

# PHY Objectives and Technical Feasibility

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# Topics

- Proposed PHY objectives
- Recent technical results

# Proposed PHY Objectives

- Define a single-wavelength 100 Gb/s PHY for operation over SMF with lengths up to at least 2 km
- Define a single-wavelength 100 Gb/s PHY for operation over SMF with lengths up to at least 10 km
- Define a four-wavelength 400 Gb/s PHY for operation over SMF with lengths up to at least 2 km
- Define a four-wavelength 400 Gb/s PHY for operation over SMF with lengths up to at least 10 km

# Feasibility

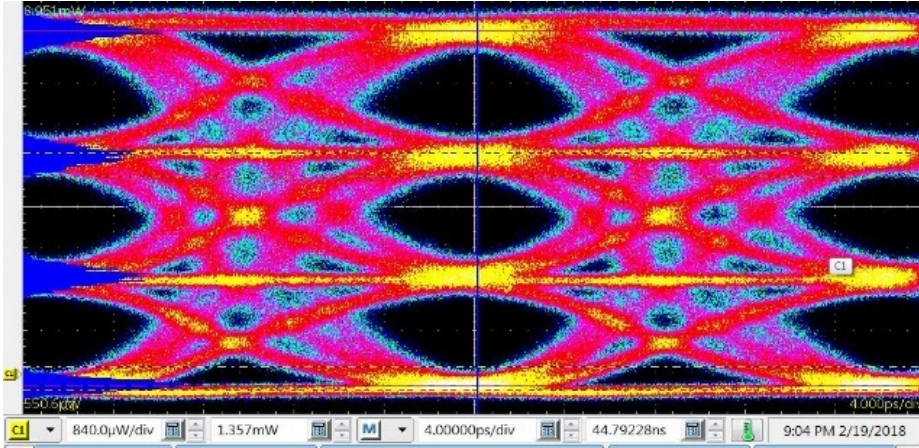
- These objectives are consistent with the scope of the study group and the market justification discussed in the CFI
- The technology to achieve these objectives is maturing quickly after the initiation on the technology development due to the 802.3bs and 802.3cd projects on 400GBASE-DR4 and 100GBASE-DR, respectively.

# Technical feasibility - Transmitters

Various transmitters capable of 100 Gb/s PAM4 have been demonstrated or presented

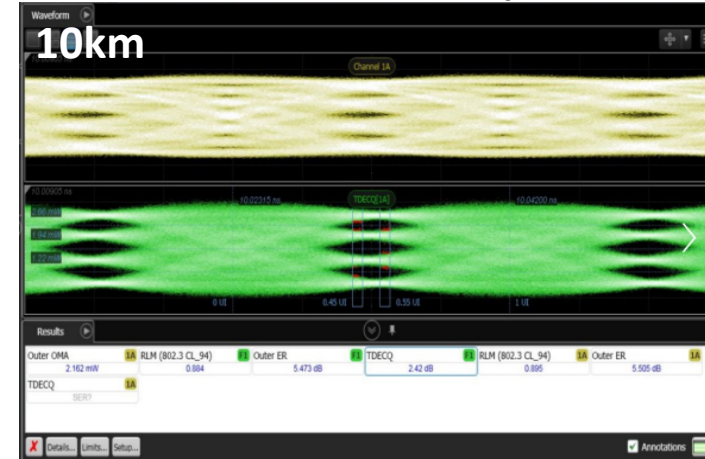
Optical eye

TDECQ = 1.26 dB (2 km @ 5.2 ps/nm)



53 GBaud PAM4 (106 Gb/s)  
IEEE Pattern PRBS13Q See - mazzini\_3cd\_01a\_0518

Courtesy Broadcom



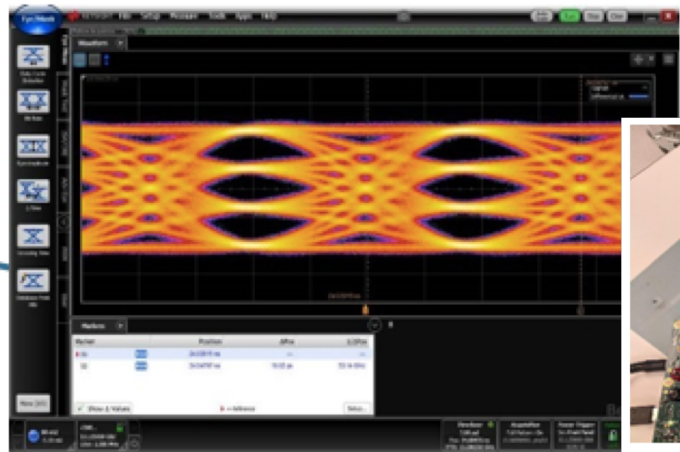
10 km Penalty = 0.21dB

19 ps/nm

ER=6.9dB, TDECQ= 2.78dB

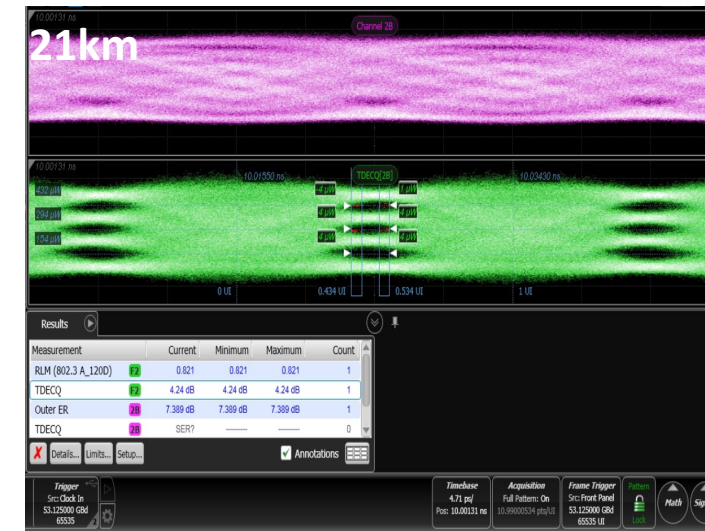
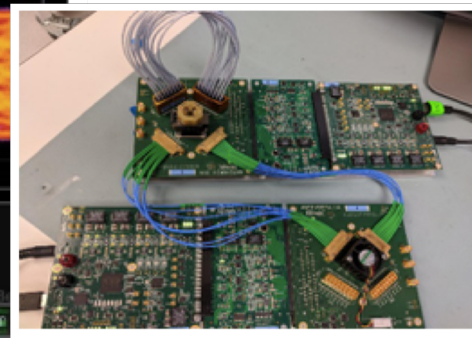
Electrical eye

Line Transmit Eye  
106.25Gbps (53.125Gbaud)



Electrical Loopback  
SNR >24dB, BER < 1e-12

Courtesy Inphi



21 km Penalty = 1.54 dB

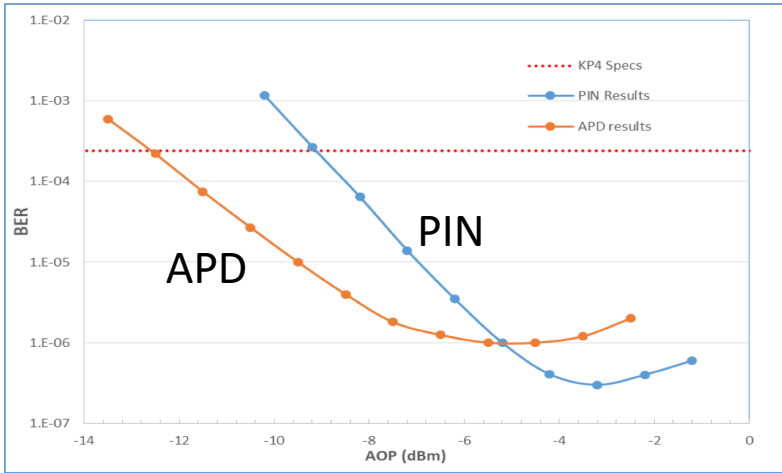
31 ps/nm

ER=7.4dB, TDECQ= 4.24dB

Transmitter:  
AWG + linear amplifier,  $V_{pp} = 1.2V$   
No emphasis applied at the AWG  
SSPRQ pattern at 53 GBd  
56GBd EML CoC,  $\lambda = 1330nm$

# Technical feasibility – Receivers

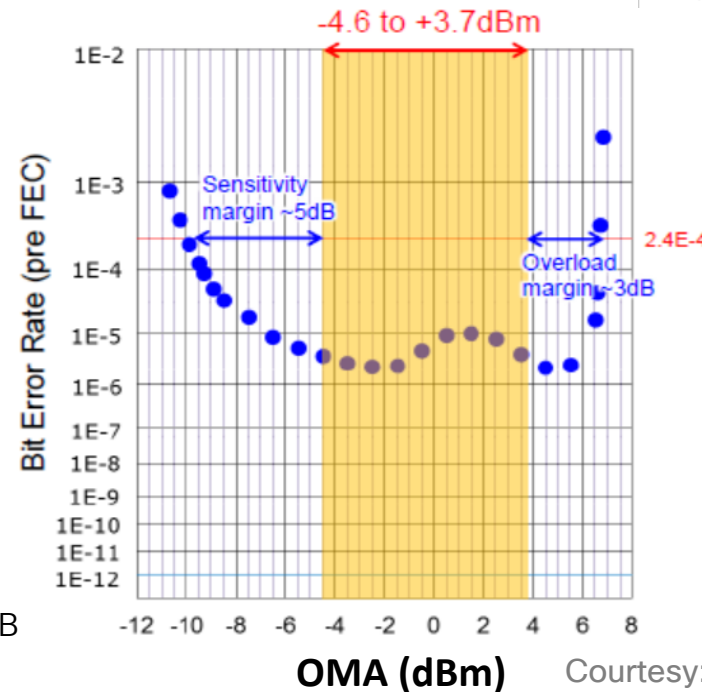
[http://www.ieee802.org/3/cfi/1118\\_1/CFI\\_01\\_1118.pdf](http://www.ieee802.org/3/cfi/1118_1/CFI_01_1118.pdf)



- 53.125GBaud, PAM4 PRBS31Q EML CoC (1304nm), ER ~ 5.1dB, SECQ ~ 1.8dB
- Same TIA, Same DSP

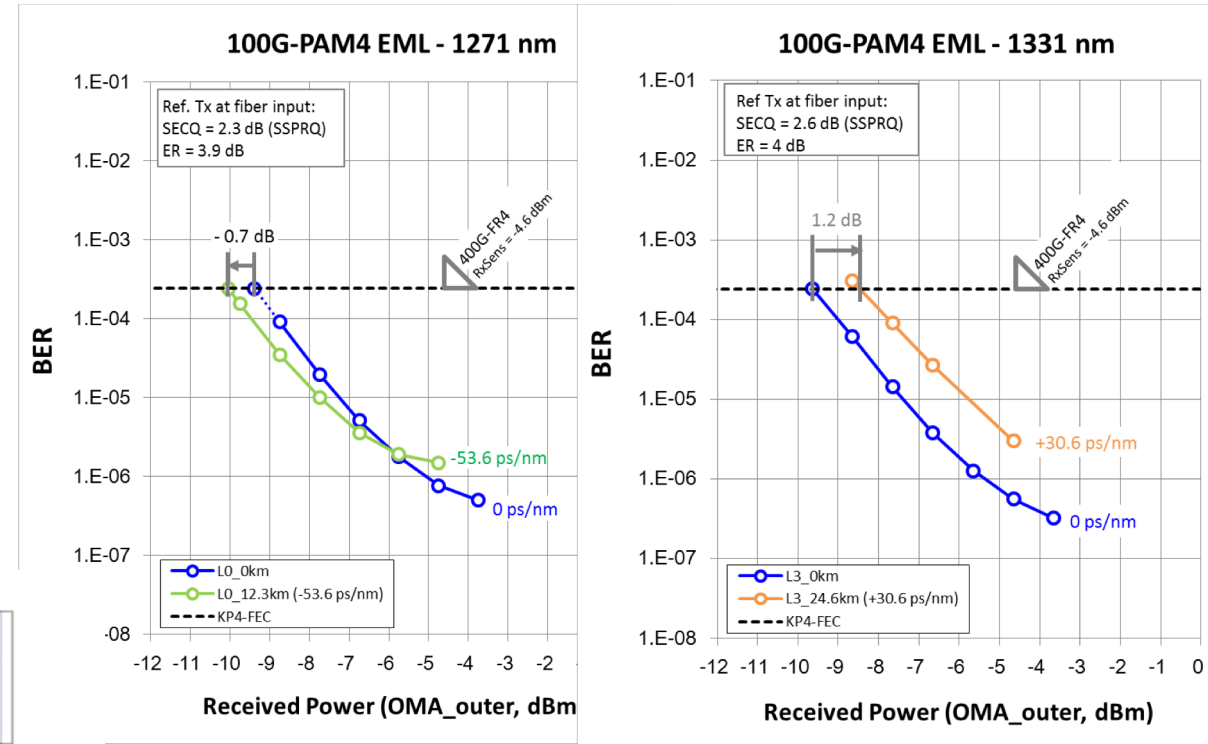
Source: IEEE OI'2018, Santa Fe, 4-6 June 2018 (Inphi/Source)  
<https://ieee-oi.org/program/>

## 400G - 2km CWDM



53.125Gbd  
 PRBS15Q  
 ER=5.5dB  
 TDECQ1.6dB

Courtesy: Sumitomo Electric



	CD (ps/nm)	CD (ps/nm)	
IEEE MIN Spec for L0, 10km	-59.4	IEEE MAX Spec for L3, 10km	33.4
Measured (1271 nm, 12.3 km)	-53.6	Measured (1331 nm, 24.6 km)	30.6

Courtesy: Oclaro

**Experimental Configuration:**  
 PRBS15 53.125 Gbaud PAM4  
 CWDM EML CWDM PIN-PD  
 DSP (FFE>5 taps)  
 SM fiber: L0 (12.3 km) & L3 (24.6 km)

# Technical Feasibility - Reliability

- Material, components and subsystems needed to build products based on these objectives are consistent with known technologies currently being developed and deployed for Ethernet based solutions
- From a reliability perspective, proposed objectives would result in products consistent with known practices for the common deployments:
  - Lasers, modulators, photodetectors, analog & digital electronics, transceiver integration & system design



# Summary

- Draft PHY objectives proposed
- Existing 100 Gb/s per wavelength technology for 500m reaches has been demonstrated publicly and Technical Feasibility for longer reaches has shown through multiple examples from multiple companies of technology options to meet the objectives