Combining Optics and SDN In next Generation data centre Networks COSIGN

Lars Dittmann

Technical University of Denmark

Brussels 23/10/14

Partners

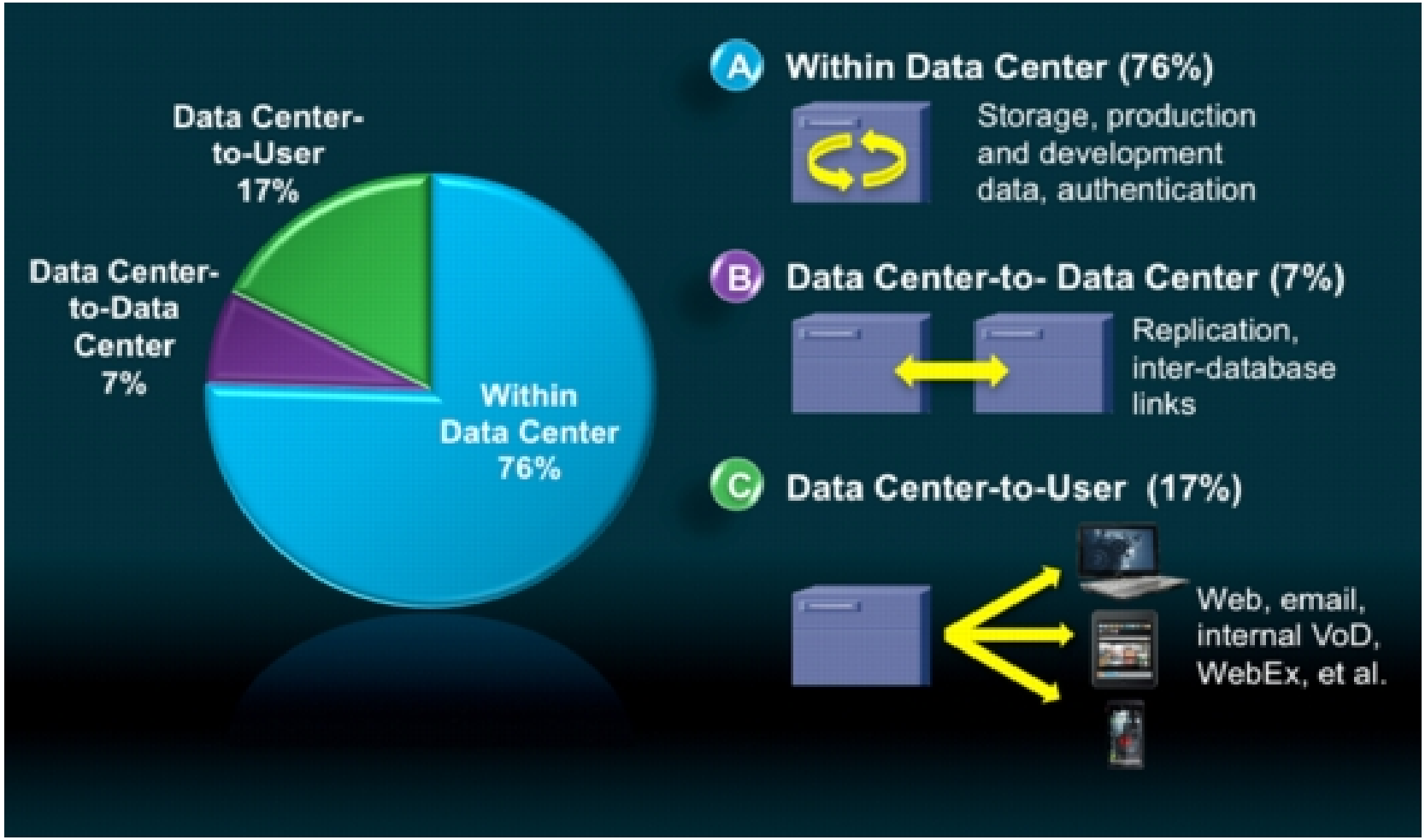
Participant no.	Participant organisation name	Part. short name	Country
1 (Coordinator)	Technical University of Denmark	DTU	DK
2	Interoute Communications S.p.A	IRT	IT
3	Nextworks	NEXTWORKS	IT
4	I2CAT	I2CAT	ES
5	Polatis	POLATIS	UK
6	University of Bristol	UNIVBRIS	UK
7	Venture Photonics	VENTURE	UK
8	Universitat Politècnica de Catalunya	UPC	ES
9	University of Southampton	UNISOUTH	UK
10	Technical University of Eindhoven	TUE	NL
11	PhotonX Networks B. V.	PHOTONX	NL
12	IBM Israel - Science and Technology Ltd	IBM	IL
13	OFS	OFS	DK

A unique combination of skills and know-how for a coordinated hardware and software design.

Why COSIGN?

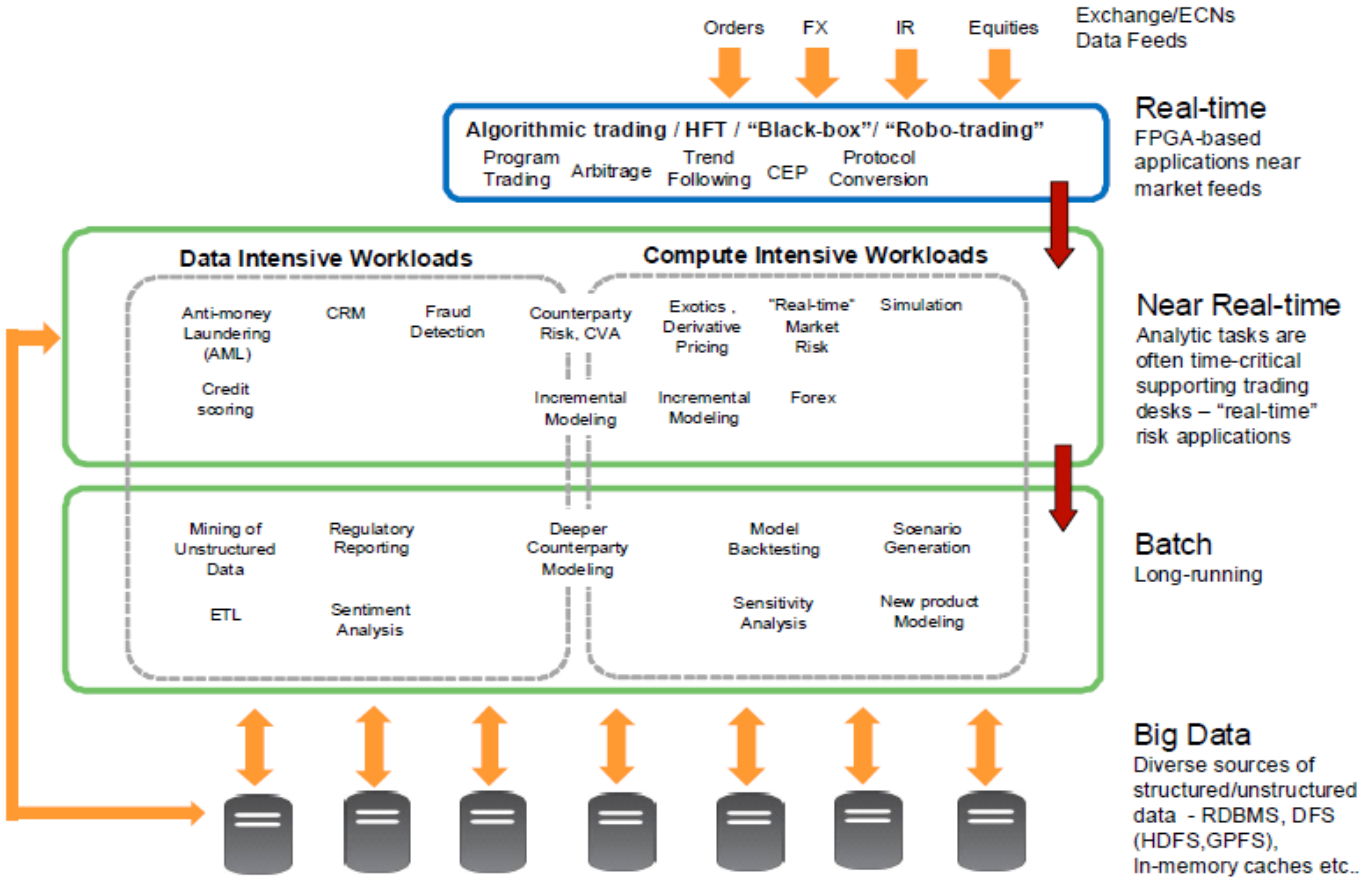
- ***Current technologies are not able to support the scaling of DC networks.***
  - ***today's DCN hardware solutions lead to architectures that impose unsustainable overheads in terms of capacity, connectivity and energy consumption requirements.***
  - ***radically new hardware technologies need to be developed, coupled with new frameworks for DCN control and service orchestration in order to enable future-proof DCN architectures.***

Datacenter traffic



Source : Cisco

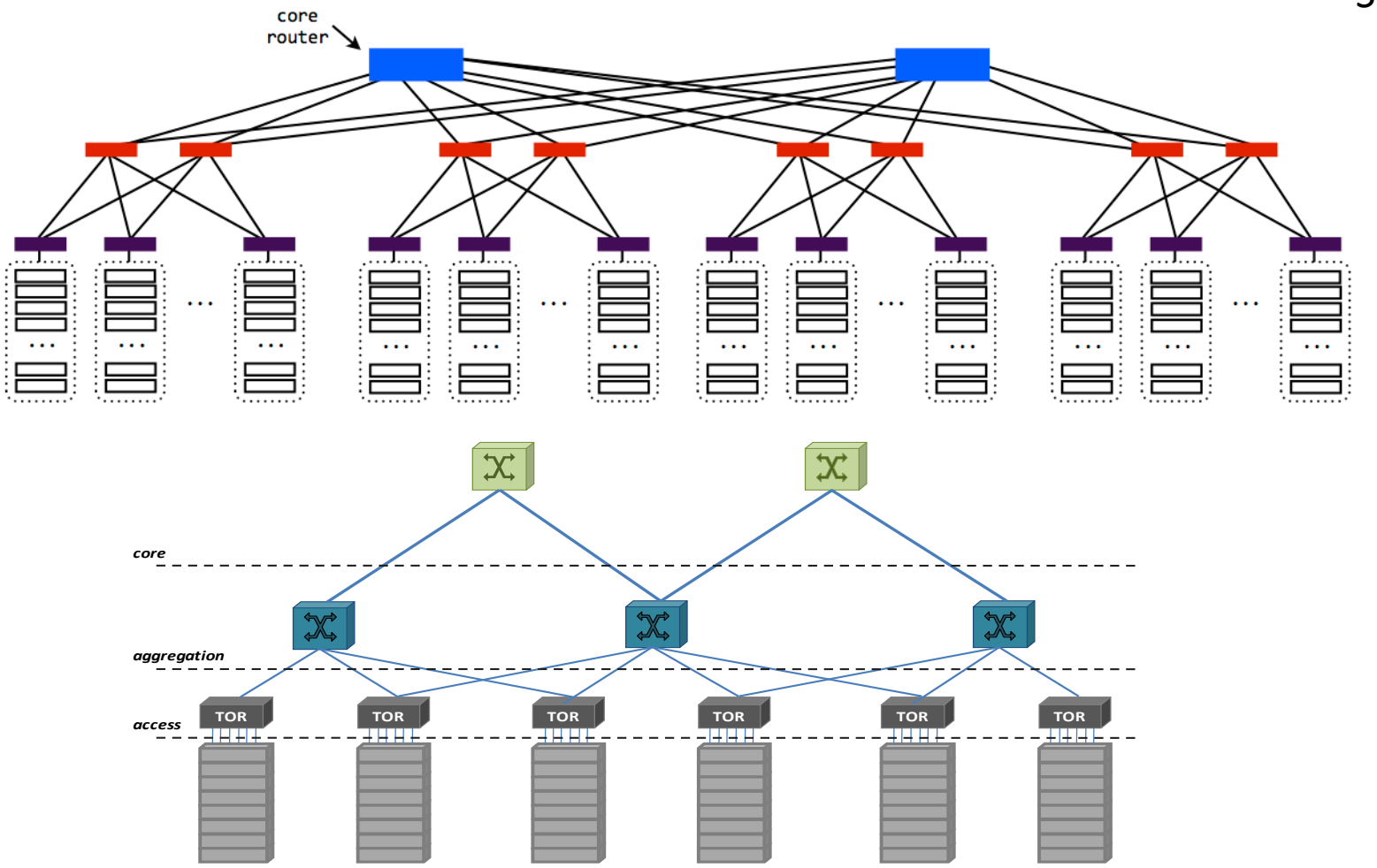
Traffic types and demands



The COSIGN goal

- ***"The main goal of COSIGN is to define and implement a flat, scalable DCN architecture, empowered by novel optical technologies and SDN based network control and service orchestration for future-proof dynamic, on-demand, low-latency, and ultra-high bandwidth intra-data centre applications."***

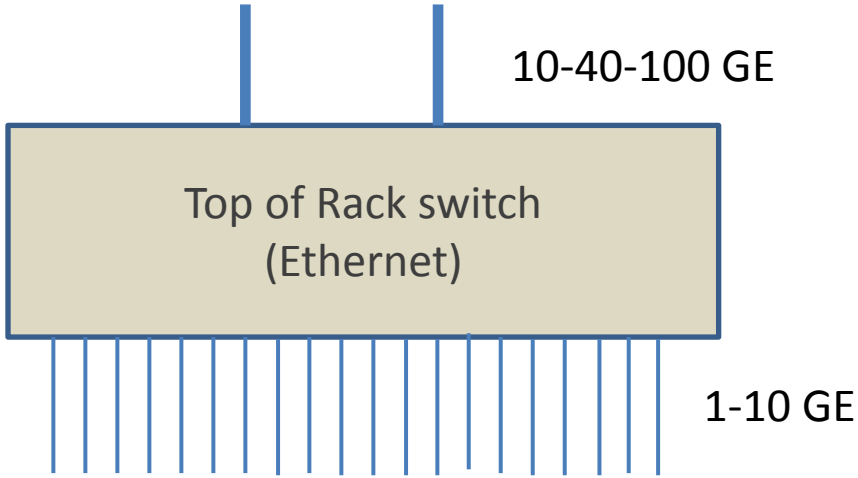
Classical DCN's



Typical topologies: FAT tree, Folded CLOS, Butterfly networks

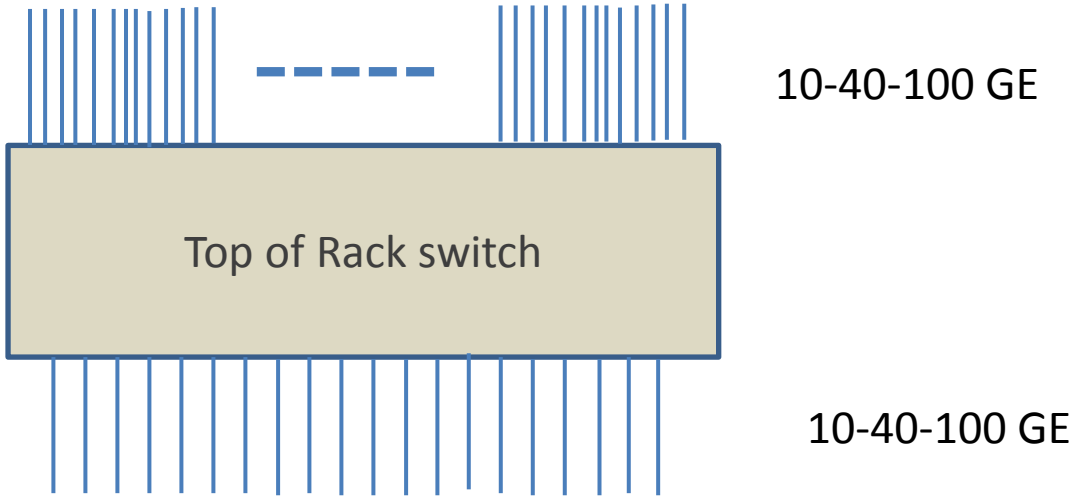
Classical DCN's

- Typical concept: aggregation based hierarchy.
- Role of ToR switch: interconnect servers in same rack – aggregate outgoing rack traffic into a few uplink connections (typically 2 for redundancy)



COSIGN step 1

Change the role of the ToR



Significant more uplink connects > 100

Direct connection to other ToR (full mesh)

Enabled by mixture of technology (singlecore and multicore fibers, wavelength etc.)

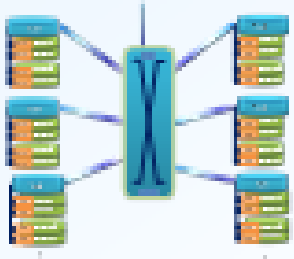
COSIGN step 2

- Introduce optical swicthing in the DCN to scale above # of uplink connection in ToR switch.
- Combining large portcount (several hundred optical ports) swicthes for (fast) circuit swicthing (sec-min scale switching) with small (tens of optial ports) switches for packet/timeslot swicthing in the nsec scale.
- Multiple topologi under investigation for handling different traffic patterns and rack -types

Star or Mesh? SDM or WDM?

Star SDM-WDM (WSS based ToR)

- Smaller number of fibers needed for inter-rack connections
- 4x25G WDM =100G/server
- 25G granularity in ToR
- 100G granularity in central switch, can go down to 25G, but withreduced flexibility
- WSS is grooming 2N→N channels
- Single-Point-of-Failure (SPoF)
- Large number of ports for central switch

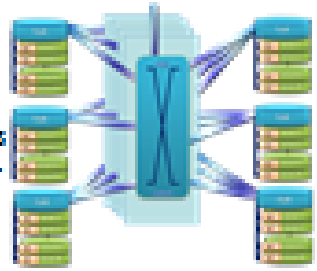


Star pure SDM (Multi-core switching)

- Smaller number of ports for central switch
- 25G granularity in central switch
- 4x25G grey interface =100G/server
- Single-Point-of-Failure (SPoF)
- 100G granularity in ToR

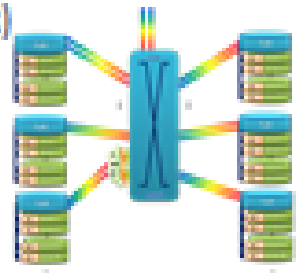
Star pure SDM (space switch ToR)

- Overlaid central switches for scalability
- 10x10G or 4x25G grey =100G/server
- 10G/25G granularity in ToR
- 10G/25G granularity in central switches
- Normal number of ports for each center switch
- Single-Point-of-Failure (SPoF)
- Higher number of fibers needed for inter-rack connections



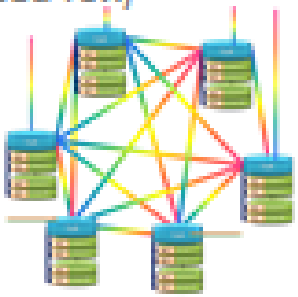
Star pure WDM (AWG based ToR)

- 1x100G DP-QPSK =100G/server capacity
- Smaller number of ports for central switch
- One hop rack-rack connections
- Single-Point-of-Failure (SPoF)
- 100G granularity in ToR
- 100G granularity in central switch



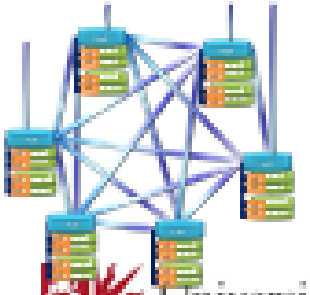
Mesh pure WDM (WSS based ToR)

- All-to-all direct connections
- Two hop rack-rack connection
- Multi-hop if more capacity needed
- 1x100G DP-QPSK =100G/server
- Number of fibers for inter-rack communication aggressively scales with number of racks
- 100G granularity



Mesh pure SDM (space switch ToR)

- All-to-all direct connections
- Two hop rack-rack connection
- Multi-hop if more capacity needed
- 10x10G or 4x25G grey =100G/server
- 10G/25G granularity in ToR
- Number of fibers for inter-rack communication aggressively scales with number of racks



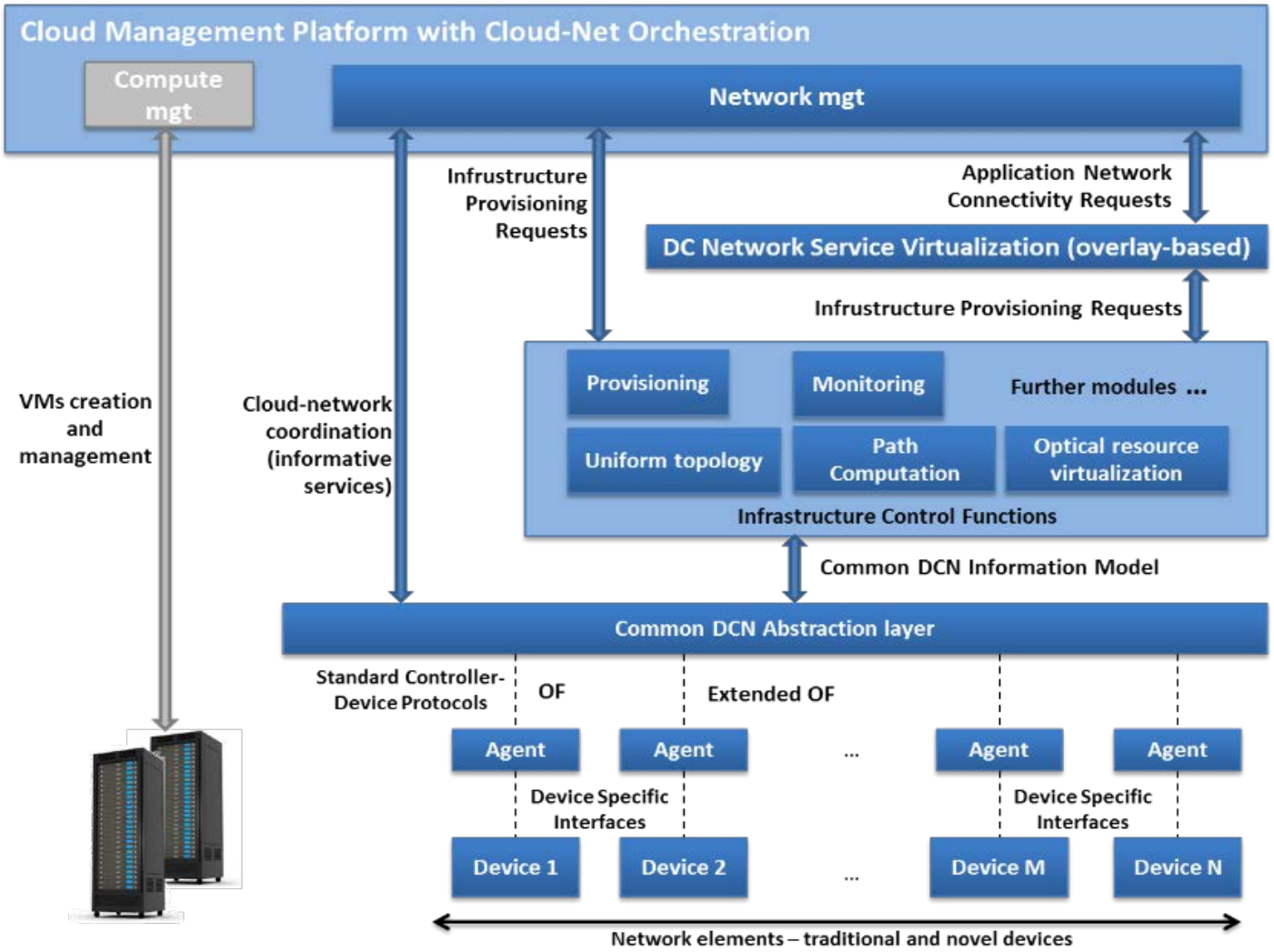
highperformancenetworks group

University of BRISTOL

COSIGN step 3

- Integrate the DCN resources into a common resource control framework
- SDN based framework selected for integration with computational and storage/memory resources
- Multiple platforms and interface ”standards” under investigation.

COSIGN top level architecture

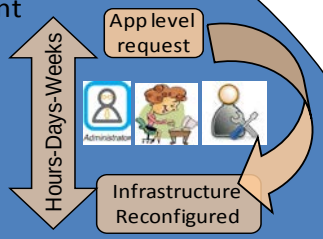


The COSIGN approach

COSIGN

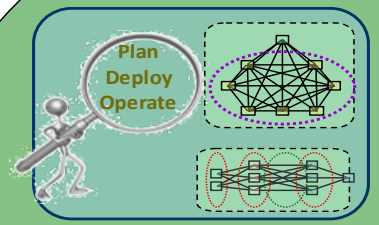
Manual, Painful, Error-prone

- Workload deployment requires time and intervention of different admin roles
- Connectivity of workload components is static
- Performance is achieved with over provisioning, questionable scaling characteristics



Orchestrated Management

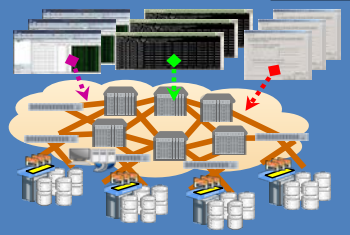
Automated, Streamlined, Optimized



- Rapid and flexible workload management
- On demand resource allocation and release
- Scalable and efficient virtualized workload components connectivity

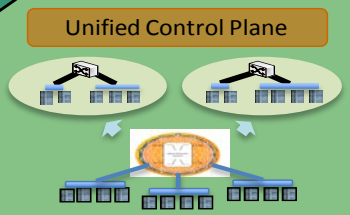
Discrete, Heterogeneous, Complex

- Multiple management roles and domains
- Unable to make global decisions efficiently and dynamically
- Requires expertise in different vendor technologies



Control Plane

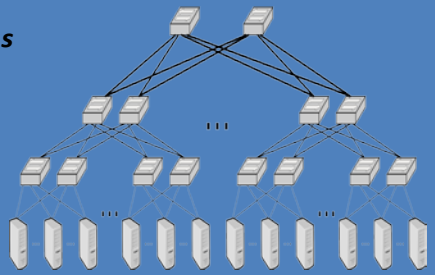
Consolidated, Converged, Programmable

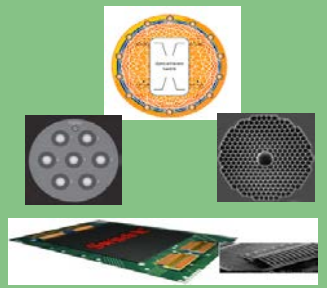


- Unified IT and SDN orchestrator
- Converged IT + Network virtualization for data centers
- Efficient and optimized virtual resource utilization and allocation
- Enhanced abstraction mechanisms for emerging optical technologies

Traditional fat-tree designs

- Over provisioned
- Inefficient for east-west communications
- Restricts (virtual) server placement decisions



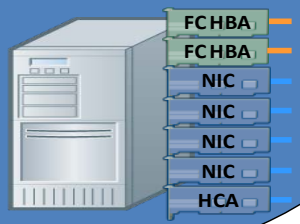


High-performance optical solutions

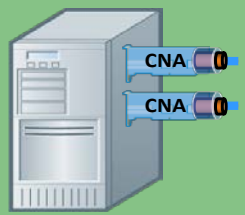
- Flattened DC network architecture
- Fast TOR switch
- 3D stacked transceiver
- InP fast switch
- Low loss beam-streering switch
- Hollow-core and Multi-core fibers

Cabling mess

- Many different incompatible interconnects

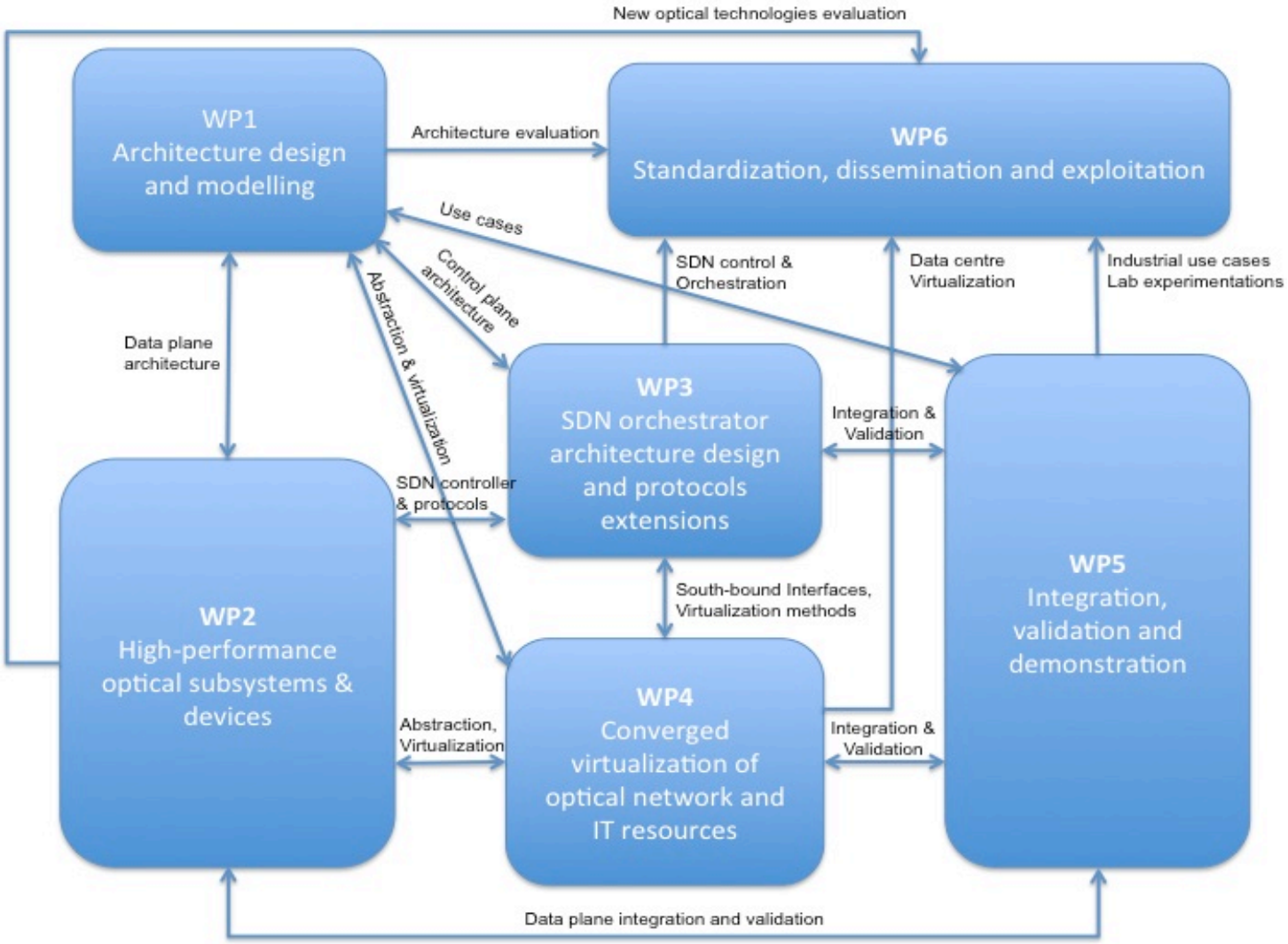


Data Plane



Converged DCN interconnect

The COSIGN project



S.M.A.R.T objectives

- *COSIGN will demonstrate that using a disruptive approach using optical technology, the datacenter network capacity can grow with a steeper growth-rate compared to conventional technology and by the end of the project duration provide at least 25 times more capacity than would have been achieved by an evolutionary approach based on a conventional solution (and by 2020 100 times more capacity).*

- *COSIGN will demonstrate that this new hardware approach for the datacenter network can be alligned and integrated into a common control plane and integrated into a fully orchestrated datacenter management solution, that will enable provisioning of new cloud based services in minutes compared to month (as it is today)*

Info:

www.fp7-cosign.eu

Contact:

ld@com.dtu.dk