Contributions from the CaON Cluster: Key Research Challenges for Optical Networking

Support of multi-Gbps access rates:
Acceleration of access deployment through reduced total cost of ownership, broader introduction of open access models and converged solutions supporting transport of mobile and fixed traffic in both front- and backhaul scenarios. Seamless integration of access and metro/aggregation with unified control and management planes also through software-defined networking paradigms for traffic engineering, virtualization and context-aware networking. New solutions for simultaneous support of more users per feeder (>1000) with higher speeds (up to 10 Gb/s peak) and longer reach (100 km). Green and fast (1 Gb/s and beyond) home networking.

Spectrum management: capacity management and bandwidth granularity provisioning
Flexible spectrum allocation taking advantage of elastic space, frequency and time multiplexing, ability to dynamically and efficiently partition the fibre bandwidth into variable-size spectrum slots. Future research should focus on: transmission, switching and grooming technologies enabling transport services ranging from 100s Mbps to beyond Tbps with associated new control plane solutions to support adaptivity, flexibility and elasticity in optical networks.

Optical Network and IT convergence: for high performance, global reach clouds empowered by optical network infrastructures
Research should address service provisioning over hybrid infrastructures composed of both IT resources (i.e. compute, storage, data centres) and optical networks. It will require the capability to virtualise the physical optical network infrastructure (analogue or digital) and federate heterogeneous resources from different providers. It also needs unified management and provisioning procedures including considerations for dynamic control plane functionalities and Software Defined Network procedures for the whole integration with the IT network infrastructures.

Optical network control plane:
Main research challenges include: (i) true multi-vendor and carrier control plane solutions, including extensions for elastic technologies (ii) split architectures that decouple the control plane from the optical transport – several architectural options might support this: OpenFlow as an open/vendor-independent interface to network data plane; multi-technology and multi-domain path computation services coupled with traffic optimization, Software Defined Networking at large, (iii) control plane interfaces to external end-user "systems" (e.g. clouds) for any type of bandwidth-on-demand service and seamless integration with the service layer workflows.

Cognitive, self managed optical networks:
Technology platforms to dynamically re-purpose, evolve, self-adapt and self-optimize functions/devices/systems of the optical network. Research should focus on optical/opto-electronic technologies that would allow for environment-aware, self-x systems that can change any parameter based on interaction with the environment with or without user assistance. Research on cognitive control and management plane should enable network-wide infrastructure dynamic self-adaptation, self-handling across heterogeneous systems.

Energy efficient optical networking:
Improve the design, planning and operations for energy aware management, introduction of new simpler protocols, definition of energy friendly resilience and support of planning and routing algorithms capable of 100 times energy consumption reduction. Work should particularly focus on energy efficient network services for applications such as P2P, grid or cloud services relying on optical-based network infrastructure.