Объединение дата-центров через сеть WDM с FSP 3000 и Cloude connect

Олег Агапов
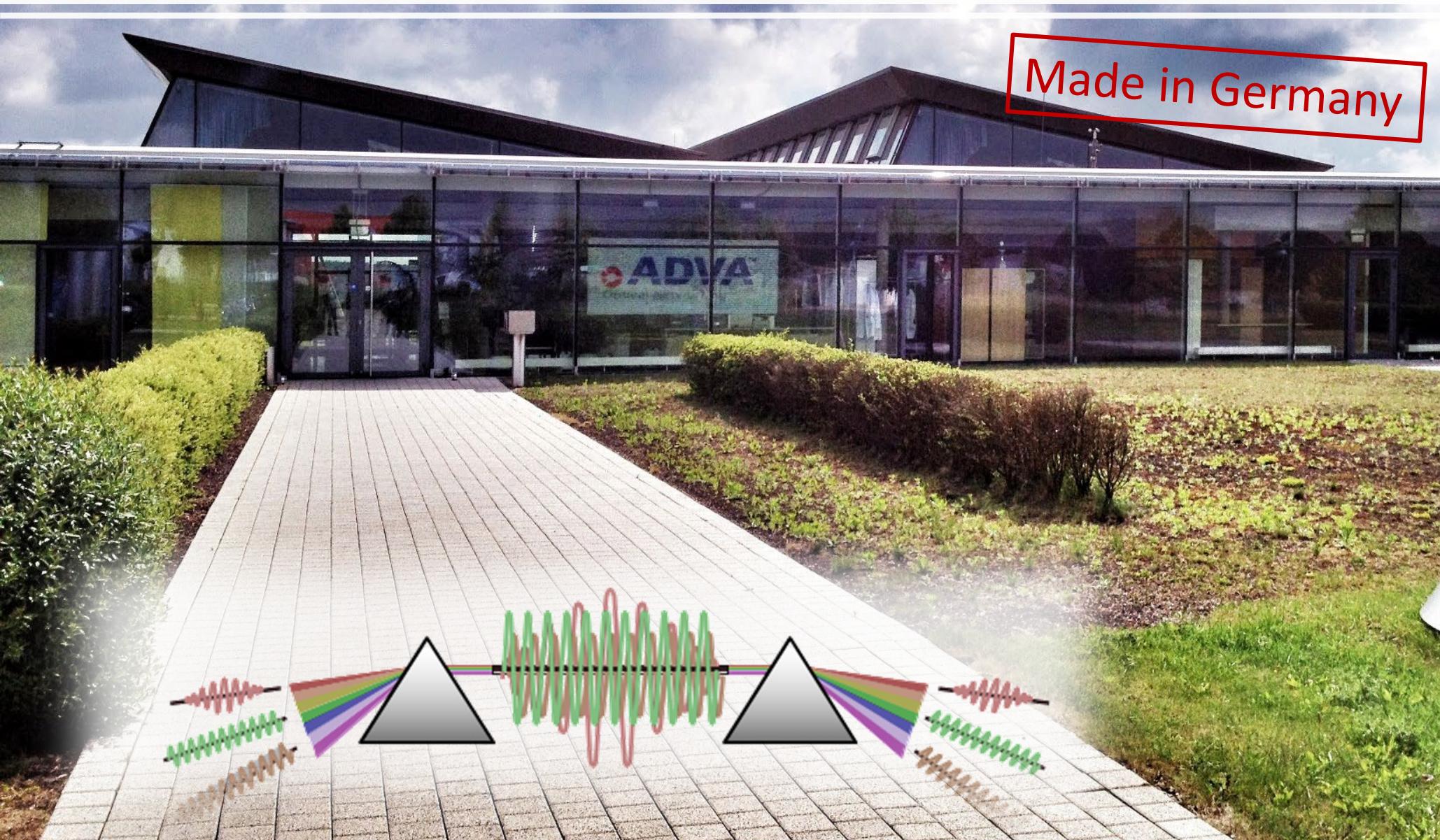
Компания ADVA

- Штаб-квартира – г. Мюнхен, Германия;

- Офис в Берлине

- Производство – г. Майнинген (бывшие производственные помещения "Robotron", Германия;

- Представительства в 15 странах мира: Германия, США, Австрия, Великобритания, Норвегия, Италия, Польша, Франция, Китай, Япония, Индия, ОАЭ, Швеция, Сингапур, Южная Африка.

- Штат сотрудников - в настоящее время в компании насчитывается свыше 1500 человек.
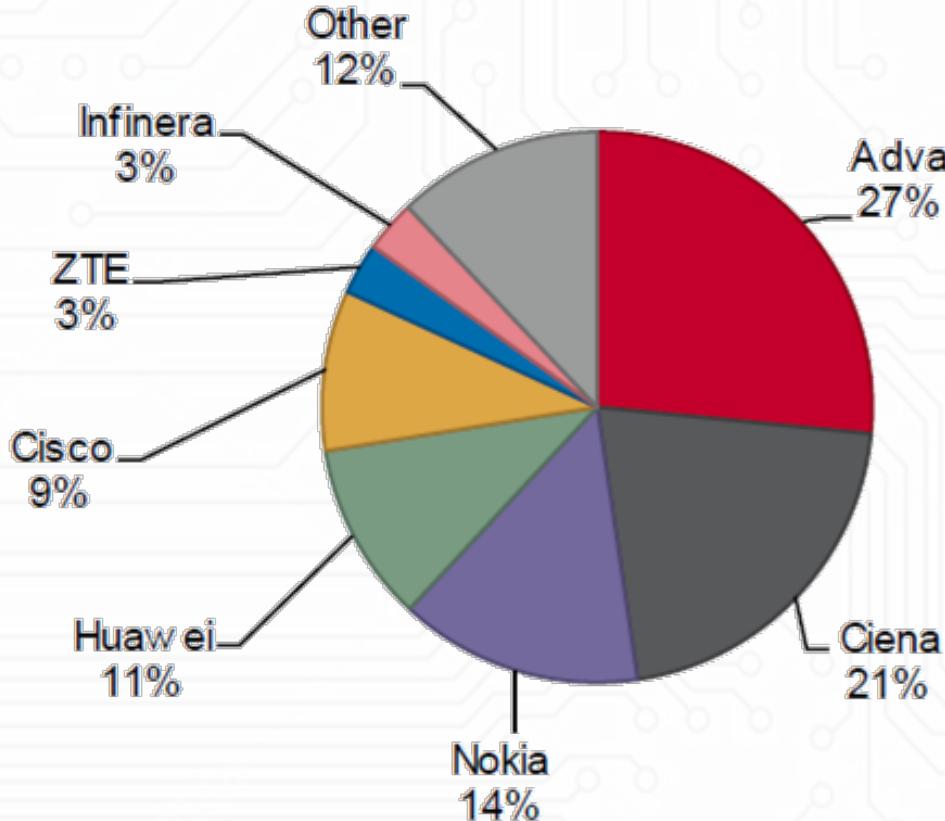
Завод Meiningen, Germany

Made in Germany
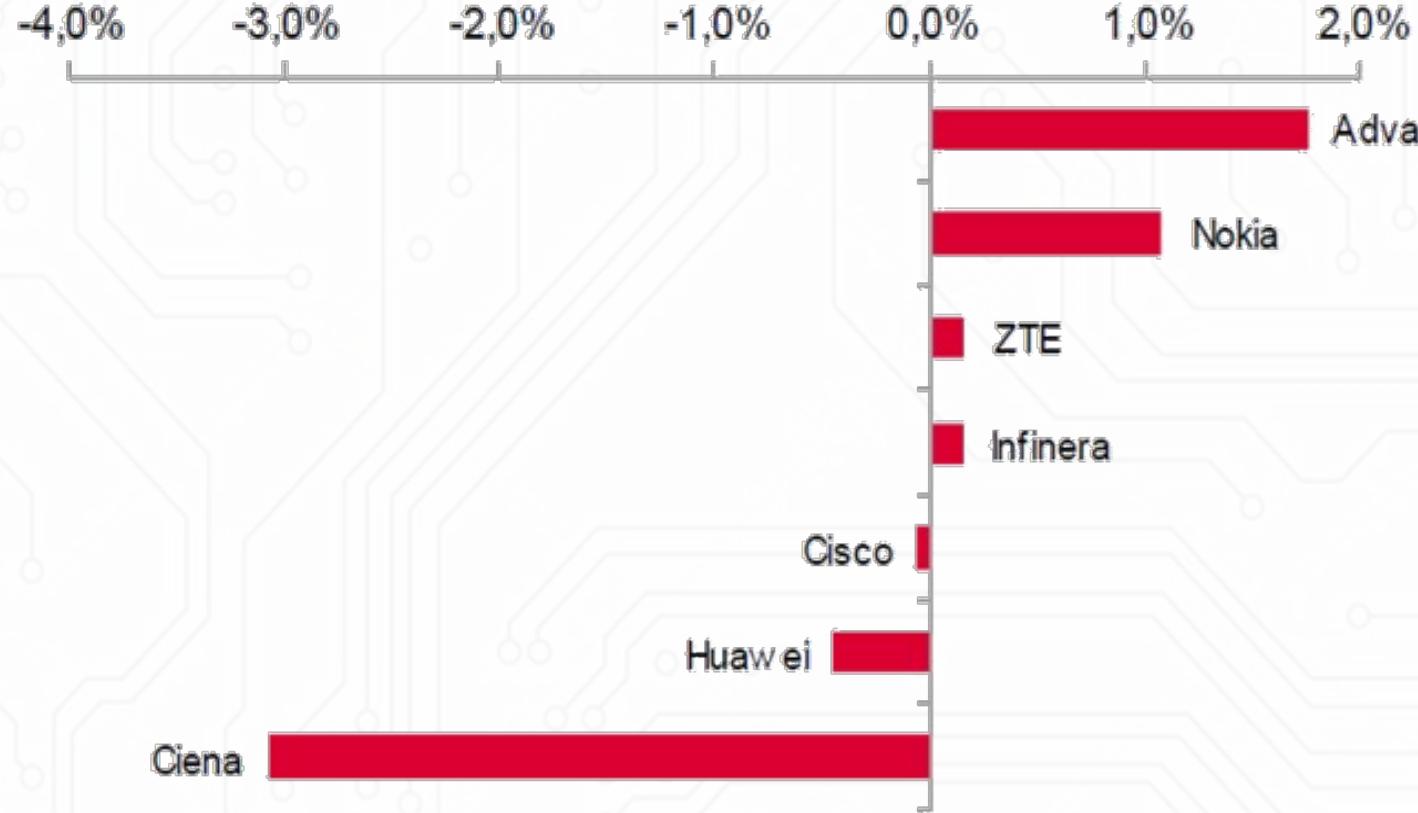
Доля рынка для решений-Enterprise DCI

3Q15–2Q16: $0.3bn market

Other 12%
Infinera 3%
ZTE 3%
Cisco 9%
Huawei 11%
Nokia 14%
Adva 27%
Ciena 21%

Share change vs. 2Q15-1Q16

-4,0% -3,0% -2,0% -1,0% 0,0% 1,0% 2,0%

Adva
Nokia
ZTE
Infinera
Cisco
Huawei
Ciena

Подтвержденная клиентская база в Европе, России и СНГ

История компании ADVA

Scaling the business

>1500 employees
Revenue >USD 500 million
Award winning supply chain

Going global

Expansion in North America
Revenue >USD 250 million

Foundation
of the company

Going public
FSE: ADV

| 1994 | 1999 | 2000 | 2006 | 2010 | 2013 | 2016 | 2020 |

First product

Metro-WDM for enterprise DCI

Adding Ethernet

First fiber-based Ethernet services

Portfolio expansion

Optical+Ethernet Network automation

Strategic acquisitions
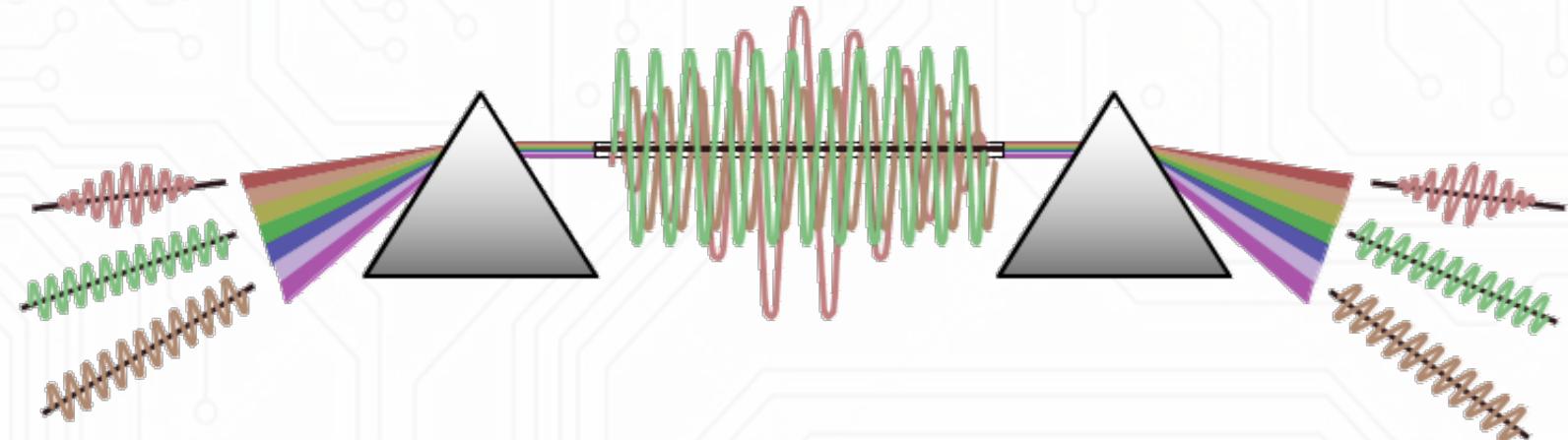
Synchronisation Software and virtualization

# 2001: ADVA FSP-II –the first Cisco DWDM "Metro 1500"-Series (OEM contract)
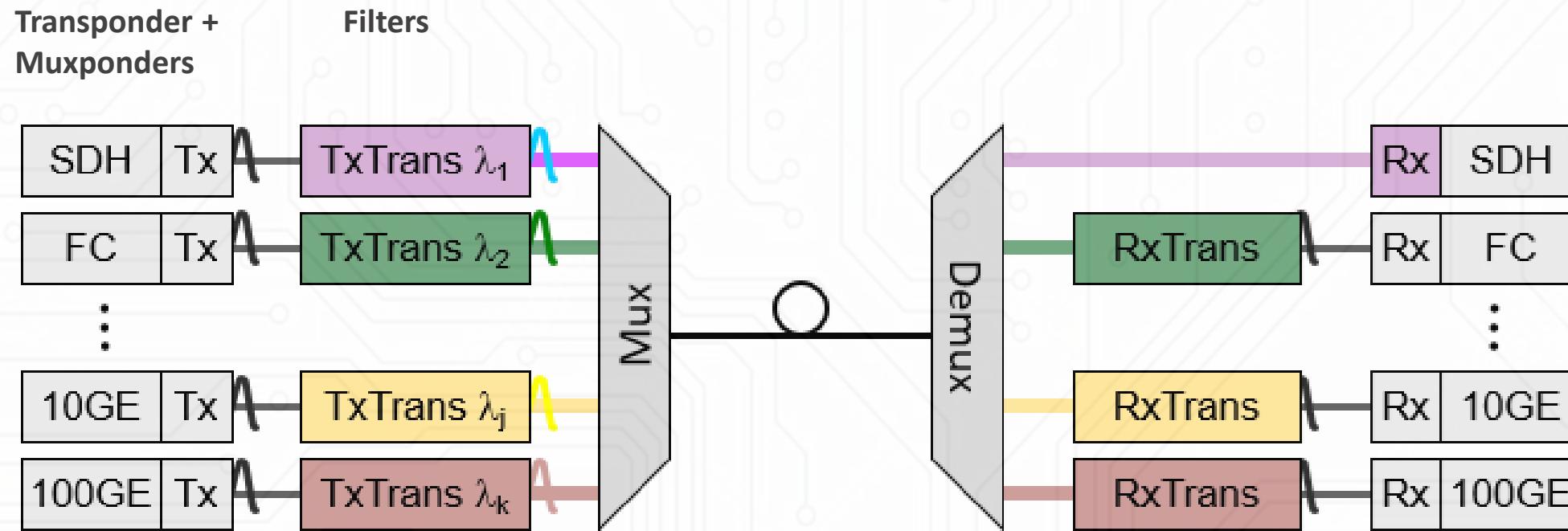
ESCON, CLO, CLR, FastE, ATM, 1GE

Wavelength Division Multiplexing

Общая схема построения WDM сети

**Transponder +
Muxponders**

Filters

Новые технологии

Open Optical Transport

Most cost-, space- and power-efficient product

Multi-Tbit/s flexibility and scalability

Open optical line system

Network Encryption

Fixed and mobile user secure cloud access

Secure business Ethernet connectivity

Lowest latency inflight encryption
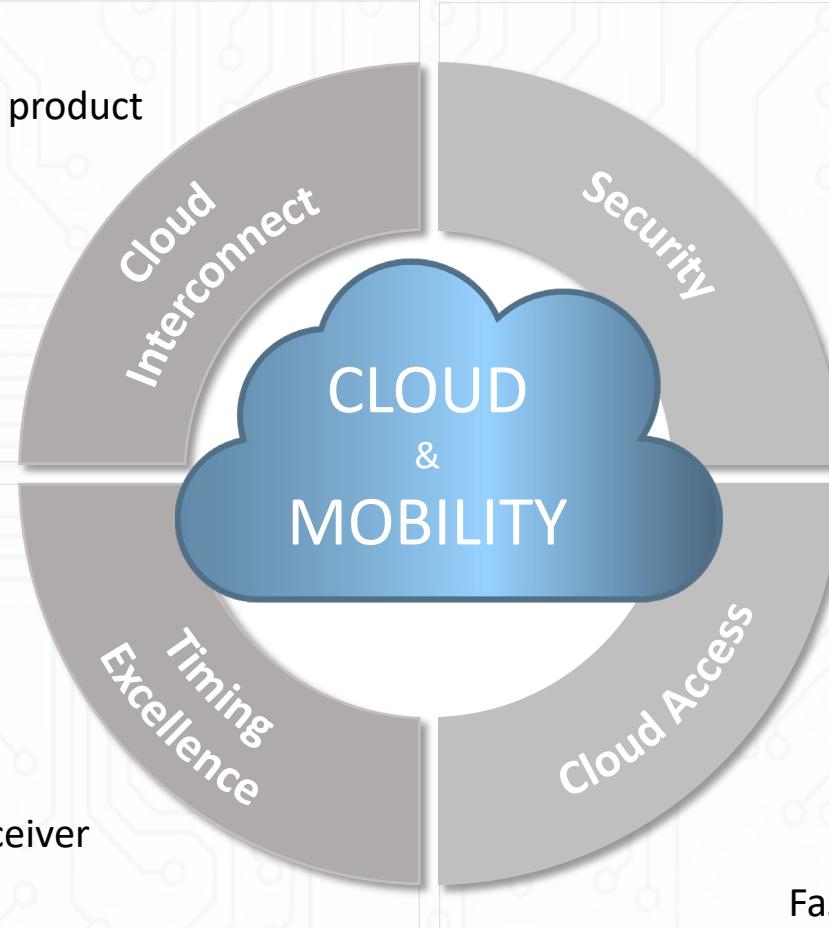
Network Synchronization

Cesium primary reference clock source

Modular PTP grandmaster and GNSS receiver

PTP grandmaster on SFP
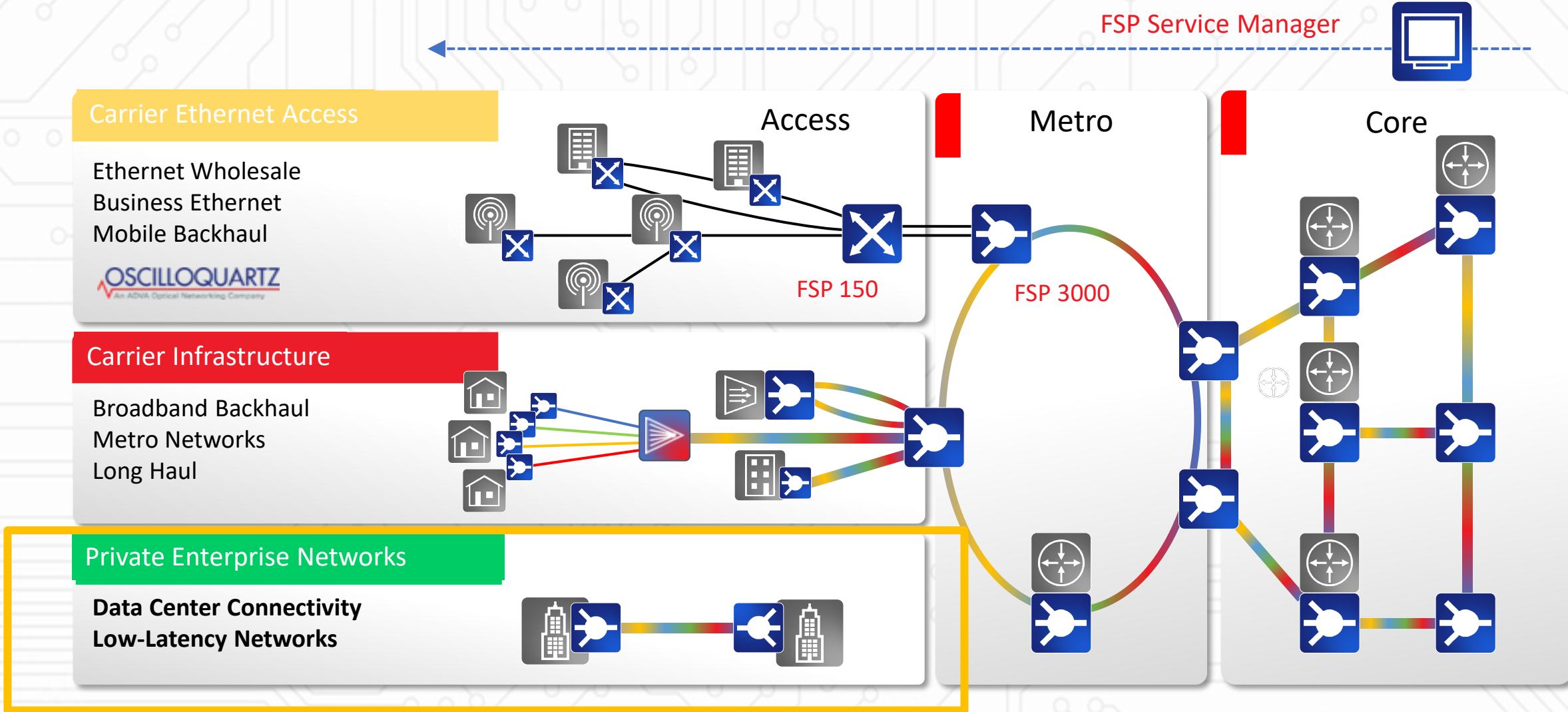
Virtualized Cloud Services

NFV infrastructure and orchestration

enabling choice, performance and agility;

Fast service creation – operational simplicity

CLOUD & MOBILITY

Cloud Interconnect

Security

Timing Excellence

Cloud Access

Open, programmable and secure connectivity solutions

Сетевое решение

FSP Service Manager

Carrier Ethernet Access

Ethernet Wholesale
Business Ethernet
Mobile Backhaul

OSCILLOQUARTZ
An ADVA Optical Networking Company

Access

FSP 150

Metro

FSP 3000

Core

Carrier Infrastructure

Broadband Backhaul
Metro Networks
Long Haul

Private Enterprise Networks

Data Center Connectivity
Low-Latency Networks

Объединение центров обработки и хранения данных (ЦОД, СХД)

Основные возможности

Безопасность - Data Center Interconnection

ADVA™
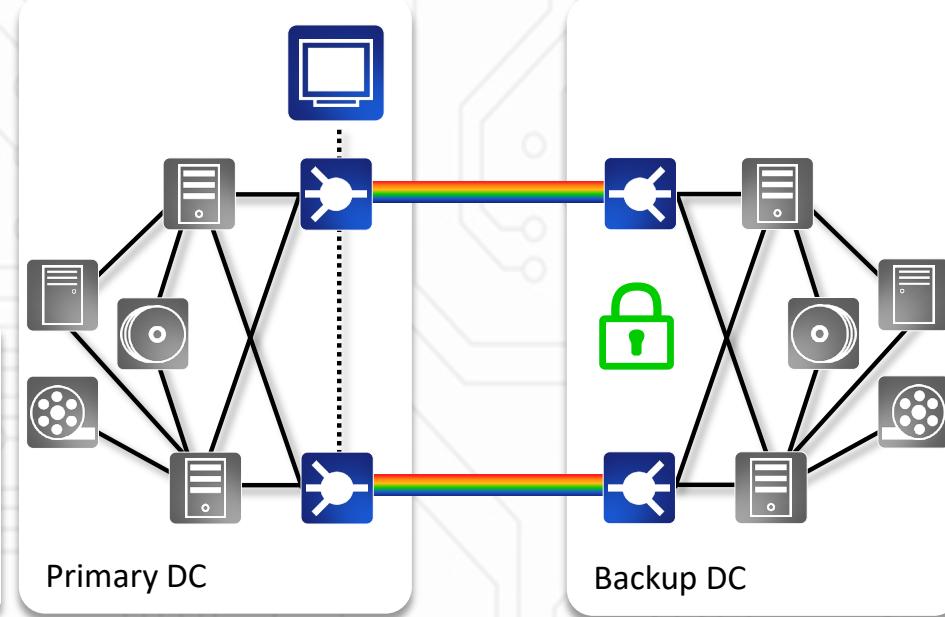
Services:

Fibrechannel
1,2,4,8 and 16,32G

1GE, 10GE, 100GE
Infiniband,
IBM Ficon, Couplink
Link, Sysplex

Server Cluster
Heartbeat

Primary DC

Backup DC

Why ADVA?

Highest performance

Lowest latency

Maximum security

- From cloud access to Terabit/s connectivity
- First to market with partner qualifications (IBM, Brocade)
- Differentiated feature set including 100G Metro & encryption

Innovation for high-performance data center connectivity

NETWELL

Важность низкой задержки

length of fiber
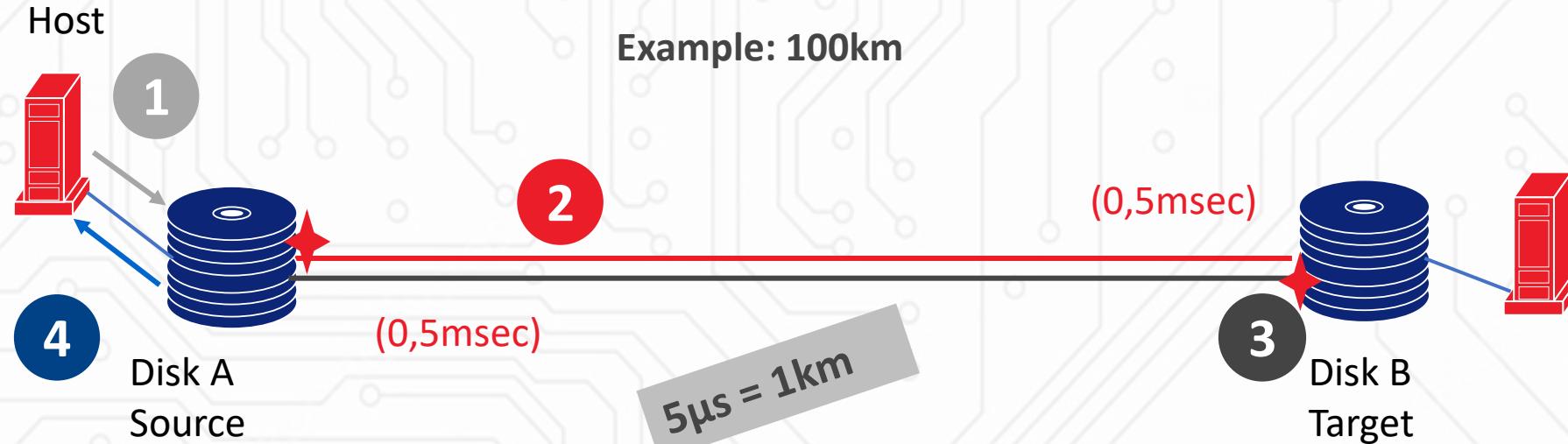
length	in km	delay in microsec	in msec
1	km	5	0,005
10	km	50	0,05
50	km	250	0,25
100	km	500	0,5
150	km	750	0,75
0,02	km	0,1	0,0001

speed of light in glass:
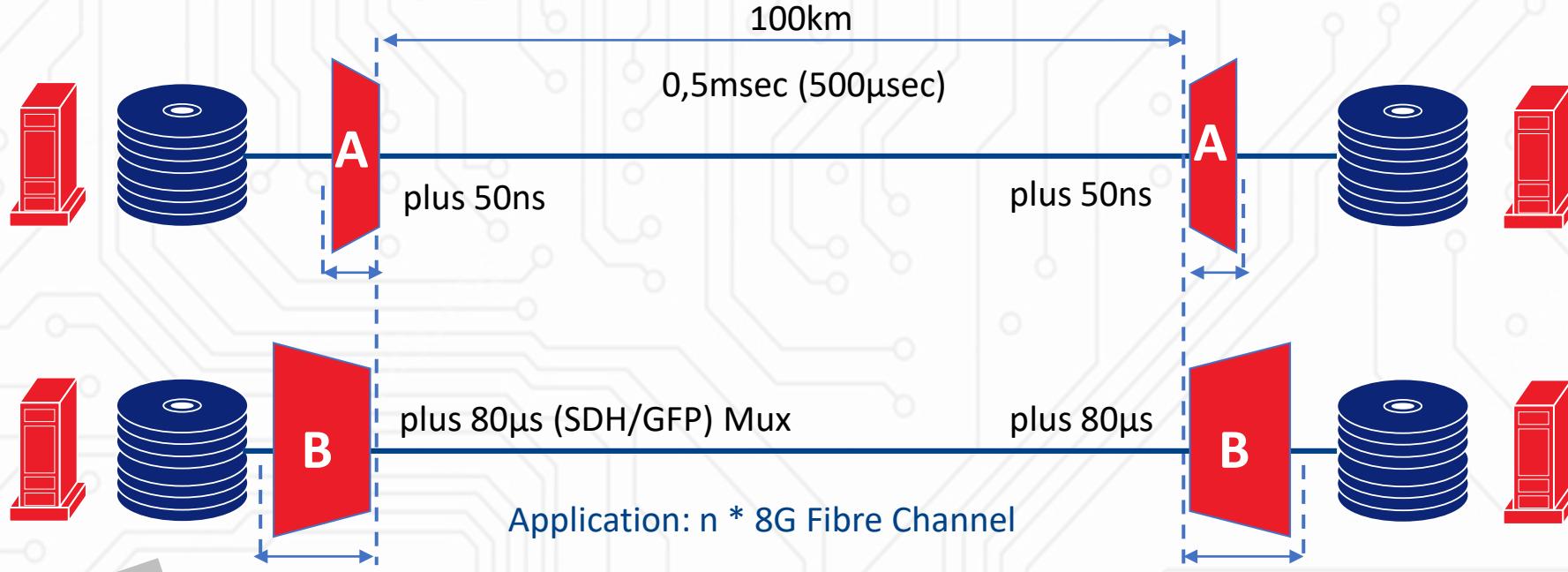
$$s = c \cdot t \quad with \quad c = 2 \cdot 10^8 \frac{km}{s} \quad \Rightarrow \quad 1\mu s \cong 200m$$

5µs = 1km

Host

Example: 100km

**1**

2

(0,5msec)

(0,5msec)

4

Disk A
Source

3

Disk B
Target

5µs = 1km

1 write I/O from host to source

2 I/O is transmitted to the target

3 Receipt acknowledgment is provided by target back to the source

4 Ending status is presented to host

Low latency leadership

100km

0,5msec (500μsec)

A plus 50ns plus 50ns **A**

B plus 80μs (SDH/GFP) Mux plus 80μs **B**

Application: n * 8G Fibre Channel

5μs = 1km

**Result: both ADVA multiplexers will add an
additional "virtual" lengths of 20 meters versus 32km**

ADVA round trip: (10m+100km+10m+10m+100km+10m) = 200,04km

**Competitor round trip: (16+100+16+16+100+16)km = 264km**
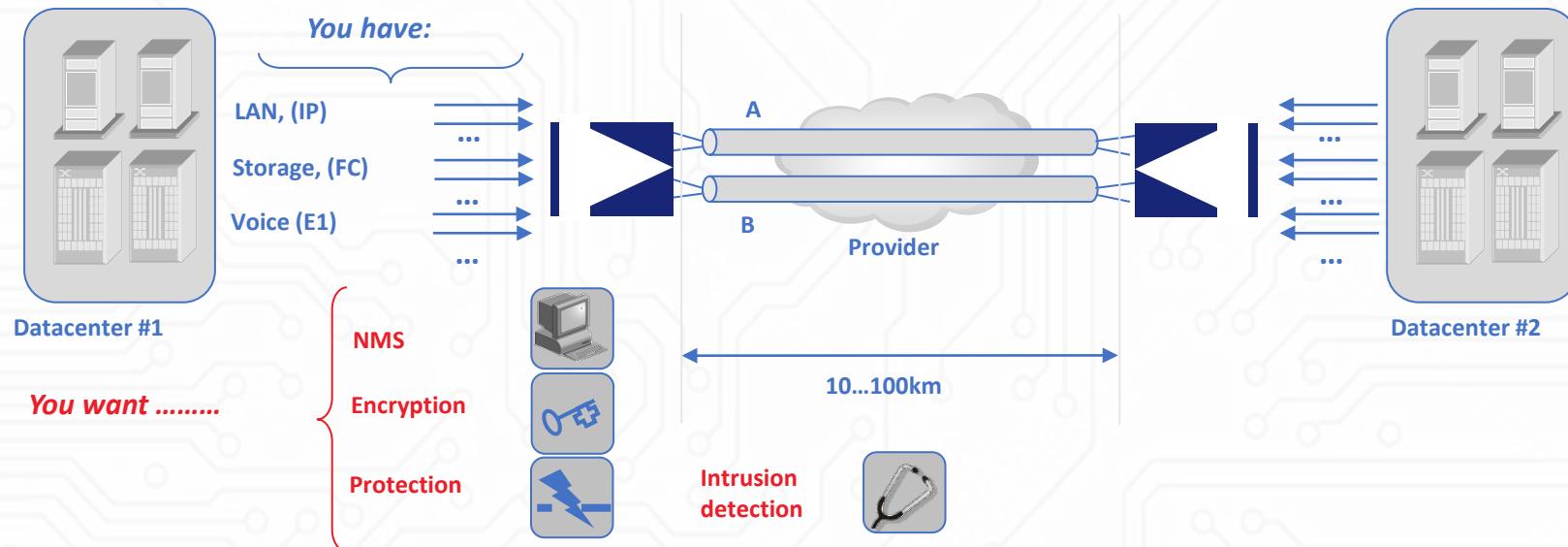
Мотивация WDM для СХД

Why to use an optical DWDM?

1. Optical fibers are available (owned or rented)?
2. Distance between datacenters 10...120km
3. Mix of various data, voice and storage services
4. High count of services
5. High security level (protection, intrusion detection ...)
6. Centralized management of all transmission services

Minimum 3 x „YES"

Vendors for Datacenter Infrastructure Partnerships - Interoperabilities

Partnerships in Datacenter environment
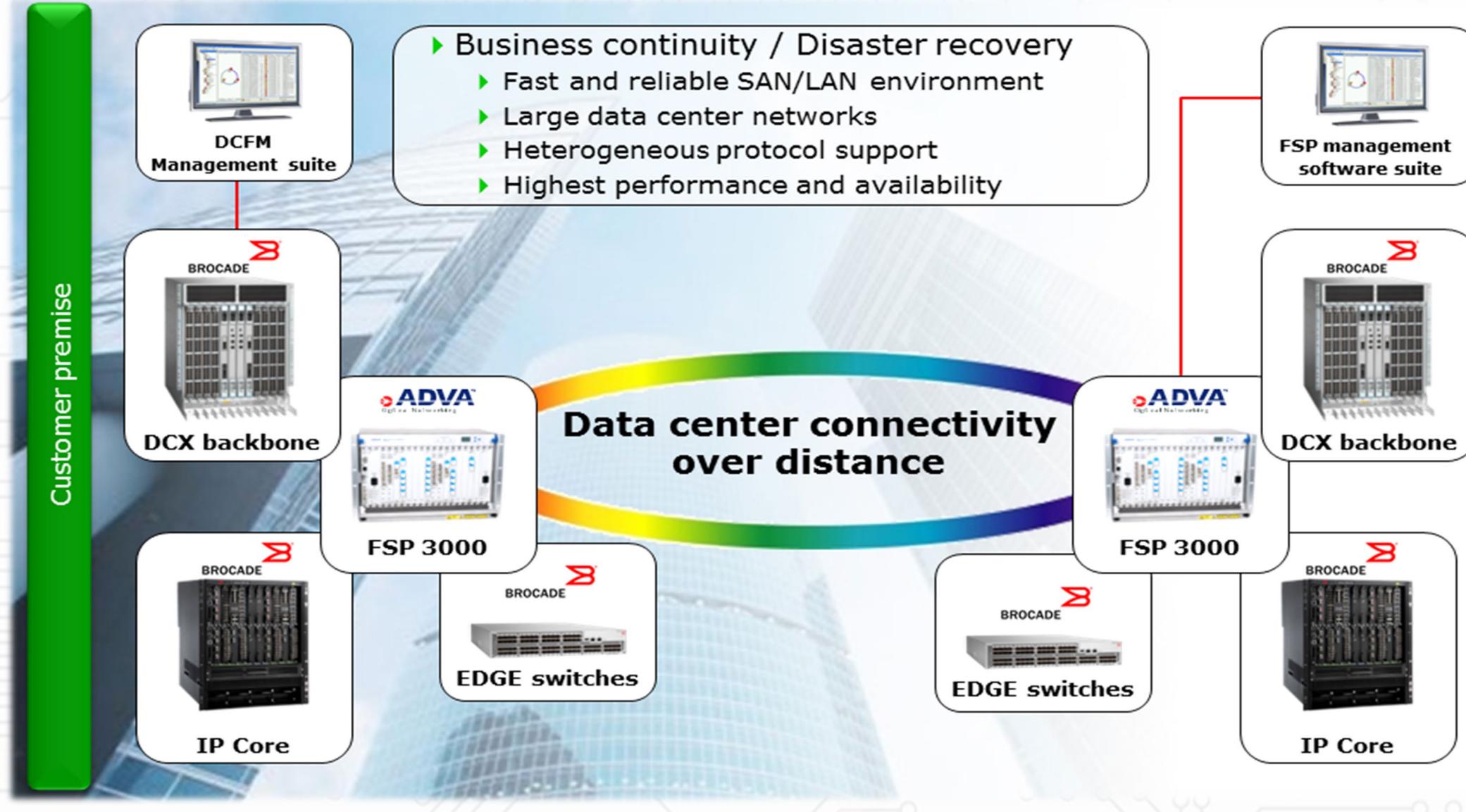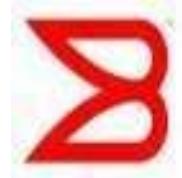
**Mandatory Storage vendor qualifications/certifications!**

SAN vendor	Applications, Protocols..
IBM	Mainframe Server coupling, GDPS
Brocade	Fibrechannel 2,4,8,16G (32/128G), VDX trunking
Dell, HP	NonstopServer, Server clustering
Hitachi Data Systems, EMC	Disk Mirrroring: TrueCopy, SRDF

Brocade

▸ Business continuity / Disaster recovery
  ▸ Fast and reliable SAN/LAN environment
  ▸ Large data center networks
  ▸ Heterogeneous protocol support
  ▸ Highest performance and availability

DCFM Management suite

FSP management software suite

BROCADE
DCX backbone

BROCADE
DCX backbone

ADVA
Optical Networking
FSP 3000

Data center connectivity over distance

ADVA
Optical Networking
FSP 3000

BROCADE
IP Core

BROCADE
EDGE switches

BROCADE
EDGE switches

BROCADE
IP Core

Customer premise

**32G FC**

4G… / 8G… / 16G FC… / ??

ISL-Trunking

VCS/VDX Ethernet Trunking
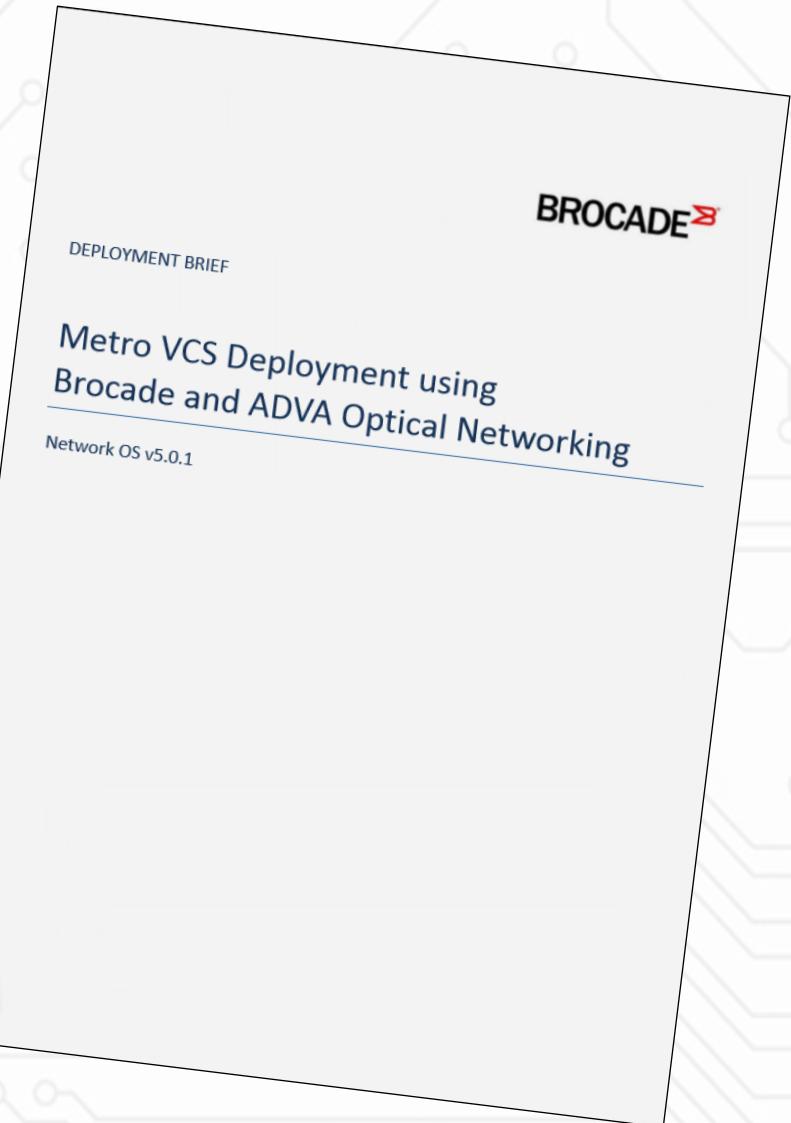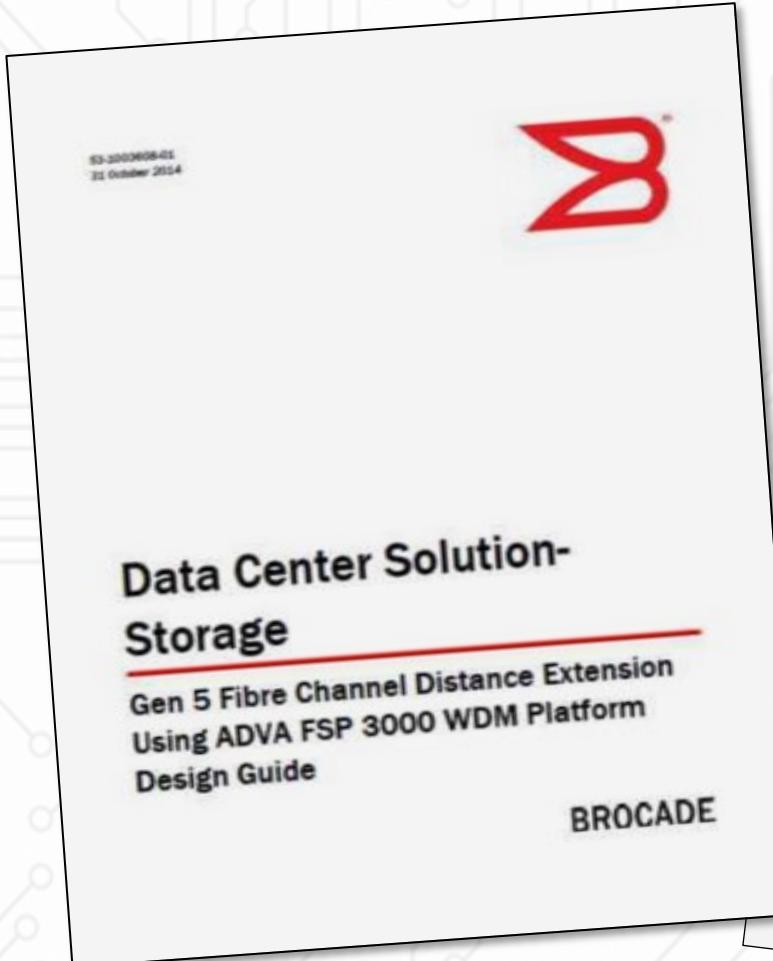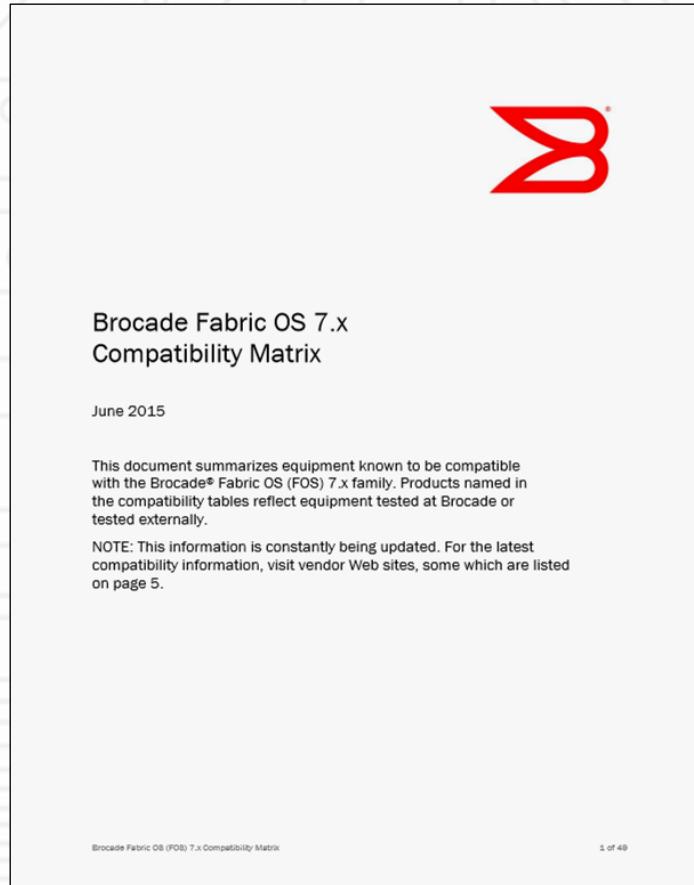
Full support of Brocade's ISL Trunking protocol

Frames are sent by the host in particular order

| 1 | 2 | 3 | 4 | 5 | ... |

Combination of 4x 16 ISL into a 64G pipe

Hardware on RX-side re-assembles the frames
(ARB Primitives are required)

FSP
FSP

FSP
FSP

| 1 | 2 |
| 3 | 4 |

Frames will distributed across all 4 links to achieve max. performance

| 1 | 2 | 3 | 4 | 5 | ... |

Frames are received by the storage in the original order

- Features like ISL Trunking, Encryption, Compression, QoS, Credit Recovery requires a special WDM module design for support
- -> Dedicated set of WDM transport modules for Datacenter Connectivity needed

ADVA knows about specific Brocade FC-protocol modifications.
ISL-Trunking support approved in real projects over years.
Distances up to 65km (Moscow region as example)

Solution Collaterals Brocade & ADVA

Brocade Fabric OS 7.x
Compatibility Matrix

June 2015

This document summarizes equipment known to be compatible with the Brocade® Fabric OS (FOS) 7.x family. Products named in the compatibility tables reflect equipment tested at Brocade or tested externally.

NOTE: This information is constantly being updated. For the latest compatibility information, visit vendor Web sites, some which are listed on page 5.

Data Center Solution-Storage

Gen 5 Fibre Channel Distance Extension Using ADVA FSP 3000 WDM Platform Design Guide

BROCADE

DEPLOYMENT BRIEF

Metro VCS Deployment using Brocade and ADVA Optical Networking

Network OS v5.0.1

http://www.brocade.com/content/brocade/en/backend-content/pdf-page.html?/content/dam/common/documents/content-types/solution-design-guide/brocade-data-center-storage-sdg.pdf

Схемы резервирования сервисов

Overview protection cost versus availability

„pricelist": How much is one more „9" after comma?

Scenario	Category	Cost Index[1]	Availability [%][2]
unprotected		1,00	99,94
line protection (RSM)		1,10	99,99
line protection (VSM)		1,10	99,99
Channel protection (NPCUP)		1,38	99,994
Card protection		2,13	99,996
Client layer protection (CL)		2,00	99,99997

[1] Based on a 16Ch System with 4xGbE, 4x10GbE, 6x2G FC; 50km G652, HW Cost only
[2] Based on a fiber availibility of 99,95% and a MTTR of 4h
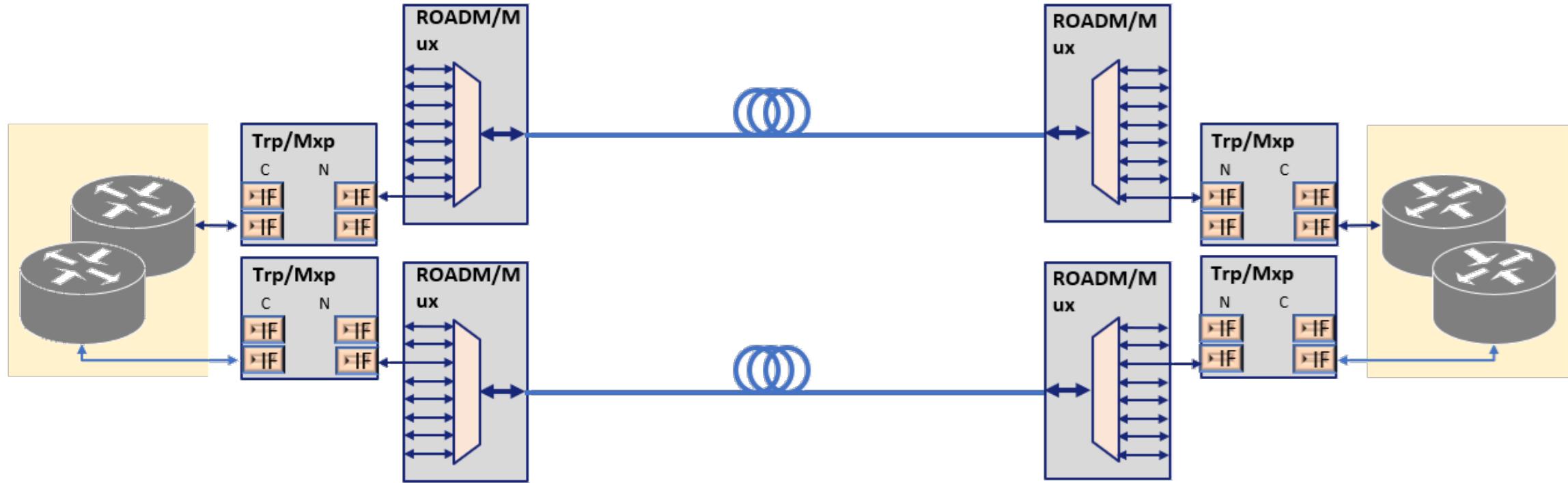
Versatile Protection

- Protection of a line (fiber), group or channel

- Versatile Switch Module (VSM)
  - Triggered by LoS of supervisory channel (OSCM)
  - Protection path available for low priority traffic
  - Need OSC

- Remote switch module with optical line monitoring (RSM-OLM)
  - Pilot channel provides detection of fiber cuts, intrusion and degradation
  - Switching time <15ms
  - Variant for Single fiber working available
  - Protection path available for low priority traffic

- Optical Path Protection Switch (OPPM)
  - Integrated optical power monitor
  - Protection Trigger Partners (Boards detect)

99,99%

Client Layer Protection

- Switchover by client equipment

- Client and transport equipment is protected

- Highest service availability

- High CAPEX

99,99997%

Hardware
FSP3000

# System Architecture
9HU High End Shelf

ADVA™

Central Equipment Management Panel

3x RJ45 Ethernet

Telemetry interface (16xI/O) and LED's

4x PSCU interfaces for inventory of passive units
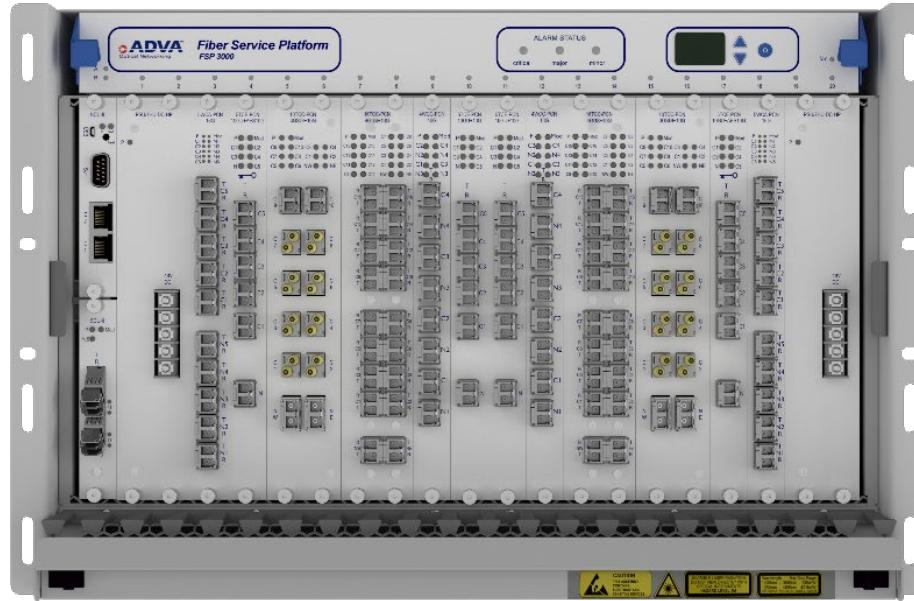
User interface (Display) and shelf alarm status LED's

High power support **by optimized air flow management and individual swappable fan units**

Network Controller Unit (NCU-II, NCU-II-P) for NE Management

Separate electrical and optical cable management

Shelf Controller Units (SCU-II) for Connectivity within and between shelves

1000W Power Supply Units (AC/DC) with Redundancy

NETWELL

System Architecture
7HU Common Shelf and 1HU Slimline Shelf

- 7HU Shelf (20 slots)
  - Redundant PSU
  - NCU-II, SCU-II
  - OSCM + OSFM
  - EDFA + DCM
  - Filters + Transponders
- 1HU Slimline Shelf (2 slots)
  - Redundant DC feed or redundant AC or DC power supplies
  - SCU-II, SCU-S
  - NCU-II, NCU-S
  - Filters + Transponders
  - E-Temp variant for operating from -33 ˚C to +55 ˚C

The Industry Benchmark for DWDM

2011

2015

ADVA Optical Networking Introduces Industry's First 100G Metro Solution

ADVA FSP 3000 Now Delivers Unprecedented Performance and Efficiency for Metropolitan Networks

September 08, 2011

ADVA Optical Networking Unveils All-New Data Center Interconnect Solution

FSP 3000 CloudConnect™ Sets New Industry Benchmarks for Density, Scalability and Energy-Efficiency

June 01, 2015

100Gbit/s

5.6Tbit/s
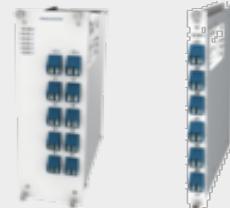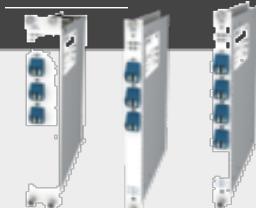
- 100G on a dual-slot line card
- 2.4Tbit/s per fiber
- 1Watt per 1Gbit/s

- 400G on a single slot line card
- 25.6 Tbit/s per fiber
- 0.5Watt per 1Gbit/s

Equipment Density – Scalability – Energy-Efficiency – Programmability

FSP 3000 Components
Chassis and Optical Modules

Infrastructure	Dimension	Environmental
Chassis	19" ETSI and 23" ANSI/NEBS 1RU, 7RU and 9RU options	-36 to -72VDC or 120/230VAC

Optics	Fixed	Configurable
Filter	16ch CWDM to 192ch DWDM Group splitter modules Channel splitter modules Configurable VOA modules	96 channel C-band DWDM 9-degree WSS ROADM module Colorless channel module Flexgrid today 192ch point to point

| Optics	EDFA	RAMAN
Amplifier	Variable gain control Single and double stage Booster and pre-amplification Ingress and egress monitoring	96 channel spectrum 50dB single span reach
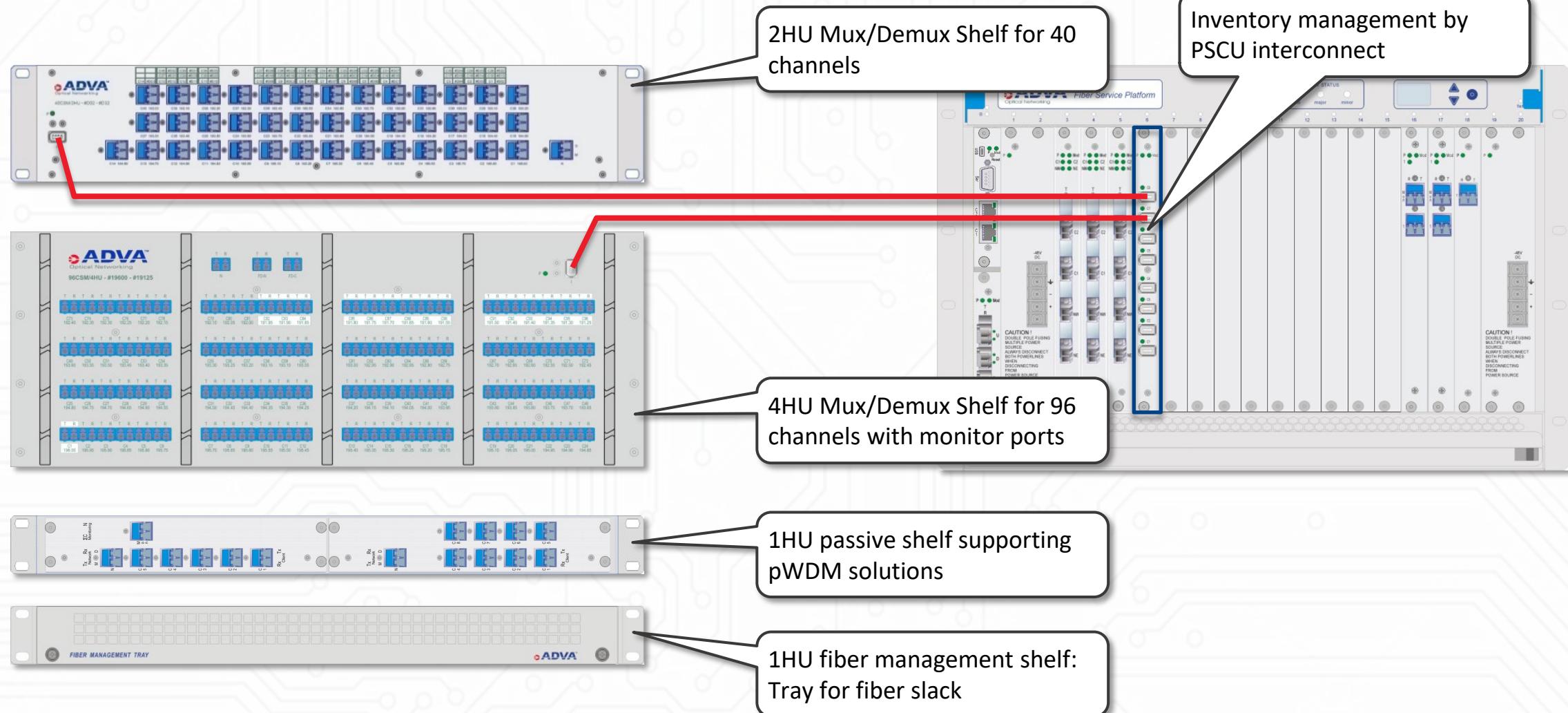
FSP 3000 Components
Transponder and Multiplexer Modules

| Transponder	Key Features	Interface Speeds
Core modules	G.709 framing Digital performance monitoring 50GHz C-Band tunable optics Channel card protection	Network: 100G, 10G, 2.5G Services: OTN, SONET/SDH Ethernet, FC, Video
Access modules	Service transparency Optical performance monitoring Pluggable network interfaces Cost optimized	Network: 10G, 4G, 2.5G Services: OTN, SONET/SDH Ethernet, FC
Enterprise modules	Application-specific Certified for storage applications Low-latency design Service transparency	Network: 100G, 10G and 2.5G Services: Ethernet, SONET/SDH ESCON, FC, InfiniBand

System Architecture
Passive Shelves

2HU Mux/Demux Shelf for 40 channels

Inventory management by PSCU interconnect

4HU Mux/Demux Shelf for 96 channels with monitor ports

1HU passive shelf supporting pWDM solutions

1HU fiber management shelf: Tray for fiber slack
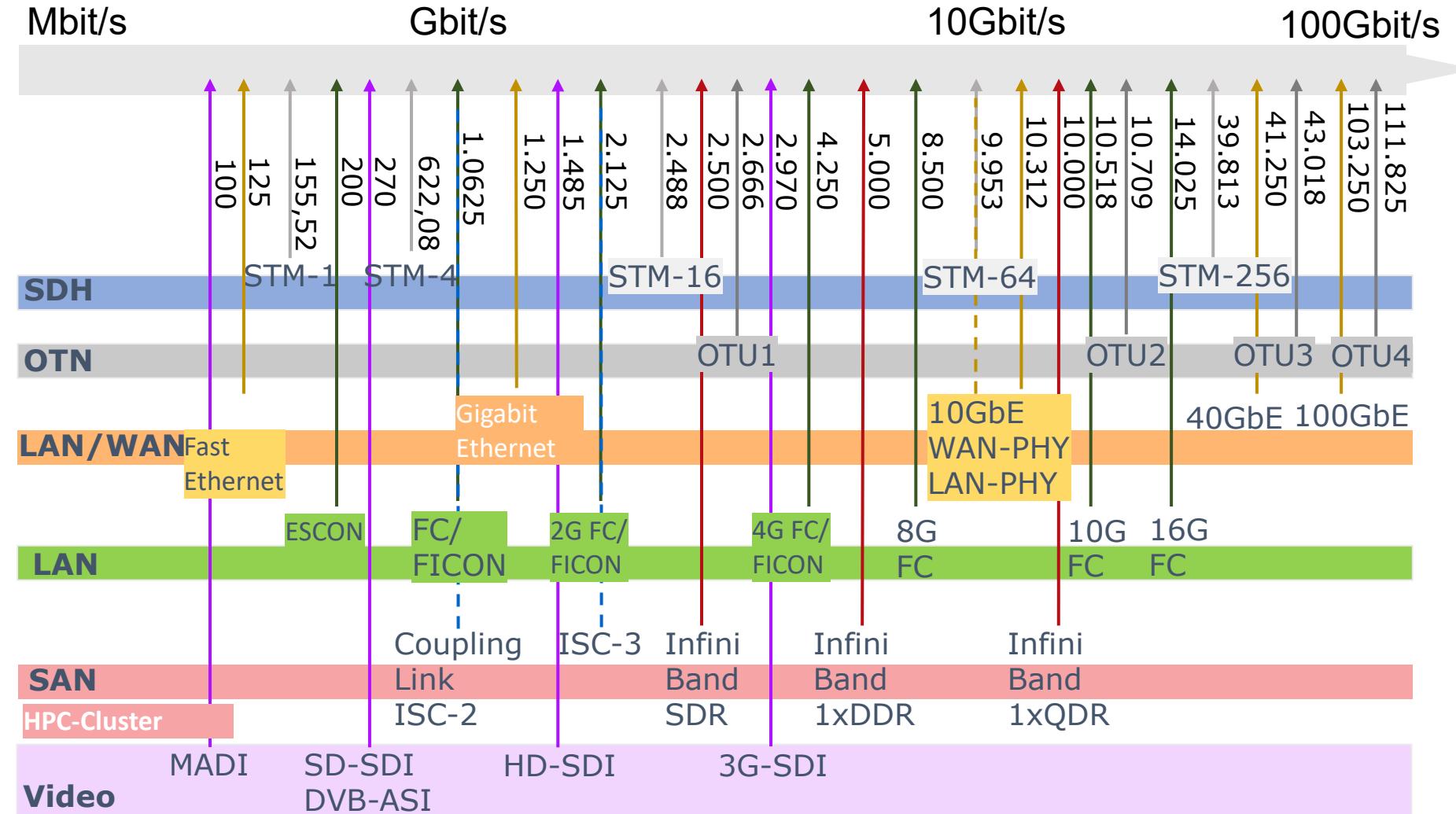
Transponders & MUXponders
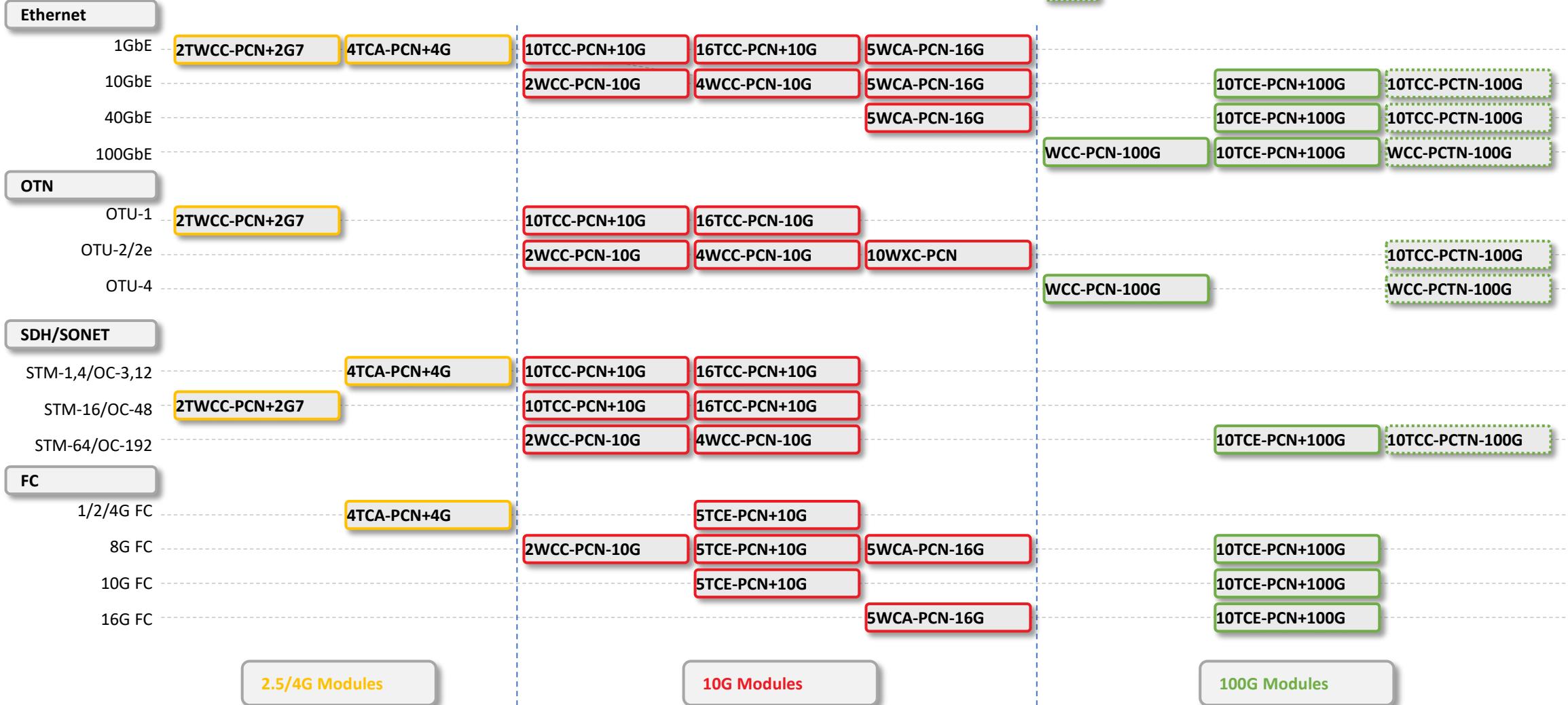
Multiservice Application
Overview - Native Service Offerings
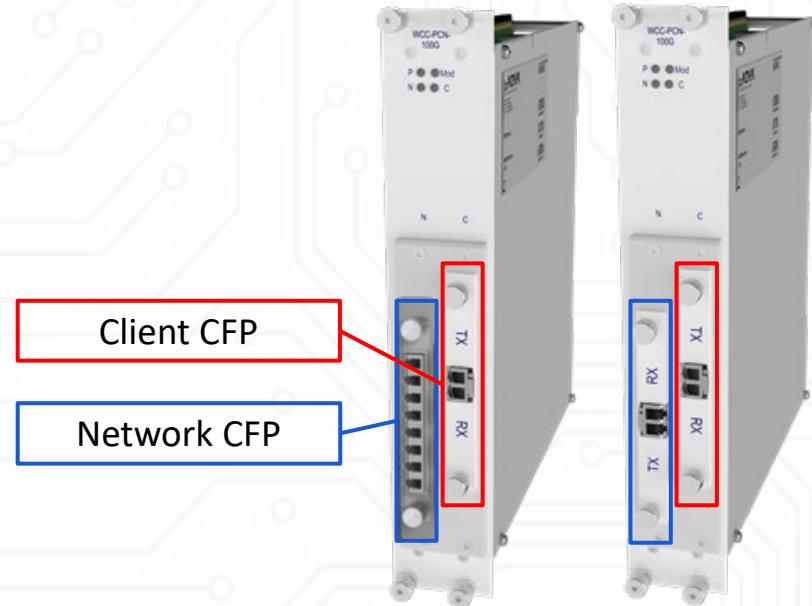
Channel Cards Options by Service
Guideline

ADVA™

| | Primary Choice |
| Secondary Choice |

Ethernet

1GbE	2TWCC-PCN+2G7	4TCA-PCN+4G	10TCC-PCN+10G	16TCC-PCN+10G	5WCA-PCN-16G	
10GbE			2WCC-PCN-10G	4WCC-PCN-10G	5WCA-PCN-16G	10TCE-PCN+100G · 10TCC-PCTN-100G
40GbE					5WCA-PCN-16G	10TCE-PCN+100G · 10TCC-PCTN-100G
100GbE						WCC-PCN-100G · 10TCE-PCN+100G · WCC-PCTN-100G

OTN

OTU-1	2TWCC-PCN+2G7	10TCC-PCN+10G	16TCC-PCN-10G		
OTU-2/2e		2WCC-PCN-10G	4WCC-PCN-10G	10WXC-PCN	10TCC-PCTN-100G
OTU-4				WCC-PCN-100G	WCC-PCTN-100G

SDH/SONET

STM-1,4/OC-3,12	4TCA-PCN+4G	10TCC-PCN+10G	16TCC-PCN+10G		
STM-16/OC-48	2TWCC-PCN+2G7	10TCC-PCN+10G	16TCC-PCN+10G		
STM-64/OC-192		2WCC-PCN-10G	4WCC-PCN-10G		10TCE-PCN+100G · 10TCC-PCTN-100G

FC

1/2/4G FC	4TCA-PCN+4G		5TCE-PCN+10G		
8G FC		2WCC-PCN-10G	5TCE-PCN+10G	5WCA-PCN-16G	10TCE-PCN+100G
10G FC			5TCE-PCN+10G		10TCE-PCN+100G
16G FC				5WCA-PCN-16G	10TCE-PCN+100G

2.5/4G Modules   **10G Modules**   **100G Modules**

NETWELL

100G Regional Transponder Solution
WCC-PCN-100G dual CFP

Client CFP

Network CFP
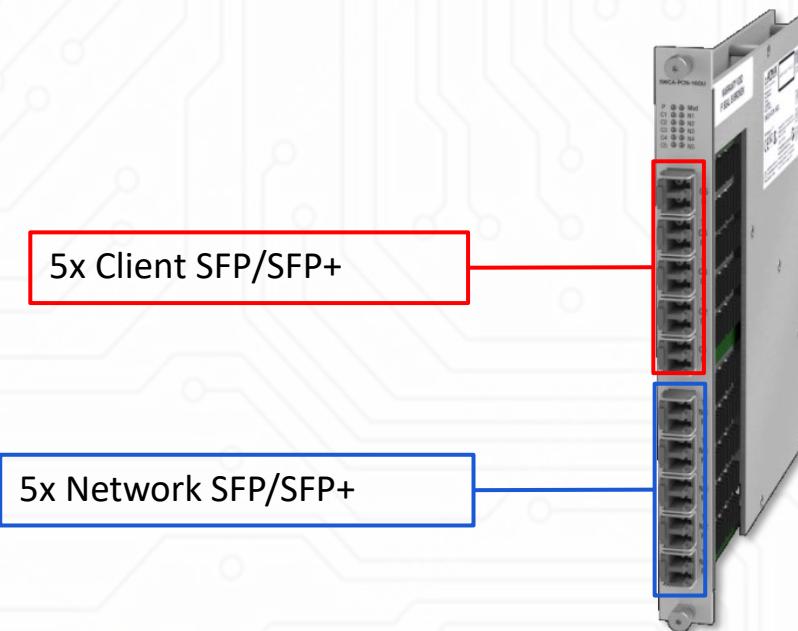
- Dual CFP - compact 100G transponder
- Metro and Regional networks (overlay and upgrades)
- High bandwidth efficiency (96x100Gb/s= 9.6 Tb/s)
- Network port CFP options
  - Coherent DP-QPSK, SD-FEC included
  - 4x28Gb/s direct detect, adjustable FEC
  - LR4 for OTU-4 "handover"
- OTN, PCS & MAC layer monitoring
- 100GE and OTU-4 client CFP (SR10, LR4)

Client   **Module**   **Network**

100G coherent,
4x 28G DWDM
(96ch C-band)

CFP ← 100GbE OTU-4 — G.709 framing OTN-, Eth-PM GCC0/1/2 — ODU-4 — OTU-4 / OTN PM / adjust. FEC → CFP

SR10, LR4

GFEC

Grey (LR4)

10G Data Center Channel Card
5WCA-PCN-16GU

ADVA™

5x Client SFP/SFP+

5x Network SFP/SFP+
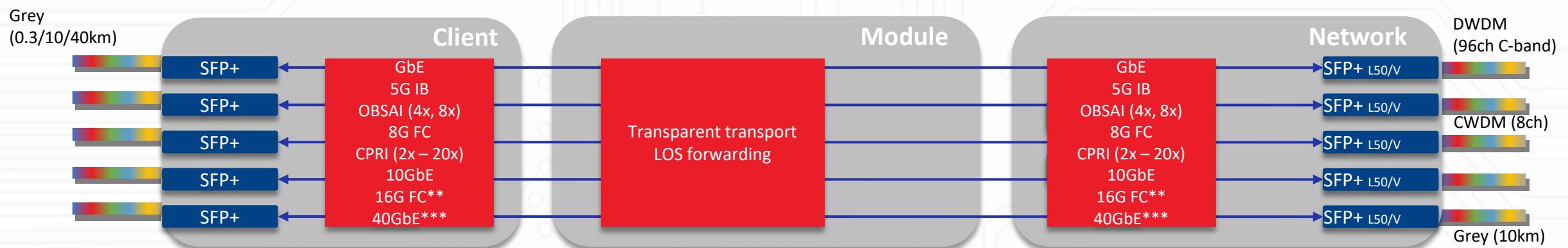
- Quint-Transponder, ultra-high density, lowest cost per bit
- Multi-service
  - 5G IB, 8G FC, 16G FC
  - **GbE,** 10GbE, 40GbE (SR4, **LR4** via break out cable)
  - **CPRI from 1228.8 Mb/s to 10137.6 Mb/s**
  - **OBSAI 3072 Mb/s and 6144 Mb/s**
- Optimized for Data Center and Mobile Backhaul
- Low latency
- Client Channel Card Protection*

Grey
(0.3/10/40km)

Client

| SFP+ |
| SFP+ |
| SFP+ |
| SFP+ |
| SFP+ |

GbE
5G IB
OBSAI (4x, 8x)
8G FC
CPRI (2x – 20x)
10GbE
16G FC**
40GbE***

Module

Transparent transport
LOS forwarding

Network

DWDM
(96ch C-band)

| SFP+ L50/V |
| SFP+ L50/V |
| SFP+ L50/V |
| SFP+ L50/V |
| SFP+ L50/V |

GbE
5G IB
OBSAI (4x, 8x)
8G FC
CPRI (2x – 20x)
10GbE
16G FC**
40GbE***

CWDM (8ch)

Grey (10km)
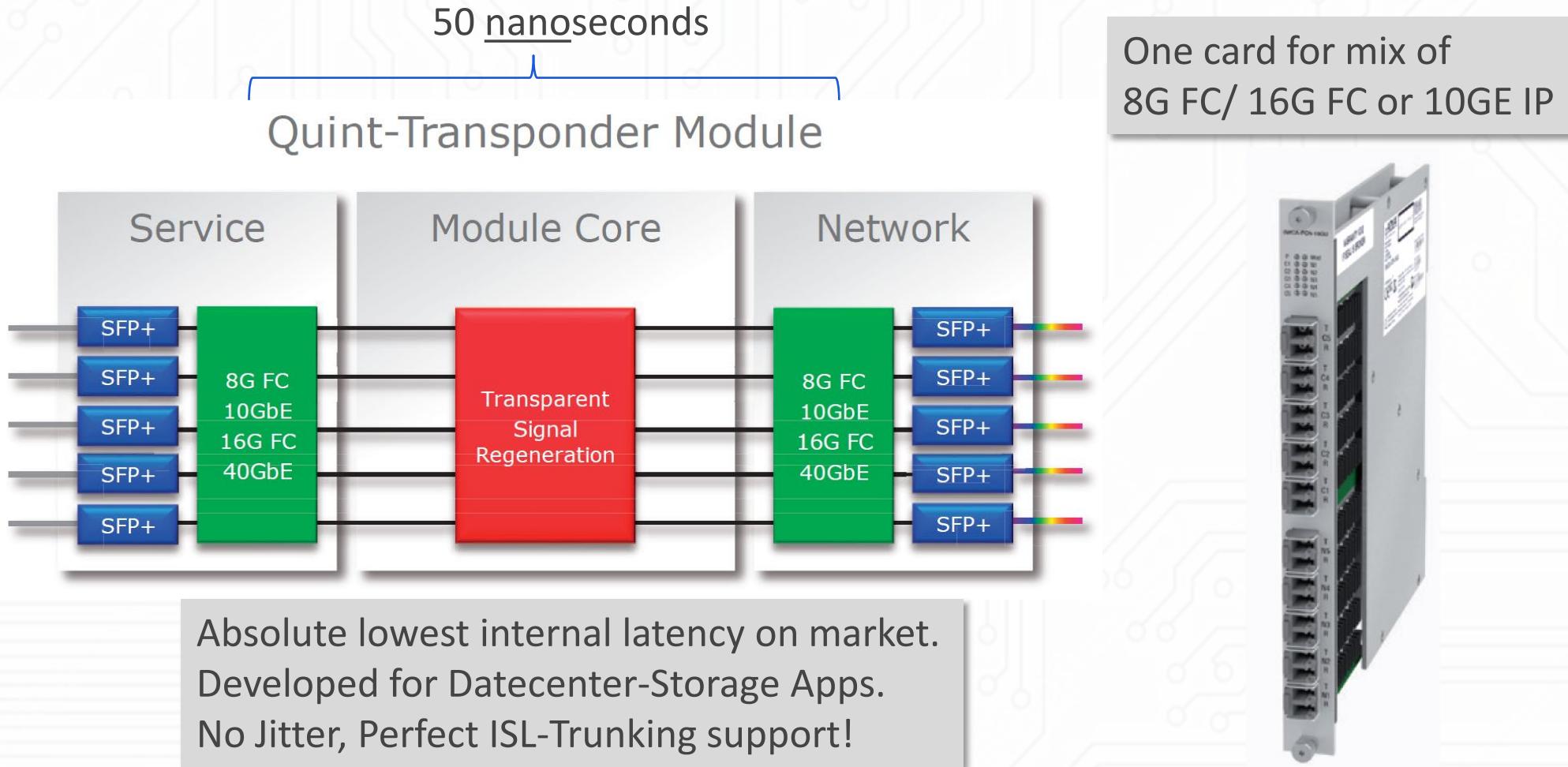
CWDM (8ch and 40GbE LR4)
DWDM (96ch C-band)
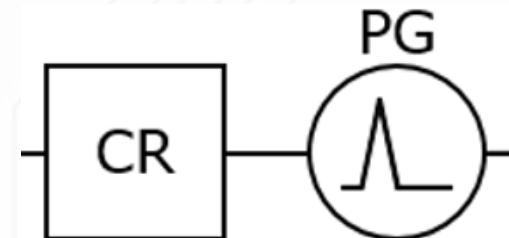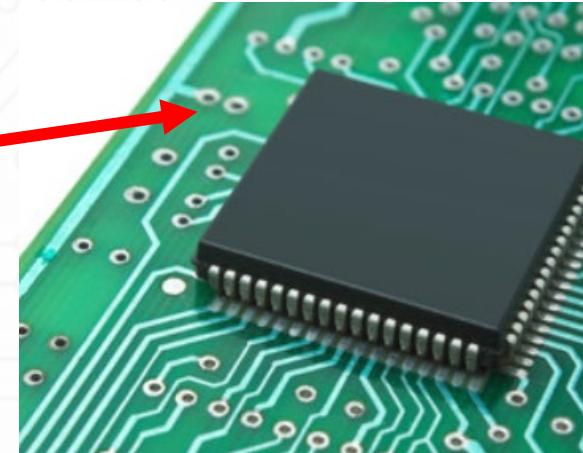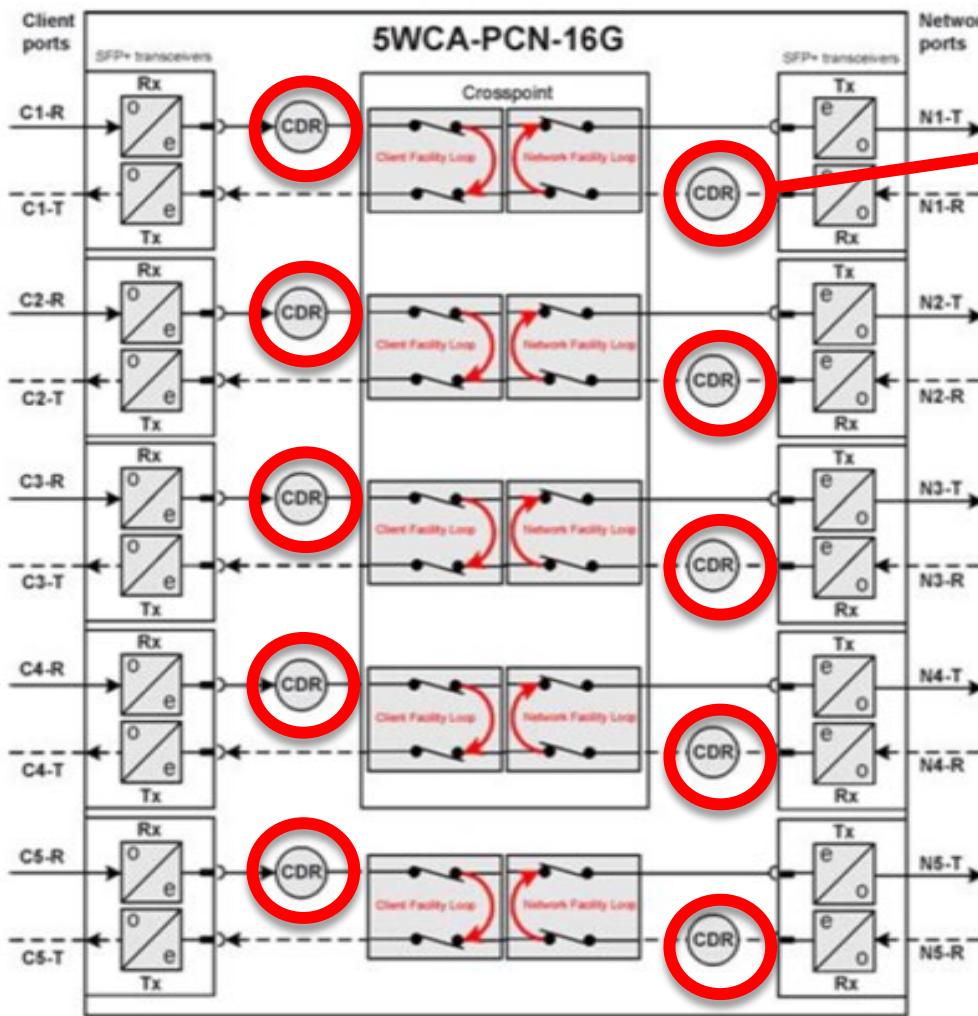
* Except 40GbE
** Dedicated 16G FC SFP+
*** Via break out cable, supports SR4, LR4 clients

NETWELL

ADVA's specialized 10G/8G/16G Data Center Channel Card
5WCA-PCN-16G

ADVA™

50 nanoseconds

Quint-Transponder Module

One card for mix of
8G FC/ 16G FC or 10GE IP

Service	Module Core	Network

SFP+

SFP+

SFP+

SFP+

SFP+

8G FC
10GbE
16G FC
40GbE

Transparent
Signal
Regeneration

8G FC
10GbE
16G FC
40GbE

SFP+

SFP+

SFP+

SFP+

SFP+

Absolute lowest internal latency on market.
Developed for Datecenter-Storage Apps.
No Jitter, Perfect ISL-Trunking support!

NETWELL

ADVA's specialized 10G/8G/16G Data Center Channel Card
5WCA-PCN-16G
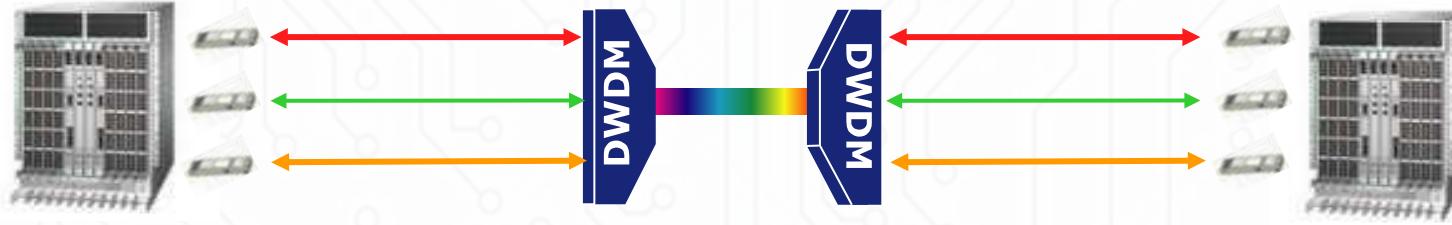
ACTIVE Signal Restoration –
„A must" for Fibrechannel >25km!
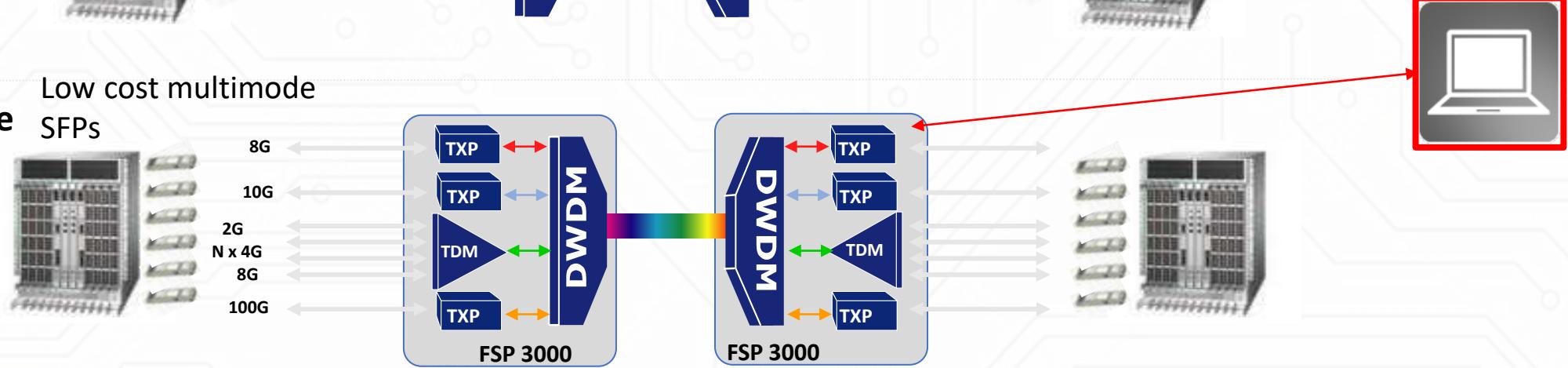
Passive WDM vs. active WDM solutions

Passive
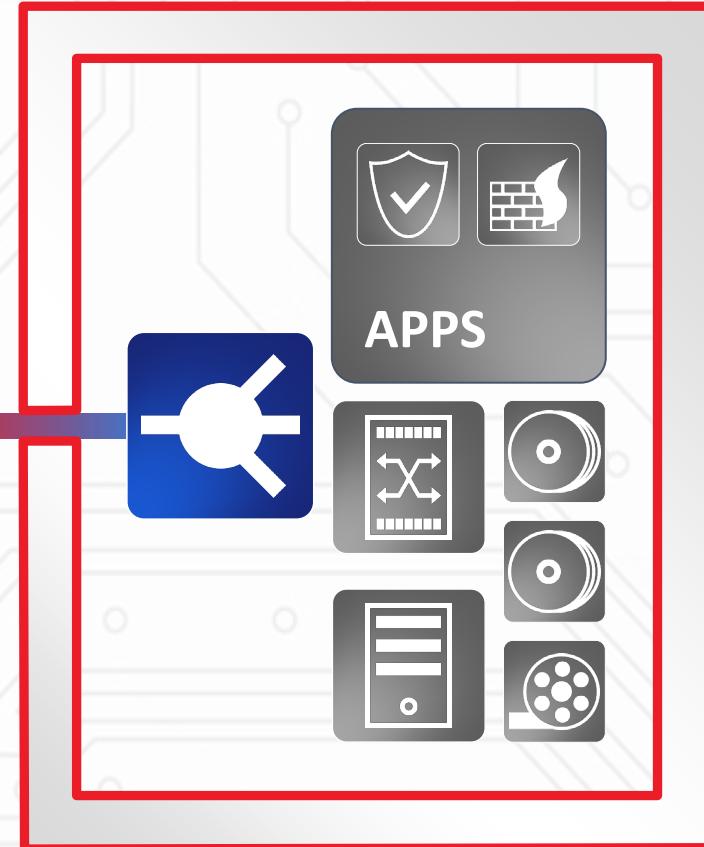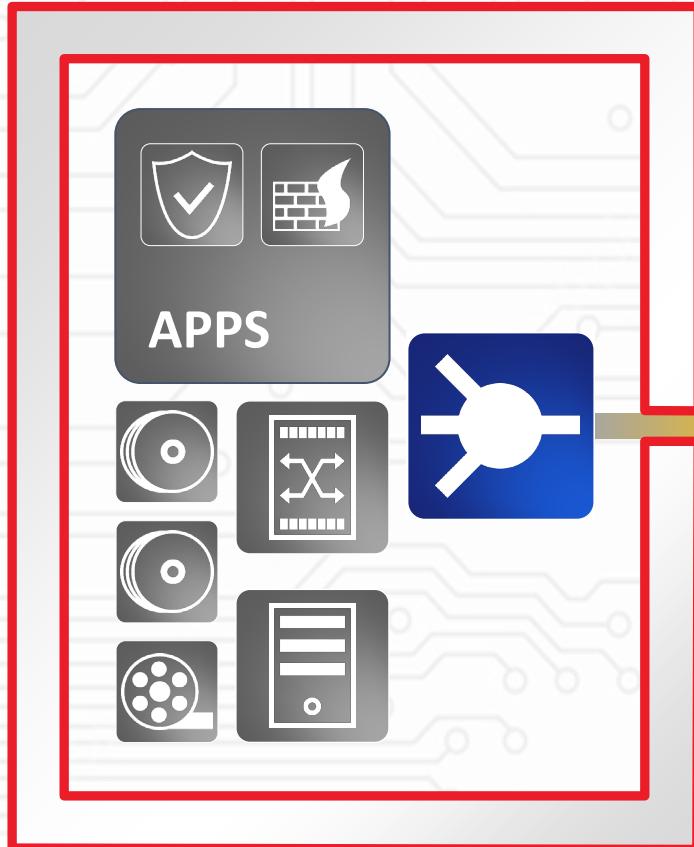
Active

Low cost multimode SFPs

8G
10G
2G
N x 4G
8G
100G

FSP 3000

FSP 3000
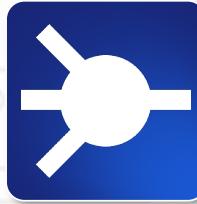
- Higher capacity (more channels per fiber)
- Higher aggregate bandwidth (up to 100G per wavelength)
- Higher distance (up to 200 km without mid-span amplifier)
- More secure (automated fail over, NMS, optical monitoring tools, embedded encryption)

You have central Management for all connectivity processes.
One point of control!
One competence!

Next Risk: Physical Access to the Data Center

This is possible! No Joke…

Street cabinet

Splice boxes / cassettes
(Outdoor / Inhouse)

Y-Bridge for
service activities
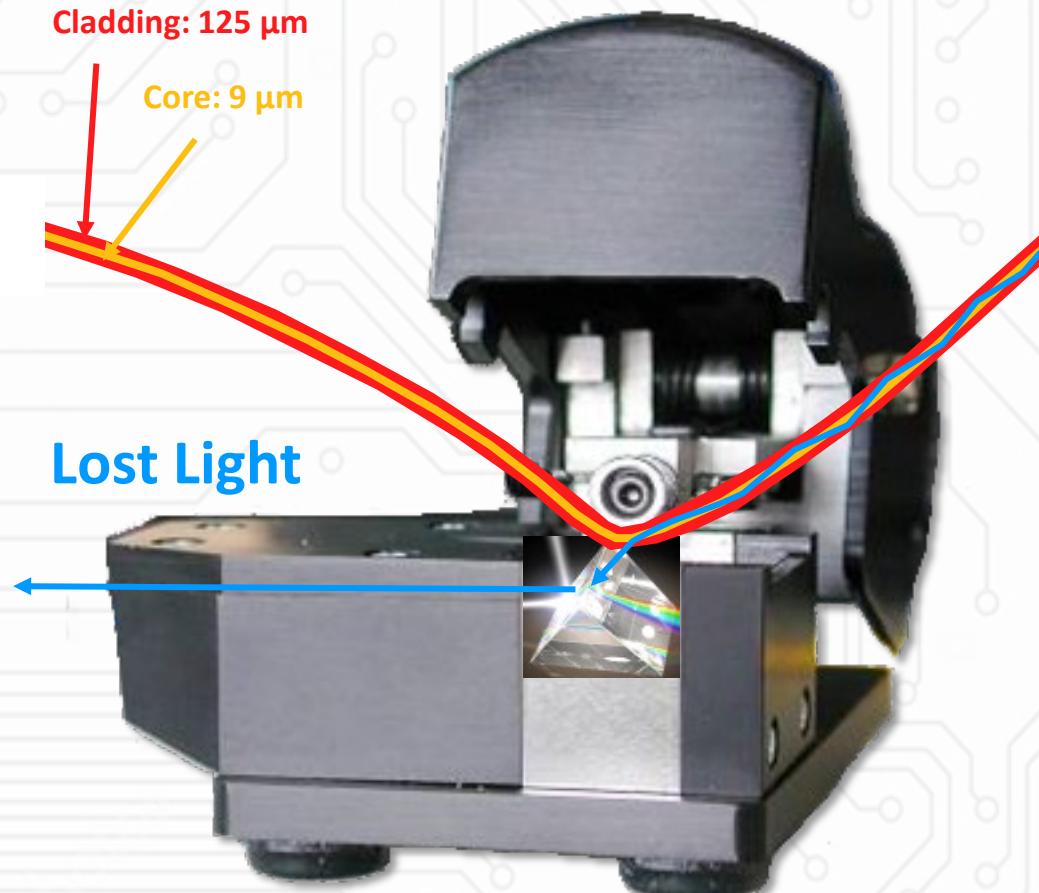
Fiber Coupling device

There are multiple ways to access fiber

You can buy such device …

Cladding: 125 µm

Core: 9 µm

Lost Light

NETWORK WORLD
THE CONNECTED ENTERPRISE
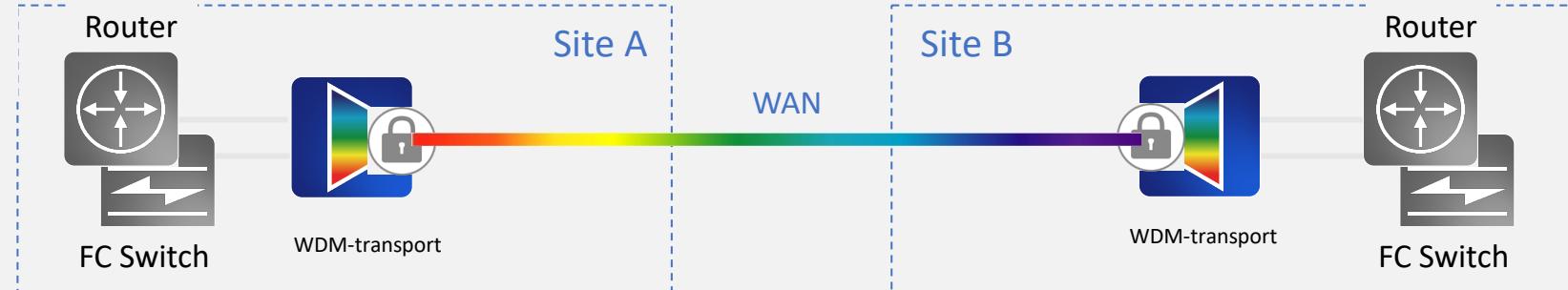
"For both public and private networks, optical taps and analytic devices are required and inexpensive maintenance equipment in common use worldwide today. **Various types of optical taps [...] are also used for corporate espionage…**"

„Clearly, **physical protection** of optical transmission media and junction boxes **is essential**; in addition, **data encryption plays a role in protecting sensitive data.**" [5]
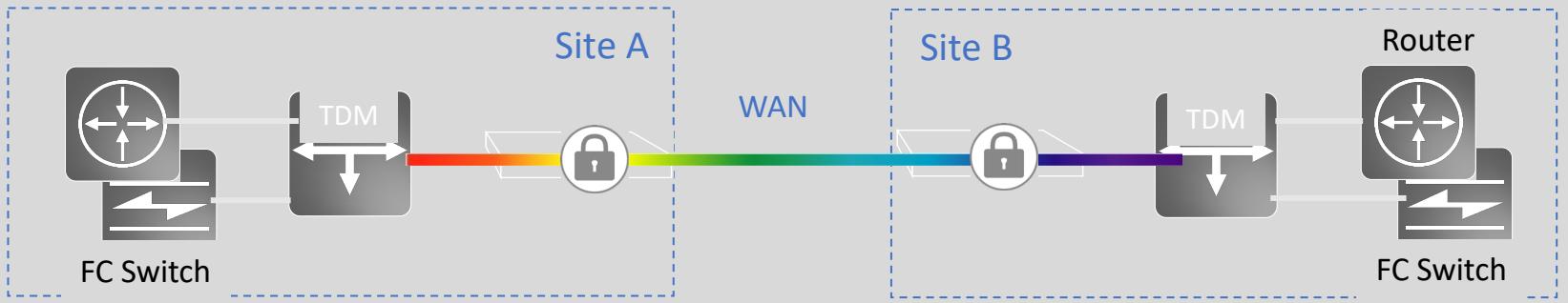
[5] Security Strategies Alert, M.E. Kabay, March 2003

How to increase the Optical transmission security?

xWDM based Encryption

Router

Site A

Site B

Router

WAN

FC Switch

WDM-transport

WDM-transport

FC Switch
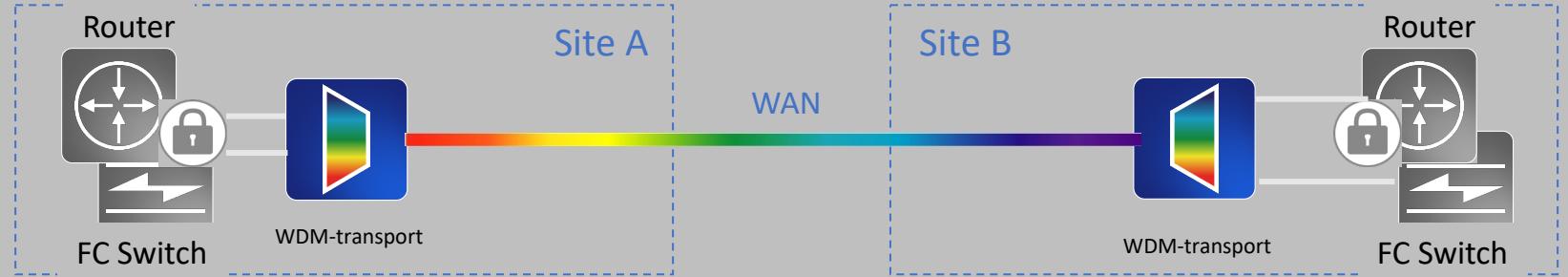
Appliance based Encryption

Site A

Site B

Router

WAN

TDM

TDM

TDM

FC Switch

FC Switch

Ipsec / MacSec Encryption

Router

Site A

Site B

Router

WAN

FC Switch

WDM-transport

WDM-transport

FC Switch
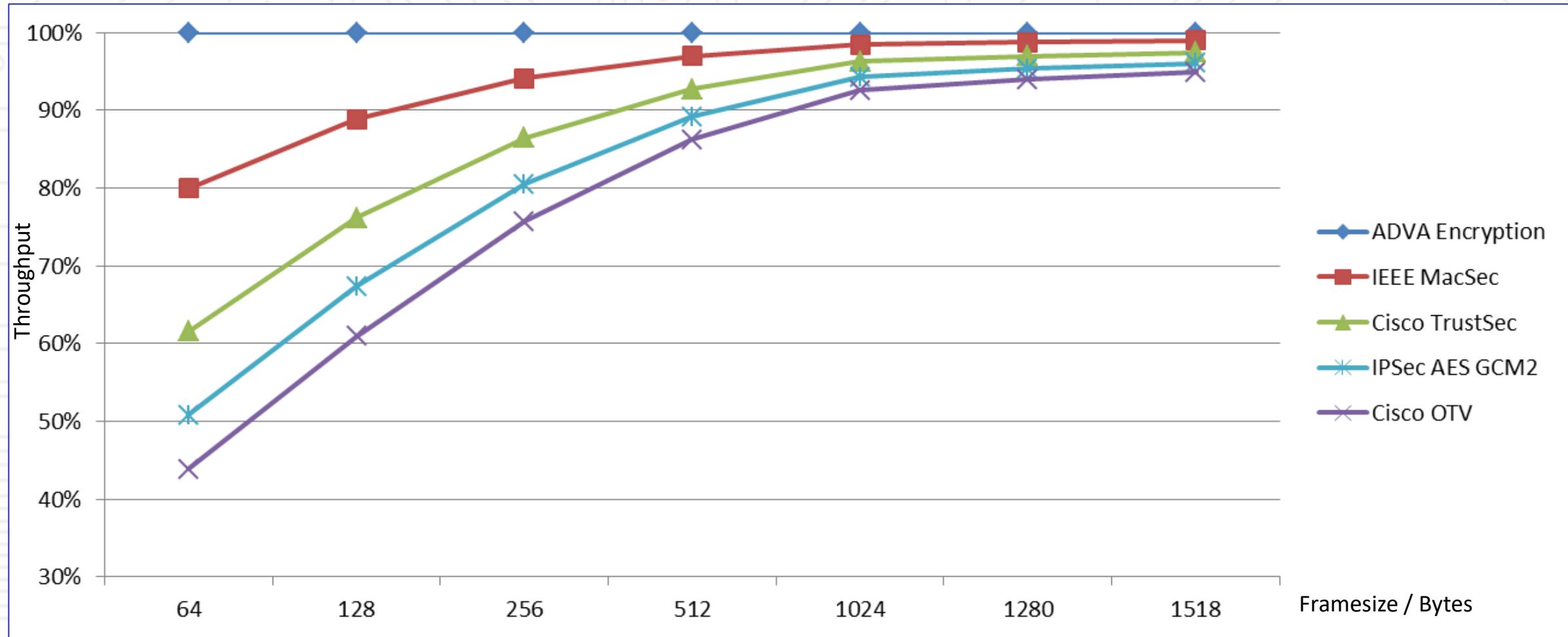
Speed, throughput and simplicity
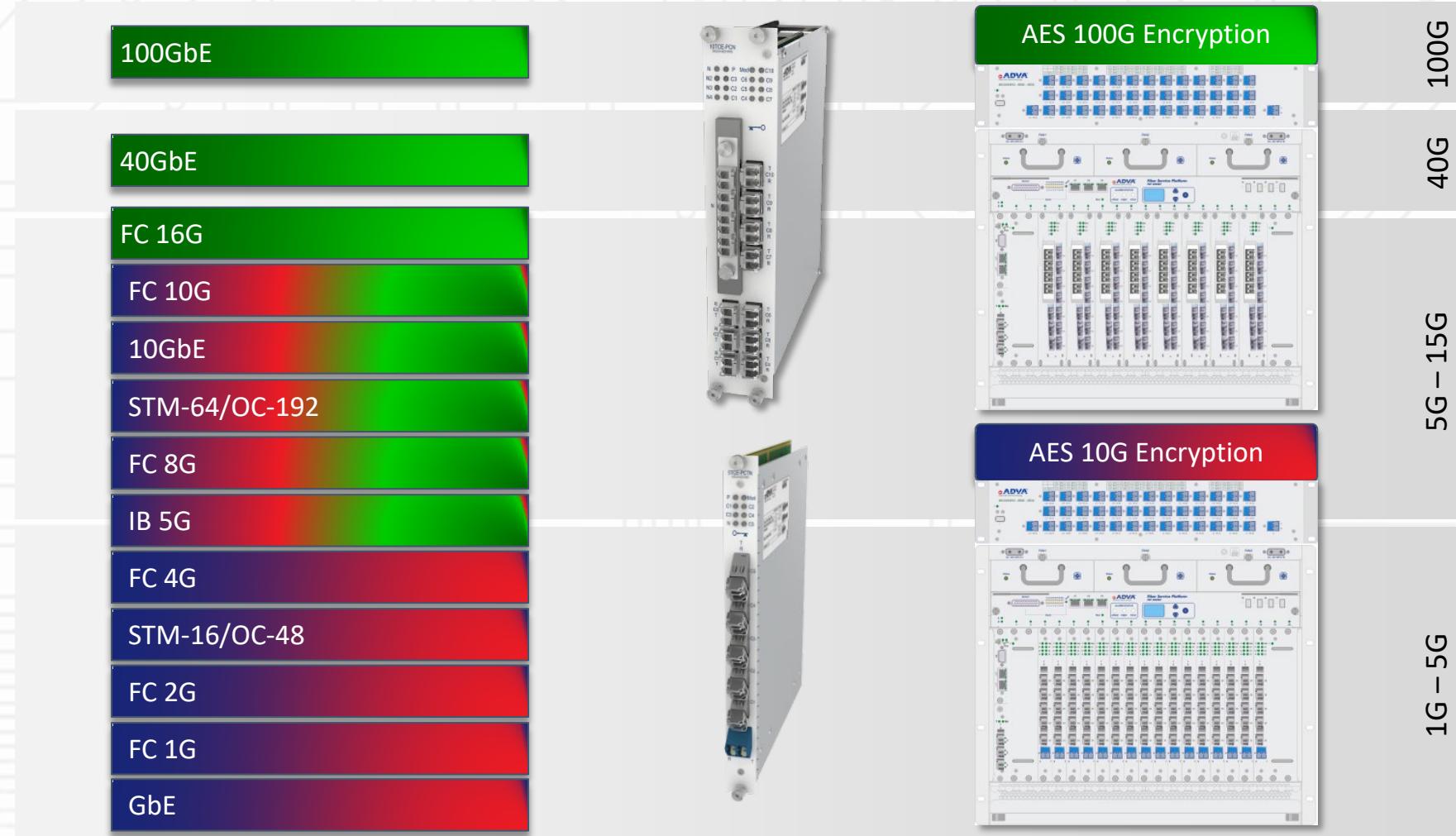
Technologies on the Market:
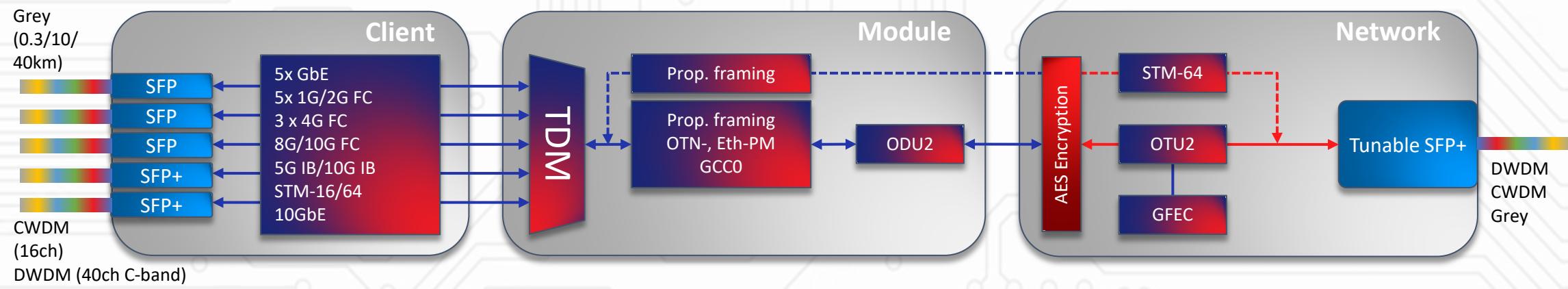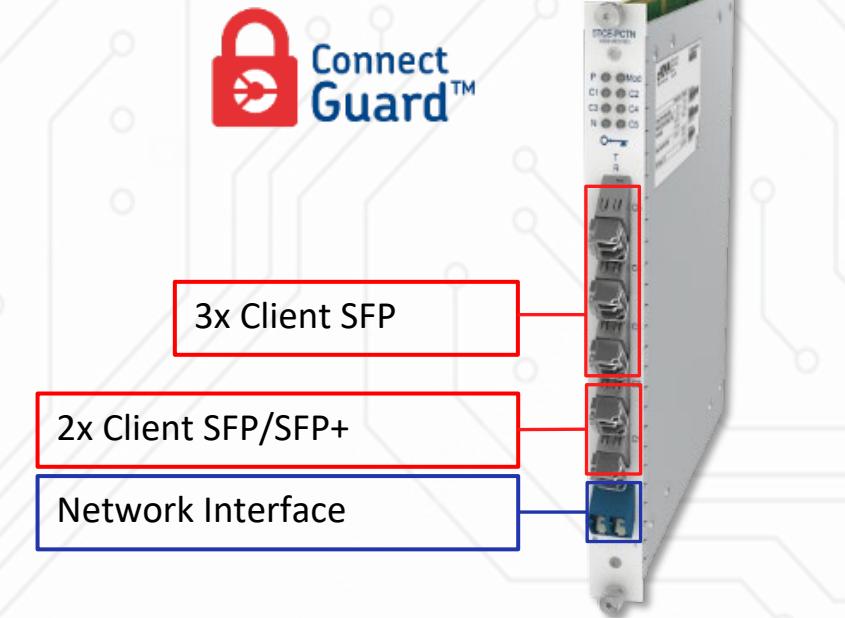
Result: ADVA's Layer 1 Encryption Solution Suite

100GbE	
40GbE	
FC 16G	
FC 10G	
10GbE	
STM-64/OC-192	
FC 8G	
IB 5G	
FC 4G	
STM-16/OC-48	
FC 2G	
FC 1G	
GbE	

AES 100G Encryption

AES 10G Encryption

100G

40G

5G – 15G

1G – 5G

10G Muxponder with Encryption
5TCE-PCN-10GU+AES10G

ADVA™
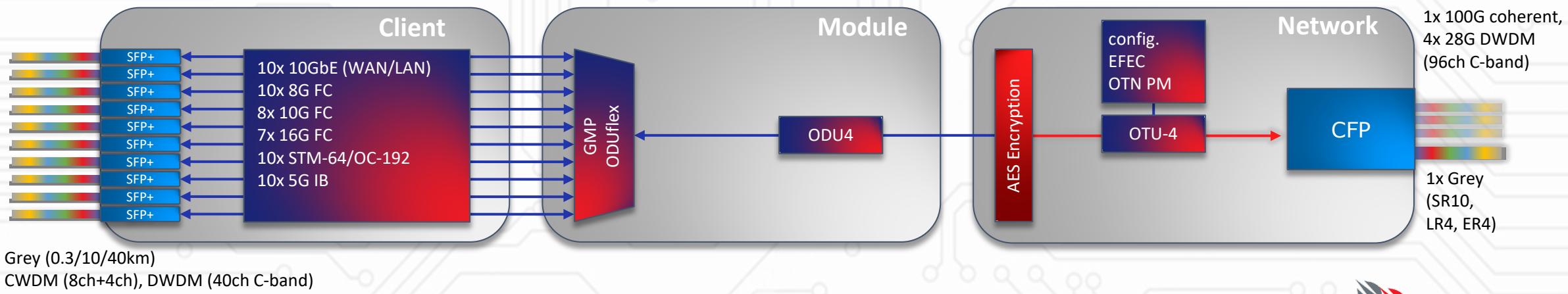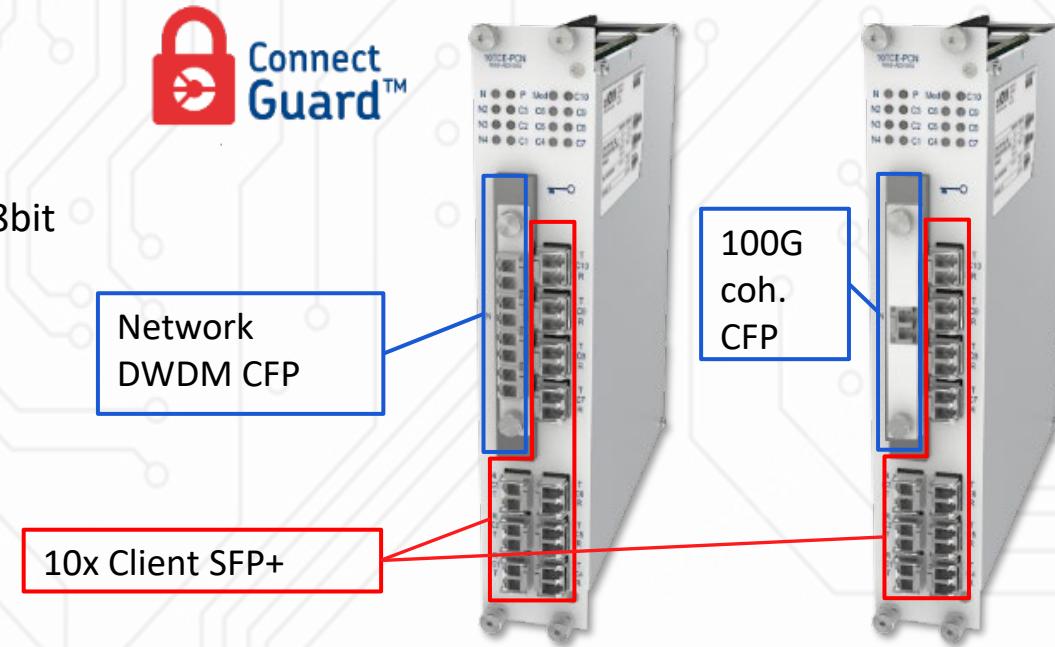
- Universal Enterprise Mux-/Transponder

- AES256 encryption

- Dynamic key exchange every 10 minutes, Diffie-Hellman 1536bit

- 5x Any Multi-service clients

- Transparent / Framed mode

- SDH Network variant 5TCE-PCN-8GU+AES10GS

Connect Guard™

3x Client SFP

2x Client SFP/SFP+

Network Interface

Client

Grey (0.3/10/ 40km)

| SFP |
| SFP |
| SFP |
| SFP+ |
| SFP+ |

5x GbE
5x 1G/2G FC
3 x 4G FC
8G/10G FC
5G IB/10G IB
STM-16/64
10GbE

CWDM (16ch)
DWDM (40ch C-band)

TDM

Module

Prop. framing

Prop. framing
OTN-, Eth-PM
GCC0

ODU2

Network

AES Encryption

STM-64

OTU2

GFEC

Tunable SFP+

DWDM
CWDM
Grey

NETWELL
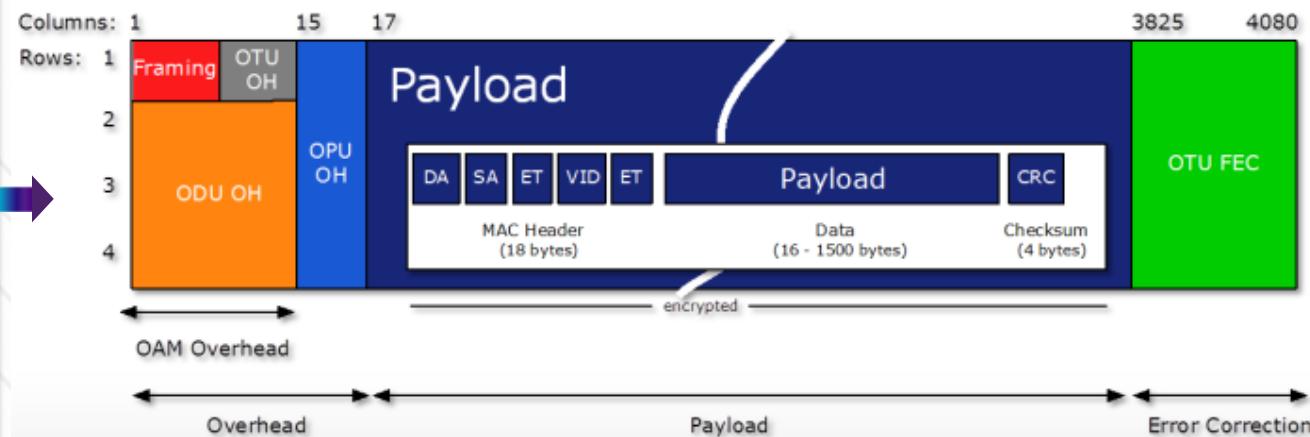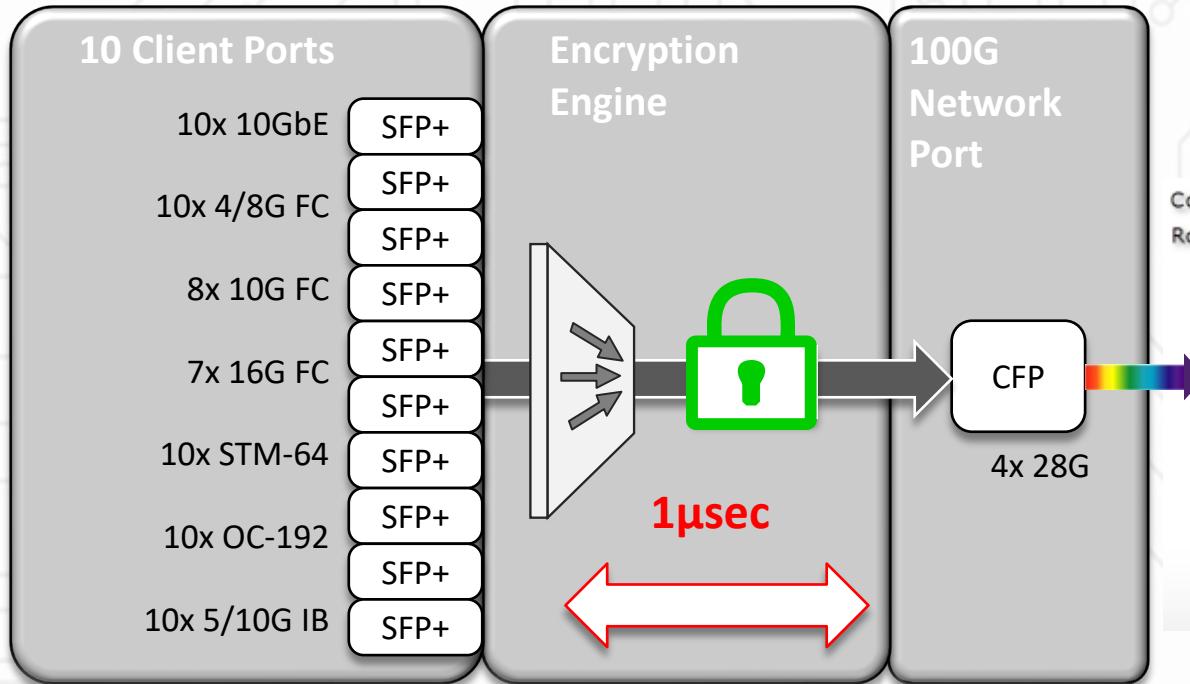
100G Muxponder with Encryption
10TCE-PCN-16GU+AES100G

ADVA™

- Universal Enterprise Muxponder 100G

- AES256 encryption

- Dynamic key exchange every 1 minute, Diffie-Hellman 2048bit

- Up to 10 x any multi-service

- 10GE, FC8/10/16, 5G Infiniband

- 40GE/100GE by means of 4x/10x 10GbE via break out cable (SR4, LR4 and SR10)

  - High bandwidth efficiency (up to 96x 100 Gb/s = 9.6 Tb/s)

Connect Guard™

Network DWDM CFP

100G coh. CFP

10x Client SFP+

Client

SFP+
SFP+
SFP+
SFP+
SFP+
SFP+
SFP+
SFP+
SFP+
SFP+

10x 10GbE (WAN/LAN)
10x 8G FC
8x 10G FC
7x 16G FC
10x STM-64/OC-192
10x 5G IB

Module

GMP ODUflex

ODU4

Network

AES Encryption

config. EFEC OTN PM

OTU-4

CFP

1x 100G coherent, 4x 28G DWDM (96ch C-band)

1x Grey (SR10, LR4, ER4)

Grey (0.3/10/40km)
CWDM (8ch+4ch), DWDM (40ch C-band)

NETWELL
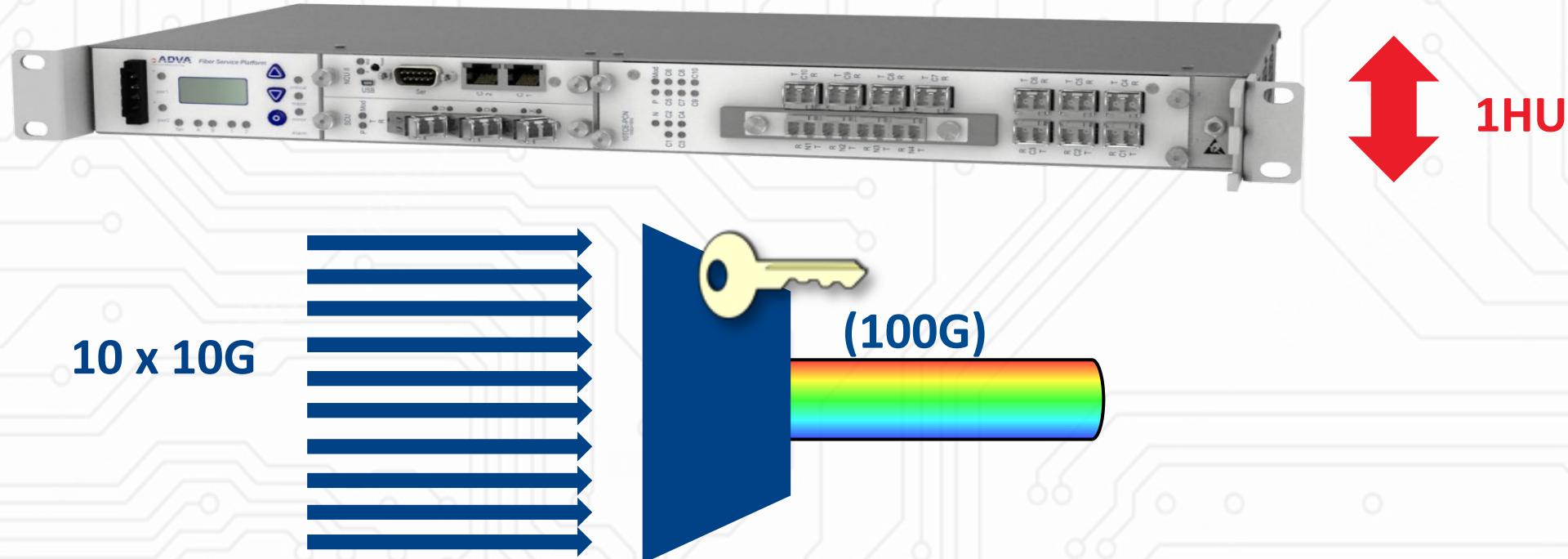
Universal DWDM Security Card

- First with 100G in-flight (line-speed) encryption.

- Bulk encryption includes full header and checksum for integrity.

- Zero overhead means 100% throughput, even with short packets.

- All LAN, WAN, SAN, and HPC traffic can be combined in single color.

Smallest 100G 1HU DWDM-CryptoBox!

1HU

10 x 10G

(100G)
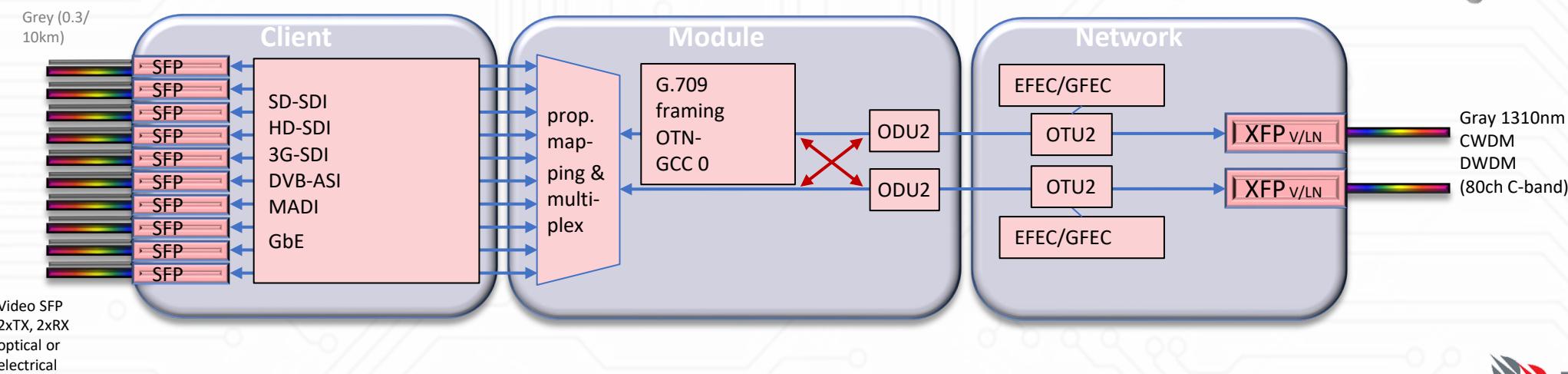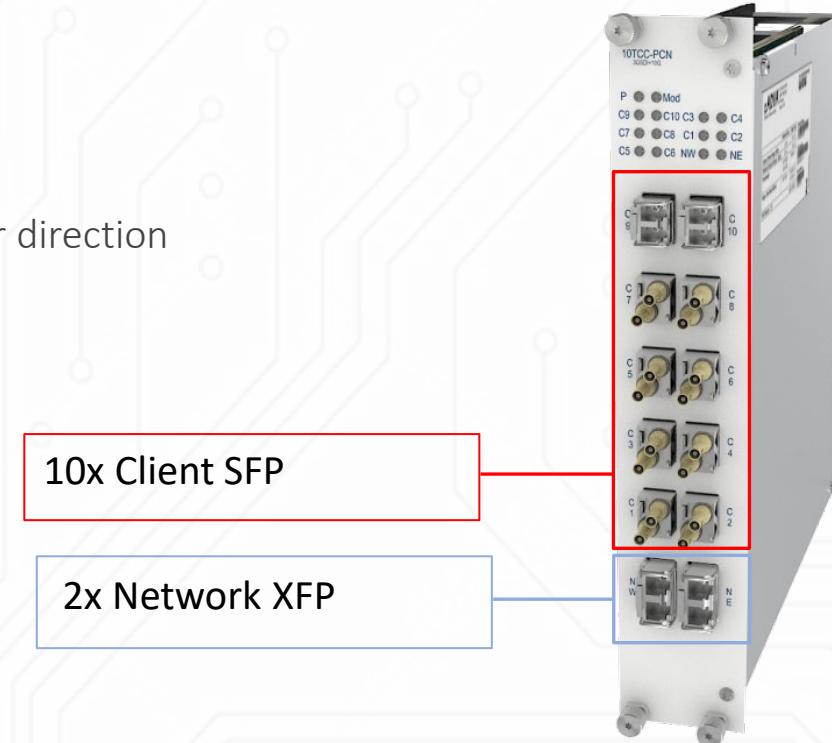
Special Topic:
TV and Video
Transport
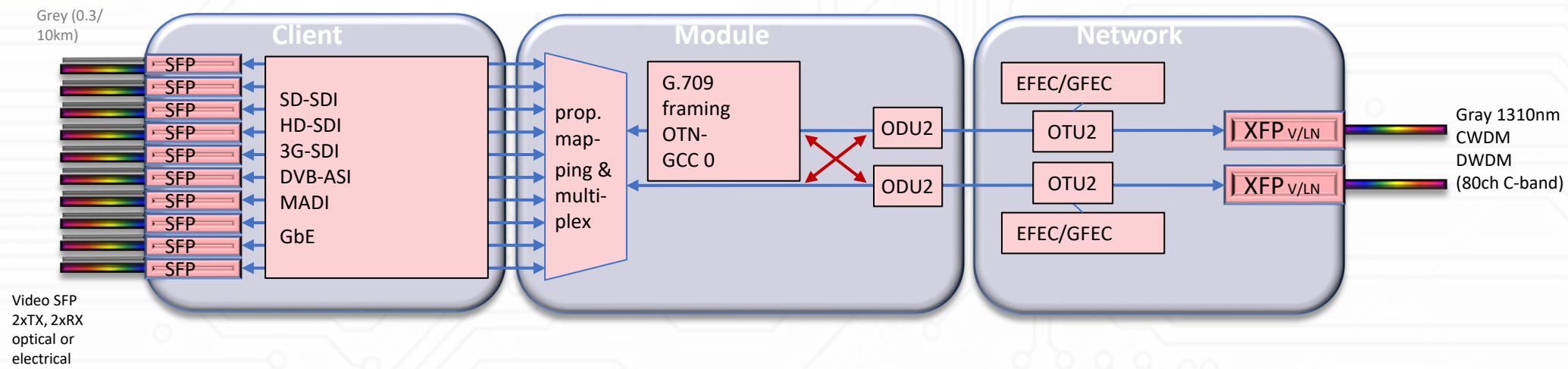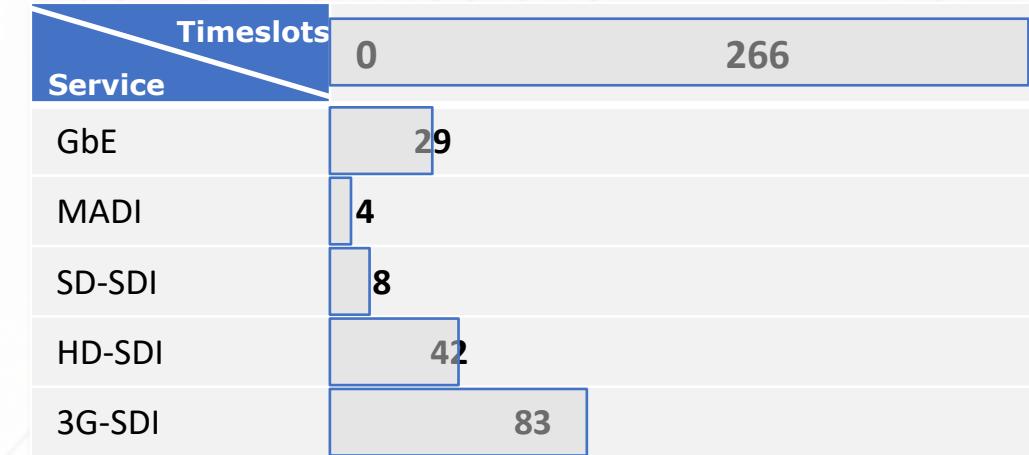
Native Video Transport
10TCC-PCN-3GSDI+10G

- Applications : 3G-SDI, HD-SDI, SD-SDI, DVB-ASI, MADI and GbE

- Unidirectional and bidirectional services for up to 16 x Tx or Rx clients per direction

- Add/Drop, pass-through, drop&continue, hairpin for mirror ports

- Proprietary mapping into OPU2

- Client channel card protection and channel protection

- OTU2 network interface w/ GFEC/EFEC

10x Client SFP

2x Network XFP

Grey (0.3/10km)

Client

SFP
SFP
SFP
SFP
SFP
SFP
SFP
SFP
SFP
SFP
SFP
SFP

SD-SDI
HD-SDI
3G-SDI
DVB-ASI
MADI
GbE

Video SFP 2xTX, 2xRX optical or electrical

prop. map-ping & multi-plex

Module

G.709 framing OTN-GCC 0

ODU2

ODU2

Network

EFEC/GFEC

OTU2

OTU2

EFEC/GFEC

XFP V/LN

XFP V/LN

Gray 1310nm CWDM DWDM (80ch C-band)

Native Video Transport
Aggregation & Interfaces
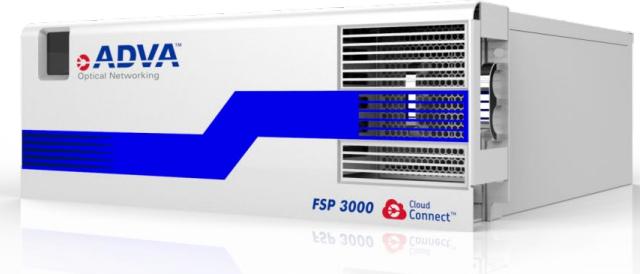
- 2x TX or 2x RX

- Optical (1310nm) and electrical client interfaces (HD-BNC)

- GbE 850nm/1310nm SFPs

- Up to 16 uni-directional services

- 266 virtual time-slot

Service / Timeslots	0	266
GbE	29	
MADI	4	
SD-SDI	8	
HD-SDI	42	
3G-SDI	83	

Grey (0.3/ 10km)

Client

SFP
SFP
SFP
SFP
SFP
SFP
SFP
SFP
SFP
SFP
SFP

SD-SDI
HD-SDI
3G-SDI
DVB-ASI
MADI

GbE

Module

prop. map-ping & multi-plex

G.709 framing OTN-GCC 0

ODU2

ODU2

Network

EFEC/GFEC

OTU2

OTU2

EFEC/GFEC

XFP V/LN

XFP V/LN

Gray 1310nm CWDM DWDM (80ch C-band)

Video SFP 2xTX, 2xRX optical or electrical
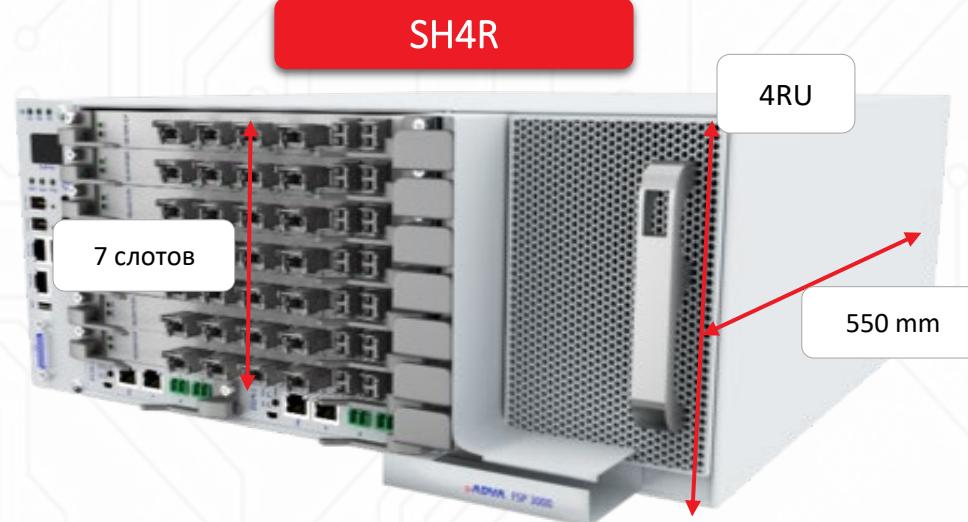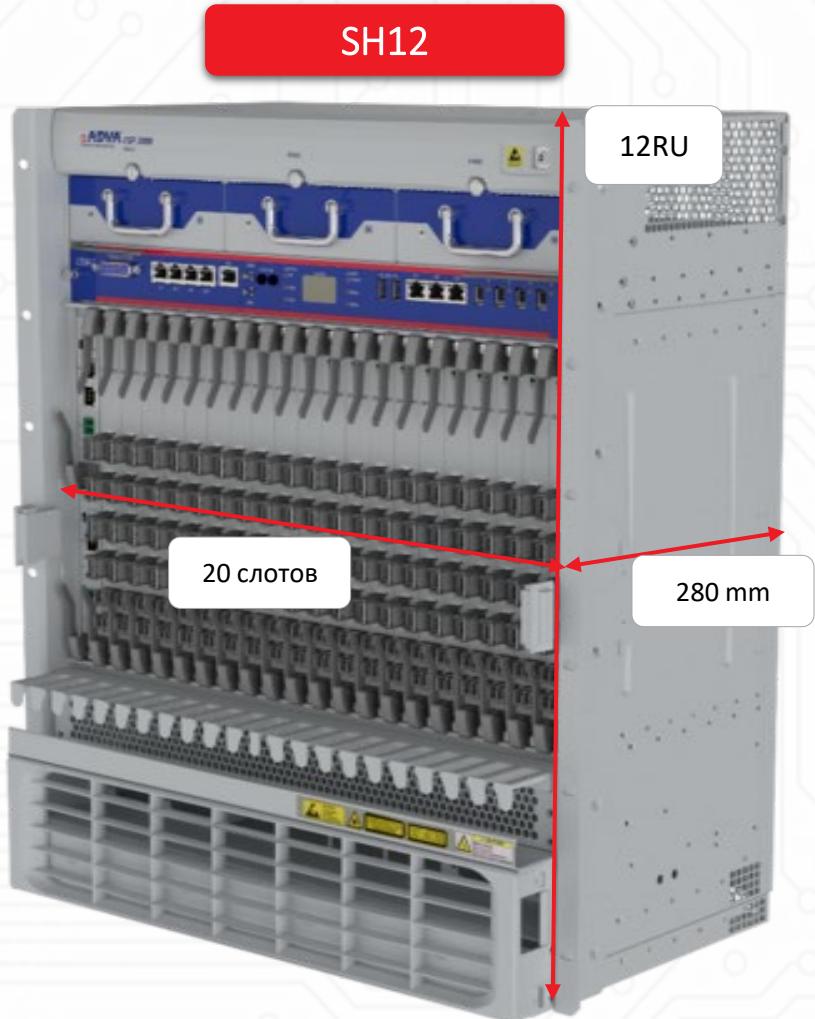
256x 100GbE
2560x 10GbE
Single 19" Rack

New for 2016/2017

25.6Tbit/s in one rack !

FSP 3000 Cloud connect

SH12

12RU

20 слотов

280 mm

SH4R

4RU

7 слотов

550 mm

QSFP28 Form factor

Open & Programmable
Software Interfaces

SH1

1RU

2 слота

450 mm

CloudConnect and MicroMux
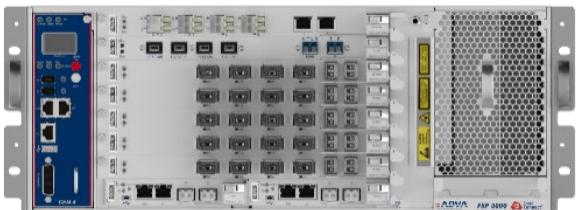
CloudConnect System-in-a-box versatility, large scale aggregation

2 Tbit/s capacity	5Tbit/s capacity
Steffen: perfect service mix! 4RU	9RU
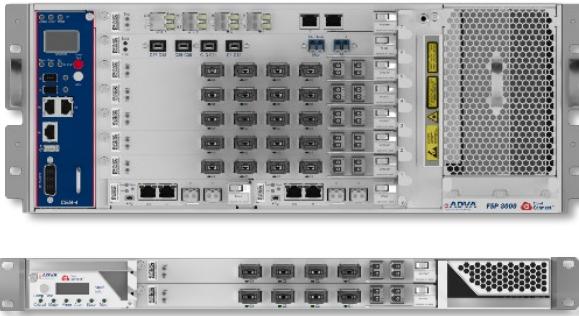
With ADVA MicroMux	Client Options 20 x 100GbE 40 x 40GbE 200 x 10GbE	Client Options 52 x 100GbE 104 x 40GbE 520 x 10GbE

New for 2016: CloudConnectTM Components

Transponder	Key Features	Interface Speeds
QuadFlex	Software defined transponder **400G per module** Single slot, 4x QSFP28 clients Flexgrid support	Network: configurable 100G QPSK, 150G 8QAM or 200G 16QAM Dual coherent interface Services: 100G Ethernet, OTU4
MicroMux	Plug-based 10/40G multiplexer Used for 100G interfaces Active module with SM/MM breakout cables for QuadFlex clients	Network: 100GbE to host Services: Ethernet 10G/40G, MM: 100GbE
OpenFabric400	Multiplexing, ADM and Switching/grooming functions Multi-service, QSFP+/QSFP28 clients AES256 Encryption variant	Interfaces: 2x 100G (100GbE/OTU4) 20x 10G (10GbE/STM-64/OTU2e) 5x 40G (40GbE/OTU3) SAN services

CloudConnect™ Solution Components

Datacenter Optimized Shelves

- 4RU shelf - high scalability config
- 1RU shelf - min space config
- Highly modular scaling
- 450mm depth, rear power, fans

400G Line Card Modules

- QuadFlex: Flexible coherent, 16QAM for max scalability
- QuadExtend: Direct detect 400G for lowest cost @ short reach
- 100G QSFP28 client ports

Flexible Multiplexing
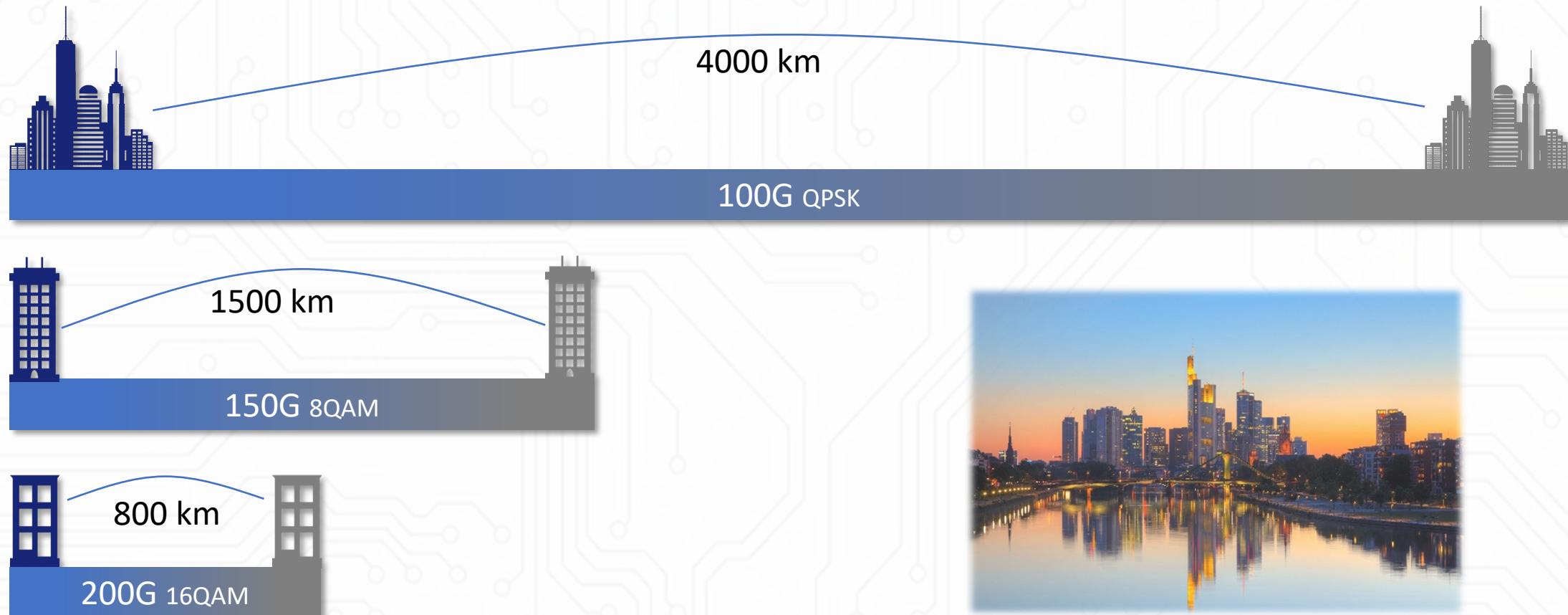
- 200G Mux card for range of Ethernet services
- QSFP28 MicroMux for line card-integrated multiplexing of 10&40GbE client signals

Cloud OS oriented software

CloudConnect™ System Reach
Performance meets Distance

4000 km

100G QPSK

1500 km

150G 8QAM

800 km

200G 16QAM
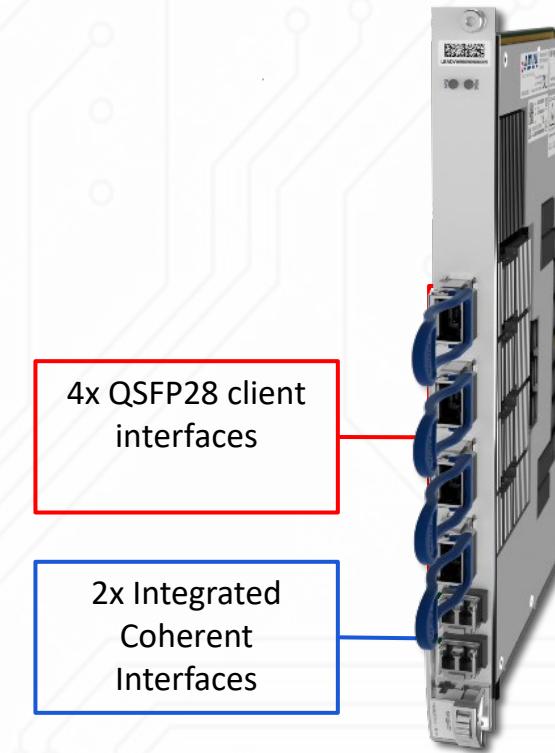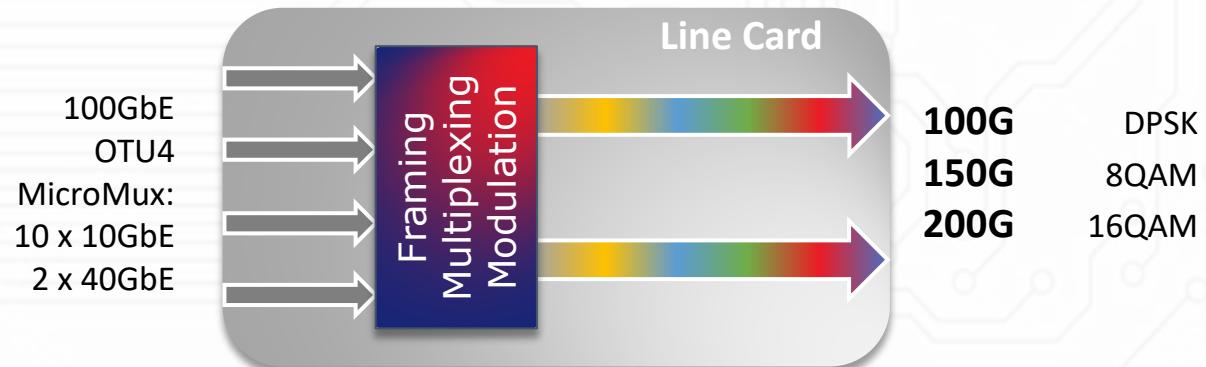
Network and cost scalability by link dependent optimization

CloudConnect™ QuadFlex
Density and Flexibility

ADVA™

400G Flexible Line Card

- Optimizing DCI in Metro and Core
- QSFP28 client interfaces
- 25.6Tbit/s C-Band fiber capacity
- Configurable capacity at 100-200G line speeds
- Flexgrid alignment to any Optical Line System

4x QSFP28 client interfaces

2x Integrated Coherent Interfaces

E ENERGY EFFICIENT

100GbE
OTU4
MicroMux:
10 x 10GbE
2 x 40GbE

Framing Multiplexing Modulation

Line Card

100G   DPSK
150G   8QAM
200G   16QAM

NETWELL
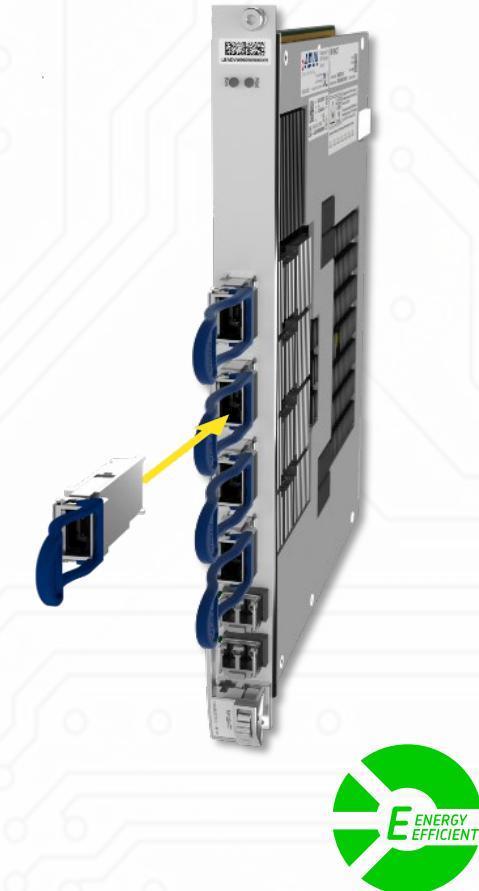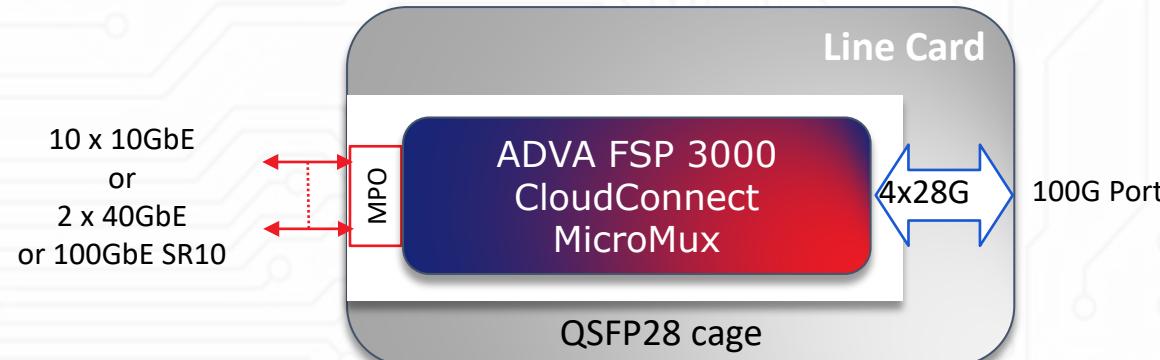
CloudConnect™ MicroMux
World's Smallest Multiplexer

QSFP28 Integrated Multiplexer

- Enables 100G ports to support 10GbE and 40GbE
  - Fan out for single-mode and multi-mode clients

- 100% system capacity also for 10 & 40GbE

- Simple service migration by changing pluggables

Line Card

10 x 10GbE
or
2 x 40GbE
or 100GbE SR10

MPO

ADVA FSP 3000
CloudConnect
MicroMux

4x28G

100G Port

QSFP28 cage

MicroMux Services

10GbE

Services

10x LR (single mode), 10km

10x SR (multi mode), 300m

Monitoring

Byte and frame counter

Utilization

LoS

40GbE

Services

2x PSM4 (single mode), 2km

2x SR4 (multi mode), 300m

Monitoring

Byte and frame counter

Utilization

LoS

100GbE

Services

1x SR10 (multi mode)

Monitoring

Byte and frame counter

Utilization

LoS

Brocade & ADVA
# Support of 32G Fibrechannel

1. You need an 32G FC Device!
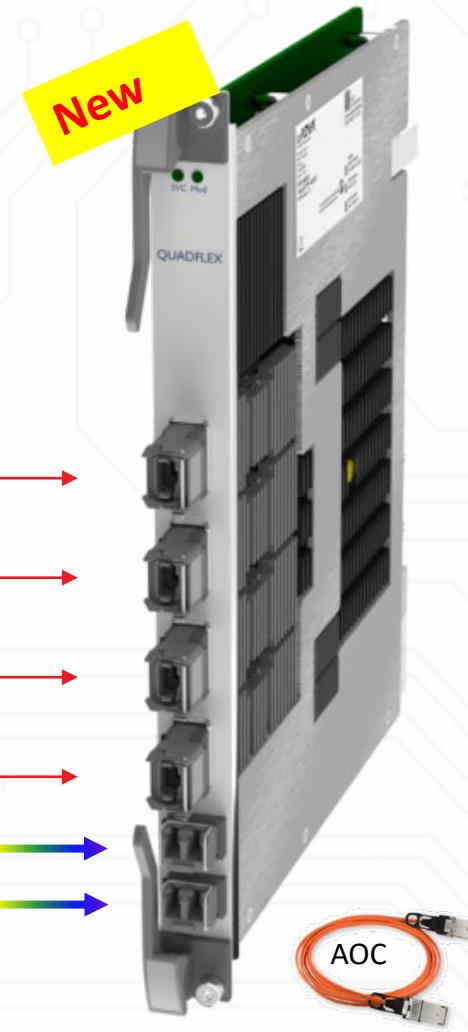
2. You need 200/400G transport technology

- 2 x integrated, flexible coherent interfaces
  - 200-400G client capacity dependent on interface configuration
- Up to 25.6Tb/s C-Band fiber capacity with flex-grid capability
  - Future 51.2Tbit/s C+L Band
- 4 x QSFP28 client interfaces : 100GbE, OTU4
  - Types: SR4, LR4, CWDM4, AOC

| Mod Format	Module Capacity	Reach (typ.)
DP-QPSK	200Gbit/s	3500km+
DP-8QAM	300Gbit/s	1500km
DP-16QAM	400Gbit/s	800km

New

4 x QSFP28 client interfaces

2 x integrated coherent interfaces

AOC
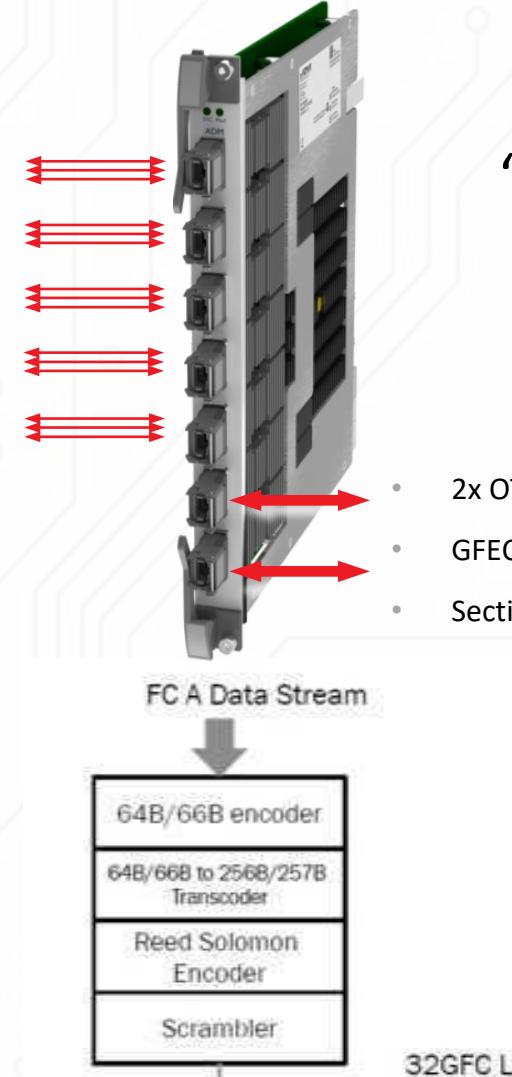
# 3. SAN Transport via Muxponder card
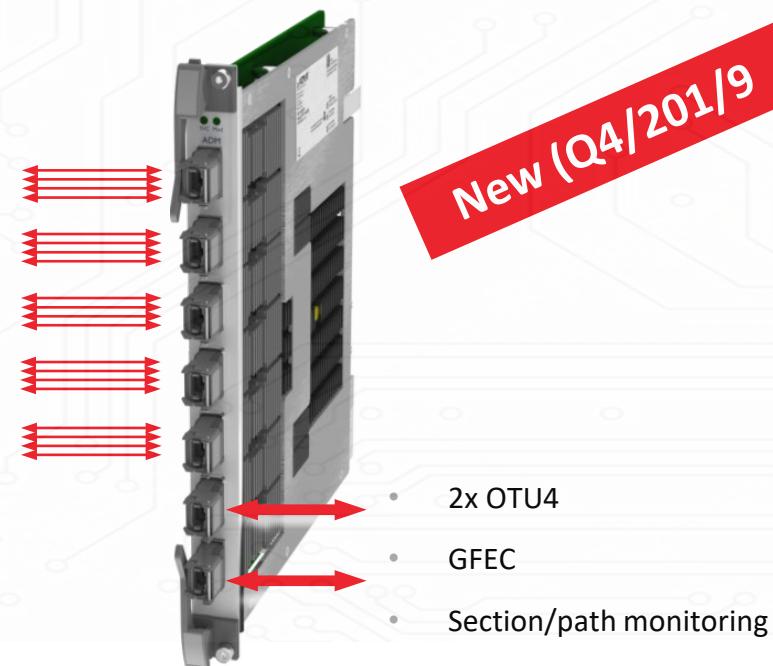
- 16G /32G FC support
  - 28.05GHz service rate (matching OTU4 lane rate)
  - PCS transparent transport
  - Minimum skew for Brocade trunking
  - Up to **6x 32G FC** or up to **12x 16G FC**
  - 128G FC (later release)
- Service support on Quad Pluggables
  - 16G FC via fan out of QSFP14 or multi rate QSFP28/SR4 and QSFP28/PSM4
  - 32G FC via fan out of dual rate QSFP28/SR4 and QSFP28/PSM4
 - 3x service per QSFP

New

"OpenFab-SAN"

- 2x OTU4
- GFEC
- Section/path monitoring

FC A Data Stream

64B/66B encoder
64B/66B to 256B/257B Transcoder
Reed Solomon Encoder
Scrambler

FC B Data Stream

64B/66B decoder
256/257B to 64B/66B Transcoder
Reed Solomon Decoder
Descrambler

32GFC Link
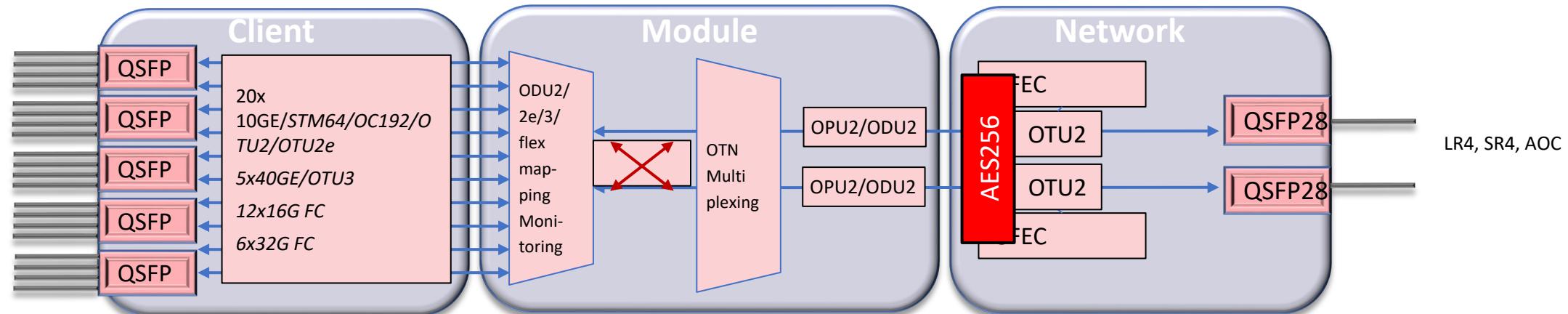
4. AES-Encryption on Top

ADVA™

- Network side encryption (2x 100G AES)
  - DH based dynamic Key exchange
  - AES 256 Encryption
  - X.509 Support
- Client side service mix
  - 10/25/40/100GE
  - OTU2/2e/3
  - SDH/SONET
  - 16G and 32G FC
  - ADM support

New (Q4/201/9

- 2x OTU4
- GFEC
- Section/path monitoring

Client

| QSFP |
| QSFP |
| QSFP |
| QSFP |
| QSFP |

20x
10GE/*STM64/OC192/O*
TU2/OTU2e

5x40GE/OTU3

12x16G FC

6x32G FC

10G: LR, SR
40GE:
SR4, PSM4

Module

ODU2/2e/3/ flex map-ping Moni-toring

OTN Multi plexing

OPU2/ODU2

OPU2/ODU2

Network

FEC

AES256

OTU2

OTU2

FEC

QSFP28

QSFP28

LR4, SR4, AOC

NETWELL

ADVA's Security Suite

ADVA-Package: FSP 3000 Security Suite

Physical Layer Monitoring

Power Tracking
Intrusion Detection
Optical Time-Domain Reflectometer (OTDR)
Access Line Monitoring (ALM)

Encryption

AES-256
Authentication
Diffie-Hellman

Security-Hardened Software

RADIUS
Secure Shell
SNMPv3

A complete and integrated solution leveraging advanced technology

Physical Layer Monitoring

Fiber Cut:
Detection through software-adjustable switching thresholds

Fiber Degredation:
Alarm generation through adjustable fiber attenuation thresholds
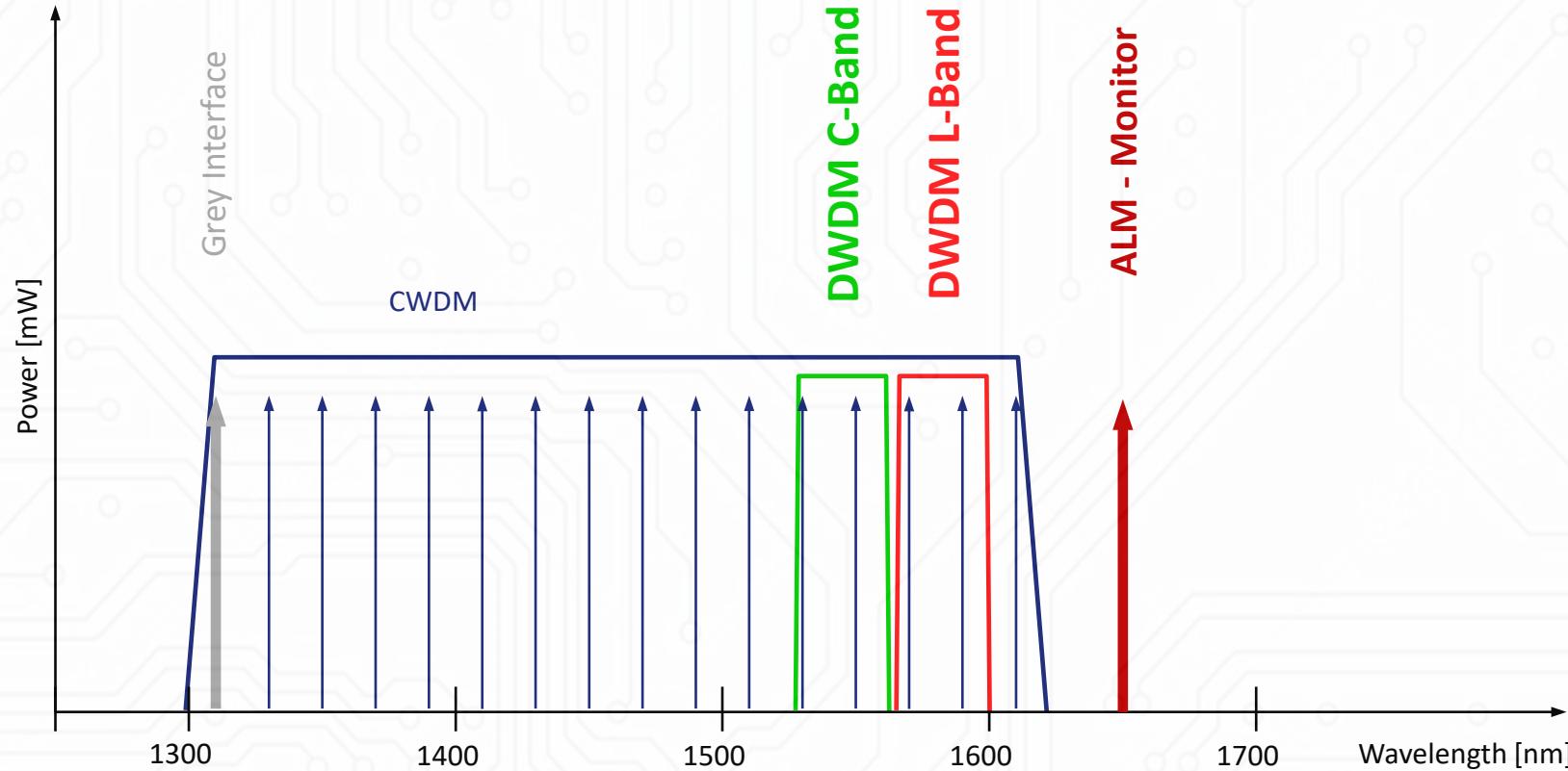
Long Term Effects:
Long term fiber performance information monitoring
Intrusion detection through correlation of typical power signatures

Fault Location Detection:
In-service OTDR measurement or Access Link Monitoring (ALM)
to locate fiber problems and possible fiber taps
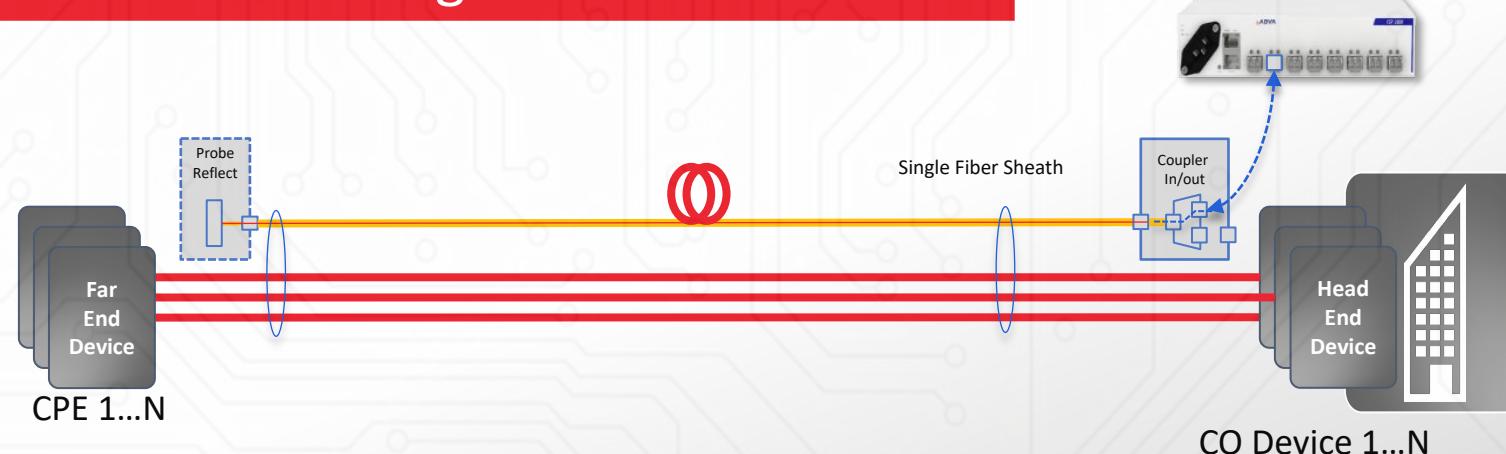
Physical Layer Monitoring

ALM Wavelength Overview
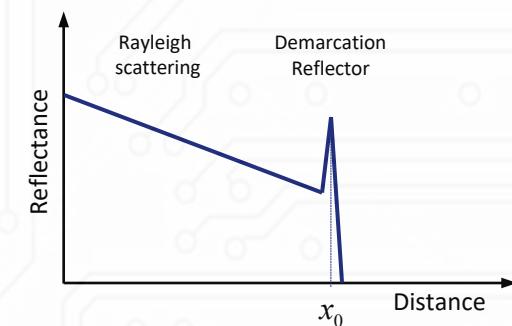
Permanent ALM Monitoring does not interfere with any other transport wavelengths

Physical Layer Monitoring

Dedicated Monitoring Fiber
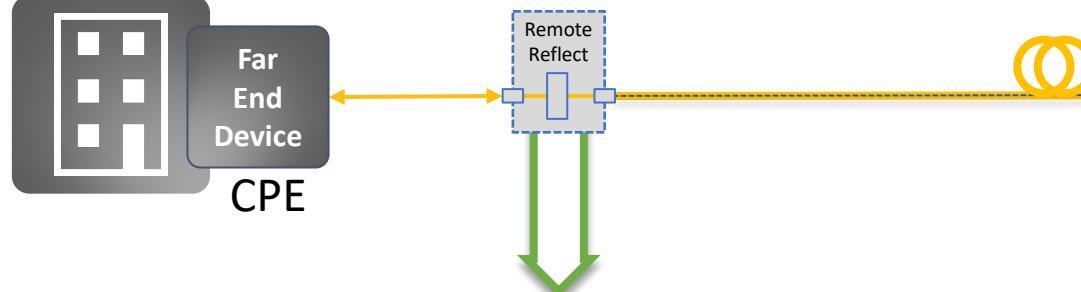
- A dedicated dark fiber is used to monitored the integrity of a fiber sheath
- No Probe in/out filter is required in this configuration
- Demarcation at the CPE is realized by a Probe Reflector
- Architecture is compatible with both SFW as well as DFW

Permanent Monitoring

You will receive <u>alarms/warnings before Bit errors will come!</u>
All failures will be documented and stored. Real reflectometry!

1 ALM Monitor Unit

Two variants:
AC and DC

Remote Reflect

Far End Device
CPE

Coupler In/out

Head End Device
CO

3 Demarcation Reflector
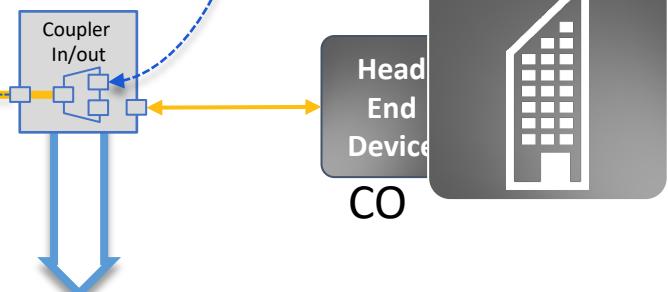
Two realization options:
- Pluggable demarcation reflector (FC/SC)
- Patchcord with integrated reflector (LC/PC)

2 WDM Coupler

Two realization options:
- 1HU module w 16 integrated filters (LC/PC)
- Ruggedized Y-cable (LC/PC)

Спасибо

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