



**smar**to**ptics**

Universal Data Center Connectivity

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# We are Smartoptics

Optical transmission solutions making networks more powerful

## COMPANY

Established: 2006  
HQ: Oslo Norway  
R+D: Stockholm Sweden  
Sales: Europe, US, Australia

## STRONG GROWTH

18 consecutive profitable quarters  
20% year on year growth  
Service providers, media and entertainment, corporate data centers, Internet exchanges

## TECHNICAL EXCELLENCE

Strong transmission and DWDM background.  
Smart, intelligent cost effective solutions for demanding network tasks.  
Complete network solutions

## STRATEGIC ALLIANCES

Unique Brocade, Netapp, HDS, EMC partnerships.  
HPE Complete partner  
Worldwide reseller / integrator network

## INNOVATIVE DESIGNS

Revolutionize network services and decrease costs.  
World first distance extending passive multiplexer  
Brocade approved embedded 16/8GFC DWDM solutions

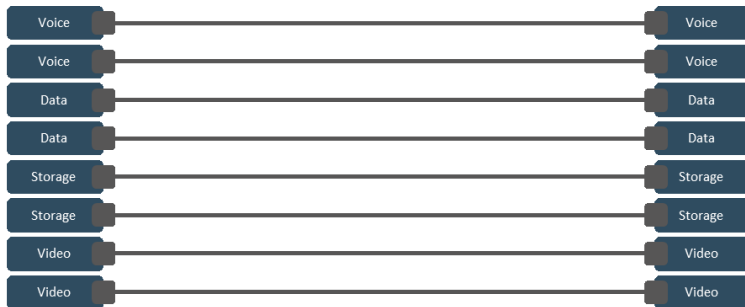
## OUR CULTURE

Straight forward and personal  
Business partnerships that drive new levels of performance  
Innovation that leads to disruptive solutions to network build



# What is xWDM?

Simultaneously transporting multiple traffic on a single dark fiber network



## Individual dark fibers required per service

Multiple fibers required (wasteful and high Opex)

Single channel (grey) transceivers



## WDM

Multiple services transported together on one dark fiber

Wavelength specific (colored) transceivers connect to a multiplexer

Single dark fiber connection required instead of multiple

Maximizes fiber utilization and significantly reduces opex

Huge amounts of data can be synchronously connected between sites

# CWDM or DWDM?

## Coarse Wavelength Division Multiplexing

Up to **18** wavelength channels

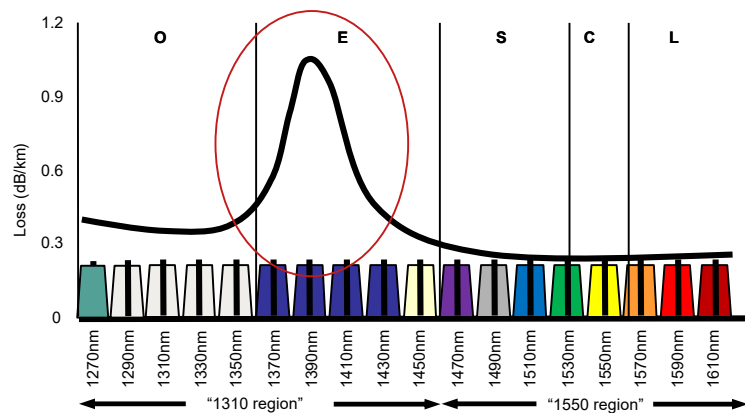
**20nm** channel spacing

**70km, unamplified** only technology

Water Peak limits usable range

Sweet spot: **1GE and 4/2/1GFC**

Historically was lower in cost, large install base



## Dense Wavelength Division Multiplexing

Up to **80** wavelength channels

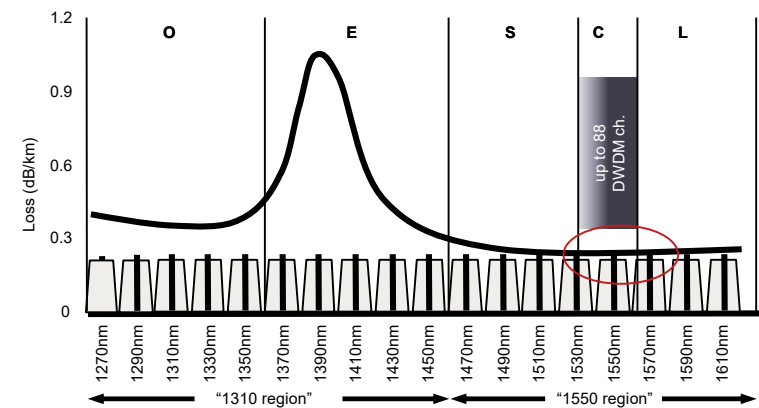
**0.8nm** channel spacing

**80km** unamplified, **200km** amplified, 1000km+ with regen

Flat region avoids Water Peak and is ideal for amplification

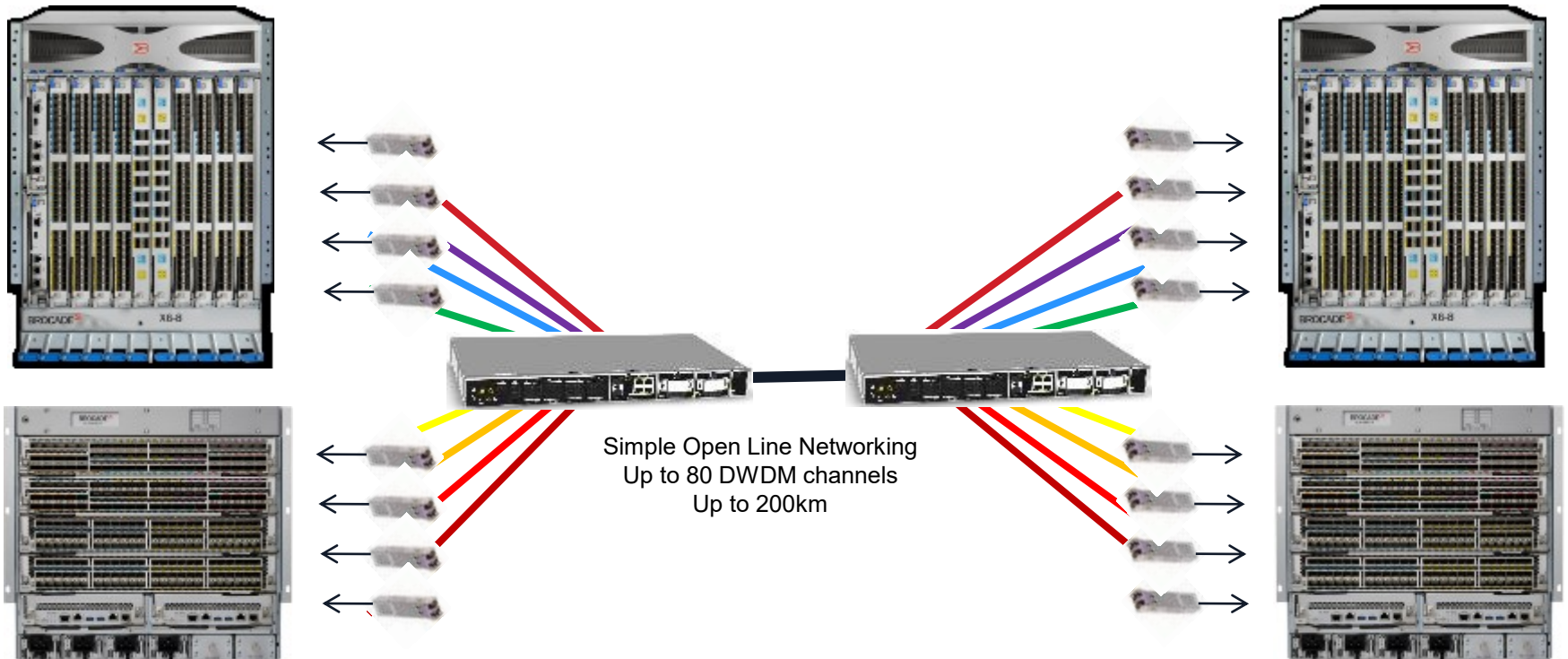
Sweet spot: **100/40/10GE and 32/16/8G FC**

Technology of choice for green field installations



# Embedded xWDM – its so simple

## SFP based Data Center Interconnect (DCI) solutions



- Use colored xWDM SFPs directly in SAN/IP switch
- Mux/Demux combines wavelength channels on to a single dark fiber
- LC patch cable connects transceiver to multiplexer
- Single channel connectivity, 16ch CWDM, 88ch DWDM



smartoptics

Embedded 16G Fibre Channel

Modular 100G

Transponders & Muxponders

M-Series

Open line networking

Inline amplification with OADM

smartoptics

**Smartoptics and Brocade**

**The strategic alliance**

# Brocade alliance

Best in class one stop solutions for SAN connectivity

Embedded 16/8G FC CWDM/DWDM transceiver solutions

32G embedded GEN6 switch support (G620, X6, SX6)

Layer 1 approvals that support Brocades functions:

D-Port testing / SAN health check / Encryption / FEC / ISL trunking

No specific DWDM configurations

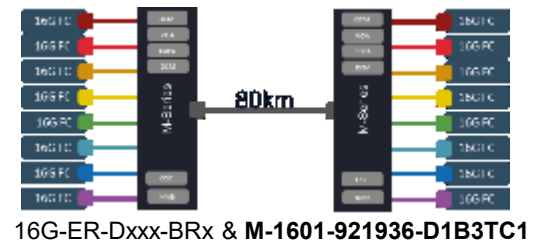
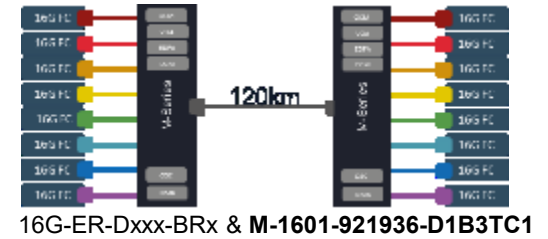
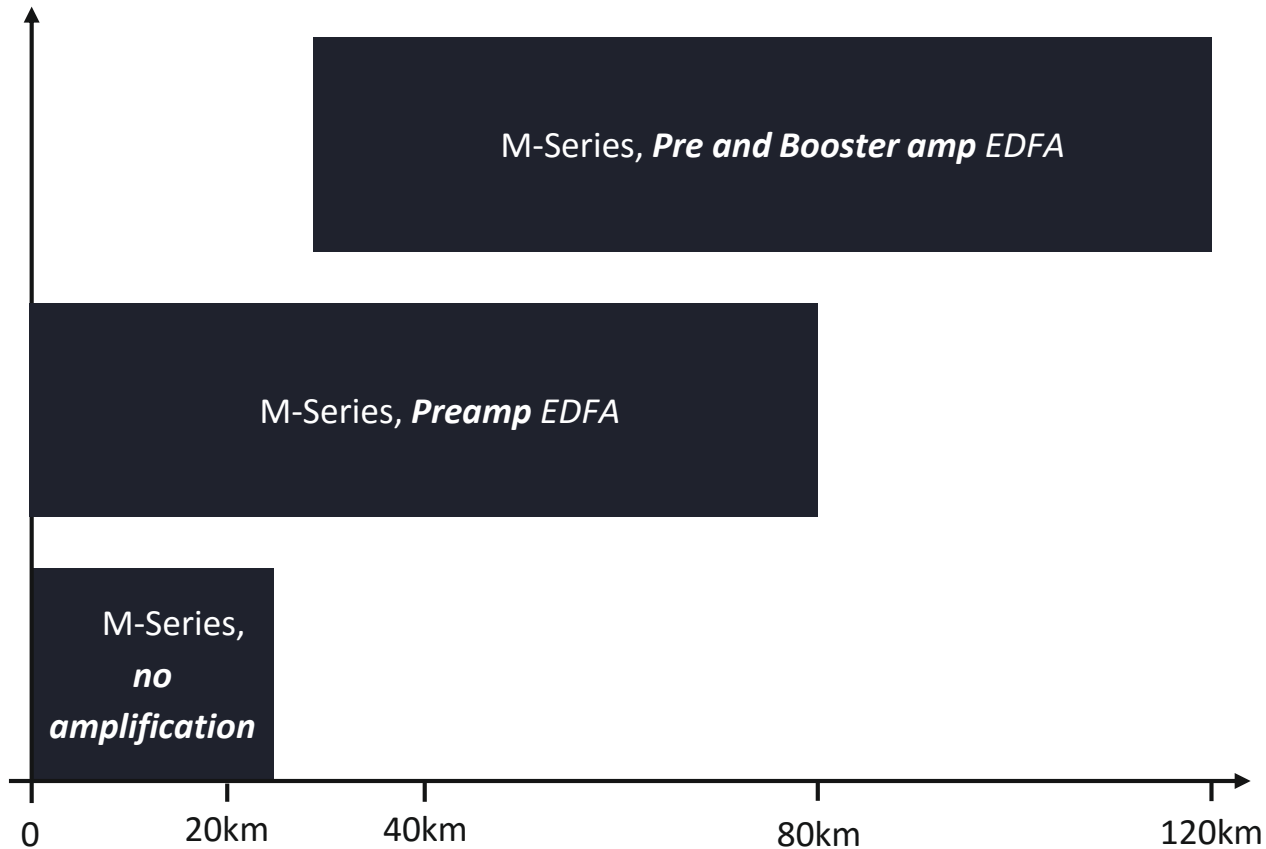
(transponder systems are complex and require R\_RDY mode)

100's km plug and play synchronous replication

Low cost green data center networking



# Importance of M-Series to 16/32G FC DCI



16/32G FC transceiver networking limited to approx. 25km without additional amplification

M-Series increases the reach of embedded 16G FC networking, same plug and play approach

Simplifies DWDM networking by removing need for complex transponder systems

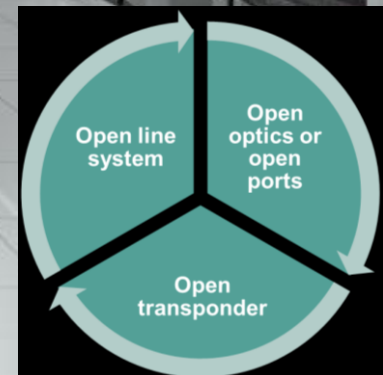


# Decentralized Open line networking



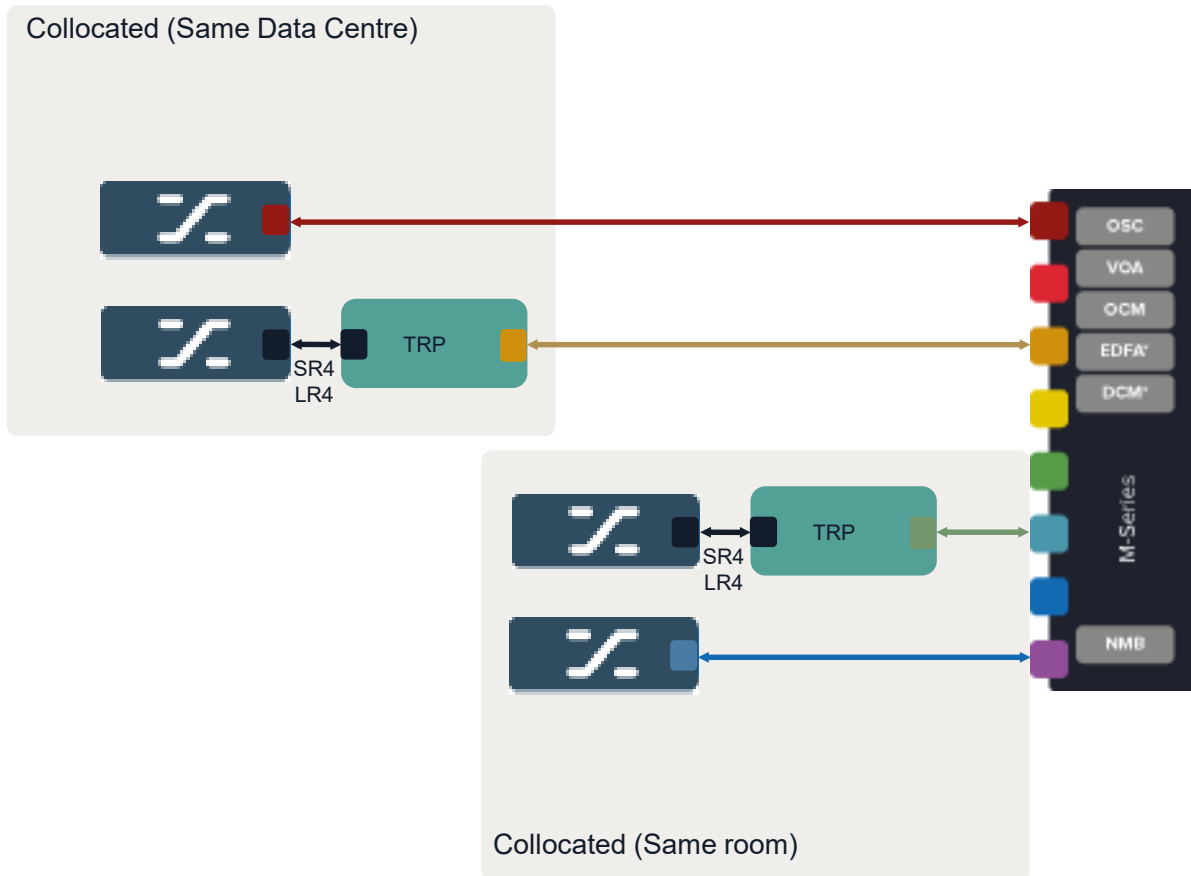
## DCP-M

Open line networking DWDM multiplexer  
Any mix of DWDM transceivers and transponders  
DWDM elements placed where required in DC not tied to central chassis  
Up to 200km (600km repeater mode)  
Traffic monitoring



# Open line system for fully heterogenous networking

Flexible service offerings

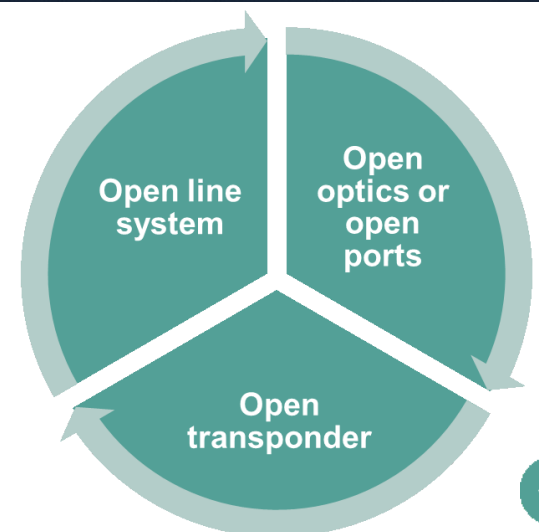


Decentralized DWDM networking

Embedded DWDM direct in to Router

SR4/LR4 Conversion via a DCP101  
(Open Transponder as a service)

Interconnect from Remote DCP101 or  
3rd party DWDM line System



# Complete QSFP28 transceiver portfolio



## SO-QSFP28-SR4

QSFP28, 100GBase, 850nm,  
MM, DDM, 100m@OM4, MPO

New



## SO-QSFP28-SWDM4

QSFP28, 100GBase, SWDM4,  
MM, 100m@OM4, MPO



## SO-QSFP28-LR4

QSFP28, 100GBase, 1310nm,  
SM, DDM, 10km, LC

New



## SO-QSFP28-LR4-10L

QSFP28, 100GBase, 1310nm, SM,  
DDM, 10km, LC, DML Type

New



## SO-QSFP28-LR4-2L

QSFP28, 100GBase, 1310nm, SM,  
DDM, 2km, LC, DML Type



## SO-QSFP28-CWDM4

QSFP28, 100GBase, CWDM4,  
SM, 8dB, 2km, LC



## SO-QSFP28-ER4

QSFP28, 100GBase, 1310nm,  
SM, DDM, 25km, LC

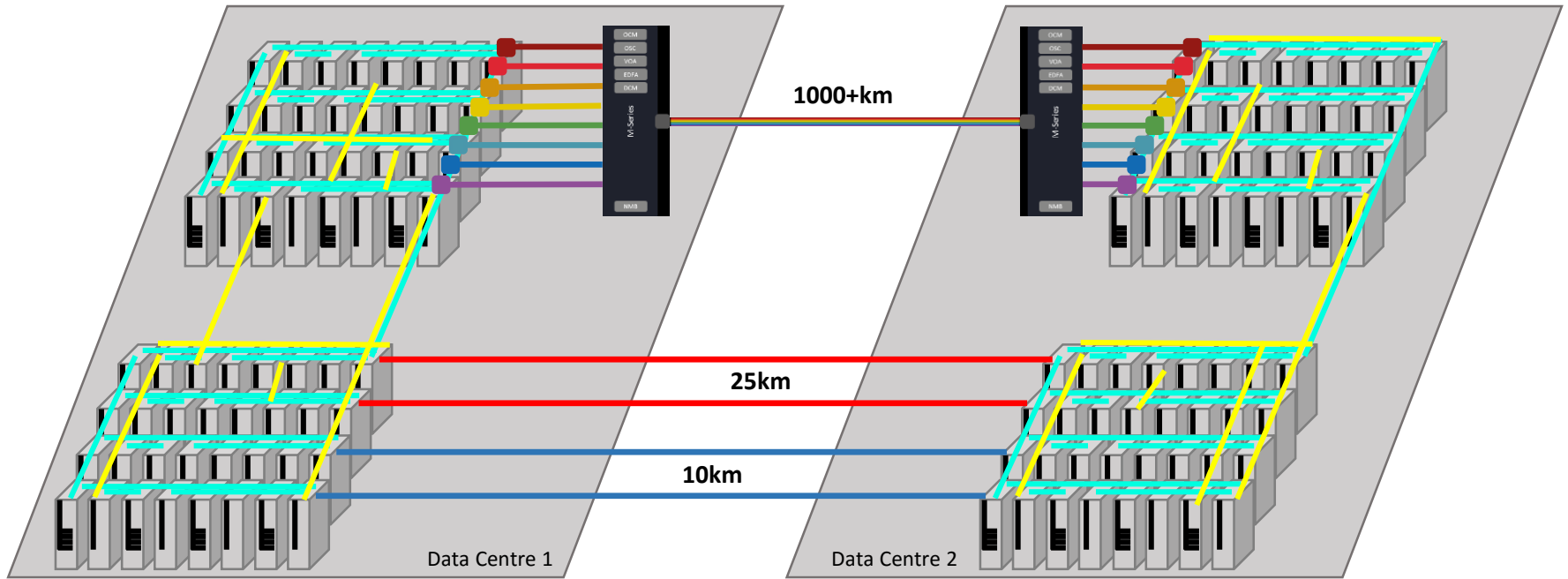
New



## SO-QSFP28-PSM4

QSFP28, 100GBase, 1310nm,  
SM, DDM, 2km, MPO





### Intra rack



#### DAC - Direct Attached Copper

Low cost cable assembly server to top of rack  
Removes dirty connector problems  
0-3m in the rack



#### AOC - Active Optical Cable

Cable assembly  
Same performance as using MM transceiver  
0-100m



#### Multimode transceivers

Lowest cost transceivers  
MPO connectors, special Ribbon cables  
0-100m

### Inter rack



#### AOC - Active Optical Cable

Cable assembly  
Same as using MM trx  
0-100m



#### Multimode transceivers

Lowest cost transceivers  
MPO connectors, special Ribbon cables  
SR4 100m, PSM4 2km



#### Singlemode transceivers

Structured cabling  
LR4 2&10km, CWDM4 2km

### Data Center Interconnect (DCI)



#### Single channel

Single service per fiber  
LR4, 2&10km



#### Single channel

Single service per fiber  
ER4, 25km



#### DWDM Open Line System

1U DWDM Mux/Demux  
monitoring and distance extension  
Any SAN and WAN traffic  
Zero touch provisioning



# CFP / CFP2 to QSFP28

## Converter solutions

### SO-CFP-QSFP28

CFP to QSFP28 converter

QSFP transceiver and converter instead of CFP

Full QSFP28 portfolio can be used

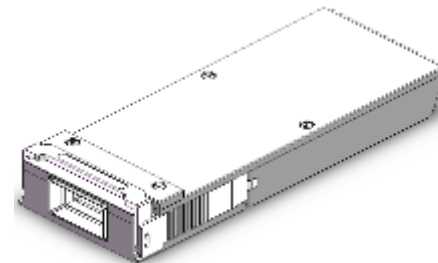
Lower cost and transceivers can be reused if CFP blades replaced



### SO-CFP2-QSFP28

CFP2 to QSFP28 converter

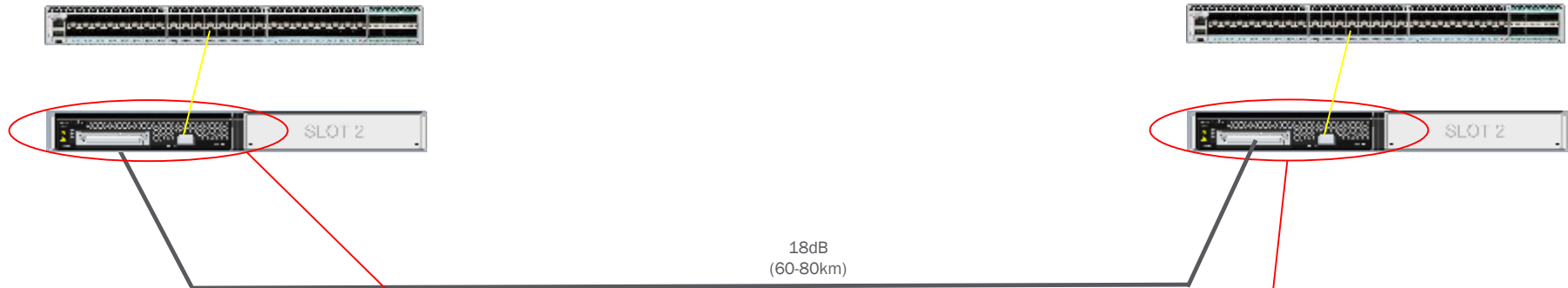
QSFP transceiver can be used instead of CFP2



# Task: How to connect 100G over distance?



# 100G Distance Extension



## DCP-101



Coherent CFP  
to line fiber



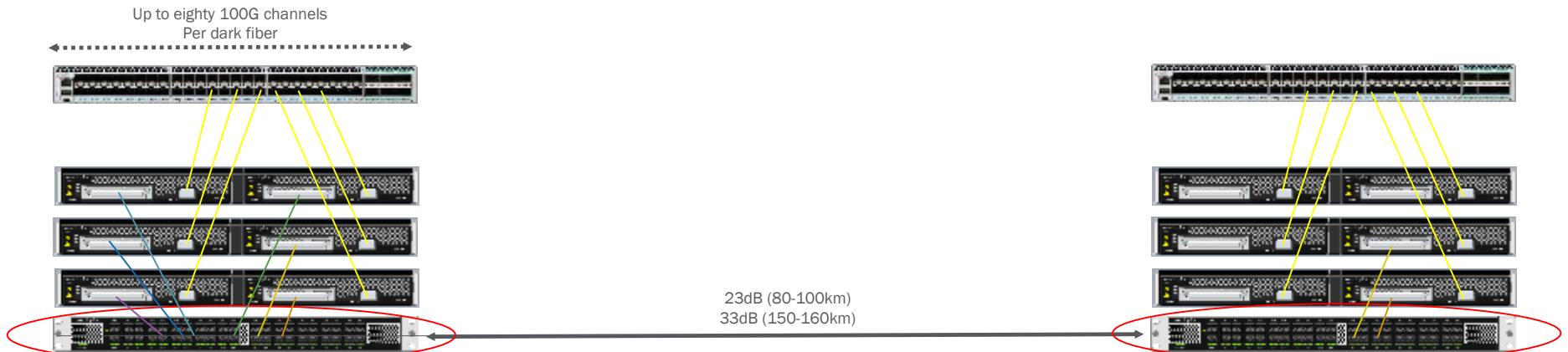
QSFP28 to  
100G switch

Low power 100G DWDM transponder  
Metro and long haul applications  
Back to front / front to back airflow  
CLI and SNMP interfaces  
Modular plug and play system

Supported QSFP28 optics:

<b>SR4</b>	MM 100m
<b>LR4</b>	SM 10km
<b>CWDM</b>	SM 2km
<b>PSM4</b>	SM 10km
<b>CR4</b>	CR4 1,2,3 & 5m

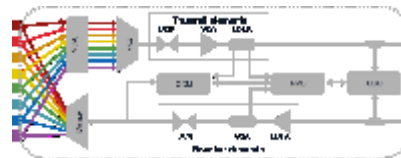
# 100G Distance Extension with intelligent DWDM



## DCP-M



To line fiber      To DWDM specific CFP channels on DCP-101s

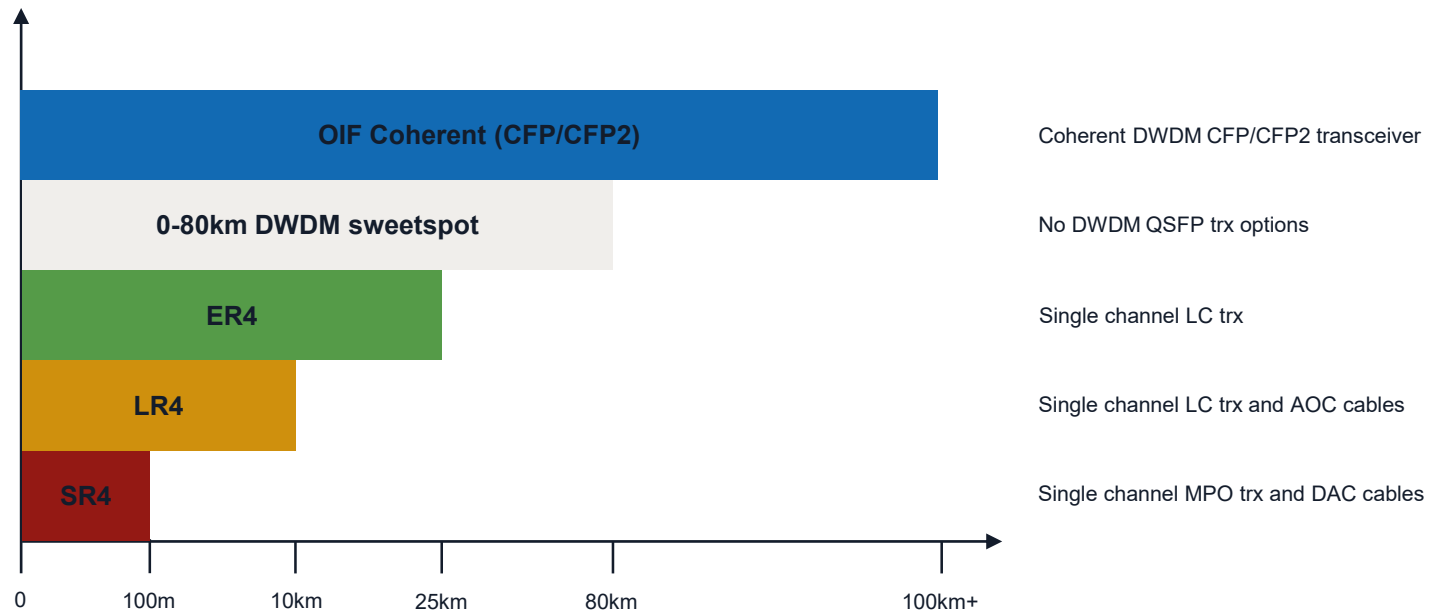


World's first distance extending DWDM multiplexer  
Zero touch optical DWDM platform for DCI networking  
Integrated distance extension, management, fiber analysis  
Self provisioning operation  
Any mix of 100/40/10GE and 32/16G FC on same dark fiber



# 100G transceiver types

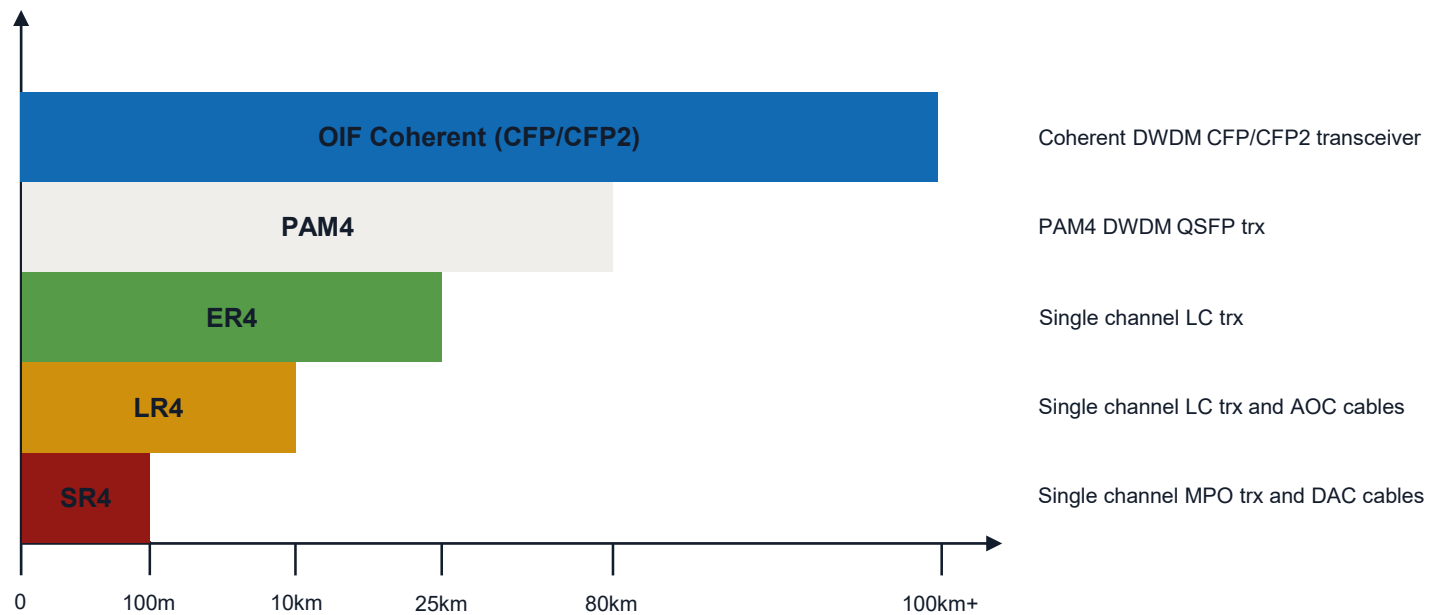
## DCI connectivity options



DWDM and distance extension connectivity is problematic for QSFP28  
CFP is too large and expensive for embedded approach  
Gap exists for QSFP28 DCI

# PAM4 transceiver architecture

## 100G DCI connectivity options



PAM4 Pulse Amplitude Modulation optical transceiver  
100G DWDM QSFP28 form factor transceiver

# QSFP28 problem solved then

Right?

## Features

Embedded DWDM approach extended to 100G

QSFP28 form factor transceiver embedded in data switch

40 DWDM channels per 1U

8Tb/s capacity per fibre pair. Minimal space & power reqts

No additional transponder transport layer (embedded DWDM approach)

No complex software (Zero touch open line system)

## Enabling

New DC's to be brought on line as integrated elements of a larger infrastructure

Flexible expansion to new lower cost locations with no change in architecture

Standardisation for geographically distributed topologies

Simple and Cost effective 100G connectivity

# QSFP28 problem solved then

Not quite

## **PAM 4 transceivers require:**

Amplification	Without it, it cannot be connected back to back
Dispersion Compensation	Without it, it is limited to ~6 km G652 fiber (17 ps/(nm*km))

**They have:**

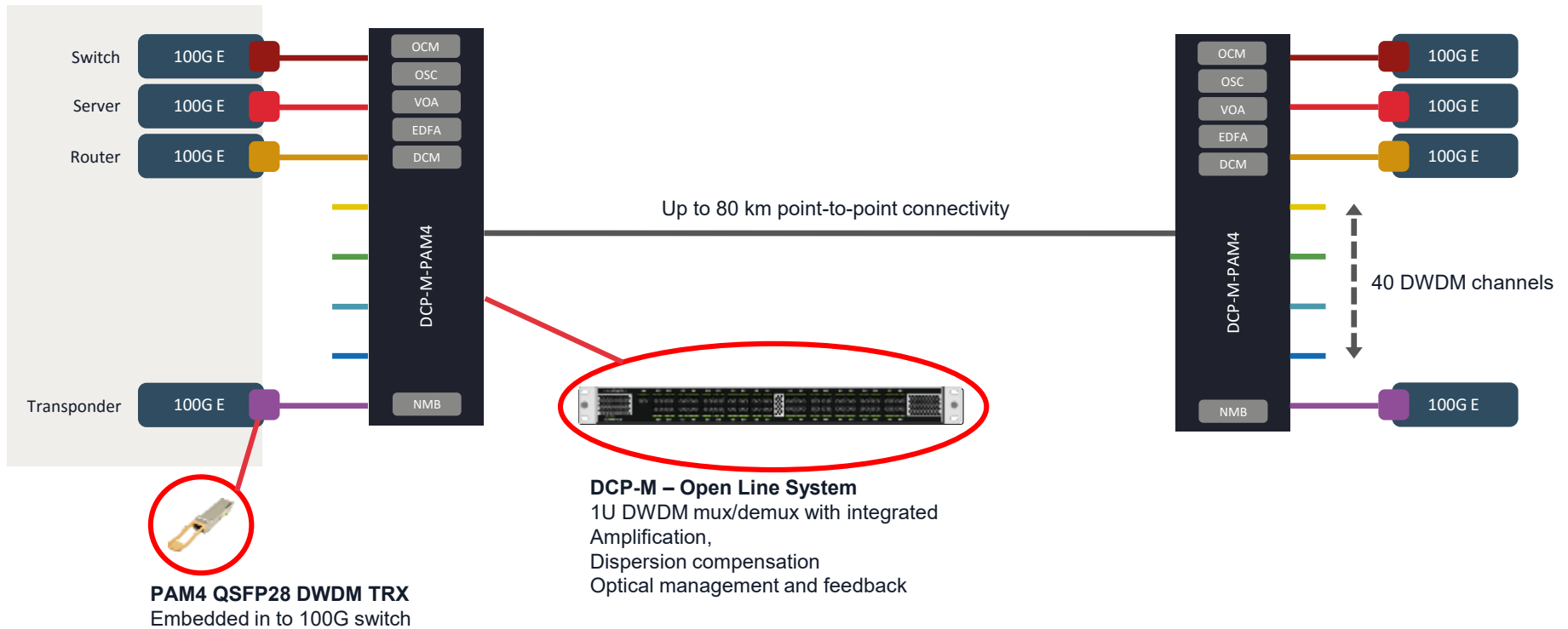
- low output power
- High OSNR requirements
- High required input power

**And to travel greater than 0km, a line system is required**

Amplification • Dispersion Compensation • DWDM multiplexer • Management System

# DCP-M-PAM4

DCP-M optimized for PAM4 DCI



# DCP-M40 validated with Inphic Colorz™ PAM4



## Smartoptics validates interoperability of M-Series with Inphi's Colorz™ PAM4 DWDM QSFP28

Oslo, Norway and UK – March 20<sup>th</sup>, 2017 – Norway-based Smartoptics, a leading provider of optical networking solutions has announced that it has successfully validated interoperability of its M-Series platform with Inphi Corporation's Colorz™, the industry's first Silicon Photonics 100G Pulse Amplitude Modulation (PAM4) platform solution for 80km DWDM Data Center Interconnect (DCI) in QSFP28 form factor.

Smartoptics is validating the market once again with the validation of Inphi's for use with our i-Clear2 platform solution. Clear2 utilizes advanced PAM4 signaling and delivers up to 4Tbps of bandwidth over a single fiber, allowing multiple data centers located up to 80km of each other to be connected and act like a single data center. M-Series is the perfect complement to the Clear2 platform solution for long distance DCI applications to a wide-extended optical metropolitan networking of data.

Seem Davies, Co-Founder, Marketing and OEM Director at Smartoptics, offers a refreshing simple belief in optical connectivity and is continuing to build on its position of providing a simple and cost-effective DCI portfolio. M-Series takes full advantage of the advances in PAM4 technology and is the ideal complement to expand Clear2 platform solution.

"We are pleased to see Smartoptics validating a compact DCI platform offering a plug and play solution compatible with Clear2 to finally provide a simple solution for customers looking to move up their game, taking full advantage of Clear2 and enables faster transaction cycles for 100Gbps data center connectivity," said Dr. Lotte Haggen, founder, senior vice president, Optical Interconnect at Inphi.

Smartoptics designs and enhances existing optical fiber optic networks through simple and cost-effective DWDM and DWDM based solutions. Features include: flexible, scalability and cost efficiency. Instead of complex and expensive telecom grade solutions, Inphi Smartoptics revolutionized the DWDM market by introducing the world's first intelligent, modular, plug-and-play, cost-effective, and easy-to-use, multi-wavelength, multi-channel, and distance extension features of a traditional fixed DWDM system. Key features include:

- Intelligent 1U DWDM Multiplexer
- up to 80 DWDM channels
- plug-and-play, modular, intelligent
- optical channel monitoring and supervisory channel
- automatic distance measurement function
- data provisioning with tunable dispersion compensation module (DCM)

Smartoptics offers optical transmission solutions making networks more powerful, expanding network virtualization, reducing investment or make of traditional DWDM products from Smartoptics allow corporate data centers, government, making solution providers and service providers and providers the cost-effective solutions to fulfill their ongoing and future network capacity needs. Headquartered in Oslo, Norway, Smartoptics is an international provider with thousands of installations all around the world. The award-winning approach has helped companies from every industry sector stay ahead of increasing network demands. [Learn more at www.smartoptics.com](http://www.smartoptics.com)

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Follow the link:

<http://www.smartoptics.com/news/smartoptics-validates-interoperability-m-series-inphi-colorz-pam4-dwdm-qsfp28/>



# 100G interop

Brocade

Solution Brief approved and going live at Brocade



If you go to the bottom of here  
<http://www.smartoptics.com/partners/>

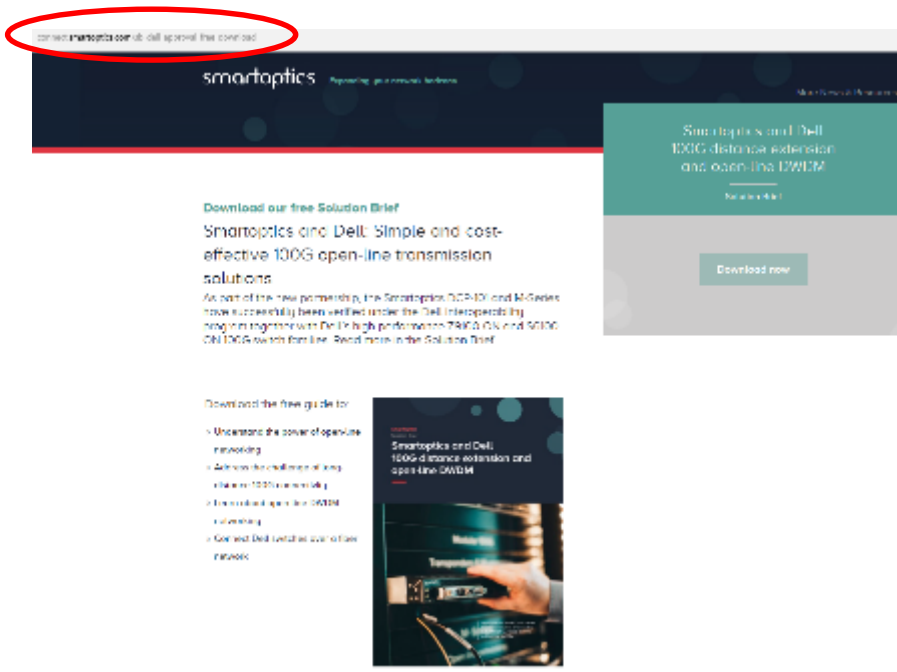
# 100G interop

Dell



**Dell Technologies** is Dell, Dell EMC, Pivotal, RSA, SecureWorks, Virtustream, and VMware. A collective force of innovative capabilities trusted all over the world to provide technology solutions and services that accelerate digital transformation. Together, Smartoptics and Dell provide simple and cost-effective 100G open-line transmission solutions that enable the Dell Z9100-ON and S6100-ON 100G switch families to be connected over dark fiber.

Read more in the Solution Brief ← If you click this



If you go to the bottom of here <http://www.smartoptics.com/partners/>

← You find this



# Strategic alliances

Best in class solutions. Approved by leading switch vendors.

Storage Area Networking

**BROCADE**

**CISCO**

SAN OEMs

**DELL**

**Hewlett Packard  
Enterprise**

**IBM**

**EMC<sup>2</sup>**

**HITACHI  
DATA SYSTEMS**

**NetApp**

Cloud Computing

**Inphi**  
*Think fast.*

**Edge-core**  
NETWORKS

**PICAO**  
WHITE BOX SDN

**ipinfusion**



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