Optimizing Scale-Up & Scale-Out Data Center & AI System Topologies with Samtec CPX Interconnect

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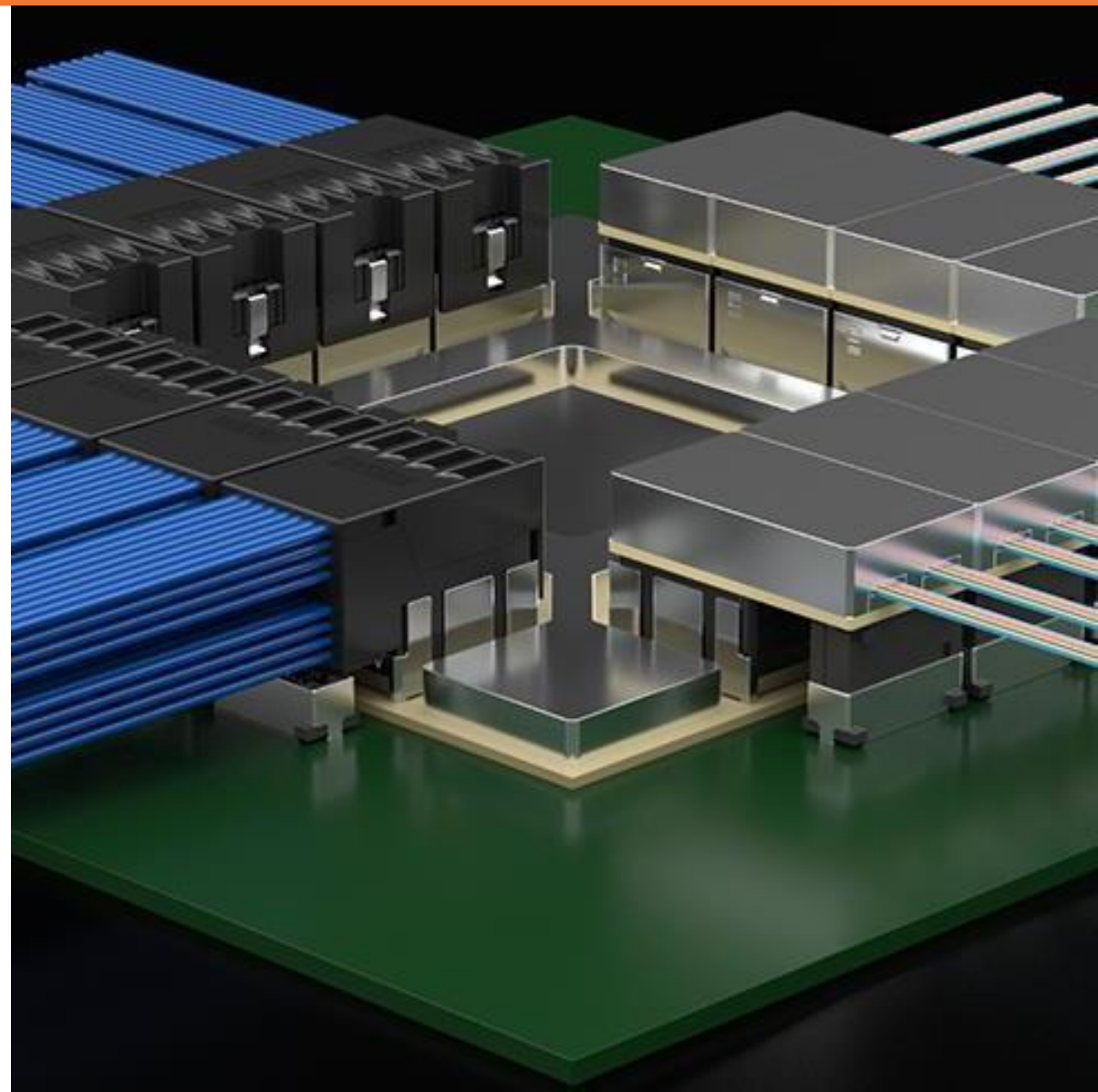
PCB Carolina 2025

November 12, 2025

INNOVATIVE TECHNOLOGIES • SUDDEN SERVICE • GLOBAL REACH

Agenda

- Introduction to Samtec
- Scale-Up/Scale-Out AI/Data Center Infrastructure Overview
- Co-Packaged Copper (CPC) Interconnect Solutions
- CPC Case Studies
- Co-Packaged Optics (CPO) Interconnect Solutions
- Advantages of “CPX” Interconnect Solutions
- Next Steps
- Q+A



ABOUT US

Founded in 1976, Samtec is much more than just another connector company, we put people first with a commitment to exceptional service and quality products. We believe that taking care of our customers and our employees is paramount in how we approach our business. This belief is deeply ingrained throughout Samtec and means that you can expect **exceptional service** coupled with **technologies** that take the industry further faster.

GLOBAL **REACH**

HEADQUARTERS
NEW ALBANY, IN
USA

40 LOCATIONS

125+ COUNTRIES SERVED

6,500+ EMPLOYEES

PRIVATELY
OWNED COMPANY

SUDDEN **SERVICE**

ReServe SHIPS TOMORROW — MORE THAN 200k PART NUMBERS SHIP IN 1 DAY

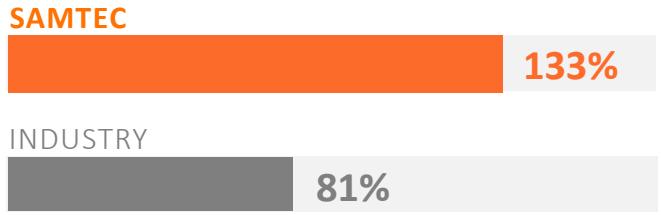
24HOUR SUDDEN SAMPLE — 24-HOUR FREE SAMPLES

2DAYS WORLD DIRECT — 2 DAYS TRANSIT TO ALL MAJOR MARKETS

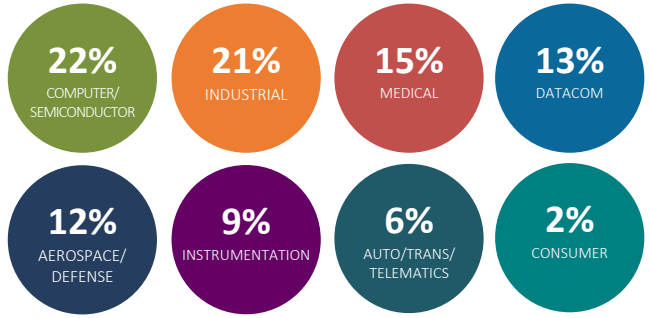
Bishop — **#1** CONNECTOR MANUFACTURER

INDUSTRY **UPDATE**

SALES GROWTH (10-year span)

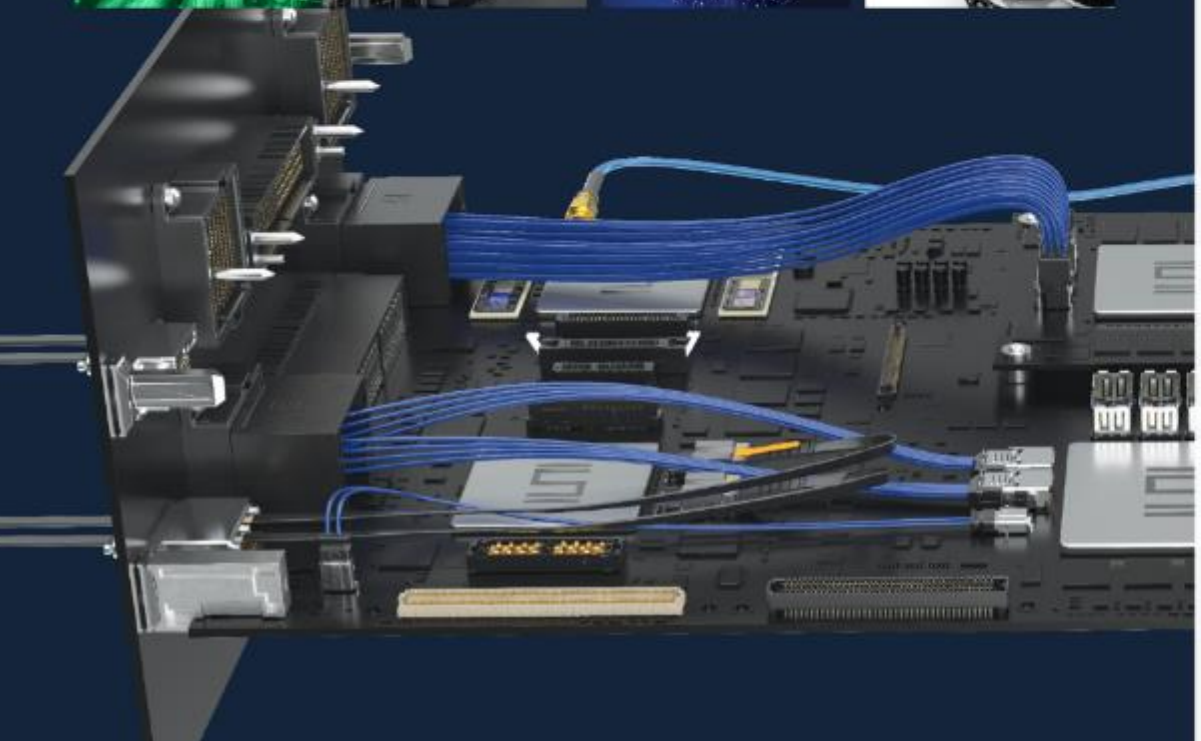


MARKETS SERVED



THE TECHNICAL RENAISSANCE IS...

...driven by ***progress***, challenged with unprecedented performance ***demands***, a catalyst for next level technologies and ***innovation***...



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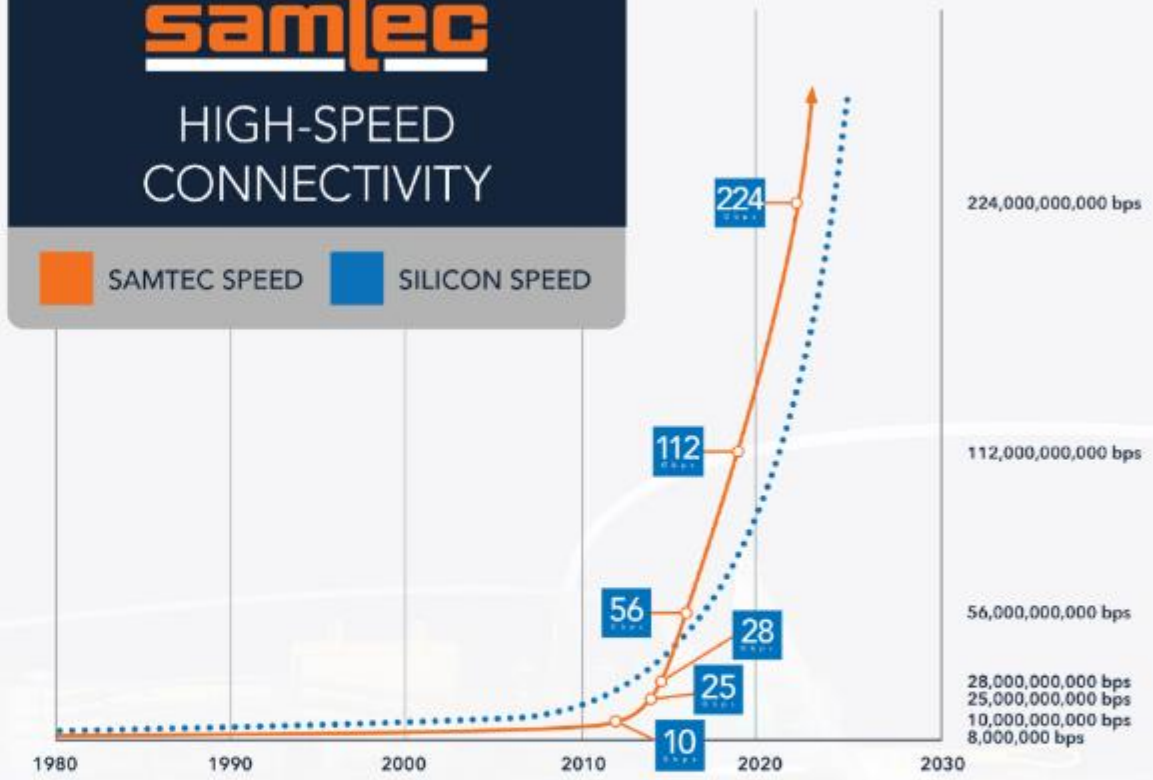
HIGH-SPEED CONNECTIVITY

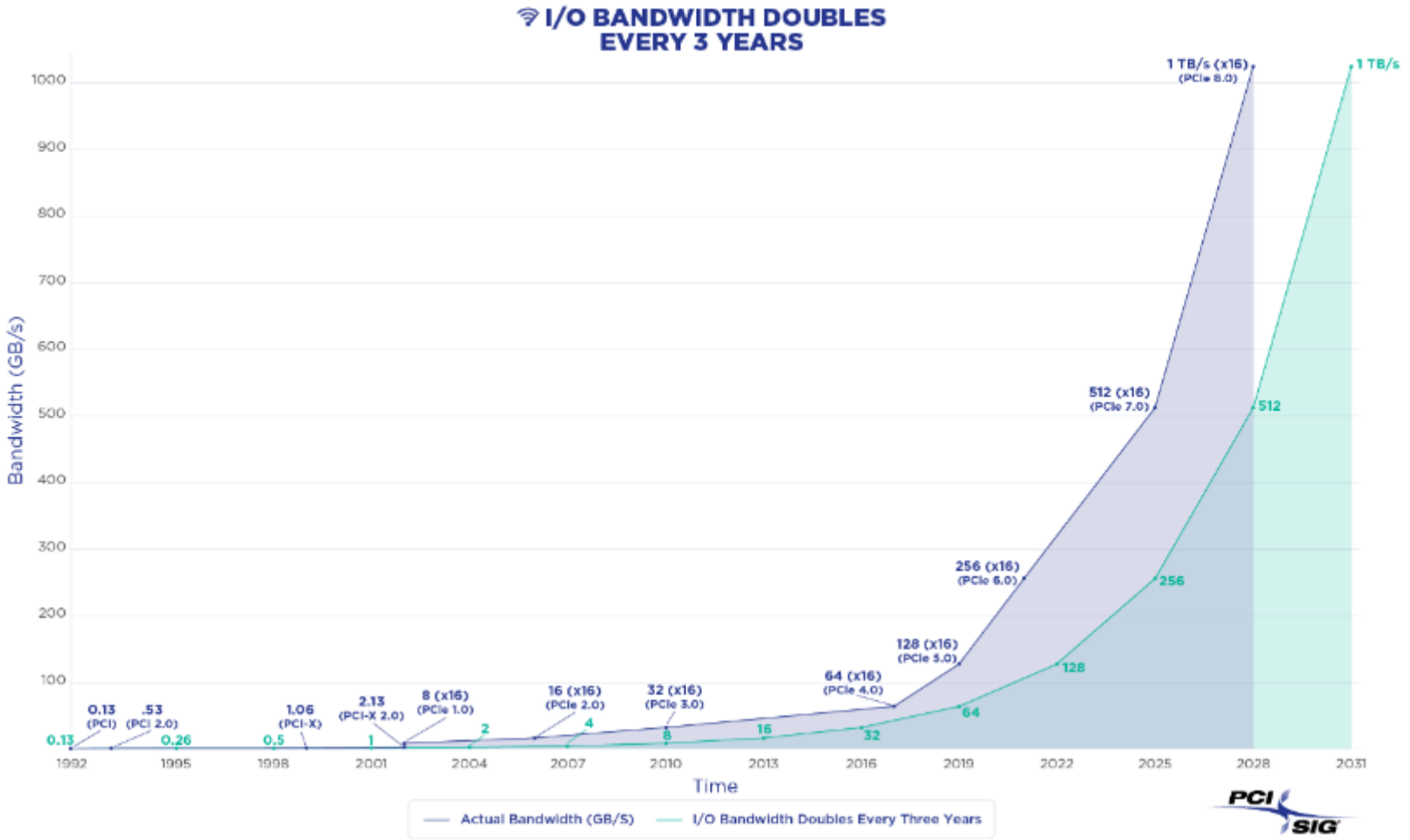


...and enabled by Samtec's

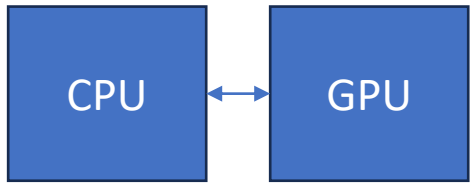
SILICON-TO-SILICON™ SOLUTIONS

AI Infrastructure: I'll Take a Double

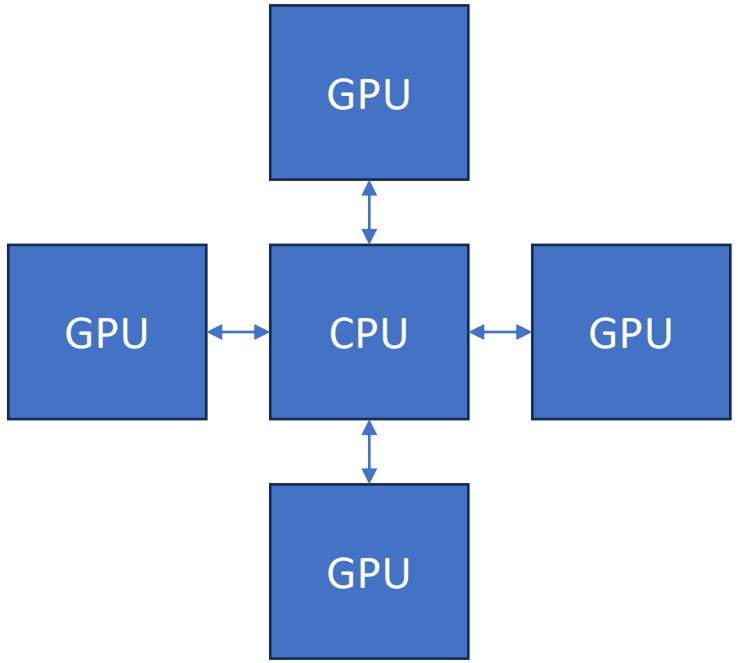
- AI Infrastructure doubling ever quicker
- 2x the model size
- 2x the data rate
- 2x the data volume



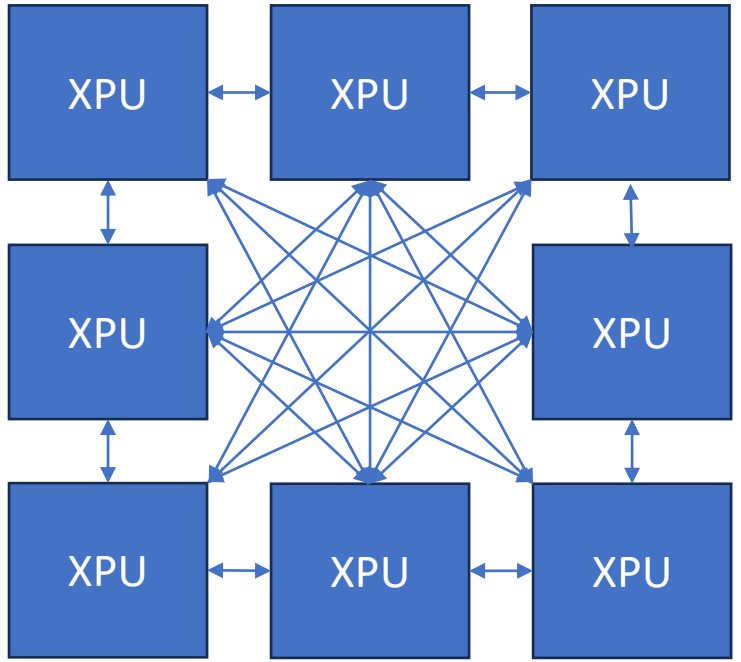
AI Infrastructure: I'll Take a Double



~2019
PCB Traces

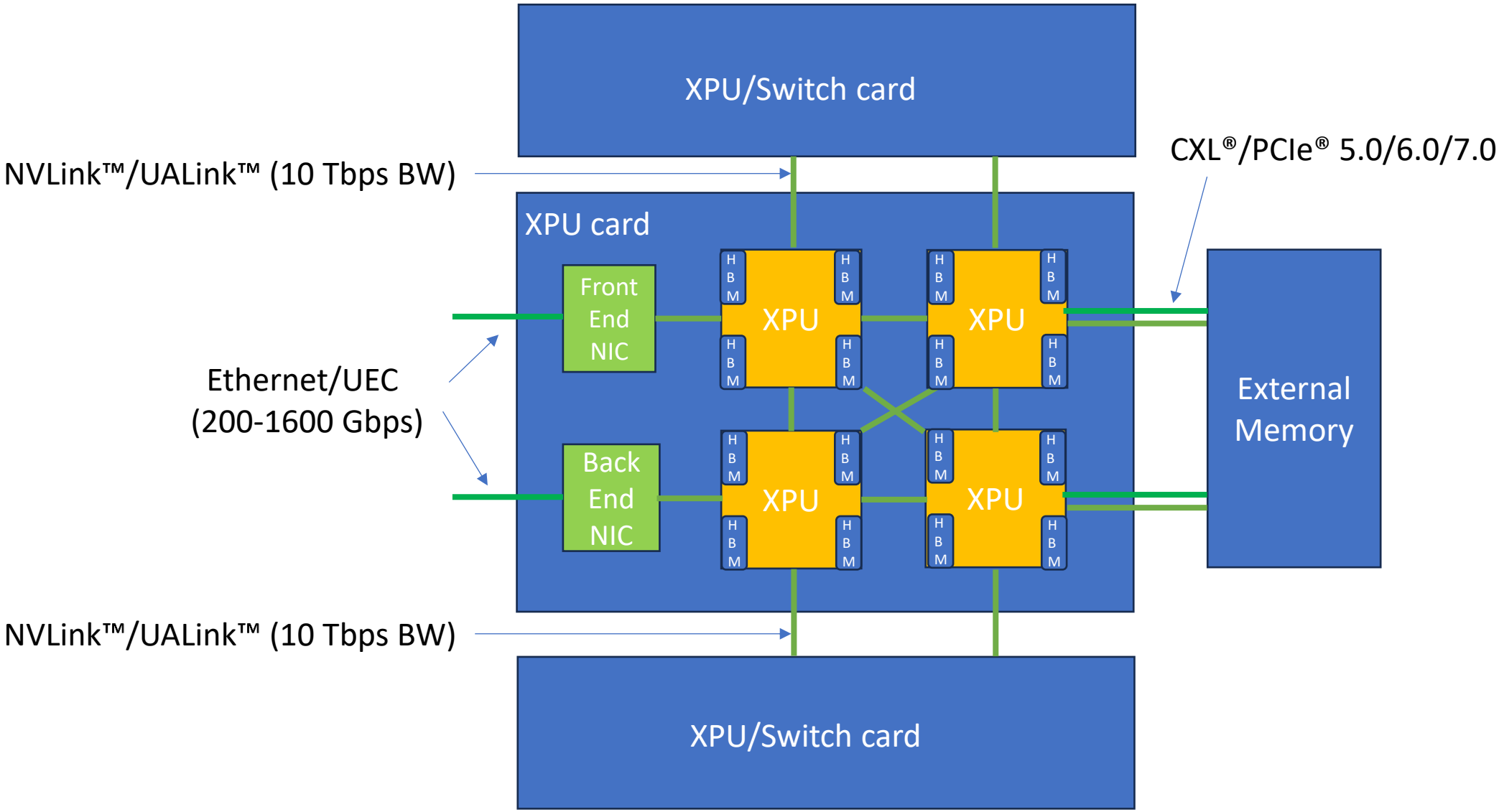


~2022
Copper Cabling

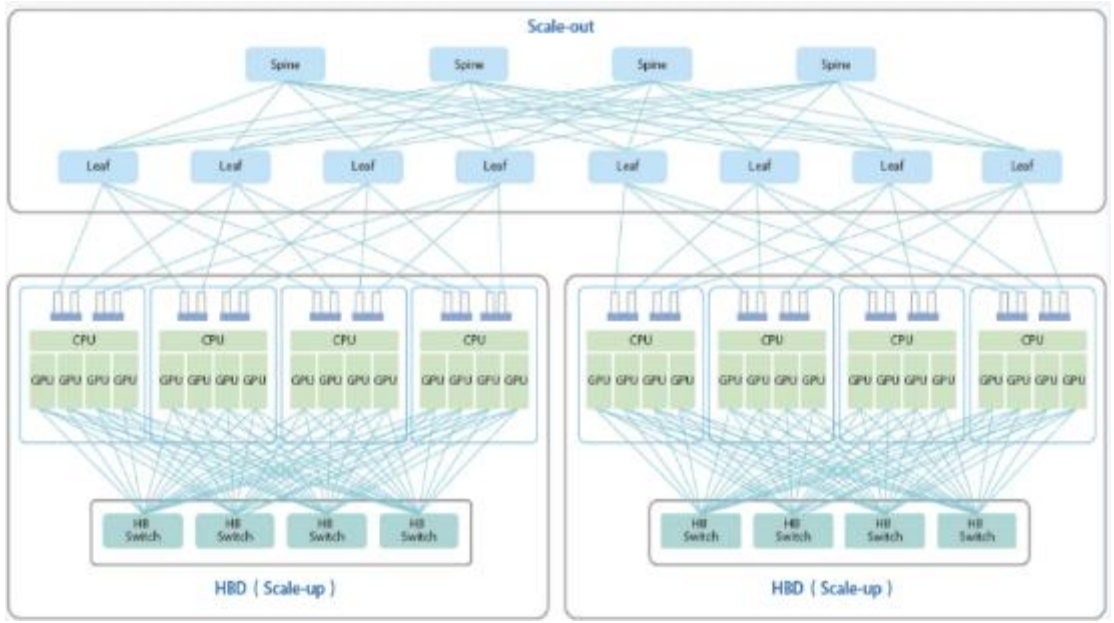


~2025
Fiber Optics

Pop the Hood: AI Interconnects



Scale-Up/Scale-Out Conundrum



- How many different solutions to offer?
- What architecture or technology will the customers use?
- Front Panel or Backplane?
- CPC or CPO or NPO?
- SiPh or MicroLED or THz Waveguide?
- LPO or DSP or Retimers?

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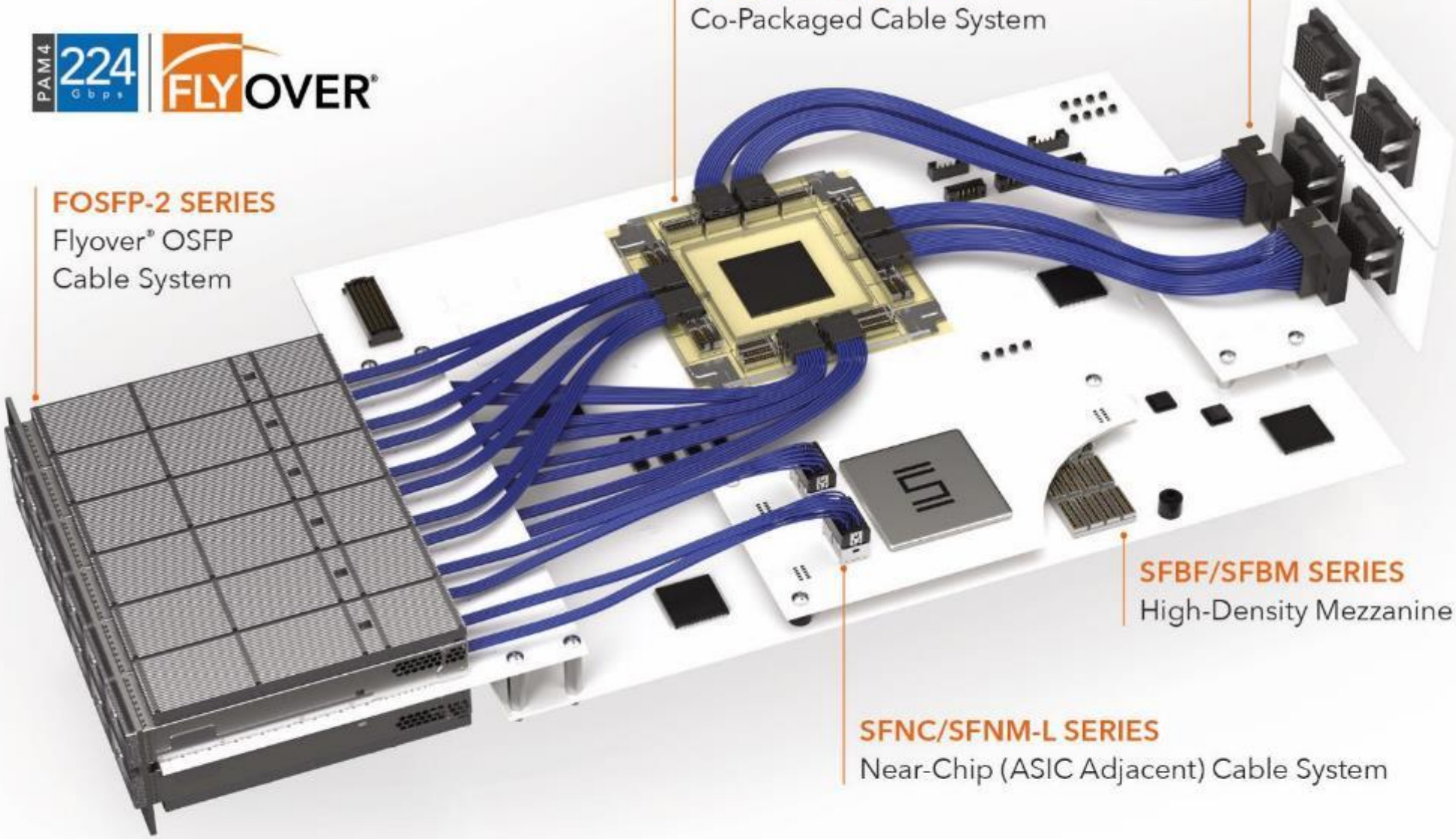
PAM4 224 Gbps | SI-FLY® HD

PAM4 224 Gbps | FLYOVER®

SBCM/SBCF SERIES
Backplane Cable System

SFCC/SFCM SERIES
Co-Packaged Cable System

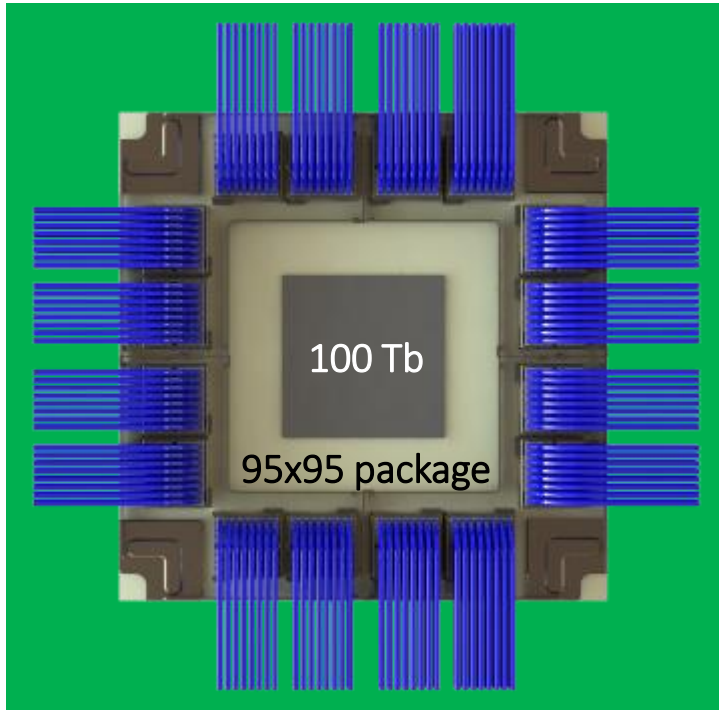
FOSFP-2 SERIES
Flyover® OSFP
Cable System

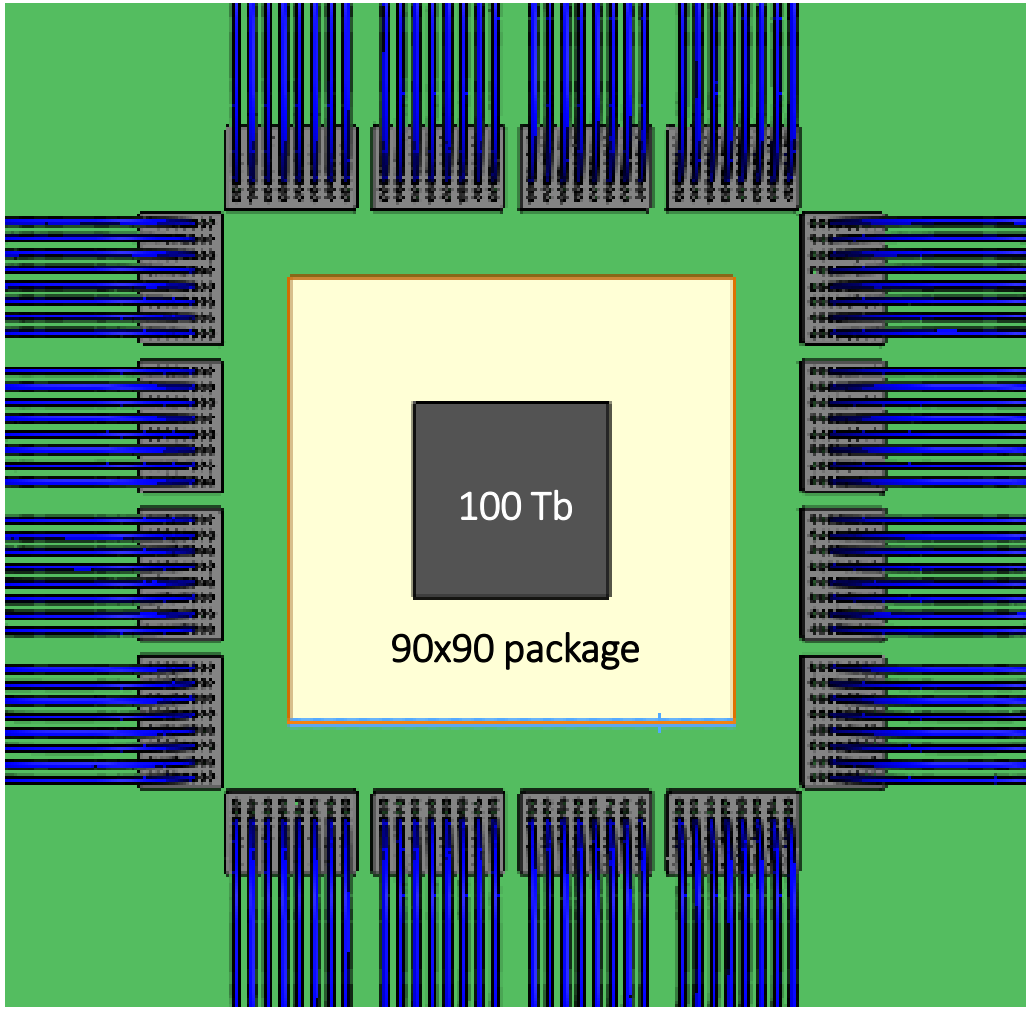


SFBF/SFBM SERIES
High-Density Mezzanine Arrays

SFNC/SFNM-L SERIES
Near-Chip (ASIC Adjacent) Cable System

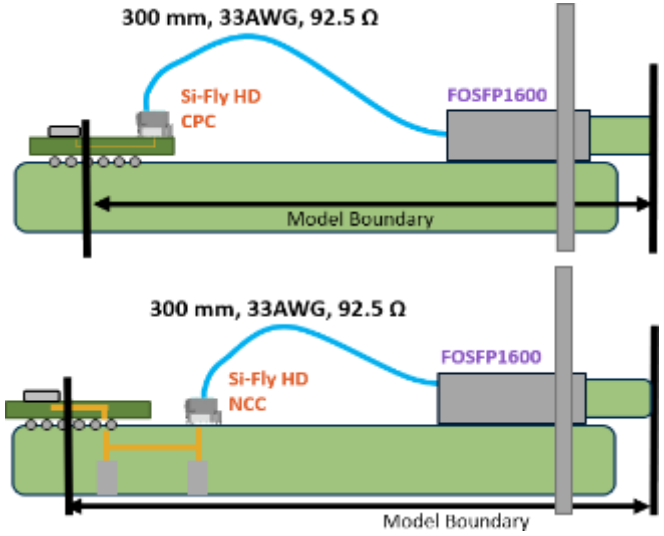
Si-Fly® Co-Packaged vs Near Chip





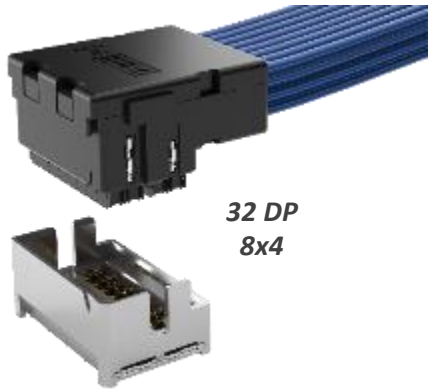
Si-Fly® Co-Packaged vs Near Chip

- Overall mated heights (CPC):
  - 8DP x 4 rows (32 DP): ~11 mm
  - 8DP x 8 rows (64 DP): ~20 mm
- Approximately -4.6 dB IL difference



Total IL: -14.4 dB

Total IL: -19.0 dB



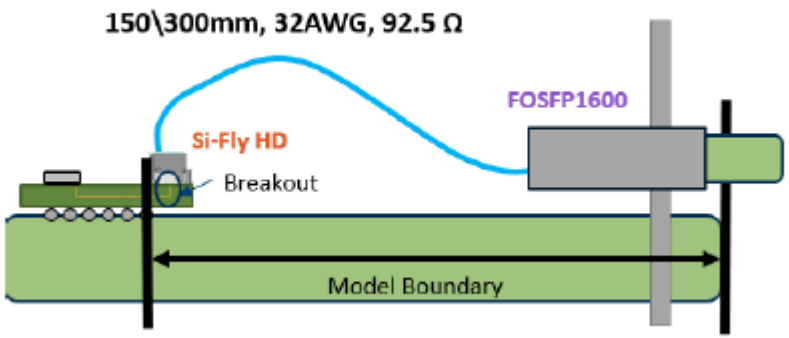
32 DP 8x4

16 DP 4x4

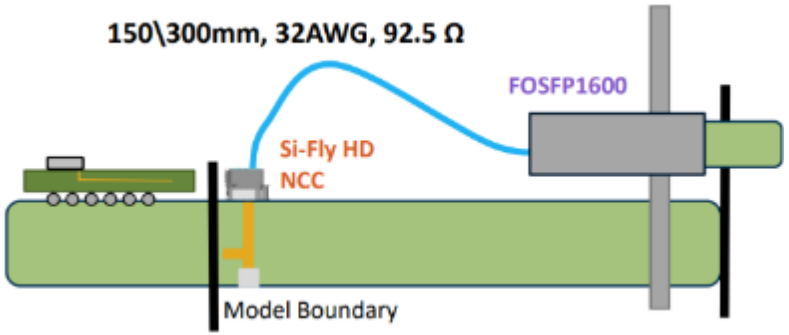
FEATURES	CO-PACKAGED (64DP)	NEAR-CHIP (16DP)
Pair-to-Pair Pitch	1.50 mm	2.80 mm
Row-to-Row Pitch	1.83 mm	2.00 mm
Connector Length	14.70 mm	15.90 mm
Connector Depth	16.46 mm	11.45 mm
Board Surface Area	242 mm^2 [0.375 in^2]	182.1 mm^2 [0.28 in^2]
Signal Density (mm^2)	3.8 mm^2 per DP	11.4 mm^2 per DP
Signal Density (in^2)	170 DP per in^2	57 DP per in^2
PCB Limitations	HDI/Package Substrate	Traditional PCB

Enabling Various System Topologies

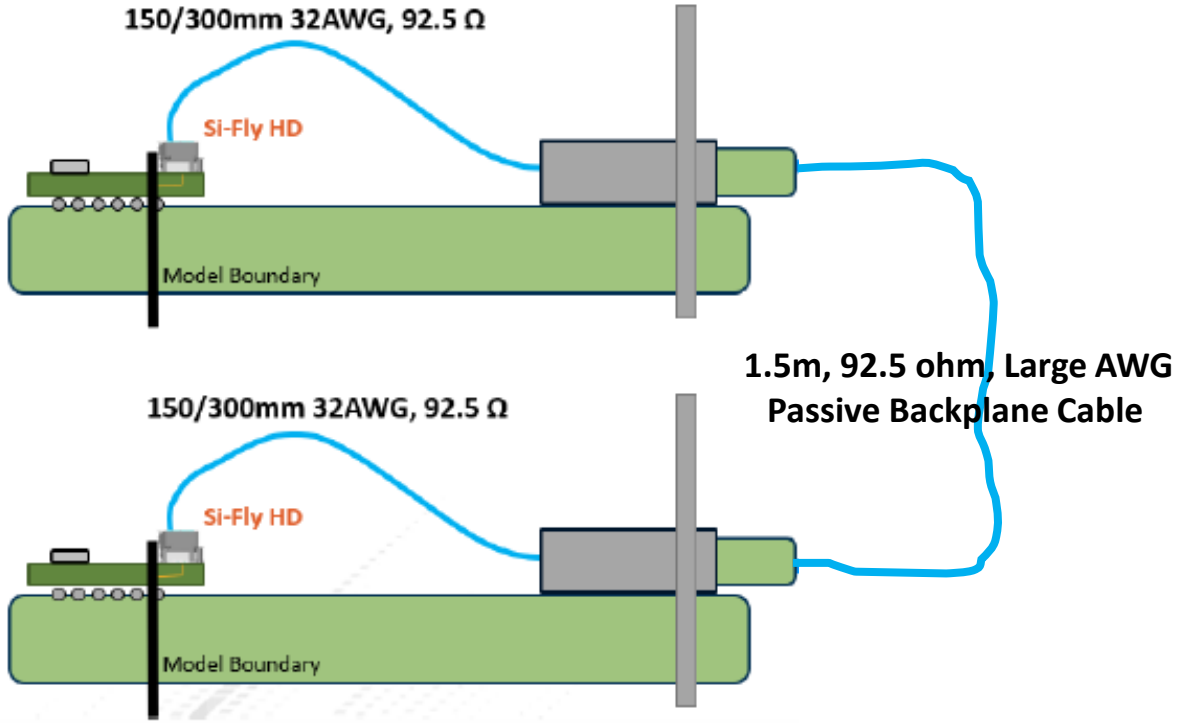
CPC to Front Panel



NCC to Front Panel



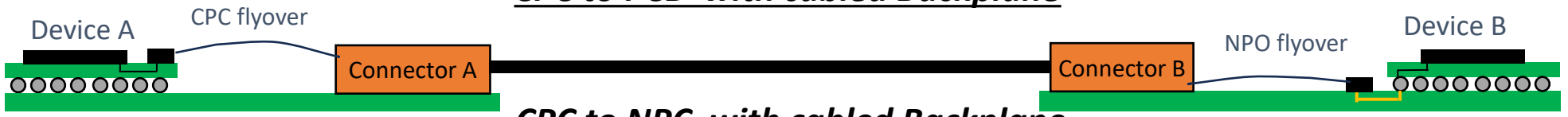
CPC to Backplane



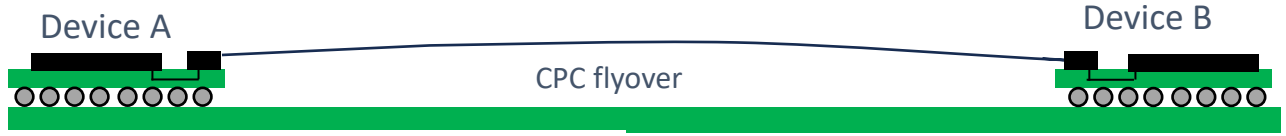
Enabling Various System Topologies

CPC to CPC with cabled Backplane

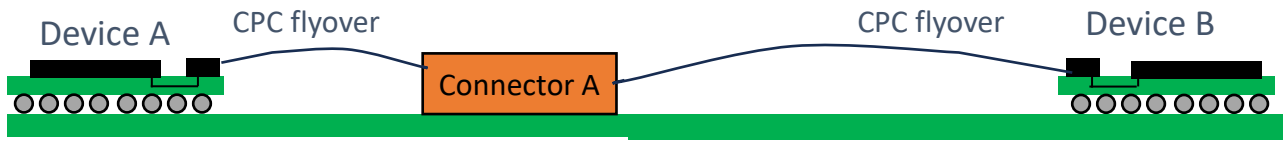
CPC to PCB with cabled Backplane



CPC to NPC with cabled Backplane



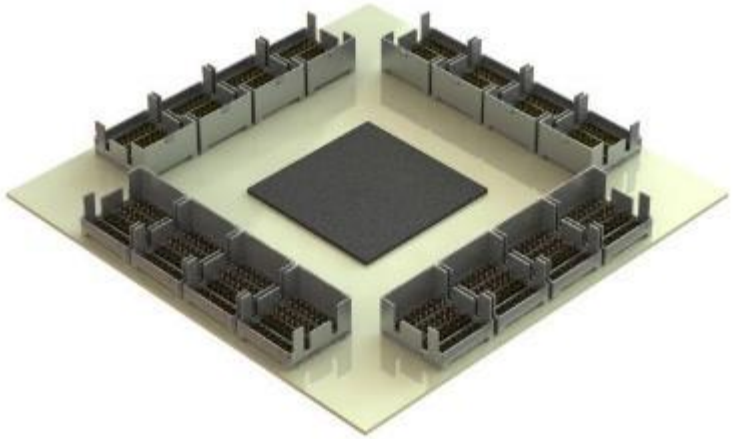
CPC to CPC



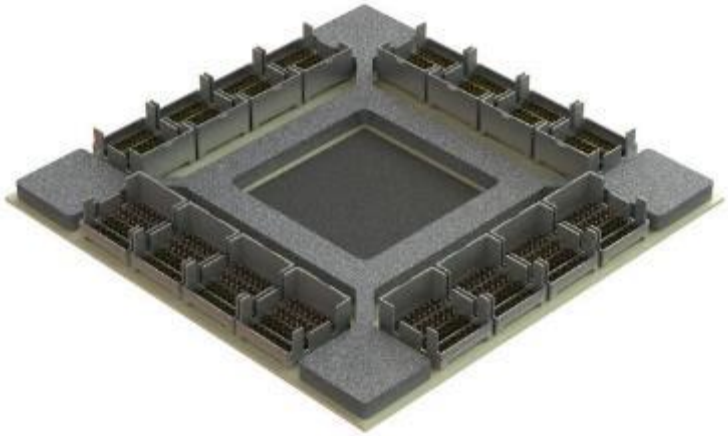
CPC to CPC with connector

Si-Fly® HD Co-Packaged Connectivity

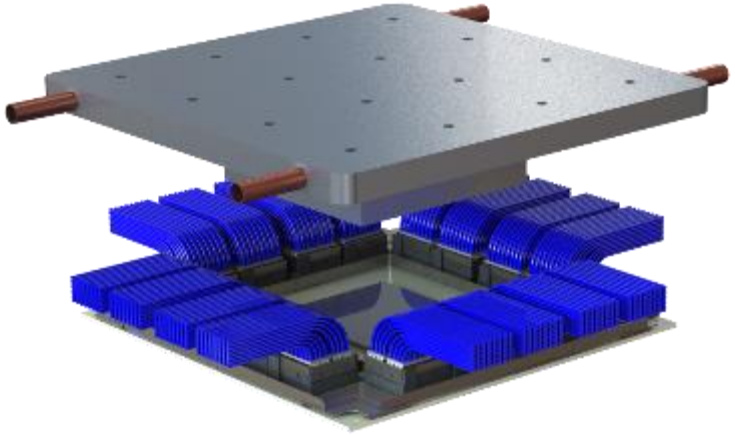
SMT Reflow
Si-Fly® HD + ASIC Die



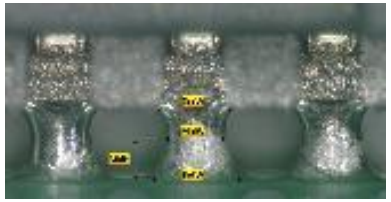
Substrate with Stiffening
Support Ring



Mate Cables and Install
Cold Plate Cooling Hardware



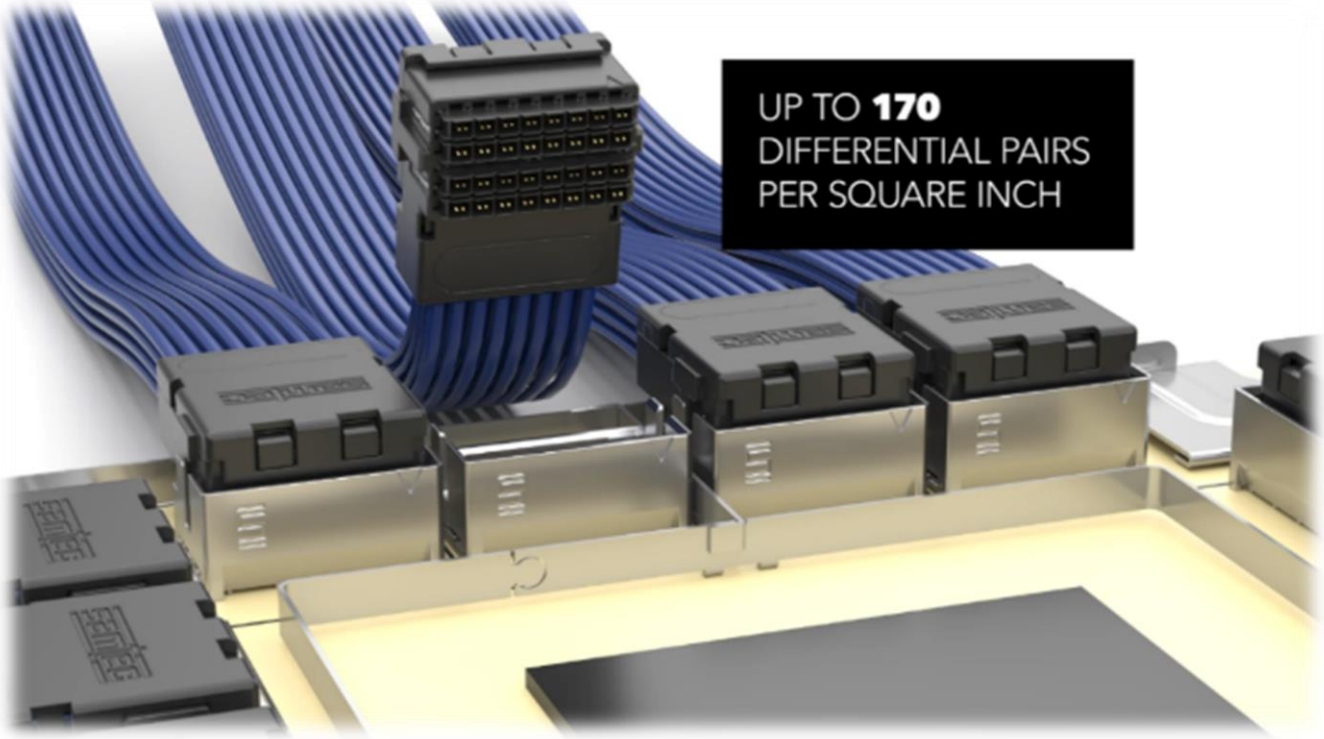
- Connector to be solder reflowed to substrate
  - Target SAC305, but other low temp solders possible
- Features non-solder ball design
  - Offers improved uniformity, repeatability and coplanarity
- Solder, stiffener, assembly process
  - TBD in collaboration with OEM



Si-Fly® HD Co-Packaged Connectivity

Si-Fly® HD Co-Packaged Cable Interconnect

- Ultra-High-Density Co-Packaged Substrate-to-Cable
  - No external hardware required for retention
  - Highest density interconnect supporting 224 Gbps PAM4
  - Designed with 32 AWG EyeSpeed® Hyper-Low Skew twinax

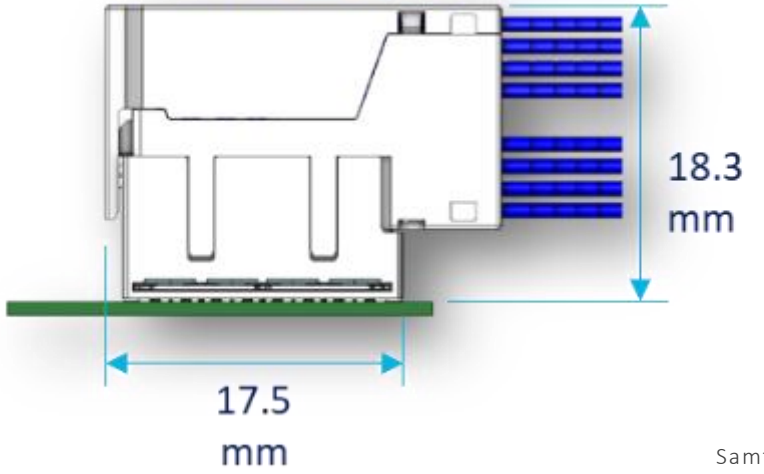


PAM4 224 Gbps

SI-FLY HD
CO-PACKAGED
(SFCC/SFCM)

SI-FLY HD CPC

64 DP, x32 lanes
6.4 Tbps Aggregate

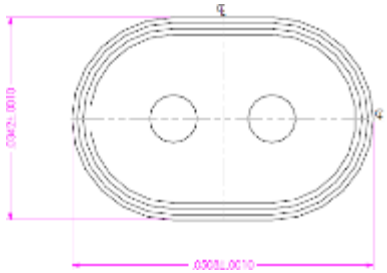


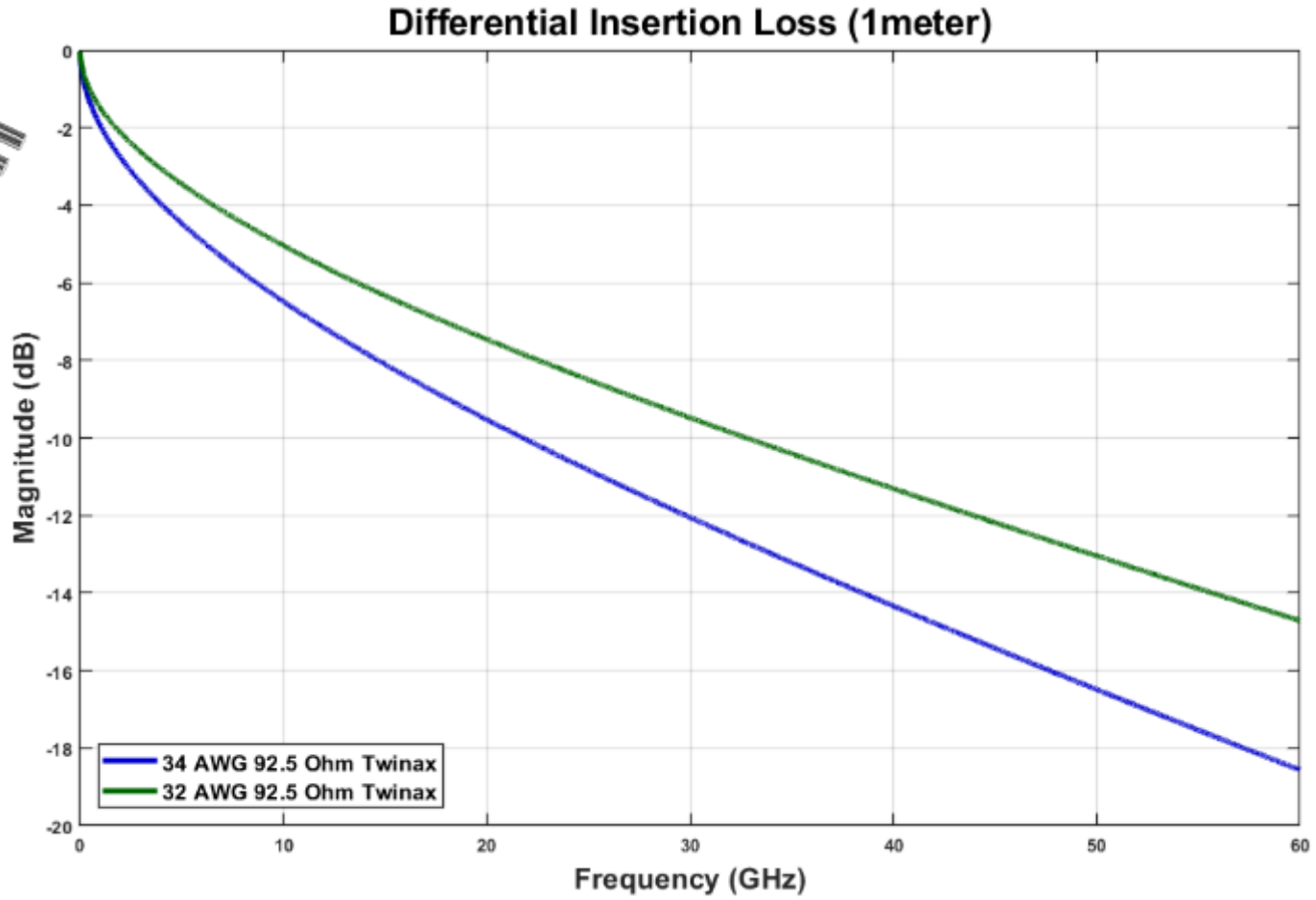
Samtec Flyover® Cable Technology

- Hyper-low skew
  - 1.75 ps/m max intra-pair
- Best SI performance
  - Highly tuned drainless construction
- Optimal flexibility
- Commercially available
- 448 Gbps PAMx under development

EYE SPEED Hyper-Low Skew 224 Gbps

32 AWG



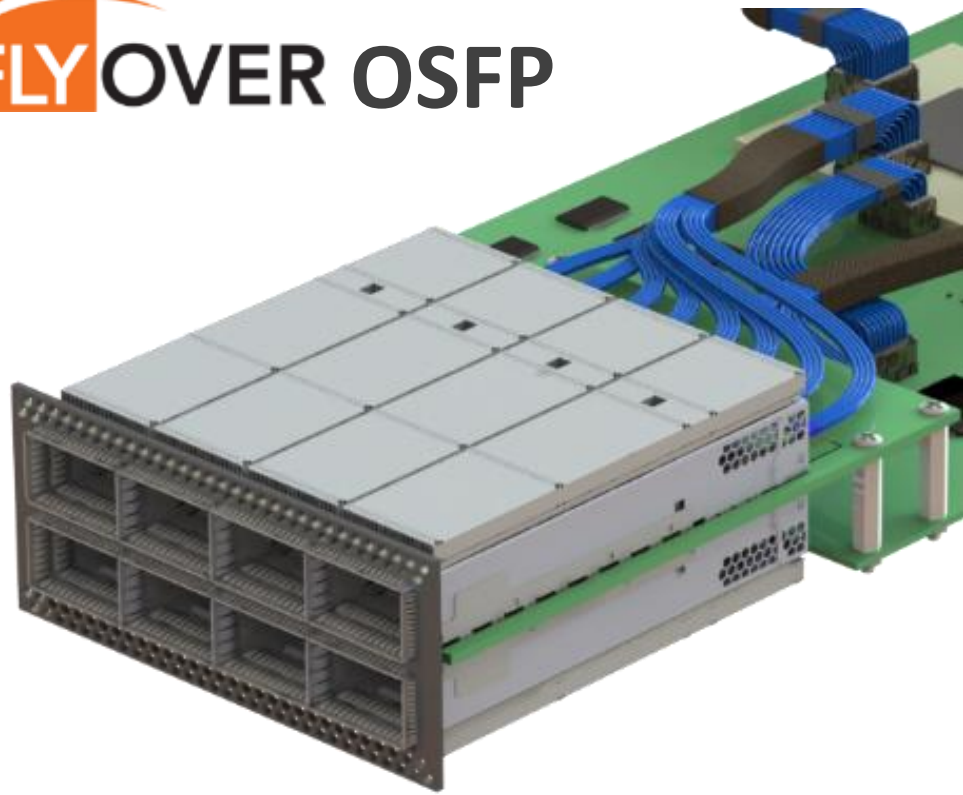


Backplane and Front Panel Connectivity

PAM4 224 Gbps SI-FLY™ BP

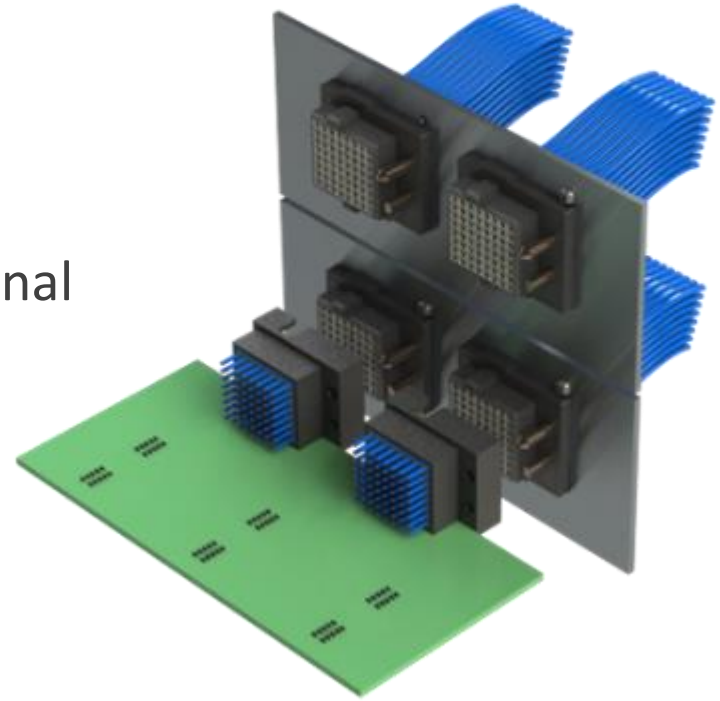
64 DP
8 DP/Row x 8 Rows

PAM4 224 Gbps FLYOVER OSFP

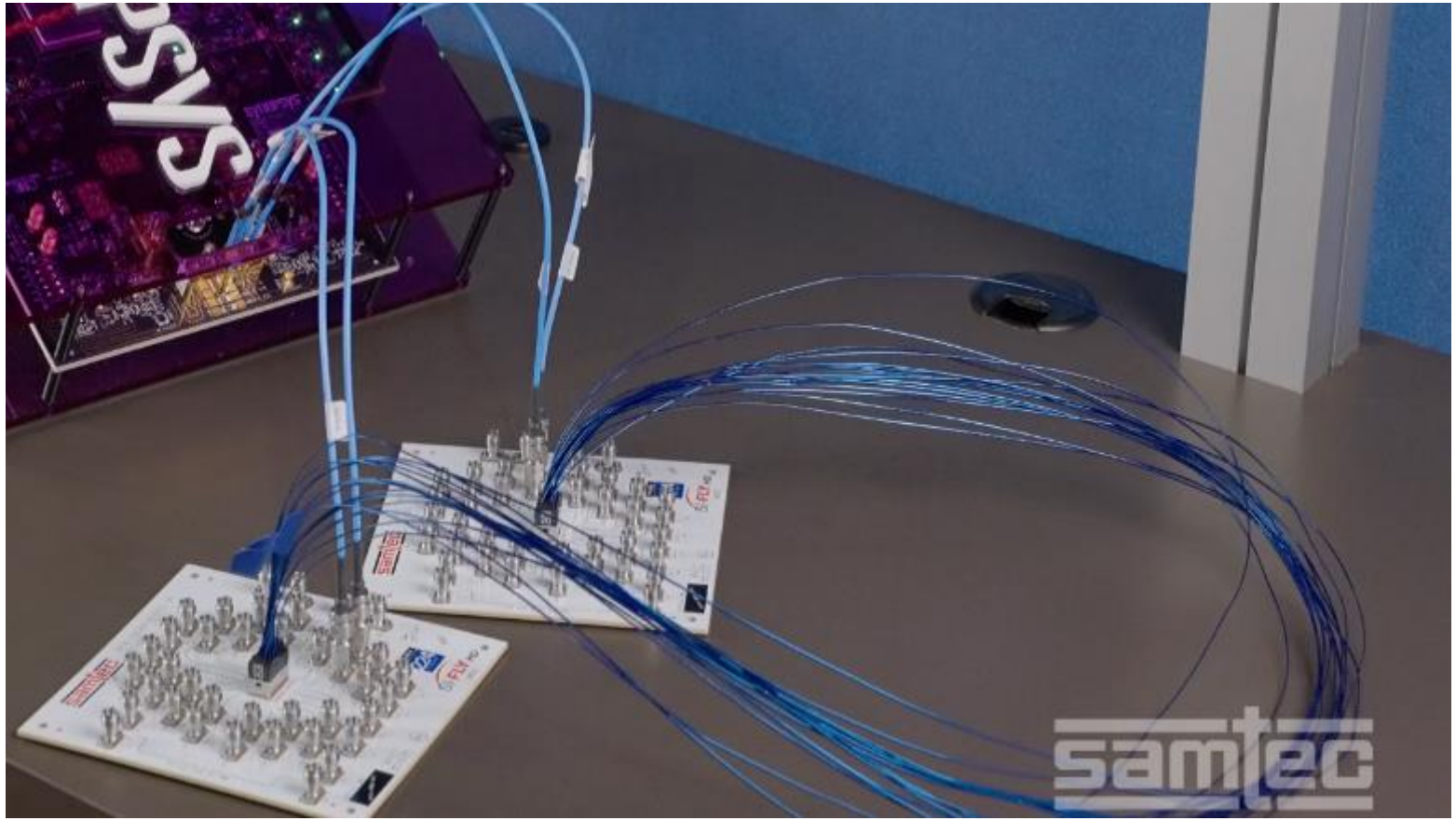


Si-Fly® HD Backplane Connectivity

- High-density in 1 RU application
- 1792+ DP with guidance per connector
- 2048 DP with ganged connectors
- Blind mate capable without external mechanism or pressure



Synopsys 224G LR NCC Demonstration



- Total channel IL
  - -40 dB @ 56 GHz
- Pre-FEC BER
  - 3.0 e-09

Broadcom 200G SR CPC Demonstration

- Total channel IL
  - -20 dB @ 53 GHz
- Pre-FEC BER
  - 9.3 e-13

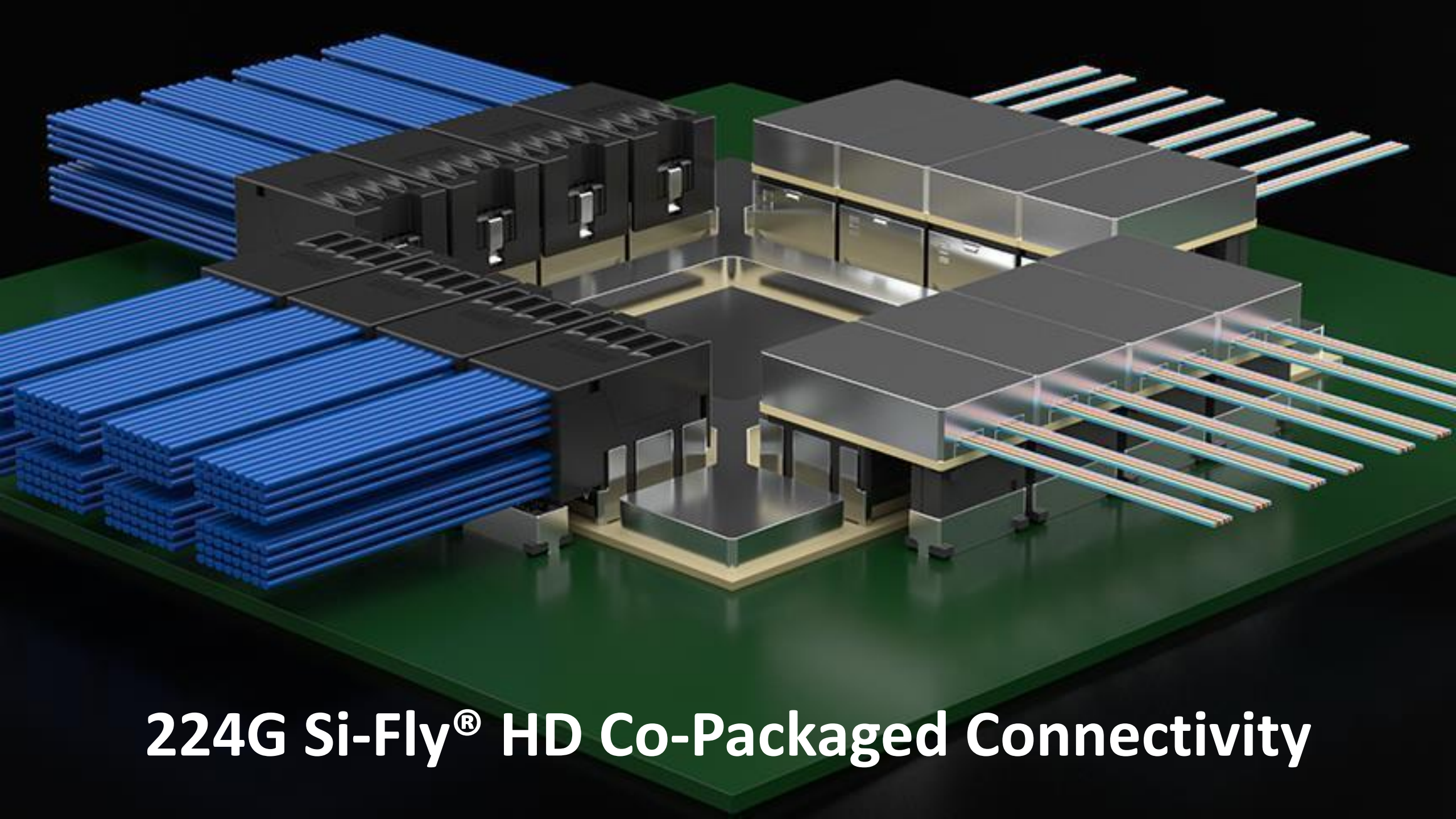
Broadcom 200G LR CPC Demonstration

- Total channel IL
  - -48 dB @ 53 GHz
- Pre-FEC BER (DC'25)
  - 1.6 e-9 (one lane)
- Pre-FEC BER (OCP'25)
  - 3.0 e-11 (three lanes)

CPC in Scale-Up Architectures

- Joint PoC between Marvell and Samtec
- CPC cable with backplane
- >2x density of front panel
- 2x interconnect density within rack
- Lower power consumption

Path to CPC for 224 Gbps PAM4/448 Gbps PAMX in the same form factor



224G Si-Fly® HD Co-Packaged Connectivity

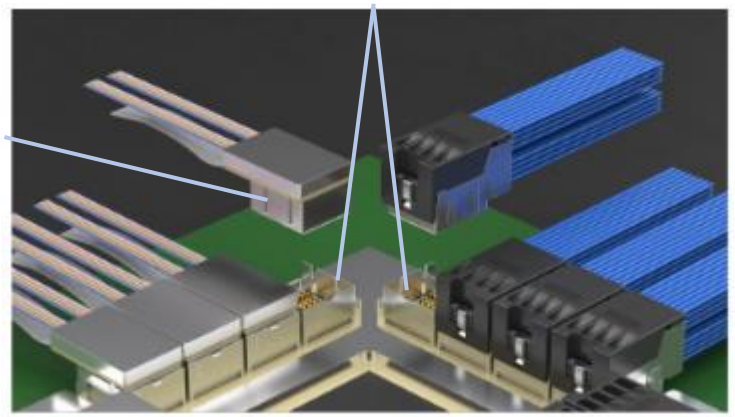
Si-Fly® HD “CPX” Interconnect

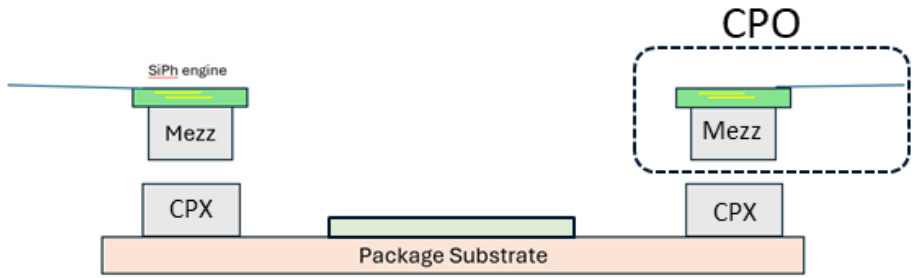
- CPX Socket
  - Accepts both CPC and CPO
  - 6.4 Tbps in 14.9 mm x 16.7 mm
  - Soldered to substrate package by OSAT
- CPX Mezzanine
  - Soldered to bottom side of optical engine
  - Entire optical transceiver electrically detachable similar to Front Panel Pluggable

PAM4 224 Gbps

CPX Mezz

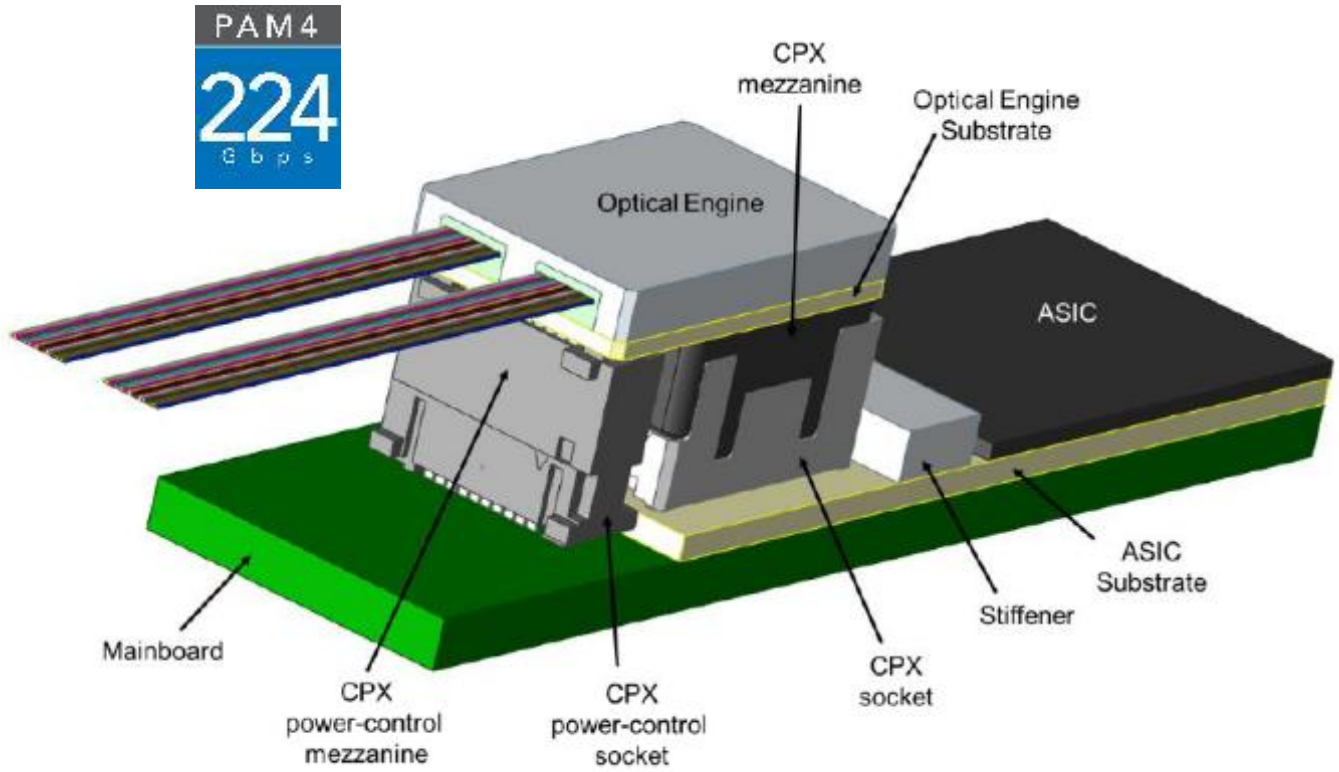
CPX socket



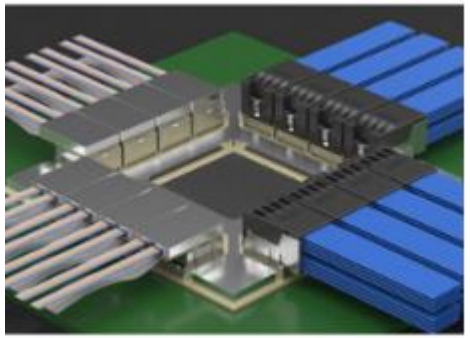


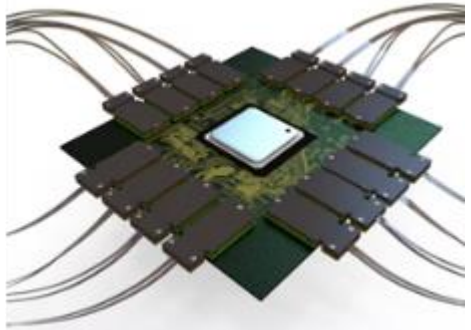
Si-Fly® HD CPO Details

- High-speed and power/control terminals soldered to its bottom of optical substrate
- High Speed Mezzanine Connector
  - 64 DPs
- Power/Control Connector
  - 40 pins
  - Multiple power rails
  - 10x control signals
- Integrated thermal relief
- Optical engine defined by OEM/partner



Si-Fly® HD CPX vs Alternative CPO





	Si-Fly® HD CPX	Alternative CPO
CPO	Y	Y
CPC	Y	N
Electrically Detachable	Y	N
Optically Detachable	Y	Y
Density (95 mm x 95mm)	102T	??
Yield	~100%	<<100%
Complexity	Low	High
Ecosystem	Sames as FPP	OSATs

Si-Fly® HD Second Sourcing Agreement

TechWire International
Media Relations for the Electronics Industry

samtec

FOR EDITOR USE:
English | Image
September 2025

FOR IMMEDIATE RELEASE

Samtec Inks Second-Source License Agreement with Molex to Expand Reach of Si-Fly HD High-Speed Interconnects for Data Center and AI Applications

New Albany, IN, USA – September 9, 2025: Samtec, Inc., the service leader in the connector industry and a premier provider of high-speed connectivity solutions, and Molex, a global electronics leader and connectivity innovator, today announced a license agreement naming Molex as a second source for the Samtec Si-Fly® HD product family. This collaboration provides customers with extended product availability and supply flexibility to a portfolio of robust, scalable connectivity solutions for a wide range of high-performance applications demanding high signal integrity and density.

The Si-Fly HD product family delivers industry-leading signal integrity for high-speed applications and supports data rates critical for modern networking, communications, and computing systems. As part of the agreement, Molex will manufacture and distribute these interconnects to customers worldwide, ensuring uninterrupted access to advanced connectivity solutions, while benefiting from the combined engineering and support expertise of both teams.

"Collaborating with Molex as a second source for Si-Fly HD demonstrates our commitment to providing customers with reliable worldwide supply and exceptional technical support," said Brian Vicich, CTO of Samtec. "Molex's manufacturing capabilities, deep engineering expertise, and global reach make them an ideal resource to extend the availability of this high-performance interconnect family."

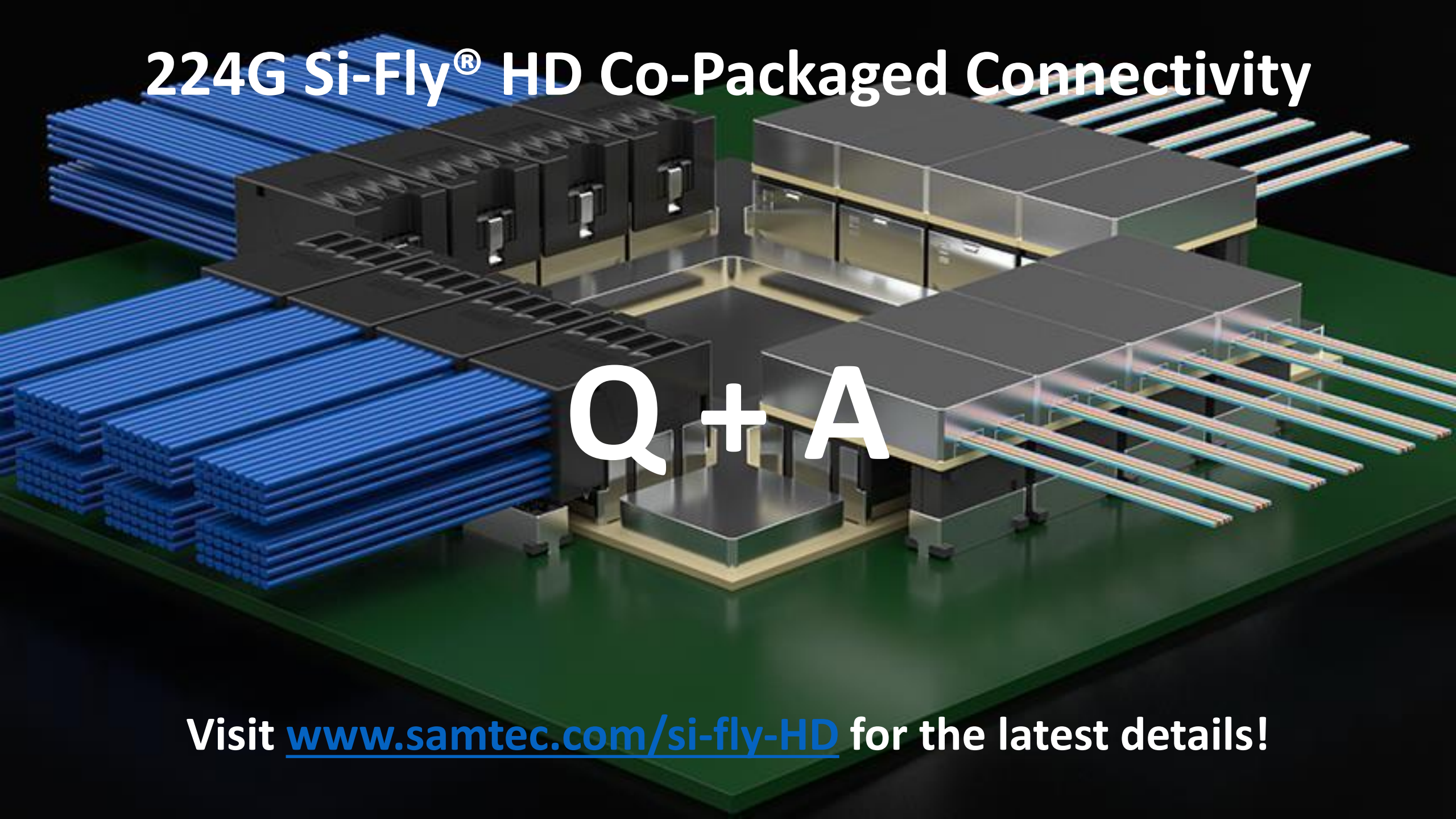
- Long history of dual sourcing options
- Focus on targeted solutions for key applications
- Samtec and Molex enter into new second source agreement for Si-Fly® HD High-Speed Interconnects
- See September 9, 2025 press release for more details

Si-Fly® HD CPX Advantages

- Same interconnect system:
  - Copper twinax cabling
  - Silicon Photonics
  - TeraHz Waveguide
  - MicroLED . . .
- Footprint density
  - 95 x 95 mm package
  - 3 dB channel advantage at 224G over compression technology
- Low external retention force
  - Key requirement for optics
- Stable over temperature performance
- Scalable
  - 448 Gbps PAMx under development
  - 400 Tbps in 1 OU chassis
  - Expanding eco-system of optical engine providers
  - MSA in planning stages
- Available:
  - Now!

Visit www.samtec.com/si-fly-HD for the latest details!

224G Si-Fly® HD Co-Packaged Connectivity



Q + A

Visit www.samtec.com/si-fly-HD for the latest details!