OIF Update! Defining 800ZR, 800LR, and Random 400ZR Information

ECOC 2022

Karl Gass – OIF Physical & Link Layer Working Group, Optical Vice Chair

OIF - Where the optical networking industry's interoperability work gets done

Who:

- 130+ member companies
  - Network operators
  - System vendors
  - Component vendors
  - Test & measurement vendors
  - Academia & research

What:

- Identify needs, gaps
- Develop interoperable optical, electrical, and control solutions
- Publish Implementation Agreements

Why:

- Accelerate adoption of advanced technology to connect a global, open networked world

Challenge: Support innovation while preserving interoperability, optimizing performance and cost

An international consortium that since 1998, has brought together industry groups from the data and telecom worlds

OIF - Membership-driven Work

Network and Cloud Operators

Network Control and Operation Projects

Equipment Developers

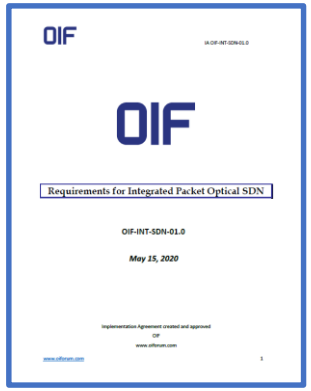
Electrical, Optical, Protocol, Co-Packaging, and Management Projects

Technical Committee

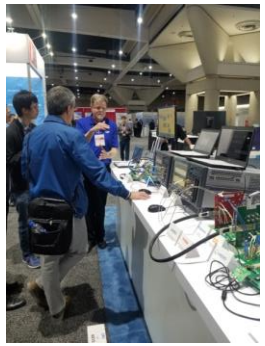
- Network Operator WG
- Networking & Operations WG
- Interoperability WG
- Physical Layer User Group
- Physical & Link Layer WG

Market Awareness and Education Committee

Implementation Agreements



Interoperability Demonstrations



Implementation Agreements

OIF

ACCELERATING MARKET ADOPTION OF OPTICAL NETWORKING TECHNOLOGIES

PROJECT HIGHLIGHTS 2022

What OIF Does

- Identifies Industry Needs and Gaps
- Develops Implementation Agreements
- Performs Interoperability Demonstrations

OPTICAL

800G
- Coherent
- Optimized for Cost
- Multivendor Interoperability

400ZR
- Coherent
- Optimized for Cost
- Multivendor Interoperability

IC-TROSA
- Low Power
- Small Form Factor

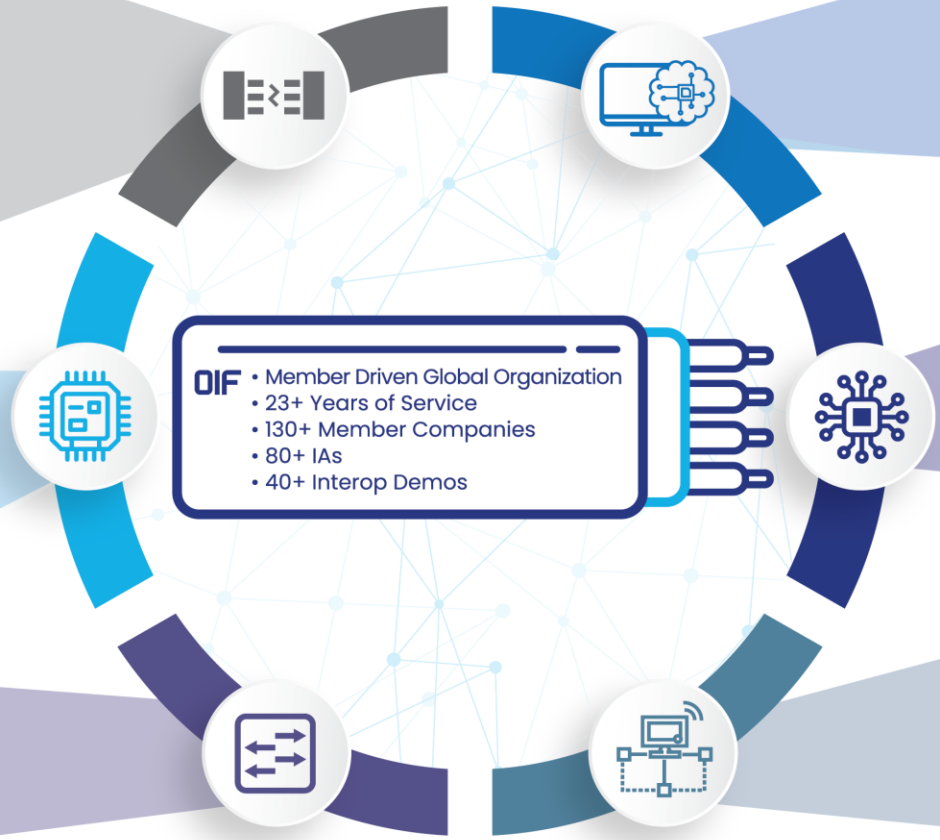
CO-PACKAGING

Co-Packaged Modules
- Densely Integrated Modules
- High Capacity, Energy Efficient

External Laser Sources
- Multivendor Interoperability

PROTOCOL

FlexE
- More Efficient
- Agile Networking



MANAGEMENT

CMIS and Coherent CMIS
- Common
- Flexible
- Extendable

ELECTRICAL

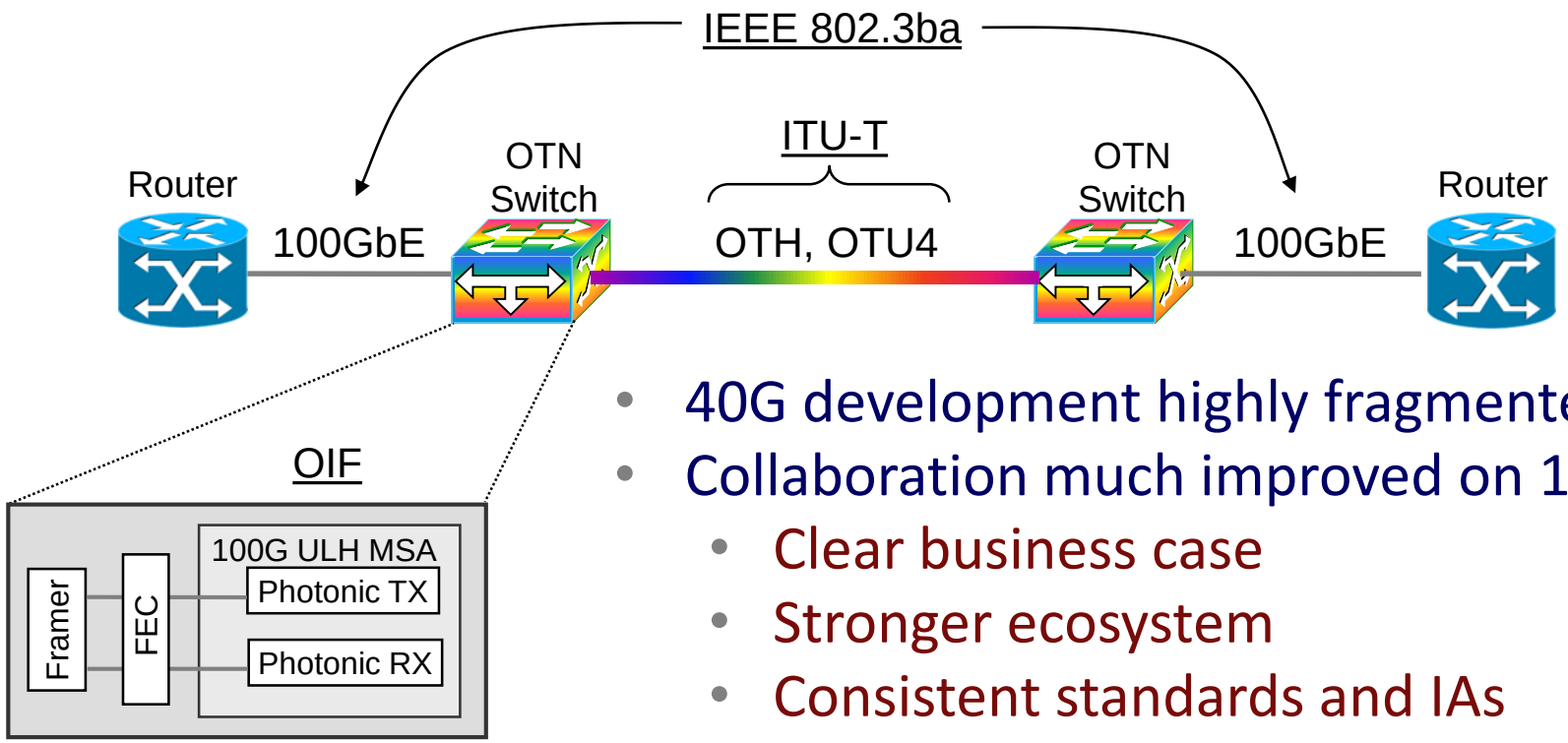
CEI
- High-Speed Building Blocks
- 224G, 112G, 56G, 28G

NETWORKING

Transport SDN APIs
- Automation
- Programmability
- Interoperability Tested

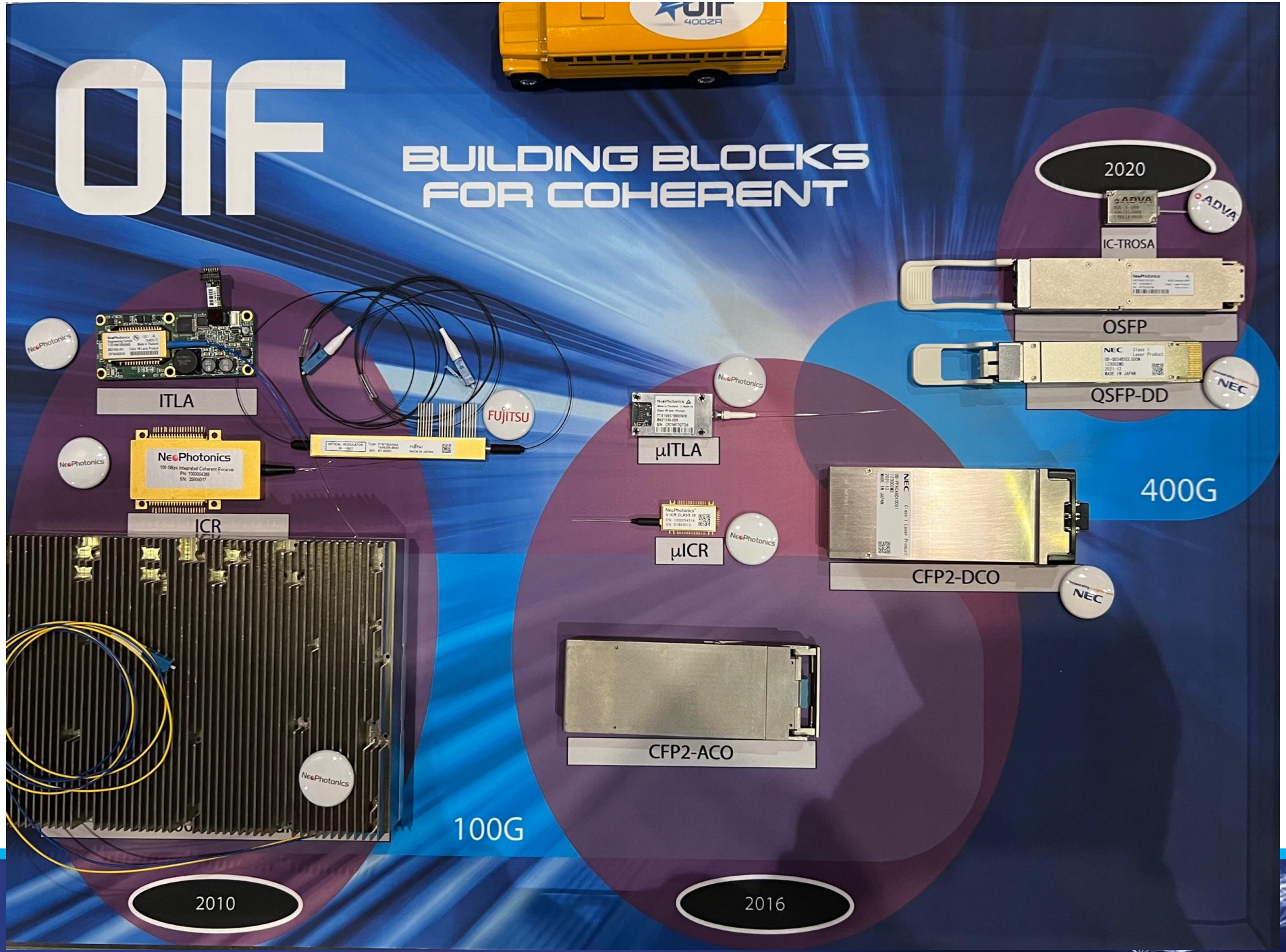
FOR MORE INFORMATION, VISIT WWW.OIFORUM.COM

How the OIF Accelerated 100G



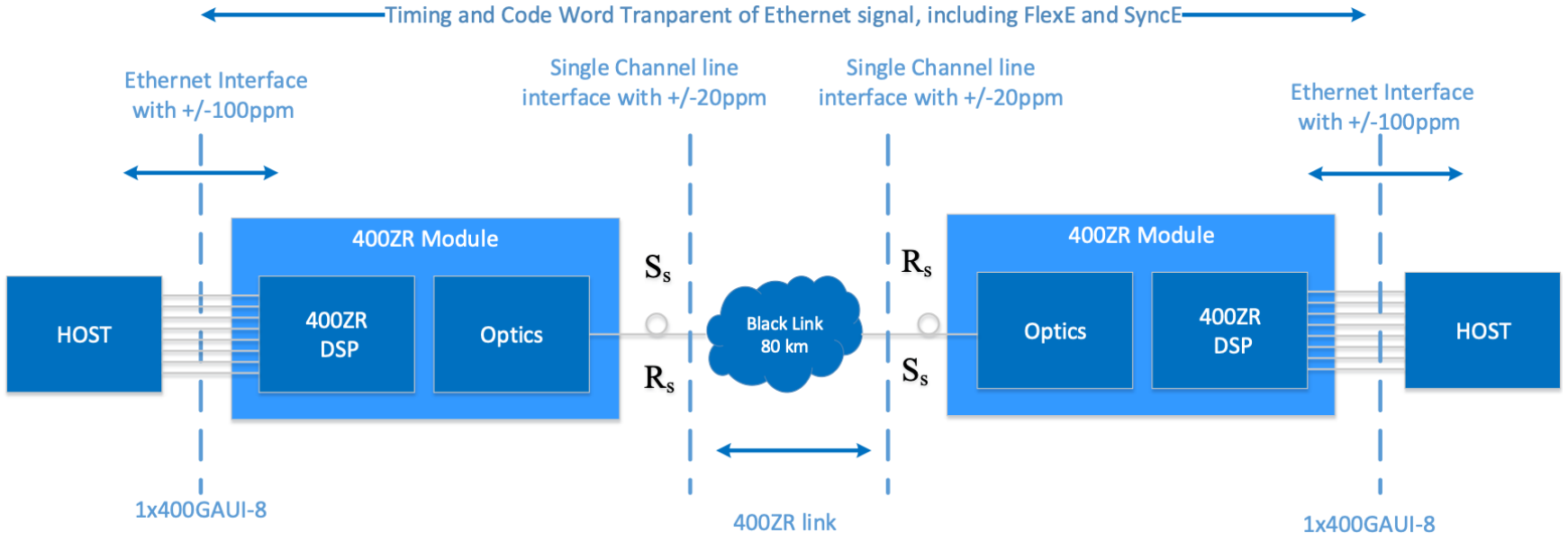
- 40G development highly fragmented
- Collaboration much improved on 100G
  - Clear business case
  - Stronger ecosystem
  - Consistent standards and IAs

- OIF work on 100G DWDM transport united the industry around
  - An overall framework including a modulation format
  - Detailed IA's including photonics Tx/Rx modules


OIF
BUILDING BLOCKS
FOR COHERENT
400ZR
2020
ADVA
IC-TROSA
OSFP
QSFP-DD
NEC
400G
ITLA
NeoPhotonics
FUJITSU
ICR
µITLA
µICR
CFP2-DCO
CFP2-ACO
100G
2010
2016

What is 400ZR?

- 400ZR is an interoperable, cost-effective, 400Gb/s interface based on single-carrier coherent DP-16QAM modulation, low power DSP supporting absolute (Non-Differential) phase encoding/decoding, and a Concatenated FEC (C-FEC) with a post-FEC error floor <1.0E-15.
- 400ZR operates as a 400GBASE-R PHY.



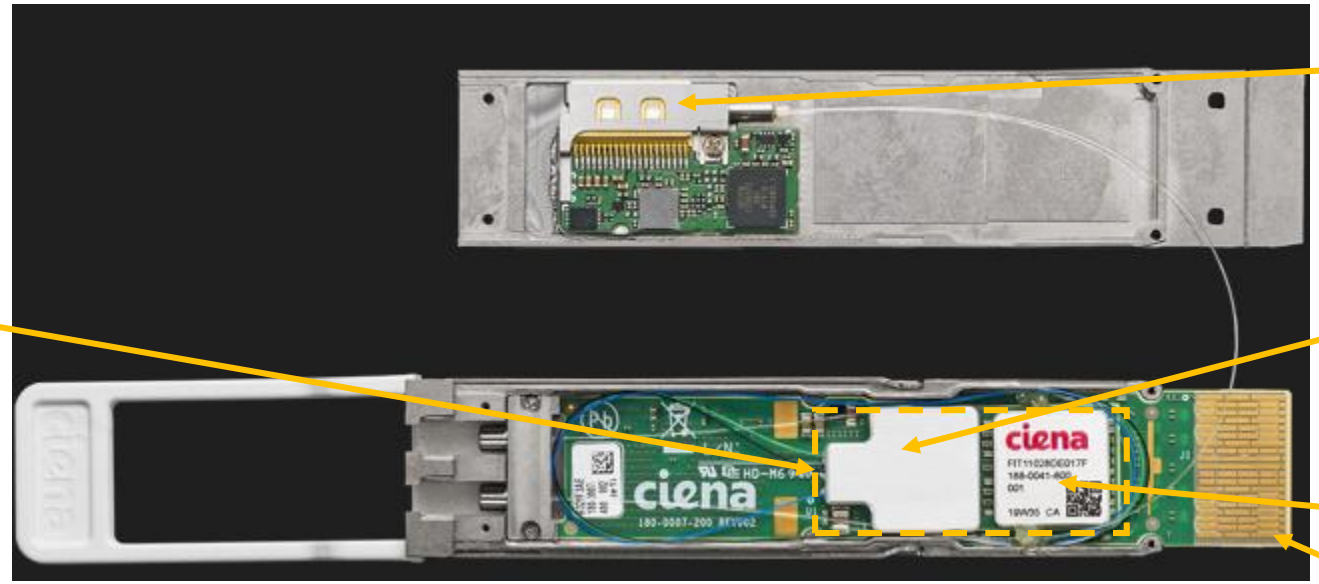
400ZR Key Optical Specifications

- DWDM Transmitter and Receiver specs: Optical Device Performance
  - OSNR ≤ 26dB
  - TX output power ≥ -10dBm
  - Received optical power ≥ -12dBm

- Transmission link penalty: DSP+Optics impairments
  - CD ≥ 2000 ps/nm with ≤0.5dB OSNR penalty
  - PMD ≥ 10 ps with ≤0.5dB OSNR penalty
  - PDL ≥ 3.5dB with ≤1.3dB OSNR penalty
  - SOP ≥ 50 rad/ms with ≤0.5dB OSNR penalty

- EVM included as Informative in Appendix

Anatomy of a 400ZR QSFP-DD



Laser

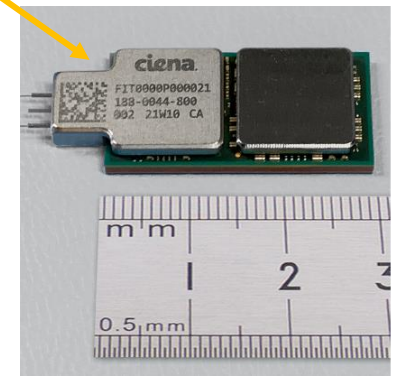
Coherent Optical Sub-Assembly (COSA)
Silicon photonics modulator/demodulator, driver, TIA

7nm coherent DSP

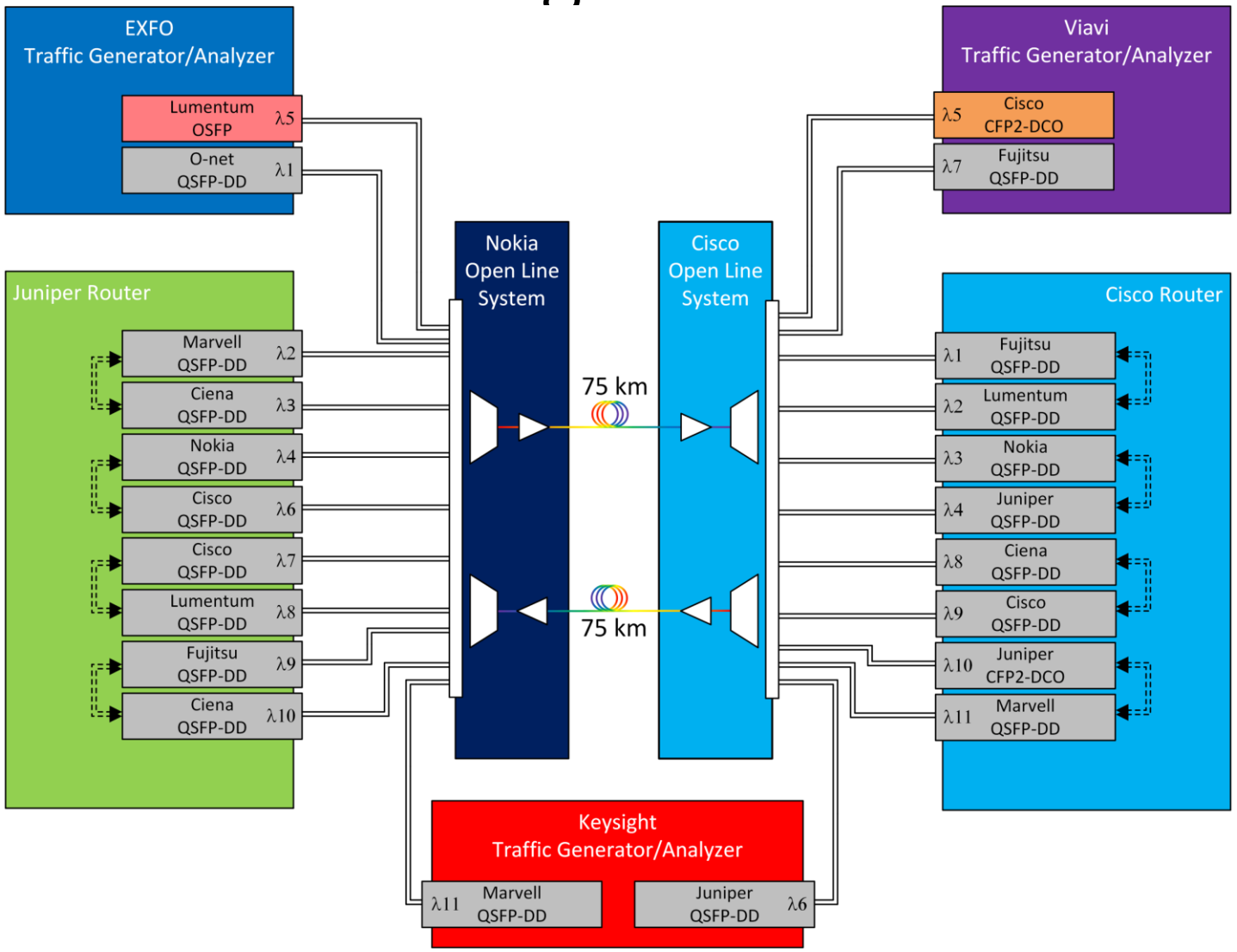
Host connection

External heat sink
Optimized for both front-back and transverse cooling

Transceiver-on-chip (ToC)
Optimized coherent modem for pluggable form factors combining DSP & COSA on common chip substrate



ECOC 2022 400ZR Demo Block Diagram



800ZR & 800LR

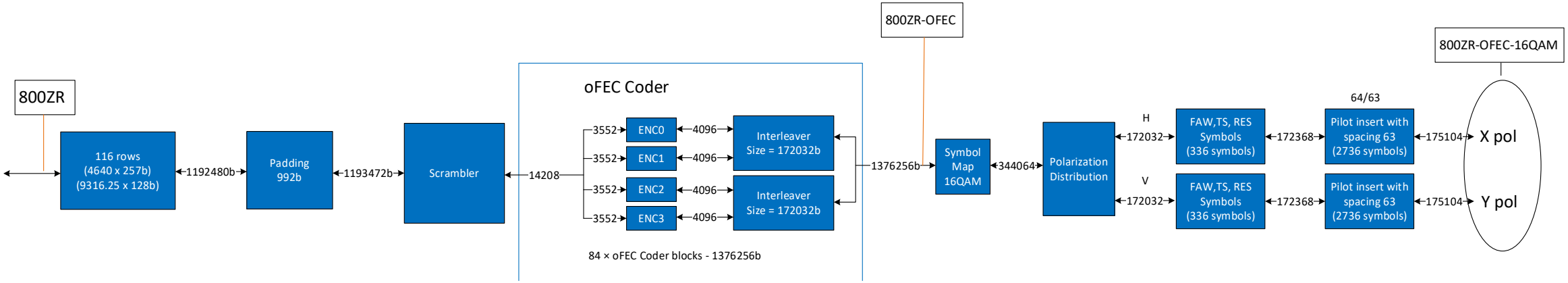
800ZR Goals

- Single channel 800G coherent interface for use in amplified, point-to-point, DWDM noise limited links with 150GHz spacing
- Target at inter-DC applications over 80km reach
- Support 100GE/200GE/400GE/800G-ETC client types over a single carrier optical interface with less then 1.0E-15 bit-errors.
- Form factor agnostic

- Goals like 400ZR, only faster

800ZR Baseline

- Non-differential DP-QAM16 modulation and forward error using OFEC
  - Prioritize performance over power dissipation
- GMP mapping 8 x 100G ZR clients to the 800ZR frame
- FLEXO-8e transport container



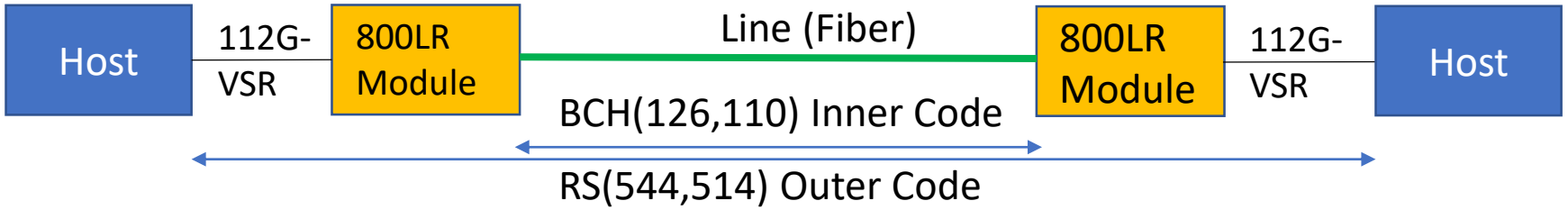
800LR Goals

- Unamplified link 6-8dB loss
- Single wavelength 800G coherent interface (O-band or C-band?)
- Target at intra-DC applications up to 10km reach
- Support 400GE and 800G-ETC client types
- Form factor agnostic

- Enable ultra low-latency, low-power, low-complexity modules
- Create a new class of coherent interfaces which are suitable for the coming generation of data center coherent optical interconnects

800LR Baseline

- Based on a concatenated FEC architecture with RS(544,514) as the outer code and BCH(126,110) as the inner code
- Simplified DSP frame with 1/64 pilots
- Use of RS(544,514) as the outer code enables design of light-weight non-segmented (i.e without host FEC termination) modules with latency, power and complexity benefits



But wait, there’s more

OIF 400ZR Plugfest

OIF, as a good practice, holds a dry run or plugfest of our demonstration prior to ECOC…

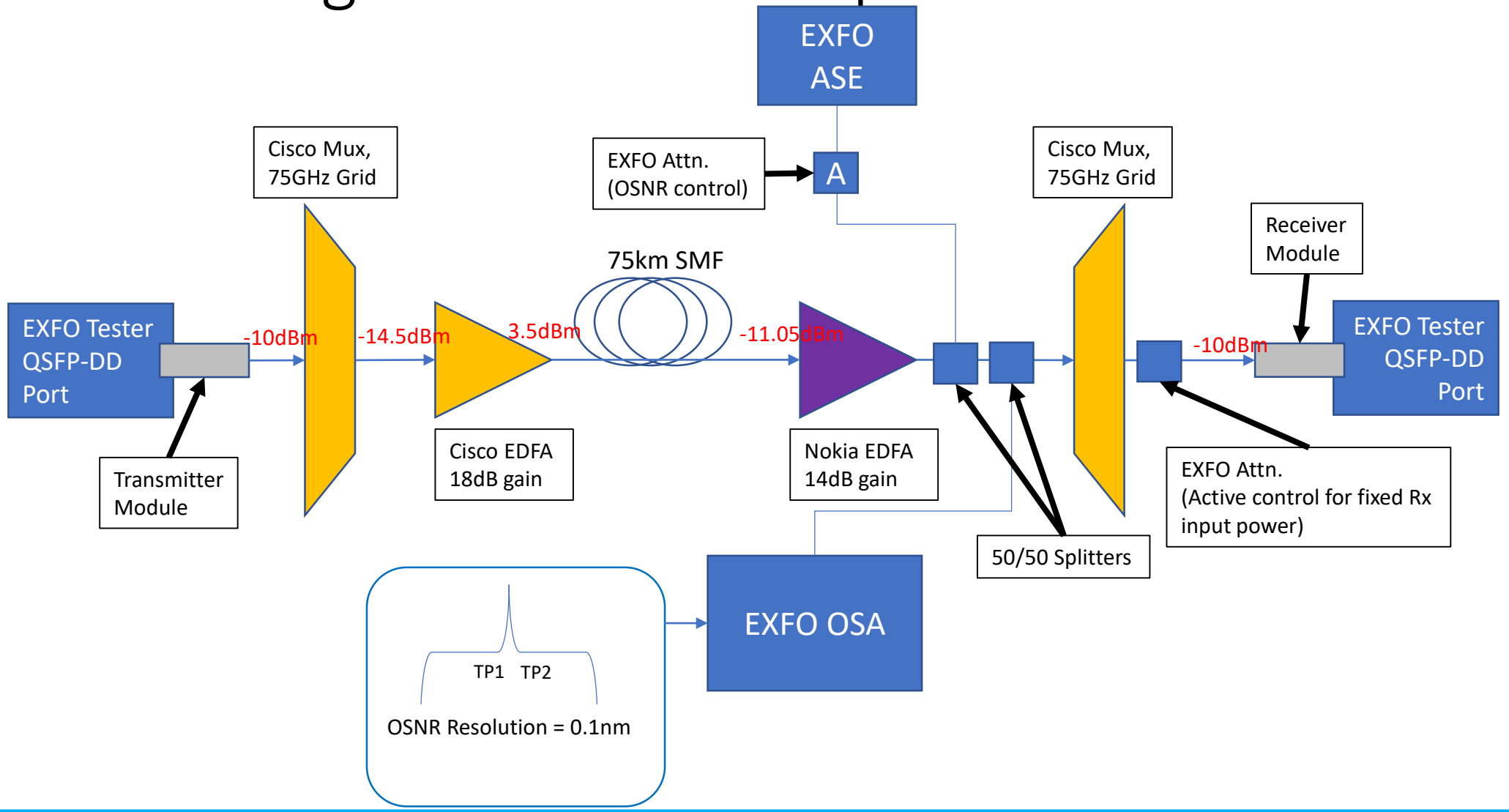
“Hey all. We have several days set aside for our 400ZR dry run for ECOC. With all the resources we have together, it would be a shame to successfully finish early and have time left over. What stretch goal would be most useful to you?”

- Karl

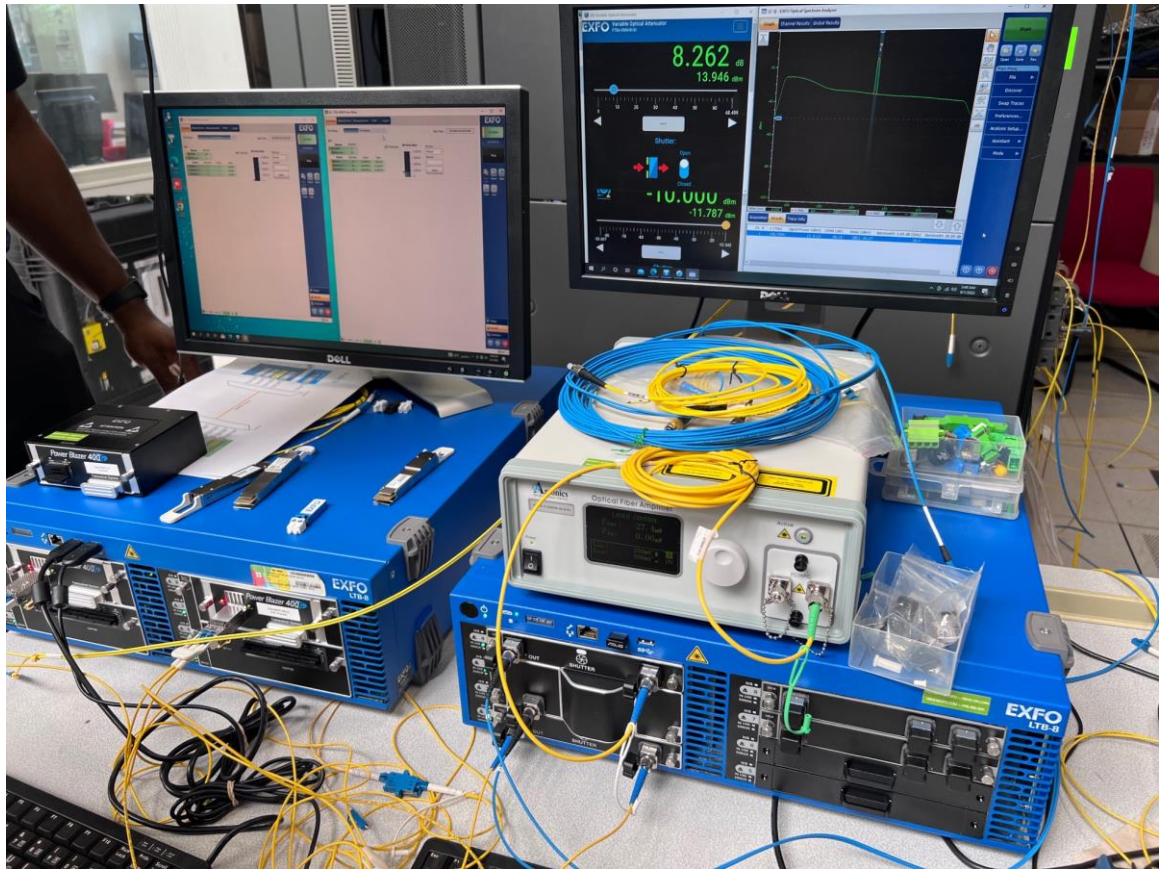
“I think we have passed the initial phase of "functional interoperability" phase, instead, we can focus on the the corner cases to demonstrate inter-op gaps and challenges. End users really care about (r)OSNR performance; less so about EVM. I think you have both aspects captured in your proposed measurements, as I understand it. But if we had to focus on just one metric, (r)OSNR is the more critical.”

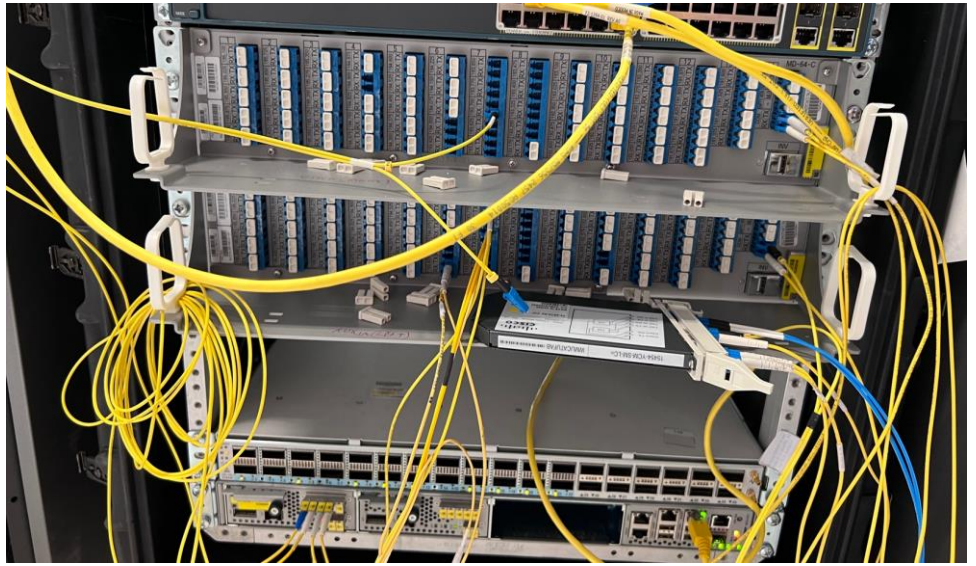
- Important Network Operator

OIF 400ZR Plugfest rOSNR Setup



OIF 400ZR Plugfest rOSNR Setup





OIF 400ZR Plugfest rOSNR Test Procedure

- Provision Tx module – High power mode, 193.7 THz.
- Provision Rx module – High power mode, 193.7 THz. Adjust so we have the power levels in the previous diagram.
- Tx to Rx through OLS. Rx to Tx back-to-back. Wait for link.
- Increase ASE noise level in .1dB steps until until a post-FEC error is reported. Back off .1dB and ensure error-free for minimum 10 sec.
- For both sides of that error-free traffic boundary: Capture reports from EXFO tester for both TX module and RX module. Capture OSA data.

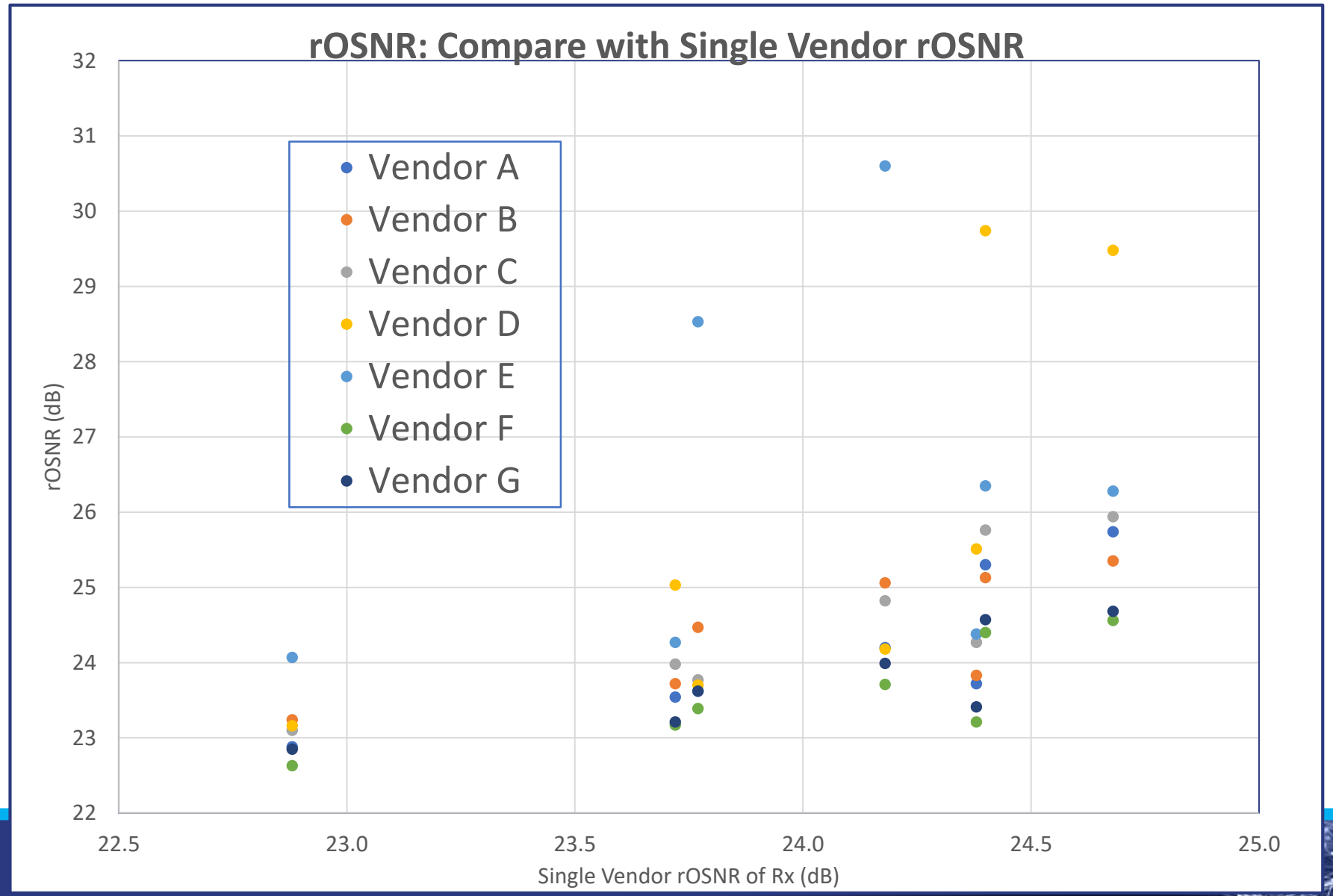
OIF 400ZR Plugfest rOSNR Results

		Transmitter						
		A	B	C	D	E	F	G
Receiver	A	22.9	23.2	23.1	23.2	24.1	22.6	22.9
	B	23.5	23.7	24.0	25.0	24.3	23.2	23.2
	C	23.6	24.5	23.8	23.7	28.5	23.4	23.6
	D	24.2	25.1	24.8	24.2	30.6	23.7	24.0
	E	23.7	23.8	24.3	25.5	24.4	23.2	23.4
	F	25.3	25.1	25.8	29.7	26.4	24.4	24.6
	G	25.7	25.4	25.9	29.5	26.3	24.6	24.7

Single Vendor rOSNR of Rx

Single Vendor defined as: same vendor, but different Tx and Rx modules.
Not loopback or back-to-back.

OIF 400ZR Plugfest Measured rOSNR Results



OIF 400ZR Plugfest Measured vs Reported rOSNR

Measured by OSA		Transmitter						
		A	B	C	D	E	F	G
Receiver	A	22.9	23.2	23.1	23.2	24.1	22.6	22.9
	B	23.5	23.7	24.0	25.0	24.3	23.2	23.2
	C	23.6	24.5	23.8	23.7	28.5	23.4	23.6
	D	24.2	25.1	24.8	24.2	30.6	23.7	24.0
	E	23.7	23.8	24.3	25.5	24.4	23.2	23.4
	F	25.3	25.1	25.8	29.7	26.4	24.4	24.6
	G	25.7	25.4	25.9	29.5	26.3	24.6	24.7

Rx Average OSNR Reported by Module CMIS (VDM)		Transmitter						
		A	B	C	D	E	F	G
Receiver	A	24.0	23.0	22.9	23.0	23.2	22.9	22.9
	B	25.0	24.1	24.1	24.3	23.6	23.4	23.3
	C	23.4	23.0	23.5	22.8	23.8	23.0	22.8
	D	23.5	23.5	21.4	23.5	23.8	23.4	23.5
	E	26.5	28.8	26.0	26.9	26.0	26.0	26.0
	F	25.4	24.8	25.2	29.2	25.5	24.6	24.8
	G	15.1	11.2	11.8	11.9	11.2	24.6	24.6

Old firmware suspected.

Delta		Transmitter							
		A	B	C	D	E	F	G	Δ average
Receiver	A	1.1	0.2	0.2	0.2	0.9	0.3	0.0	0.4
	B	1.5	0.4	0.1	0.7	0.7	0.2	0.1	0.5
	C	0.2	1.5	0.3	0.9	4.7	0.4	0.8	1.3
	D	0.7	1.6	3.4	0.7	6.8	0.3	0.5	2.0
	E	2.8	5.0	1.7	1.4	1.6	2.8	2.6	2.6
	F	0.1	0.3	0.6	0.5	0.9	0.2	0.2	0.4
	G	10.6	14.2	14.1	17.6	15.1	0.0	0.1	10.2

Summary

- OIF – “Changing the world”
- 800ZR – baseline proposal
- 800LR – baseline proposal
- 400ZR – major deployments and successful, interoperable ecosystem.
- OIF – quantitative data from Plugfest is a significant change for the Interoperability Working Group! Increased expectations for the future!

Thanks for your support!