



Technology & Market Analysis for 100G Datacenter Network Cabling

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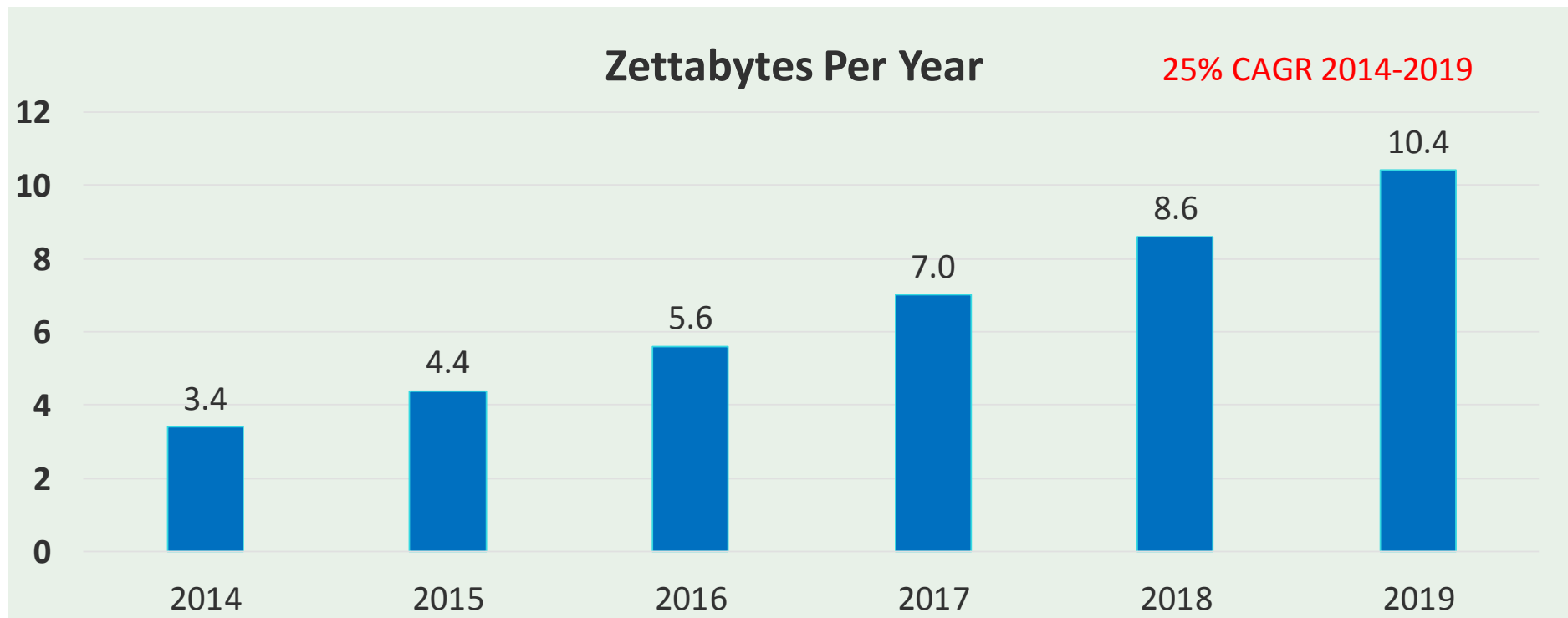
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Agenda

- Why 100G Datacenter is Needed
- Connectivity Technology and Cost Analysis for 100G Datacenter Cabling
- Key 100G Connectivity and Cabling Solution
- Outlook for Future I/O and Connectivity

Why 100G Datacenter is Needed

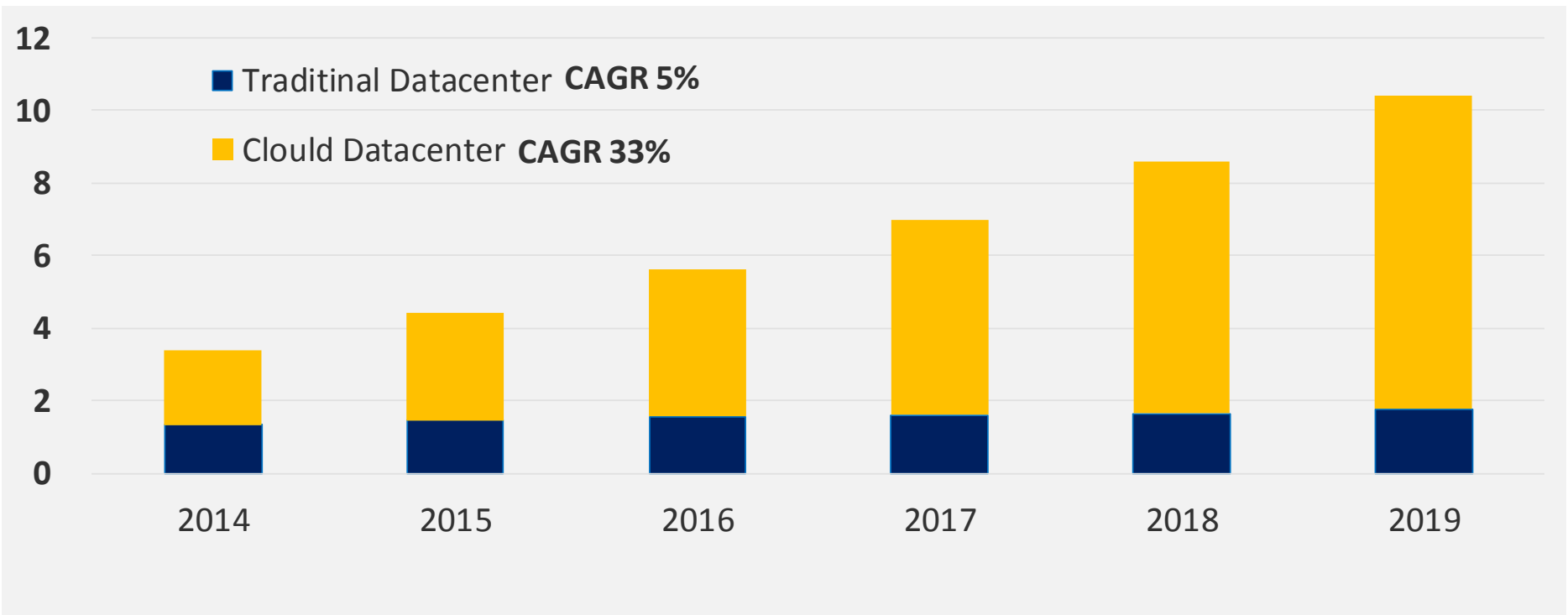
Global Data Center IP Traffic: Three-fold increase by 2019



Source: Cisco

Why 100G Datacenter is Needed

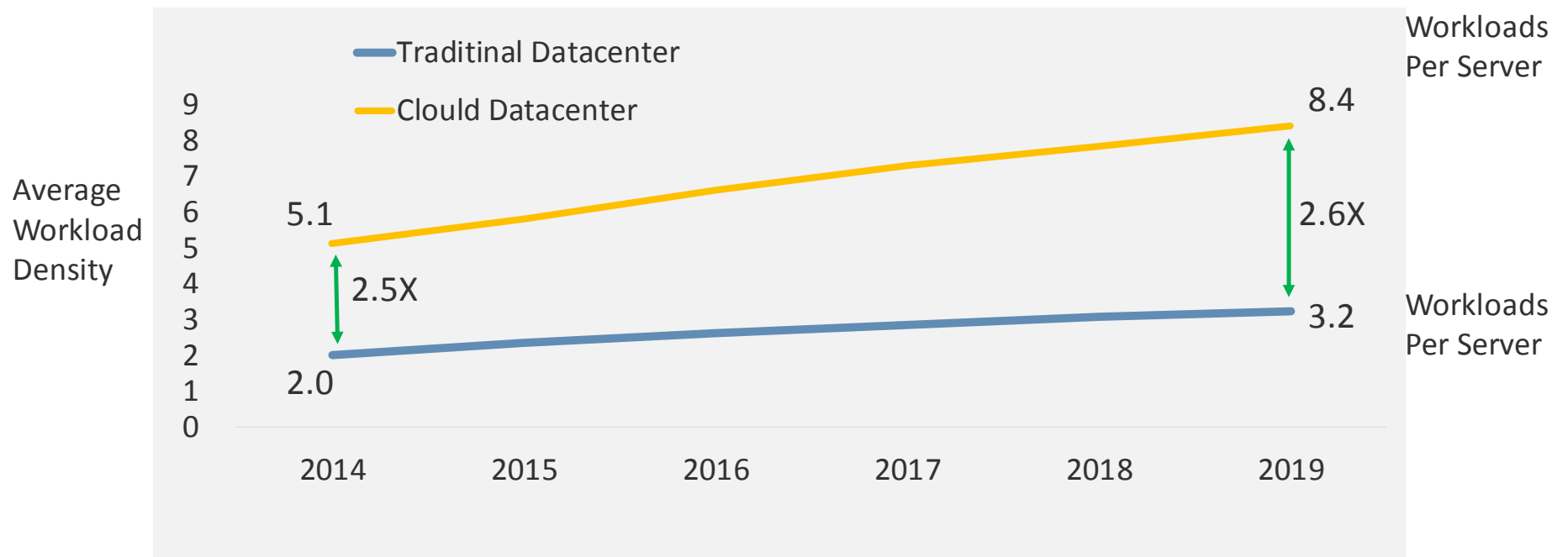
Global Data Center IP Traffic: Forecast for the percentage of traditional Datacenter and cloud Datacenter IP traffic growth



Source: Cisco

Why 100G Datacenter is Needed

Data Center Workloads Per Server: Increasing cloud virtualization

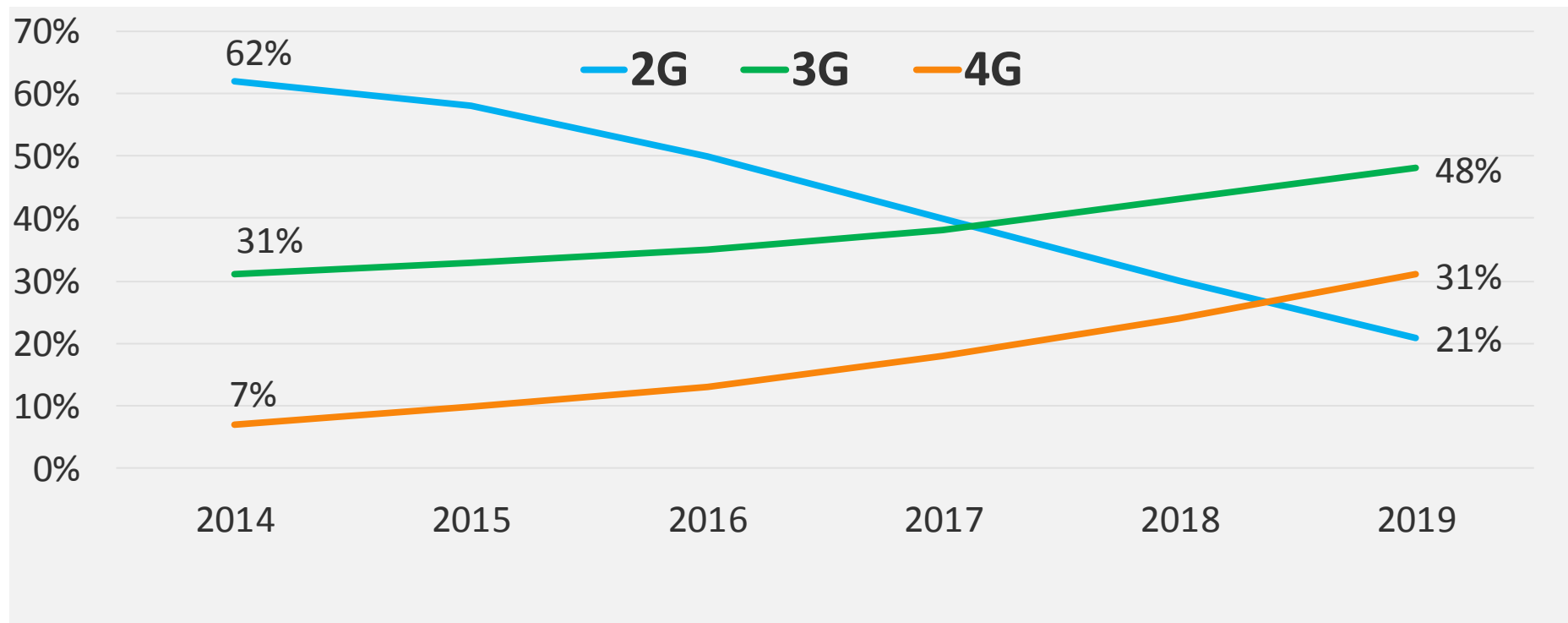


Source: Cisco



Why 100G Datacenter is Needed

Trend of Mobile Communications: Mobile communication data is growing significantly along with more 3G/4G subscribers.

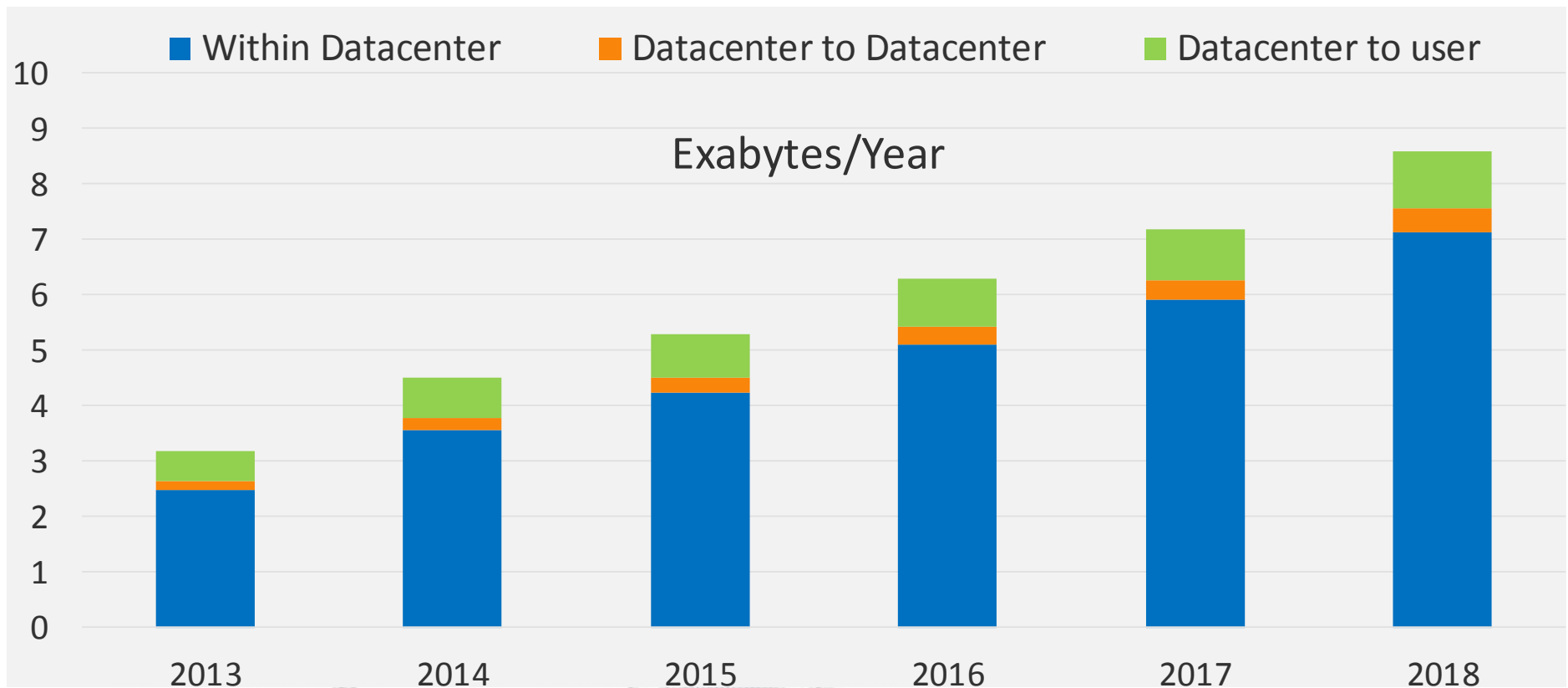


Source: Cisco



Why 100G Datacenter is Needed

Datacenter Traffic Composition: Rapid growth of data within datacenter



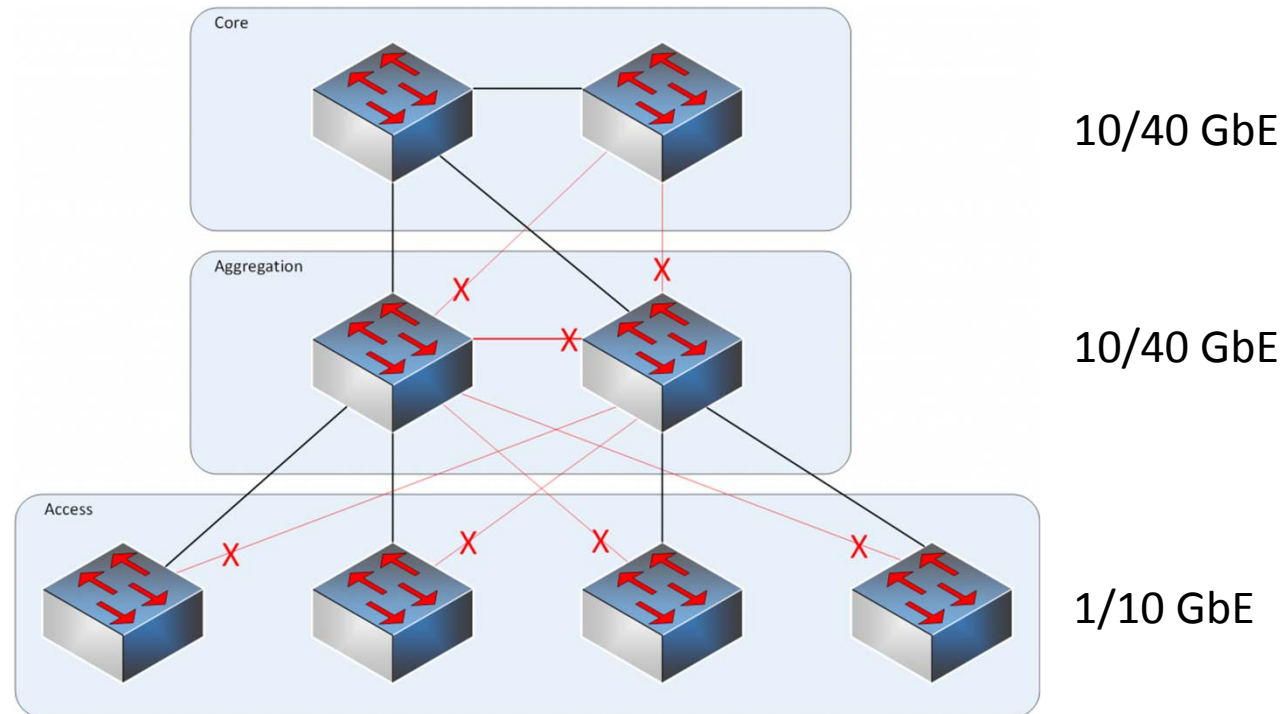
Source: Cisco



Why 100G Datacenter is Needed

Traditional Network Architecture can not meet the demand

Conventional Design

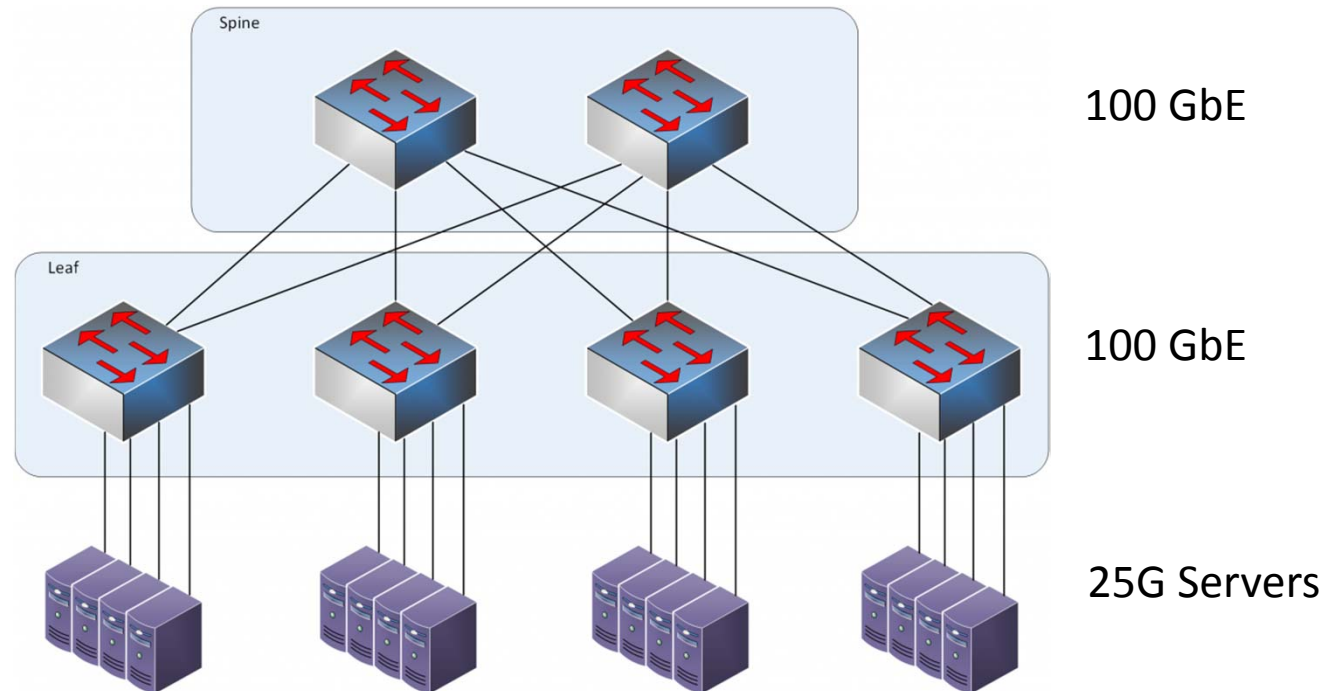


- How does a server connected to the left-most access switch communicate with a server connected to the right-most access switch?
- Not the most efficient path to take, and causes more latency while using more bandwidth of networks

Why 100G Datacenter is Needed

Network Architecture Virtualization

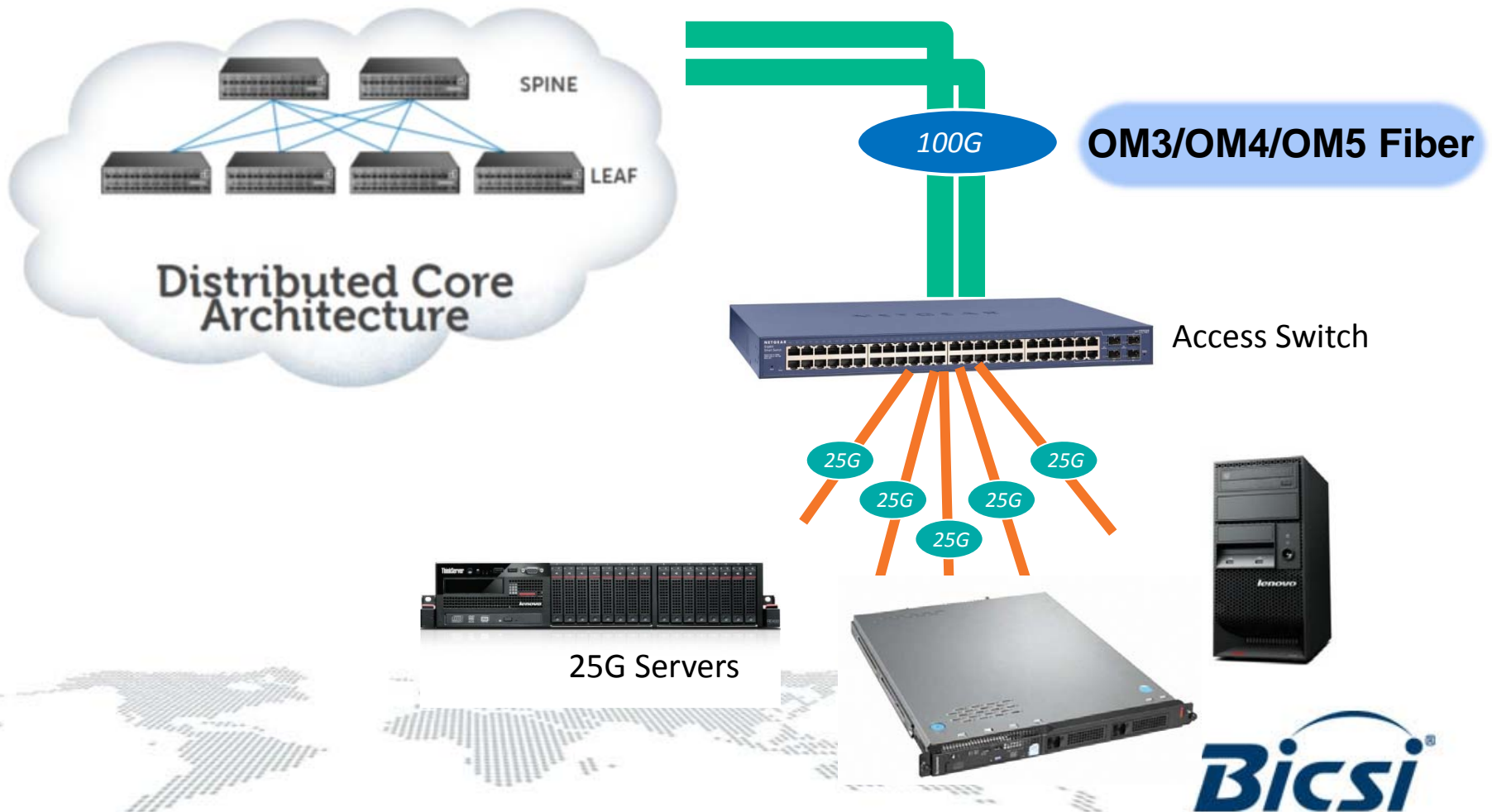
Distributed Core Fabric Design



- Distributed Core Fabric network architecture supports server virtualization
- Each Leaf switch connects to every Spine switch
 - A payload only has to hop to a Spine switch and another Leaf switch, which keeps the latency down to a predictable level

Why 100G Datacenter is Needed

Network Architecture Virtualization



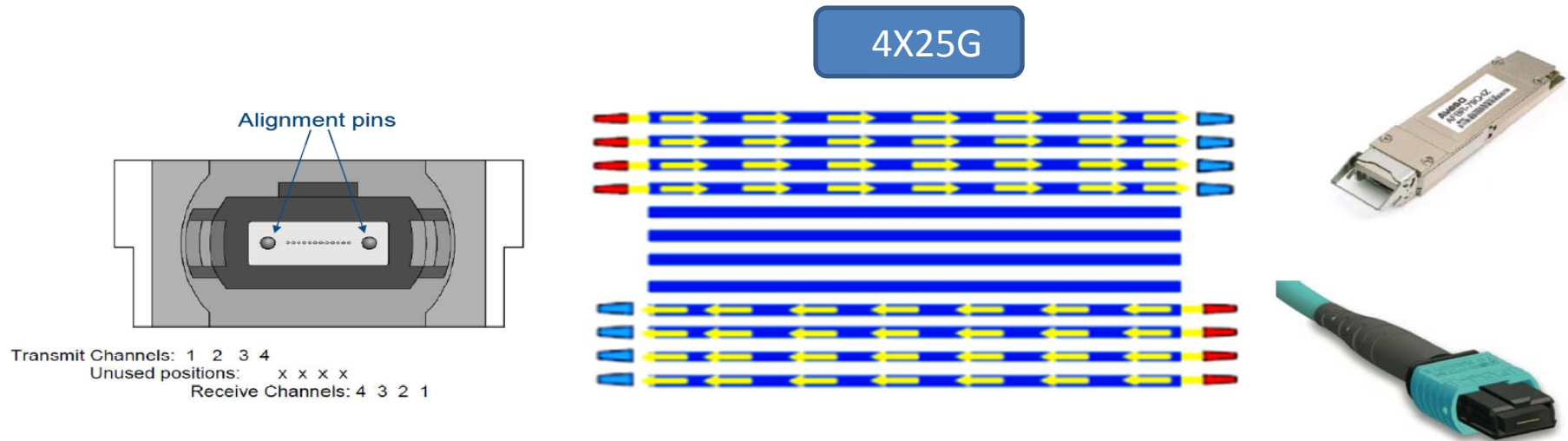


- Why 100G Datacenter is Needed
- **Connectivity Technology and Cost Analysis for 100G Datacenter Cabling**
- Key 100G Connectivity and Cabling Solution
- Outlook for Future I/O and Connectivity



Connectivity Technology and Cost Analysis for 100G Datacenter Cabling

100GBASE-SR4



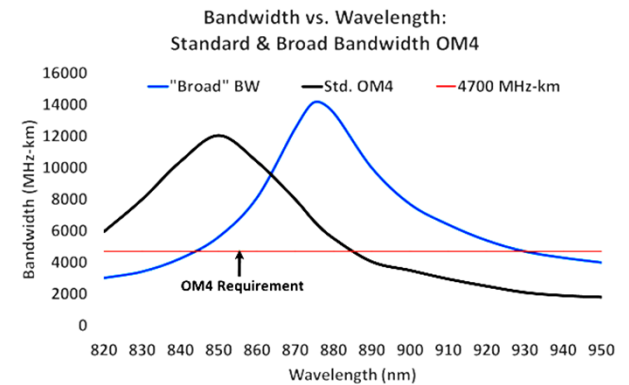
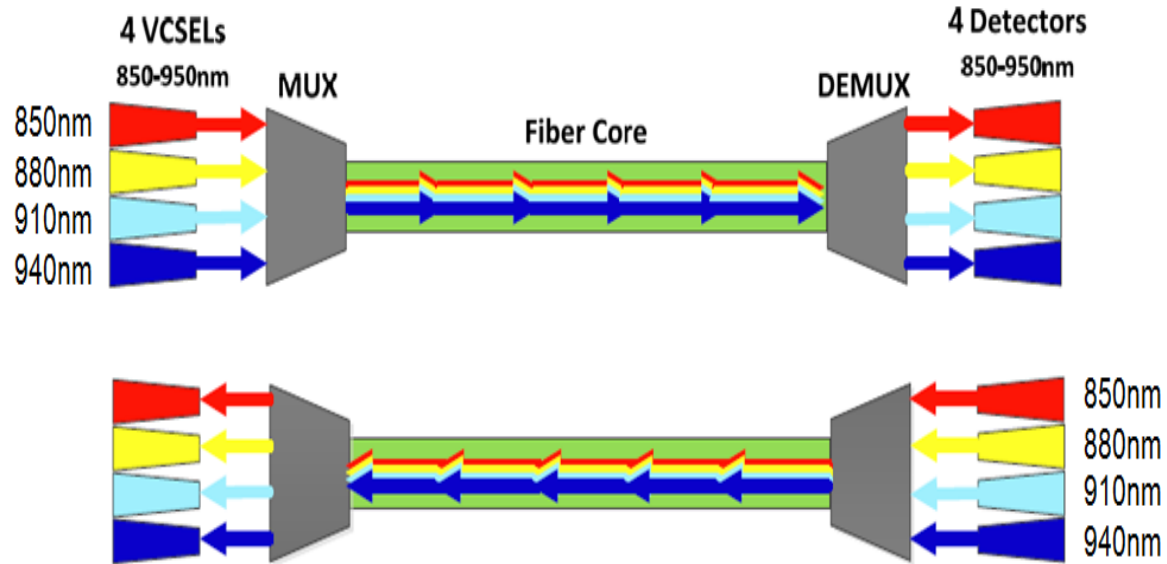
Ethernet Standard IEEE 802.3bm

OM4 support of 100GBASE-SR4 is specified at 100m, and 70m over OM3 fiber

- 4*25G optical interface for MMF
- 8 multimode fibers per 100G channel (4 x lane)
- Easy migration from 40Gb/s to 100Gb/s

Connectivity Technology and Cost Analysis for 100G Datacenter Cabling

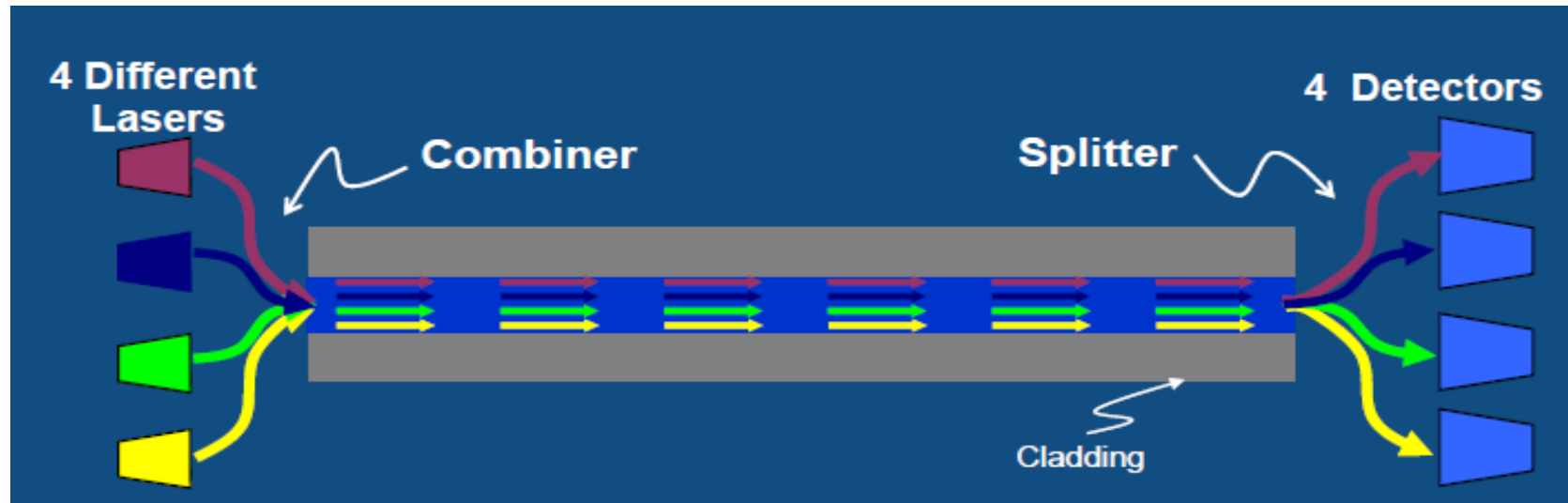
100GBASE-SWDM4 working with OM5 Wideband Multimode Fiber



WBMMF fiber has been approved by the TIA-42 Standardization Organization as TIA-492AAAE. The ISO Standardization Organization also approved WBMMF and named OM5 fiber in October 2016.

Connectivity Technology and Cost Analysis for 100G Datacenter Cabling

100GBASE-CWDM4



MSA (Multi-Source Agreements) defined application of 100GBase-CWDM4, which has not been approved by IEEE

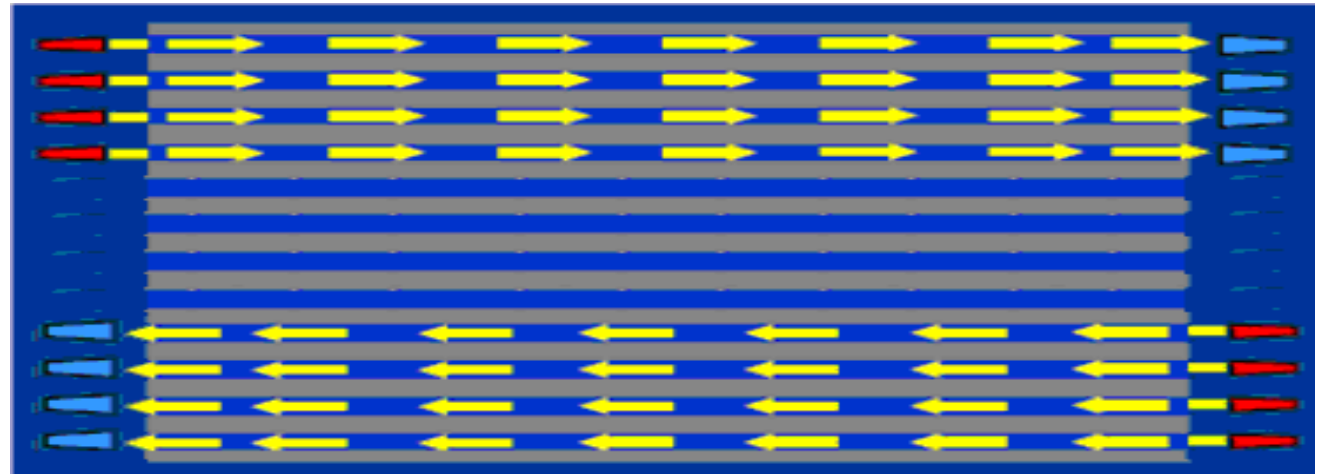
- Support 100G for 2KM
- 2 core SM fiber



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Connectivity Technology and Cost Analysis for 100G Datacenter Cabling

100GBASE-PSM4



MSA (Multi-Source Agreements) defined application of 100G BASE-PSM4 which has not been approved by IEEE

- Support 100G for 500m
- 8 SM fiber per 100G channel with MPO interface

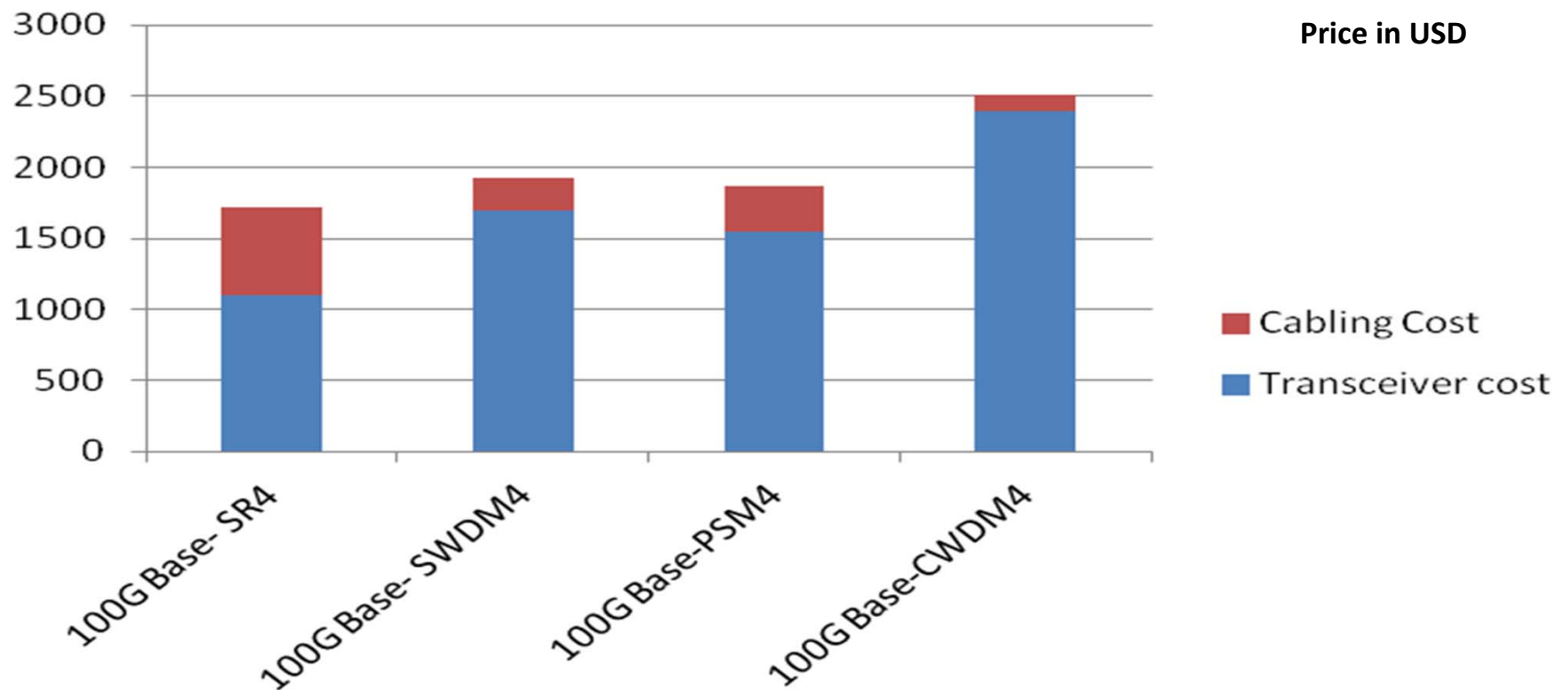
Connectivity Technology and Cost Analysis for 100G Datacenter Cabling

Technology Comparison

Ethernet Speed	Standard	Designation	Fiber Type	Number of Fibers	Max. Link Length	Interface	Transceiver
100Gb	IEEE802.3bm	100GBASE-SR4	OM3 OM4	8	70m 100m	MTP MPO	QSFP28
100Gb	SWDM Alliance	100GBASE-SWDM4	OM4 OM5	2	100m 300m	LC Duplex	QSFP28
100Gb	MSA	100GBASE-PSM4	SMF	8	500m	MTP MPO	QSFP28
100Gb	MSA	100GBASE-CWDM4	SMF	2	2km	LC Duplex	QSFP28

Connectivity Technology and Cost Analysis for 100G Datacenter Cabling

Cost Comparison = 100G Transceiver + Cabling



Connectivity Technology and Cost Analysis for 100G Datacenter Cabling

Classic Cabling Channel Model

Modular Fiber Panel



Pre-terminated Trunk



40G/100G/400G module

10G/40G/100G module

Modular Fiber Panel



10G/40G/100G/400G system can be flexibly achieved by deploying MMF pre-terminated trunk and module solution



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Key 100G Connectivity and Cabling Solution

100GBASE-SR4

1HU Line Card



25G SFP+*48Pcs

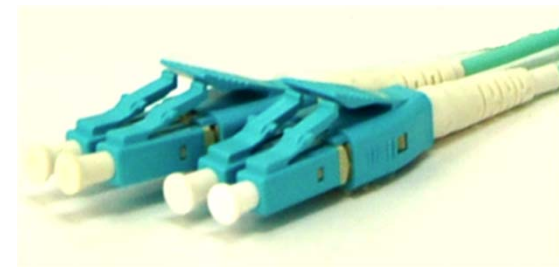
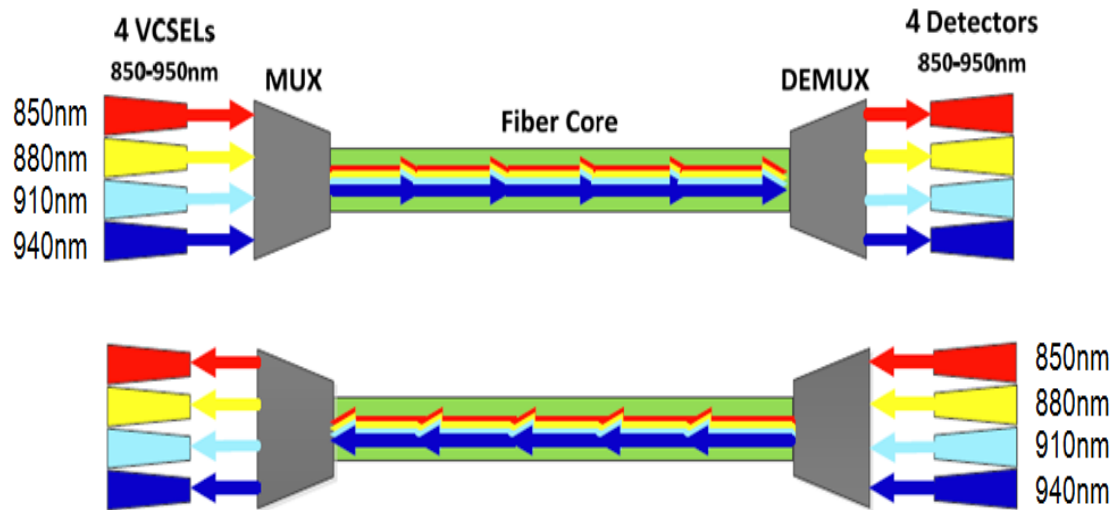


100G QSFP28*24Pcs

- 100GBASE-SR4 can be converted to 4*25G physically by using MPO-LC harness
- Can be unified to use switch equipment with 100G ports, to reduce the cost of switches and operational complexity
- The cost of the one 100G QSFP28 transceivers is approximately equal to the 70% cost of the 4 pcs of 25G transceivers

Key 100G Connectivity and Cabling Solution

100GBASE-SWDM4



- 100GBASE-SWDM4 compared to the conventional MPO 8-core interface to save up to 75% of the amount of optical fiber
- Support at least 300 meters distance and meet majority of data center application requirements, and does not need to configure a variety types of transceiver to deal with distance issue
- SWDM solution has big potential to reduce its cost substantially when there is large-scale deployment



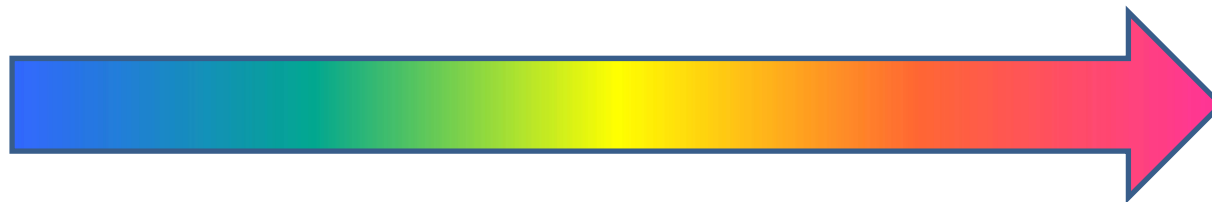
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Outlook for Future I/O and Connectivity

Trend of High Speed Interface Technology

	10G	20G	25G	40G	50G	100G
10GbE	1x					
40 GbE	4x	2x		1x		
100 GbE	10x		4x		2x	1x
400 GbE			16x	10x	8x	4x
1TbE						10x



A single fiber lane can carry an increasing amount of data

Outlook for Future I/O and Connectivity

Data Center Technology Trends

Yesterday

Physical Aggregation



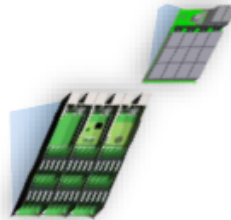
- Shared Power
- Shared Cooling
- Rack Management
- Cu Interconnects

Today

Modular Compute Interconnect Integration

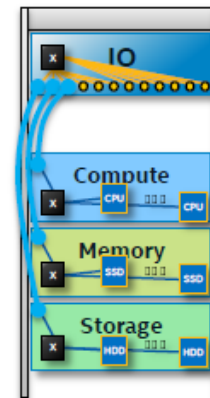


- Modular refresh
- Transitioning to Photonic Interconnects



Future

Subsystem Aggregation



- Pooled compute
- Pooled storage
- Pooled memory
- Shared boot
- Photonics Interconnects

Source: Intel

Outlook for Future I/O and Connectivity

Evolving Silicon Photonics and I/O

What is Integrated Photonics?

Today: 25 Gbps x 4 = 100Gbps



Scale UP

50Gbps x 4 = 200Gbps



200G

Scale OUT

25 Gbps x 8 = 200Gbps



Scale up AND out

x16, x32...

Speed	Width	Rate
25	x4	100G
25	x8	200G
25	x16	400G
50	x25	1.25T

Scale up AND out

Future Terabit+ Links

Low cost integrated photonics allows for scaling from 100Gbps to > 1Tbps

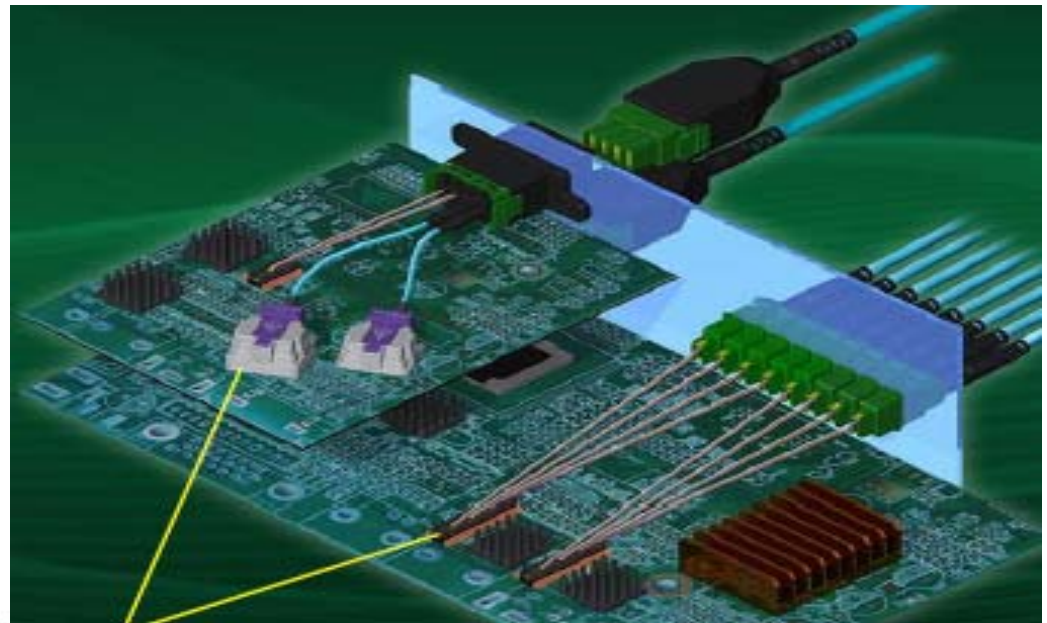
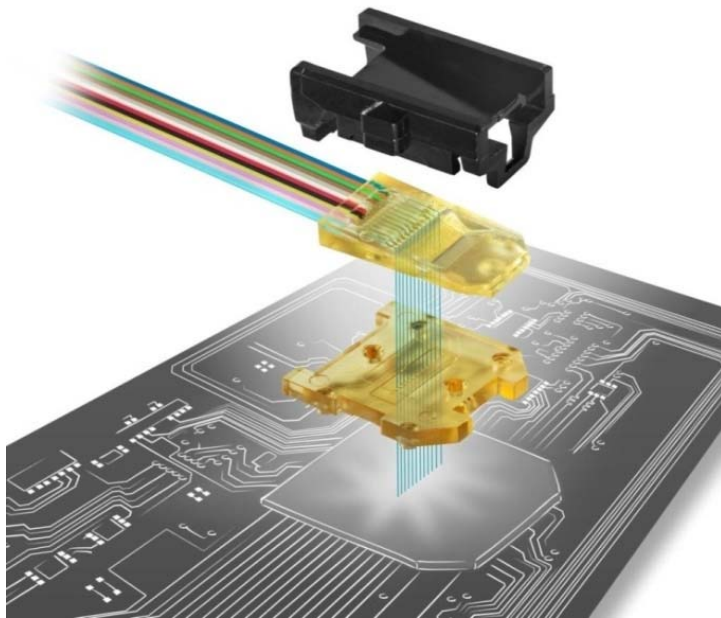
IDF14
Source: Intel



Outlook for Future I/O and Connectivity

Next Generation of Interface Technology

PRIZM[®] LightTurn[®] is a miniature multi-fiber connector interface for next generation small form factor multimode parallel optical I/O modules

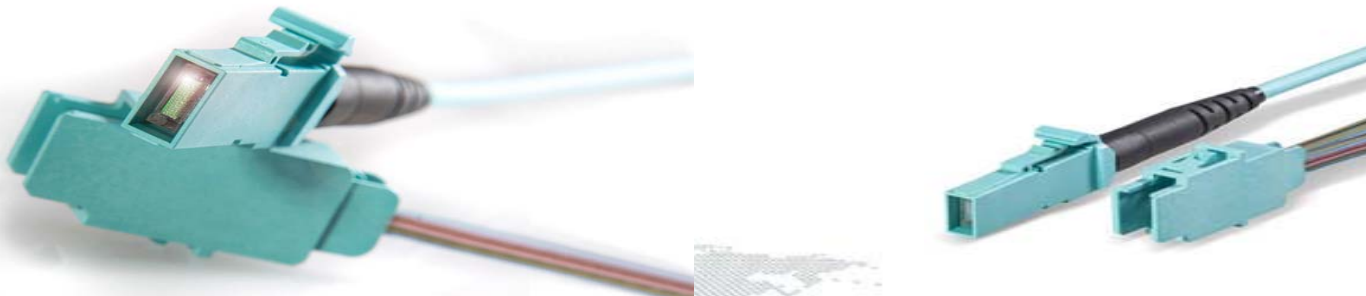


Outlook for Future I/O and Connectivity

MXC™ the Future I/O Interface >100G

Using the most advanced high-density interconnect technology, MXC™ the Big Data Connector can provide a direct card edge interface to embedded optical engines such as Intel® Silicon Photonics chips

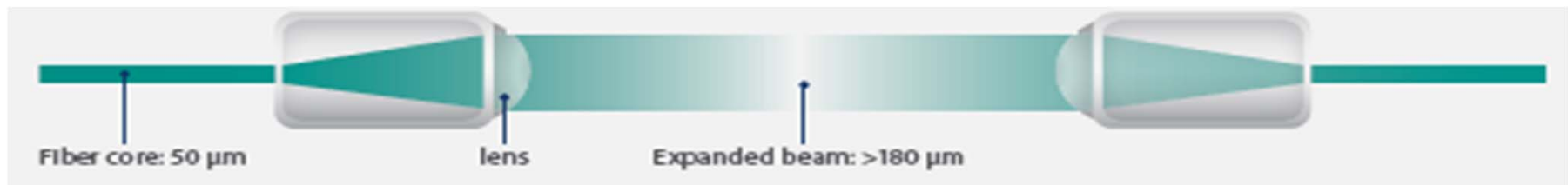
- High Performance Computing
- Switching/Routing Fabrics
- Switch to Server Interconnects



Outlook for Future I/O and Connectivity

MXC™ the Future I/O Interface >100G

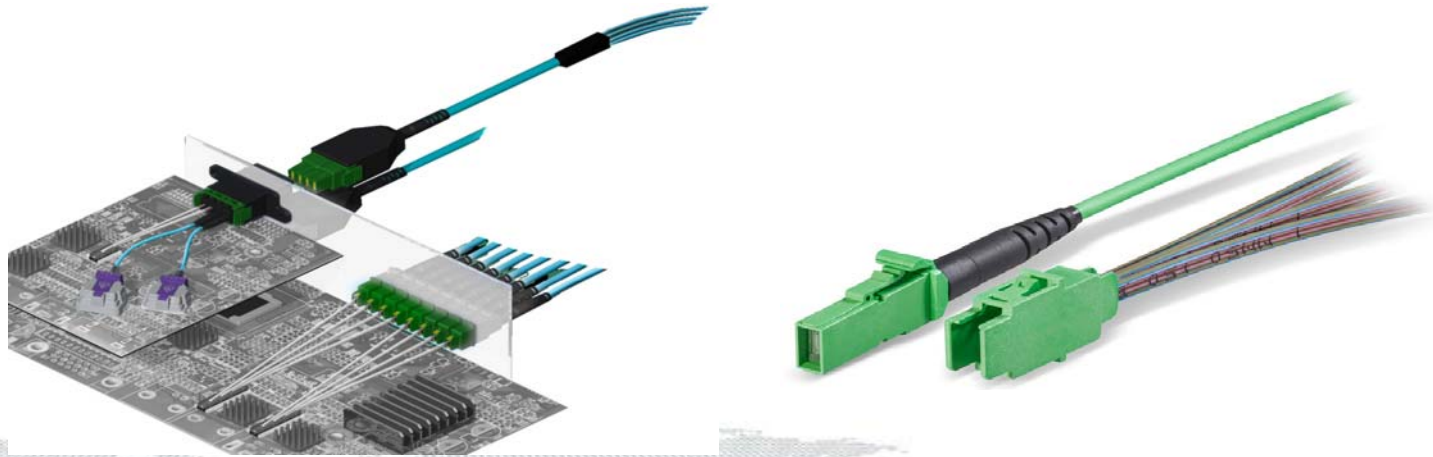
- The expanded beam lens technology
- Greater alignment tolerances at the mating plane of the connectors which guarantees consistently low I/L and high R/L
- Larger beam cross section results in decreased impact of debris
- Less spring force required for mating



Outlook for Future I/O and Connectivity

MXC™ the Future I/O Interface >100G

- The number of fiber cores in a single MXC interface reaches $16 \times 4 = 64$ core which can support 800G per port (i.e. current 8 MMF*100G)
- Core switch 1HU line card with MXC™ interface can support transmission capacity @ $800\text{G} \times 48\text{Port} = 38.4 \text{ Tbit/s}$



Summary and Recommendation

100GBASE-SR4 has good cost performance and support 100G converting to 4 *25G physically, can improve data center operation and maintenance flexibility.

100GBASE-SWDM4 can support longer distance by reducing 75% fiber cores to realize high density deployment. With continued cost reduction, it has a good potential application in near future.

Next-generation IT equipment in datacenter with silicon photonics technology c/w PRIZM LightTurn and MXC interface etc. makes the I/O with higher density, lower cost and lower power consumption, which can support 400G, 800G, 1.6T or even higher-rate application. In next 5-10 years silicon photonics technology will play an important role in datacenter transformation.



Thank you for your attention

