# Project Information

**CELTIC**
Telecommunication Solutions

## Coexistence and Optimization for LTE-RAN and WAN

The LOOP project addresses coexistence and optimization solutions for legacy and future emerging technologies, including, among others, 3GPP LTE-RAN, WiMAX, and WiFi. LOOP innovations will be evaluated in real test environments that will serve as a basis for evaluating the products' true market potential.

## Main focus

The B3G (Beyond 3$^{rd}$ Generation) vision aims at a global infrastructure where several systems can coexist to support transparent end-to-end communications in a cost-effective manner. An important issue for next generation wireless systems will be coexistence and optimization to provide a "network-of-wireless networks" accommodating a variety of radio technologies and mobile service requirements in a seamless and cost-effective manner. To address these issues, the main focus of LOOP will be to explore innovative solutions targeting:

**Network Discovery, Session Management and Roaming** allowing the end-user to maintain session continuity whilst roaming between operators and wireless technologies.

**Ad-Hoc Networking for Relay-based Cell Coverage Extension** will extend wireless and mobile coverage providing enhanced QoS delivery, and extended service delivery to remote, and fringe users.

**Dynamic Spectrum Allocation for Heterogeneous Networks** to investigate the opportunistic use of licensed spectrum by secondary systems for optimized utilization of scarce spectral resources.

**Intra-System Optimization** to maximize network utilization by exploring the application of a cross-layered protocol architecture.

Figure 1 identifies LOOP's global scenario to address key solutions in ad-hoc networking, session management and roaming, and its optimization.

## Approach

The LOOP approach to address the key scenarios on network coexistence and optimization can be identified by the following multidisciplinary work flow:

**Coexistence Scenarios**

A foreground study to precisely define the

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## LOOP

Project ID: CP4-016

Start Date: July 2007

Closure date:  December 2009

### Partners:

CBT, Communication & Multimedia, S.L, Spain

CTTC - Centro Tecnológico de Telecomunicaciones de Catalunya, Spain

Demokritos, Greece

Instituto de Telecomuniçðes, Portugal

Iquadrat, Spain

Portugal Telecom Inovação, S.A., Portugal

Semantix, Greece

Telefónica I+D, Spain

TRIMEK, Spain

TurkCell, Turkey

University of Aegean, Greece

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### Project Website

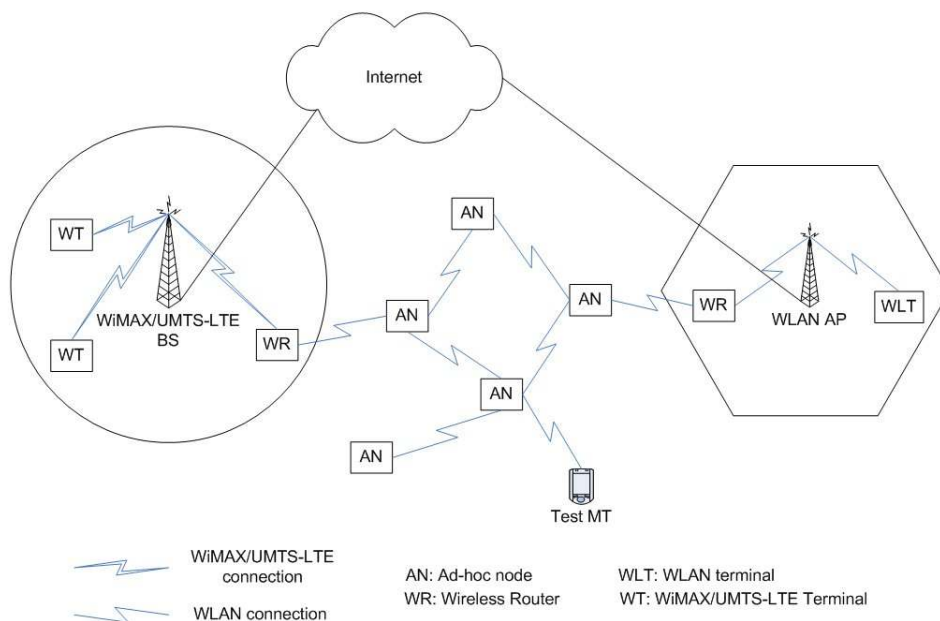www.celtic-initiative.org/projects/loop

www.proyectoloop.com/

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*Figure 1 Ad-hoc networking to provide "virtually" collocated cellular/WMAN and WLAN*

coexistence scenarios and problem definition for researching and demonstrating practical solutions to network discovery, session management and roaming; ad-hoc networking; dynamic spectrum allocation, and intra-system optimization.

### System Coexistence and Optimization

The pre-competitive R&D work will investigate practical solutions for the coexistence scenarios. Namely, solutions for:

♦ Network Discovery, Session Management and Roaming

♦ Ad-Hoc Networking for Relay-based Enhanced Cell Coverage

♦ Dynamic Spectrum Allocation for Heterogeneous Networks

♦ Intra-system Optimization

### Coexistence Demonstration

LOOP will conduct a feasibility study on the innovative protocols using software simulation tools available within the consortium, and real networking test bed equipment.

## Main results

In the scope of the project, the major results expected are:

### Network discovery, Session Management and Roaming

♦ Advanced algorithms for network discovery, selection and resource allocation for heterogeneous systems.

♦ A Universal Coexistence Layer (UCL) to ensure service continuity over heterogeneous networks, and interoperability with IMS.

### Ad-hoc networking for Relay-based enhanced cell coverage

♦ Results will target solutions in Wireless Router (WR) design, network discovery, association mechanisms and in multi-hop routing protocols.

♦ New cooperative MAC protocol based on cross-layer design and cooperative ARQ mechanisms.

### Dynamic Spectrum Allocation for heterogeneous systems

♦ Opportunistic radios for monitoring and utilization of available licensed radio spectrum.

### Intra-System Optimization

♦ New efficient resource management mechanisms based on cross-layer optimization assuming a distributed queuing MAC protocol in 802.11 systems.

♦ Dynamic Resource Allocation solutions based on cross-layer design for LTE/WiMax.

♦ Cross-Layer Optimised solutions for the Dynamic Spectrum Allocation solutions and the Ad-Hoc relay scenarios.

### Testing and Demonstration

♦ To allow the end-user to attain an indicative figure-of-merit for the proposed system coexistence scenarios in real networking environments.

♦ New testing equipment to facilitate deployment for future emerging wireless communication scenarios.

## Impact

### As researchers and chip vendor, opportunity to innovate:

♦ Enhanced performance: scheduling policies based on cross-layer design, cooperative ARQ, advanced receivers for opportunistic radio….

### New business opportunities for manufacturers:

♦ To provide dual mode terminals (for instance 3GPP LTE and WLAN interoperability)

♦ New network equipment to support the notion of "co-operative networks"

♦ New testing equipment to allow coverage planning and QoS delivery for future emerging wireless deployment scenarios

### New Business opportunities for Service providers and Application designers

♦ Beyond3G networks will allow operators to anticipate features and services that may be mandated by networks, and thus by the customers.

♦ Efficient bandwidth utilization using cognitive radio concepts will constitute an alternative source of revenue for the operator, and pose less demand on scarce spectral resources.

♦ Mobile or PC embedded applications that facilitate full-exploitation of LOOP capabilities through simple and amicable interfaces could open new market opportunities for third party developers.

The LOOP project will transfer engineering know-how for industry to meet the short-term market requirements, and allow industry to anticipate with ease the so called "super 3G" (LTE) commercial deployment foreseen for 2009.

## 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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