

Project profile

EPAMO

Energy-efficient piezo-MEMS tuneable RF front-end antenna systems for mobile devices



One major limitation of today's mobile phones is the imperfect impedance matching of the aerial to the front-end circuitry. This problem can lead to poor efficiency overall. Additional shielding of the signal by hand, head or environmental obstacle, aerial miniaturisation and matching across the broad frequency spectrum also contribute to degrading the performance. The ENIAC JU project EPAMO combines the strengths and experience of leading European specialists to address such issues and develop new aerial and front-end technologies with the aim of enhancing the performance of future mobile phones.

Sub Programme

- Nanoelectronics for energy efficiency
- Nanoelectronics for wireless communications
- Silicon process and integration for nanoelectronics
- Equipment, materials and manufacturing for nanoelectronics

With the introduction of 3G mobile phone systems, the whole mobile telephony industry including equipment manufacturers, materials and component suppliers, design and test houses as well as simulation tool providers faced new requirements with respect to the radio-frequency (RF) architecture of terminals. Current and future multi-mode and multi-band standards in communications, enabling the use of an individual handset in mobile networks all over the world, will result in a strong increase in the complexity of the RF architecture of the phones.

In addition, the trend towards the ever increasing functionality of handsets, including audio, video, GPS, browsing and personal computing, increases the pressure on the miniaturisation and cost control for the RF front-end to keep at a reasonable level the overall form factor and average sales price of a mobile phone.

By using advanced CMOS technologies, a further improvement in the

next generation of transceiver ICs will be possible. However, for the RF front-end, new technologies and system architectures will be required to fulfil the ever-increasing requirement for higher data rates and energy efficiency.

Facing the challenges

The ENIAC JU project EPAMO is addressing the major challenges of providing cost-efficient solutions for the future high performance RF systems, enabling energy-efficient mobile communication systems and relying upon highly-miniaturised and integrated RF components.

EPAMO will explore and implement multiple innovative processes and testing technologies to realise an adaptive aerial front-end system for 4G mobile phones. With the benefit of closed-loop aerial tuning, mobile phone radio power levels can be reduced by more than 50% while, in base stations, a saving of at least 10% seems to be possible.

The project will help using the in-

stalled mobile phone infrastructure in a more efficient way, reducing the number of new base stations to be installed to cover future data traffic. It is estimated that the implementation of this technology has a global energy-saving potential of more than 10,000 GWh a year on the basis of a constant data volume to be transmitted.

New switching technology

EPAMO aims to explore the potential of ultra-high density, RF micro-electromechanical systems (MEMS) switch arrays to be integrated in an energy-efficient agile RF transceiver with reconfigurable aerial.

Of particular interest will be high-force piezoelectric MEMS actuators based on lead zirconate titanate (PZT) thin films, high-reliability metallic contact switches, low-loss silicon and composite glass-silicon 200-mm diameter wafer substrates. With this technology it will be possible to produce galvanic switches to replace today's capacitive switches, significantly extending the application field for RF MEMS switches. Fine pitch, through-wafer vias will allow high-density 3D system integration in ultra-small RF module substrates with integrated components.

The project covers the whole development process including simulation and modelling, design and layout, materials development, process technology development, device measurement and reliability/quality testing.

Further miniaturisation

The basic idea is to develop a recon-

figurable aerial concept which can be fully integrated with today's RF front-end module solutions using advanced heterogeneous 3D integration technologies. The core of this system will be an array of ohmic RF MEMS switches based on piezoelectric actuation using thin layers of PZT integrated into a CMOS-like thin film technology.

These MEMS switches will be the key components in an adaptive matching circuit between the aerial and the RF front-end module providing the required switching and filtering functionality. This innovative RF solution will boost current and future mobile phone system performance.

The continuing trend towards further miniaturisation and integration is an ever increasing challenge in the design of complex RF systems, due to critical RF interaction on signal lines. By introducing tuneable RF elements, the overall systems architecture can be simplified, leading to a significant cost reduction in future RF systems. Therefore the development of tuneable RF components will be a key enabler of future highly-advanced RF systems and this will strengthen the leading position of the European RF community and industry in the face of worldwide competition.

The European mobile phone industry today holds a leading position in RF and wireless technologies and the results of EPAMO offers the potential to further strengthen this position by developing the next generation of systems and subsystems for the RF front-end of mobile phones.

Energy efficiency

Partners:

- AixACCT Systems
- Boschman Technologies
- Christian-Albrechts University of Kiel
- EPCOS
- EPCOS Netherlands
- Fraunhofer Institute for Reliability and Microintegration
- Fraunhofer Institute for Silicon Technology
- Landshut Silicon Foundry
- MASER Engineering
- Okmetic
- Picosun
- Plan Optik
- Silex Microsystems
- SolMateS
- TNO Defence, Security and Safety
- University of Twente
- VTT

Project co-ordinator:

- Thomas Metzger, EPCOS

Key project dates:

- Start: April 2011
- Finish: March 2014

Countries involved:

- Finland
- Germany
- The Netherlands
- Sweden

Total budget:

- €13.3 million

Details correct at time of print but subject to possible change. Updates will be included in the project summary at the end of the project.



The ENIAC Joint Undertaking, set up in February 2008, co-ordinates European nanoelectronics research activities through competitive calls for proposals. It takes public-private partnerships to the next level, bringing together the ENIAC member states, the European Commission and AENEAS, the association of R&D actors in this field, to foster growth and reinforce sustainable European competitiveness.