

# Connectivity Trends in the Data Center



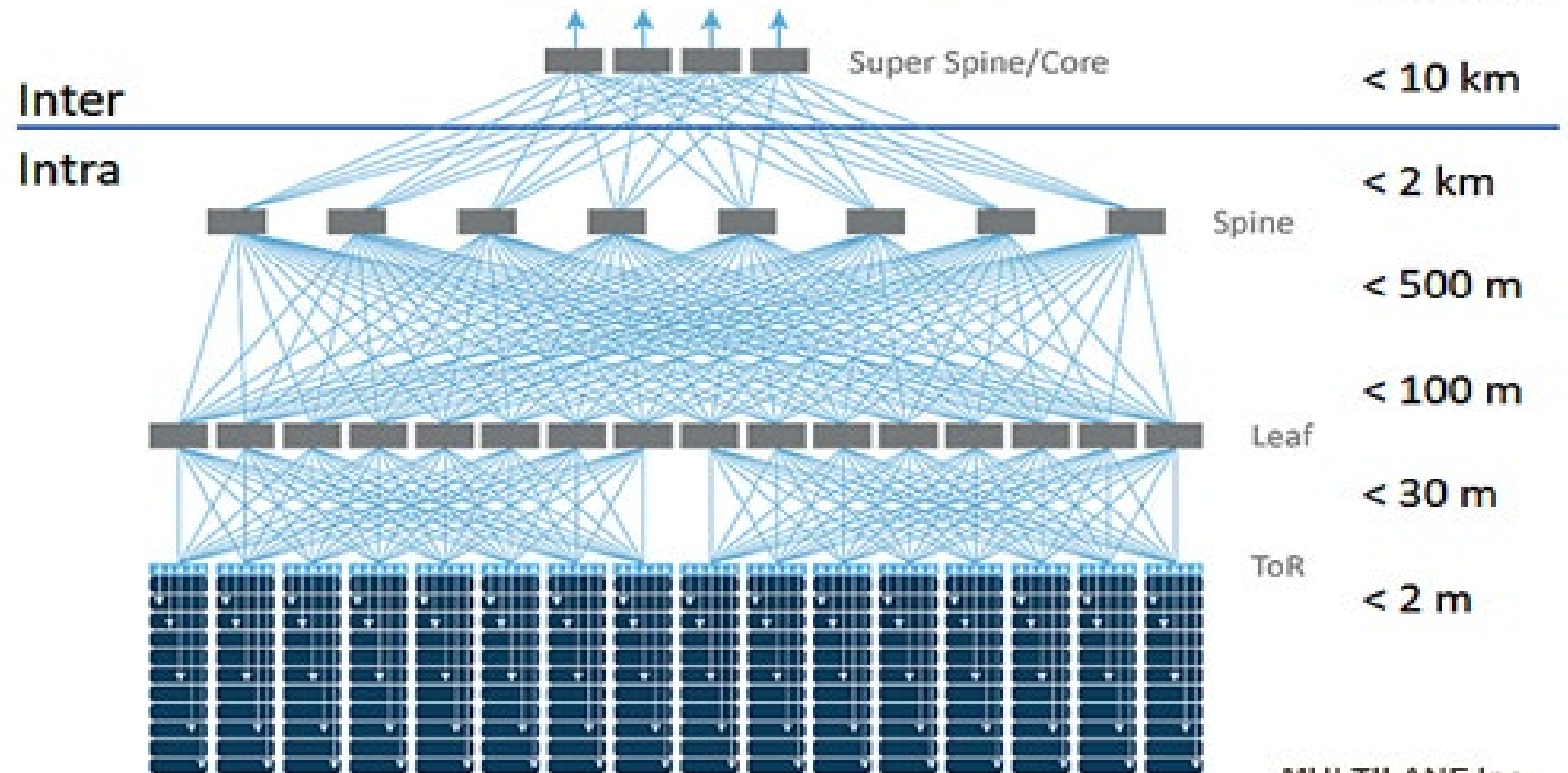
U.S. CHAMBER OF COMMERCE

**Bob Hult**  
**Director of Product Technology**



Data centers are huge networks of switches and interconnects

Each layer typically requires greater bandwidth and reach



MULTILANE Inc.



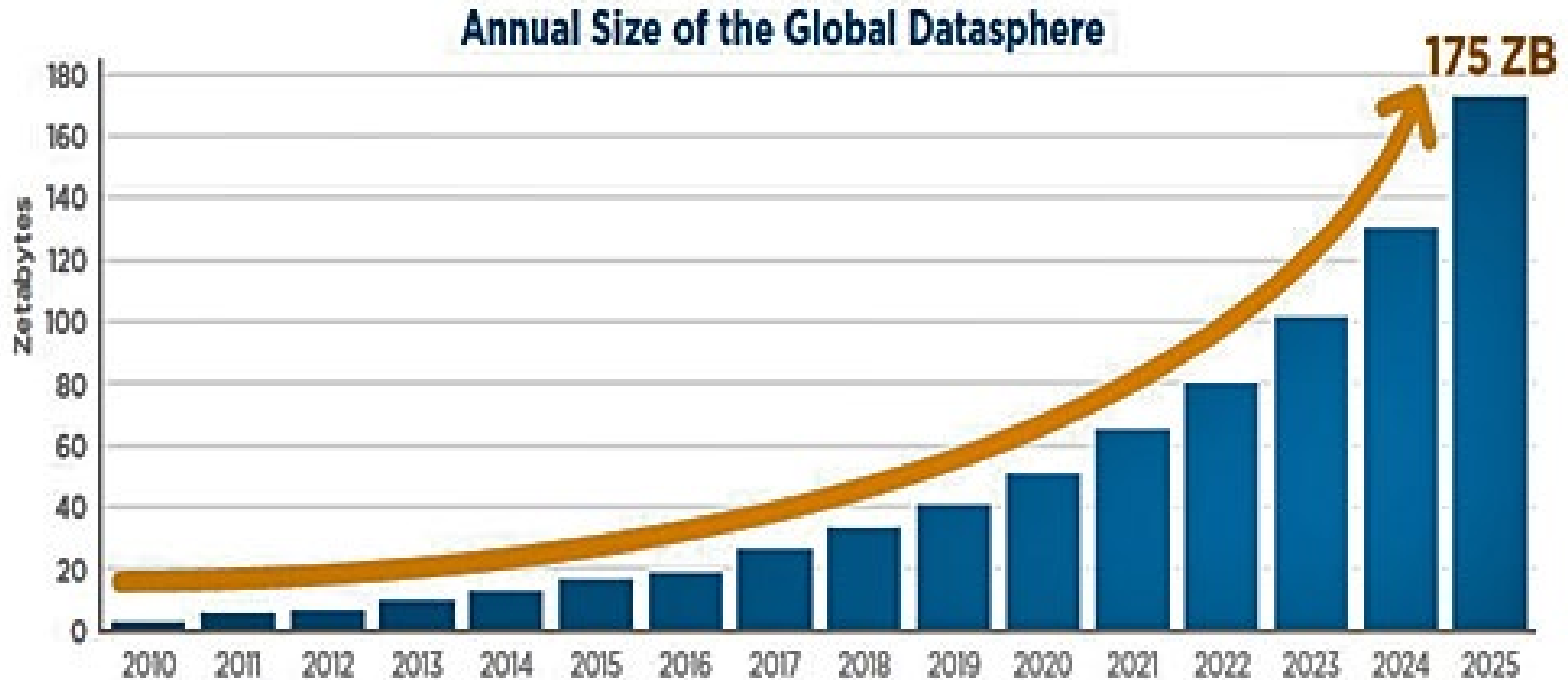
# Data Center Growth



- \$100 billion Capex with 15% CAGR
- Cloud data transmission measured in Zettabytes
- Typical hyperscale datacenter:
  - 100,000 Servers
  - 10,000 switches
  - 1,000,000 optical interconnects



# Data center traffic is accelerating



Source: Data Age 2025, sponsored by Seagate with data from IDC Global DataSphere, Nov 2018



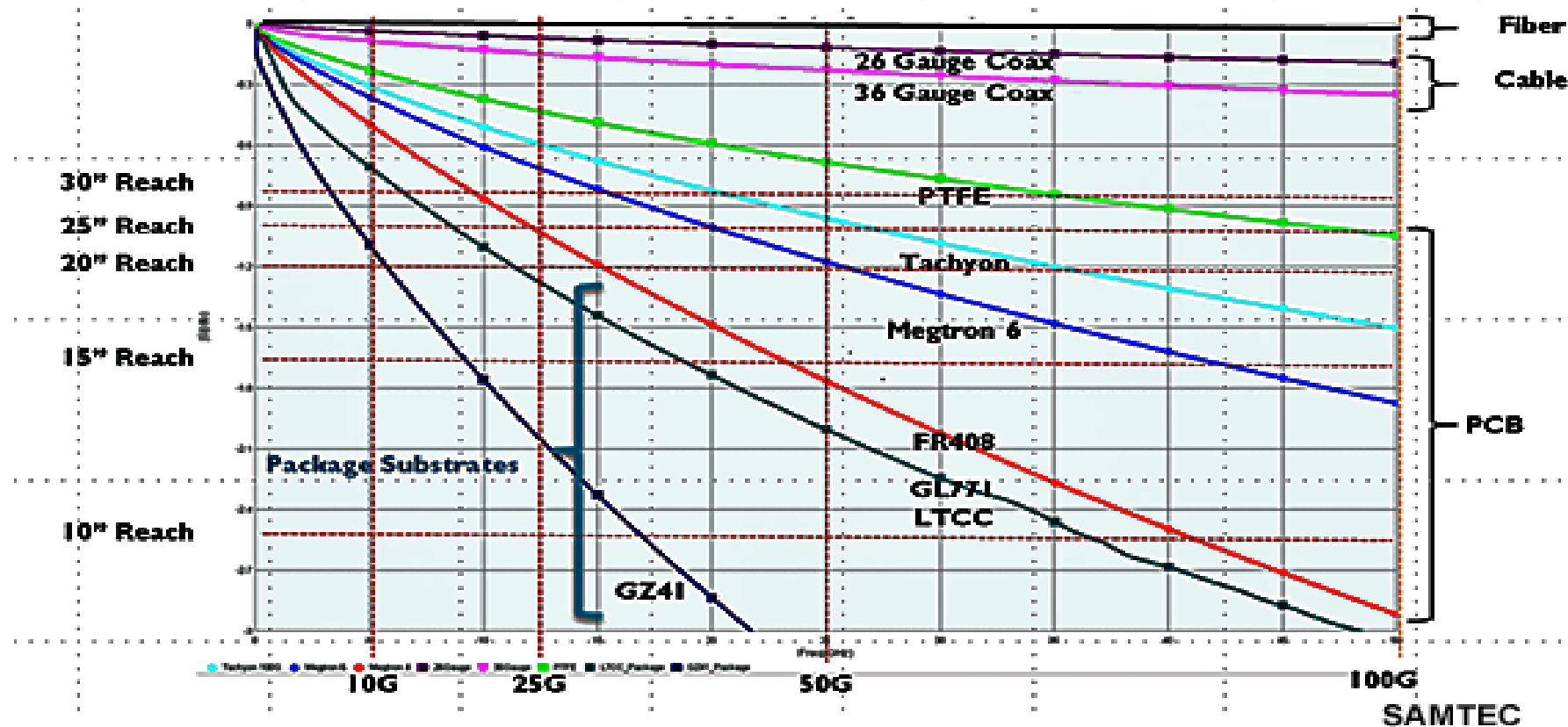
# *Data Center expansion / upgrades driven by:*

- Demand for increased capacity
- Faster switching speeds
- Reduced latency
- Need for network automation
- Reduced power consumption
- Need to implement new revenue-producing services
- Reduced hardware and operating costs



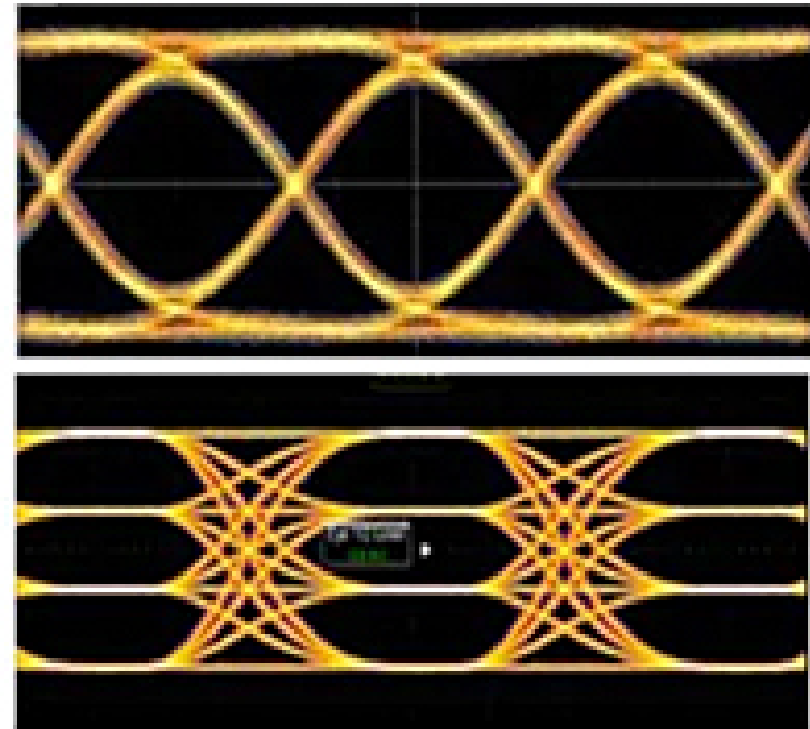
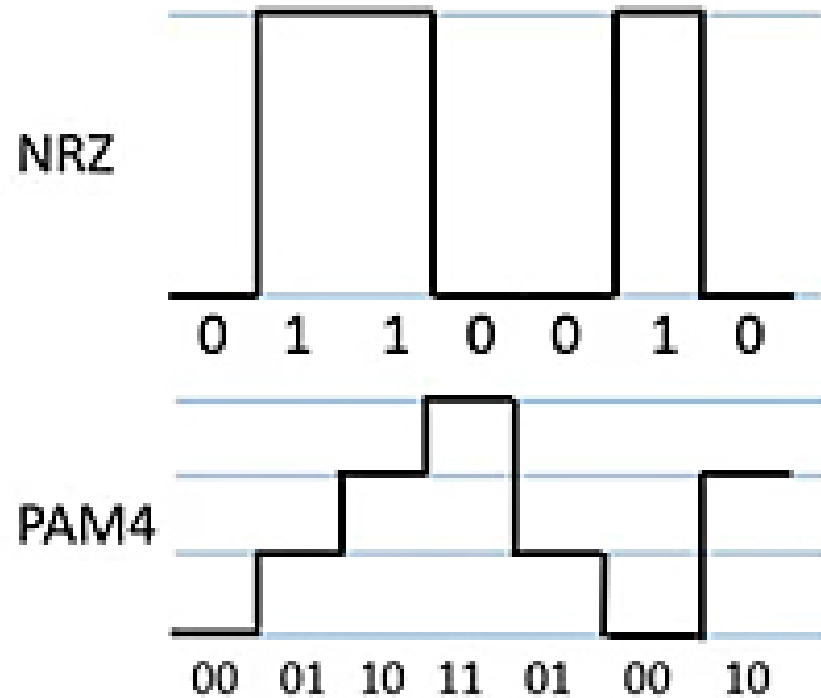
# Challenge

Copper is hitting performance limits of speed and reach



# Solution

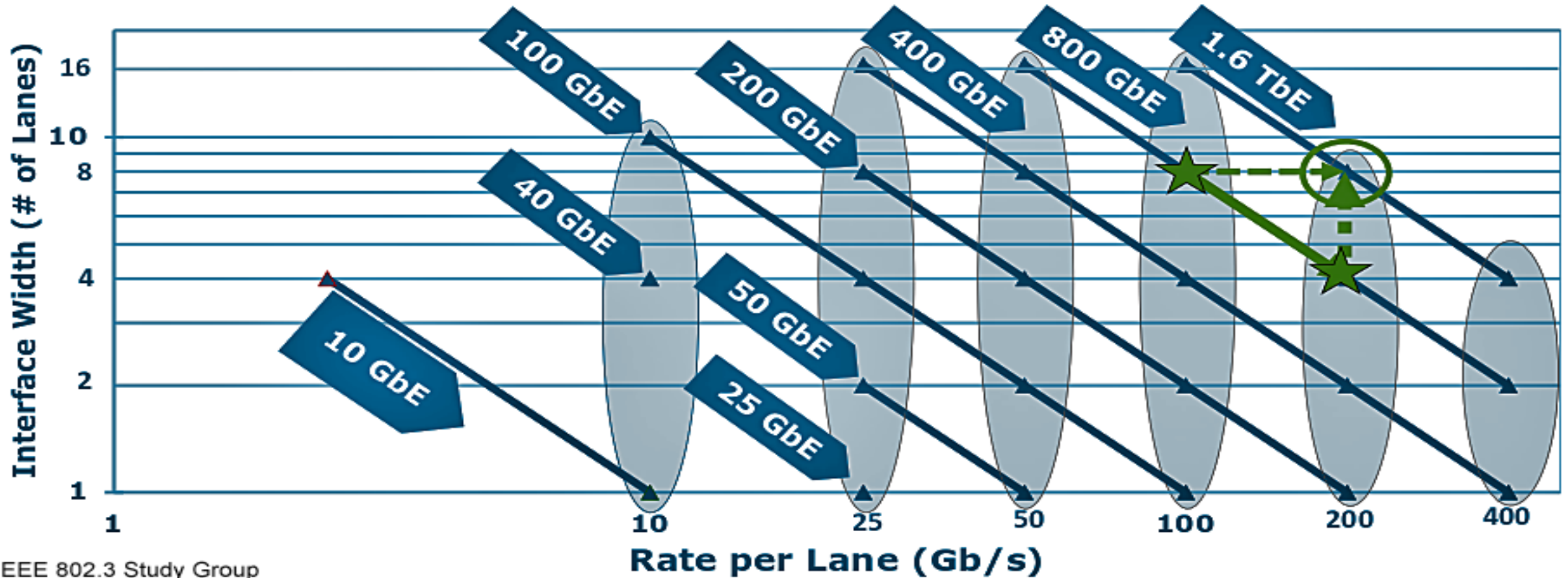
## PAM4 Modulation



Kumoh National Institute of Technology

# Solution

## The Relationship Between Ethernet & Signaling Rates



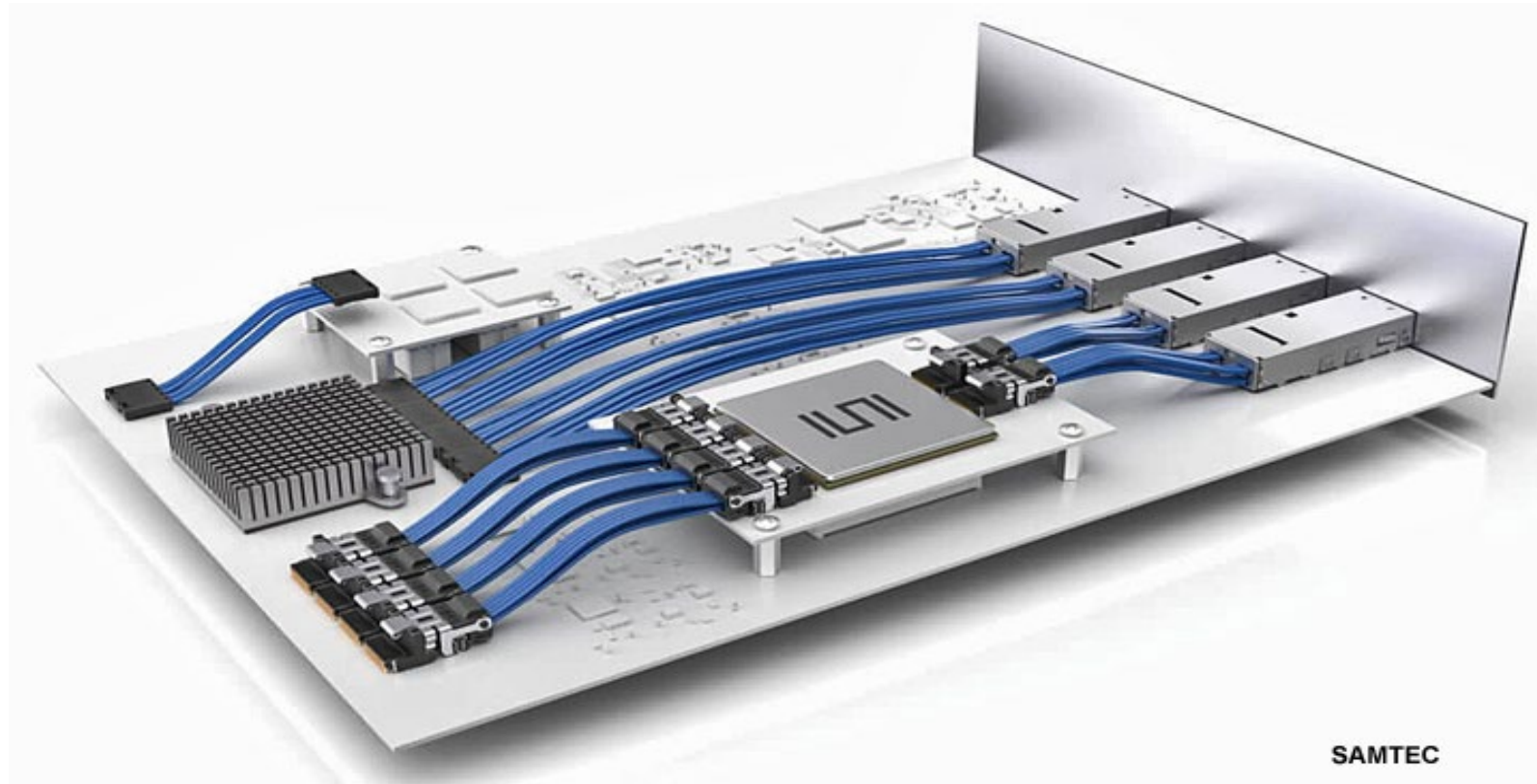
IEEE 802.3 Study Group





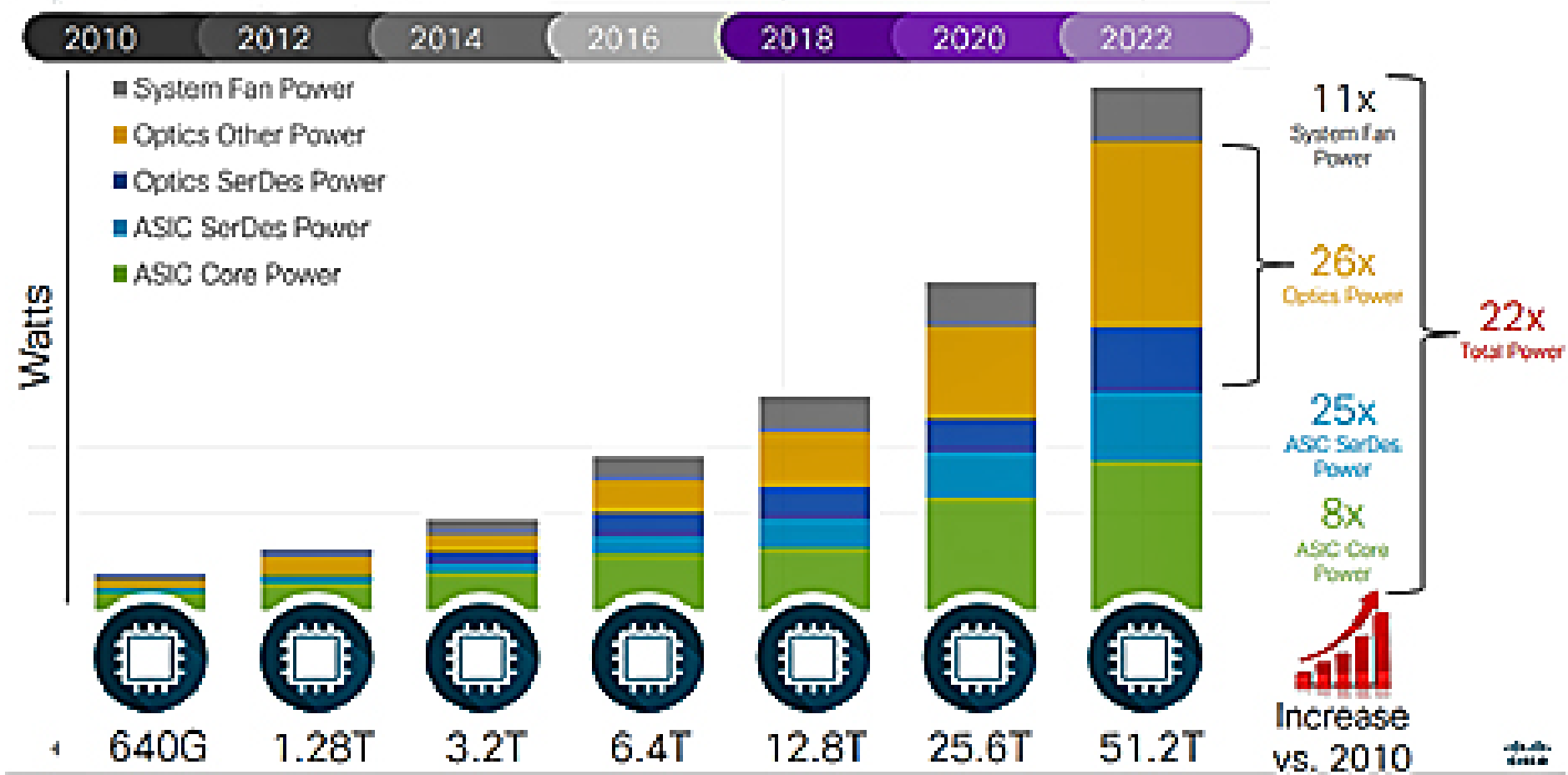
# Solution

## “Flyover” Technology



# Challenge

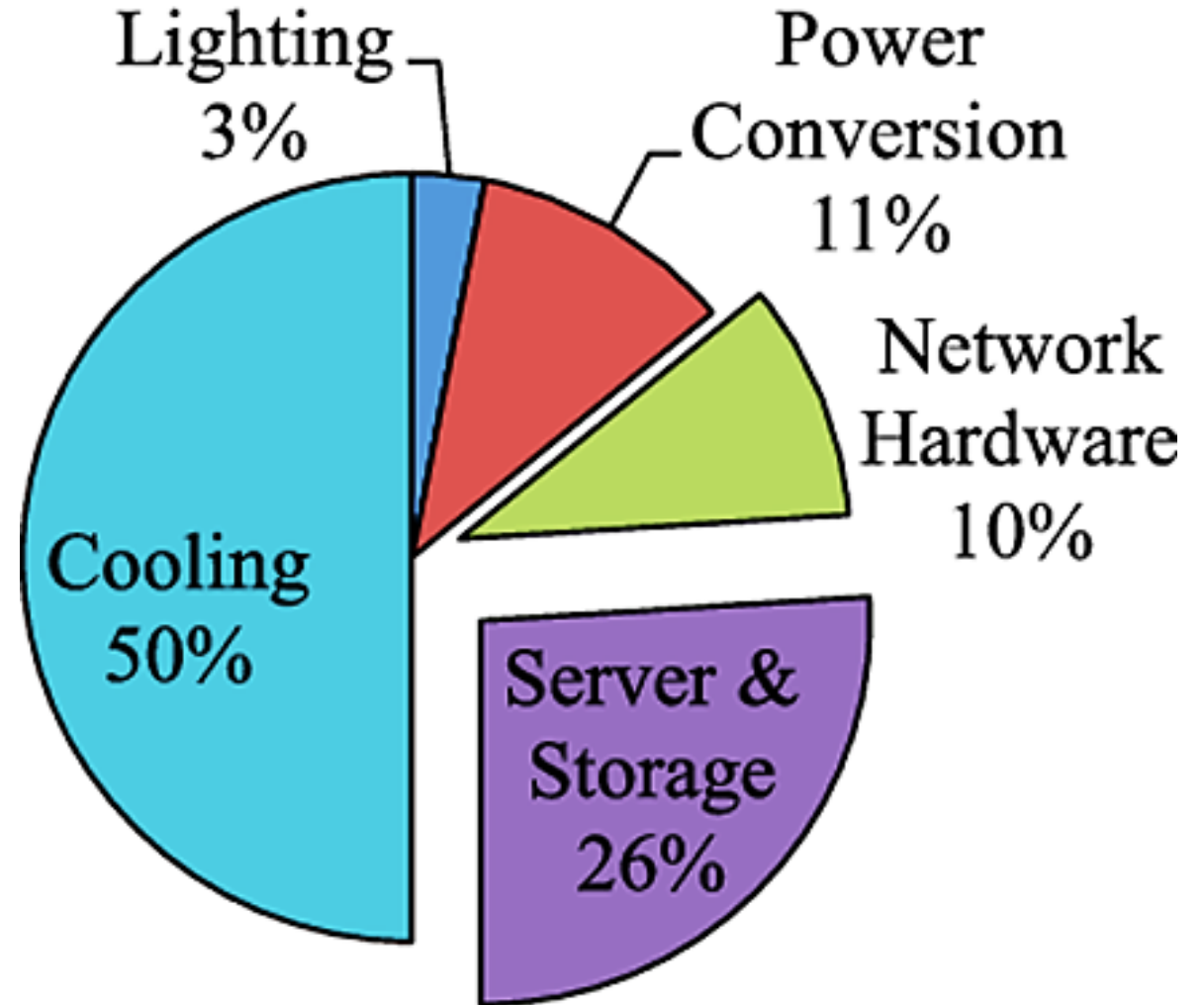
Power consumption is growing at an unsustainable rate



# Solution

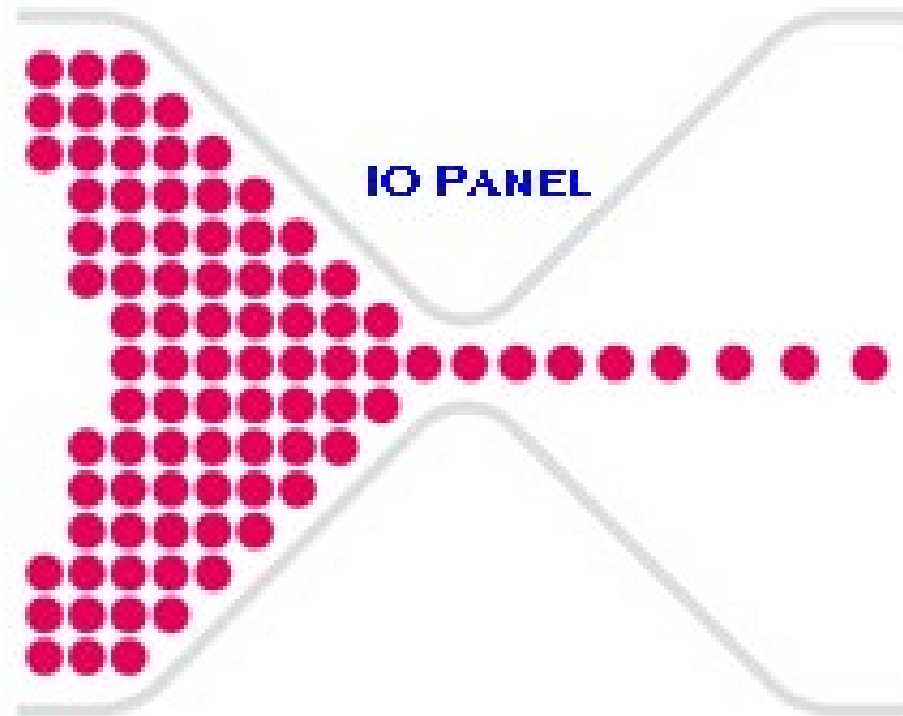
Higher efficiency design:

- *Reduced power per bit  
(Target ranges from 10 to 2 pj/bit)*
- *Reduce generated heat*
- *Simplifies thermal management strategy*



# Challenge

I/O Panel / Data Density Limits performance



# Challenge

Physical limit  
of available  
space for  
standard  
pluggable  
modules in a  
1U chassis



NeoPhotonics

# *Solution*

## High Performance Pluggable Optical Transceivers

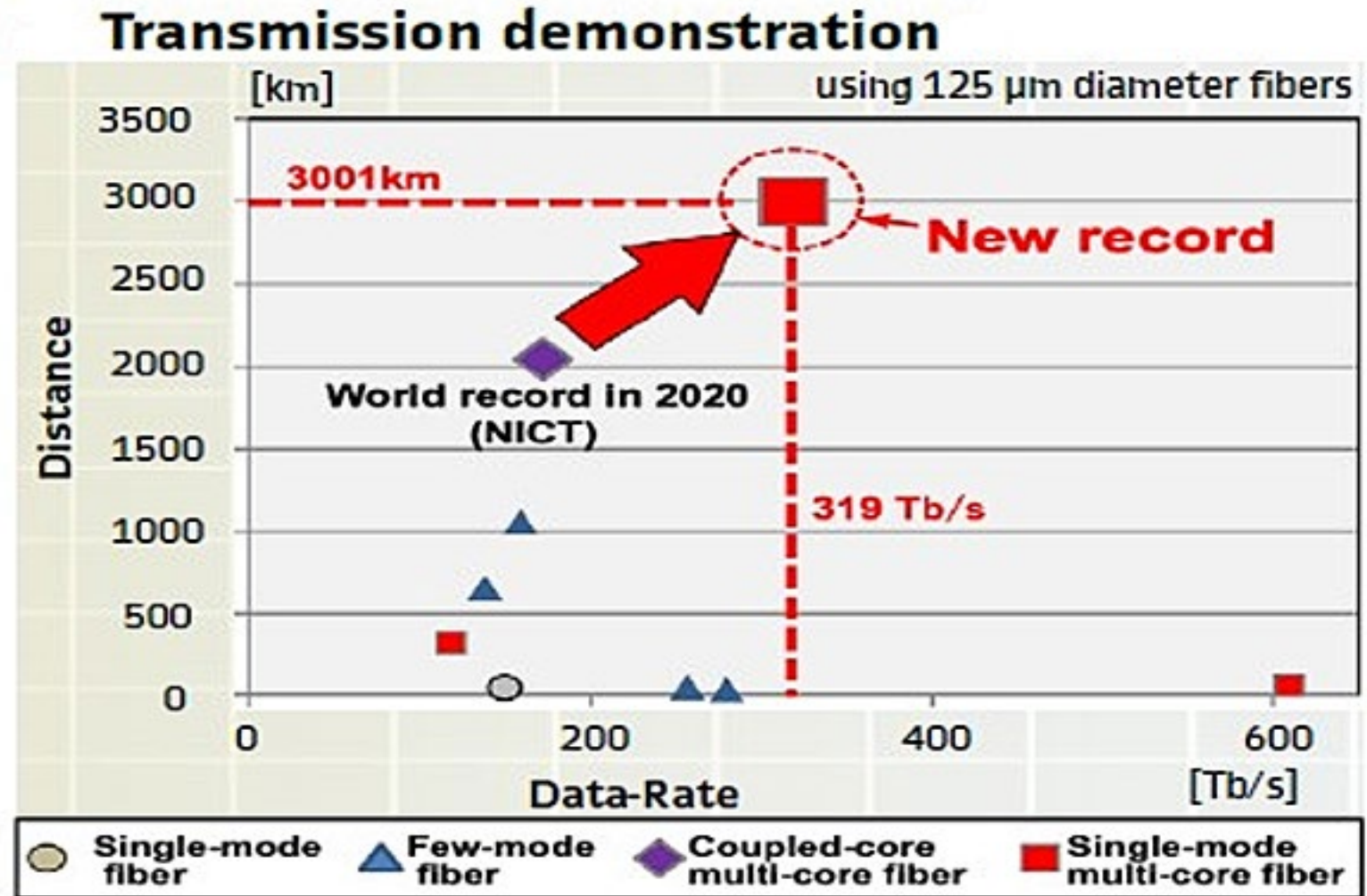
- QSFP-DD
- OSFP
- OSFP-XD



MOLEX

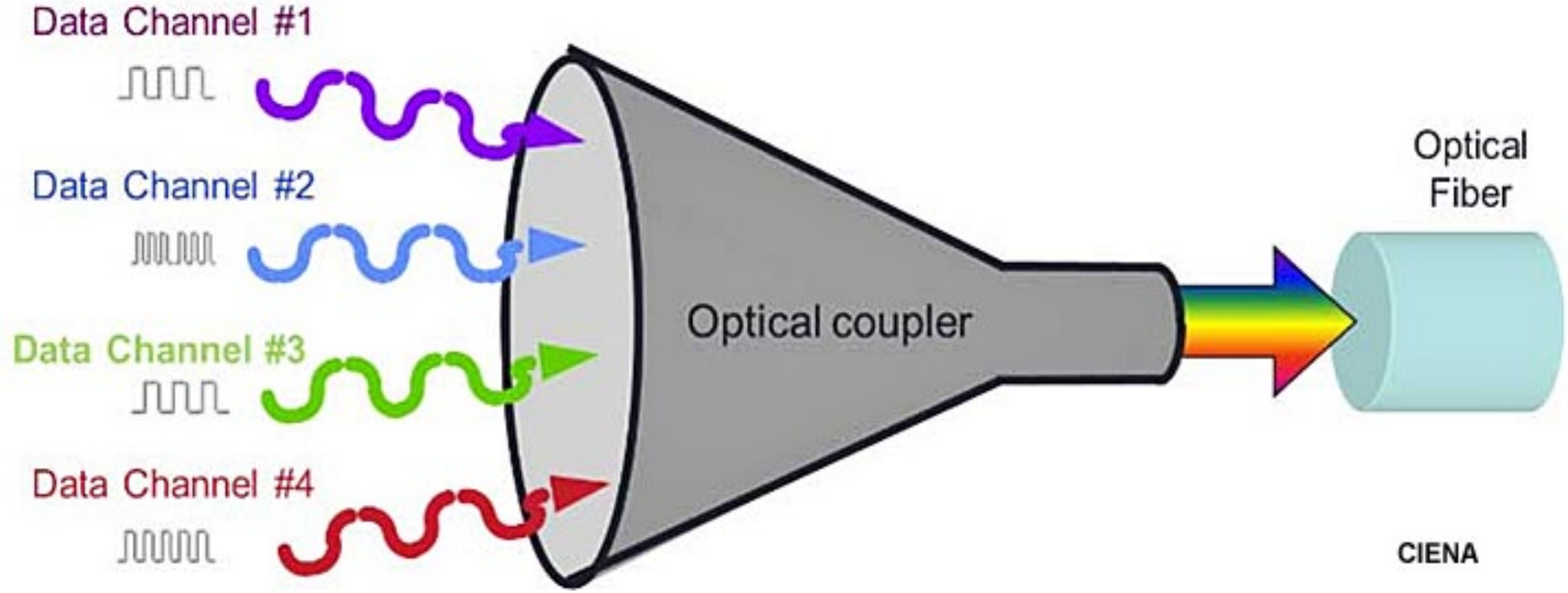
# Solution

Optical data transmission



# Solution

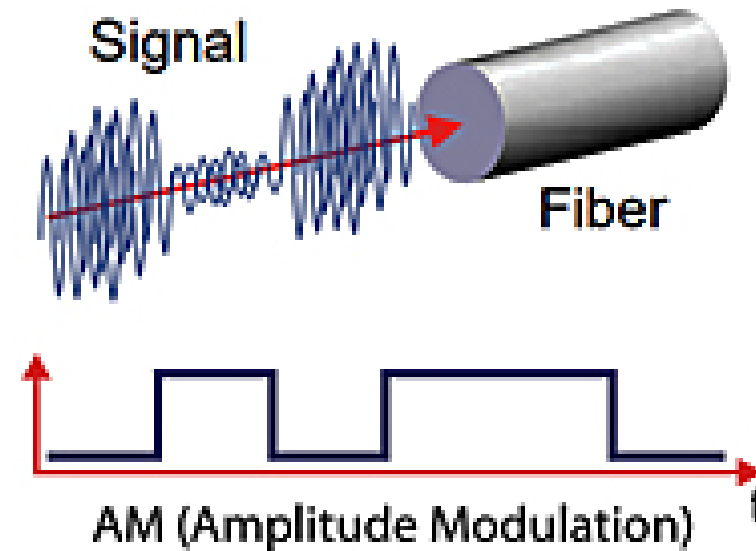
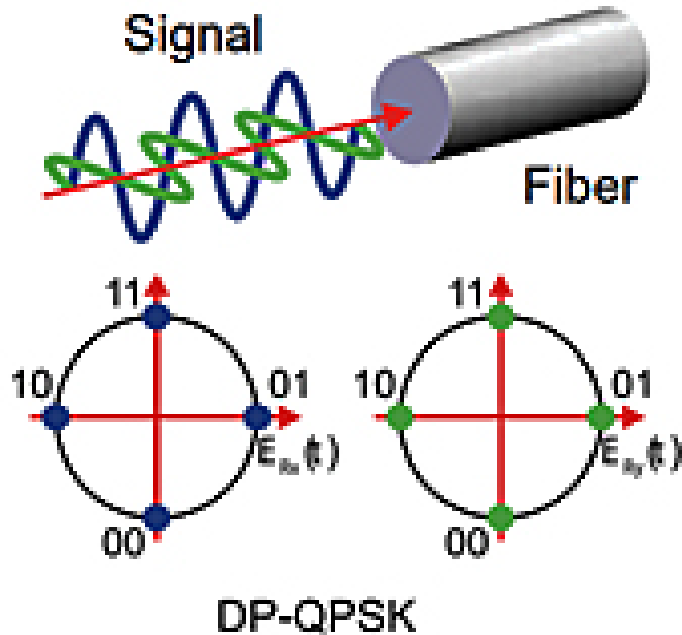
## Wave Division Multiplexing





# Solution

## Coherent Optical Transmission



T8

# Solution

Two dominant ferrule/connector types

LC – single fiber ferrule



Uni-boot designs are common

Courtesy 

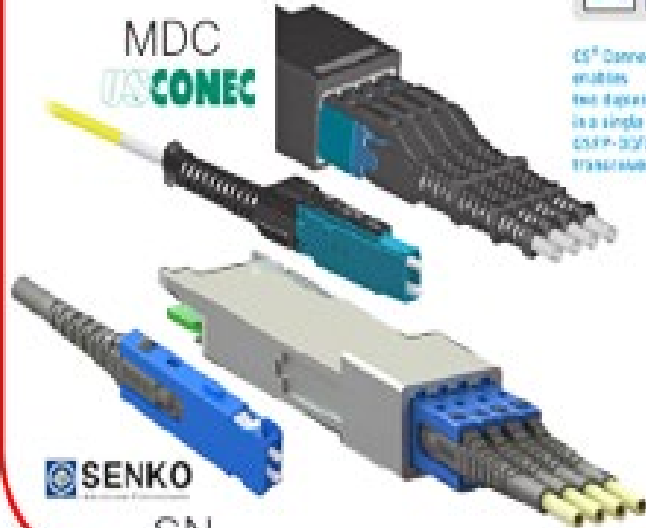
MPO/MTP – multiple fiber ferrule





Courtesy 

New


New Dual ferrule connectors



MDC 

CS<sup>2</sup> Duplex 

CS<sup>2</sup> Connector enables two duplexes in a single connector footprint

 SN

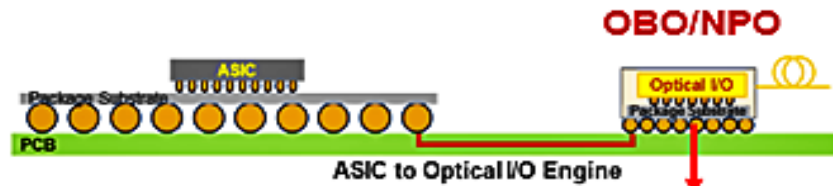


# Solution

## Near Package / Co-Package Optics

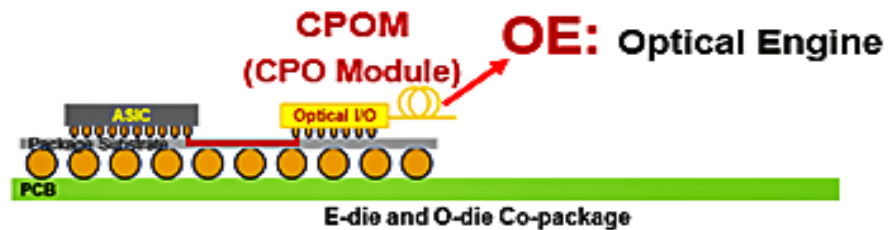


Pluggable



OBO/NPO

On Board Optics/Near Package Optics



CPO

Co-Package Optics



OEIC

Optics Electronic Integrated Circuit

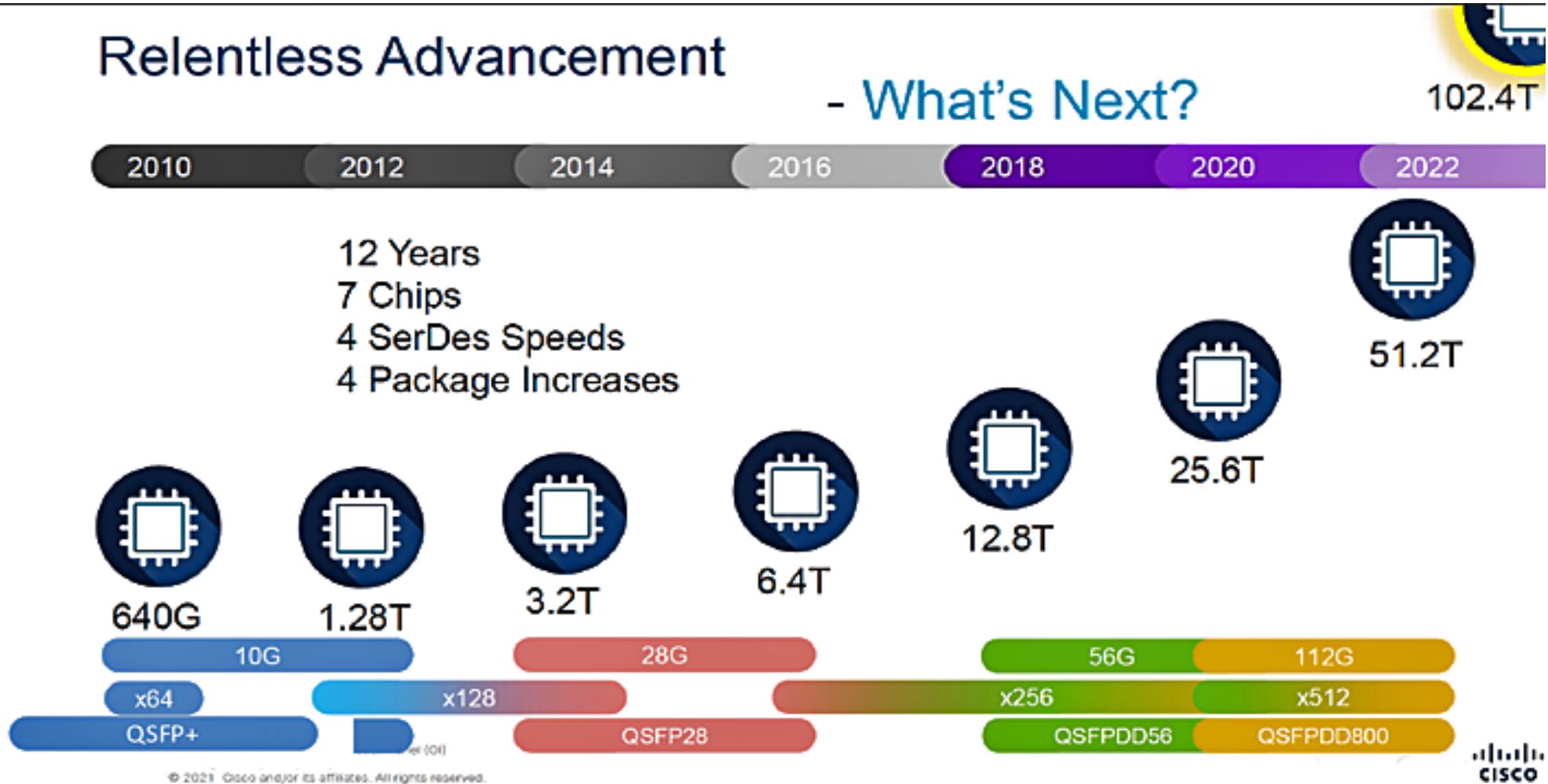
IPEC

#ETT2023

# Switch Silicon Bandwidth

Relentless Advancement

- What's Next?



# Thank You

