



Dynamic network infrastructures for high performance data centre interconnects

At A Glance: LIGHTNESS

Low latency and high throughput dynamic network infrastructures for high performance data centre interconnects



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LIGHTNESS – comprising partners from Italy, the Netherlands, Spain and United Kingdom - aims at develop an advanced Data Centre Network architecture to meet the emerging needs of current cloud, high performance computing and storage applications.

Main Objectives

The main objective of the LIGHTNESS project is to develop a high-performance network infrastructure for data centres, where innovative photonic switching and transmission solutions are deployed. Harnessing the power of optics enables data centres to effectively cope with the emerging requirements of cloud, high performance computing, and storage server-side applications.

Current Data Centre Network (DCN) infrastructures are usually built out of commercially available Ethernet switches that are grouped in a fat-tree configuration. The actual scalability of such electrical solutions in view of the unprecedented amount of data centre x²workloads expected in the near future, is a concern.

LIGHTNESS proposes the integration of Optical Circuit Switching (OCS) and Optical Packet Switching (OPS) technologies in the intra-DC network environments. The rationale behind this solution is to fulfil the requirements of emerging applications running in data centres in terms of ultra-high bandwidth and low network latency. **A unified SDN/GMPLS enabled network control plane on top of the DCN** offers dynamic and flexible procedures to provision and re-configure the DCN resources.

LIGHTNESS is an **industry-driven project** which brings together a cloud service provider and data centre owner (Interoute), a telecom manufacturer (Infinera), an SME with strong background in network control plane solutions (Nextworks), an HPC research centre (Barcelona Supercomputing Center), and three major universities (Technische Universiteit Eindhoven, University of Bristol, Universitat Politecnica de Catalunya) with wide experience in optical switching and control/management frameworks for optical networks.

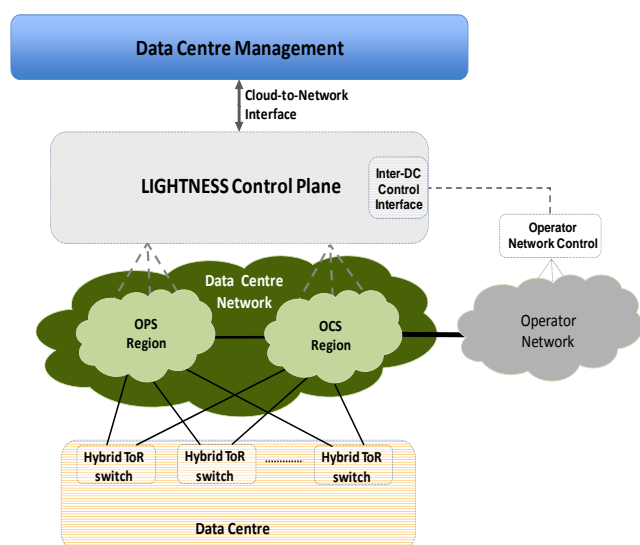
LIGHTNESS defines and implements a scalable Data Centre Network architecture for ultra-high bandwidth, dynamic and on-demand network connectivity services

Technical Approach

LIGHTNESS scientific and technical activities of the project are organised into 5 main Work Packages:

- **WP2 “Requirements and architecture design”**, which is dedicated to the DCN architecture specification, by taking also care of scalability studies and performance predictions through dedicated simulation activities.
- **WP3 “Data Plane design, implementation and evaluation”**, which designs and implements the OPS, OCS and hybrid top-of-the-rack (TOR) switches to provide scalable, flexible and high bandwidth optical interconnectivity within the DCN infrastructure.
- **WP4 “Unified Control Plane for intra-Data Centre network”**, which provides the SDN/GMPLS enabled network control plane for dynamic and on-demand provisioning of connectivity services in the DCN.
- **WP5 “Experimental validation”**, which takes care of integrating and validating the WP3 and WP4 prototypes in the LIGHTNESS testbed.
- **WP6 “Dissemination, Standardization and Exploitation”**: which carries out activities to promote external visibility of project outcomes and results, mainly in terms of technical achievements.

Finally, all the activities related to the management of the project are included in WP1 “Project Management”.



Key Issues

The key issues that LIGHTNESS will tackle are:

- Research and design a novel scalable and ultra-high capacity data centre interconnect architecture to meet the ultra-high bandwidth and low network latency requirements of current cloud and HPC applications.
- Develop an OPS switch with highly distributed control and port-count independent configuration time, to provide nanosecond scale latency and high throughput in the DCN.
- Develop a TOR switch operating at data rate of 40 and 100 Gb/s, to interface the data centre servers to the hybrid OPS/OCS DCN and efficiently aggregate traffic in long-lived data flows and short lived packet flows.
- Leverage the SDN and GMPLS frameworks to develop a unified control plane for advanced optical network connectivity in the DCN. Dynamicity, flexibility and resiliency need to be combined to offer advanced bandwidth on demand services to the data centre providers.

Expected Impact

LIGHTNESS will contribute towards the innovation of data centre infrastructures by setting the foundations for the adoption and deployment of its solutions. In detail, LIGHTNESS is expected to:

- Strengthen the European industry in the fields of data centre technologies, and contribute to the development of the technology for the future generation of European cloud-computing infrastructures.
- Increase cost and energy efficiency of data centre network infrastructures, by introducing novel scalable interconnect architectures and modular technologies with reduced cost/bit.
- Accelerate the uptake of novel data centre network infrastructures. The industrial partners in LIGHTNESS (mainly Interoute and Infinera) can guarantee the exploitation of the project results and provide the motivation to develop and deploy the concept of LIGHTNESS.
- Create wider market opportunities for data centre operators, which can develop new services addressing wholesale and corporate markets new needs