

# 16-Wavelength 800-Gbps Bidirectional Link over Single-Mode Fiber Using Microring Transceivers

Nikhil Kumar, Senior Director Photonics  
Lightmatter

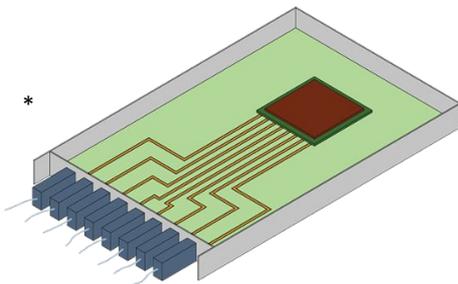
OFC 2026



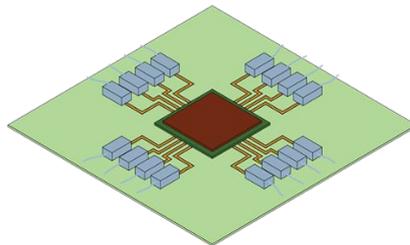
# Enabling new communications technologies

Closer and closer to the chip

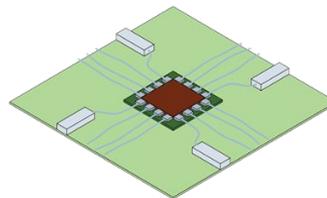
Gen I  
Pluggable Optics



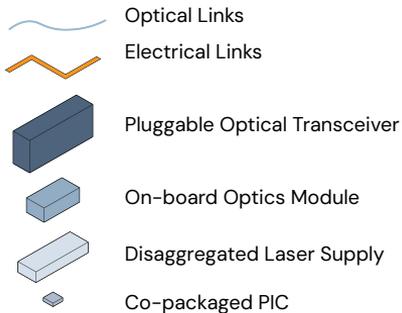
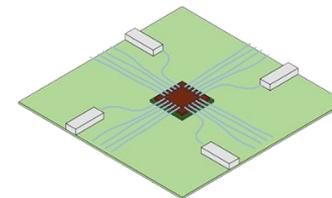
Gen II  
On-board Optics



Gen III  
2.5D Co-packaged Optics



Gen IV  
3D Stacked  
PASSAGE™



## Why bring optics closer to the SoC?

- Reduction in interconnect power
- Increased bandwidth
- Higher bandwidth density at die edge
- Bypass intermediate stages (PCIe)

\*Used with permission from Dr. John Bowers and adapted from an article in Applied Physics Letters (2021)

# Lightmatter 3D Photonics Ecosystem

HYPERSCALE VOLUME-READY

Passage™ CPO

Custom ASIC  
Partners



Passage™ SerDes  
and EIC Partners



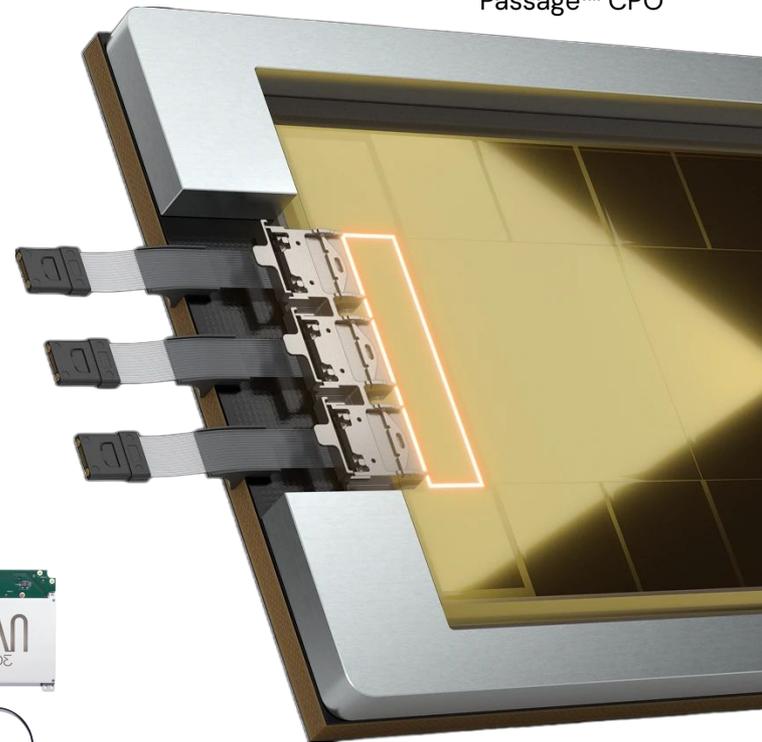
LIGHTMATTER  
Passage™ PIC



Detachable  
Fiber Array Unit

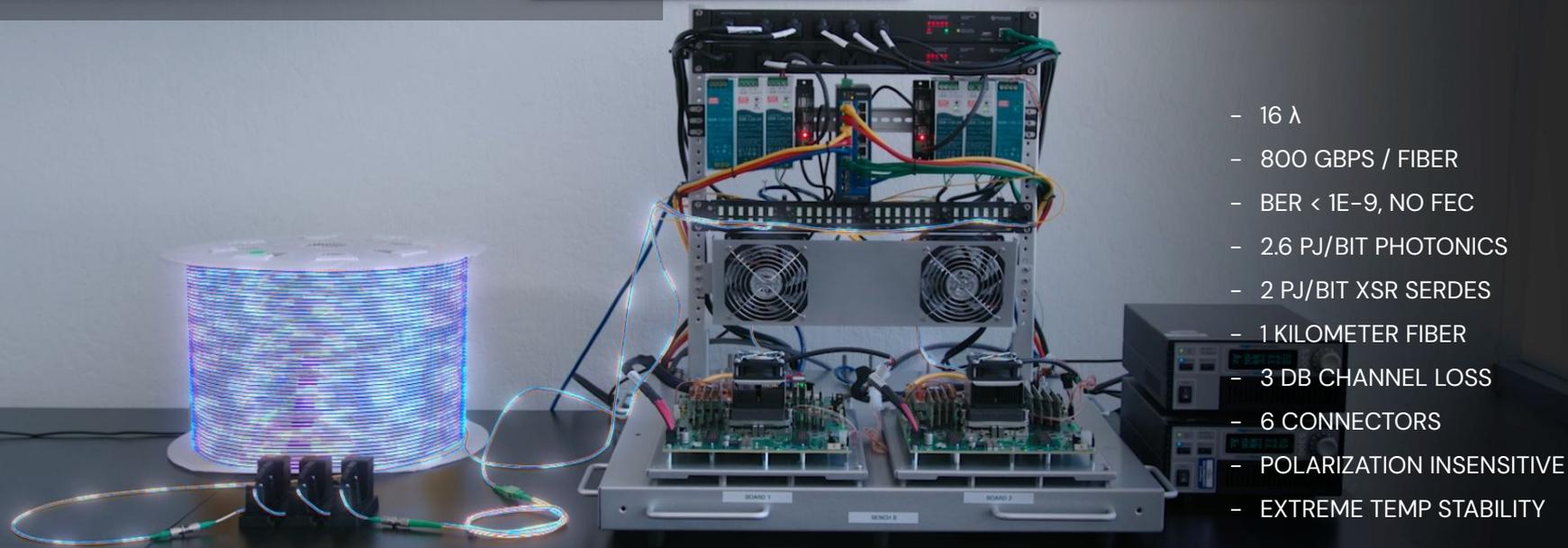


Guide® VLSP™  
Light Engine

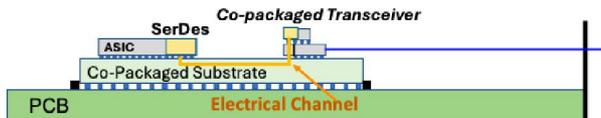


PHOTONIC CHIPS FOR AI

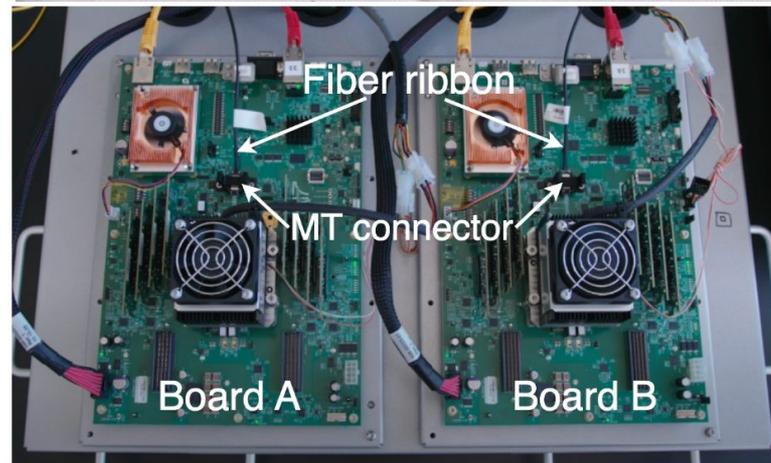
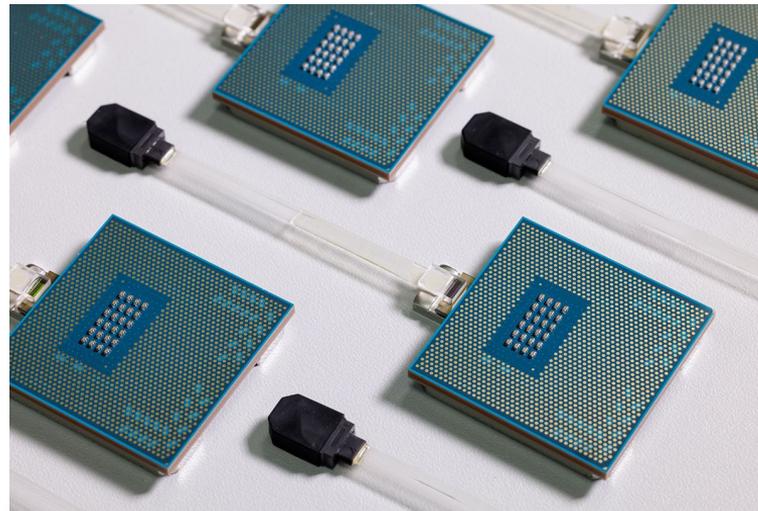
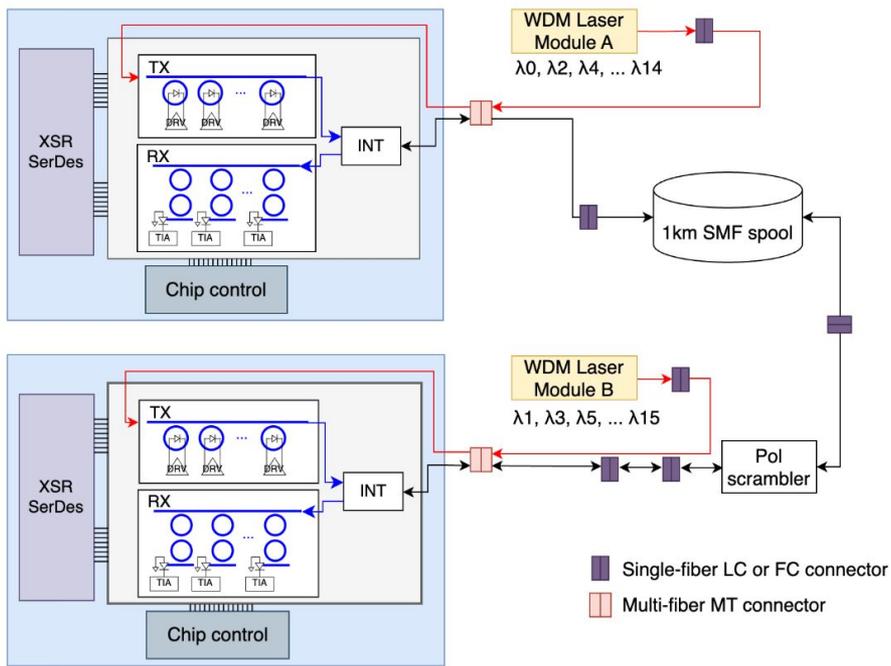
# The first 16-wavelength bidirectional link.



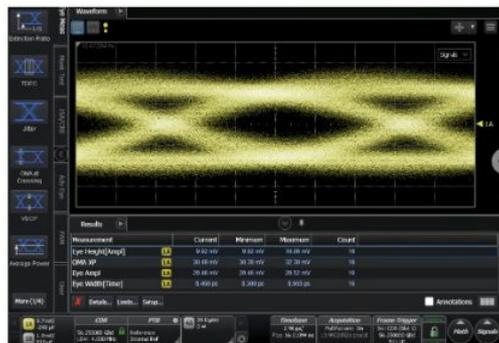
- 16  $\lambda$
- 800 GBPS / FIBER
- BER < 1E-9, NO FEC
- 2.6 PJ/BIT PHOTONICS
- 2 PJ/BIT XSR SERDES
- 1 KILOMETER FIBER
- 3 DB CHANNEL LOSS
- 6 CONNECTORS
- POLARIZATION INSENSITIVE
- EXTREME TEMP STABILITY



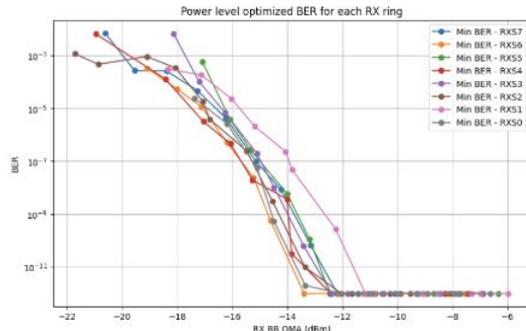
Reference CPO: OIF "Compute Optics Interface (COI): Energy Efficient Photonic Interconnects for AI Compute Scale-up"



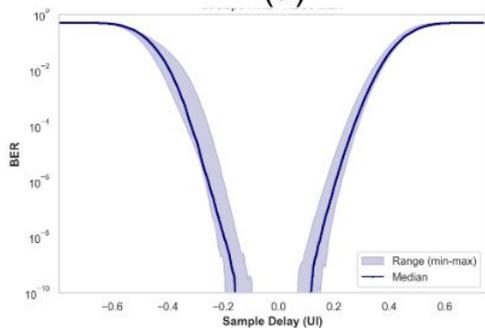
# Tx and Rx Characterization



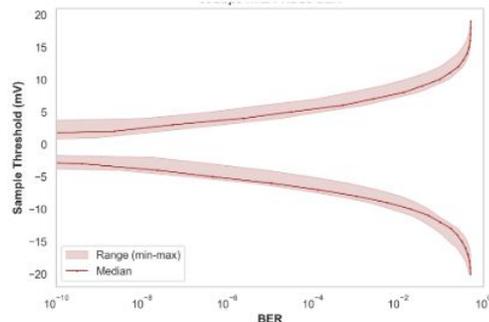
(a)



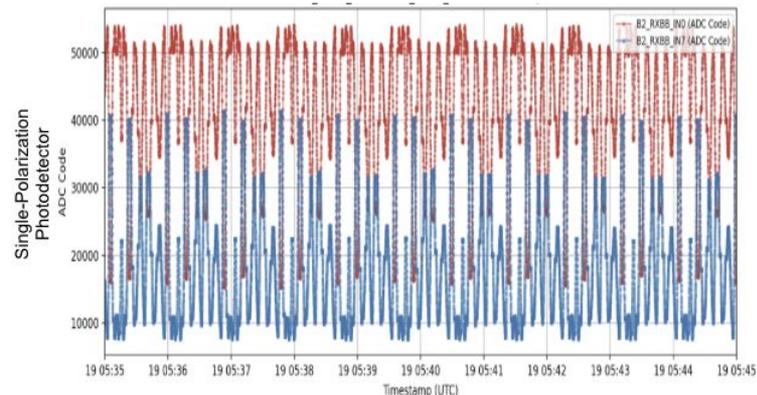
(b)



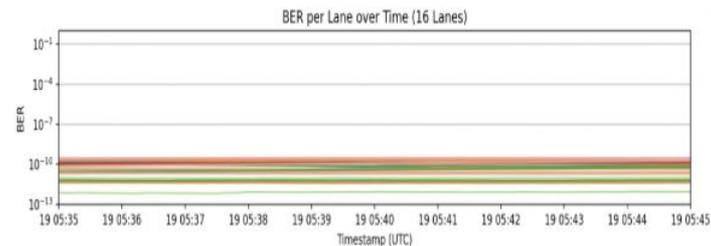
(c)



(d)

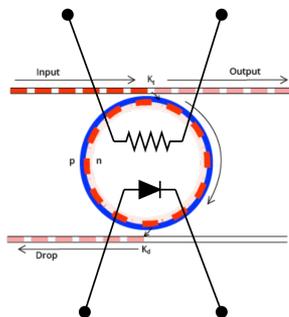


(e)



# The heart of the engine: silicon microrings

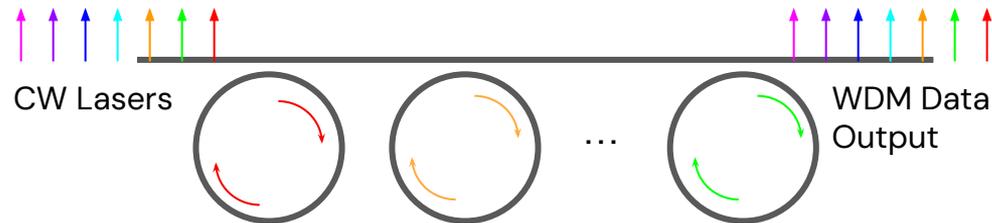
Ultra-compact, high-speed, WDM-friendly



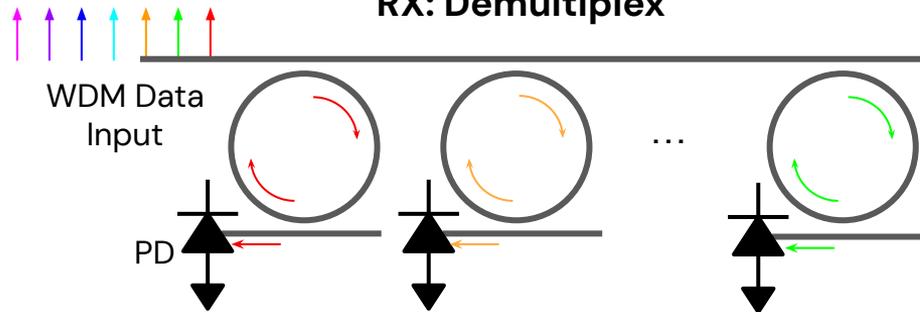
Diameter ~ 15um

Resistive heater  
for tuning  
Depletion PN junction  
for modulation

## TX: Modulate + Multiplex

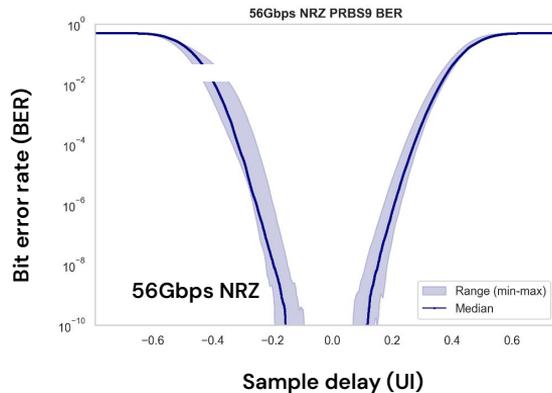
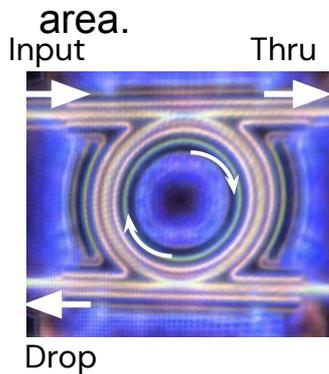


## RX: Demultiplex

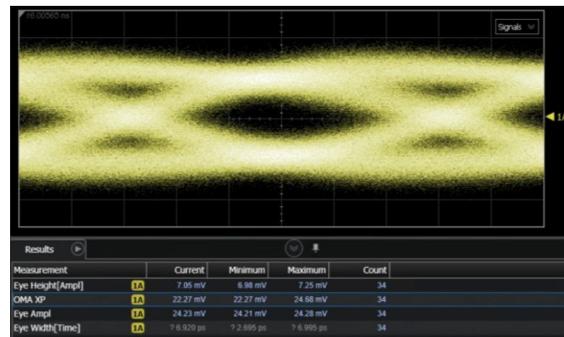


# Ultracompact transmitter and receiver

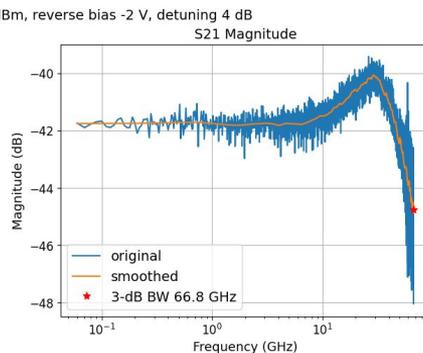
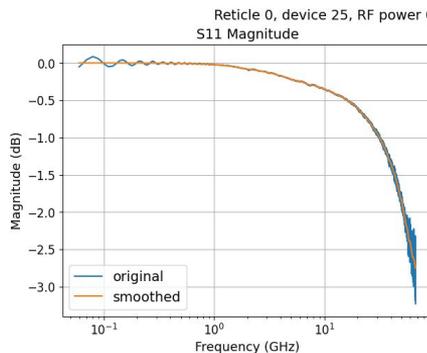
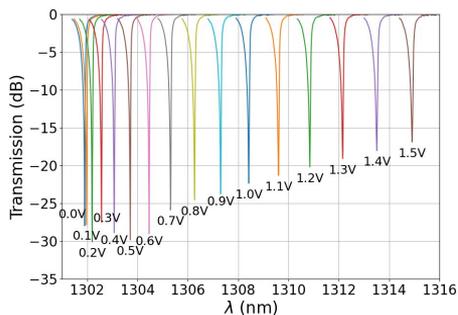
Microrings with inductorless driver and analog front end enable **0.006 mm<sup>2</sup>** Tx + Rx



Sample threshold (mV)



BER



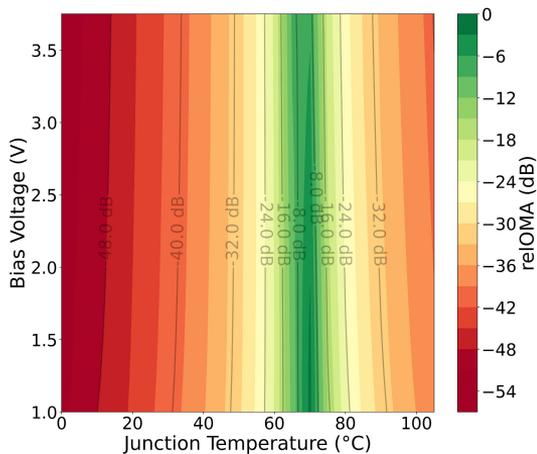
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LIGHTMATTER MRM CONTROL TECHNOLOGY

# MRM in fluctuating thermal environments

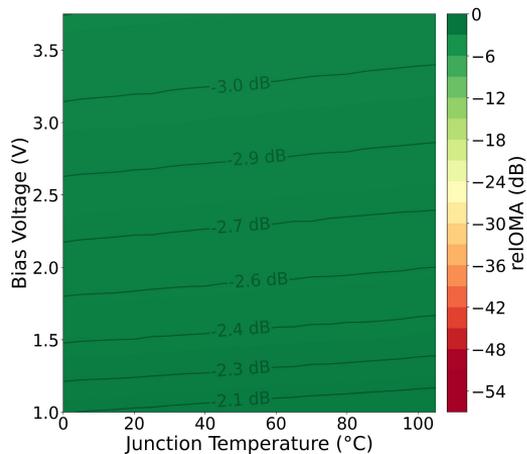
## MRM No control



Feedback control loop  
gives the MRM a wide  
operating range: 0°  
C-105°C

## MRM

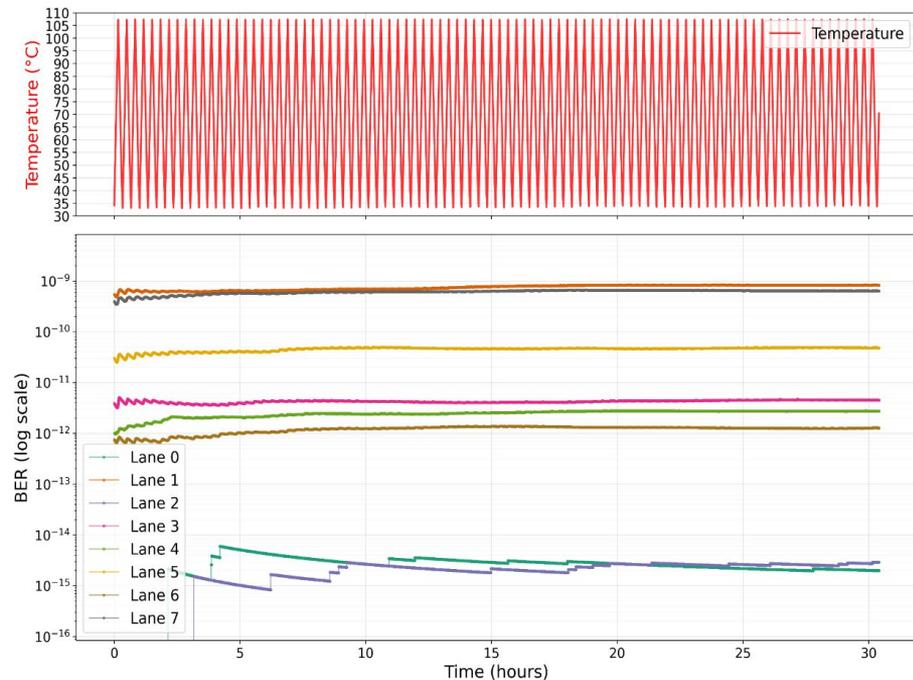
LIGHTMATTER CONTROL TECHNOLOGY



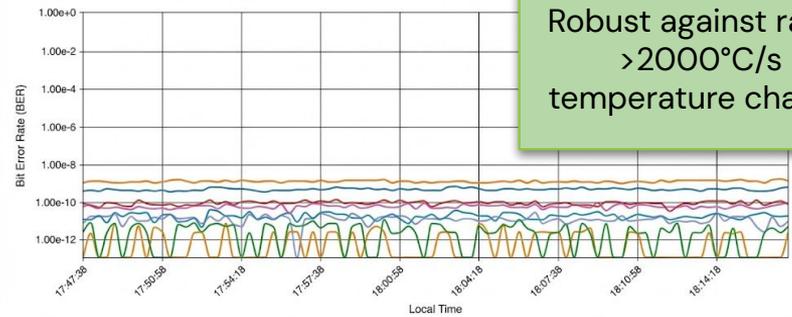
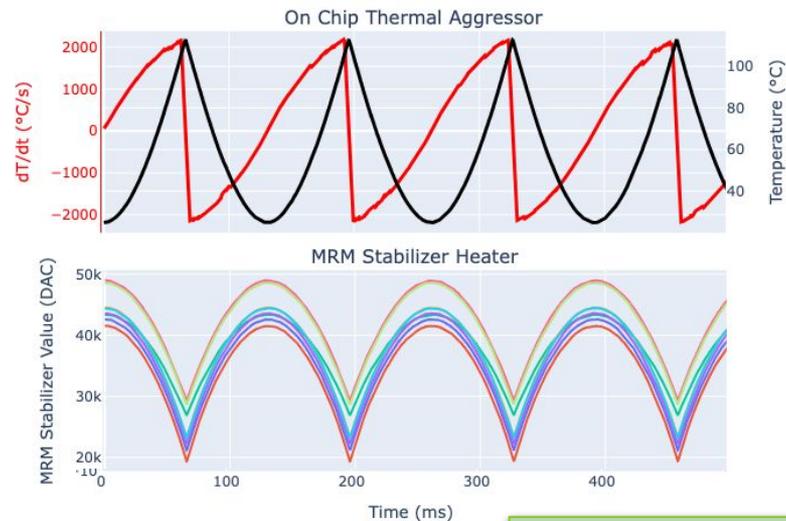
- Thermally stable
- C, O band support
- <5dB transmit eff. loss
- It is a multiplexer!
- Backed by top foundries

# MRMs in extreme thermal excursions

Using Lightmatter MRM control technology



Measured robustness against repeated temperature cycling



Robust against rapid >2000°C/s temperature change

PASSAGE M1000

PASSAGE 50 EVK

PASSAGE 100 EVK

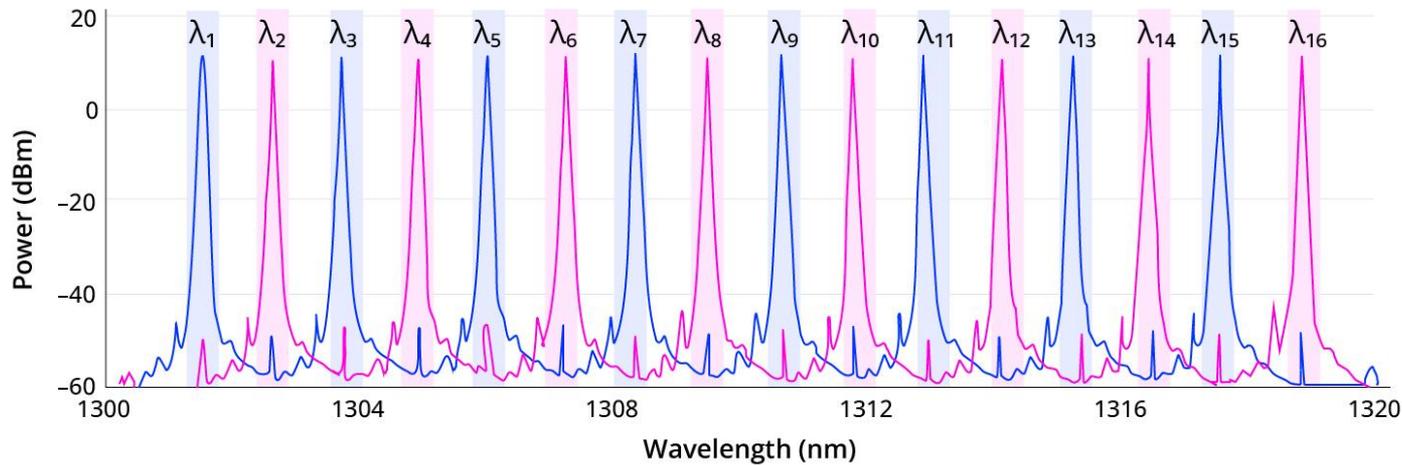


THREE RECORD-SETTING GENERATIONS OF PHOTONIC HARDWARE IN VALIDATION RACKS TODAY.



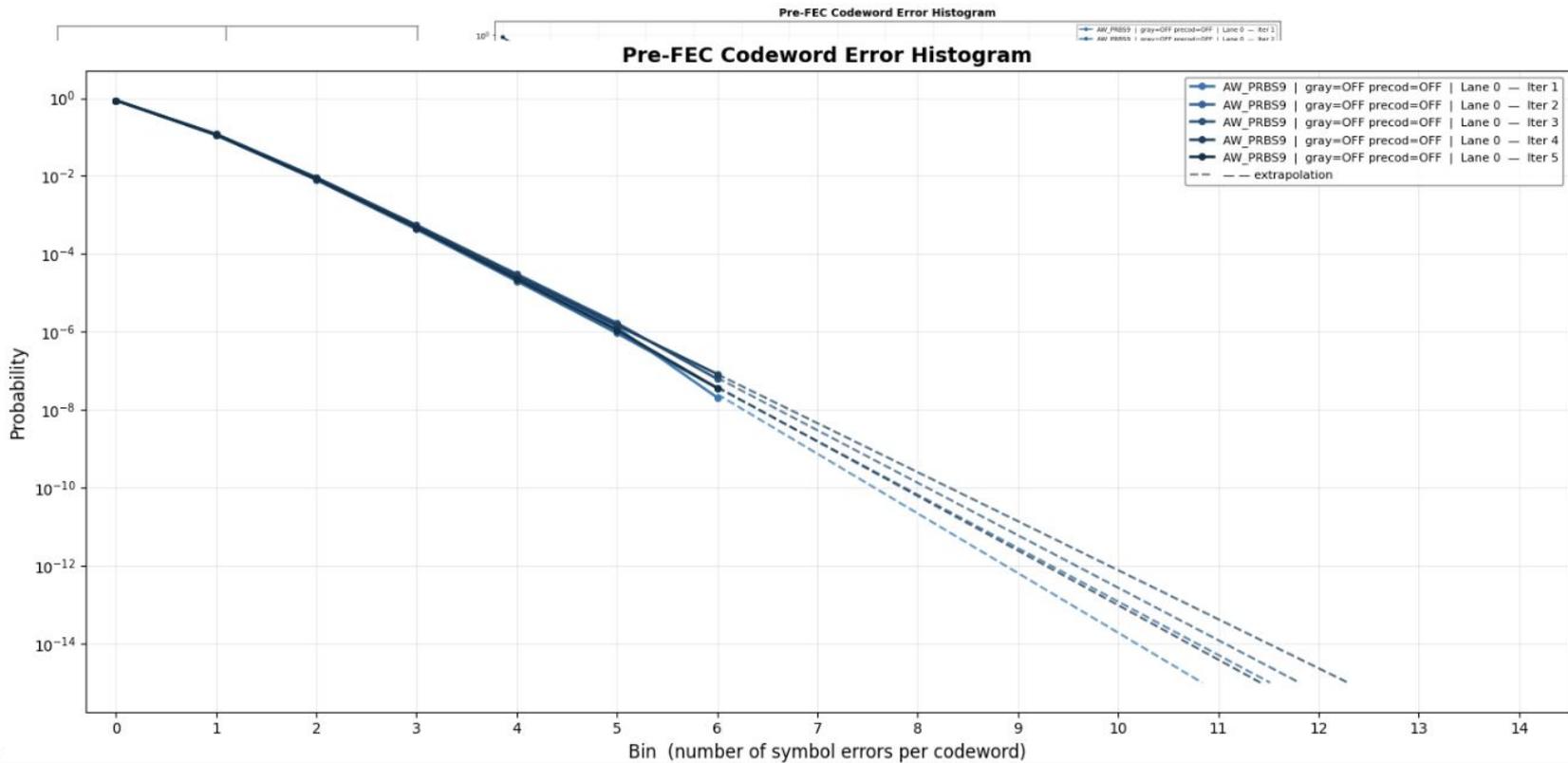
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# Support entire range of SerDes rates & link formats

STANDARDS  
COMPLIANT

OR

CUSTOM  
ADVANCED

56 Gbps

NRZ  
DWDM  
1→16 λ per fiber  
Bi-Directional  
Uni-Directional  
Ultra-low Latency  
Energy



112 Gbps

PAM4  
DWDM  
1→16 λ per fiber  
Bi-Directional  
Uni-Directional  
Latency +  
Energy +



224 Gbps

PAM4  
CWDM  
1→4 λ per fiber  
Bi-Directional  
Uni-Directional  
Latency ++  
Energy ++



448 Gbps

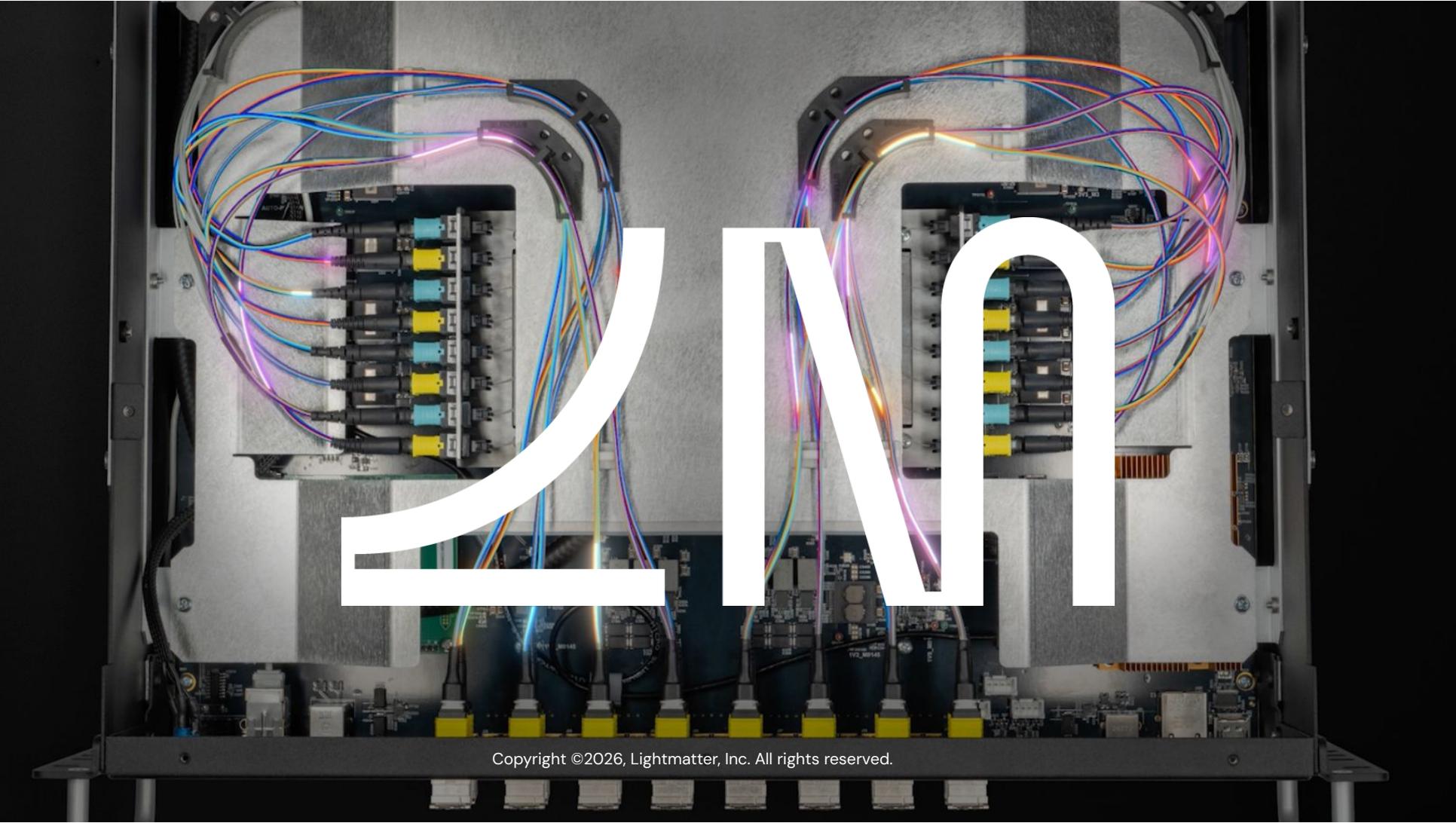
PAM4  
CWDM  
1→4 λ per fiber  
Uni-Directional  
Latency +++  
Energy +++



800G and 1.6T per fiber is available today.

BiDi and UniDi at 32T and above per optical engine, up to 1 km.

 In Silicon



# LM

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