

ARTIST4G - Advanced Radio Interface Technologies for 4G Systems

Offering ubiquitous user experience in cellular mobile systems through innovations on interference management and new relay concepts, and building consensus to foster the development of standards thanks to the participation of major actors from Finland, France, Germany, Italy, Netherlands, Poland, Spain, Sweden and UK.

At A Glance: ARTIST4G

Advanced Radio Interface Technologies
for 4G Systems

**PROJECT LOGO
UNDER
CONSTRUCTION**

Project Coordinator

Bernard Le Floch
France Télécom
Tel: +33 2 99 12 45 10
Fax: +33 2 99 12 40 98
Email: bernard.lefloch@orange-ftgroup.com
Project website: <http://ict-artist4g.eu>
(under construction)

Partners

Alcatel-Lucent Deutschland AG (G)
Commissariat à l'Énergie Atomique (FR)
Chalmers Tekniska Högskola (SW)
Docomo Communications Laboratories Europe (G)
Eurecom (FR)
France Telecom SA (FR)
Mitsubishi Electric R&D Centre Europe (NL)
Nomor Research (G)
Nokia Siemens Networks (G, PL, FI)
Qualcomm CDMA Technologies (G)
Sequans Communications (FR)
Telecom Italia (IT)
Telefónica Investigación y Desarrollo (SP)
Technische Universität Dresden (G)
Vodafone Group Services Limited (UK)

Duration: January 2010 – June 2012

Funding scheme: IP

Total Cost: 14,4 M€

EC Contribution: 8,7 M€

Contract Number: INFISO-ICT-247223

Main Objectives

The first 3GPP Long Term Evolution standard version is complete and ready to be deployed. Although it increases peak data rate and spectral efficiency compared to legacy techniques, cell-edge and average user throughputs are still significantly lower than the peak rates. In the LTE-Advanced Study Item, ways to extend the standard are being explored.

However, most of the intelligence remains on the base station side with strategies consisting in avoiding interferences.

The main ARTIST4G objective is to improve the ubiquitous user experience of cellular mobile radio communications systems by satisfying the following requirements:

- High spectral efficiency and user data rate across the whole coverage area
- Fairness between users
- Low cost per information bit
- Low latency

A good key performance indicator for this objective is the ratio of the cell-average over the cell-edge spectrum efficiency. This ratio will be enhanced with respect to the following guideline:

- Improve significantly the cell-average spectrum efficiency over cell-edge spectrum efficiency ratio.
- Maintain or improve the cell-average spectrum efficiency.

ARTIST4G will also address the impact of these concepts on the network architecture.

Finally the project will not only use theoretical analysis and simulations to develop and validate innovative concepts, but also enable proof-of-concept via hardware prototypes and field trials in a representative test bed. It is expected that it will create a major impact on standardization and provide the partners with a technological head-start that will strengthen the European position in cellular communications.

*Improving the
ubiquitous user
experience of
cellular mobile
radio
communications
systems*

Technical Approach

The non-uniformity of the quality of service within the network can be tackled following two different approaches. On the one hand, one can try to change the network topology in order to harmonize the transmit power distribution. However it would be naive to think that a perfect uniform throughput distribution can be achieved given the intrinsic nature of propagation rules. Thus on the other hand, one can try to minimize the main limiting factor: interferences.

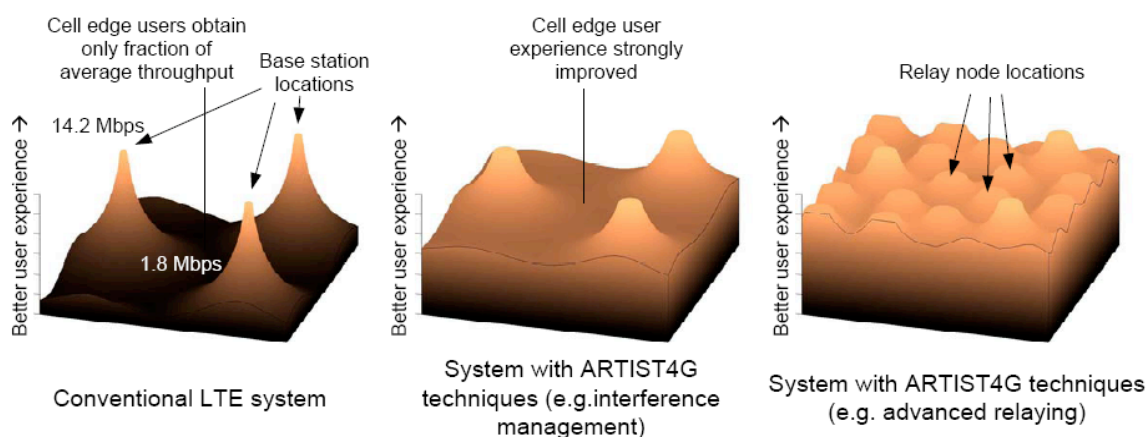
The second topic studied to achieve balanced user experience is advanced relay techniques. Several techniques that go beyond the scope of current standardization work will be addressed.

Both interference management and relaying techniques will impact the network architecture. ARTIST4G project will propose new architecture solutions for supporting these techniques.

Finally, ARTIST4G will provide a proof-of-concept of the proposed methods.

Key Issue

The optimal combination of the three approaches,



Consequently, the major research topic of ARTIST4G is interference management, which is further divided in two sub-topics:

- The first approach is to *avoid* interference at the receiver. This can be interpreted as keeping a high level of orthogonality between multiple transmissions, while improving spectral efficiency.
- The second approach is to step back from the paradigm of fully avoiding interference by designing purely orthogonal transmission schemes and, instead, allow for soft-tuning between avoidance and allowance for interference. The goal here is to *exploit* interference.

This disruptive approach puts more focus on the receiver implementation (in uplink and/or downlink).

The spirit of these concepts is illustrated by the following: "orthogonality lures by its beauty but it blinds the reason".

The relative performances of different approaches will depend on the topology, environment, and terminal capabilities. Efficient usage of the proposed methods in various coexistence scenarios will also be investigated in ARTIST4G project.

namely interference avoidance, exploitation and relays, is a key issue of the project. To help in this task, appropriate models will be needed at system levels that do not already exist. A corner stone of this model is the introduction of interference-cancelling receivers for which no link to system interface exists yet.

Expected Impact

- Rich and uniform quality of experience for mobile customers
- Strengthened European leadership in mobile broadband systems
- Increased economic efficiency of mobile access infrastructures (cost/bit)
- Consensus building among major 3GPP actors fostering standards development
- Accelerated uptake of the next generation of mobile networks