The ICARUS platform addresses significant research challenges related to system coexistence, scale, interoperability, and evaluation tool design, in the scope of a beyond 3G scenario where a diverse wireless networking world of “network-of-wireless-networks” accommodating a variety of radio technologies and mobile service requirements coexist in a seamless manner.

ICARUS provides an efficient, accurate and scalable virtual distributed testbed (VDT) implementation to support cross-system and cross-layer optimization of heterogeneous systems in a unified manner.

Main focus

The future leads towards a diverse wireless communications environment where the end user will be provided with “flexibility and choice”, meaning the ability to attain any service, at any time on effectively any network, in order to enhance the quality of life of the individual.

The achievement of the vision, where applications exploit in an efficient way the available wireless system resources, raises the need for a heterogeneous system evaluation platform.

The developed virtual testbed, which covers the radio access network layers, considers all the aspects relevant for the analysis and dimensioning of a wireless network and is a very powerful tool for researchers to design and evaluate next generation wireless networks.

In the case of wireless technologies, one of the keys to achieve an optimum usage of the resources will rely on cross-layering, where a much richer set of information may be required to be exchanged between layers. Therefore the development of simulation tools that enable this rich transfer of information between layers and systems will be essential for the design and evaluation of new algorithms.

Due to the fact that future wireless systems will incorporate a significant variety of technologies, some of which are not specified yet, one of the core aspects in the simulator architecture is the definition of abstract classes that will allow the integration of new technologies.

Furthermore, ICARUS plans to develop the adequate interfaces so that the developed framework may interface real devices or test equipment, and use real data in the simulations.

The ICARUS project aims to address the above research challenges by:

- Implementing an efficient, accurate and scalable Virtual Distributed Testbed (VDT) to support cross-system and cross-layer optimization of heterogeneous systems in a unified manner.
- Through the use of the VDT, to investigate, design and evaluate cross-layer and cross-system interactions, between next generation radio protocols without neglecting important real-system details.
Approach
The development of ICARUS, a Pan-European Virtual Distributed Test-bed, will follow an approach geared towards the achievement of the following simulation framework objectives:

- **Extendibility**: Existent and future standards can be realized on the ICARUS platform;
- **Modular design**: An end-user transparent framework with ‘plug and play’ features to support algorithmic testing in a Beyond 3G heterogeneous environment;
- **Open Interface**: The open structure ensures that redeveloping and extensions can easily be achieved;
- **Scalability**: The scale of the air interface technologies can be configured freely so that the cost of system devices can be minimized;
- **Easy to update and maintain**: A Framework to allow design and evaluation of cross-system and cross-layer optimization algorithms.

In order to obtain the scientific advances in terms of an optimized radio access network solution in view of E2E (End-to-End) performance, ICARUS will consider a myriad of interoperability and optimization scenarios:

- **Cooperative context-aware RAT selection between legacy systems (HSDPA, 802.16, 802.11e, 802.11g) and future emerging technologies (IEEE 802.11 VHT, IEEE 802.16m, 802.16j and 3GPP LTE);**
- **Non-cooperative RAT selection based on game theory;**
- **Efficient Inter-system handovers in Heterogeneous MBMS enabled wireless networks;**
- **Inter-system cross-layer optimization;**
- **Physical Layer optimization and interference reduction.**

**Main results**

- **The major results** foreseen in ICARUS include:
  - A distributed wireless networking experimental infrastructure software prototype for testing cross-layer and cross-system protocols/algorithms.
  - **Cooperative context-aware RAT selection algorithms** applied to legacy and future emerging technologies.
  - Cooperative context-aware RAT selection algorithms extended to point-to-point ad-hoc links.
  - **Non-cooperative RAT selection algorithms** based on game theory to provide service continuity within a heterogeneous operator and access technology environment.
  - **Efficient Inter-system handovers protocols for Heterogeneous MBMS enabled wireless networks.**

**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 European countries.

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