

Field trial with Integrated ROADMs and GMPLS compliance

The FIRM project aimed to deploy a field trial consisting of an optical transport network based on ROADMs (Reconfigurable Optical Add/Drop Multiplexing) with GMPLS (Generalised Multi-Protocol Label Switching) compliance to set up and tear down light-paths dynamically under an ASON (Automatic Switched Optical Network) architecture. In this context, FIRM has developed, tested and demonstrated an integrated system by turning a static OADM into a ROADM with tunable transceivers, reconfigurable matrices and embedded intelligence.

Main focus

The FIRM project has developed and tested a flexible and intelligent network architecture, enabling broadband and cost-effective transport networks that will enhance the delivery of

new services and end-to-end connectivity for the development of the Information Society. By using a novel technology of reconfigurable optical switches and tunable transponders together with a unified control plane (GMPLS), the FIRM ROADM enables unprecedented flexibility for the network manager, allowing on-the-fly network reconfiguration, flexibility and bandwidth while reducing capital and operating expenditures (CAPEX and OPEX).

OADMs on the market are either fixed or, at best, manually reconfigurable, and wavelengths can only be routed to a limited number of ports, thus leading to inherent limitations. The proposed innovative ROADM enables on-demand provisioning, improves the QoS provided to customers, and will address seamless migration towards dynamic networks.

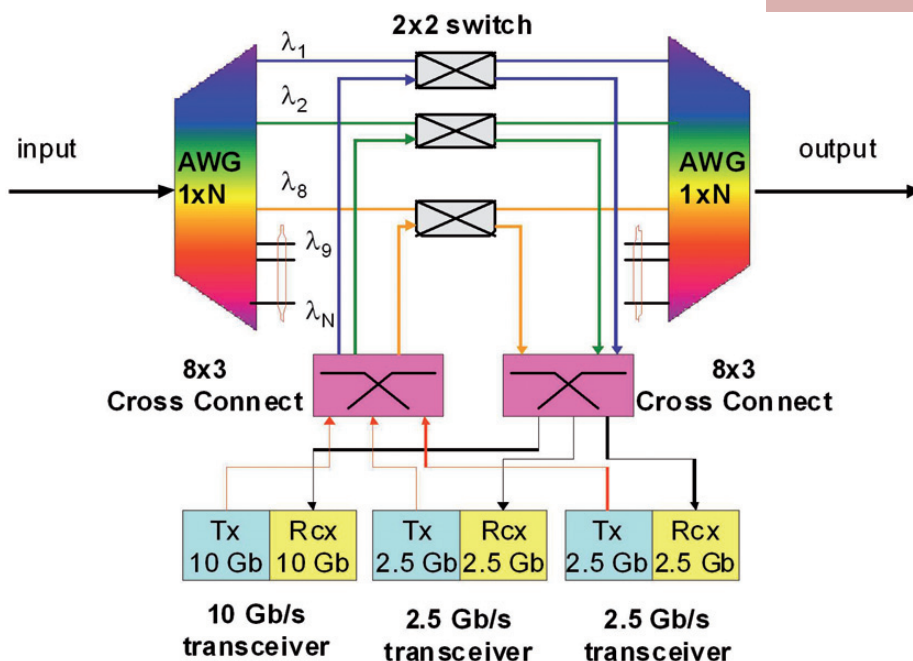


Figure 1: General architecture of the FIRM ROADM



Firm

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Partners

Fundación I2CAT, Spain

InTune, Ireland

Sercalo, Switzerland

Telefónica I+D, Spain

Universidad Politécnica de Cataluña, Spain

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www.celtic-initiative.org/projects/firm

Approach

FIRM has developed, tested and demonstrated an integrated system by turning a static OADM into a ROADM with tunable transceivers, reconfigurable matrices and embedded intelligence. By upgrading existing products with the integration of external devices, a cost-effective solution can be offered within a short time.

The FIRM approach has included the following steps:

ROADM framework analysis.

The performed business model and techno-economic viability analysis in a short/medium-timescale has shown that the ROADM solution provides unprecedented flexibility and scalability to transport networks. The network architectures, concepts, and solutions for all optical transport networks will enable increased bandwidth capacity, lowering the operational and capital costs (OPEX and CAPEX) and enhancing the delivery of new services and end-to-end connectivity.

Optical Node development.

FIRM has succeeded in integrating a full working ROADM prototype from discrete components (e.g. transceivers, matrices, multiplexers), correctly assembling optical components from different providers and guaranteeing an efficient interoperability. A control module system with embedded intelligence has also been developed in order to control and monitor all the components of the ROADM.

About CELTIC

Celtic is a European research and development programme, established as Eureka cluster, 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. Launched in November 2003, Celtic (Cooperation for a sustained European Leadership in Telecommunications) was founded and has been supported by major European telecommunication players, both vendors and operators. Celtic fills the gap between public R&D programmes not specifically focused on telecoms and short-term R&D efforts by the telecoms industry

Timeframe: 8 years, from 2004 to 2011

GMPLS control plane.

GMPLS-based CCI (Connection Control Interface) interfaces have been developed and integrated into the ROADM, to allow for automatic, control-plane-driven connections setup. Moreover, a basic Network Management System (NMS) has been adapted to trigger connection requests (soft-permanent) and to manage remotely the active optical devices of the FIRM ROADMs.

Field trial deployment.

The FIRM ROADM has been deployed in a field trial with access to end user applications and with a Pan-European scope, with two additional ROADMs funded by I2CAT. Over this infrastructure, an all optical ROADM-based dynamic network has been assessed with some representative broadband and digital applications to stress the field trial network and test its performance.

Achieved results

The main result of the project is a reconfigurable, control-and-management (C&M) enabled integrated ROADM (Figure 2 (a)) which will allow a technology evolution without replacing currently static OADMs. By upgrading existing products with the integration of external devices, FIRM offers a cost-effective solution that could be available within a short time. By implementing two additional semi-reconfigurable ROADMs (Figure 2 (b)), an ASON and all-

Total budget: in the range of 1 billion euro, shared between governments and private participants

Participants: companies from the telecommunications industry (small, medium and large), universities, research institutes, and local authorities from all 35 Eureka countries may participate in Celtic projects.

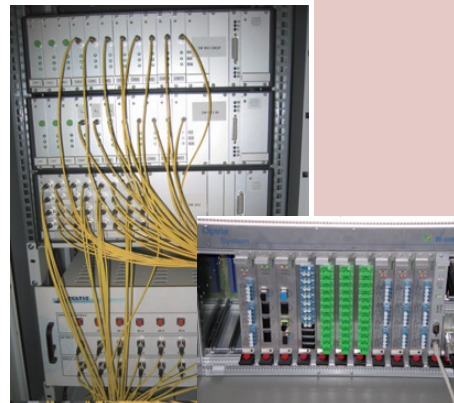
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optical WDM switching field trial (composed by 3 optical nodes) has been built in the last phase of the project.

This field trial is composed of the FIRM ROADM, two sROADMs, a distributed GMPLS control plane, tunable lasers, and real end users.



FIRM ROADM **Semi-reconfigurable ROADM (sROADM)**

This field trial has allowed to evaluate the performance of the ROADM functionality in a real environment. A test for the protection at OMS (Optical Multiplex Section) level has been successfully carried out.

Impact

Telecommunication networks are emerging as the central link of the information-based economy and society. The common denominator of emerging communication services is a robust, flexible and intelligent network infrastructure. Focusing on the development of ROADMs, the FIRM project contributes to the development of technologies and architectures that allow a generalized availability of broadband metro/access, and the evolution from current SDH/ATM infrastructures to intelligent and flexible all-optical networks. These infrastructures are a key enabler to the wider deployment of the information and knowledge-based society and economy.

This is done by defining network and node architectures, concepts and solutions for all optical transport networks which will enable increased bandwidth capacity in the underlying optical core and metro networks, proportional to the expected evolution in user requirements and services. Such new and efficient concepts for network management and control will lower the operational and capital costs (OPEX and CAPEX) and will enhance the delivery of new services and end-to-end connectivity. In summary, FIRM has contributed to enhance Europe's competitiveness in the development of flexible and intelligent all-optical networks.