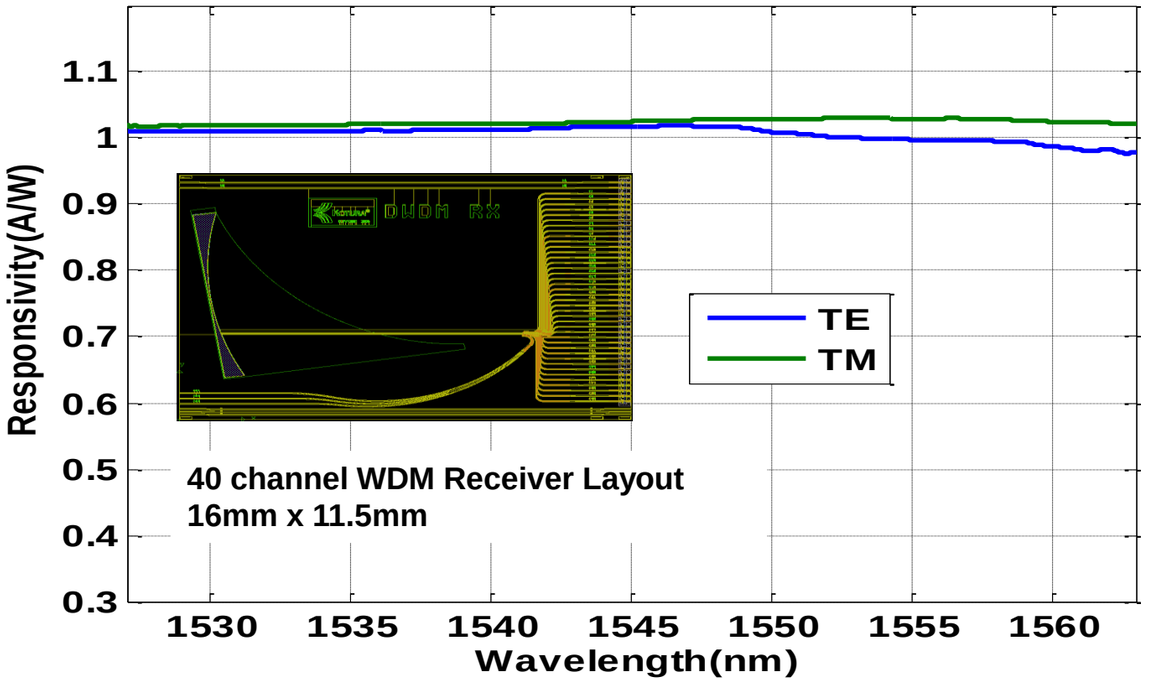


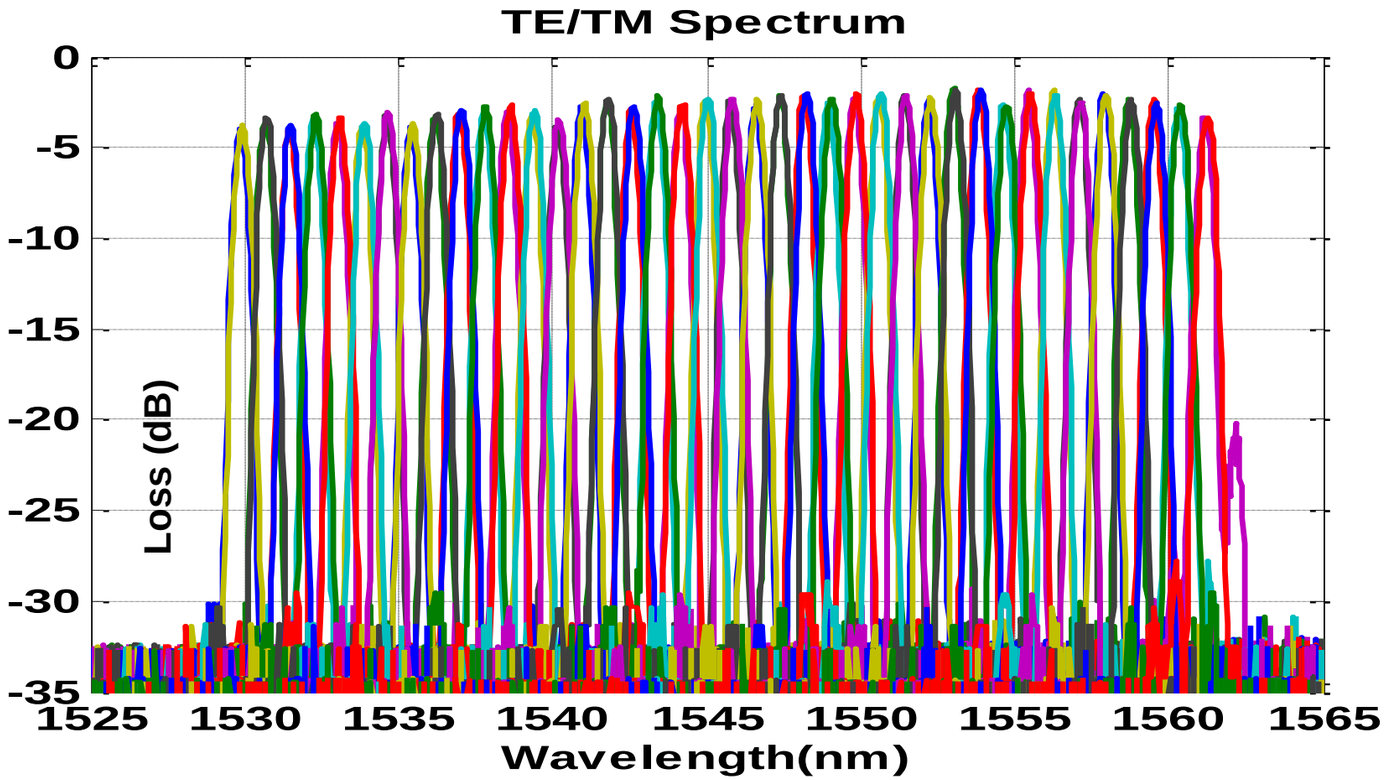




Spectra on a 12 channel multiplexer

Density & Scalability: Mellanox has Demonstrated > 1Tb/s Devices

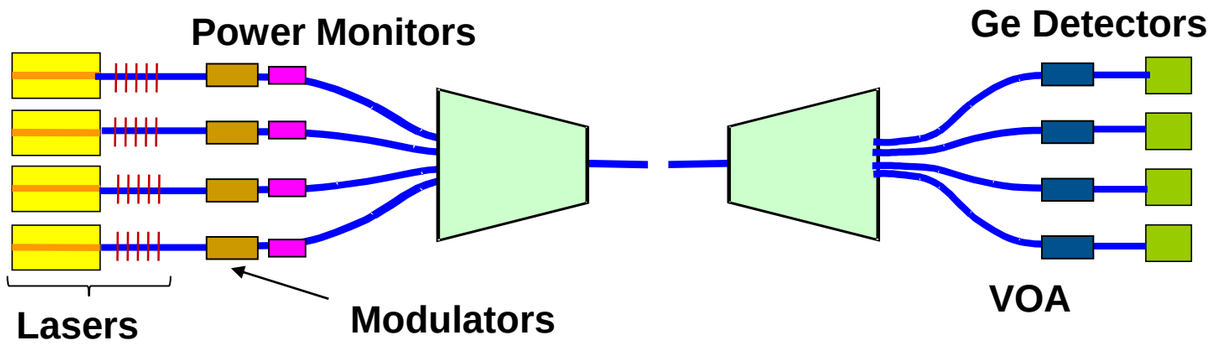


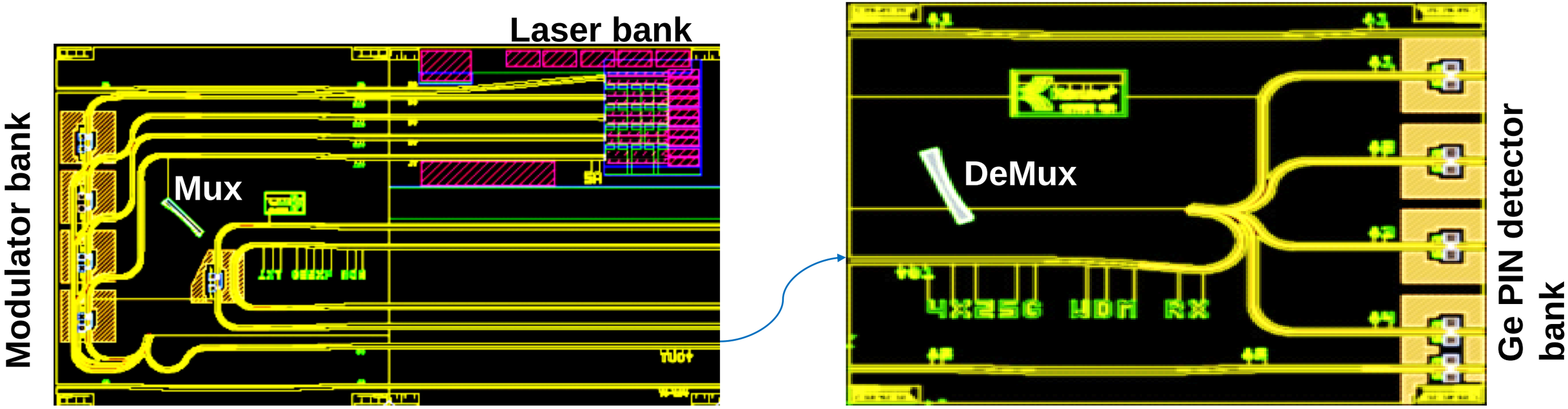


Connecting one fiber is a little easier and cheaper than connecting 40!

Echelle Gratings Allows Us to Squeeze 4x25G WDM 100G into a QSFP

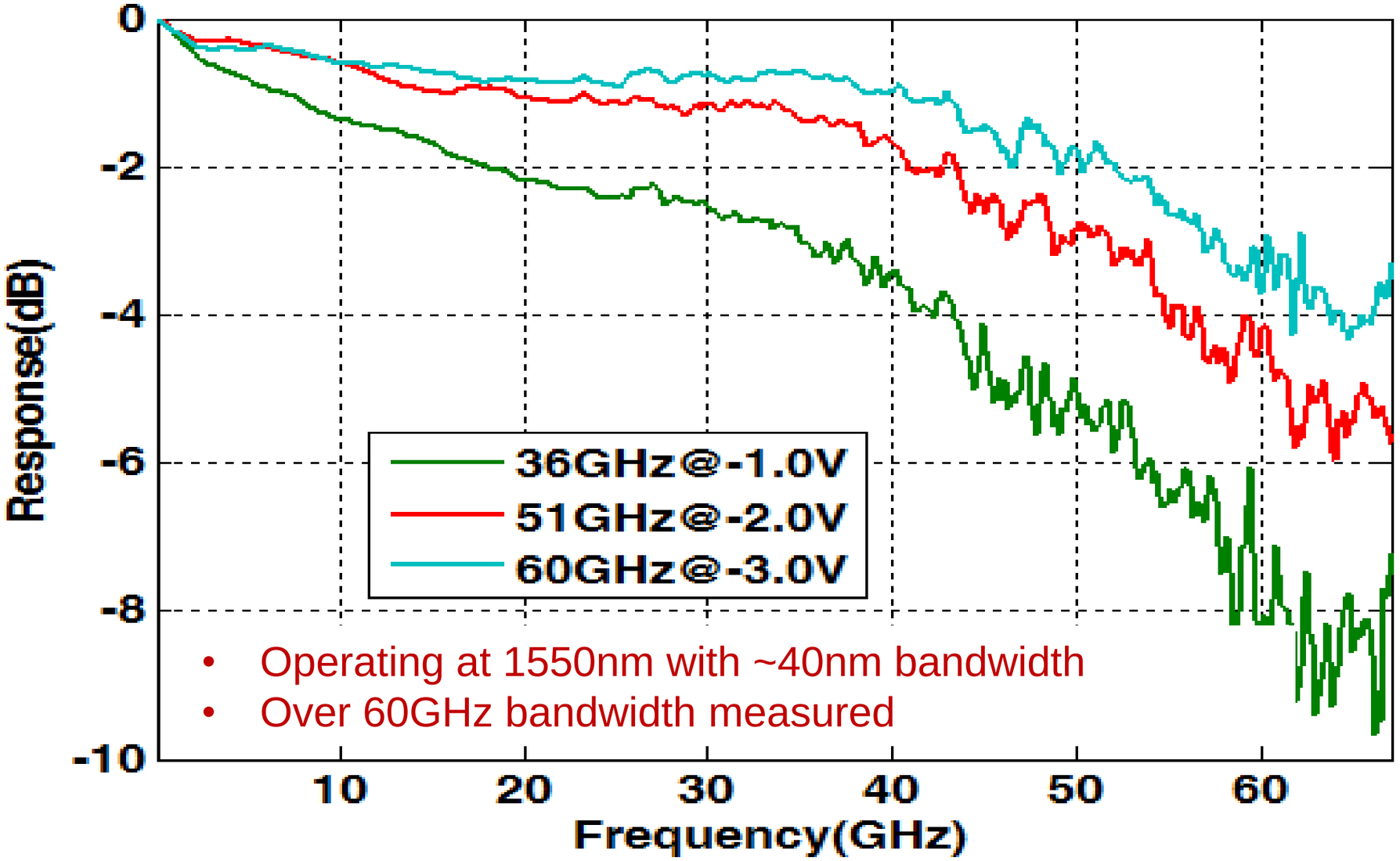
- QSFP package provides great density
- WDM link uses standard SMF duplex fiber (same as 10G today)
- 2 km reach





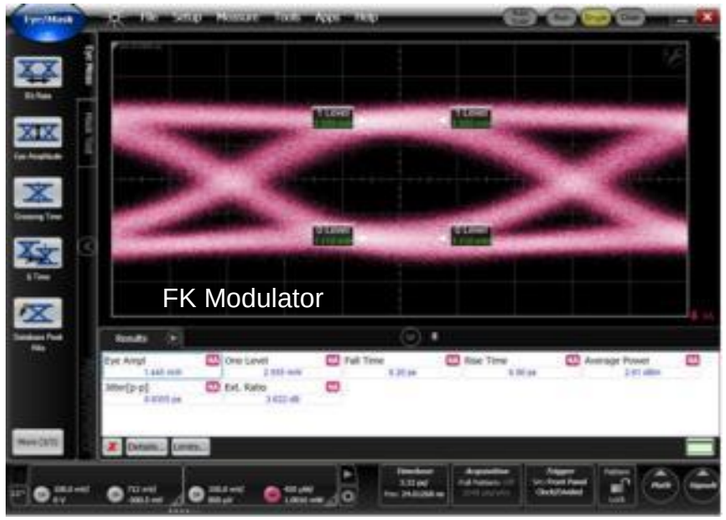
Silicon Photonics is the Fastest Path to EDR & 200GbE

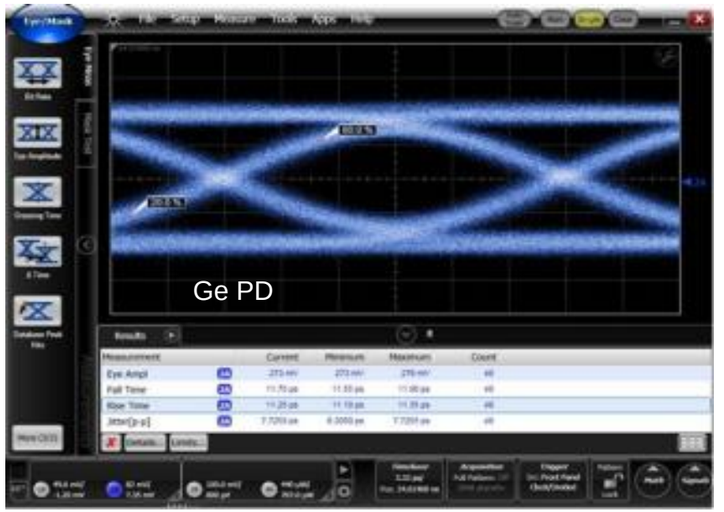
FDR EDR HDR NDR



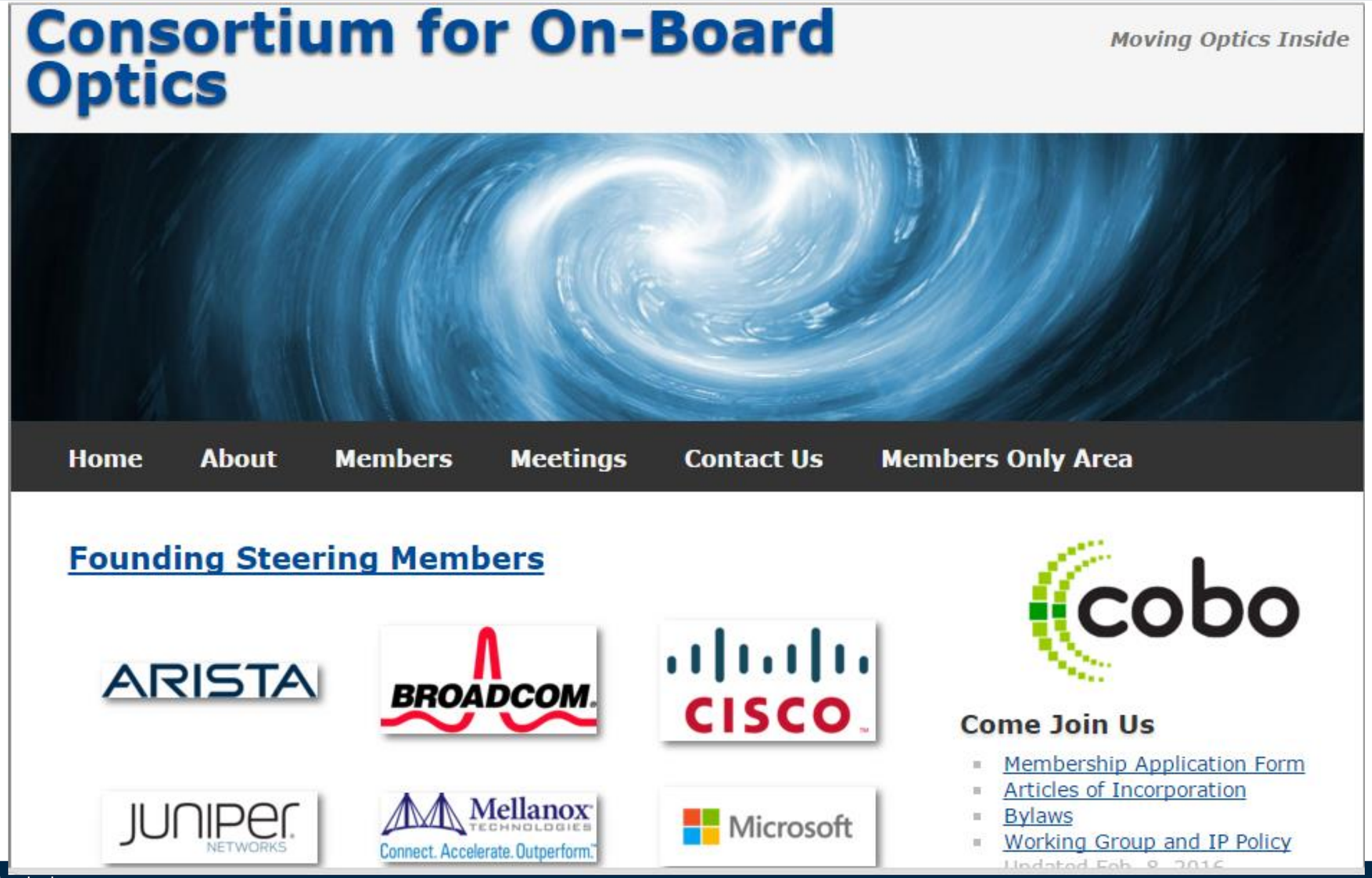
- Operating at 1550nm with ~40nm bandwidth
- Over 60GHz bandwidth measured

50 Gb/s Eyes





The Future for Silicon Photonics in Data Center Fabrics



Thank You

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