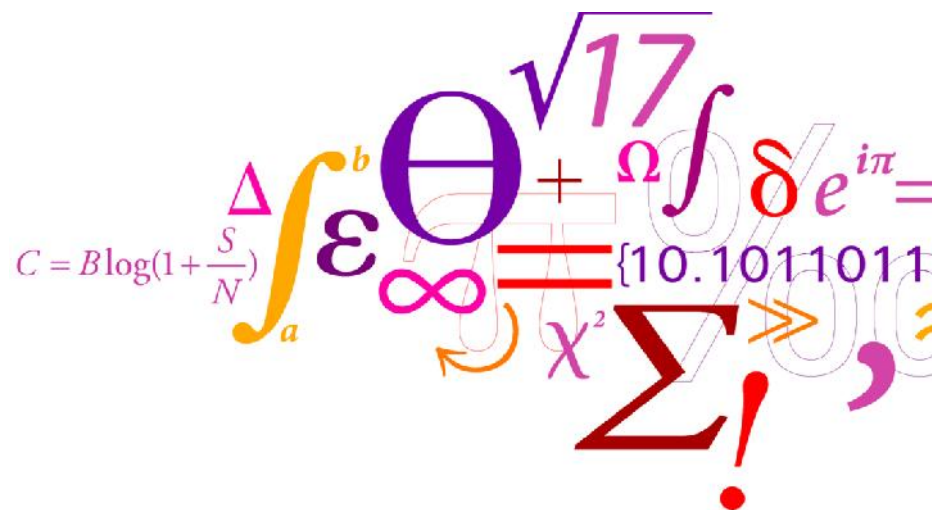# Providing and orchestrating flexible DataCenterNetworks (DCNs)

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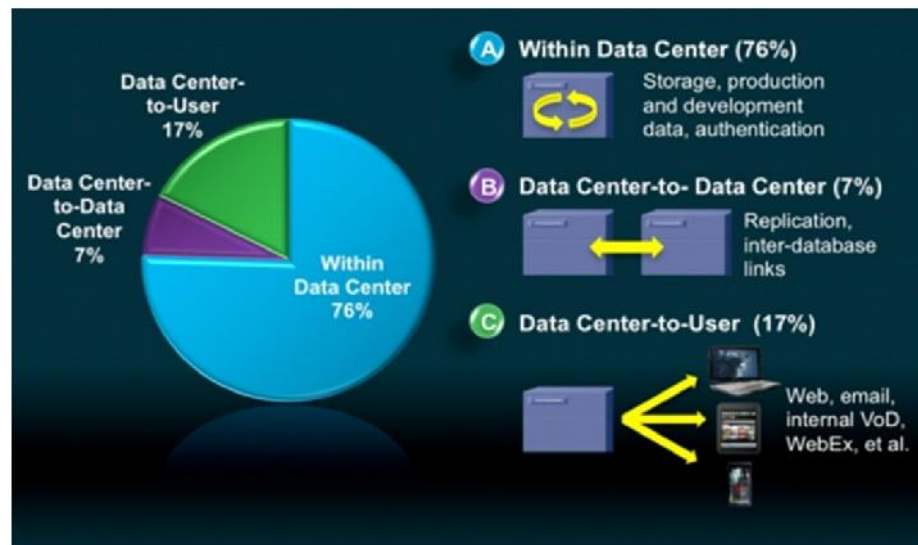
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$$C = B\log(1+\frac{S}{N})$$

The challenge for future datacenters

- The Internet is not only an "information super highway", but also an "information super library".
- More and more information is being generated by more and more devices (every second hundreds of new devices are being connected).
- For every byte move between user and a data center – 5-7 bytes are moved inside.
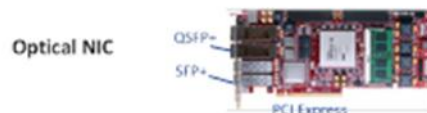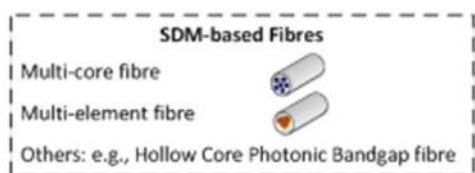
The DataCenterNetwork (DCN)
– an island within the datacenter

- The DCN is more an enabling resource rather than an integrated resource.

- DCN's are commonly designed and implemented based on initial demands and assumptions for the use of the computational and storage resources.

- DCN's are commonly based on scaling of classic solution and legacy protocols (Fat-tree just becomes even more fat – and TCP becomes DC-TCP).

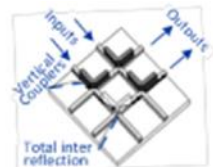DTU Fotonik, Technical University of Denmark
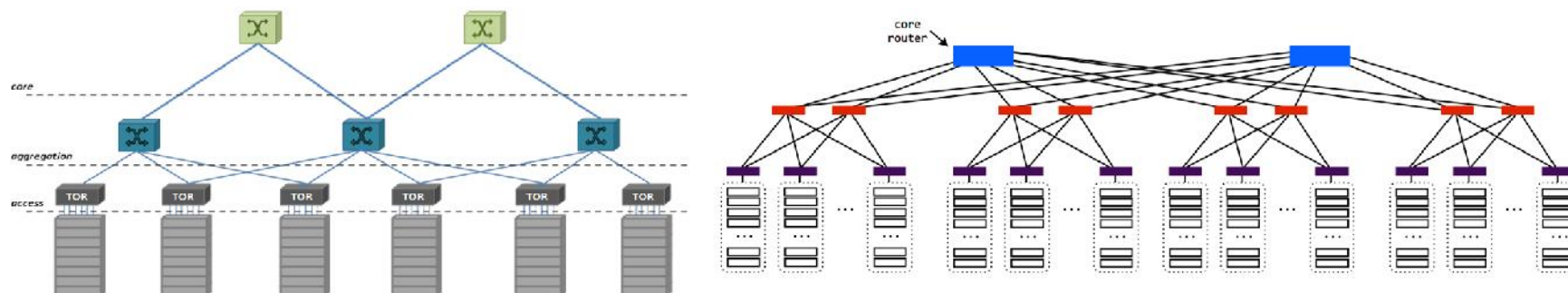
Why new approaches for DCNs

- Current technologies are not able to support the scaling of DC networks (capacity demand is growing faster than in communications networks in general).
  - 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.
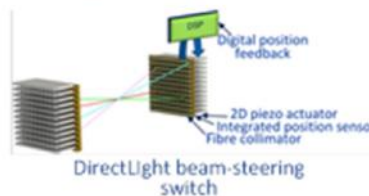
The COSIGN approach

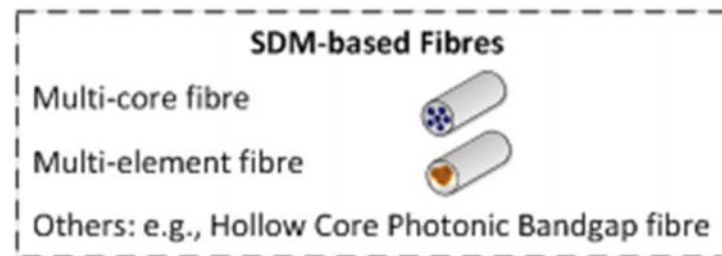
Manual, Painful, Error-prone
- Workload deployment requires time and intervention of different admin roles
- Connectivity of workload components is static
- Performance is achieved with over provisioning, questionable scaling characteristics

App level request

Administrator

Infrastructure Reconfigured

Hours-Days-Weeks

Orchestrated Management

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

Plan Deploy Operate

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

Unified Control Plane

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

FCHBA
FCHBA
NIC
NIC
NIC
NIC
HCA

Data Plane

CNA
CNA

Converged DCN interconnect

The COSIGN project 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.
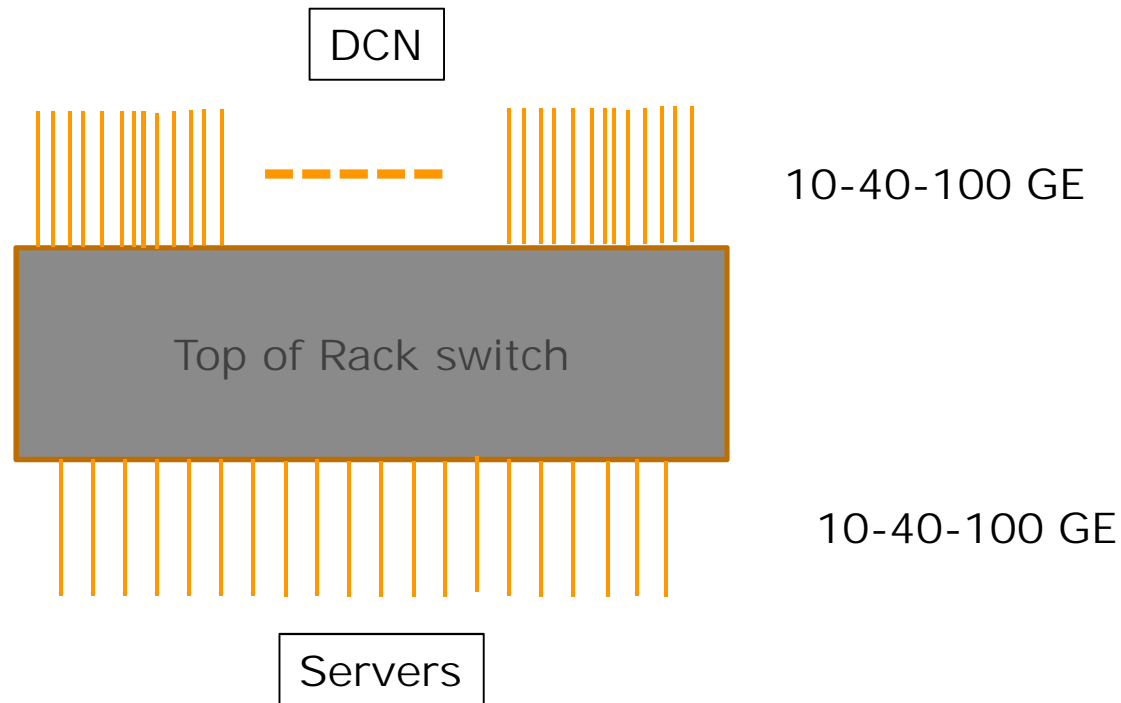
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Classical DCN's

- 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)

10-40-100 GE

Top of Rack switch

(Ethernet)

1-10 GE
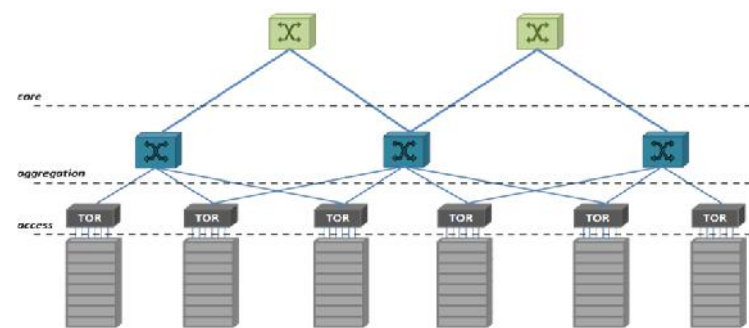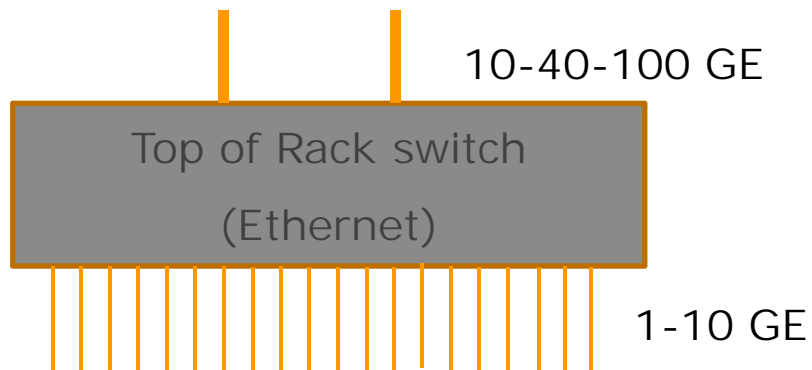
COSIGN short term approach
Change the role of the ToR

DCN

10-40-100 GE

Top of Rack switch

10-40-100 GE

Servers

Significant more uplink connections > 100

Direct connection to other ToRs (full mesh - hybercube)

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COSIGN

COSIGN medium term

- 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
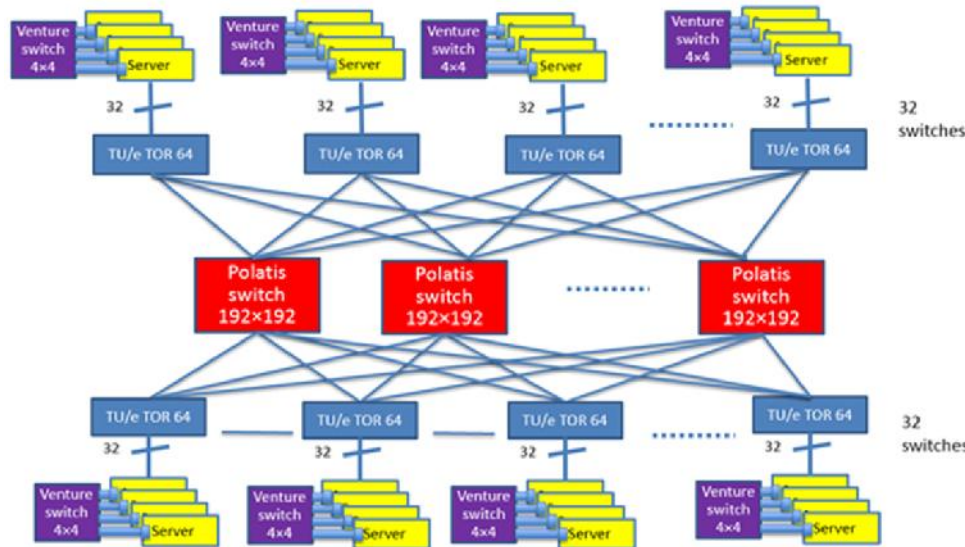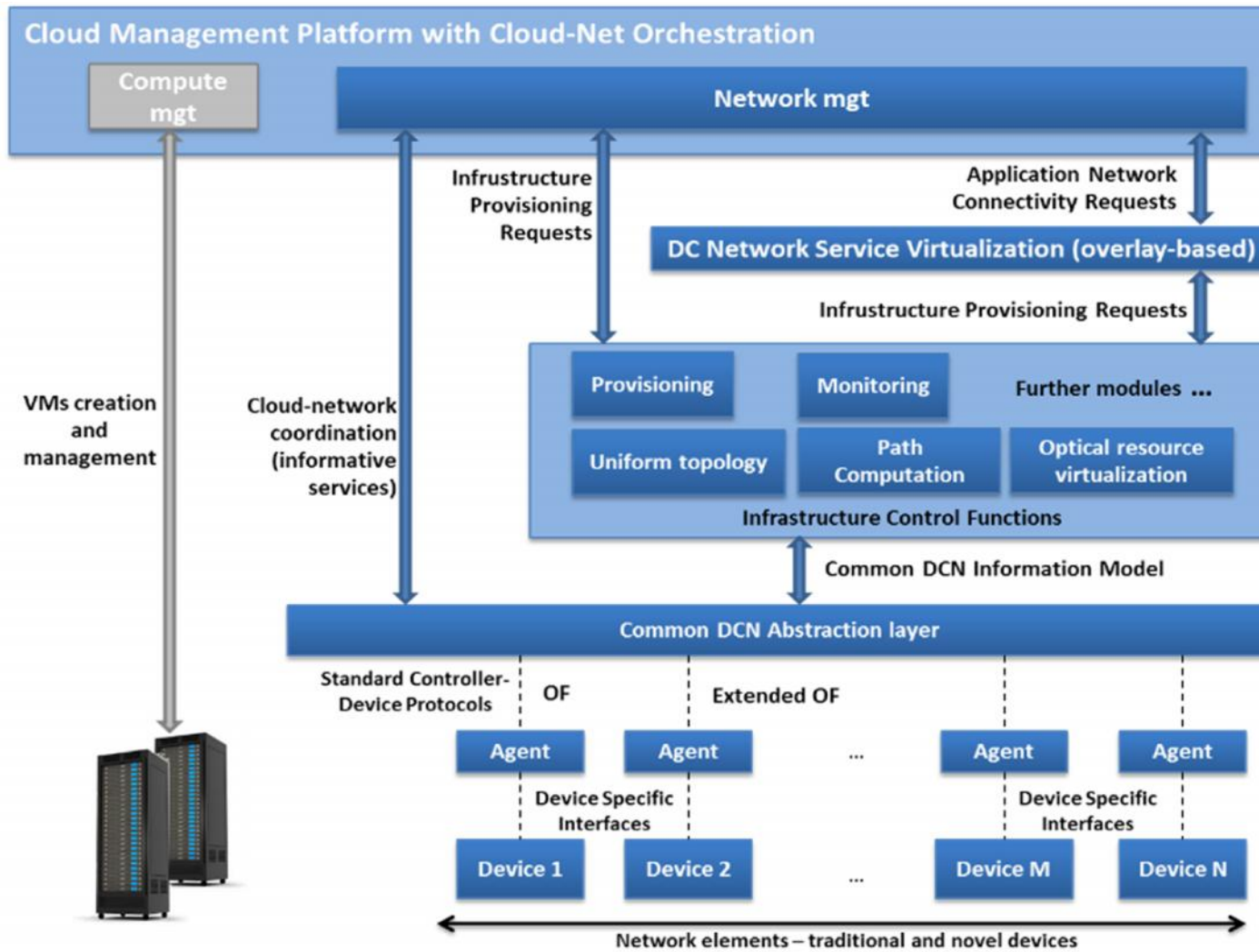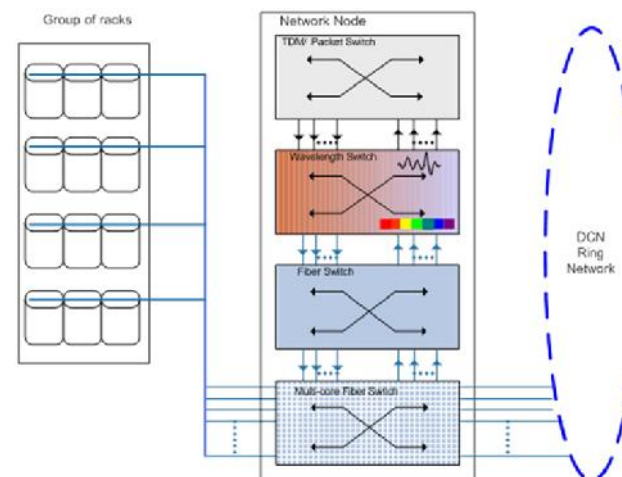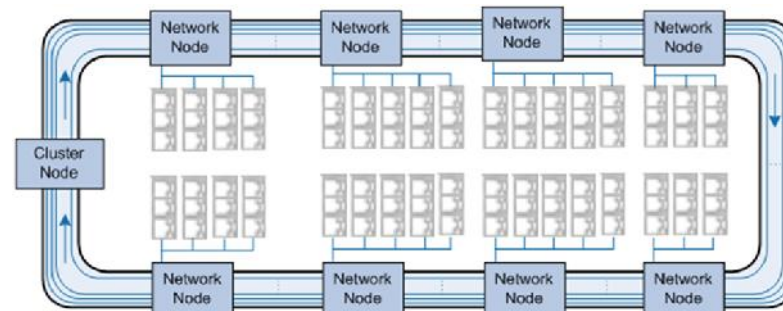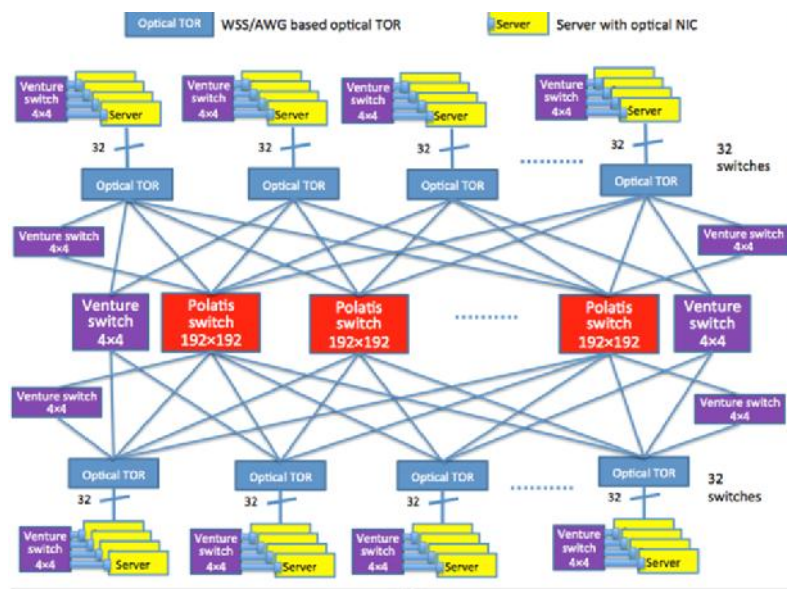
COSIGN control and orchestration

- 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.
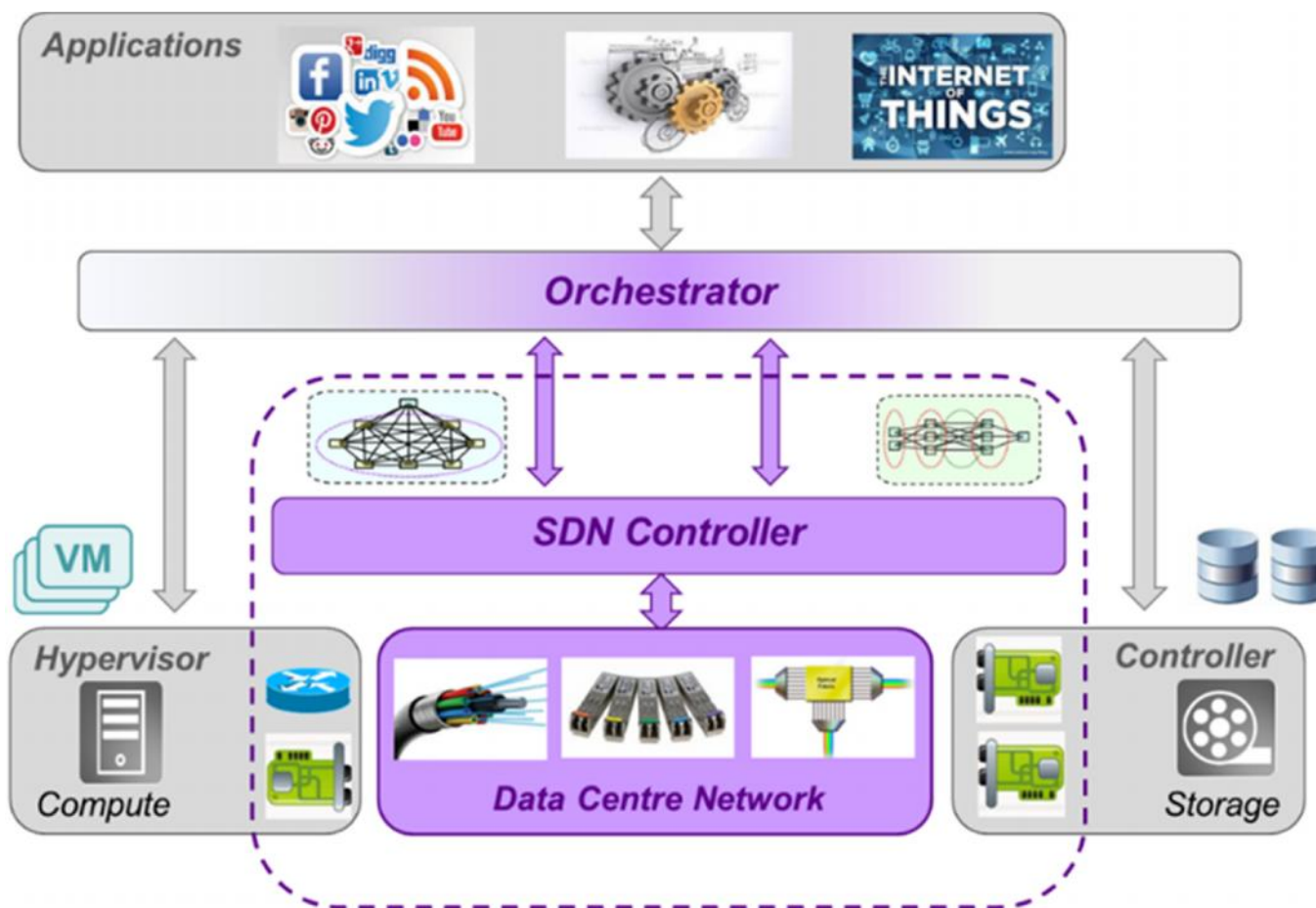
COSIGN top level architecture

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Long term scenarios – same control plane and orchestration – new disruptive dataplane

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Conclusion

- New disruptive solutions are needed to handle the growth in datacenter traffic

- New solutions are only fully exploited and used if properly integrated into the datacenter control and service orchestration.

- Even if DCN cost is normally considered less than 10% of the datacenter cost it can enable a much better utilization of other resources.

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