

# Project Achievements



## Road to media-aware user-Dependant self-aDaptive

The main outcome of R2D2Networks is a user-dependant media-aware self-adaptive network management system that helps the network to learn What, When, Where and How different services and resources are to be used. It advances the current home and access/aggregation networks towards architectures with better use of connectivity resources and optimization of the provided service quality. The proposed solution is based on a resource manager that dynamically optimizes the network resources based on customer's Quality of Experience (QoE) and behaviour.

### Main focus

Current access network architectures do not allow operators or household owners to dynamically control which services at what quality level should be delivered to the access link (i.e. static virtual circuits are used for IPTV). Services are delivered in a best-effort fashion, and in case of

bandwidth failures or link congestion, all services used by the household are impacted, displaying long delays and decreased QoE.

The main focus of this project was the development of a network management system that automatically optimizes the service delivery to the households independent of specific content provision architectures. Within this concept, the user and access/aggregation networks are continuously monitored regarding the provided service QoE. Tools to monitor the network and the perceived QoE of users in real-time have been developed to check that the services are offered as agreed. These monitoring data and user feedback form the basis for the decisions made in the network manager entities.

### Approach

A formal and complete definition of the requirements and specifications of the R2D2 system was produced, aiming at a



## R2D2-Networks

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### Partners:

Centro Tecnológico de Telecomunicaciones de Catalunya, Spain

Ericsson AB (EAB), Sweden

Fundación Tecnalia Research & Innovation, Spain

IKUSI, Spain

Lund University, Sweden

Sintef, Norway

Telefónica I+D, Spain

Telnet-RI, Spain

UNINETT AS, Norway

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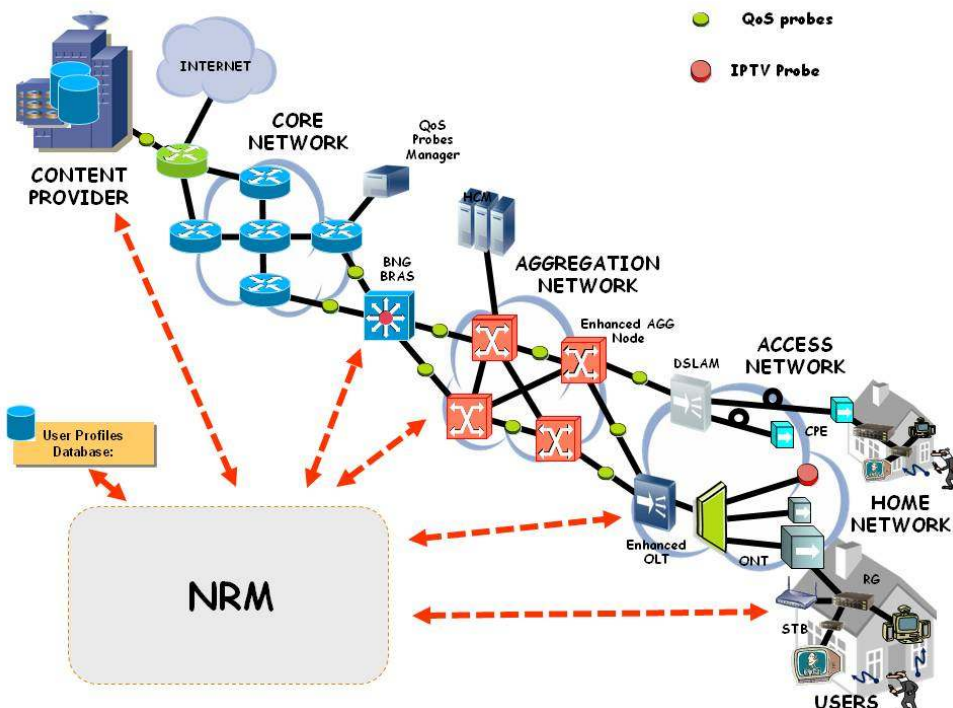
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### Project Website

[www.celticplus.eu/projects/celtic-projects/call6/R2D2NETWORKS/r2d2networks-default.asp](http://www.celticplus.eu/projects/celtic-projects/call6/R2D2NETWORKS/r2d2networks-default.asp)

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*user-dependant* and *self-adaptive* system.

Special attention was paid to the design of specific *network and QoE monitoring tools*, and its integration within in-home and access/aggregation network elements.

The in-home network design fitted the R2D2 home network elements, like the QoS/QoE monitoring home agent, based on the most prominent home network architectures and standards, e.g. HGI and ETSI TISPAN.

Regarding the network management system, its design targeted the implementation of all the modules and interfaces for the Network and Resource Manager (NRM) and deploying a prototype that has been included in the R2D2 test bed. This prototype uses the standards from different fora (NGN TISPAN, BBForum, IETF) as the basis for interfacing with the different network elements.

The testbed focused on the demonstration of how QoE for video contents can be assured by the NRM prototype. Beside, the applicability of R2D2 concepts was demonstrated over different network accesses, namely, GPON and xDSL.

## Achieved results

Main results from R2D2Networks project include:

- ◆ Advanced User Profiles, which store information about the us-

ers' behaviour and preferences in terms of QoE. These User Profiles also contain subscription information that allows the translation of QoE concepts into network resources to be assigned.

- ◆ A set of polynomial equations that enable QoE evaluation using typical QoS metrics (packet loss and jitter) for video contents.
- ◆ A set of user tools that enable end-users to provide feedback about their QoE, either by using a STB remote control or by accessing to specialized web applications in their smart phones.
- ◆ A number of network elements that gather QoS/QoE information about the content flows retrieved by an end-user. Main results were
- ◆ A QoE probe prototype able to evaluate QoE for video contents sent over a GPON access.
- ◆ A QoS probe prototype able to launch QoS tests from the home network to inner locations in the network
- ◆ A STB/HCM able to report the status of QoS parameters of the contents played in a user's TV Set.
- ◆ An enhanced DSLAM able to report QoS parameters in a xDSL access.
- ◆ The design of enhanced network elements, like an enhanced OLT, that allow better management

and configuration of these elements in terms of QoS

- ◆ The development of a central management module, the NRM, which interfaces with the tools/network elements quoted above, gathers the information provided by them, assesses the QoE, and uses the Advance User profile to take corrective action on the network, if permitted and/or needed.

Those elements have been integrated in a R2D2 test bed where a complete model of the network segments from content provider to end user (Core, Aggregation, Access and Home) has been laid up. In order to make the testing ground more complete, two different types of network accesses were used in the testbed: GPON and xDSL.

## Impact

The future holds a multitude of new services that will be delivered over the telecommunication networks. The evolution is not limited by creativity or customer requirements, but by technical and economical obstacles. There are architecture and security constraints that need to be addressed, but also user-oriented impediments.

The many advanced technologies provided in R2D2Networks will enable the exploitation of the already deployed European infrastructures cost-effectively, whilst applying research into the user-centric based services environment, with specific attention to the efficient management of connectivity resources among the home, in-building and access networks.

R2D2Networks content provider's independent network management system will reduce services' time to market by providing real feedback of their impact on the network resources and users' opinion, and also allow smaller operators to benefit from our solution in the way towards a real "Service Delivery Network".

## 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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