Building a more efficient network

How will faster networks lower the cost, latency and energy consumption?

Thomas Vedsmand
Infrastructure System Engineer
Nordics, Baltic States & Eastern Europe

2024Q1

A PROVEN PARTNER TO THE WORLD'S TOP NETWORKS

COMMSCOPE IS BACKED BY THE EXPERTISE, INNOVATION AND RESOURCES THAT ENABLE US TO DELIVER POWERFUL RESULTS.

30,000
TALENTED INNOVATORS

15,000+
PATENTS

$800M
EACH YEAR IN R&D

WE'RE PROUD TO PARTICIPATE IN THESE PRESTIGIOUS ORGANIZATIONS

- O-RAN Alliance
- WFA
- WBA
- WInnForum
- IEEE at many levels
- On Go Alliance
- NGMN
- ISO/IEC
- TIA
- CableLabs
- SCTE
- IEEE
- ETSI
- Broadband Forum
- ITU-T
- CENELEC
- Linux Foundation Networking
- Connectivity Standards Alliance
- Bluetooth
- MoCA
- HDMI
- RDK
- PRPL

CommScope's diverse solutions portfolio empower all kinds of networks, all over the world.

- Wired
- Cellular wireless
- Wi-Fi and IP networks
- Data center infrastructure
- In-building, campus and large venue connectivity

GLOBAL SUPPLY CHAIN RESPONSIVENESS AND RESILIENCE

55
SUPPLY CHAIN LOCATIONS

10,000+
PARTNERS IN 150+ COUNTRIES

The diversity and resilience of our global manufacturing footprint is evident, and our global network of contract manufacturers and suppliers are a key strength for CommScope enhancing our ability to deliver for our customers.

20,000 people building and delivering critical communication network equipment across the globe

46
Sourcing materials from 46 countries enabled a shift in the supply chain during the COVID-19 pandemic

24/7
By working around-the-clock, our global team mitigated supply chain pressure

2x
Procurement dual-sourced key materials. Our contract manufacturers bolstered our production and resiliency

30x20
CommScope has more than 30 distribution centers across more than 20 countries

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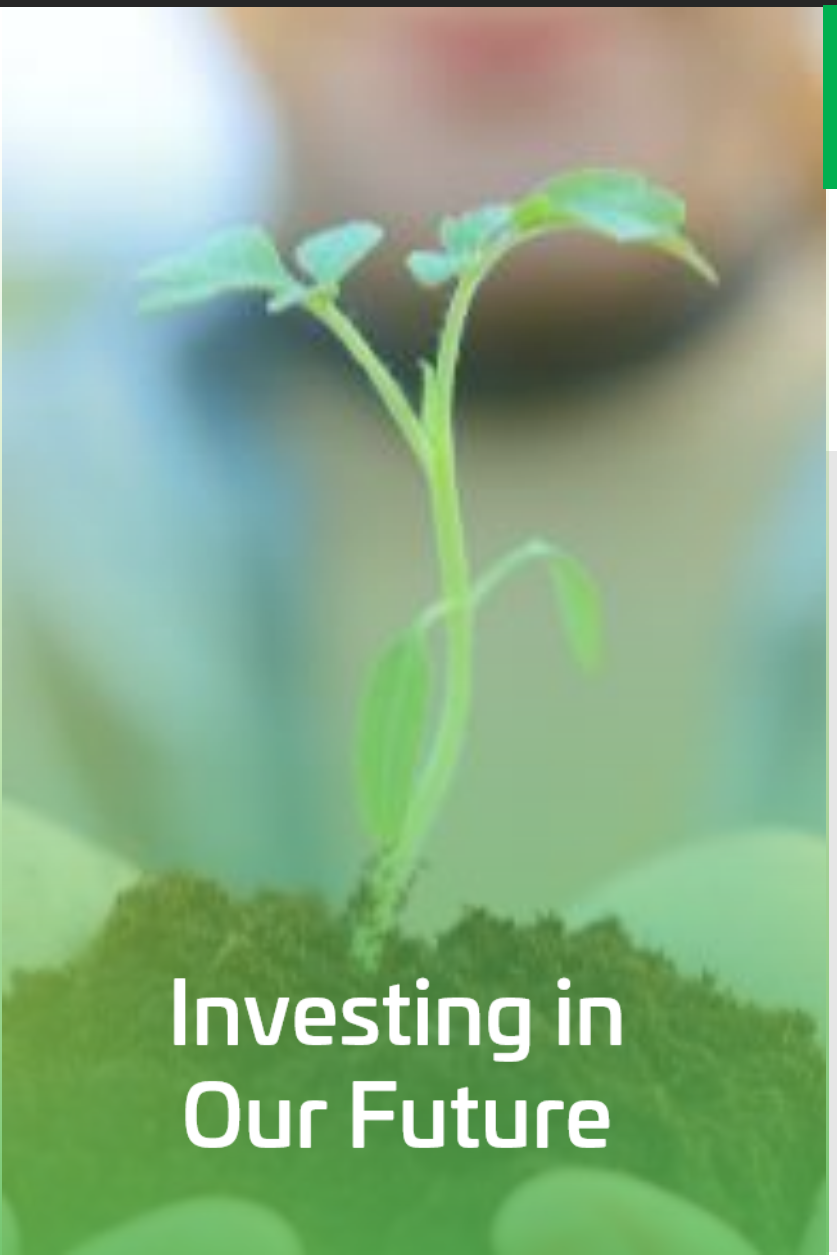

Investing in Our Future

As a leader in sustainability and environmental responsibility, we can help you meet your own green objectives.

Gold level CSR rating from EcoVadis

Recognized in Newsweek's 2020 list of America's Most Responsible Companies

96.7%

of applicable Home Network business unit product shipments complied with the relevant U.S., Canadian or EU set-top boxes (STB) or Small Network Equipment (SNE) energy efficiency voluntary

A-

Awarded a score of A- in the 2020 CDP Climate Change scorecard, which puts CommScope at a Leadership Level for the first time.

90%

Maintained our environmental certification in line with the ISO14001:2015 standard. The certification scope now covers 90% of our manufacturing facilities.

8.6%

reduction in Greenhouse Gas (GHG) emissions

85.3%

of non-hazardous waste diverted from landfill

9.3%

reduction in water withdrawal

ZERO

"major non-conformances" in third-party certifications

90%

of our manufacturing facilities are certified according to the ISO45001:2018

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Agenda

Datacenter speed trends

Flattening the network

Connectivity types

Prepare for the future

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Networks are shifting from 2 fiber
over 8 to 16 fiber applications

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Hyperscales

Cloud

MTDC

Enterprise

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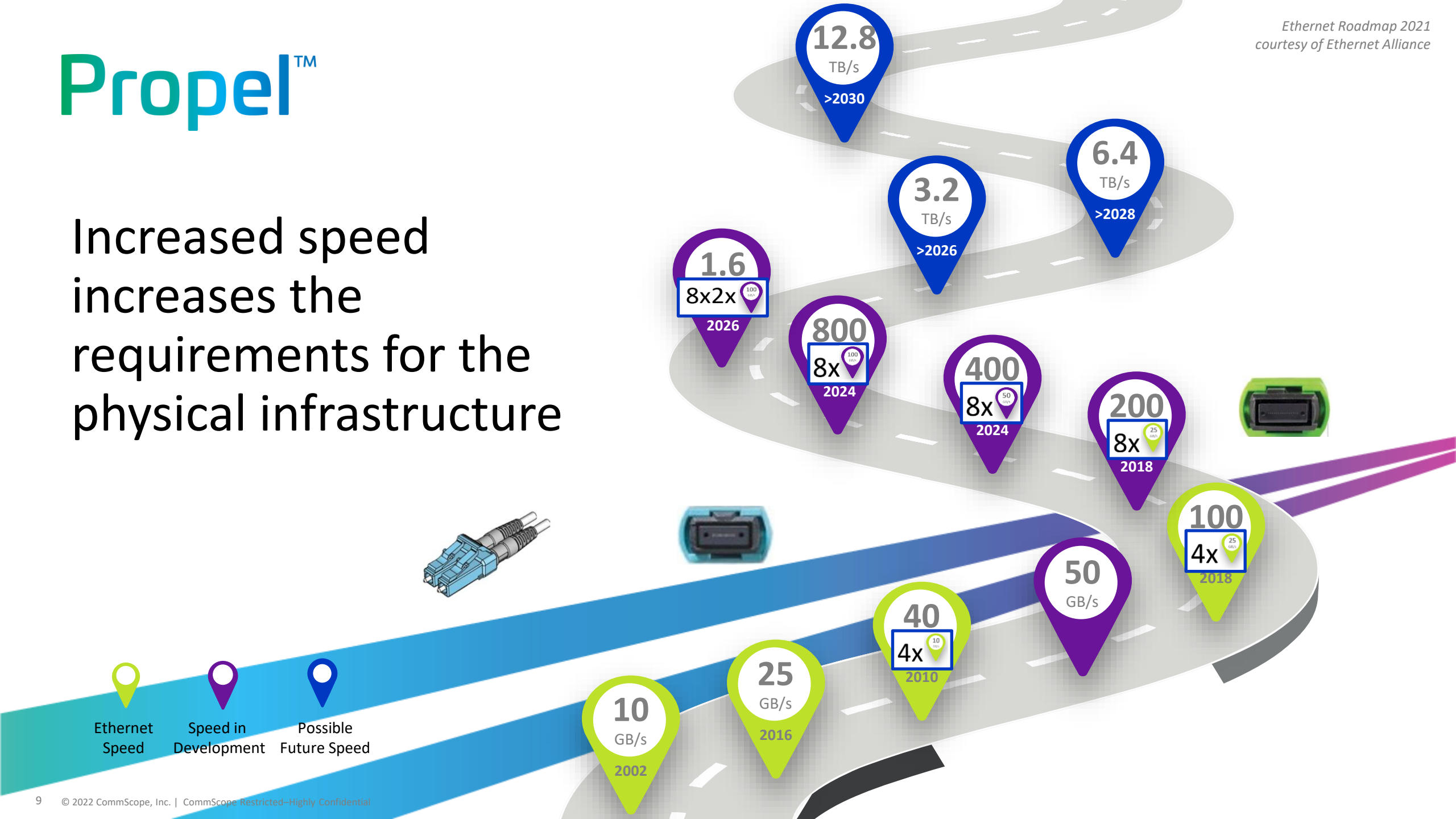
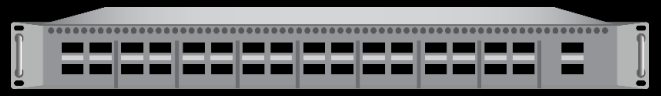
Increased speed increases the requirements for the physical infrastructure



Ethernet Roadmap 2021
courtesy of Ethernet Alliance

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	
2021	50G	12.8T	 32 ports of 400G	256 Electrical I/Os
2022	100G	25.6T	 32 ports of 800G	

512 Electrical I/Os coming soon?

Rapid succession of technology

NVIDIA announced the SPECTRUM-4
a 2U switch with 128 ports of 400G
51.2T = 1024 I/Os
expected power savings = 40%

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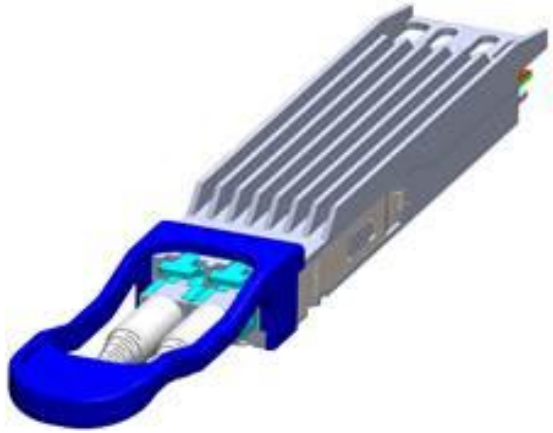
Cisco’s Nexus 400 GbE (bottom) and 100 GbE 32 port switches in action

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



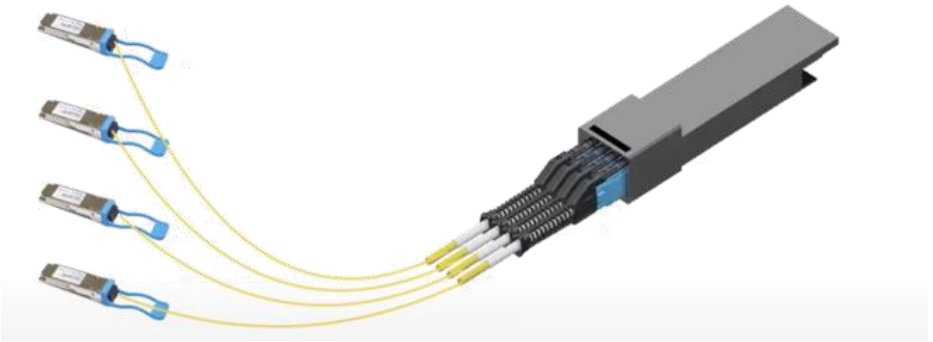
OSFP

400G MDIs

Media dependent interface (MDI)

400G capacity QSFP-DD connectors

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

Increasing requirements

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Standards

- Cabling standards
  - Connector loss 0.75 dB
  - Splice loss 0.3 dB
  - LC-LC spliced link
    - 0.75+0.3+cable+0.3+0.75 = 2.1 dB
  - LC/MPO to MPO/LC
    - 4 x 0.75 dB = 3 dB
  - 2 connected MPO links
    - 8 x 0.75 dB = 6 dB
- Application requirements
  - Newer applications have a power budget around 2 dB

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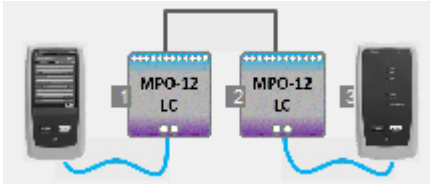
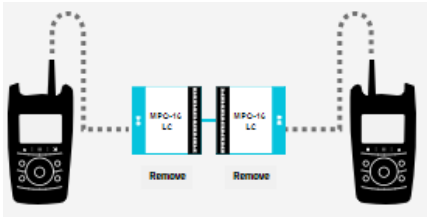
- Low Loss



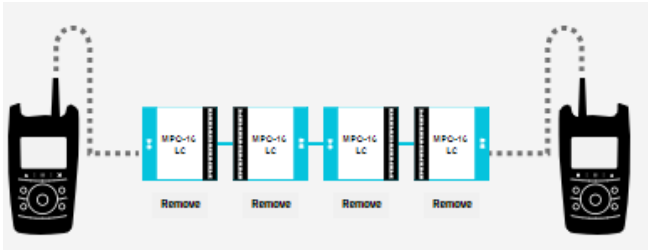
(dB)	850nm	1.33	1300nm	1.13
ULL (dB)	850nm	1.15	1300nm	0.95

- Ultra Low Loss



Loss Calculations

850 nm Loss	1.15	dB
1300 nm Loss	0.95	dB



Loss Calculations

850 nm Loss	1.61	dB
1300 nm Loss	1.41	dB

Optical connectors comparison

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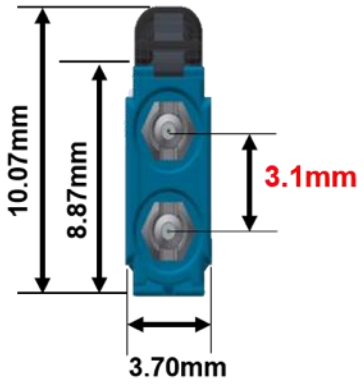
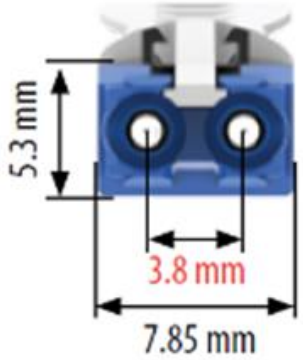
SN®

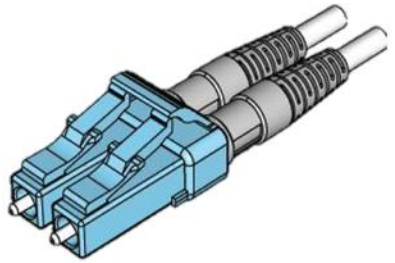
MDC

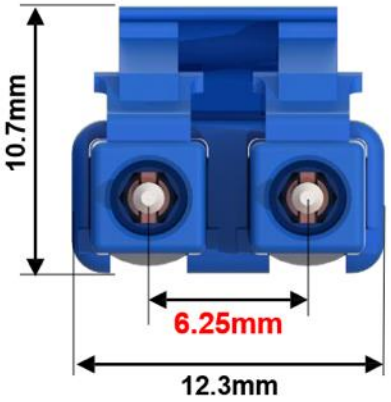


CS

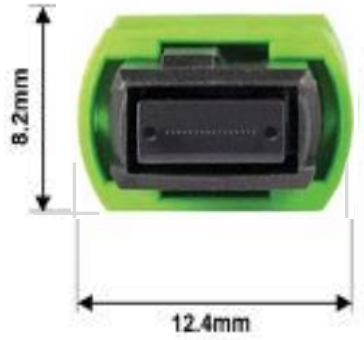


LC Duplex





MPO



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What about smaller Data Centres (2013Q4)

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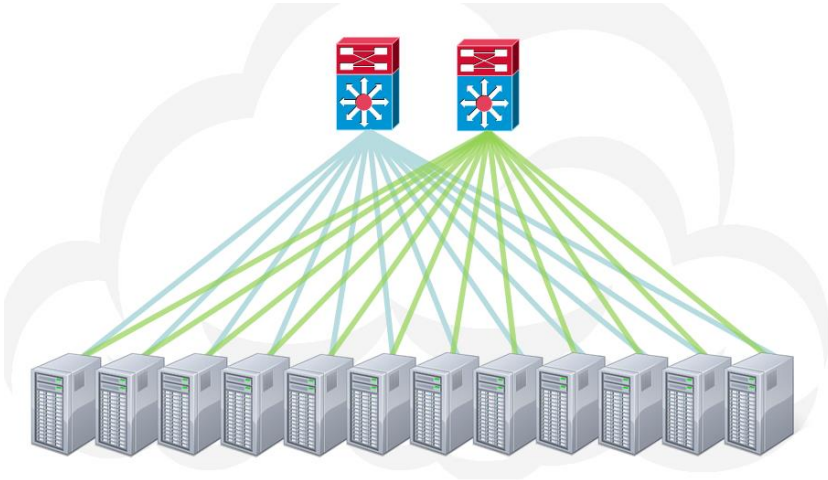

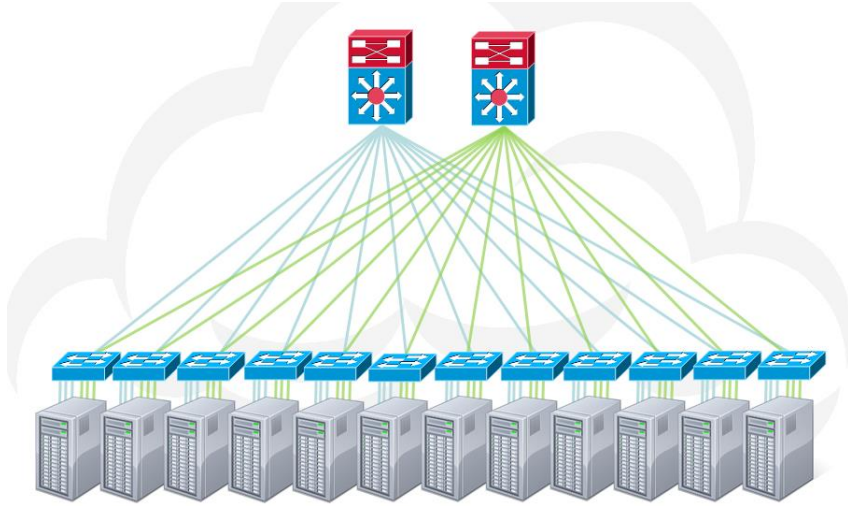

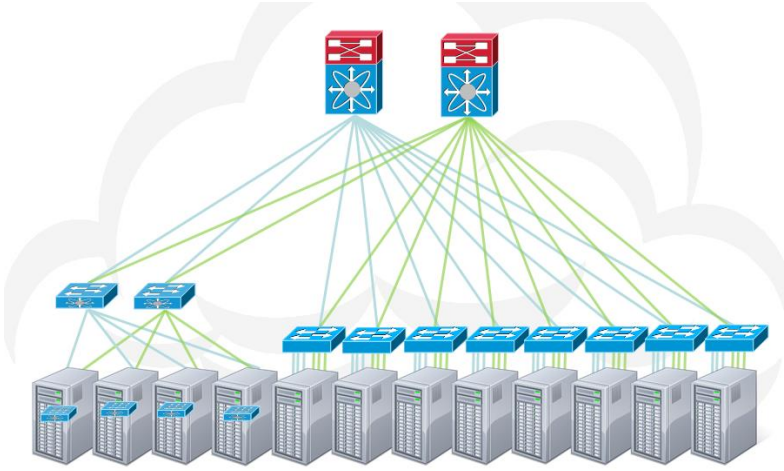

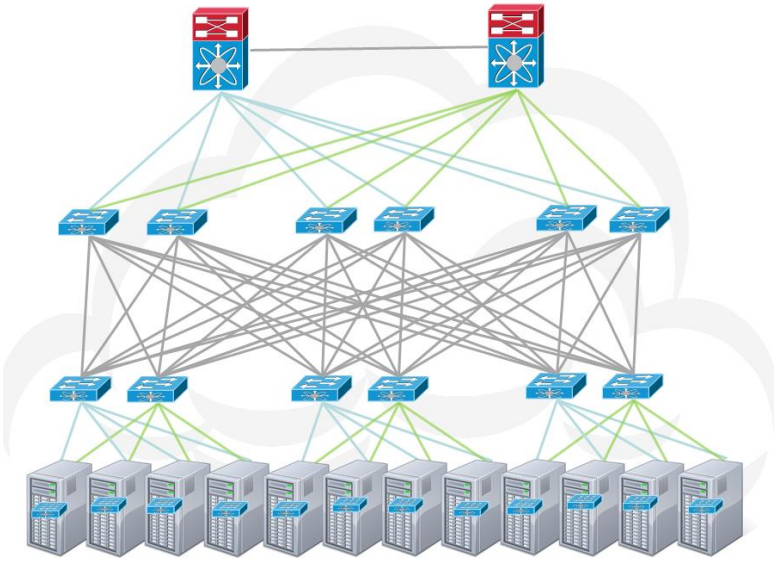

Data centre Design

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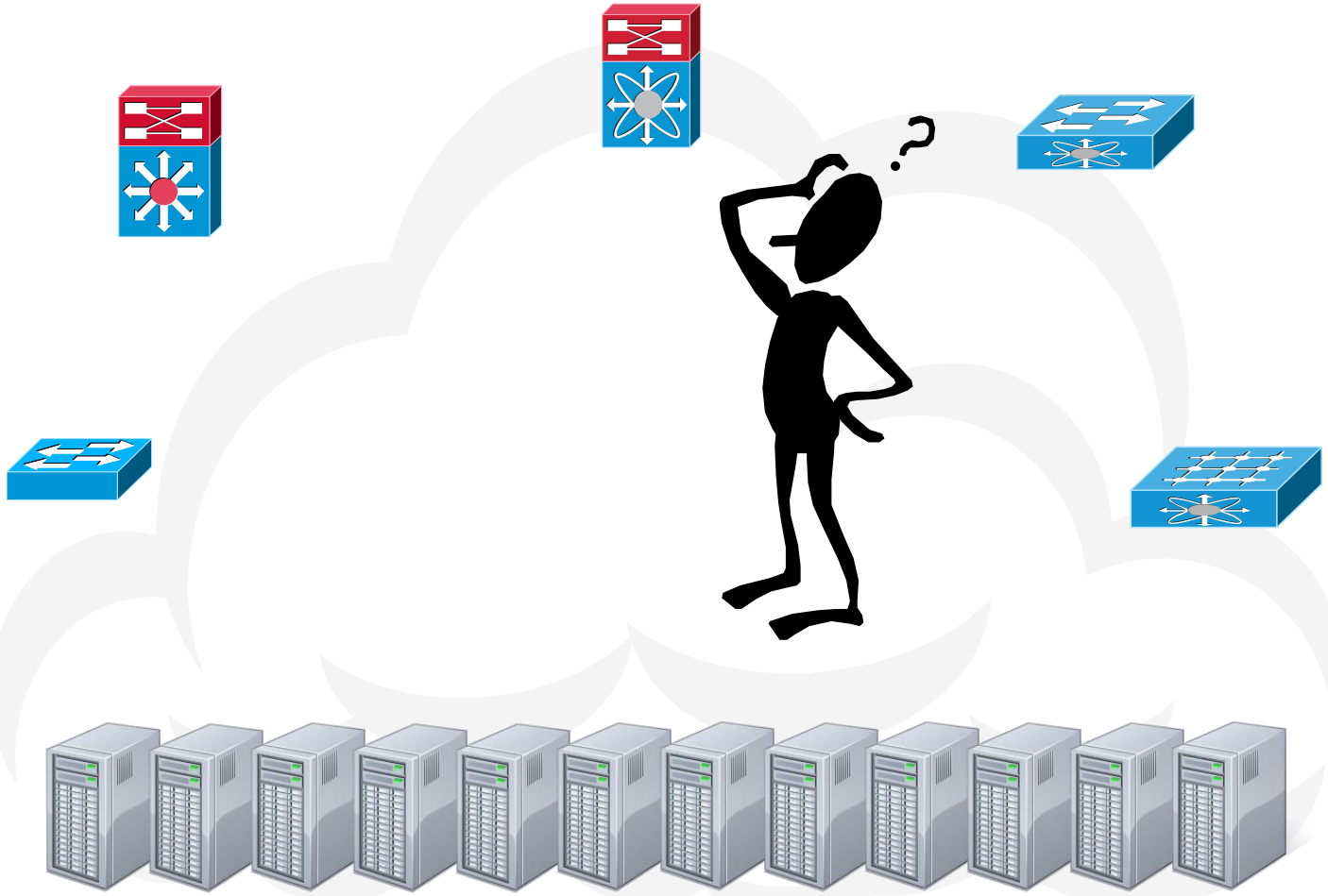

The future will be diferent from today

Data centre Design

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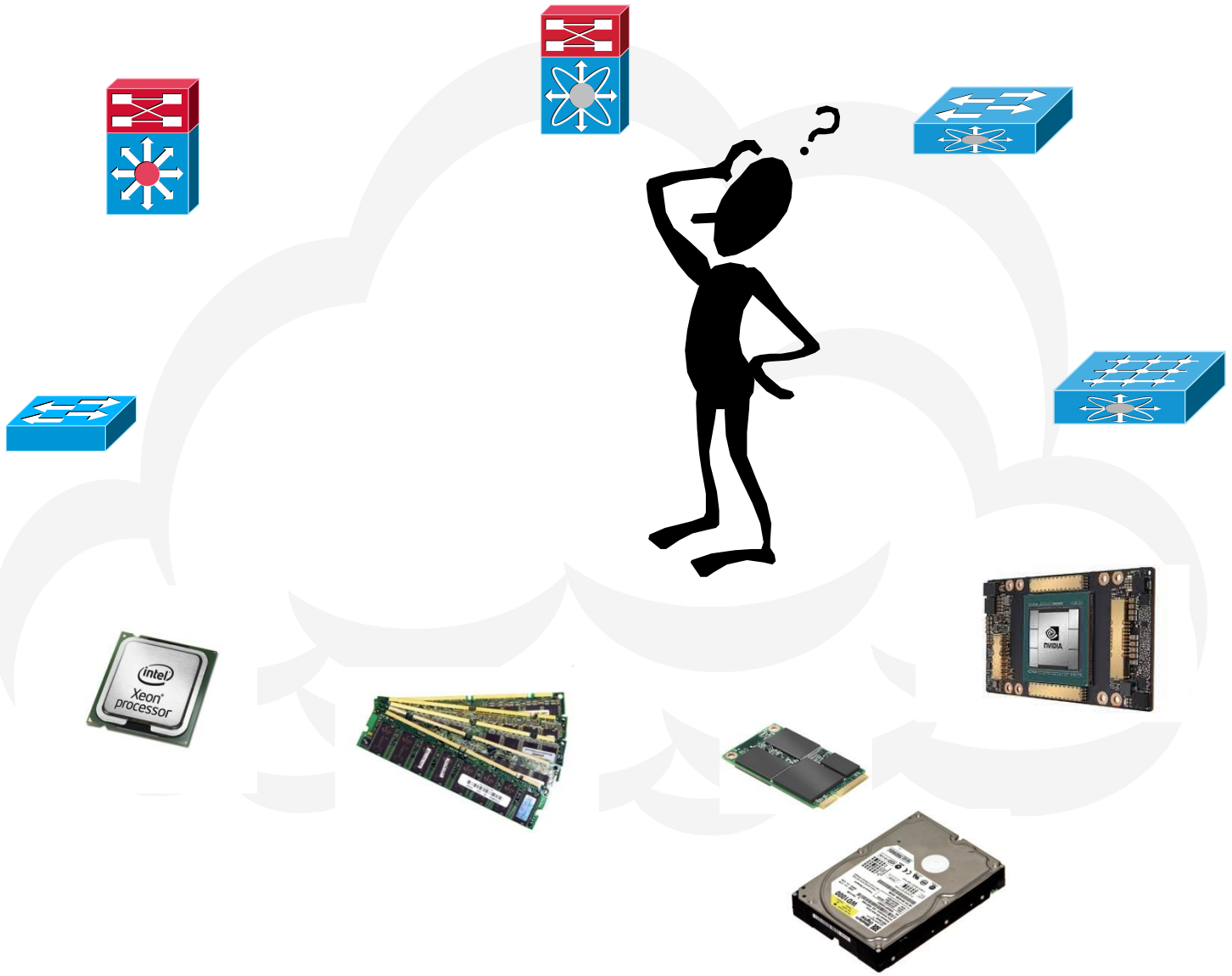

The collapsed network

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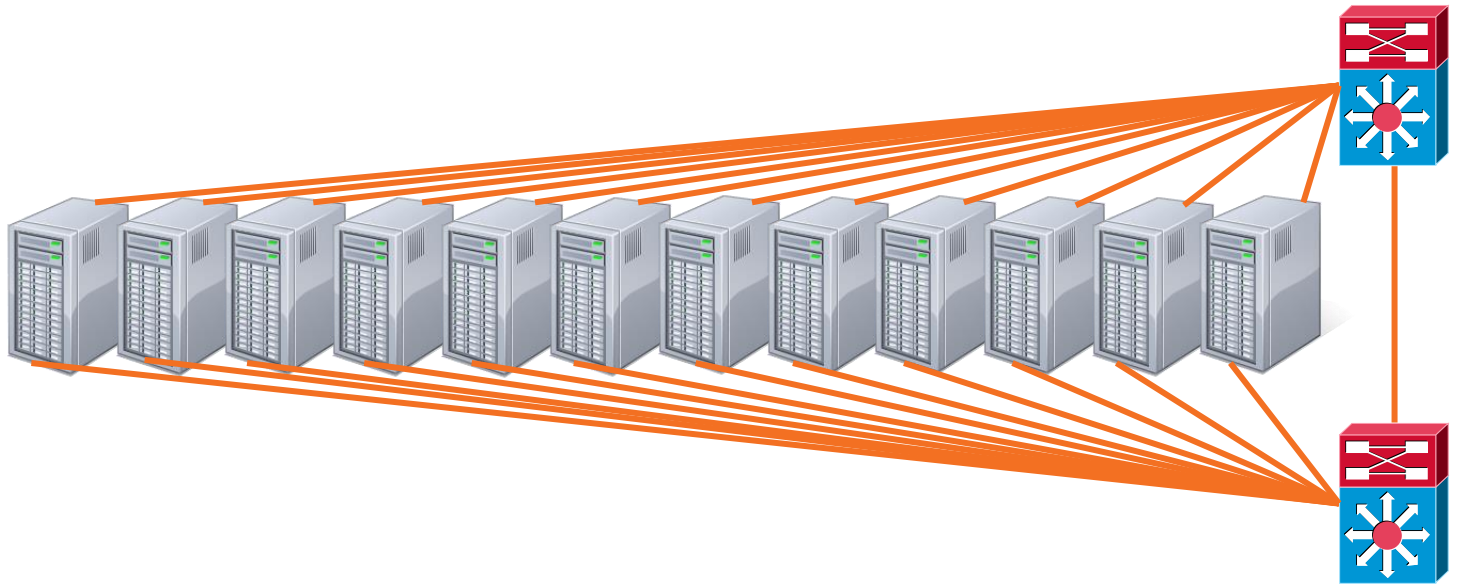

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The future is already here

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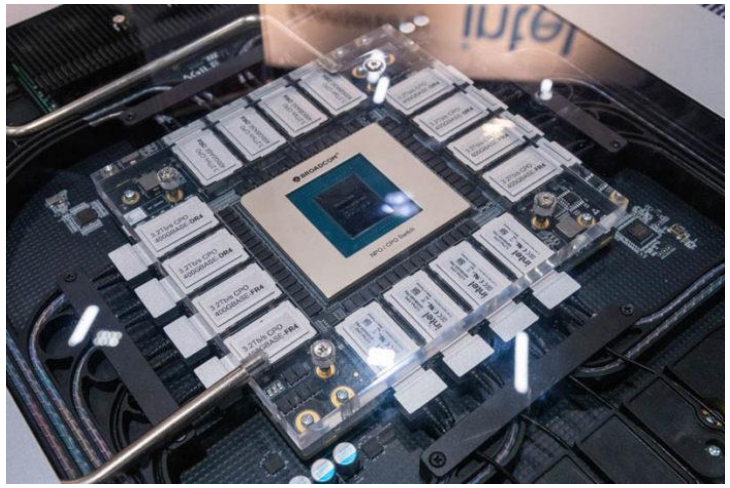

7060PX4-32 & OSFP | 7060DX4-32 & QSFP-DD

ANNOUNCING SPECTRUM-4 ETHERNET SWITCH

Accelerated Ethernet Fabric — Cloud, Enterprise, and AI

512 Ports

51.2T	100B	12.8T	37.6B	400G & 800G	4X
Bandwidth	Transistors	Crypto	Packet Rate	Ports	Higher Throughput

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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 Ethernet and beyond

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

Panels

- **Adapt and grow** as needs change
- **Modular** and **interchangeable**
- **Blade-based** layout
- Minimum **size/weight**
- **Ergonomic & easy access**
- **One person** install
- Module **interchangeability**
- Support 8-12-16 and 24-fiber connectivity and **up to 288** connected fibers per **RU**
- **Method B Enhanced polarity**

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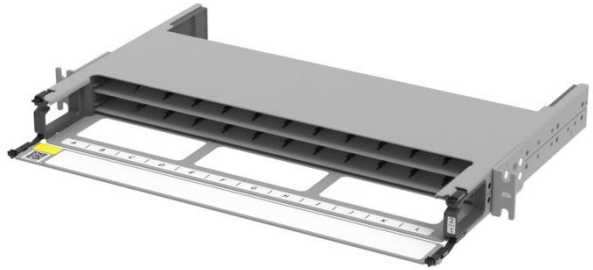

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Flexibility

MPO8, MPO12, MPO16 to LC conversion

MPO24 to LC conversion MM

MPO8, MPO12, MPO16 to SN conversion SM

LC adapter modules

SN adapter modules

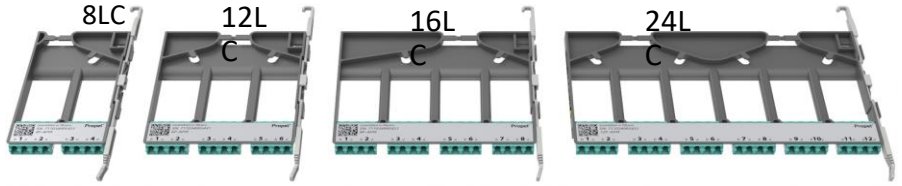
MPO8, 12, 16, 24 adapter modules

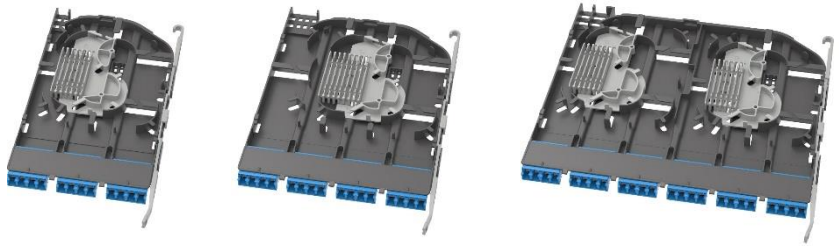
LC and MPO splice modules

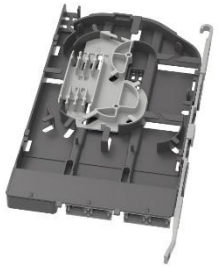
MPO to MPO conversion modules

MPO to MPO mesh modules

QSFP breakout modules







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Leading with 16-fibers

Most efficient multipair building block for trunk applications

End-to-end APC multimode or singlemode provides application insurance benefits compared to UPC

Enable cost effective backbone switch/breakouts

Supports migrations whether duplex or multipair 4, 8, or 16 fibers; multimode & singlemode

Strive for lower risk in datacenters

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- Automate as much as possible
- Limit physical work inside DC
- Improve documentation
- Improve planning

Cyber security

EUROPEISKA KOMMISSIONEN

Bryssel den 13.9.2023
C(2023) 6068 final

MEDDELANDE FRÅN KOMMISSIONEN

Kommissionens riktlinjer för tillämpningen av artikel 4.1 och 4.2 i direktiv (EU) 2022/2555 (NIS 2-direktivet)

7. Enligt artikel 21.1 första stycket i direktiv (EU) 2022/2555 ska medlemsstaterna säkerställa att väsentliga och viktiga entiteter vidtar lämpliga och proportionella tekniska, driftsrelaterade och organisatoriska åtgärder för att hantera risker som hotar säkerheten i nätverks- och informationssystem som de använder för sin verksamhet eller för att tillhandahålla sina tjänster. Dessa åtgärder bör vara riskbaserade och bör kunna förhindra eller minimera incidenters konsekvenser. I artikel 21.1 andra stycket i direktiv

8. Vid bedömningen av en sektorsspecifik unionsrättsakts likvärdighet med de relevanta bestämmelserna om cyberriskhantering i direktiv (EU) 2022/2555 bör man särskilt fästa vikt vid om säkerhetskraven enligt den rättsakten omfattar åtgärder som syftar till att säkerställa säkerheten i nätverks- och informationssystem. Definitionen av ”säkerhet i nätverks- och informationssystem”, som fastställs i artikel 6.2 i direktiv (EU) 2022/2555, avser nätverks- och informationssystems förmåga att med en viss tillförlitlighetsnivå motstå händelser som skulle kunna undergräva tillgängligheten, autenticiteten, riktigheten eller konfidentialiteten hos lagrade, överförda eller behandlade uppgifter eller hos de tjänster som erbjuds genom eller är tillgängliga via dessa nätverks- och informationssystem. Användningen av begreppen ”tillgänglighet”, ”autenticitet”, ”riktighet” och ”konfidentialitet” i definitionen avser alla fyra skyddsmål som rör säkerheten i nät- och informationssystem. Begreppet ”nätverks- och informationssystem”,

9. Ett annat viktigt övervägande vid bedömning av en sektorsspecifik unionsrättsakts likvärdighet med kraven i artikel 21.1 och 21.2 i direktiv (EU) 2022/2555 är att de riskhanteringsåtgärder för cybersäkerhet som krävs enligt rättsakten bör vara baserade på en ”allriskansats”. Eftersom hot mot säkerheten i nätverks- och informationssystem kan ha olika ursprung kan alla typer av händelser ha en negativ inverkan på entitetens nätverks- och informationssystem och potentiellt leda till en incident. Därför bör de riskhanteringsåtgärder för cybersäkerhet som entiteten vidtar skydda inte bara entitetens nätverks- och informationssystem utan också dessa systems fysiska miljö mot sådana händelser som sabotage, stöld, brand, översvämning, telekommunikations- eller elavbrott eller obehörig fysisk åtkomst som kan undergräva tillgängligheten, riktigheten, integriteten eller konfidentialiteten hos lagrade, överförda eller behandlade uppgifter eller hos de tjänster som erbjuds genom eller är tillgängliga via nätverks- och informationssystem. Följaktligen bör de riskhanteringsåtgärder för cybersäkerhet som krävs enligt en sektorsspecifik unionsrättsakt specifikt skydda nätverks- och informationssystemens fysiska säkerhet och säkerheten i deras miljö från systemfel, mänskliga misstag, skadliga handlingar eller naturfenomen[4].

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Automated Infrastructure Management Standards

- ISO/IEC 18598
  AIM Standard
- ANSI/TIA-5048
  AIM Standard
- CENELEC EN 50667
  AIM Standard
- ANSI/TIA-606B
  Addendum 1
- ANSI/TIA-5017
  Physical Network Security
- ISO/IEC 14763-2
  Cabling installation and operation
- BICSI 00xz9-2019
  DC Operations and Maintenance Best Practices

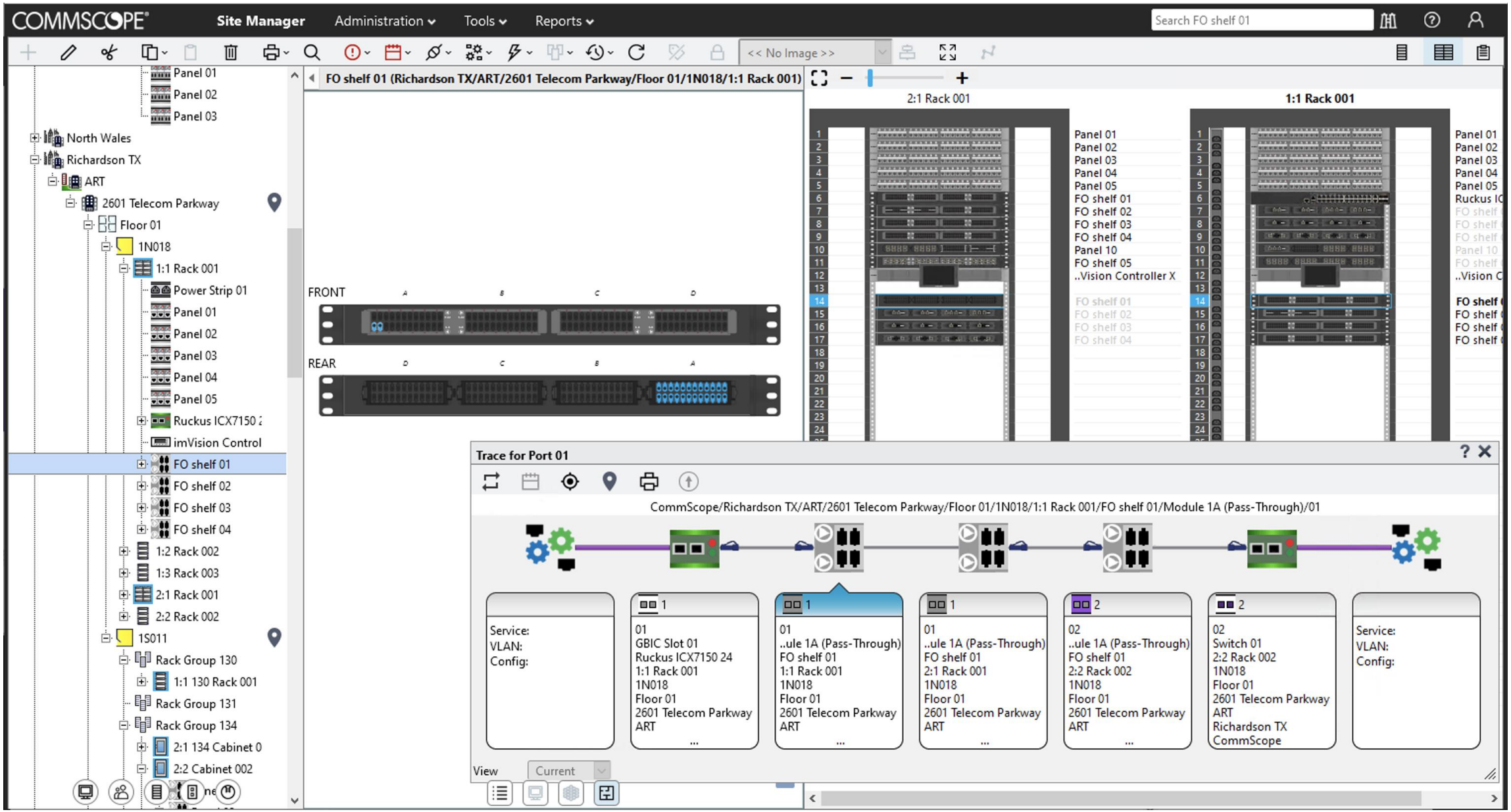
Automatic Detection Of The Insertion And Removal Of Cords

Real-time Monitoring Of Connectivity Changes

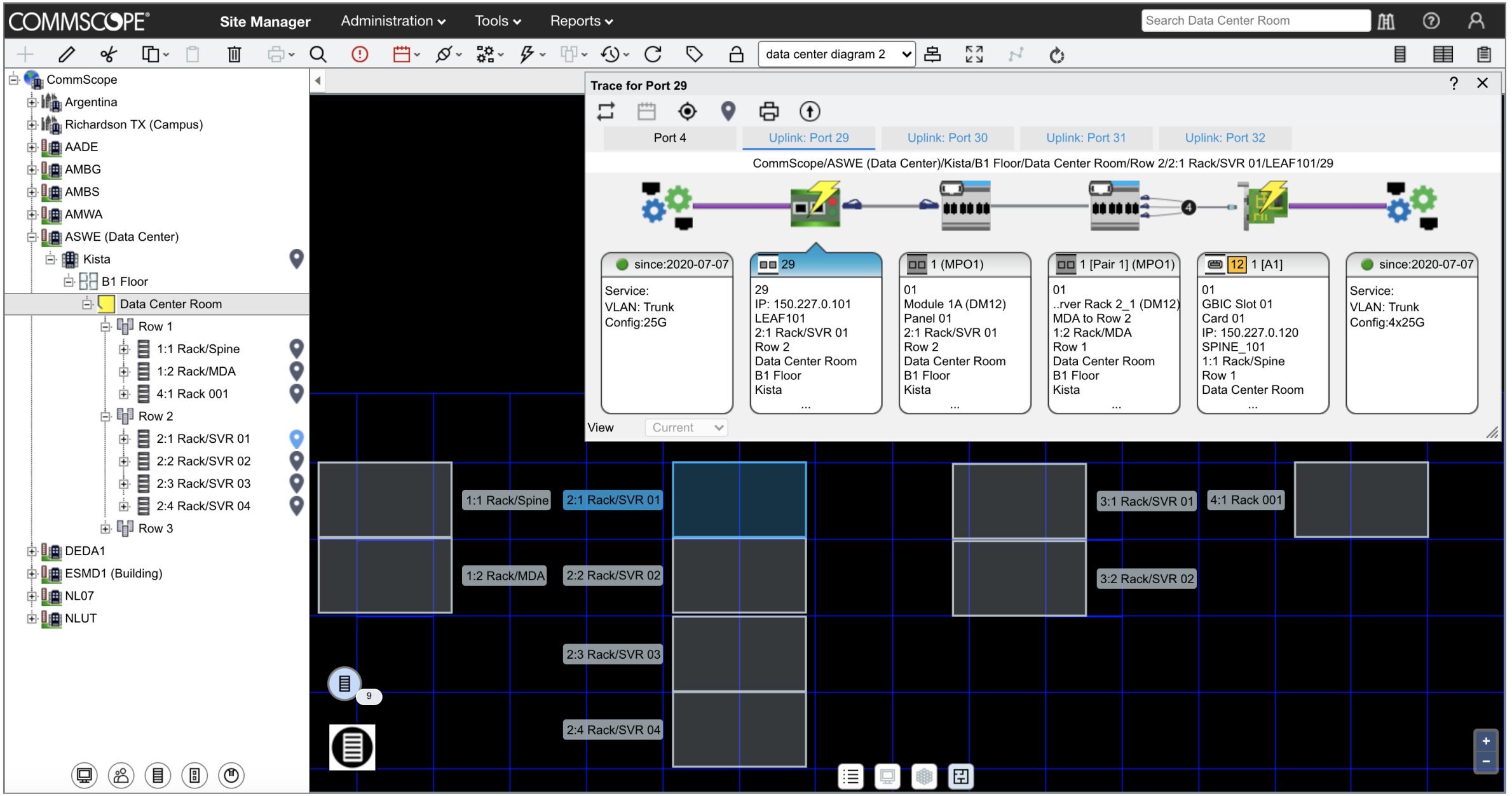
Network Device Discovery And Their Location Information

Document Cabling Infrastructure

Data Center: Rack Elevations and Panel View



Data Center: Floor Plan with Racks and Point-to-Multipoint Connectivity



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Get control over the physical layer

- Planning of changes reduce risk
- Up to date documentation
- Complete list of devices and their location
- Find physical location when security event occurs
- Work orders
- API for integration with other systems
- Local support

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