

**Low latency and HIGH Throughput
dynamic NETWORK infrastructureS for high
performance datacentre interconnectS**

LIGHTNESS Introduction

10th Oct, 2012

LIGHTNESS Consortium

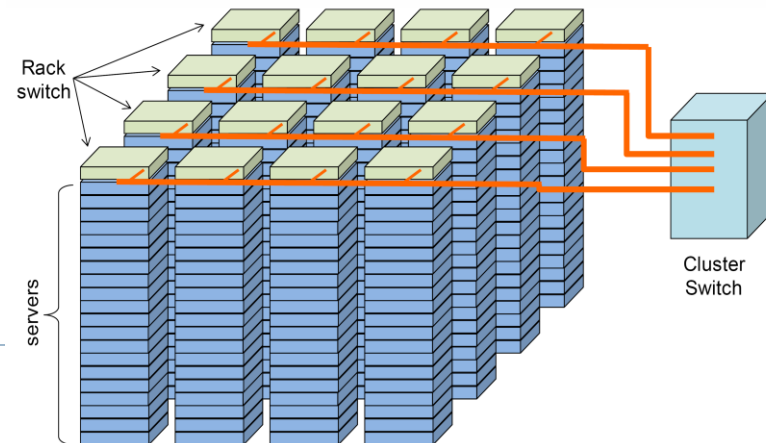
LIGHTNESS involves partners from industry and academia

1. Interoute - **Coordinator**
2. Technical University of Eindhoven
3. Nextworks s.r.l
4. Barcelona Supercomputing Centre
5. University of Bristol - **Technical leader**
6. Universitat Politècnica de Catalunya
7. University of California Davis
8. Infinera



LIGHTNESS Context and Challenges

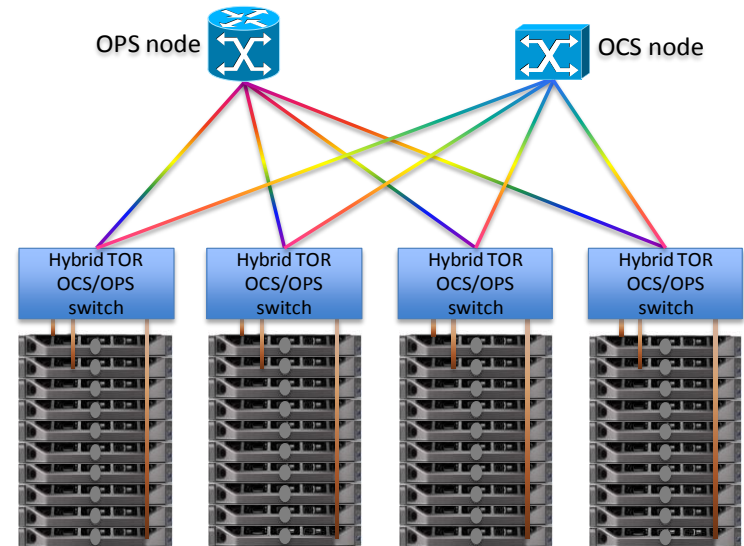
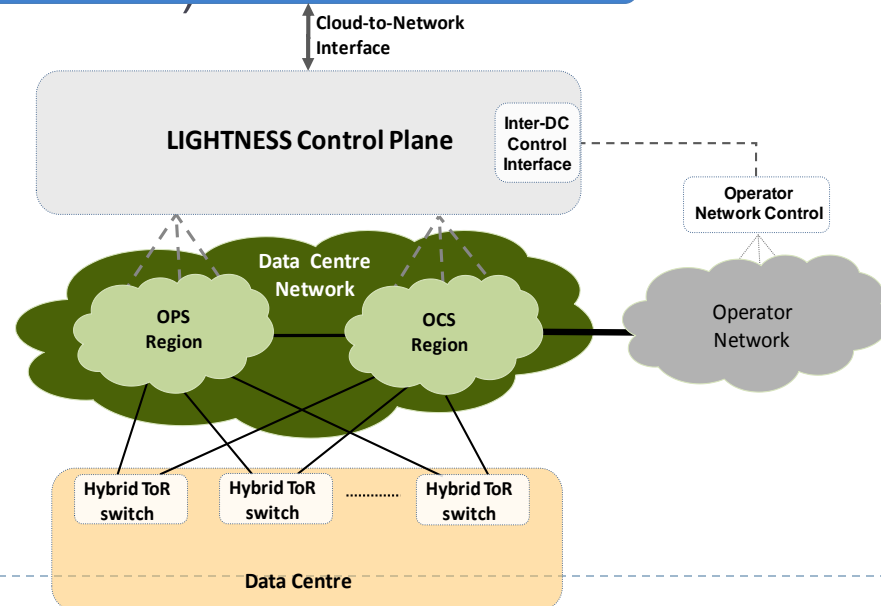
- ▶ Data centres are growing in size and complexity to accommodate the ever-increasing demand for cloud services:
 - ▶ Volume of users and cloud applications, High Performance Computing, Big Data applications, etc.
- ▶ One of the most challenging issues when scaling out a data centre is its network infrastructure, specifically the inter-rack connections
 - ▶ Data throughput and port capacity scalability
 - ▶ Low latency
 - ▶ Dynamic bandwidth services
 - ▶ Low power consumption
 - ▶ Fault tolerance support



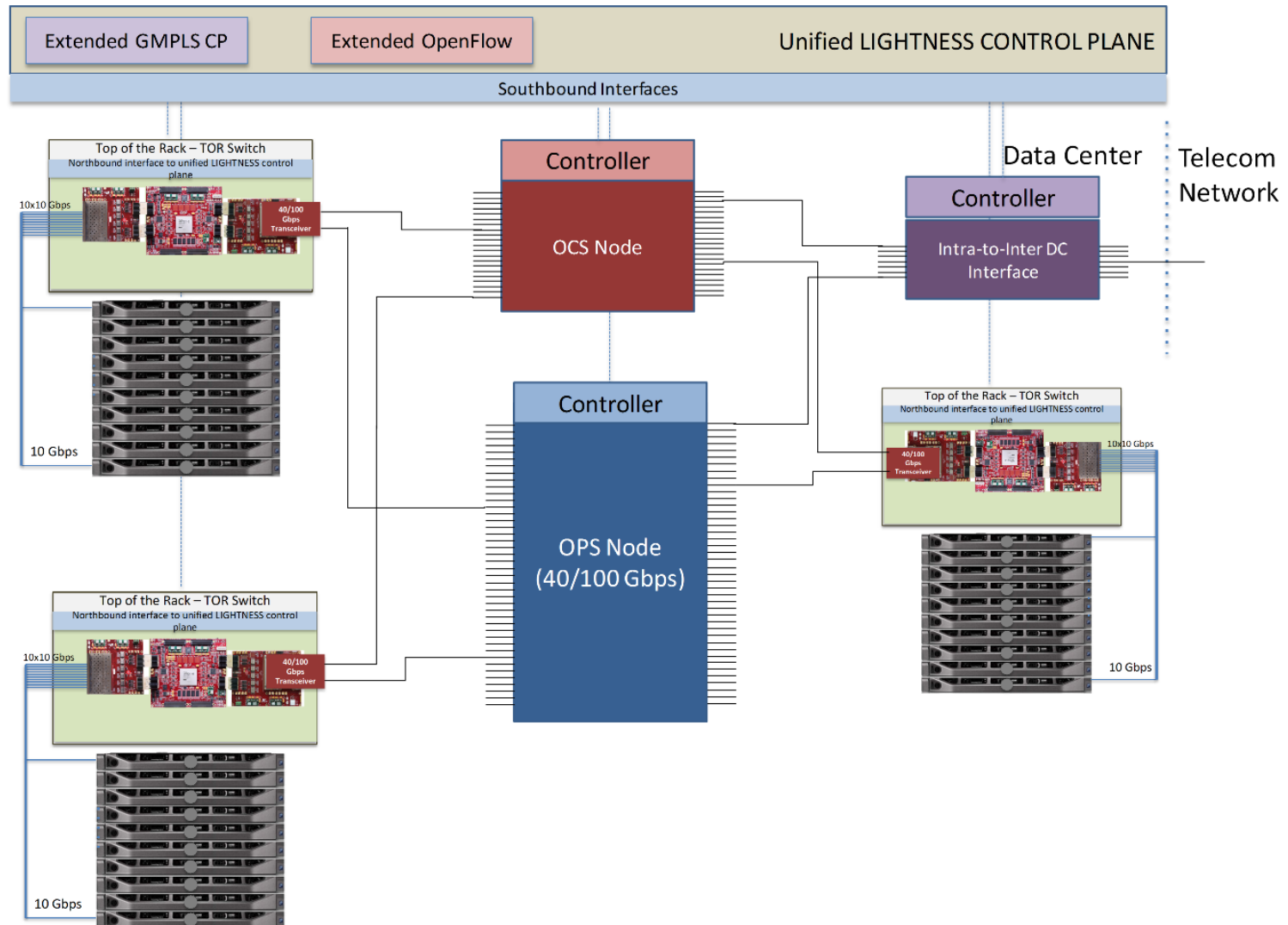
LIGHTNESS Concept and Innovation

- ▶ LIGHTNESS will design a new interconnection network architecture for intra data centre network (DCN)
 - ▶ Overcome the limitations of current DCNs
 - ▶ Electronic switching; Not-scalable tiered DCN architectures; Static BW provisioning
 - ▶ Hybrid OPS/OCS Fabric (nodes: OPS, OCS, Hybrid TOR)
 - ▶ Unified DCN Control Plane (solutions: GMPLS, OpenFlow, other SDN)

Data Centre Management



LIGHTNESS Technical Approach



Business and Industrial Opportunities

▶ **Impact on the competitiveness of Data Centre operators**

- ▶ LIGHTNESS provides ability of flexible and dynamic network configuration, which can reduce acquisition & operation costs and increased scalability
- ▶ Data Centre operators, such as Interoute, can strengthen its positioning on the market by deploying dynamic and on-demand provisioning of network resources

▶ **Impact on the competitiveness of vendors**

- ▶ The LIGHTNESS solution based on a hybrid OPS/OCS paradigm in the DCN provides highly flexible transport services with ultra-high bandwidth capacity and very low latency
- ▶ Telecom vendors, such as Infinera, can benefit from
 - ▶ LIGHTNESS hybrid data plane solution by offering DCN-suited optical transport products
 - ▶ LIGHTNESS unified network control plane by integrating with its optical product line control plane suites

▶ **Impact on the competitiveness of SMEs**

- ▶ SMEs, such as Nextworks, will greatly benefit from the application of LIGHTNESS concepts to provide enhanced and customized control planes and interfaces in the DCN
- ▶ LIGHTNESS offers opportunities to create effective value-chain where SMEs can offer customized solutions for software and hardware modules composing the overall system

Measurable Success Criteria

- ▶ OPS (4x4; > 40Gb/s) switch implementation and functional assessment
- ▶ OCS and TOR switches (40 and 100Gb/s) implementation and functional assessment
- ▶ LIGHTNESS network control plane protocol extensions design (GMPLS, OpenFlow)
- ▶ LIGHTNESS network control plane interfaces design (Cloud-to-Network, Southbound, Inter-to-Intra)
- ▶ Integration of OPS, OCS and TOR switches plus LIGHTNESS network control plane prototypes
- ▶ Experimental evaluation of the LIGHTNESS testbed
- ▶ LIGHTNESS concepts and results publicly demonstrated



Thank you!

LIGHTNESS Main Objectives

Design ultra-high capacity transport networks for intra-Data Centres

- ▶ Design and realise a prototype based on a new OPS/OCS fabric, new TOR solution and Unified control plane

Design and prototype high-scalable and strictly non-blocking OPS nodes

- ▶ A new, scalable and ultra high capacity OPS node with highly distributed control.
- ▶ ns scale latency, 1000s ports, >100 Gbps per port

Design and prototype hybrid TOR switch and inter-rack (CORE) switch

- ▶ A new TOR switch prototype to interface the servers to the hybrid OPS/OCS DCN

Design and prototype a unified network control plane for dynamic and on-demand high bandwidth network services provisioning in the intra-DC scenario

- ▶ Implement novel multi-technology and multi-layer control mechanisms and procedures

- ▶ Disseminate and exploit project results and achievements and promote solutions to major standardization bodies

Business and Industrial Opportunities

- ▶ **Impact on the competitiveness of Data Centre operators**
 - ▶ Ability of flexible and dynamic network configuration provided by LIGHTNESS will have a highly positive impact on competitiveness of the data centre operators due to reduced acquisition and operation costs and increased scalability
 - ▶ Service and network infrastructure providers, such as Interoute, can strengthen its positioning on the market by deploying dynamic and on-demand provisioning of network resources driven by applications
- ▶ **Impact on the competitiveness of vendors**
 - ▶ The LIGHTNESS solution based on a hybrid OPS/OCS paradigm in the DCN provides highly flexible transport services with ultra-high bandwidth capacity and very low end-to-end latencies.
 - ▶ Telecom vendors, such as Infinera, can benefit from the adoption of the LIGHTNESS hybrid data plane solution in terms of impact on the Data Centre market, by offering to their customers DCN-suited optical transport products. Moreover, by integrating the LIGHTNESS unified network control plane with its future optical product line control plane suites, it will allow Infinera's customers to develop more competitive networking solutions

Business and Industrial Opportunities

▶ **Impact on the competitiveness of SMEs**

- ▶ The SMEs will greatly benefit from the opportunities, offered by the application of LIGHTNESS concepts, to provide enhanced and customized control planes and interfaces in the DC environment
- ▶ LIGHTNESS offers opportunities to split the development of complex software solutions into several specialized components (network management and control, multi-domain interfaces, cloud-to-network interfaces), creating an effective value-chain where several SMEs will be able to cooperate and offer customized solutions for the software and hardware modules composing the overall system
- ▶ LIGHTNESS is a concrete opportunity for SMEs, such as Nextworks, to create the ground for true modular solutions both in terms of software technologies and business value-chains
- ▶ This will increase Nextworks' chances to partner with other actors in the data centre and telecom business, and to collaborate on the production of complete network control plane solutions, with an overall critical mass and expertise that cannot be achieved by each SME alone

Measurable Success Criteria

Year	Success criteria
Y1	Overall LIGHTNESS network architecture completed and delivered
	Preliminary simulation results for the assessment of the proposed architecture completed and delivered (including applicability and preliminary scalability benchmarks)
	OPS switch specification completed and delivered
	OCS and hybrid TOR switches specification completed and delivered
	LIGHTNESS unified network control plane architecture completed and delivered (including deployment scenarios, key service concepts, functional decomposition and procedures and semantics over the control plane abstract interfaces)
Y2	Consolidated simulation results and scalability studies completed, including an overall architecture performance assessment
	OPS switch implementation and early functional assessment completed
	OCS and TOR switches implementation and early functional assessment completed
	LIGHTNESS network control plane protocol extensions (GMPLS, PCE, OpenFlow) design completed
	LIGHTNESS network control plane interfaces (Cloud-to-Network, southbound, internal) design completed
	Preliminary release of the LIGHTNESS network control plane software components
Y3	Final simulation results and scalability studies, including the analysis of the DC application infrastructure
	Release of the LIGHTNESS network control plane prototypes (two releases, one preliminary at the beginning of Y3 and one final consolidated after testbed validation)
	OPS, OCS and TOR switches plus LIGHTNESS network control plane prototypes integrated and experimentally evaluated in the LIGHTNESS testbed. Test results collected and documented.
	LIGHTNESS concepts and results publicly demonstrated