

LIGHTMATTER

From Electrons to Photons: A Lightmatter Perspective on 3D Photonic Interconnect

I.S.E.S. Korea 2025
28 August 2025
Suwon, Korea



International
Semiconductor
Industry Group



\$850M RAISED

Fidelity
Google Ventures
Sequoia
Spark Capital
Viking

T. Rowe Price
Matrix Partners
SIP Capital
MIT
Stanford

3
OFFICES



Mountain View (HQ)



Boston



Toronto

288
EMPLOYEES



Nicholas Harris, PhD
Founder, CEO



Simona Jankowski
CFO



Sujatha Wagle
VP, Supply Chain Ops



Boon Tan
VP, Product Engineering



Praveen Kukkamalla
VP, Sales



Darius Bunandar, PhD
Founder, Chief Scientist



Ritesh Jain
SVP, Engineering & Ops



Beth Keil
SVP, People



Colin Sturt
General Counsel



Israel Kandarian
Head of Creative Marketing



Thomas Graham
Founder



Bob Turner
SVP, Sales & Solution Arch

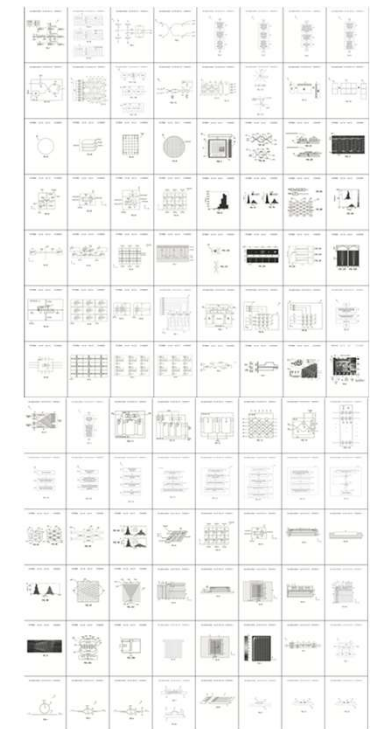


Steve Klinger
VP, Product



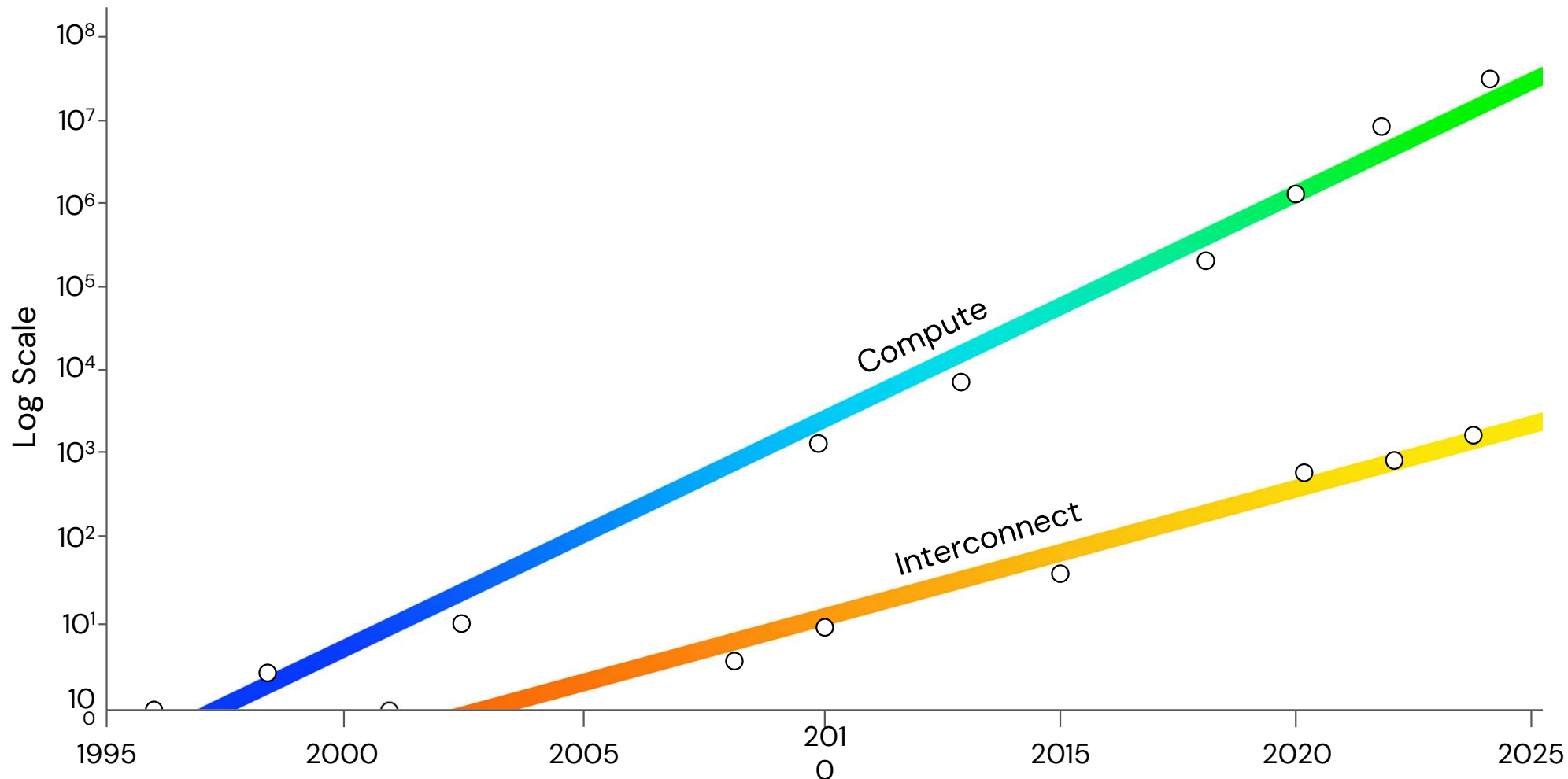
Kaushik Patel, PhD
VP, Photonics & SI Eng

310
PATENTS



Granted & Pending

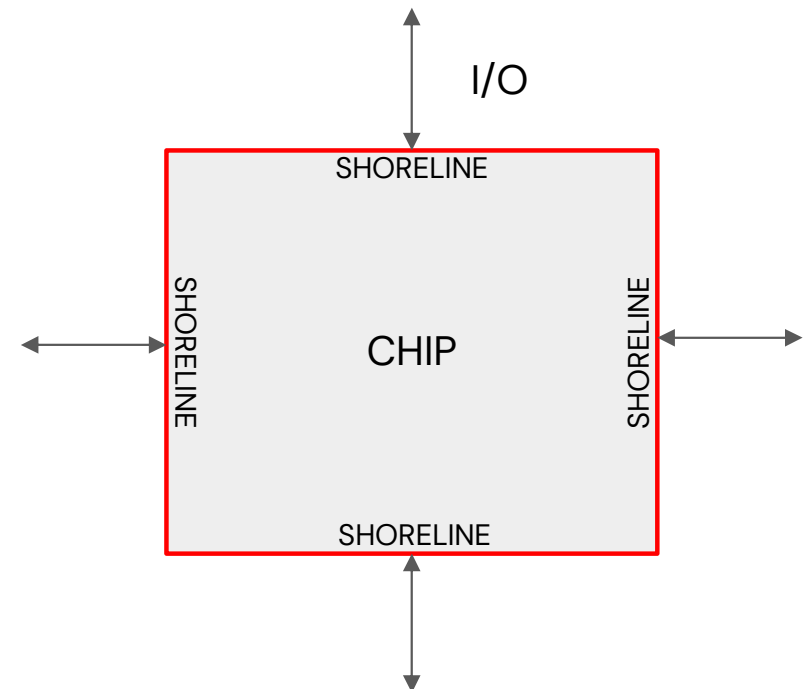
Interconnect Progress is too Slow



Existing Interconnects: Shoreline Limited

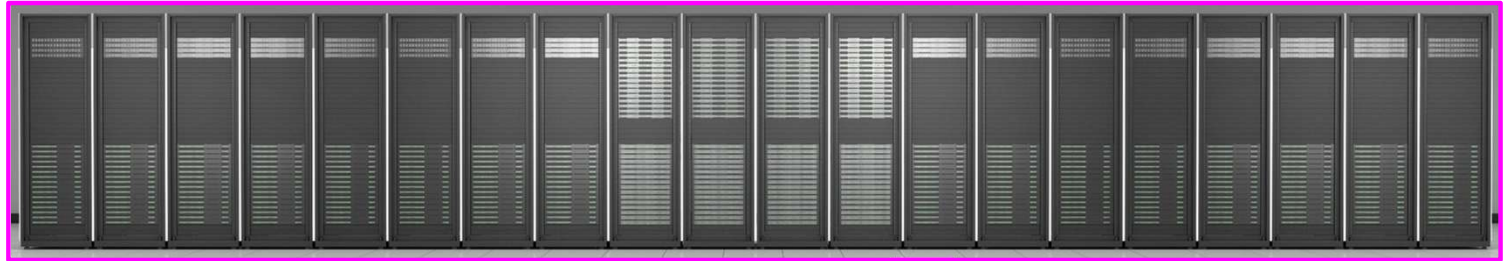
Communication
happens on the
chip perimeter

There is not enough shoreline

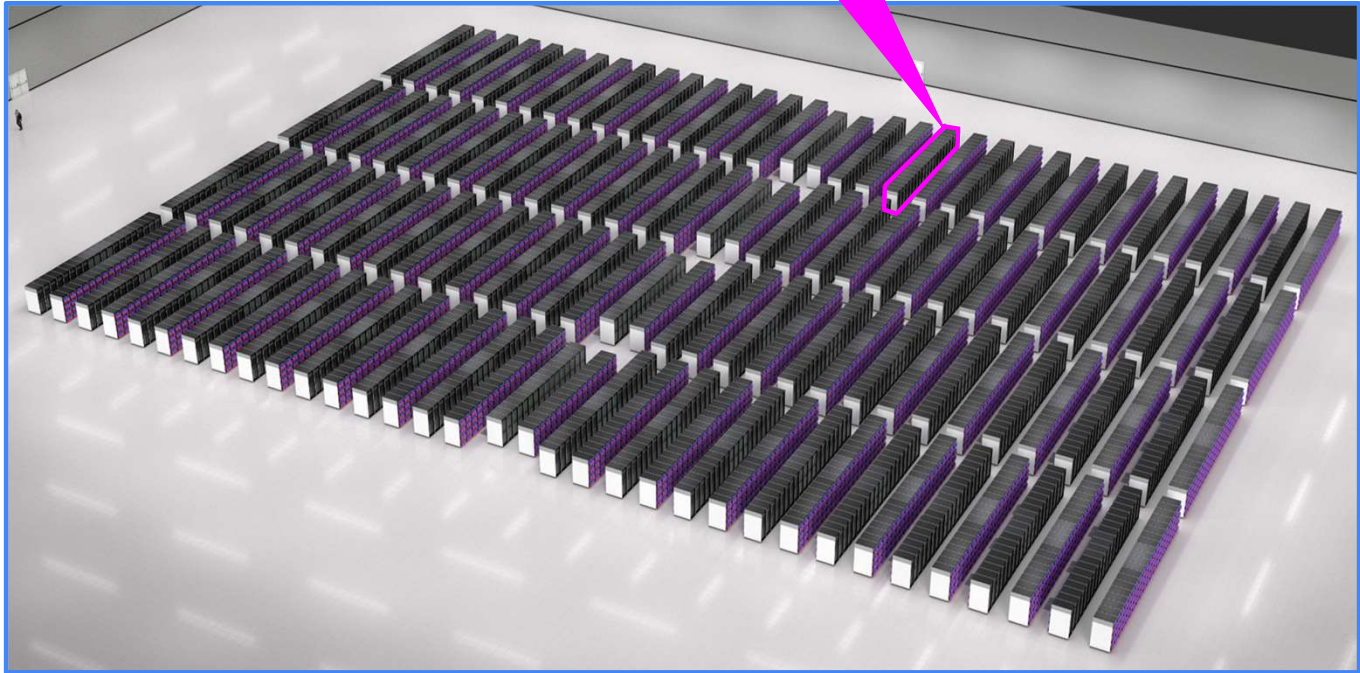


A new paradigm is needed

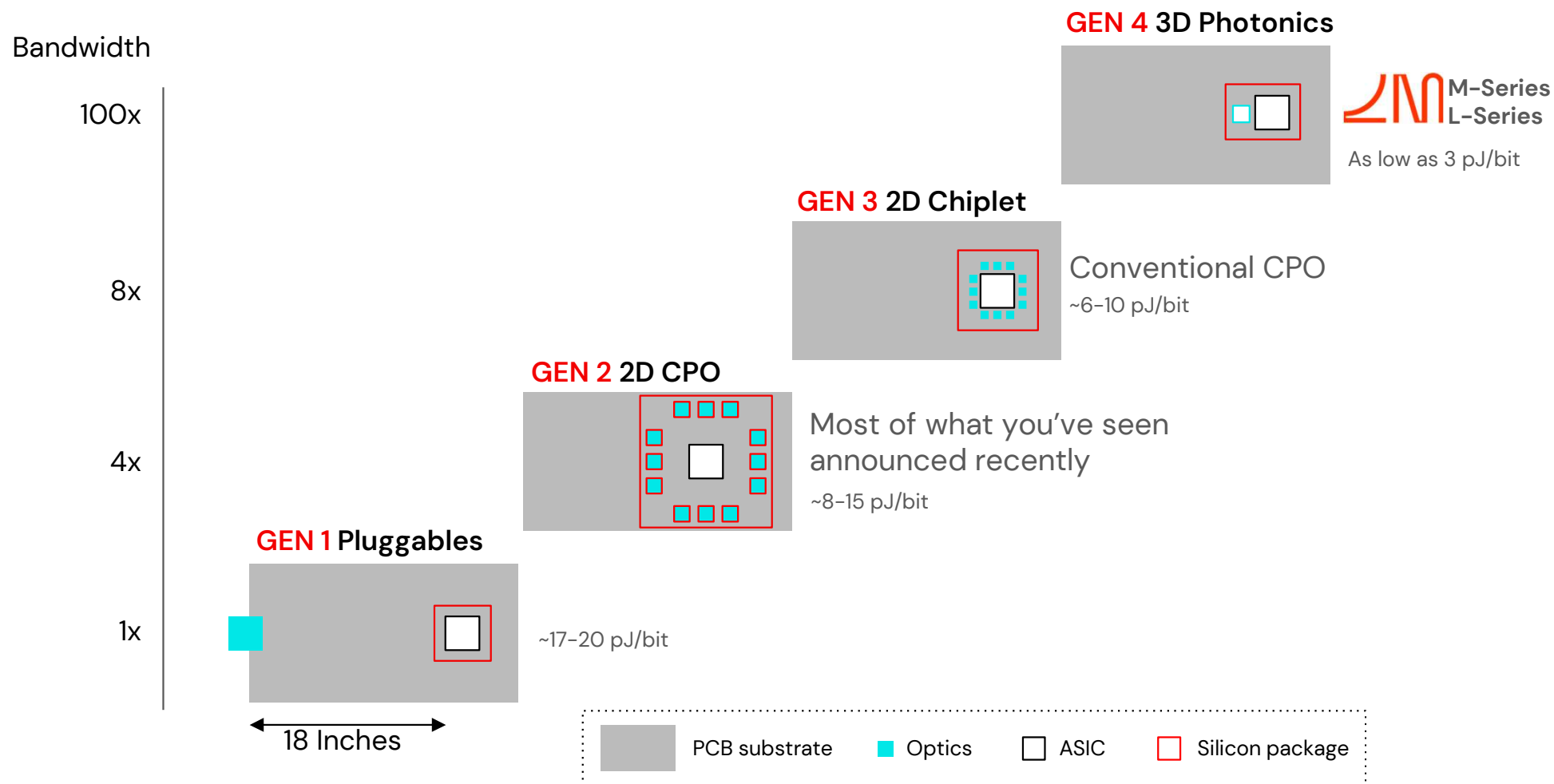
Single-Brain AI Datacenters



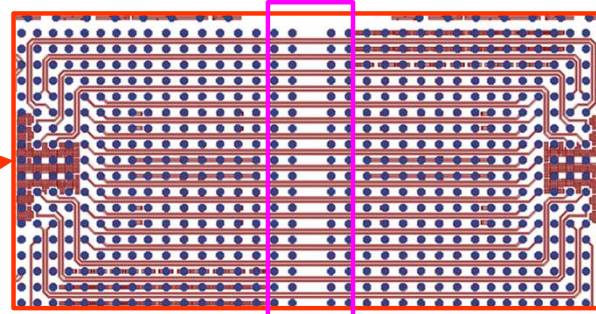
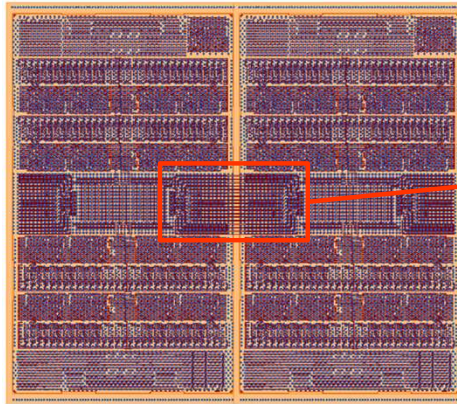
**PHOTONICS
NEEDED!**



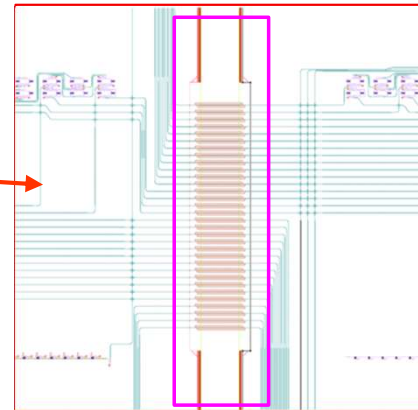
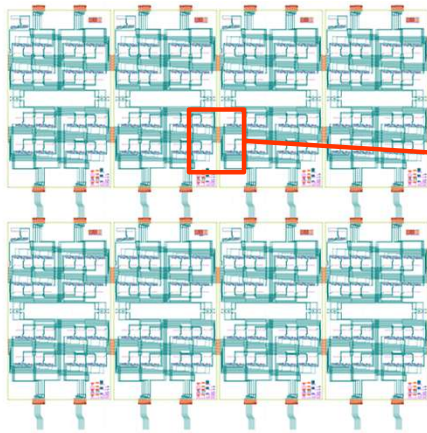
The Promise of Silicon Photonics



Neighboring Tiles Communicate Electrically and Optically



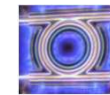
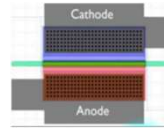
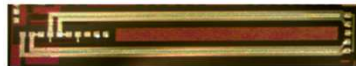
Cross reticle metal stitching on RDL



US Patent 12,124,081
US Patent 12,092,866

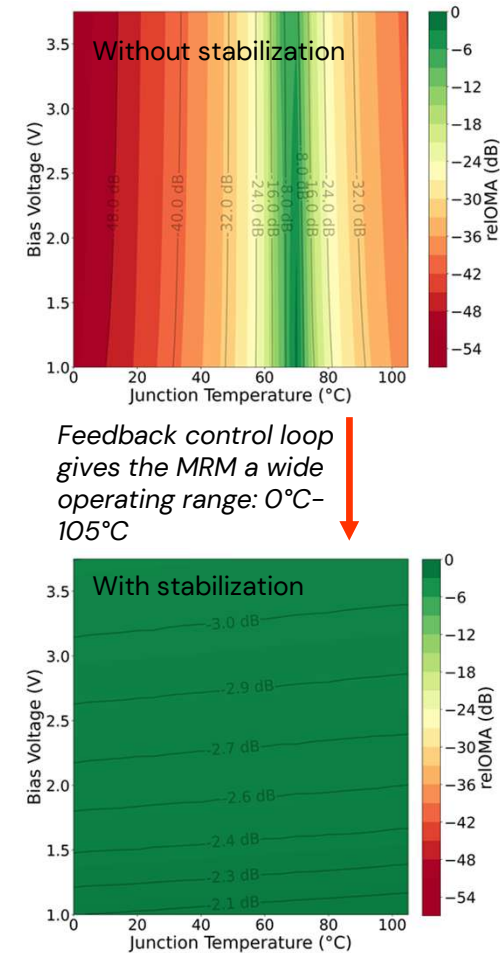
Cross reticle waveguide stitching

Why Rings are Revolutionizing Photonics



Metric	MZM [1]	SiGe/Ge EAM [2, 3]	LM's MRM [4]
3D-CPO compatible?	No, too large. >1000μm	No, too large. 50–100μm	Yes, ~15μm in diameter.
Need another multiplexer?	Yes	Yes	No, already a multiplexer
Thermal stability	Stable, only thermal gradient between the two arms affect.	Stable with feedback loop. Modulation is temperature dependent.	Stable with feedback loop. Transmission depends on ring resonance.
Power consumption [5]	~50 mW	~10 mW	~1 mW
Transmitter penalty	<5 dB	<10 dB	<5 dB
Optical bands	O-band & C-band	C-band only	O-band & C-band

- [1] M. Streshinsky, et al. Opt. Express 21, 30350–30357 (2013).
 [2] J. Fujikata, et al., Opt. Express 31, 10732–10743 (2023).
 [3] Y. Liu, et al., PRJ 8, 1474 (2023).
 [4] E. Timurdogan, et al. Nature Communications 5, 4008 (2014).
 [5] DAB Miller, et al. Opt. Express 20, A293–A308 (2012).

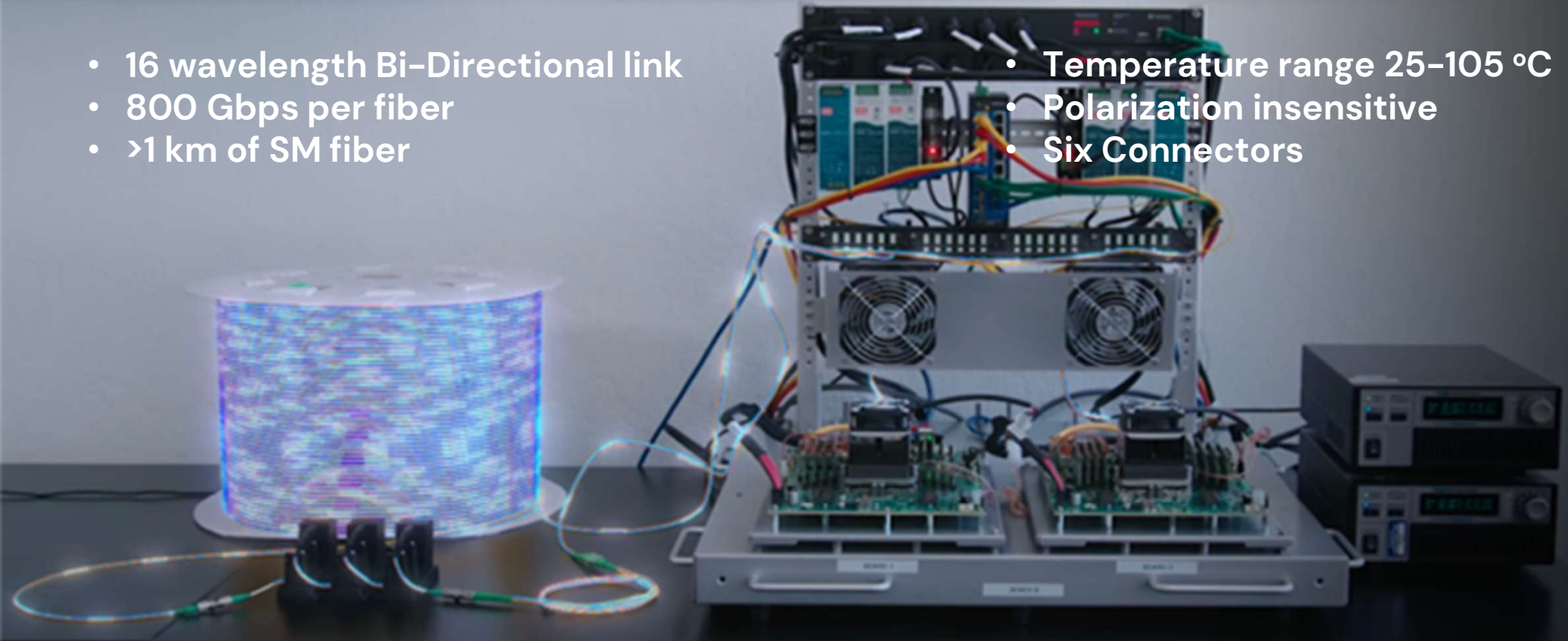


Note: "Relative OMA" (relOMA) is relative to 1 mW laser into the MRM.

Passage™ Link Demonstration

- 16 wavelength Bi-Directional link
- 800 Gbps per fiber
- >1 km of SM fiber

- Temperature range 25–105 °C
- Polarization insensitive
- Six Connectors



Passage™ Link Architecture Options

STANDARDS COMPLIANT

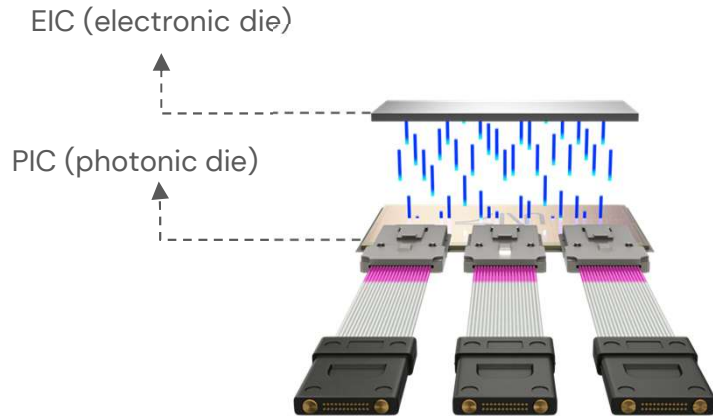
OR

CUSTOM ADVANCED

Bandwidth	Modulation	Number of Wavelengths	Transmission Type	CWDM/DWDM
56 Gbps	NRZ	16	Bi-directional	DWDM
56 Gbps	NRZ/PAM4	16	Uni-directional	DWDM
112 Gbps	PAM4	16	Uni-directional	DWDM
224 Gbps	PAM4	4	Bi-directional	CWDM
224 Gbps	PAM4	4	Uni-directional	CWDM

Beyond the Limit of 2D

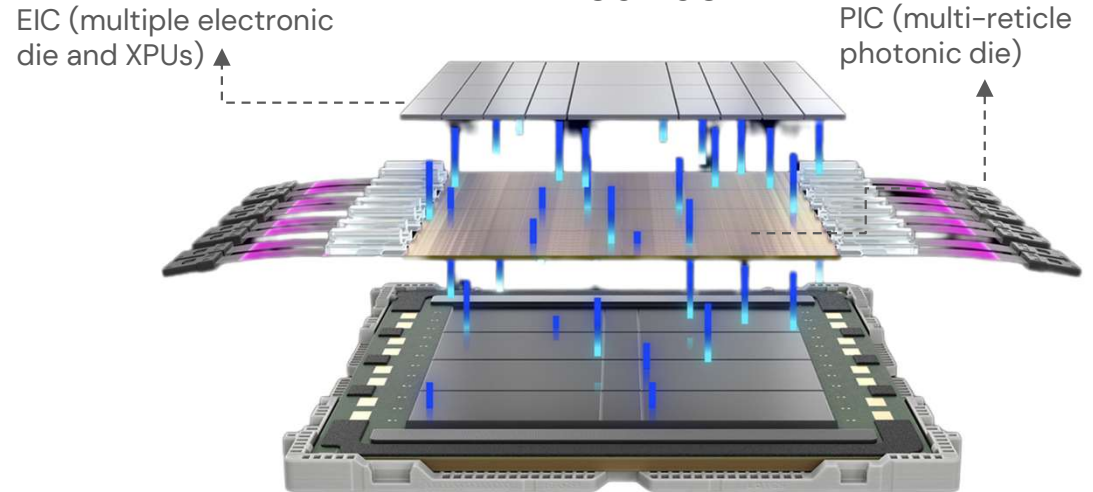
GEN 4 3D CPO L-series



64 Tbps

1.6 Tbps / fiber (Tx+Rx)

GEN 4 3D Interposer M-series

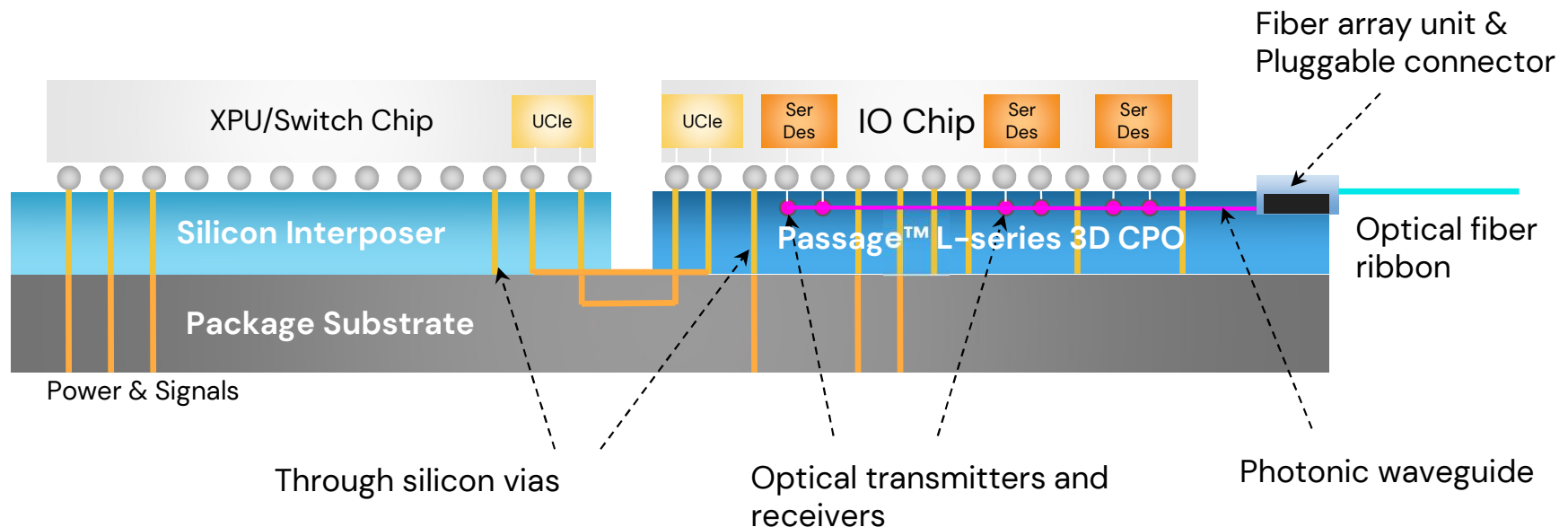


114 Tbps

800 Gbps / fiber (Tx+Rx)

3D Stacking Requires Compact Optical Tx and Rx

Passage™ L-series



Standard processes today

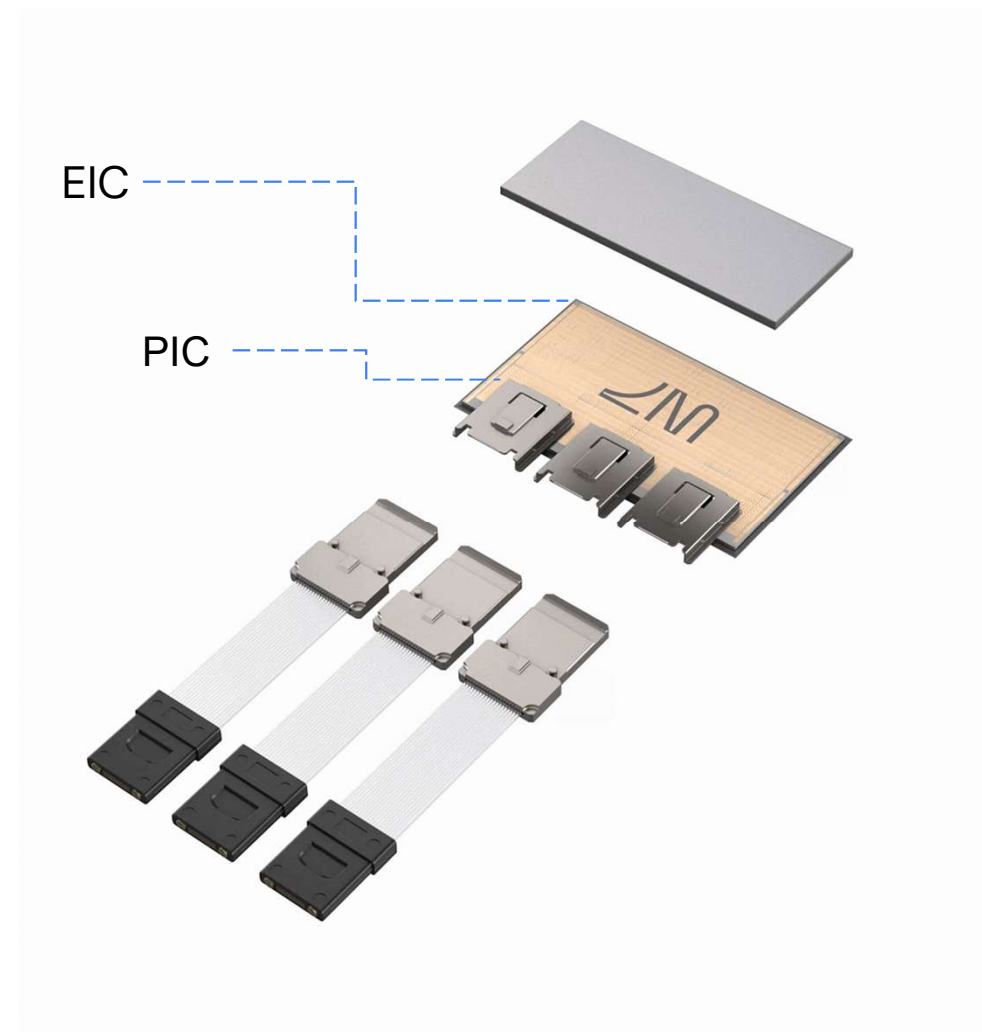
Bump pitch: ~120 μm

Bump size: ~80 μm

Area for a transmitter/receiver: 0.015 mm^2

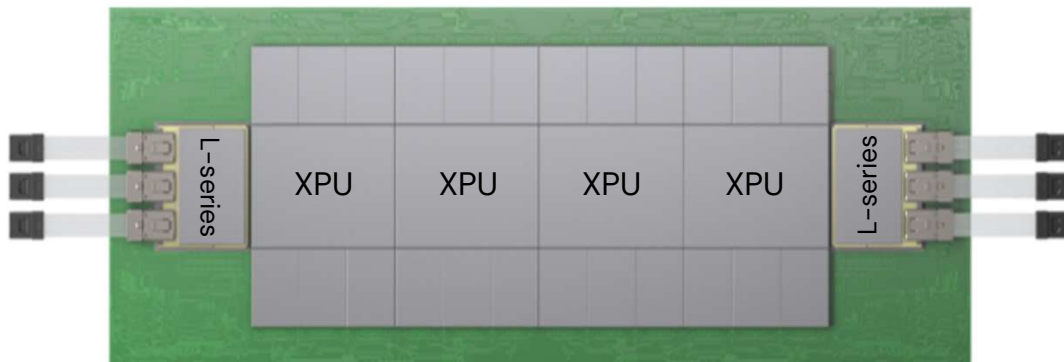
Passage™ L-series 3D CPO

- Fastest Co-Packaged Optics
- L-series 3D Photonic Engine
- I/O EIC with UCle & SerDes
- Shoreline is no longer the limit
- >1.5 Tbps/mm

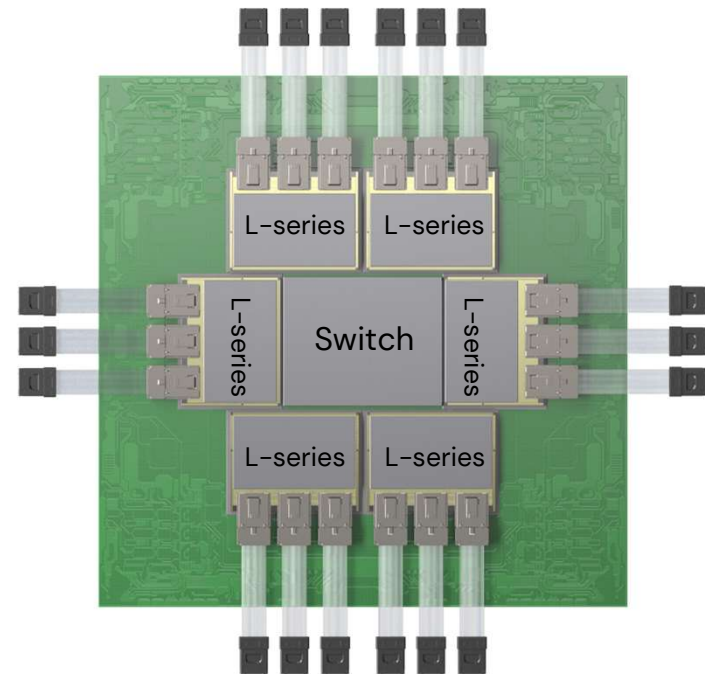


Passage™ 3D CPO Scale-Up

64 Tbps XPU

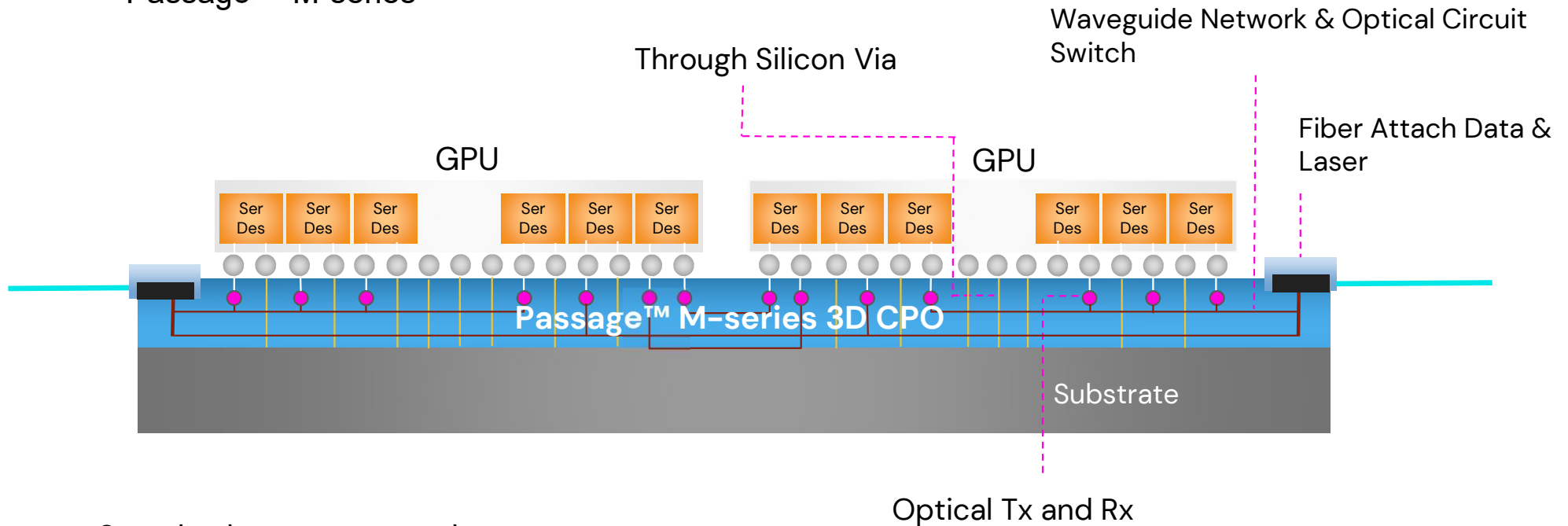


200 Tbps Switch



3D Stacking Requires Compact Optical Tx and Rx

Passage™ M-series



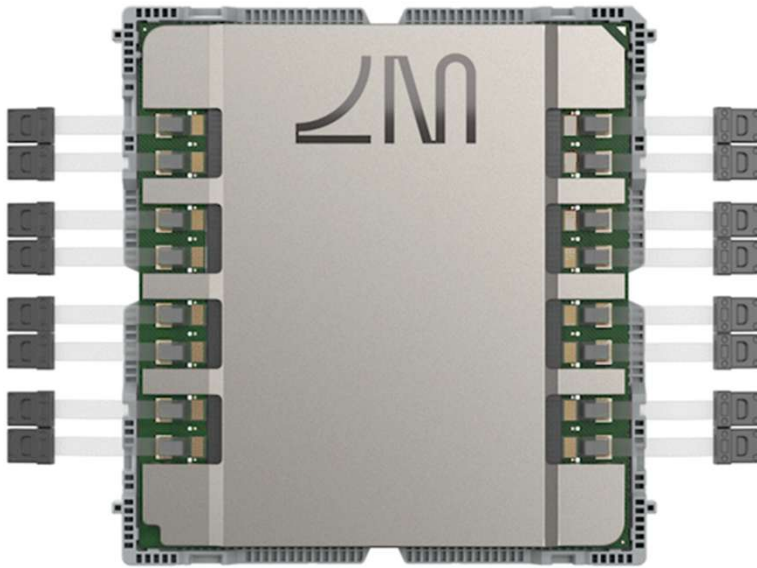
Standard processes today

Bump pitch: $\sim 120 \mu\text{m}$

Bump size: $\sim 80 \mu\text{m}$

Area for a transmitter/receiver: 0.015 mm^2

Passage™ M1000: A 3D Photonic “Superchip” Platform



Bandwidth Density Leadership

SerDes eye diagrams

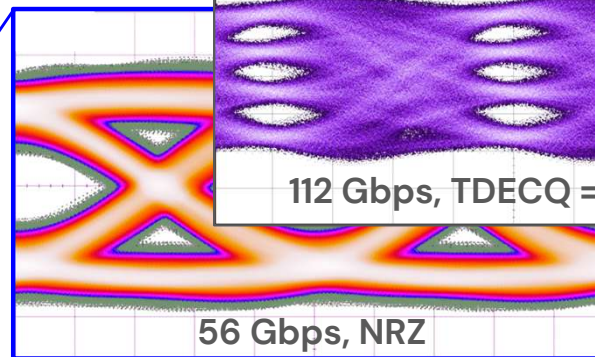
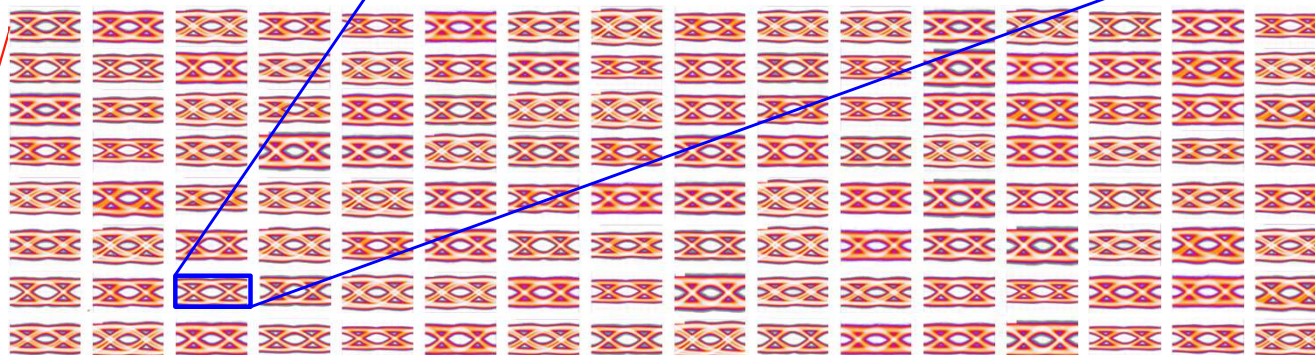
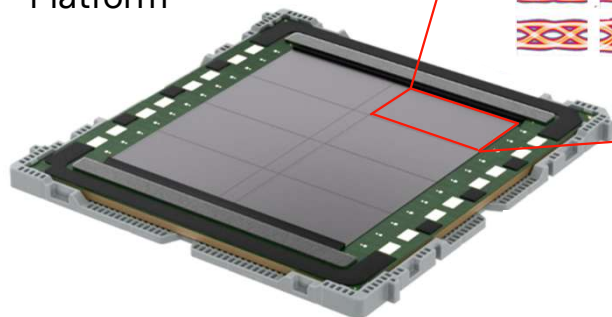
PAM4 also enabled

112 Gbps, TDECQ = 0.83 dB

56 Gbps, NRZ

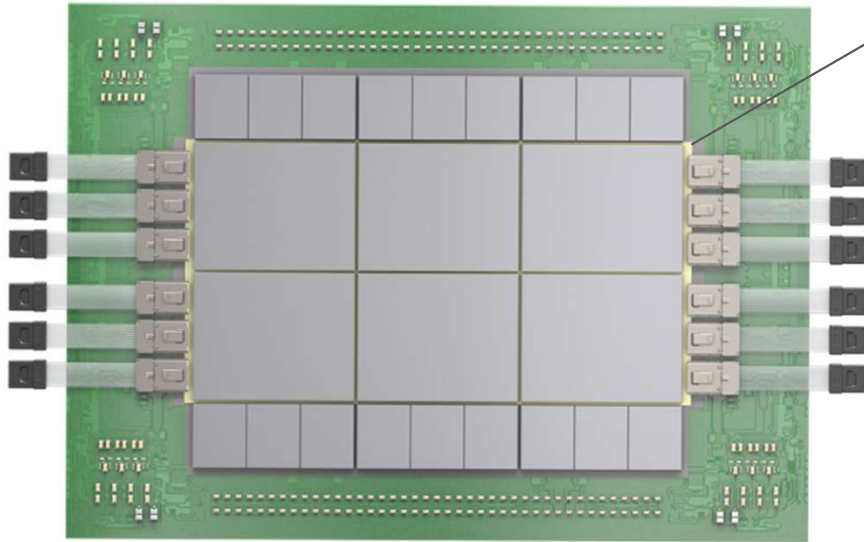
128 SerDes per tile

Passage M1000
Platform



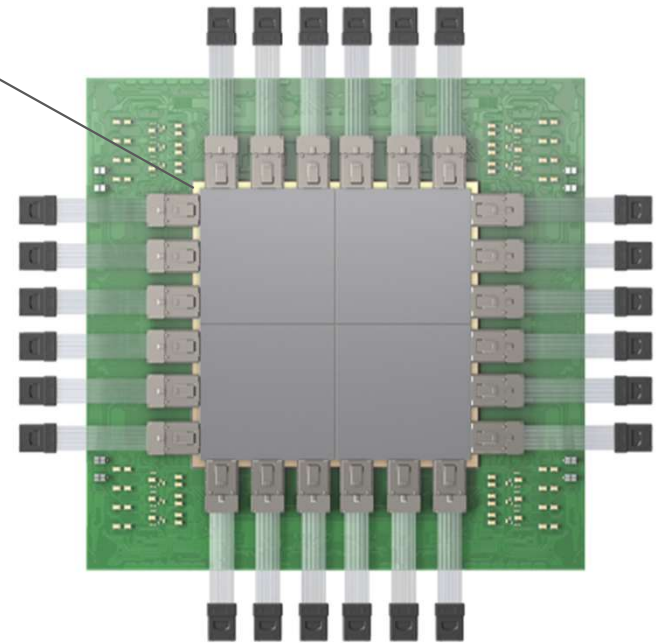
3D Interposer Scale-Up and Out to 1M Nodes

200 Tbps XPU

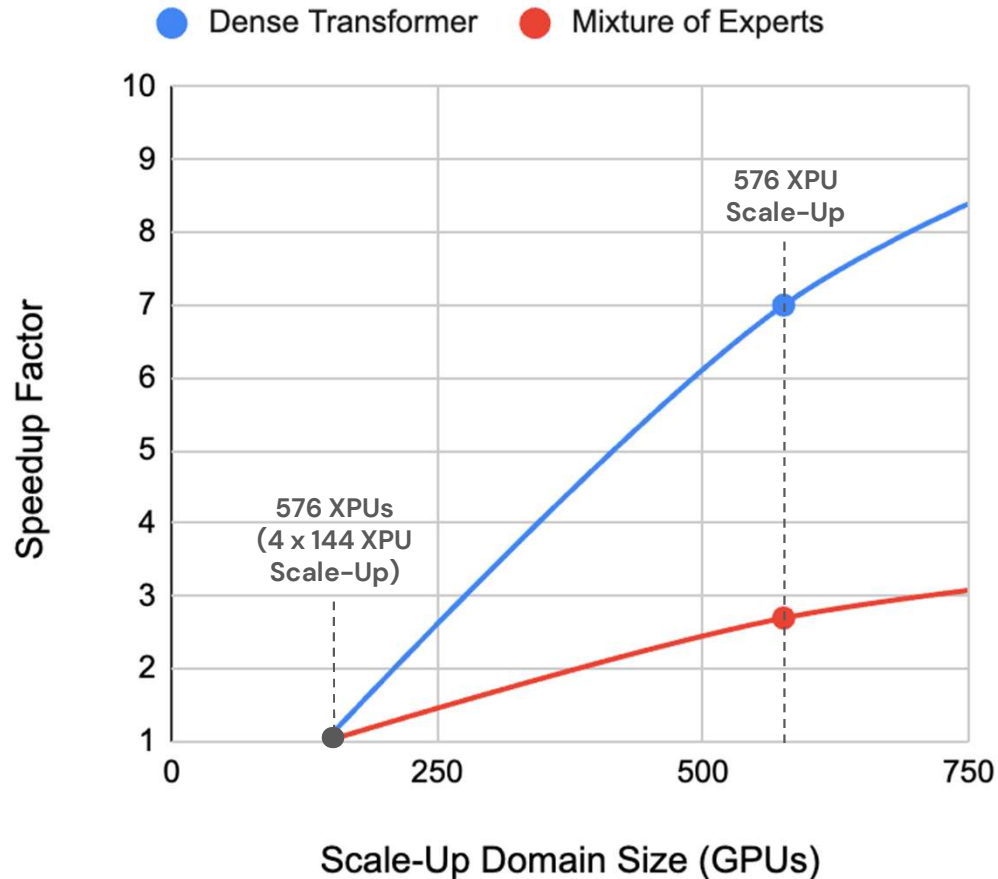


Passage M-Series
3D Photonic Interposer

1 Pbps Switch



Passage™ Accelerates AI Model Training Time



3-7X Training speedup

>60% TCO Savings

Source and assumptions:

- Passage 64 Tbps vs. 28.8 Tbps electrical
- Based on Lightmatter AI modeling framework
- MoE model: 4.7T parameters, 256 experts, 8 active
- TCO savings based on MoE model operating costs
- Dense transformer model: 100T parameters

Lightmatter Leading the Way

Technology

Leading 3D photonics revolution in AI data center

Performance

Bandwidth and radix advantage – no shoreline limitation

Quality

Production-ready with world-class partners

8+ years of technology innovation, system development and optimization

THANK YOU!

