

# Cognitive techniques find its way into the Optical Networks

**CHRON addresses the challenge of controlling and managing the next generation of heterogeneous optical networks applying cognitive techniques, in order to help in the building of the Future Internet. This research will take place thanks to the participation of entities from Spain, Denmark, Germany, Poland, Greece and Italy.**

## At A Glance: CHRON

**Cognitive Heterogeneous Reconfigurable Optical Networks**



### Project Coordinator

Dr. Rubén M. Lorenzo

CEDETEL

Tel: +34 983 54 65 02

Fax: +34 983 54 66 96

Email: [ict-chron@cedetel.es](mailto:ict-chron@cedetel.es)

Project website: [www.ict-chron.eu](http://www.ict-chron.eu)

**Partners:** Centro para el Desarrollo de las Telecomunicaciones de Castilla y León (ES), Technical University of Denmark (DK), Huawei Technologies Duesseldorf GmbH (DE), Telekomunikacja Polska SA (PL), Research and Education Laboratory in Information Technologies (EL), Universidad de Valladolid (ES), Center for REsearch And Telecommunication Experimentation for NETworked communities (IT)

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## Main Objectives

The Future Networks will be of a highly heterogeneous nature, ranging from a wide variety of classes of services with different requirements, to wide physical layer diversity in optical transmission techniques and optical switching paradigms. **The CHRON project proposes an approach of heterogeneous reconfigurable optical networks, capable of observing, acting, learning and optimizing their performance.** This new approach is based on introducing cognition into the control and management plane. A cognitive network becomes a kind of network that detects network conditions, traffic patterns and user demands and is able to efficiently take decisions and adapt to the new network state on each moment of time. This kind of network is able to meet the needs of a particular user while optimizing available resources of the whole network.

**Cognitive processes will make the next generation of optical networks smarter!**

The specific objectives of CHRON are the following:

- To define an overall optical transport network architecture with cognitive control.
- To identify services and application scenarios that can exploit the advantages of the architecture.
- To develop techniques for traffic, impairment and performance monitoring.
- To increase energy efficiency of the network.
- To disseminate the project results and contribute to relevant standardization fora.

Therefore, the Cognitive Heterogeneous Reconfigurable Optical Network must be able to provide effective decisions on:

- How to route traffic, either through existing lightpaths, new lightpaths or triggering a reconfiguration process of the virtual topology;
- How to assign resources, not only wavelengths, but also the most appropriate transmission/switching technique, optical launch power, modulation format, bit-rate, etc., thus relaying in cross-layer design techniques;
- Which elements should be powered on/off and when.

## Technical Approach

CHRON develops and showcases a network architecture and a control plane which efficiently use resources in order to fulfill QoS requirements of each type of service and application supported by the network in terms of bandwidth, delay and quality of transmission, and reducing energy consumption.

The CHRON project will last 36 months. Its activities are divided into 7 work packages (WPs):

- **WP1. Project Management** is devoted to handle all the administrative and financial issues of the consortium.
- **WP2. Network and Service Definition** is in charge of defining the overall architecture. It also deals with the interrelation between the service requirements, network scenarios and technologies.
- **WP3. Cognitive Decision System** defines and implements the cognitive decision system, which constitutes the core of the control architecture.
- **WP4. Network Monitoring System and QoT Evaluation Techniques** is in charge of implementing the network monitoring system, which checks quality of transmission and traffic load and provides feedback to the cognitive decision system
- **WP5. Control and Management System** deals with control and management issues of the architecture, thus forwarding instructions of the cognitive system to network elements.
- **WP6. Integration and Experimental Validation** experimentally validates the architecture of CHRON. In this WP, the developed system will be integrated in order to demonstrate its operation using trials carried out within the project laboratory experimental setup.
- **WP7. Dissemination, Exploitation and Standardization** is in charge of disseminating all the results produced as well as contributing to standardization bodies.

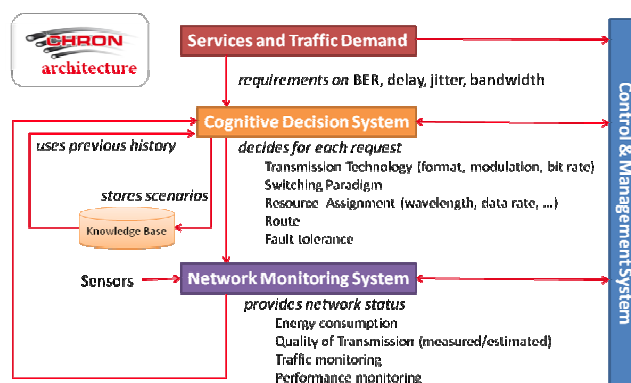
## Key Issues

The project proposes a **cognitive and dynamic approach** to tackle the lack of dynamicity of current optical network control planes; especially in view of the emerging levels of dynamic switching paradigms that can co-exist in a single future network.

CHRON will investigate **intelligent monitoring techniques** to account for advanced optical transmission techniques based on complex modulation formats with coherent detection that are being considered for achieving bit rates up to 100 Gbit/s and beyond.

The CHRON project will consider the interconnectivity between service classes, traffic types and the proposed cognitive system for reducing control and management complexity, augmented flexibility and efficient use of network resources. The proposed cognitive network can also perform cross-layer design and multi-objective optimization supporting trade-offs between performance in terms of cost and energy efficiency.

The proposed CHRON network architecture consists of the elements shown in the following figure. Basically a cognitive decision system is fed by the service and traffic demands, takes into account the current network status from a network monitoring system and learns from previous actions to output a decision to the control and management system, which forwards the commands from the cognitive system as well as offers communications between the different elements of the architecture.



## Expected Impact

Through this project it is intended to reinforce the positioning of the European industry in the field of the Future Internet, also reinforcing the European leadership in the area of photonic communication networks and cognitive network management technologies. CHRON will contribute to increasing the economic efficiency of optical networks (in terms of cost/bit), to enhancing interoperability through standardization, to expanding the market starting from new types of applications that exploit the advantages of this kind of cognitive network and to accelerating the adoption of the next generation of Internet services infrastructures.