

# Project Achievements



## 100GET End-to-End Carrier Grade Ethernet



## 100GET-E3

100GET-E3 has investigated optimized packet and circuit transport networks based on Carrier Ethernet Transport (CET) and DWDM technologies.

### Main focus

100GET-E3 addressed both the lack of "Carrier Grade" features in IP/MPLS - e.g. missing end-to-end quality of service (QoS) - and the network operators' dilemma of exponential traffic growth at flat revenue. To this end, the project has integrated investigations on both physical layer and networking aspects:

- ◆ Robust and spectrally efficient optical 100Gb/s transmission
- ◆ Minimized connection cost across technology layers, using efficient grooming and aggregation of packet traffic as well as supremely cost-effective optical switching of aggregated traffic
- ◆ Automated management & provisioning across technology layers and network domains

### Approach

To adequately address the exceptional diversity of scientific issues in 100GET-E3, a close collaboration between Nokia Siemens Networks as industrial project leader and a group of outstanding partners from

German industry, research and academia was formed in later 2007. A group of distinguished Finnish partners has complemented these activities starting mid 2008.

On the physical side, coping with divergence between traffic volumes and revenues requires capacity enhancement of legacy fibre infrastructure. To this end, a range of novel modulation formats – with preference on polarisation-multiplexed QPSK with coherent detection - has been assessed in terms of performance, complexity, feasibility and cost.

On the networking side, the added complexity of Carrier Ethernet and DWDM technologies raised questions regarding many multi-layer and multi-domain issues in the first place. The appropriate solutions found in such a layered architecture for path computation / traffic engineering, resilience, planning, management and provisioning, however, yield significant reductions of capital and operating expenditures.

### Achieved results

- ◆ Network architecture – Concepts for future IP layer, optical layer and multi-layer architectures. Whitepaper on 'control and management of multi-x networks' with special focus on automated provisioning (Generalized Multiprotocol Label Switching - GMPLS, Path Compu-

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### Partners:

CoreOptics, Germany

Helsinki University of Technology, Finland

IHP GmbH, Germany

Nethawk Oy, Finland

Nokia Siemens Networks, Finland

Nokia Siemens Networks, Germany

Technical University Braunschweig, Germany

Technische Universität Dresden, Germany

Technical University München, Germany

Tellabs Oy, Finland

Universität Würzburg, Germany

VTT Technical Research Center of Finland, Finland

### Co-ordinator:

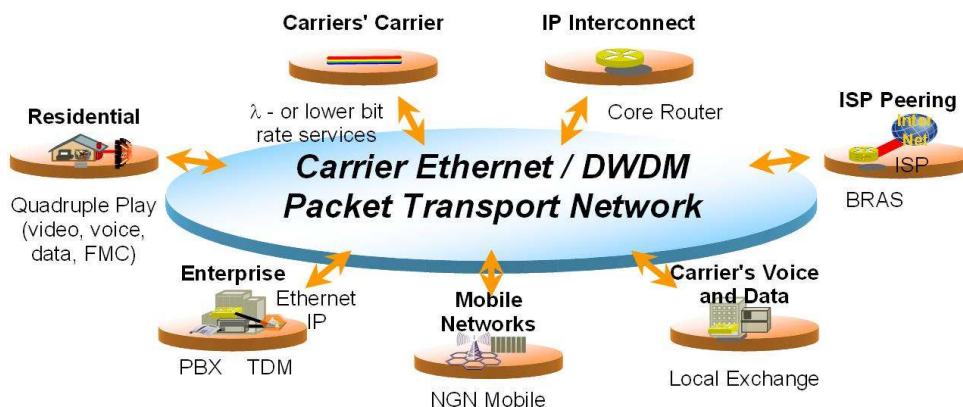
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### Project Website

[www.celticplus.eu/projects/celtic-projects/call4/100GET/100GET-E3/project-default.asp](http://www.celticplus.eu/projects/celtic-projects/call4/100GET/100GET-E3/project-default.asp)



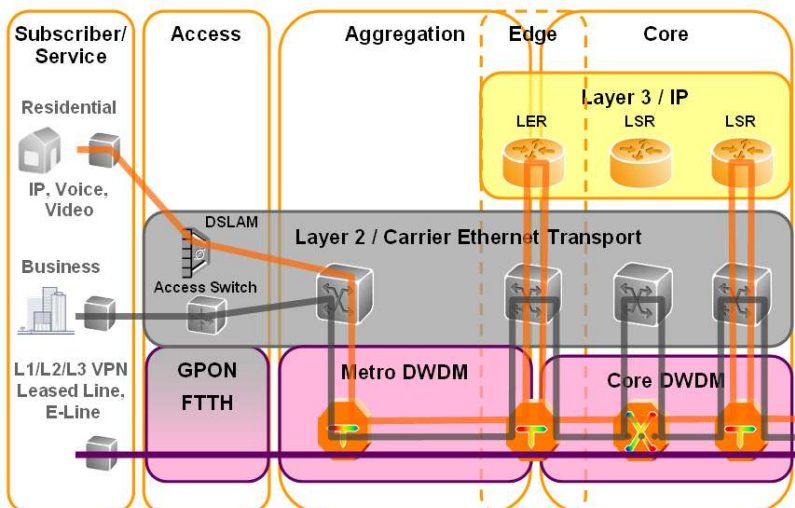
tation Element - PCE) across layers and domains/providers.

- ◆ Network planning – Planning methods for capacity planning as well as migration planning. Protection methods based on network coding. Multicast routing and protection.
- ◆ Network / service management – Network service management concepts across layers and domains/providers.
- ◆ Network / service control – Resource selection (PCE) and resource reservation (GMPLS) concepts applied to multi-layer and multi-domain transport networks. PCE multi-domain framework, various PCE algorithm implementations and performance assessments, control plane demonstrator for wavelength-switched optical networks (WSOs), IETF WG draft “PCE extensions for GMPLS” (initiator and co-author), IETF RFC “Framework for PCE-based inter-layer MPLS and GMPLS traffic engineering” (comments), PCE security.
- ◆ Techno-economics – Network automation, network virtualization and outsourcing of network operations assessed from an economic viewpoint. Total-cost-of-ownership (TCO) implications of a Control Plane architecture, Network virtualization service approaches and business models, Drivers and implications of network outsourcing.

- ◆ 100Gb/s DWDM transmission – A set of robust and spectrally efficient modulation formats have been assessed and understood in terms of performance, complexity, feasibility, and cost. Real-time aspects of a bit exact receiver implementation have been investigated using NSN's FPGA based validation platform.

mission system design not only for 100G, but also beyond.

According to the findings the standardization of 100G short-reach transmission interfaces in IEEE 802.3ba, of the OTN in ITU-T Study Group 15 and of the Path Computation Element (PCE) in IETF PCE WG has been influenced; furthermore the standardi-



The research performed in the project has led to a considerable number of patent applications.

Parts of the results concerning coherent transmission technology have already been integrated in NSN products, which today are generally available for our customers. Further results have been transferred from research into development and will be generally available in 2011. All the results have a strong impact on the trans-

zation of 100G transponder MSA architecture, as well as of 100G optical receiver and transmitter in the OIF.

The results have been published in numerous national and international conference papers and journal articles.

## Impact

Project results will pave the way for packet transport in core networks based on Carrier Ethernet and DWDM technologies, as the cost structure of IP/MPLS is considered too expensive for coping with the predicted traffic growth. The involved industrial parties will leverage their excellent footprint in circuit-switched transport, extending it to future packet transport. So far, six new products have been developed on the project results and two products have been improved using the results. Furthermore, there is also already an impact on employment: three new permanent employees have been hired by the partner organisations due to activities generated by the project results.

## About Celtic

Celtic is a European research and development programme, designed to strengthen Europe's competitiveness in telecommunications through short and medium term collaborative R&D projects. Celtic is currently the only European R&D programme fully dedicated to end-to-end telecommunication solutions.

**Timeframe:** 8 years, from 2004 to 2011

**Clusterbudget:** in the range of 1 billion euro, shared between governments and private participants

**Participants:** small, medium and large companies from telecommunications industry, universities, research institutes, and local authorities from all 35 Eureka countries.

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