Project Achievements

CELTIC Telecommunication Solutions

OPtimized Transponders for Robust Optical NETworks

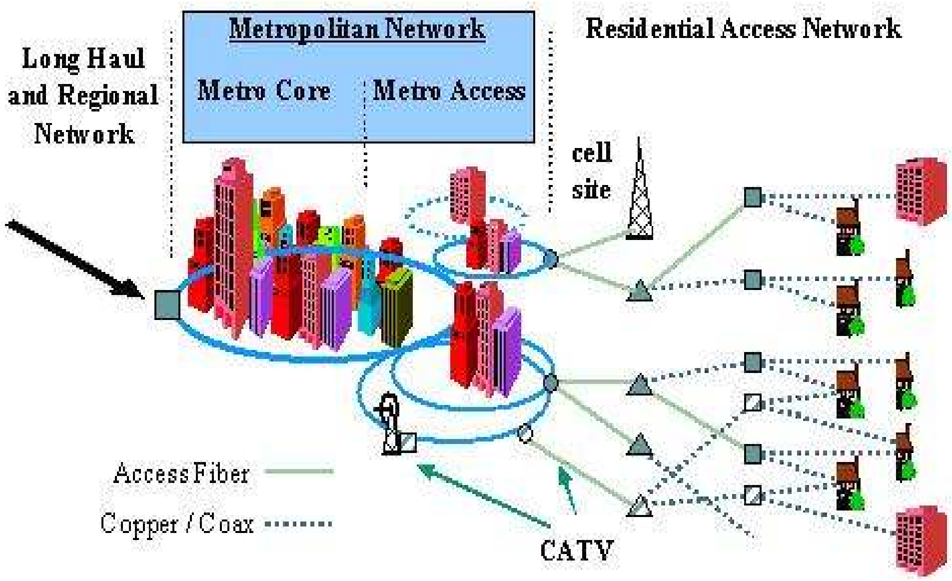
OPTRONET's target was to enable the implementation of a completely transparent optical network for metropolitan and regional communication systems, allowing the expansion of current networks without the traditional transmission limitations. By applying optimized transponders, higher distances can be covered.

Main focus

In a general end-to-end connectivity picture, the current networks consist of three major segments, the residential access, the metro/regional and the long-haul networks. A metropolitan/regional area network provides the interface link between the end-users ("residential access" or "last-mile" networks) and the backbone long-haul network. The main role of a metropolitan area network segment is to provide traffic grooming and aggregation of a full range of client protocols, from enterprise/private customers in access networks to backbone service provider networks. In addition, since the majority of the traffic stays within the same area, metro networks need to provide efficient networking capabilities within the metro area. Currently, there is a strong desire to migrate from the current SONET/SDH-based network architecture into a more proactive (dynamic and intelligent), multi-service optical network. This will allow reducing the OPEX (Operating Expenditures) and CAPEX (Capital Expenditures).

Approach

OPTRONET focused on optimizing the methods that improve system performance. Such evaluation involved work in alternative modulation formats to increase tolerance to optical transmission impairments, spectral narrowing/dispersion due to filter concatenation, intra-channel crosstalk, optical and electronic channel equalization (ECE). On the other hand, special focus on cost-effective components and sub-systems was taken into account. The project work included:



OPTRONET

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Project Website

www.celtic-initiative.org/projects/optronet

- **Identifying network solutions** and evolutionary design guidelines for metro networks.
- Identifying the system technologies that are **best fitted** for a metro-optimized system offering.
- **Defining requirements** for system technologies.
- Assessing the different systems in terms of **technical/manufacturing feasibility**.
- Identifying the **optimum targeted transparent reach** for systems operating at different bit-rates (evolution path from 2.5Gb/s to 10Gb/s to 40Gb/s).
- Specifying optimum (**performance and cost**) implementations for the system technologies (modulation formats and equalization techniques).
- Designing and building **prototypes of novel high-speed transmitters**.

Achieved results

The main results are related to the implementation of transmitters employing optical single sideband (OSSB) modulation format and the use of ECE resorting to simple electrical dispersive circuits. The major results are:

- Introduction of a new type of OSSB transmitter based on phase modulation [1]. Experimental implementation at 10Gb/s and 40 Gb/s.
- Development of an ECE method (associated to OSSB modulation) leading to transmission systems virtually unaffected by optical dispersion [2].
- Optimization of dispersion map used together with 10 Gb/s DML.
- Investigation of the use of the developed ECE technique in systems characterized by optical impairments related with metropolitan networks [3].
- A novel adaptive EDC was proposed, based on transversal filters which combine weighted signals that pass simultaneously through dispersive and non-dispersive transmission lines. The method can be used in the electrical domain as in optical domain.
- Two international patents that have been filed together with the investigation developed within the OPTRONET project.

References:

[1] D. Fonseca, A. Cartaxo, and P. Monteiro, "Adaptive opto-electrical filters for improved generation of optical single sideband signals with different pulse shapes", *IEEE/OSA J. of Lightwave Tech.*, vol. 25, no. 8, pp. 2175-2186, Aug. 2007.

[2] D. Fonseca, A. Cartaxo, and P. Monteiro, "On the use of electrical pre-compensation of dispersion in optical single sideband transmission systems", *IEEE J. of Selected Topics in Quantum Electronics*, vol. 12, no. 4, pp. 603-614, Aug. 2006.

[3] D. Fonseca, A. Cartaxo, and P. Monteiro, "Topics on OSSB modulation for 40 Gb/s transmission systems", in *Advanced Technologies for High-Speed Optical communications*, editor Lei Xu, Research Signpost, 2007.

Impact

The future optical networks, either core or metropolitan, entail the provisioning of full connectivity meaning that every node should be able to add, drop or cross-connect traffic. The node sites will coincide with amplifier/regeneration sites, but there can be amplifier/regeneration sites without add/drop traffic capabilities. In order to meet this requirement, innovative OADM/OXC architectures have to be applied, which will set their own limitations in terms of loss, filter profile, etc. In this case, additional impairments have to be considered like intra-channel crosstalk, dispersion, OSNR reduction, etc. The Consortium achieved convincing demonstrations of the benefits of Optical Single Side Band (OSSB) signals coupled with passive electric post-compensation techniques to extend the transmission reach at 10Gb/s or 40Gb/s. Conversion of traditional Optical Dual Side Band (ODSB) signals to OSSB signals coupled to electrical post compensation technique was demonstrated to be promising to extend the reach of 40 Gb/s transmission. A submission of a standards contribution in ITU-T question dedicated to 40 Gb/s applications (ITU-T SG15/Q6) could be valuable if such solution is demonstrated to be cost-effective. These methods will lead to know-how gain towards future products. Additionally, the use of these methods will give network operators information about the capabilities offered, this contributing to the increase of customer satisfaction.

Acknowledgement

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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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