

# ICT FORUM COSTA RICA 2022



ORGANIZA:



Propel™

COMMSCOPE®

“Terabit Ethernet on the Horizon”

2022

# Agenda

Propel introduction

Data center evolution drivers

Challenges solves



Networks are shifting to  
8 and 16 fiber applications



Hyperscales



Cloud



MTDC



Enterprise

# Agenda

Propel introduction

Data center evolution drivers

Challenges solves

## Why MPO16

Enables 2, 8 & 16-fiber applications without  
wasting fibers

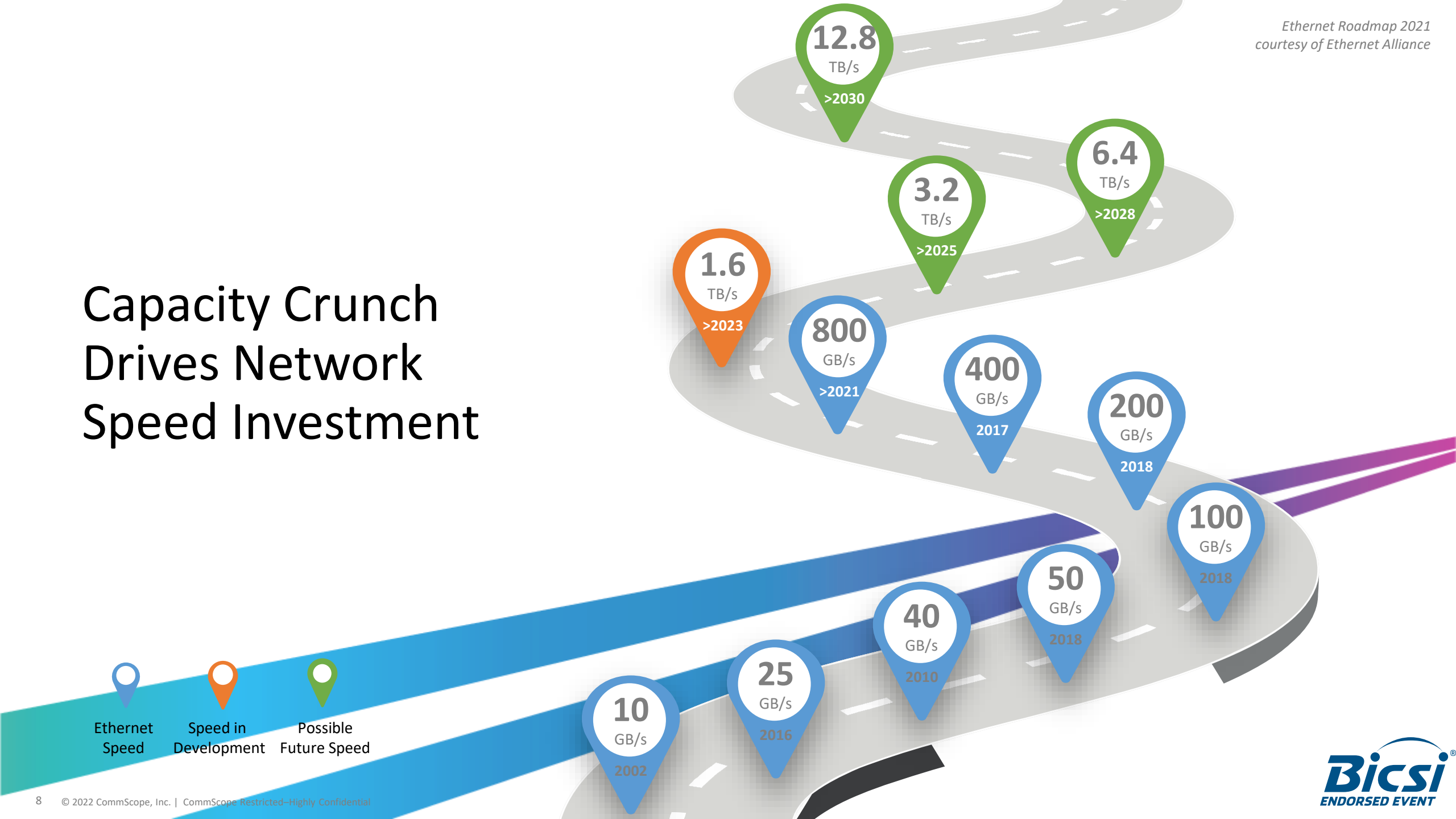
Simplifies design and installation

Backward compatible to legacy and migration aligned to  
400G/800G + applications

16 fiber applications provide 8:1 vs 4:1 breakouts:  
Enabling the lowest cost and energy per bit with improved  
latency



# Capacity Crunch Drives Network Speed Investment

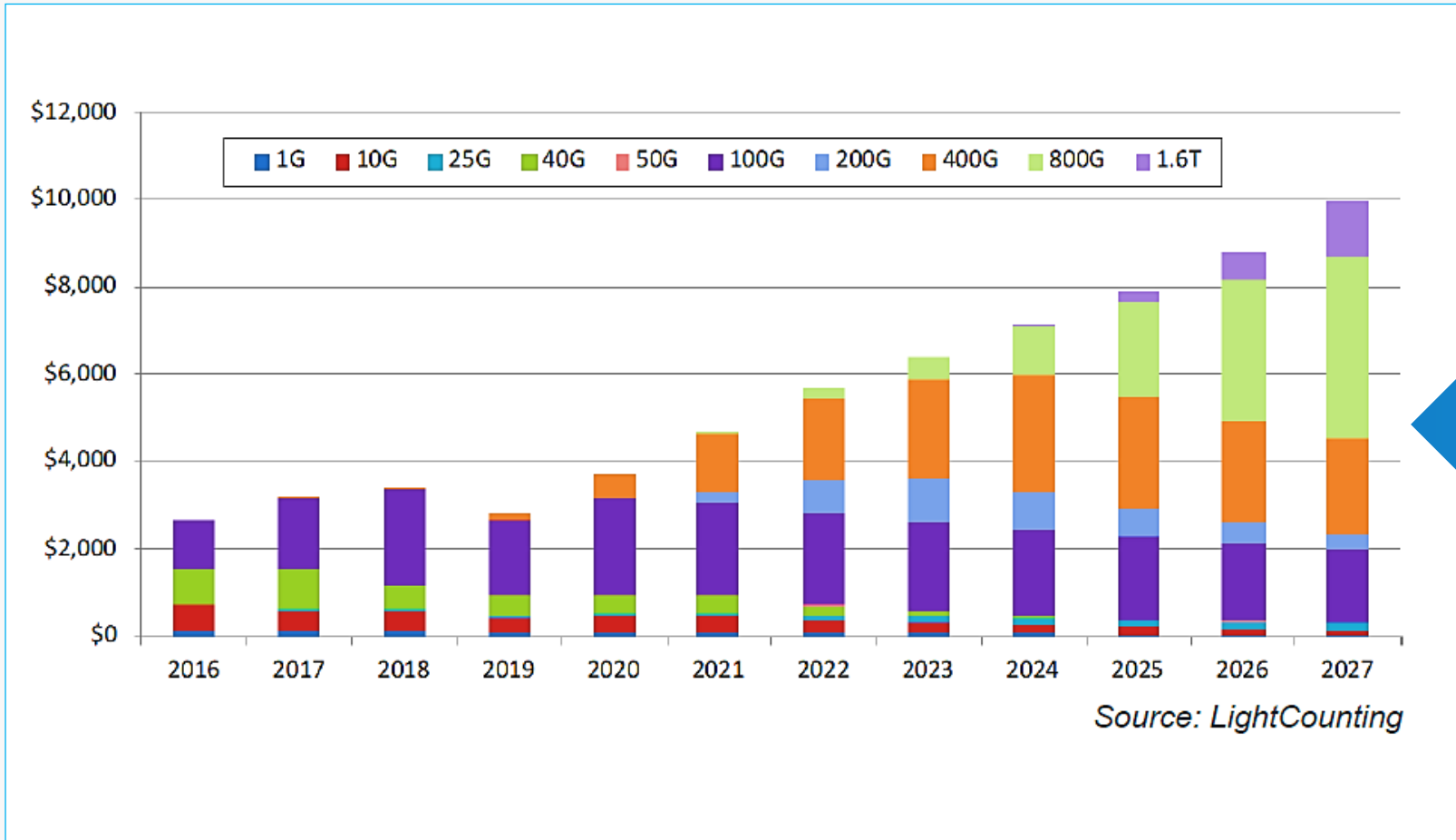







# DATA CENTER / NETWORK SPEED ACCELERATION

## Data Center Switching Sales by Speed Forecast (US\$ M)

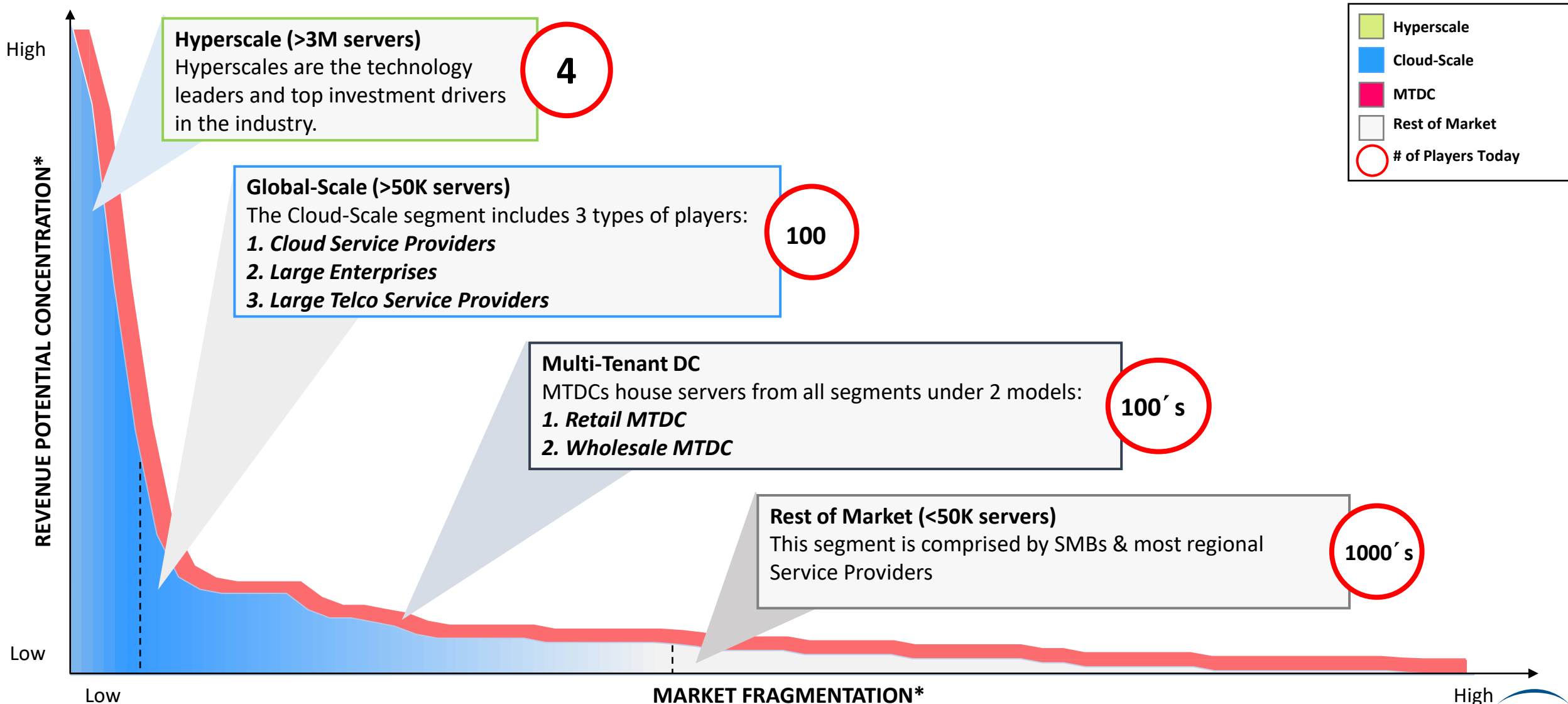


Source: LightCounting



- **1.6T products expected to arrive in '24/'25.**
- **Meanwhile, DC traffic is expected to see robust growth, fueled by edge compute, AI, ML, VR/AR, and IoT.**

# DATA CENTER / MARKET SEGMENTS



(\* ) Servers deployment data used as proxy for market opportunity and fragmentation.



# DATA CENTER / 2022 DC OPERATOR ECOSYSTEM

<200K

200-500K

500K-1M

>1M

>2M

>3M

Global-Scale Followers

Global-Scale Growth Drivers

Hyperscale

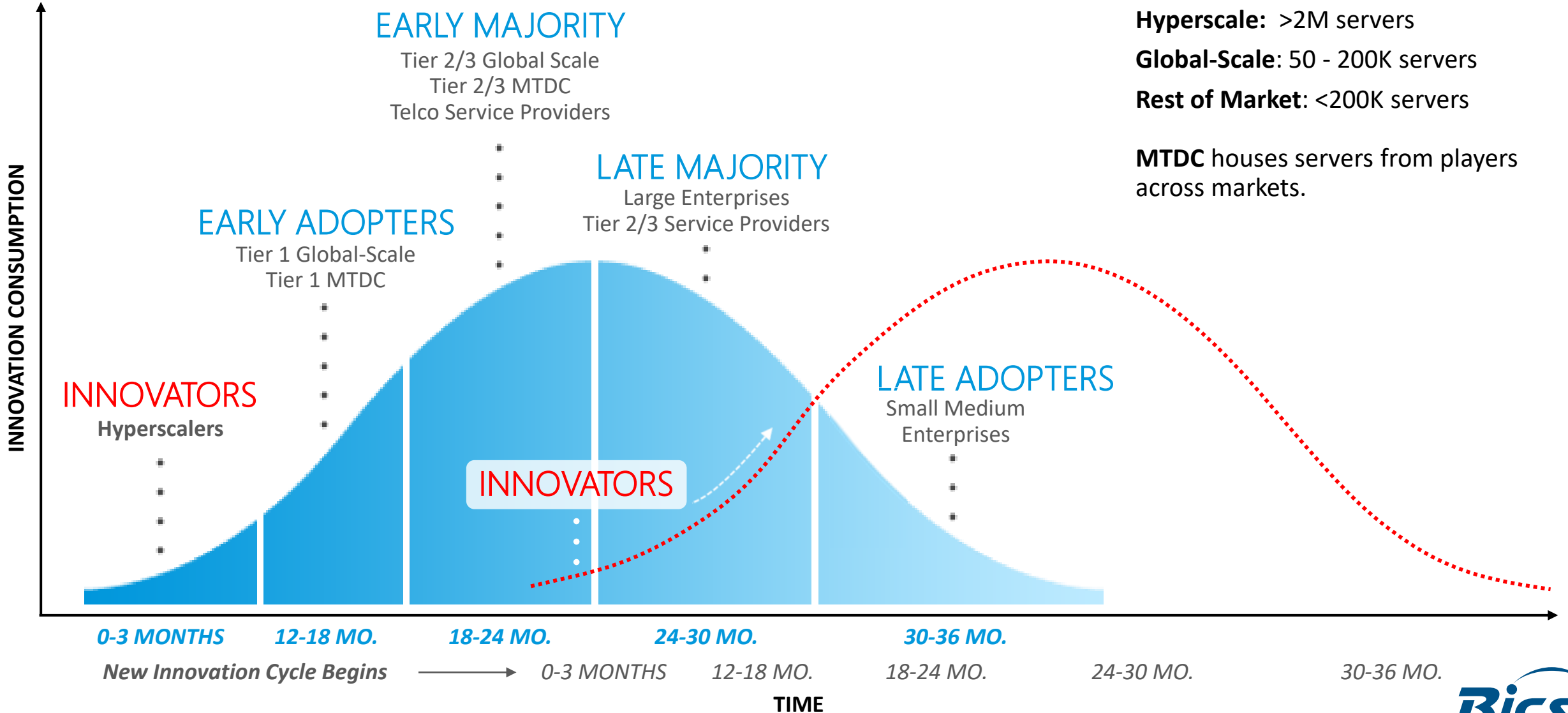
**Global-Scale Followers (<200K):** NIO, Goldman Sachs, NETFLIX, citi, slack, Bank of America, Work · Online, ZOHOO, SurveyMonkey, HSBC, GE, UPS, MUFG, Deutsche Telekom, BARCLAYS, BNP PARIBAS, ICBC, 中国工商银行, Walmart, servicenow, 青云 QING CLOUD, 网易 NETEASE, verizon, ebay, U CLOUD, 美团, 中国移动 China Mobile, snowflake, SPACEX, Never fail, EVERNOTE, box, at&t, NAVER, PayPal, Telefonica, rackspace, Square, Dropbox, américa móvil, Limelight NETWORKS.

**Global-Scale Growth Drivers (200-500K):** Fidelity INVESTMENTS, JPMorganChase, SoftBank, Akamai, DigitalOcean, 1&1, twitter, OVH.com, China unicom 中国联通, CenturyLink, 中国电信 CHINA TELECOM, Rakuten, KDDI, 360, Oath: A Verizon company, JD.COM, @mail.ru group, Yandex.

**Hyperscale (>2M):** SOFTLAYER an IBM Company, Apple, Amazon (a), NTT Communications, Alibaba.com, Google (G), Microsoft (four colored squares), Oracle CLOUD, ByteDance, Tencent 腾讯, Baidu 百度.

# Data Center Technology Adoption Lifecycle

The Hyperscale segment leads the way for technology adoption across the market.



# Moving quickly is not fast enough

## IEEE 802.3™ Industry Connections Ethernet Bandwidth Assessment

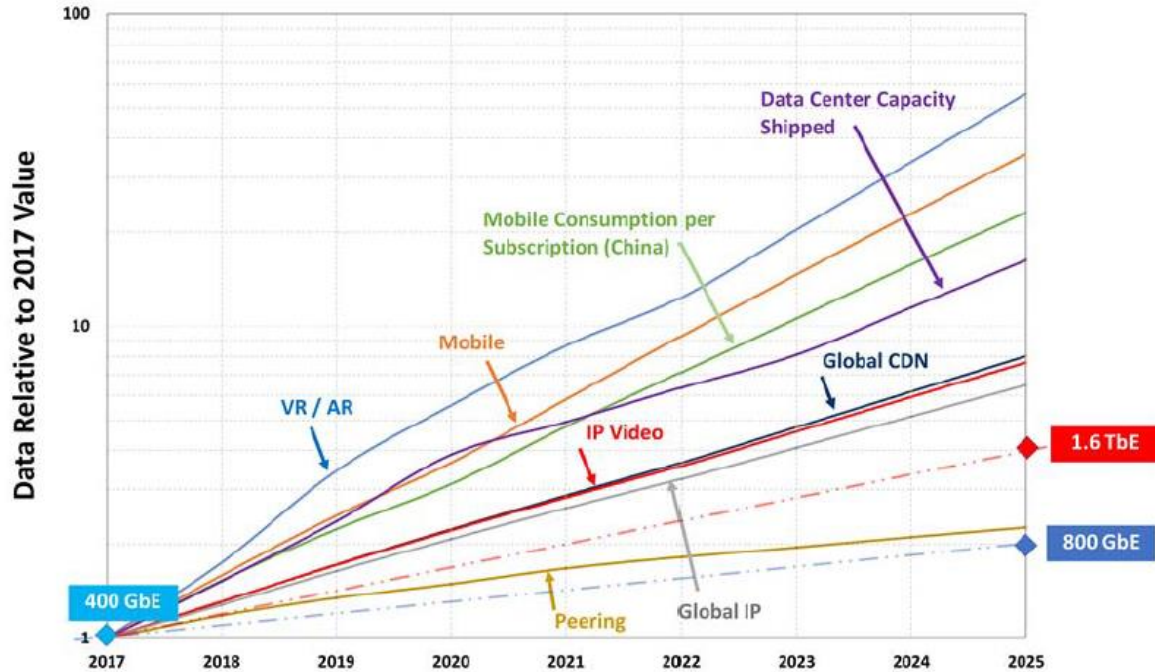
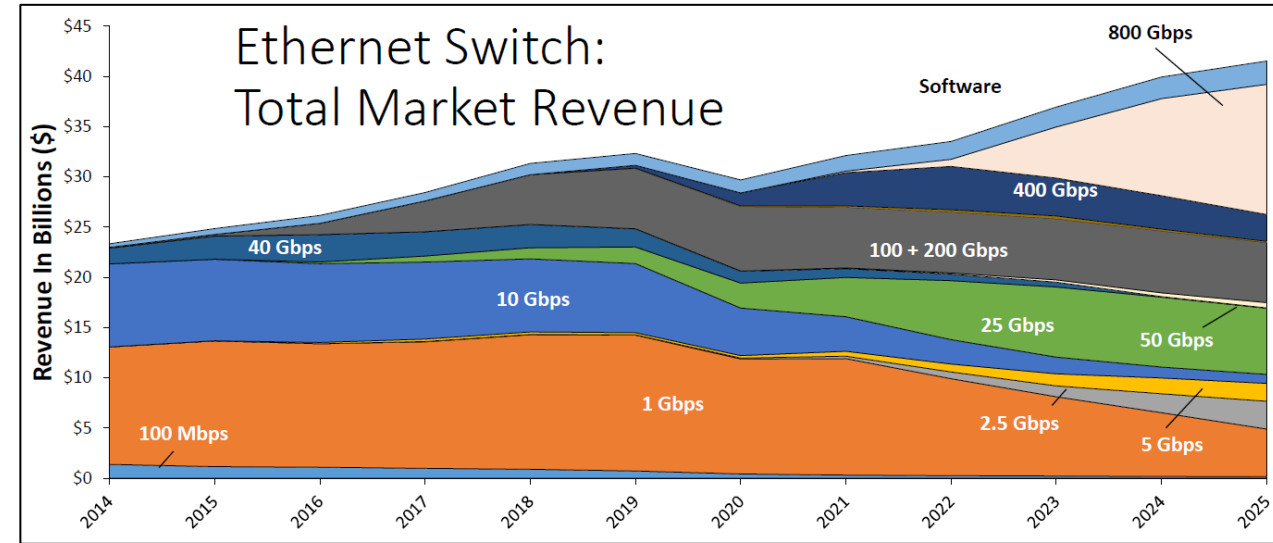
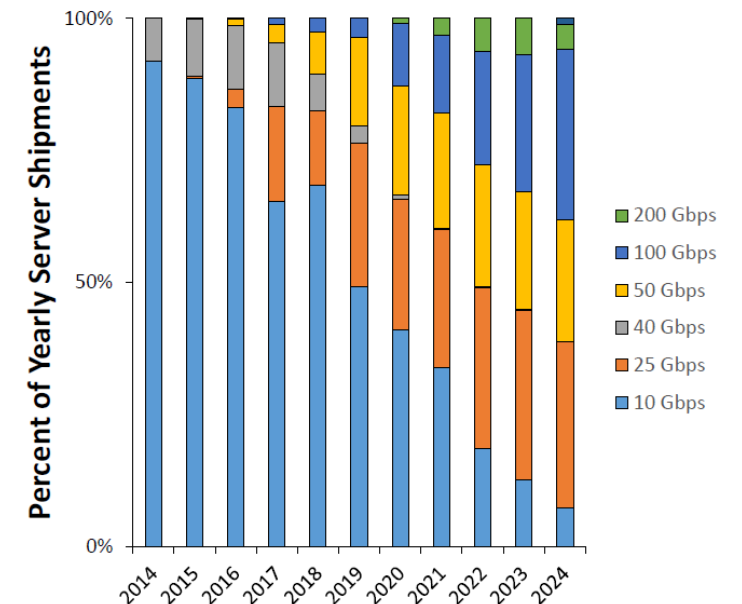


Figure 52—Bandwidth Curves (2017-2025)



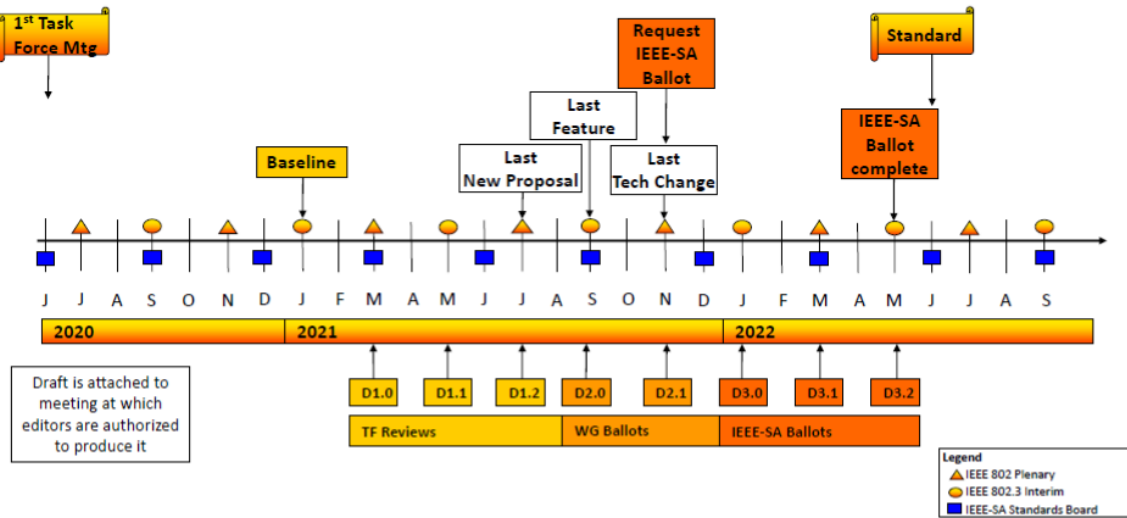
### Server High-Speed Migration (Total Market - Ports)



# The Road to 800G & 1.6T

## IEEE 802.3db 100 Gb/s Wavelength Short Reach Timeline

IEEE P802.3db Task Force Timeline  
Adopted by TF November 2020



50m / 100m reach MMF

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## Beyond 400GbE Study group

**CFI Presentation:** – Approved November 9<sup>th</sup> 2020(Virtual).

[https://www.ieee802.org/3/ad\\_hoc/ngrates/public/calls/20\\_1029/CFI\\_Beyond400GbE\\_Rev7\\_201029.pdf](https://www.ieee802.org/3/ad_hoc/ngrates/public/calls/20_1029/CFI_Beyond400GbE_Rev7_201029.pdf)

**First study group meeting:** – January 14<sup>th</sup> 2021 (Virtual).

**Rate and reach objective: Pending 802.3 Approval**

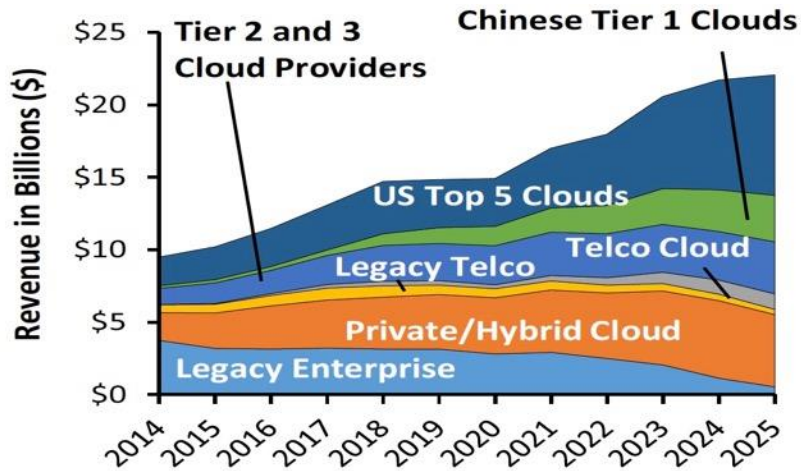
**Timeline: TBD**

- Looking to develop applications for 800Gb to 1.6Tb applications.
- Early discussions are debating the merits of 800G vs 1.6T proposals

50m / 100m reach MMF with 16f  
500m / 2km reach SMF with 16f or 8f

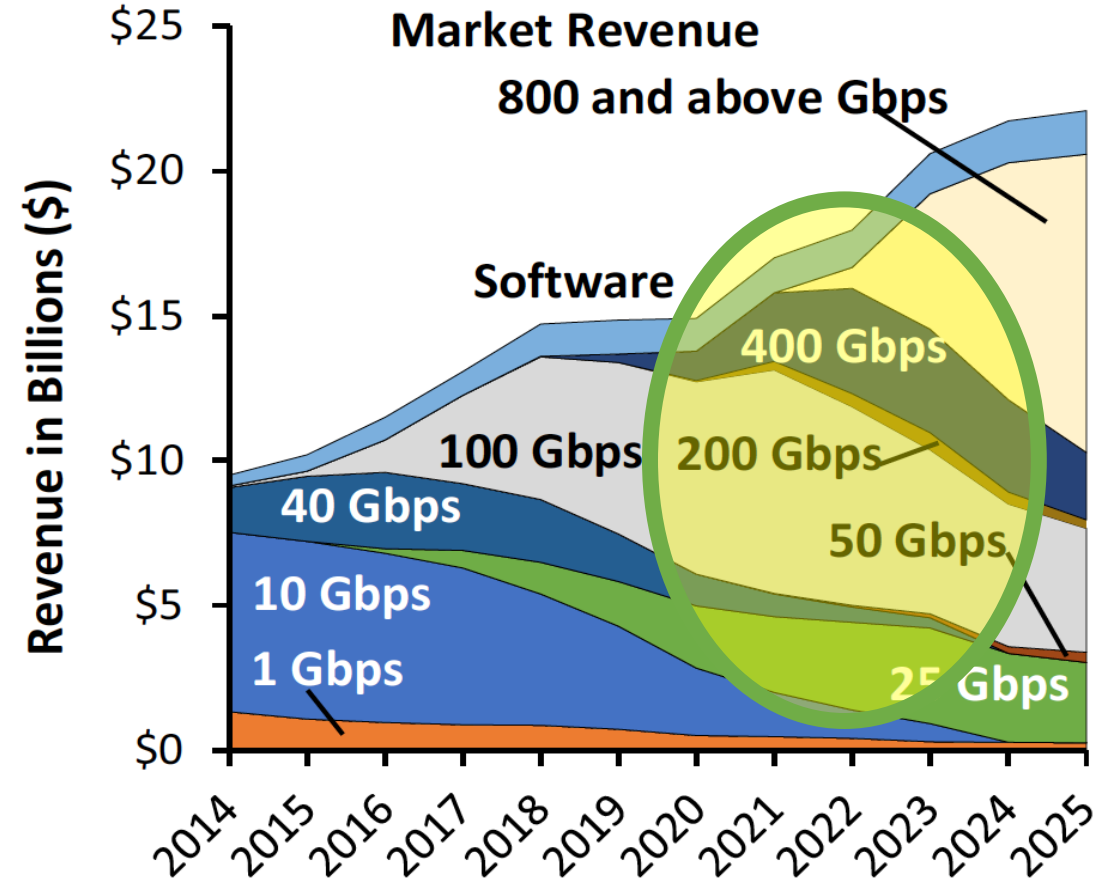
1.6T: 8 or 16 lanes ?

## The industry is moving to Cloud Infrastructure



- Cloud Scale/Large Enterprise is converting to cloud based infrastructure
- Cloud infrastructure is driving the requirement for higher capacities and transmission speeds

## Figure 9: Ethernet Switch - Data Center Market Revenue

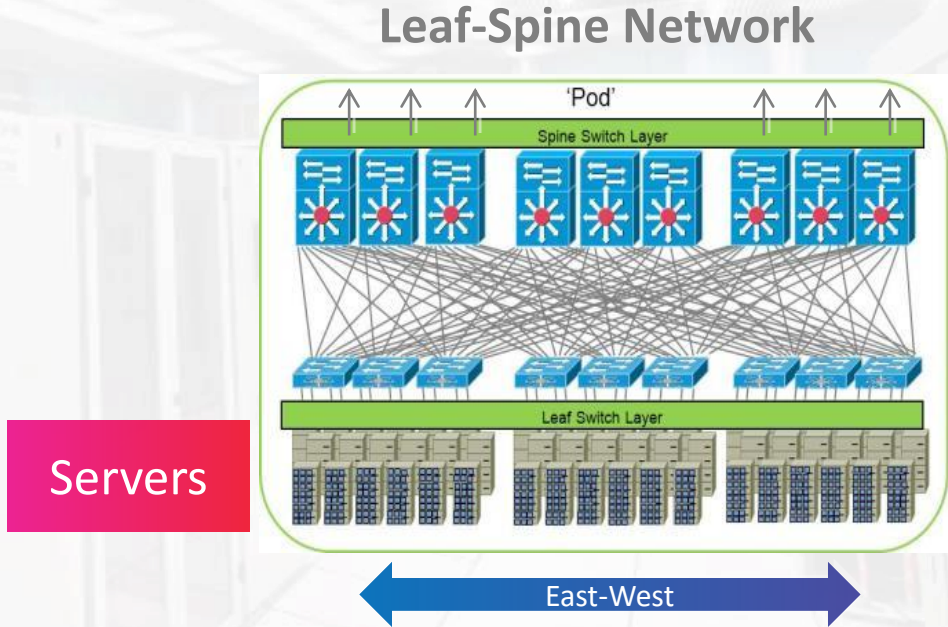
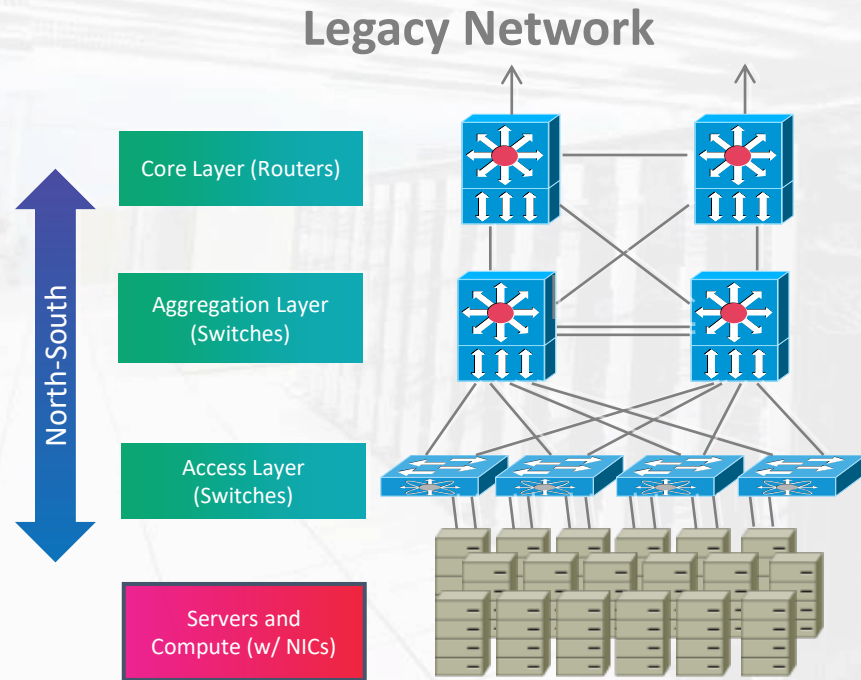


Source: 650 Group (2021)

# Evolving Cloud Infrastructure, network needs

# Cloud compute is different

- Change/Risk to upgrade strategies
- Higher speed support when?
- Can I support new network topologies?

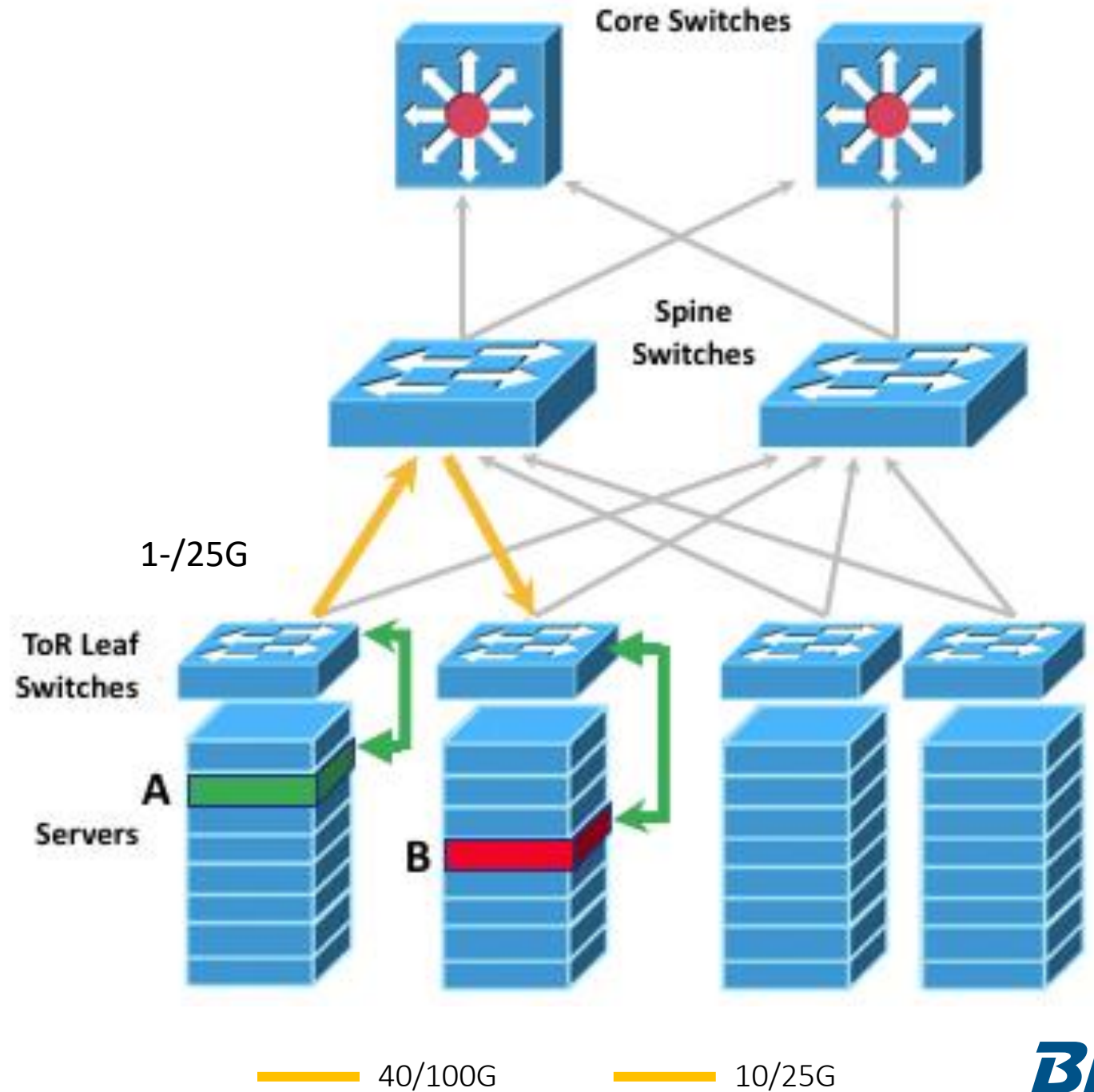


DC network topologies continue to evolve

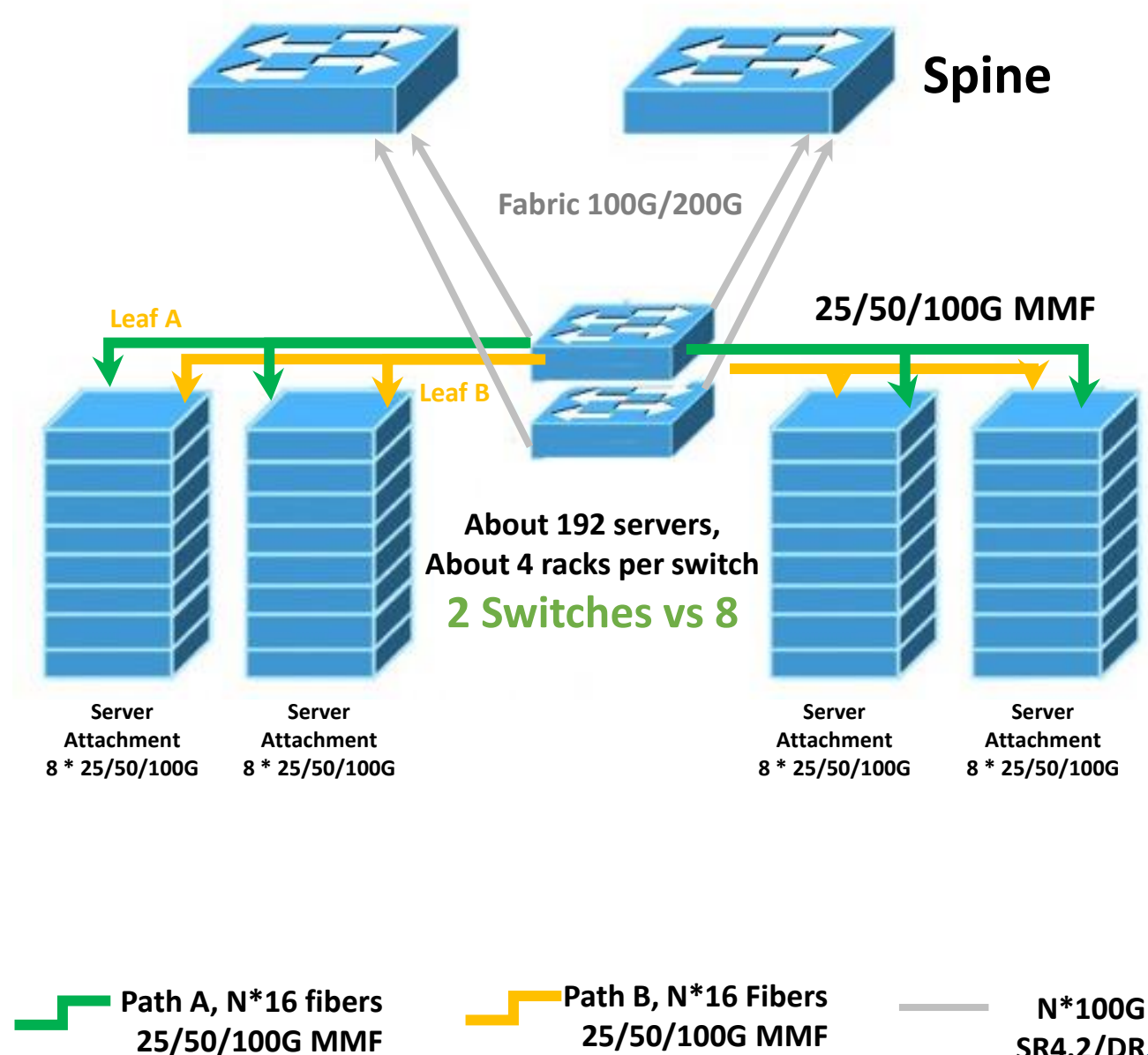


# Top of Rack Configuration

DAC/AOC



# MoR/EoR Configuration



# QSFP-DD and OSFP Modules





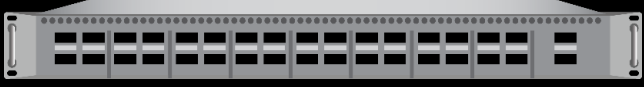
- 8 electrical I/Os (8 transmit /8 receive)
- The only way to use ASIC capacity
- 50G and 100G electrical I/Os up to 800G (today)
- New options for
  - Up to 8-way breakouts, 4-way popular for brownfield
  - New optical connectors to enable these breakouts
  - Multimode fiber and singlemode fiber options



**QSFP-DD** 



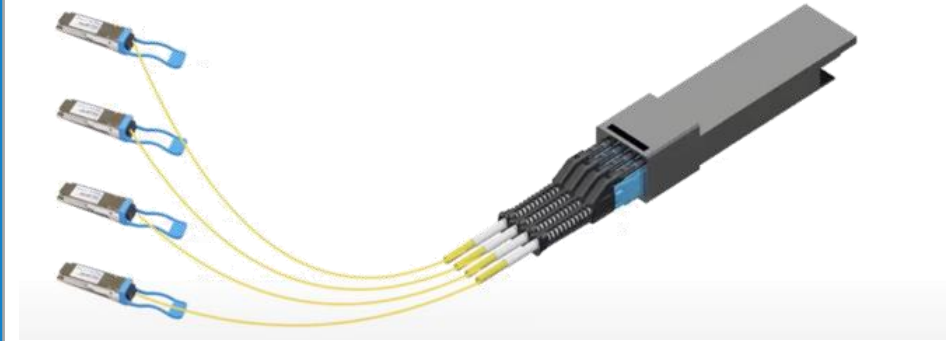
 **OSFP**

First Deployed	Electrical I/O [Gb/lane]	Switching Bandwidth	TOR/Leaf Data Center Switch Configuration	
~2010	10G	1.28T	 32xQSFP+ (40G)	Legacy technology
~2015	25G	3.2T	 32xQSFP28 (100G)	128 Electrical I/Os
~2019	25G	6.4T	 32 ports of 200G	256 Electrical I/Os
2021	50G	12.8T	 32 ports of 400G	
2022	100G	25.6T	 32 ports of 800G	

512 Electrical I/Os coming soon?

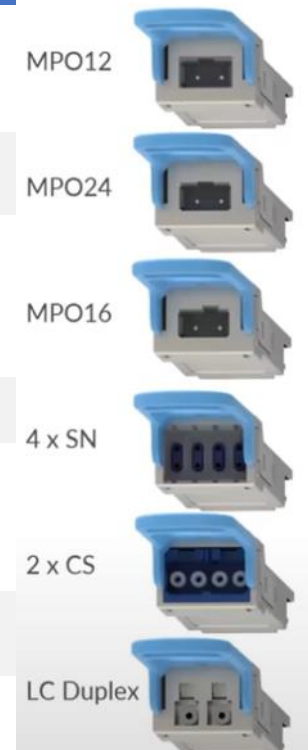
## Rapid succession of technology

400G DR4  
with 4  
duplex  
100G-DR  
fibers



New SN/MDC connector avoids MPO-MTP Splitter cable

Reach	Name Scheme A	Scheme B	Scheme C	Connector
SR (50-70m)	QDD-400G-SR4.2	400G-BiDi		MPO12
	QDD-400G-SR8	400G-SR8		MPO16/MPO24
	QDD-400G-SR4	400G-SR4		MPO12
DR (500m)	QDD-2x200G-DR4	400G-DR8		MPO16/MPO24
	QDD-400G-DR4	400G-DR4		MPO12
FR (2km)	QDD-4x100G-FR1	400G-4xFR1	400G-DR4+	MPO12/4xSN
	QDD-2x200G-FR4	400G-2xFR4		2xCS/(2xSN)
	QDD-400G-FR8	400G-FR8		LC Duplex
	QDD-400G-FR4	400G-FR4		LC Duplex
LR (6km)	QDD-400G-LR4-6	400G-LR4-6		LC Duplex
LR (10km)	QDD-4x100G-LR1	400G-4xLR1	400G-DR4++	MPO12/4xSN
	QDD-2x200G-LR4	400G-2xLR4		2xCS/(2xSN)
	QDD-400G-LR8	400G-LR8		LC Duplex
	QDD-400G-LR4-10	400G-LR4-10		LC Duplex
ER (30-40km)	QDD-400G-ER8	400G-ER8		LC Duplex
	QDD-400ZR	400ZR		LC Duplex
ZR (80-120km)	QDD-400ZR	400ZR		LC Duplex
	QDD-400G-ZR	400G-ZR		LC Duplex



# 400G MDIs

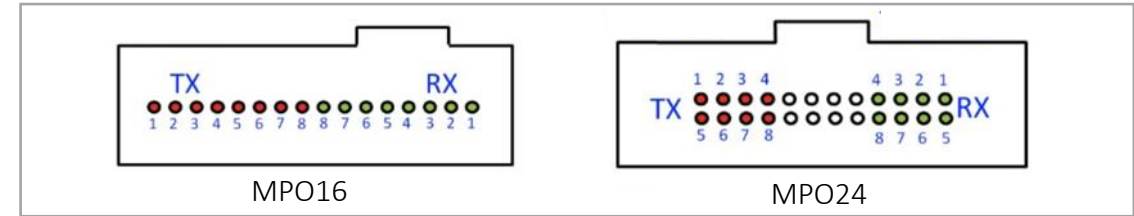
Media dependent interface (MDI)

400G capacity QSFP-DD connectors

## Waves of Speed Migrations

## Connectivity Needs to Support

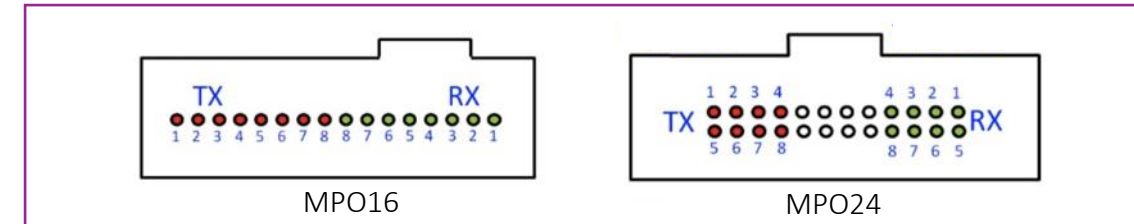
400G Port  
400GBase-SR8 (8x50G)



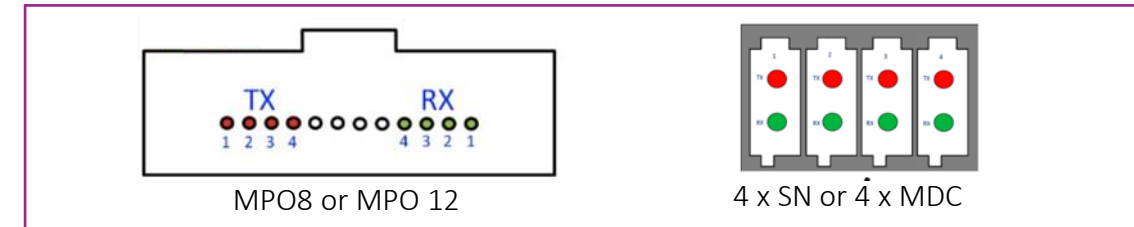
400G  
400GBase-DR4 (4x100G)  
400GBase-SR4.2 (4 x 2x50G)



800G Port = 8x100G Lanes  
800GBase-DR8  
800GBase-SR8



800G Port = 4x200G Lanes



# SERDES Speeds Will Drive Future Connectivity Needs



# IEEE Optical Applications for 400G

Power budget/max channel loss column will be added prior to launch

Rate	Multimode		1km = 1000m	Duplex	Multi-Wavelengths	Lane Rate	IEEE Project
	Singlemode			Parallel			
	PMD	Media	Reach	# of Fibers	Wavelengths		
25G	SR	1-Pair MM	100m	2	1	25G	802.3by (2016)
	SR4	4-Pair MM	150m	8	1	10G	802.3ba (2016)
40G	FR	1-Pair SM	2km	2	1	40G	802.3bg (2011)
	LR4	1-Pair SM	10km	2	4	10G	802.3ba (2016)
	ER4	1-Pair SM	40km	2	4	10G	802.3bm (2015)
	SR	1-Pair MM	100m	2	1	50G	802.3cd (2018)
50G	FR	1-Pair SM	2km	2	1	50G	802.3cd (2018)
	LR	1-Pair SM	10km	2	1	50G	802.3cd (2018)
	SR2	2-Pair MM	100m	4	1	50G	802.3cd (2018)
100G	SR4	4-Pair MM	100m	8	1	25G	802.3bm (2015)
	SR10	10-Pair MM	150m	20	1	10G	802.3ba (2016)
	DR	1-Pair SM	500m	2	1	100G	802.3cd (2018)
	LR4	1-Pair SM	2km	2	1	25G	802.3ba (2016)
	ER4	1-Pair SM	10km	2	4	25G	MSA
	SR1.4	1-Pair MM	100m	2	4	50G	802.3cd (2018)
200G	SR4	4-Pair MM	100m	8	1	50G	802.3bs (2017)
	DR4	4-Pair SM	500m	8	1	50G	802.3bs (2017)
	FR4	1-Pair SM	2km	2	4	50G	802.3bs (2017)
	LR4	1-Pair SM	10km	2	4	50G	802.3bs (2017)
	SR4.2	4-Pair MM	OM4-100m/ OM5-150m	8	2	50G	802.3cm (2019)
400G	SR8	8-Pair MM	100m	16	1	50G	802.3cm (2019)
	SR16	16-Pair MM	100m	32	1	25G	802.3bs (2017)
	DR4	4-Pair SM	500m	8	1	100G	802.3bs (2017)
	FR8	1-Pair SM	2km	2	8	50G	802.3bs (2017)
	LR8	1-Pair SM	10km	2	8	50G	802.3bs (2017)

<b>VR (MM)</b>	Short Reach	50m
<b>SR (MM)</b>	Short Reach	100-150m
<b>DR (SM)</b>	Data Center Reach	500m
<b>FR (SM)</b>	Far Reach	2 km
<b>LR (SM)</b>	Long Reach	2-10km
<b>ER (SM)</b>	Extended Reach	10-40km

# IEEE Optical Applications for 800G/MSA

Rate	Multimode		Reach	Duplex	Multi-Wavelengths	Lane Rate	800G MSA	Max Level Loss/ Channel Loss	
	PMD	Media		Parallel					
800G	800G-VR8	MM	50m	16	1	100G	IEEE 802.3df	TBD	MPO24 
	800G-SR8	MM	100m	16	1	100G	IEEE 802.3df	TBD	
	800G-DR8	SM	500m	16	1	100G	IEEE 802.3df	TBD	MPO16 
	800G-FR	SM	2km	16/8/2	4	100G	IEEE 802.3df	TBD	
	LR-4-6	SM	6km	2	4	100G	IEEE 802.3df	TBD	2 x CS 
	LR	SM	10km	16/4	4	200G	IEEE 802.3df	TBD	
	LR (High Loss)	SM	10km	2	4	200G	IEEE 802.3df	TBD	LC Duplex 
	ER	SM	40km	2	1	200G	IEEE 802.3df	TBD	
	ZR	SM	80-120km	2	1	200G	OIF	TBD	



# 800G MDIs

800G capacity QSFP-DD/OSFP connectors

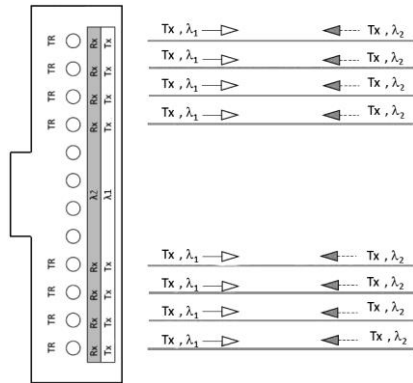
	Multimode			Duplex	Multi-Wavelengths		
	Singlemode			Parallel			
Rate	PMD	Media	Reach	# of Fibers	Wavelengths	Lane Rate	800G MSA
800G	800G-VR8	MM	50m	16	1	100G	IEEE 802.3df
	800G-SR8	MM	100m	16	1	100G	IEEE 802.3df
	800G-DR8	SM	500m	16	1	100G	IEEE 802.3df
	800G-FR	SM	2km	16/8/2	4	100G	IEEE 802.3df
	LR-4-6	SM	6km	2	4	100G	IEEE 802.3df
	LR	SM	10km	16/4	4	200G	IEEE 802.3df
	LR (High Loss)	SM	10km	2	4	200G	IEEE 802.3df
	ER	SM	40km	2	1	200G	IEEE 802.3df
	ZR	SM	80-120km	2	1	200G	OIF



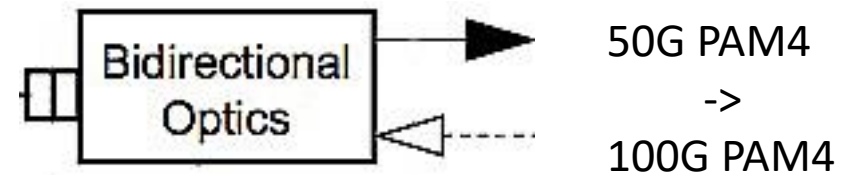
# Terabit MSA 8, then 16 100G BiDi links

Public date March 6, 2022

400G SR 4.2  
New  
800G SR 4.2

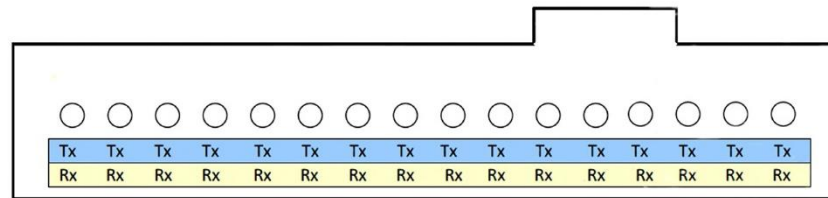


8 \* 50G PAM4 -> 8\*100G PAM4

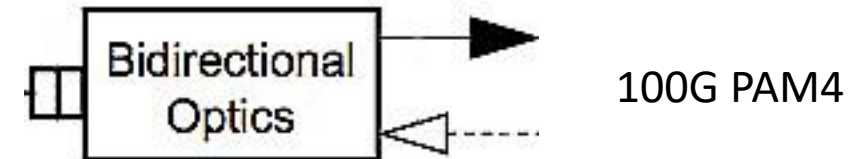


New Terabit  
MSA

1.6T SR 8.2 BD



16 \* 100G BD



100G SR1.2 A/B module

# MPO (Multiple Fiber Push-On) Connectors

8-FIBER MPO  
(MPO-8)



Singlemode APC  
Multimode UPC or APC

12-FIBER MPO  
(MPO-12)



Singlemode APC  
Multimode UPC

16-FIBER MPO  
(MPO-16)



Singlemode APC  
Multimode APC

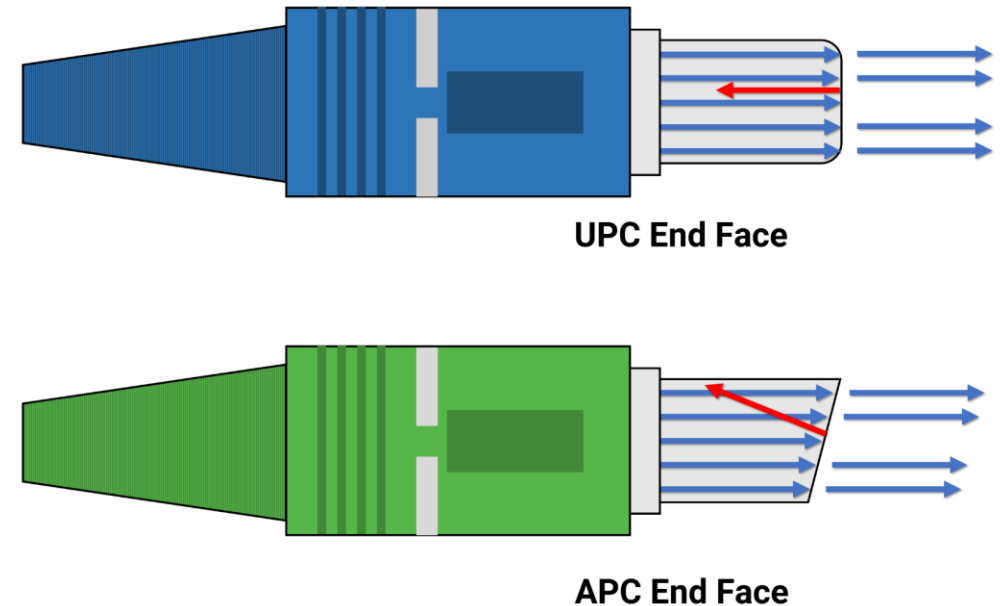
24-FIBER MPO  
(MPO-24)



Multimode UPC Only

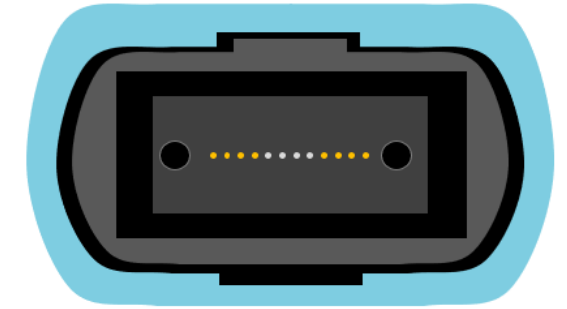
# The Need for APC

- **Angled physical contact (APC) connectors are typical in singlemode systems**
  - 8-degree angle directs reflected light into the cladding to avoid interference with the transmitter
  - Standard in singlemode systems to avoid coherent interference with system links
- **Reflectance can impact transmitter signal and degrade SNR, especially in PAM4 systems**
- **Hyperscalers are requiring multimode APC MPOs for 200 Gb/s and beyond PAM4 multimode systems**
- **Reflectance also a concern with short-reach singlemode transceivers**
  - IEEE specifies insertion loss limits for SR singlemode based on number and reflectance of connectors in the channel
- **We should not rely on APC connectivity – it is important to clean, inspect, and test high-performance systems**

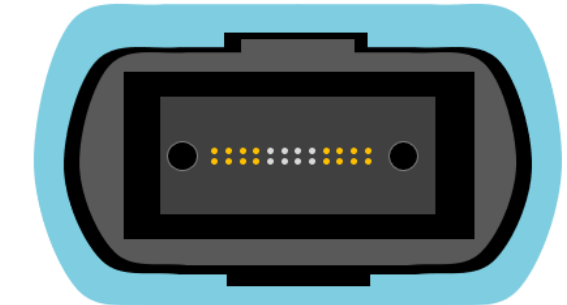


# The Rise of the 16-Fiber MPO

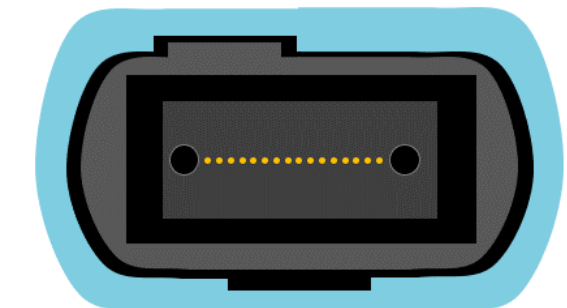
- **Existing 8/12-fiber MPOs currently support 400 Gig**
  - 400GBASE-SR4.2 (SWDM multimode)
  - 400GBASE-DR4 (short-reach singlemode)
  - Future 400GBASE-SR4
- **MPO-16 connectors currently support 400GBASE-SR8**
  - MPO-24 connectors can be used but initial deployments are using MPO-16 (MPO-24 results in 8 unused fibers)
- **SR8 and DR8 800 Gig based on 100 Gb/s PAM4 bit rate will require 16 fibers**
  - IEC is working on adding specs for multimode APC MPO-16
  - Ideal for 8 X 100 Gig breakouts
- **Considerations**
  - Different form factor (offset key)
  - Cleaning, inspection, and testing



MPO8/12



MPO24



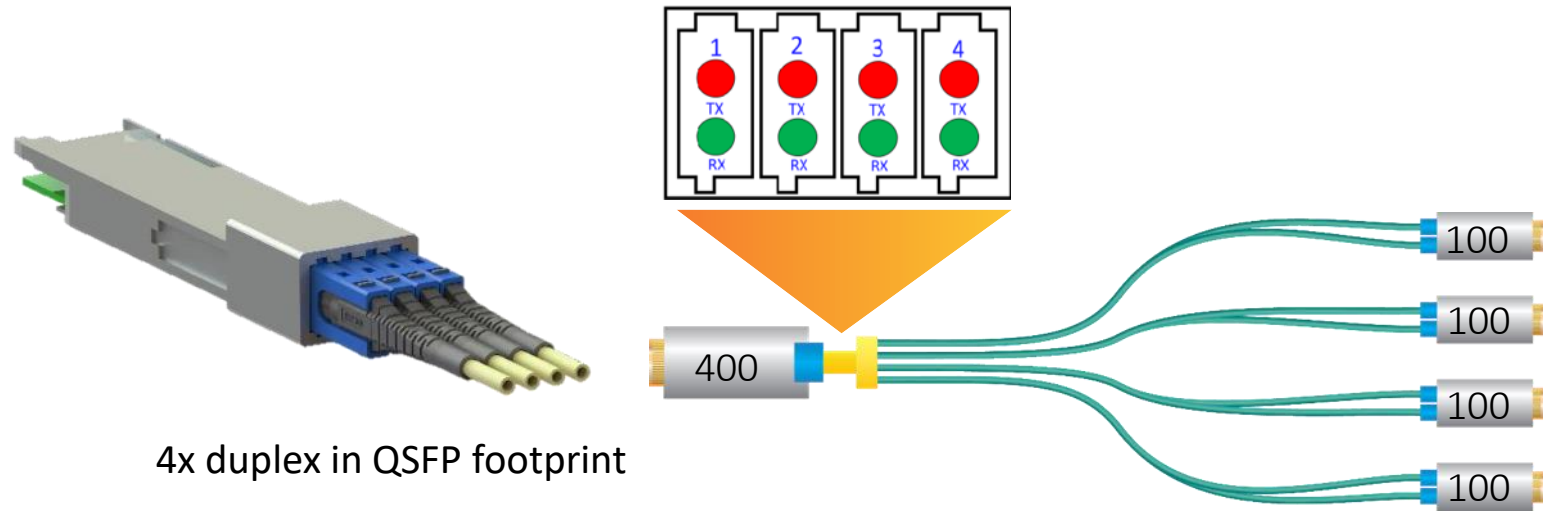
MPO16

# New VSFF Connector Options

*Breakout of 400G 8-lane switch ports to 100GE & 200GE Fabric (inter-switch) links*

- Push pull design
- More stable performance than MT Ferrule

## Leaf-Spine Cross-Connections



**SN®** Connector  
CS program



**MDC Connector**

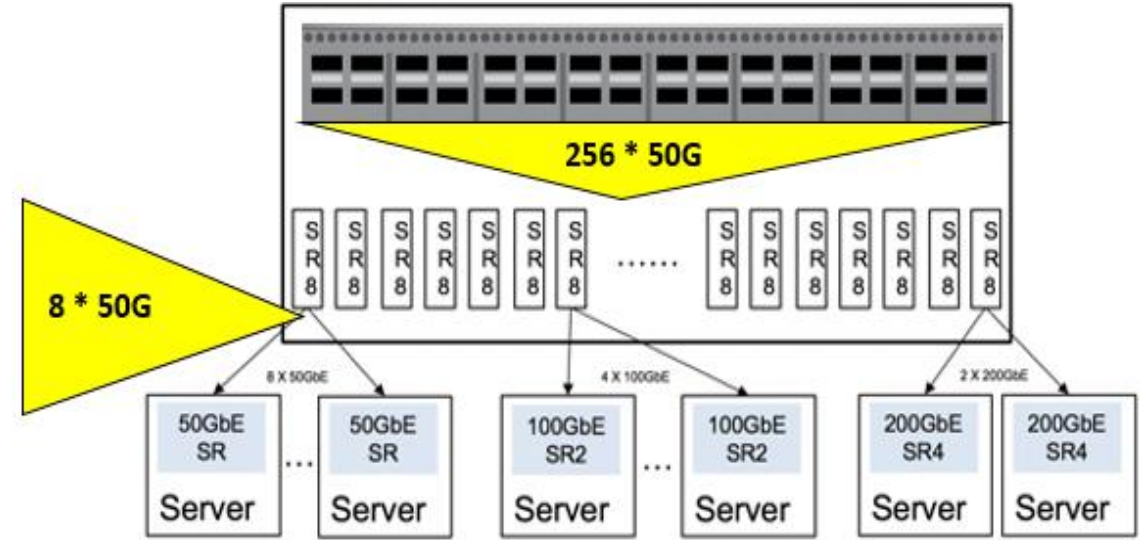
# QSFP-DD SR8 MPO16 (f)

192 Server Connections  
Per 1U Switch (3:1)

QSFP-DD SR8



MPO16 (f)  
Male Shown



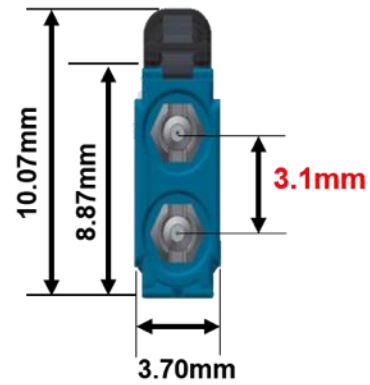
8\*50G = 400G 16Fiber SR8 MMF Server Connections

# Optical connectors comparison

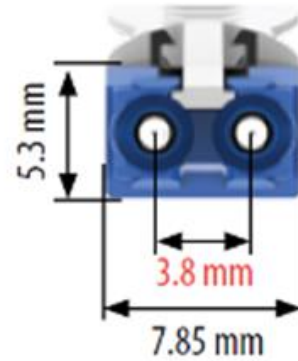
SN<sup>®</sup>



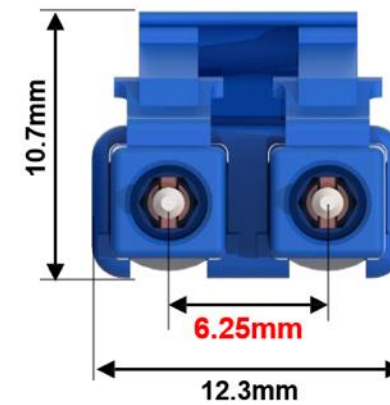
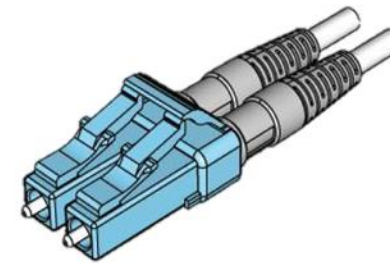
MDC



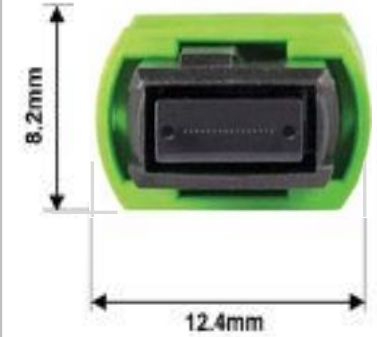
CS



LC Duplex



MPO





# Agenda

Propel introduction

Data center evolution drivers

Challenges solves

# POLL

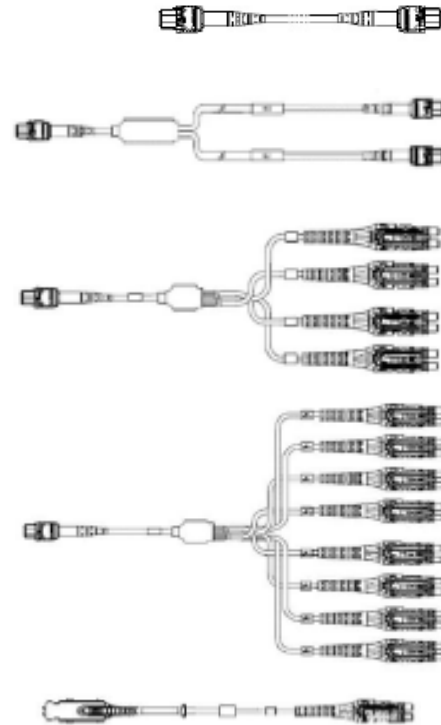
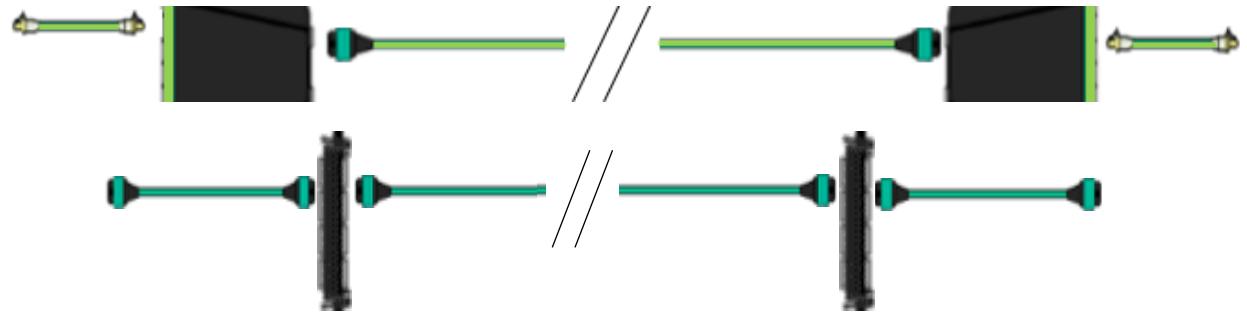
- In your opinion, how soon will you discussing 400G network architectures and infrastructure with your customers?
  - A) Already / Now
  - B) Next year
  - C) Next 3 years
  - D) Not in the foreseeable future

# What Can You Do To Support 400G-800G?

## For EXISTING installations:

- Check system architecture, media, fiber count, performance and speeds
- Fiber routing between devices and panels
- Pinned vs non-pinned MPO's
- "Transition" assemblies needed?
- PTP, Arrays, Duplex,...
- Infrastructure and Network meeting
- Align objectives and timing

MPO12, MPO24, MPO8?



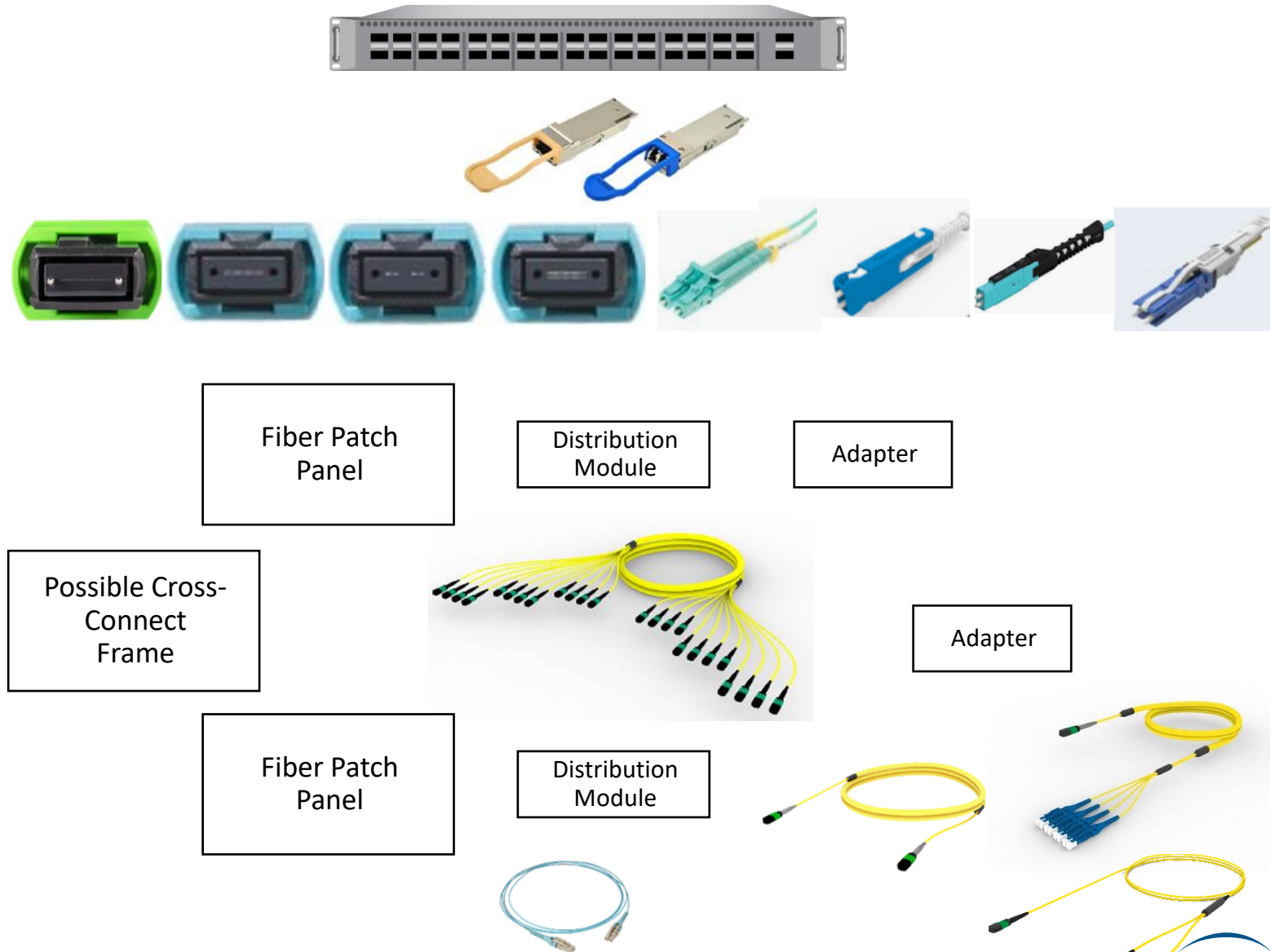
- Pinned or non-pinned trunk?
- Appropriate fiber count for applications?
- Polarity?
- Singlemode or multimode?
- Redundant cabling?
- 1:1 equipment cord vs. Array?
- IL/RL Loss considerations?
- Test and/or termination equipment
- \*Infrastructure and Network Teams: Collaboration planning

# What Can You Do To Plan Your Cabling For 400G, 800G, 1.6T & beyond?

## For NEW installations (greenfield):

- Cloud-first designs\*
- Flatten the network: Reduce Switch tiers
- 16f building blocks matching Switching:
  - Efficiency
  - Forward flexibility - backward compatible
  - Enable Duplex, 2 pr, 4pr, 8pr, 16pr applications
  - Infrastructure and Network sync
  - Align objectives and timing

## Infrastructure and Network Teams: Collaboration planning



## Next...

*Ready your infrastructure for new topologies and higher speed!*

### Full interchangeable tool set:

- Modulo 8/16/32
- Logically tie Duplex density to switch/trunk constructions
- Evolve to better Optical performance

#### Panels

- 1U, 2U, & 4U Sliding
- 72 duplex LC/MPO per RU
- 144 SN per RU

#### Modules

- MM: LC, MPO8/12/16/24
- SM: LC, SN, MPO8/12/16

#### Adapter Packs

- LC
- SN
- MPO

#### Traceability

Track optical performance and application support capability

# Cabling Infrastructure Check list



## Cable



- ISP, OSP, I/O, SM, MM, Rollable Ribbon(RR) (16f subunits)
- SM, OM5, OM4

## Connectors



- MPO16, 12, 8, 24 & LC Duplex, Mini LC,
- + SN, MDC, CS, etc.

## Cable Assemblies



- Trunks, RR Trunks, Equipment & Patch Cords, MPO-MPO, MPO Arrays, Conversion Arrays

# Propel™

