ADVA™ Optical Networking

Trends, Solutions & Limitations of Future Optical Networks

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Outline

- Introduction
- Network Trends
- Network Innovation
- Summary & Outlook

Company Introduction

ADVA Optical Networking

Our History

- More than 18 years of innovation
- Public company (FSE: ADV, TecDAX)

Our Company

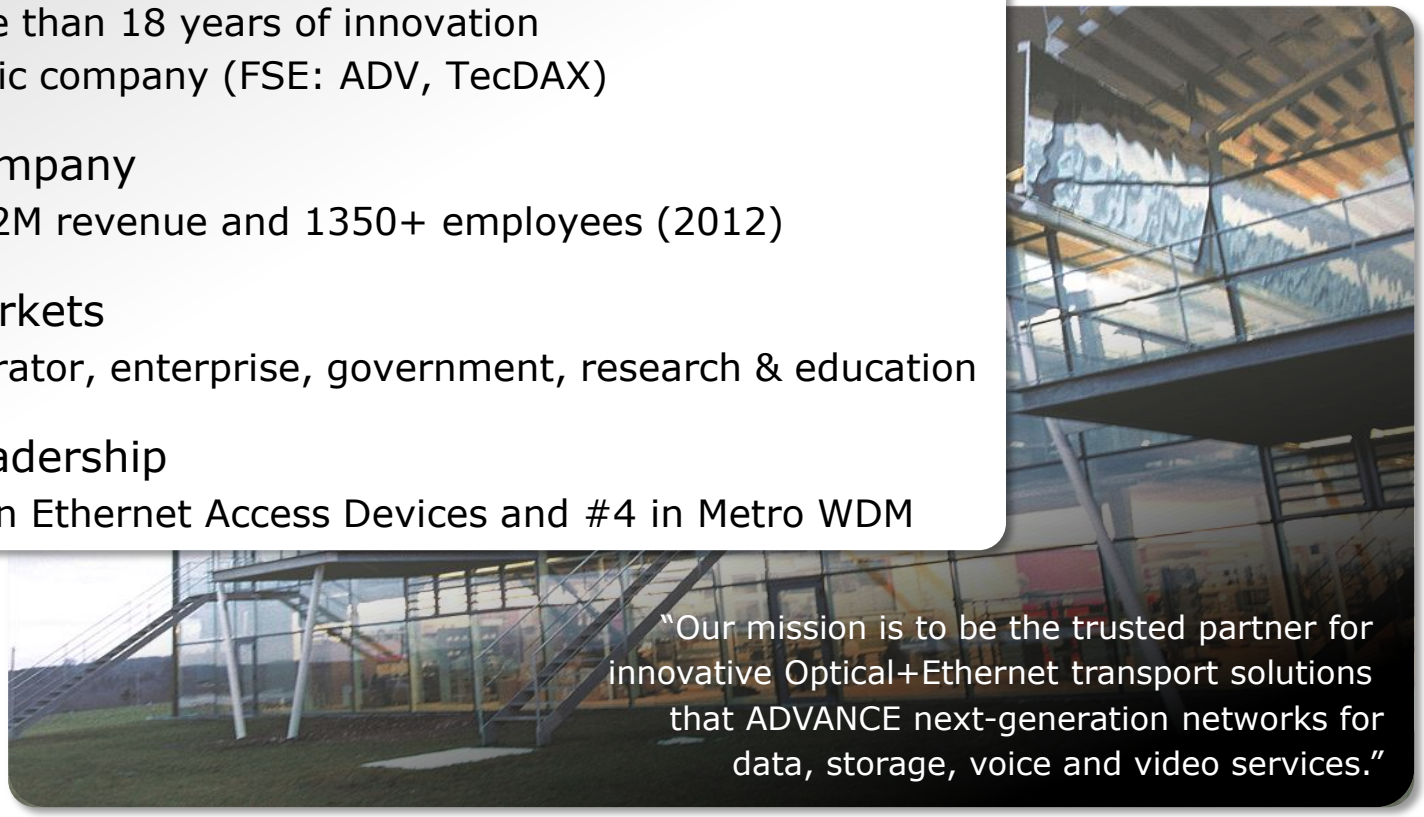
- $432M revenue and 1350+ employees (2012)

Our Markets

- Operator, enterprise, government, research & education

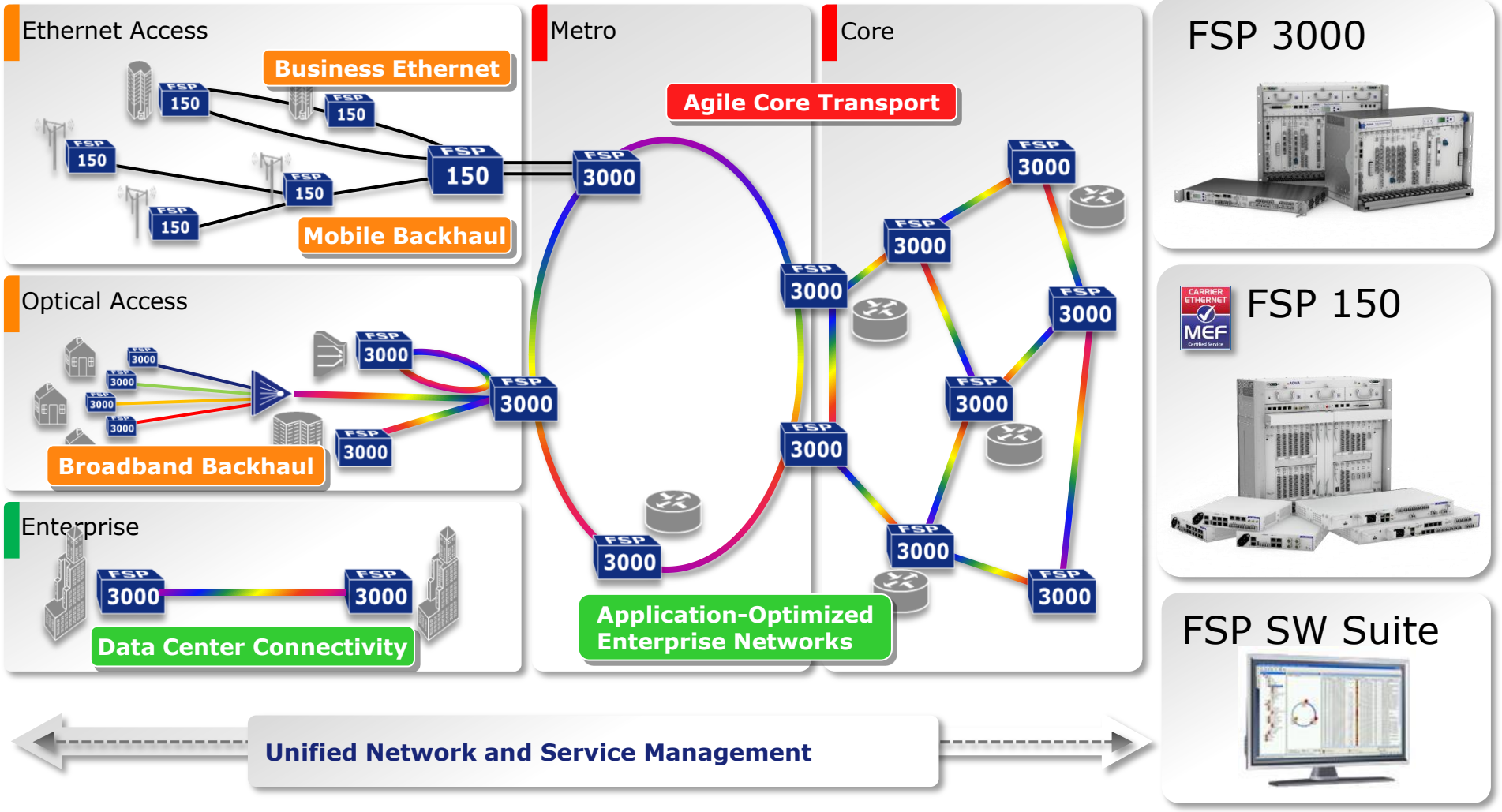
Our Leadership

- #1 in Ethernet Access Devices and #4 in Metro WDM



Trusted partner for speed and innovation.

ADVA Products & Solutions



Our Global Presence

Gdynia – Largest R&D Site

- Headquarter
- Office
- Representative

Richardson

Atlanta

Munich

Meiningen

Berlin

Singapore

Shenzhen

Serving Research & Education in Poland

- Purpose
  - National Backbone
- Applications
  - GRID COMPUTING
  - Distributed storage
  - Optical VPNs
  - Virtual laboratories
  - Distance learning
- Size & Service
  - >4.000km
  - 21 academic MAN sites
  - N x 10GbE LAN PHY
- Performance
  - Reliable, high speed connectivity
  - Flexible infrastructure for science, R&D & education

Delivering the optical infrastructure for the national Polish research network.

Optical Network Trends

What Happens in One Internet Minute?

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The Big Picture - Mega Trends

Mobile Broadband

"Mobile data traffic will increase 13-fold between 2012 and 2017. There will be over 10 Billion mobile-connected devices in 2017."

Cisco Visual Networking Index, Feb. 2013

Cloud Services & Big Data

"In a few years, we can expect the communications industry to look and feel similar to the IT industry."

Network Function Virtualization Operator Paper, Oct. 2012

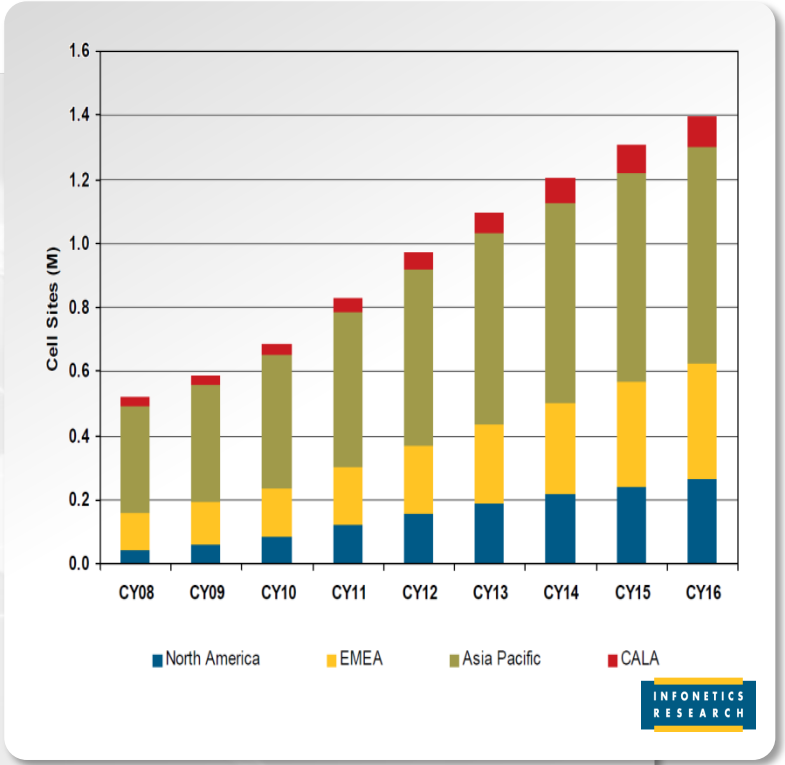
Software-Defined Networking

"SDN is possibly the biggest shift in telecoms in 30 years… The network is finally the computer."

M. Finnie, Interoute, Oct. 2012

Access and Backhaul

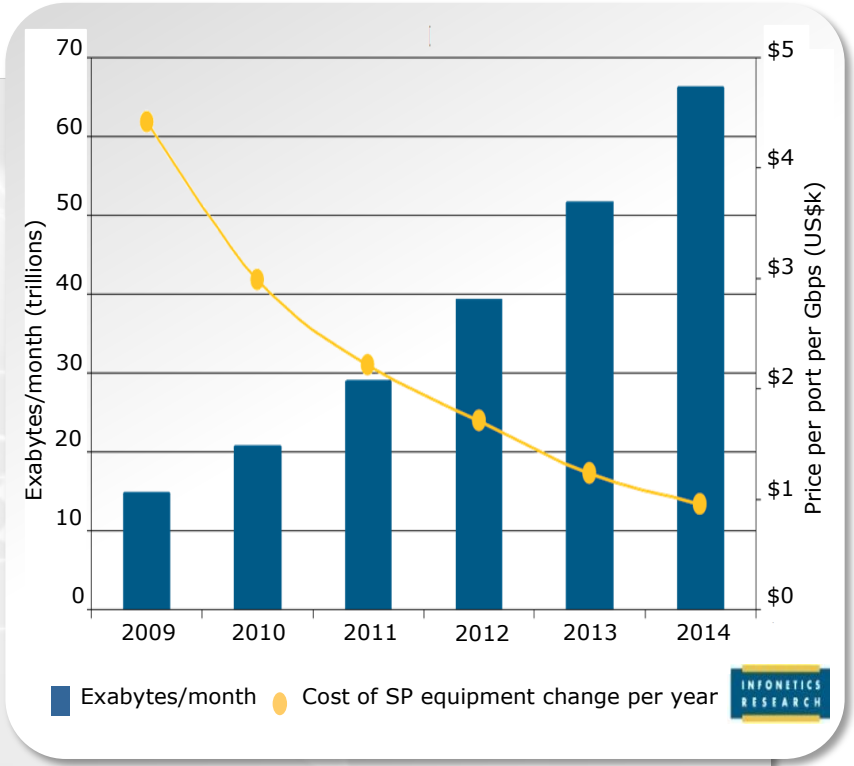
- Capacity needs outstrip copper & µwave capabilities
- Fiber needs to be driven deeper into the access
- Wholesale models become more prevalent
- Mobile networks impose new backhaul requirements
- Virtual network functions are replacing network hardware



Optical infrastructure becomes the convergence layer for fixed and mobile services.

Metro and Core

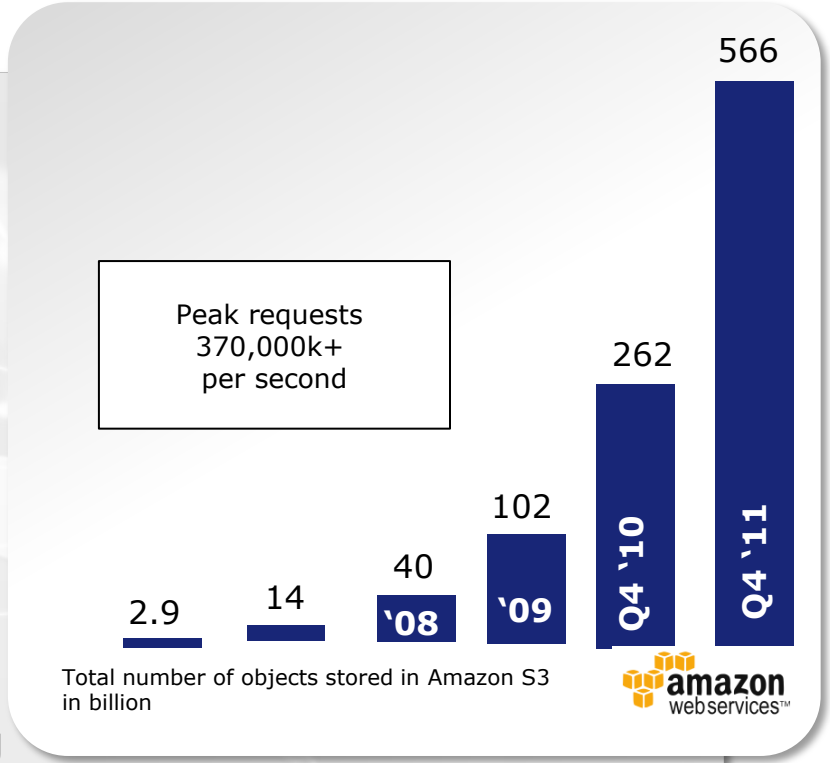
- Mega data centers & OTT change traffic patterns
- Mobility & distributed content challenge network dynamics
- Metro & core will experience a capacity crunch
- Operators consolidate number of metro & core sites
- NG-PoPs integrate IT & network functions



Agile and scalable optical networks are cornerstones for increased efficiency.

Data Center and Enterprise

- Data center capacity is growing dramatically
- Cloud services are on the rise
- Rack space, power and cooling are becoming critical resources
- Data center connectivity and access become bottlenecks
- Network virtualization is crucial for data center resource sharing

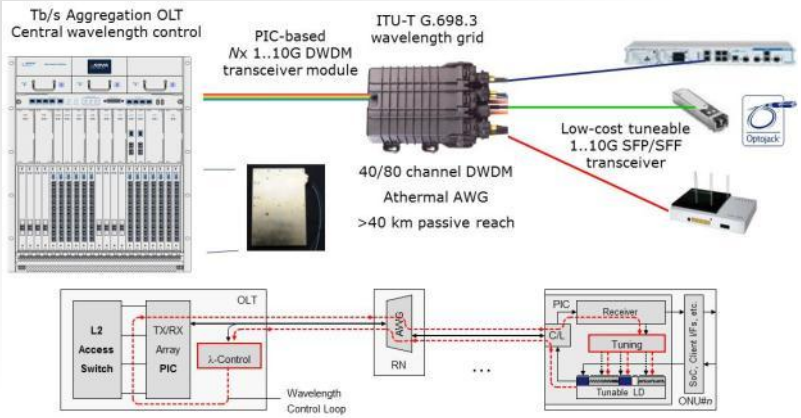


Optical technology will be the foundation for Exa-scale cloud data centers.

Optical Network Innovation

Access and Backhaul Innovation

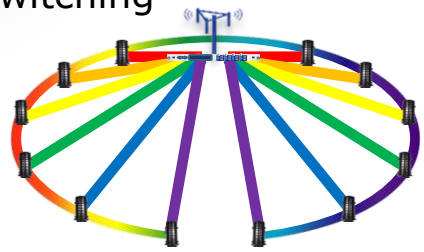
Tunable DWDM Underlay



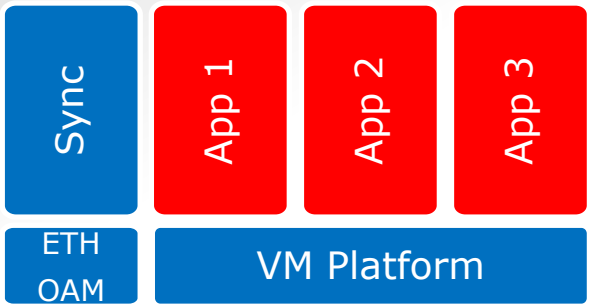
Mobile Fronthaul Optimization

CPRI-as-a-Service

- Multiplexing/Switching
- Assurance
- Compression

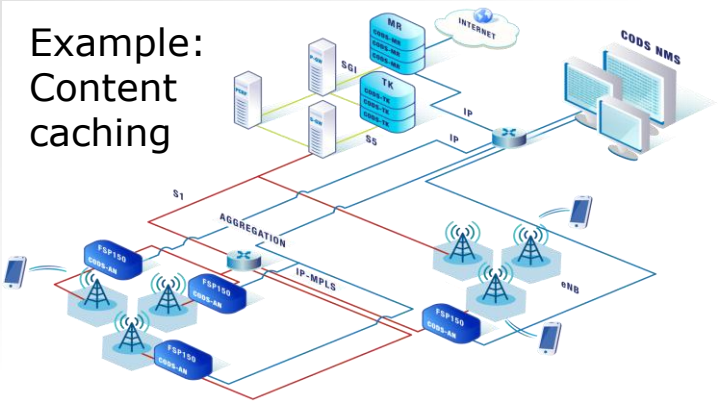


Programmable Network Devices



Network Function Virtualization

Example:
Content
caching



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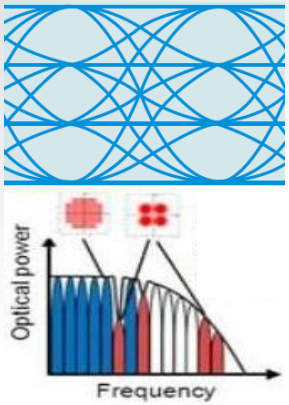
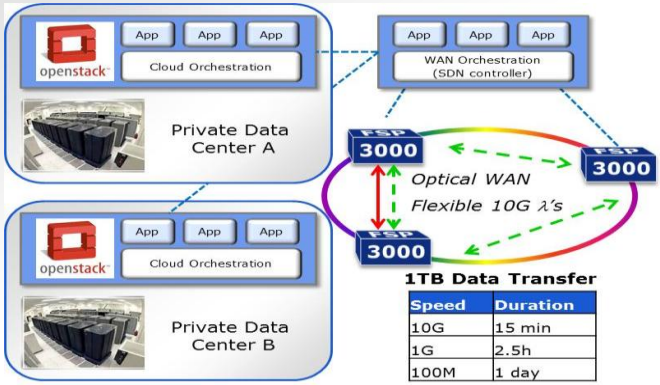
Data Center and Enterprise Innovation

400G+ Interconnects



- Direct detection, DSP-enabled
- 0.5 times lower power, cost, size
- 2+ times increased spectral efficiency

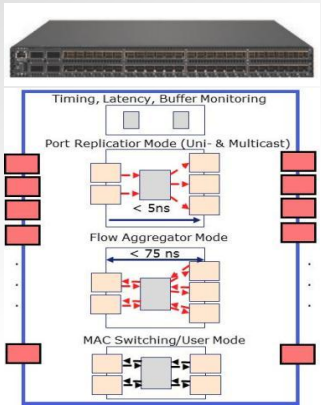
Cloud Networking



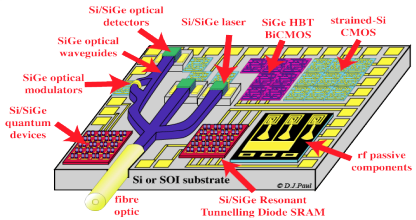
1TB Data Transfer

Speed	Duration
10G	15 min
1G	2.5h
100M	1 day

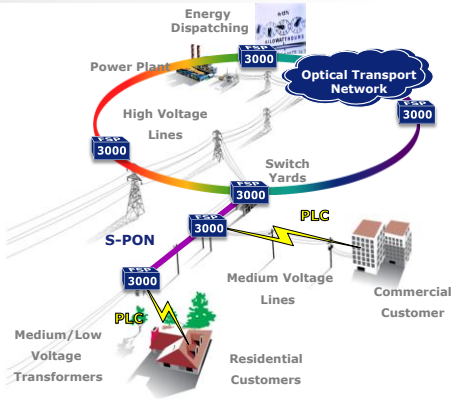
Data Center Optimization



- Low latency fabrics
- Optics integration

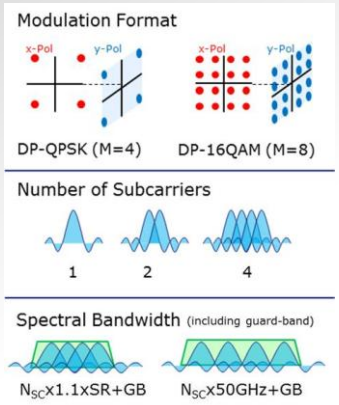


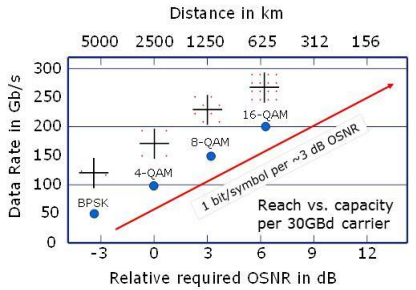
System-on-a-Pluggable



Metro and Core Innovation

SW-Defined Transceivers

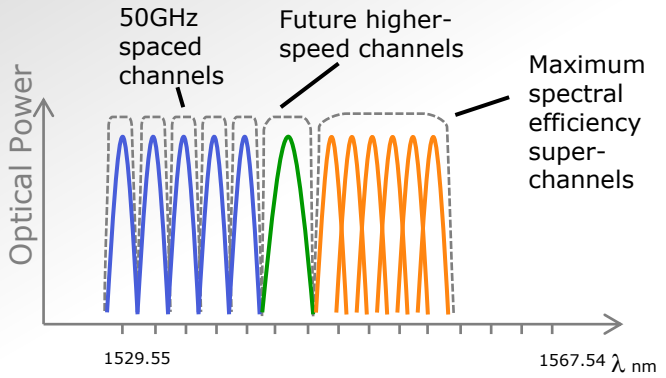




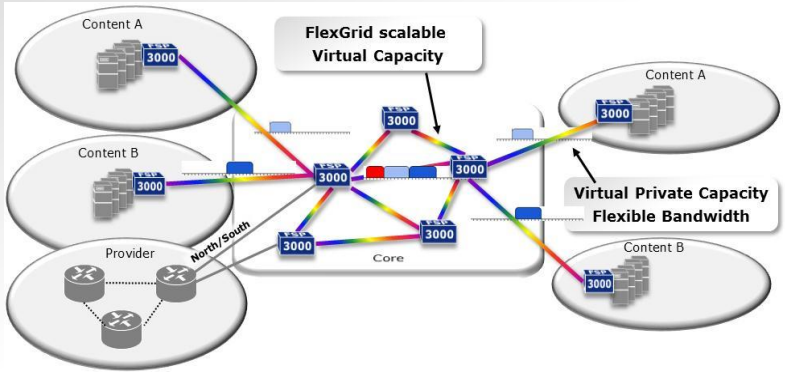
Symbol rate (SR) is additional parameter:

- 400G leverages 100G (~30GBd)
- 1T needs 2..3x SR (~75GBd)

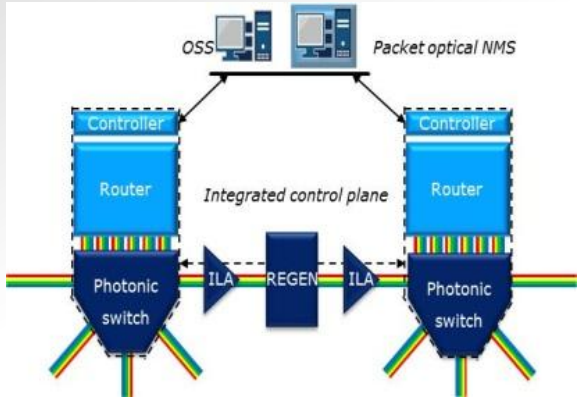
Flexible Grid Optical Layer



Optical Spectrum as a Service



Packet-Optical Integration



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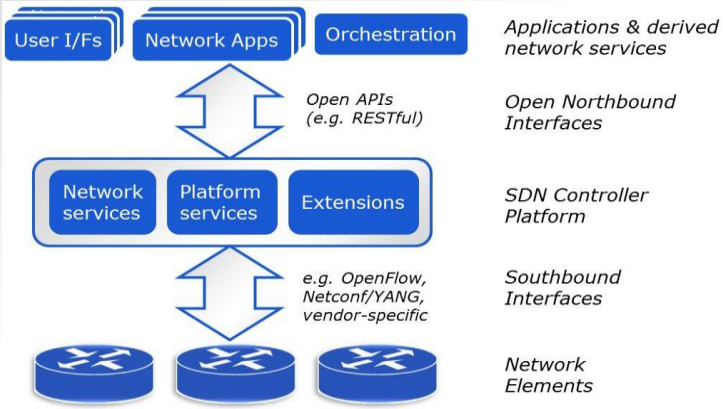
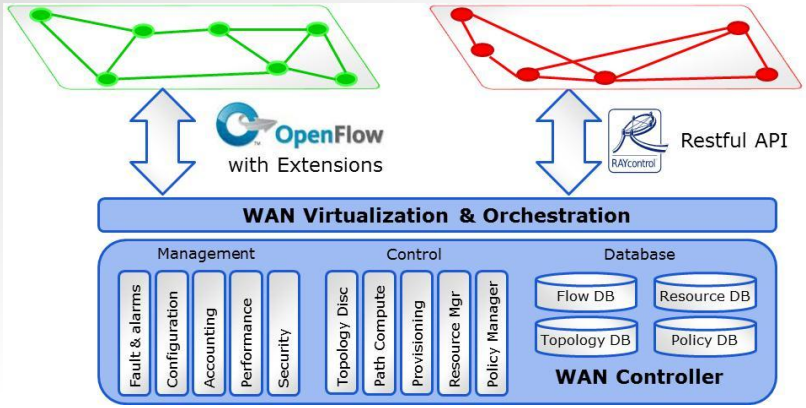
Management and Control Innovation

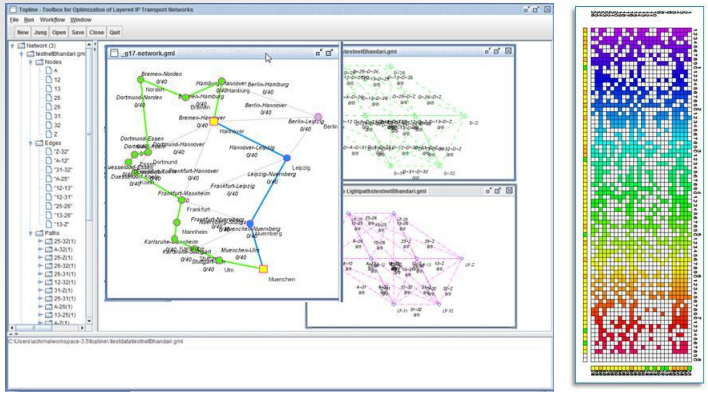
SDN Control



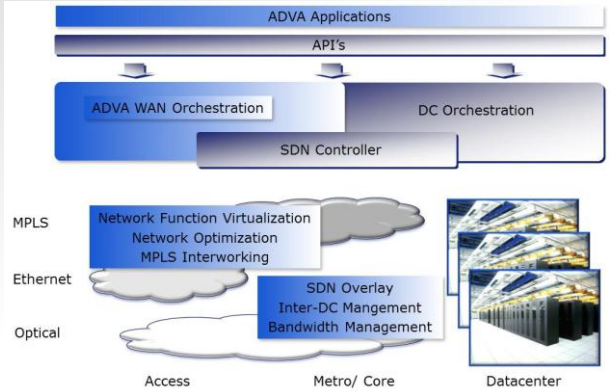
Network Virtualization



Multilayer Optimization

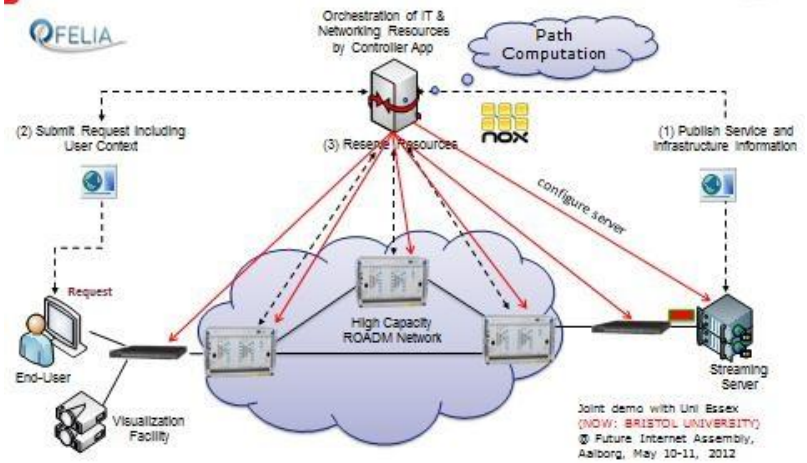


Open Application Framework

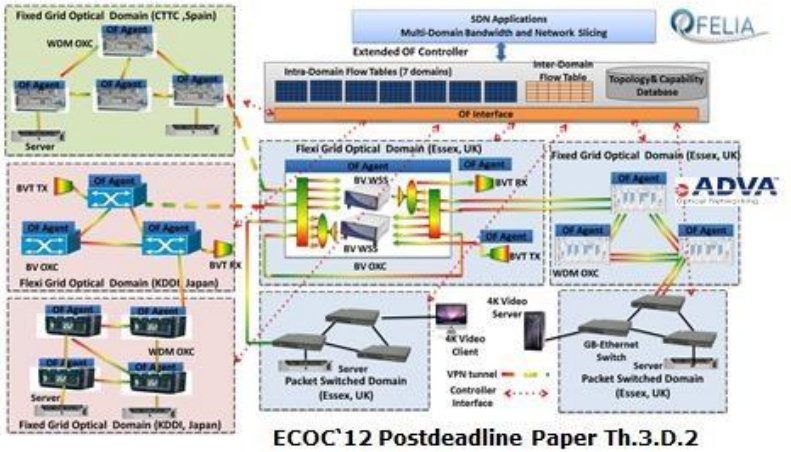


ADVA SDN Trial Activities

First Optical OpenFlow Demonstration
Packet over ROADM Testbed @ Bristol University

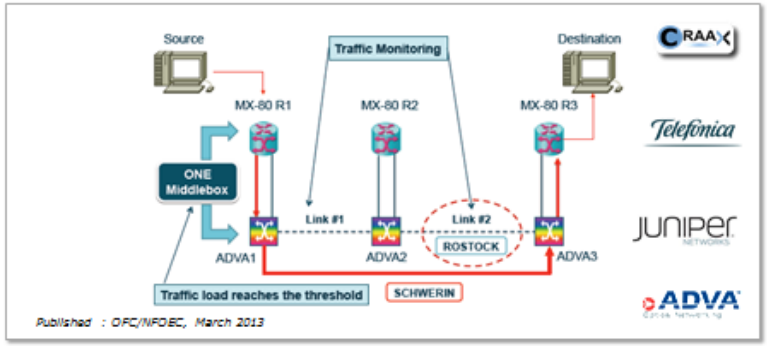


First International Demonstration
Multi-Domain & Multi-Technology Packet over Fixed/Flexi Grid



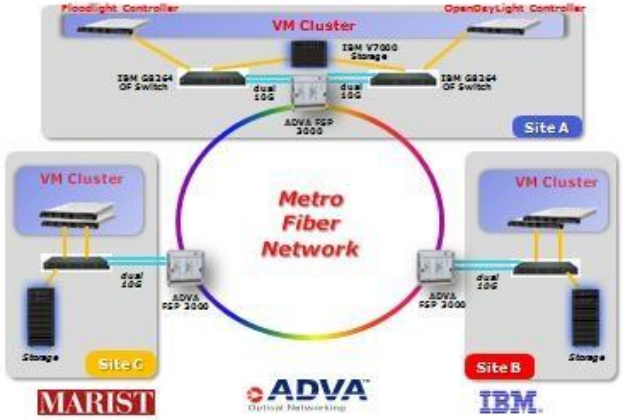
ECOC`12 Postdeadline Paper Th.3.D.2

Telefonica Dynamic Network Field Trial



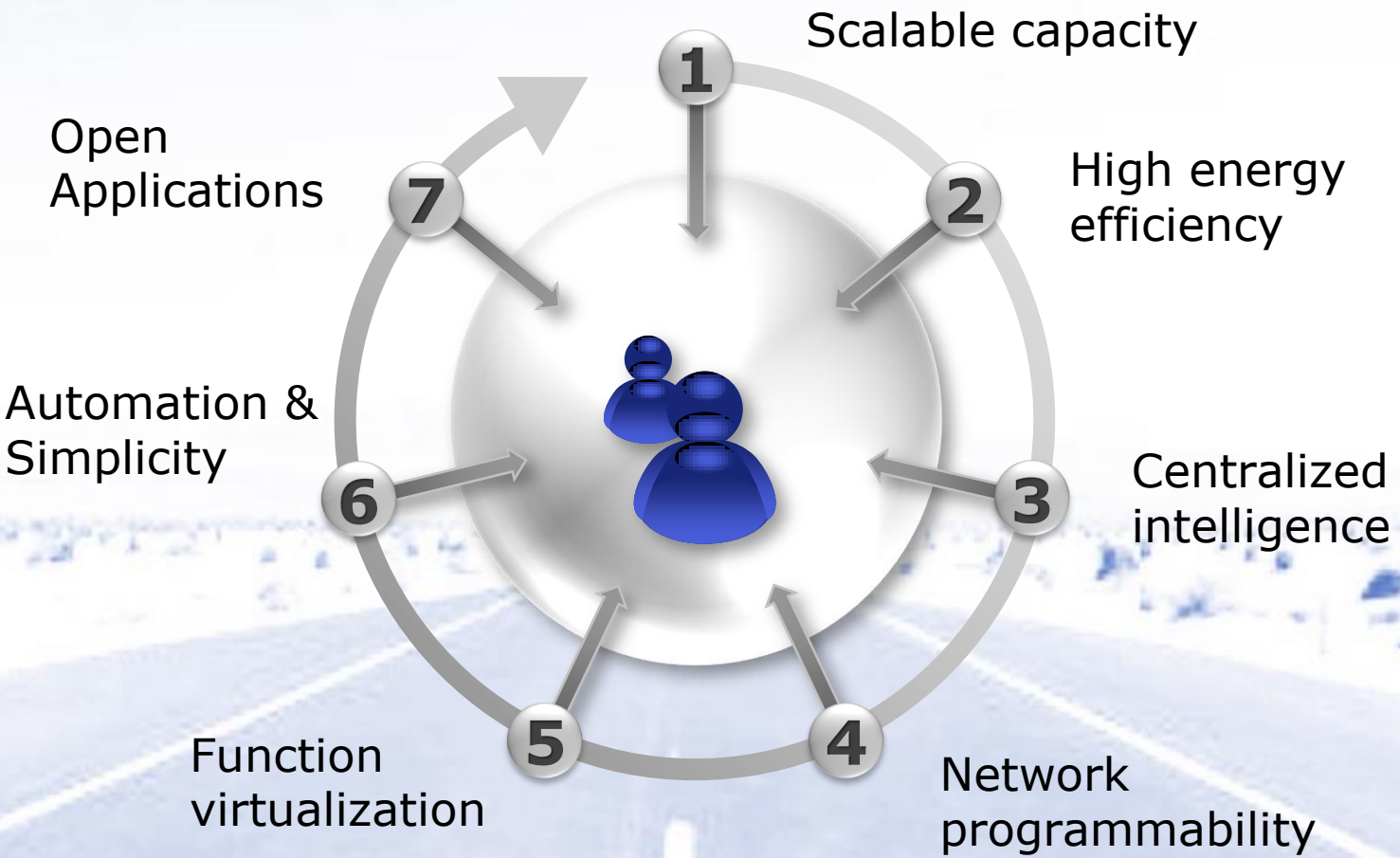
- Juniper MX-80 routers, ADVA FSP 3000 WDM
- Fully automated dynamic bandwidth-on-demand driven by router load variations
- Advanced Network Architectures Lab, Technical University of Catalonia, Juniper, ADVA Optical Networking

Marist College SDN Test Bed
Dynamic Cloud DC Networking



Summary & Outlook

Quo Vadis Optical Networking?



The future leaves much room for innovation!

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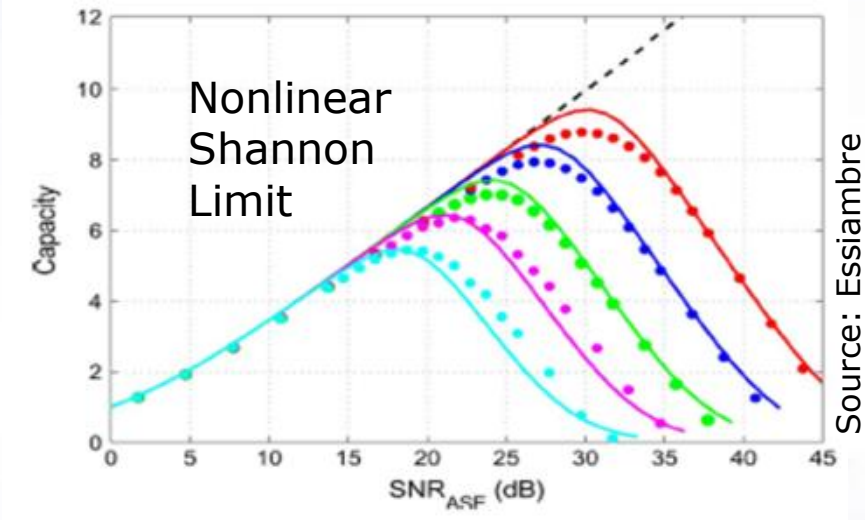
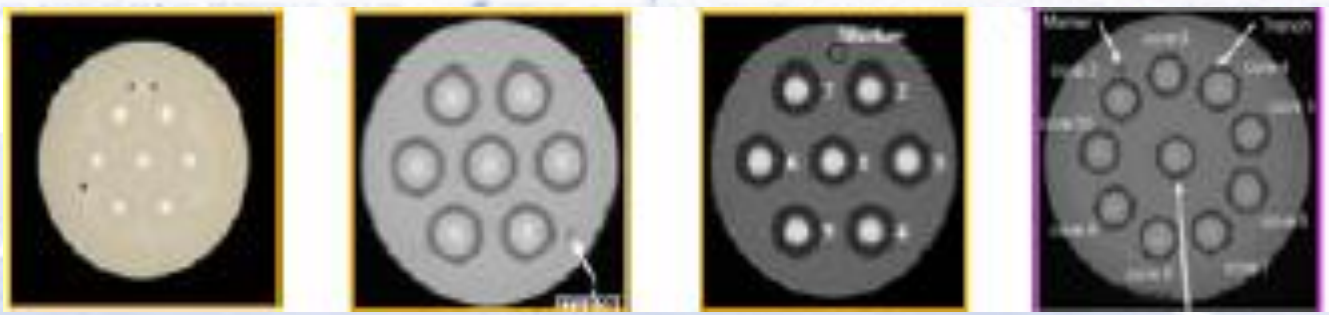
Towards Pb/s Networks
The Next Disruptive Innovation?



Source: Essiambre

New approaches
- Multi-band
- Multi-core
- Few-mode



Source: i-Free/KDDI

New fibers along with new system approaches for the next x10 capacity increase?

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Thank you

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