Project profile

Cluster for Application and Technology Research in Europe on NanoElectronics

CA101 | Power amplifiers and antennas for mobile applications (PANAMA)

PROJECT CONTRIBUTES TO

Communication	✔
Automotive and transport	
Health and aging society	
Safety and security	
Energy efficiency	✔
Digital lifestyle	
Design technology	✔
Sensors and actuators	
Process development	
Manufacturing science	
More than Moore	✔
More Moore	
Technology node	

TECHNOLOGY PLATFORM FOR PROCESS OPTIONS

Partners:

Agilent Technologies Belgium
Amcad Engineering
CEA-LETI
ELTA Systems
ESIEE Paris
Gigle Semiconductor
IEMN
IMS
Institut Telecom
KU Leuven
MC²
NXP Semiconductors France and the Netherlands
OMP
ST-Ericsson Belgium
STMicroelectronics
THALES Communications
TNO
TU Delft
TU Eindhoven
UPC-HiPICS

Project leader:

Philippe Meunier
NXP Semiconductors

Key project dates:

Start: January 2009
End: September 2012

Countries involved:

Belgium
France
Israel
The Netherlands
Spain

The PANAMA project brings together leading European partners from the semiconductor, test tools, electronic design automation and academic worlds to focus on future more efficient multi-band, multi-mode power amplifiers and transmitter systems. Power amplifiers will play a major role in the realisation of a truly mobile connected world as they have an impact on handset battery life, cost of ownership in terms of cooling and electricity, spectral efficiency and systems co-existence. This innovation in power amplifiers will demand a systems design approach, taking account of the overall environment in the specification of the systems and also system-on-chip or system-in-package co-existence issues.

Meeting future communications needs of European citizens requires more extensive use of high-capacity wireless networks. This translates into two main needs: spectrum width and multi-mode operation. Lack of spectrum means information streams must be confined to a limited bandwidth. This can be achieved by increasing the volume of bits per Hz without interfering with adjacent systems.

Another aspect of future communications is the need for every European citizen to have access to services everywhere. This requires a communications system with dynamically reconfigurable multi-standard, multi-mode operation.

At the same time, energy conservation has become a major political and a social issue. New intelligent solutions are required to reduce energy consumption. Industry therefore needs to adopt more energy-efficient nanoelectronics systems based on intelligent power components that exploit highly-innovative semiconductor technologies.

Total systems innovation

An assessment of communications versatility and power efficiency shows the power amplifier is the key component of the communications chain that requires innovation to achieve these objectives. However, advances in amplifier technologies need to be considered in the overall context of the communications system to ensure comprehensive efficiency improvements, rather than simply transferring the problem from one side of the system to the other.

The CATRENE CA101 PANAMA project set out to address this need with integrated systems, discrete systems and distributed systems – co-located with the aerial – applied to a set of target applications such as 3G/4G and millimetre-wave mobile communications handsets and transceiver base stations, avionics, mobile satellite communications and home networking.

The primary target is an efficiency gain of 20% for integrated systems, 30% for discrete systems and 10% for distributed systems. Beyond these goals, PANAMA relies on the development of innovative enabling tools in the measurement, modelling and simulation areas to enable a breakthrough in design flow.

Multiple applications domains

PANAMA targets multiple applications domains which would benefit from improved power efficiency without compromising systems-level gains or functionality. To achieve this, the project will set common goals along the chain to achieve better energy efficiency and more capabilities for each application. A common approach will facilitate the study of innovative architectures and systems-level specifications, bundling commonalities across targeted applications.

Cross-application enablers will be developed around modelling, characterisation, technology, design flow and simulation tools. These enablers will bundle the work in a set of designs realising proofs of concept for the targeted applications. From the technological point of view, the project will not develop such aspects but will use state-of-the-art technologies available to the partners.

Even if the volume of applications seems significant, the commonality of the problems and the goals within the project will allow efficient reuse and the sharing of best practices. The benefits will be measured through improved market competitiveness in the targeted application domains.

Significant power consumption

Cell-based mobile communications systems currently represent around 0.5% of total worldwide power consumption, although rapidly growing economies are eager to continue deployment of wireless communications systems. Consequently, the energy consumption is increasing with a 16 to 20% compound annual growth rate.

Recent and new communications systems – 3G/4G and wireless personal area networks – strive for more efficient use of the spectrum by using increased peak-to-average power ratio (PAPR) signals. However, power amplifiers operating under high PAPRs have to behave in a linear manner, currently only done at the cost of efficiency.

Having multiple standards in the same handset/base station also implies power losses between the power amplifier and aerial. These issues have a negative effect on battery life in mobile handsets and utility costs in base stations where cooling accounts for 50% of the total power consumption.

Handling multiple standards implies having a reconfigurable approach to a system. In the base station, a digital transmitter with a feedback loop appears to be relatively efficient in term of reconfigurability, power consumption and wideband capabilities. Further integration of the base-station power amplifier will also provide a competitive advantage.

Parallel applications

Avionics applications will also benefit from an increase in versatility and power efficiency. In this area, power-amplifier efficiency is a key specification while power consumption must be reduced for several reasons – the primary factors here are:

- Limitation of heat evacuation through air flow; and
- Reliability, which decreases with higher power consumption.

PANAMA will ensure that new avionics communications equipment will be able to take advantage of more complex modulation formats under current heat-evacuation constraints.

Mobile satellite-communications products will benefit from an increase in power-amplifier efficiency as a result of improved autonomy of the equipment or, for the same overall consumption, being able to transmit more complex signals in the same bandwidth by increasing the data rate available to the user.

Home networking on coaxial cable needs flexibility to be able to coexist with current and future terrestrial, satellite and cable-television frequencies extending up to the 2.4 GHz band. This is a mass consumer-driven market, where efficient implementations are needed to ensure that the integration roadmap continues and that the new power-saving initiatives, which apply to all types of consumer communications equipment, are met.

Shared best practices

By combining different kinds of power-amplifier development and associated circuits into one project, a sharing of best practices can be achieved. The kinds of tools and methodology developed in PANAMA will be leveraged across the different applications domains.

Finally, the CATRENE project will also provide an industrial forum sharing information between most of the leading European players active in power-amplifier development and in system-on-chip and system-in-package developments, together with key universities and small and medium-sized enterprises, so advancing industrial acceptance of non-linear power-amplifier techniques.

CATRENE (Σ! 4140), the EUREKA **C**luster for **A**pplication and **T**echnology **R**esearch in **E**urope on **N**ano**E**lectronics, will bring about technological leadership for a competitive European information and communications technology industry.

CATRENE focuses on delivering nano-/microelectronic solutions that respond to the needs of society at large, improving the economic prosperity of Europe and reinforcing the ability of its industry to be at the forefront of the global competition.

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