EUROPEAN COMMISSION
Information Society and Media Directorate-General

Components and Systems
Components

Report of the

RF-MST Cluster Workshop

Potsdam (Germany)
July 1st, 2013

Project Officer and co-chair: Antonis Galetsas
Rapporteur and co-chair: Michel Declercq

Introduction

The RF-MST Cluster Meeting 2013 has been organized in cooperation with the MEMSWAVE International Symposium on July 1st in Potsdam (DE). The hosting organization was IHP.

The goal of this workshop is to share the latest developments of RF-MST projects developed in the framework of European Institutions and other European initiatives. It also promotes exchanges between scientists active in the same area as well as synergies between projects. Clustering and discussions play a key role in enhancing the coherence of this important domain and in promoting synergies and cross-fertilization.
For the first time, the workshop gathered projects financed in the framework of the 7th F.P. of the EC as well as projects developed in the framework of CATRENE, ENIAC and EURIPIDES. This gave a real boost to the interest of the workshop and helped increase the synergy between various European initiatives.

This report does not intend to repeat or summarize the content of the presentations. A copy of the slides is available on the web site of the event (http://memswave2013.org), while a short abstract of each project and its objectives is given in annex of this report. The objective is to identify some trends in the evolution of RF-MST, to promote synergies between projects and to make recommendations for future workshops.

The presentations proposed in the workshop program can be classified as follows:

- Presentation of the host institutions IHP and TU Berlin by Prof. Bernd Tillack
- Two invited keynote speeches, dedicated respectively to the road to commercialization of RF-MST and to the presentation of WP3 of the FET Flagship laureate "Graphene", particularly relevant for its long-term vision in the field of the nanoelectronics and NEMS
- Presentation of Coordination, Support and Networking actions supported by the EC 7th F.P.
- Presentation of the latest developments in R&D projects financed in the framework of the EC 7th F.P, ENIAC, CATRENE and Euripides

After a summary of the main issues resulting from these presentations, some trends and conclusions will conclude this report.

RF-MEMS: Road to the Market

This keynote speech “RF-MEMS: Road to the Market” was given by Olivier Millet from DelfMEMS (FR).

In the 3G/4G environment, complex system architectures have to manage over 40 bands and multimode transmission protocols. Reconfigurability, antenna tuning, impedance matching networks, tunable filters and others open the path to numerous applications for RF-MEMS.
Moreover, military and space applications, radar for automotive and avionics and instrumentation offer also interesting potential markets.
The author concludes that RF MEMS are now requested. The question is no more to know if MEMS will be applied or not, but when. The supply chain exists and is consistent. However, RF-MEMS represent a very special business case. A huge budget (estimated between 25 and 45 M$ by the author) and a long development time (6 to 12 years) is necessary for going to the market with a product.
Olivier Millet concludes his talk by giving practical recommendations for reaching successfully the market with competitive RF-MEMS products.

FET Flagship project “Graphene”-Workpackage on HF-Electronics

The mission of the FET Flagship project Graphene is to take graphene and related layered materials from academic laboratories to society, revolutionize multiple industries and create economic growth and new jobs in Europe.

Graphene’s unique combination of superior properties makes it a credible starting point for new disruptive technologies in a wide range of fields. The research effort will cover the entire value chain from materials production to components and system integration, and targets a number of specific goals that exploit the unique properties of graphene. Key applications are for instance fast electronic and optical devices, flexible electronics, functional lightweight components and advanced batteries.

After a brief introduction to graphene and its unique physical properties the author described the actual state-of-the art production methods for graphene layers production.

Actual results obtained with graphene HF transistors are still far away from the expectations and show a rather poor fmax capability.

The non-linear properties of graphene are also explored, and gave already excellent results in frequency multipliers and mixers.

Many challenges remain to be solved for increasing the performances and bringing graphene from the labs to the market. Among these challenges, the author listed the reduction of output conductance of graphene FETs, the reduction of parasitic effects (contact resistances, parasitic capacitances), the optimization of the process technology, device scaling, and the realization of ICs beyond single graphene transistors.

Graphene is however a very young technology, and major improvements are expected in the next few years, thanks to the major financing effort of the EC and member stats in the framework of the FET Flagship program.

Presentation of Coordination, Support & Networking Actions in the field of RF-MEMS

The COWIN Coordination and Support Action addresses the commercial exploitation of EC-supported projects with an integrated expertise in technical, market and financial areas. This action is an excellent initiative, because the move towards commercialization and mass production remains the weak point of many R&D projects. The effectiveness of the support is now demonstrated by several success stories.
Many contacts have been taken by participants of the workshop with the COWIN team, illustrating the strong need of the RF-MEMS community for such a support action.

The NANO-TEC Coordination and Support Action is dedicated to the beyond CMOS roadmap. Its objective is to identify the next generation of devices, technologies and design concepts and to build a community that will coordinate research efforts in this field.
Many potential candidates exist for beyond CMOS technologies. The task of this Action therefore started with the definition of criteria for benchmarking, the identification of the most relevant properties to be analyzed, and the selection of potential candidates for beyond CMOS devices.
As a working methodology, four workshops have been organized between Jan. 2011 and Nov. 2012, a web platform has been created for discussion and dissemination of the information, and a report on "Recommendations for the Technology-Design Ecosystem for Nanoelectronics" has been published in Feb. 2013 by the consortium.

The NANOFUNCTION Network of Excellence (NoE) is concerned with beyond CMOS nanodevices for adding functionalities to CMOS.

NANOFUNCTION addresses 4 specific fields:

- Nanosensing with Si-based nanowires
- Si nanowires for energy harvesting
- Nanocoolers
- Exploration of new materials, devices and technologies for RF applications.

The presentation made at this workshop was mainly dedicated to this last topic.
Specific objectives are the development of RF substrate technologies and novel passive devices, as well as the investigation of the properties of nanowires for RF interconnects and antennas.

After a careful analysis of the main requirements for RF substrates and a comparison of potential candidates, an original solution based on porous silicon has been presented that offers very attractive features.
In the last part of the presentation, properties of Al and Cu nanolines for RF interconnects and nano-antennas have been presented.

Presentation of RF-MEMS projects

A total of 16 R&D projects have been presented during the workshop, among which 7 projects where presented for the first time in this forum. The main features and trends issued from the projects presented at the workshop are summarized here after.

Advances in RF-MEMS technology - Pushing technology to new frontiers

Carbon-based technologies represent clearly a new trend in R&D. This topic is particularly addressed in NANO-RF, MERCURE and, of course, in the GRAPHENE FET Flagship.

NANO-RF, which is dedicated to Carbon-based smart systems for wireless applications, addresses both Carbon Nano Tubes (CNT) and Graphene devices and explores a very wide range of applications that include CNT FETs, CNT RF-NEMS switches, CNT-based antennas, CNT interconnects, Graphene FETs, Graphene-based mixers and detectors and others.

In MERCURE, CNT are exploited for developing RF-NEMS switches and demonstrate their co-integration with GaN high-power devices.

Co-integration or monolithic integration of MEMS switches with Si and high-power GaAS / GaN technologies is a hot topic. Recent developments have been presented in many projects, including for instance EPAMO, MEMS-4-MMIC, NANOTEC, MINIMEMS, FLEXWIN, MERCURE and NANOCOM.

Advanced technology platforms for mm-wave and sub-Terahertz applications have been presented, pushing the high-frequency frontier to new limits.
The SUCCESS project addresses the multiple challenges of mm-wave systems, ranging from devices to design, testing and packaging. It targets the development of a technology platform and best-practice design methods of silicon mm-Wave SoCs and SiP for high-volume applications. The project demonstrators are in the 122.5 GHz ISM band. An interesting feature of the project is the BIST (Built-In Self Test) that solves the difficult problem of mm-wave IC production test. The SiP concept with integrated antenna is also developed, while different chips-to-package interconnection technologies are investigated.
The RF2THz project, developed in the CATRENE framework, targets a 55nm SiGe BiCMOS 0.5 THz technology with the co-integration of photonic devices. A complete industrial platform is developed , offering modeling capabilities and design blocs with DfT and BIST features.

Extreme miniaturization at the system-level is explored in WISERBAN with a Body Area Network application. 2-D prototypes have been realized while 3-D systems are presently developed.

Advances in tunability and tuning techniques have been presented in ARTEMOS, while solutions for wafer-level packaging have been presented in many projects.

MEMS switches: the key component

MEMS switches, both capacitive and resistive, remain the key building block for many applications. They appear in most projects.

Significant progress is observed in several areas, summarized here under:

Device physics and reliability, with emphasis on reduction of charge built-up, temperature sensitivity, degradation mechanisms, control voltage and others. This approach is illustrated for instance in the MINIMEMS (Euripides) project.

Miniaturization and reduction of switching time.
Miniature capacitive switches with a linear reduction of dimension by one order of magnitude have been developed in MINIMEMS, NANOCOM and NANOTEC. The resulting decrease in switching time is impressive, going from 9 μs down to 0.2 μs for instance in MINIMEMS.

Innovative materials
New materials are regularly tested for both the insulating layers in order to reduce the charge built-up phenomena, and for the contact metal layer in order to decrease the contact resistance and avoid the stitching problem in ohmic switches. Such developments have been presented in EPAMO and NANOTEC

Actuation techniques
Besides the standard electrostatic actuation that requests voltages in the range of 30 V, piezo-electric actuation is an interesting alternative, offering both a higher actuation force and a lower driving voltage. This technique is used, for instance, in EPAMO.

Power handling capability
Power handling capability has been continuously increasing over the years. A record of 10W (40 dBm) in the range 2-20 Ghz is actually in development in the framework of NANOCOM.

Monolithic integration
As described here above, monolithic integration of RF-MEMS switches with CMOS, BiCMOS, GaAs and GaN ICs is an important trend. Few supplementary steps – if any – are presently needed for achieving this feature.

Trend towards smarter microsystems

A trend towards smarter microsystems is observed, with several features that include:

- Feedback loops, local intelligence and adaptative systems controlled by sophisticated algorithms for optimized system performance.
- Increased level of integration
- Efforts for power savings
- Improved reliability

Several projects have illustrated these trends.

Beam steering antennas, addressed for instance in ARASCOM, SARABAND and FLEXWIN, are moving in the direction of local intelligence (at pixel level), increased use of monolithic integration and reconfigurability features.

FLEXWIN is using an original approach for broadband high-data rate bi-directional transmission between satellites and terrestrial (and airborne) mobile devices. The proposed solution has 2 key features: flexibility (in the sense of versatility and re-usability) and intelligent pixels. Using a multifunctional chip in each pixel, the expected RF performances is improved by the use local (distributed) amplification for Tx and Rx. The chip presents FPGA-like features with switchable/reconfigurable elements for multi-band operation.

In SARABAND, several smart antennas have been developed, including low-profile, high gain antennas, multi-beam antennas and circular switched parasitic arrays.

ARASCOM is developing agile reflect-arrays for the X-band (10 Ghz), Ku band (12 Ghz) and the W-band (77 Ghz). In a first approach, thousands of RF-MEMS switches are integrated in the radiating board for phase-controlling the reflected wave. In a second solution, the variable permittivity of liquid crystals is used for a smaller range phase control.

Reconfigurability becomes a must in today's complex multi-standards, multi frequency bands environment. It includes antenna switching, impedance matching, antenna tuning, front-end configuration switching and many others. Close-loop techniques, adaptative systems and self-reconfigurable operations illustrate the trend towards smarter systems.
These techniques are illustrated for instance in EPAMO, NANOTEC, ARTEMOS, MERCURE, NANOCOM, MINIMEMS and FLEXWIN.

Advanced frequency generation

Go-4-Time targets the realization of generic miniature timing modules relying on the combination of an integrated circuit together with different MEMS resonators assembled hermetically in a single package.
Three types of resonators are used in the project, respectively miniature crystals, MEMS silicon resonators and BAW resonators. A versatile/programmable CMOS ASIC, which includes temperature compensation features, can generate any frequency up to 50 Mhz with extreme performances in terms of ultra-low power, high frequency stability over a large temperature range (± 2 ppm from -40°C to + 85°C) and high spectral purity.

The iPHOS project combines photonics and microelectronics. This project, which does not involve MEMS, targets the development of compact, low power transceivers for high-data rate, short-distance communication links. Its original approach of dual wavelength optical sources for carrier generation is very interesting for comparison with standard (electronic) RF carrier generation. Low-cost, low phase noise and excellent tuning capabilities are among the key features expected from the proposed technique. The targeted frequency range is 60 GHz to 1 Thz.

Summary and conclusions

The RF-MST Cluster workshop, organized in connection with MEMSWAVE, is an important event sharing the latest results obtained in relevant EC-funded FP7 project as well as projects developed in the framework of ENIAC, CATRENE and EURIPIDES.

A total of 22 papers have been presented, out of which 10 are presented for the first time

The presentations selected for the 2013 workshop reflect the evolution of RF-MEMS towards a greater maturity in technology and reliability.

A trend towards increased local intelligence and smarter systems has also been observed in several projects.

Continuing on last year trend, the coverage of the RF-MEMS domain has been extended vertically, ranging from basic research in next-generation devices (Graphene, NANO-TEC) to complete systems, including access to commercial applications (COWIN).

For future editions of the workshop, it is strongly recommended to pursue in this direction. It's important to give on one hand a long-term view on R&D on future devices, disruptive technologies and design methodologies. On the other hand, Coordination and Support Actions pushing R&D results to applications and successful industrial products are of major importance. In this spirit, COWIN plays an important role that has clearly been evidenced during this workshop.

It is also recommended to continue to open the workshop to ENIAC, CATRENE and EURIPIDES projects. The quality of the selected projects and the new links it helped to create gave a new boost to the interest of this workshop.

Michel Declercq

Annex-I : Workshop program

AGENDA

RF-MST CLUSTER WORKSHOP
Potsdam, Germany, 1 July 2013

Chairmen: Prof. M. Declercq, EPFL Lausanne and Antonis Galetsas, EC DG CNECT
Rapporteur: Prof. M. Declercq

Time	Topic	Speaker
08:30	Registration	
09:00	Opening/Welcome	Antonis Galetsas (European Commission)
09:05	Presentation of hosting institutes (IHP and TU Berlin)	Prof. Bernd Tillack (Head of Dep. of IHP and professor of TU Berlin, DE)
09:20	RF-MEMS: Road to the market	Olivier Millet (DelfMEMS, FR)
09:40	Introduction of COWIN Marketplace	Geraldine Andrieux (project coordinator of COWIN, Yole Developpement, FR)
09:50	The role of graphene in future RF micro- and nanosystems by Graphene FET Flagship	Daniel Neumaier (AMO Gmbh, DE)
10:20	NANO-TEC: Beyond CMOS Roadmap – RF-technologies	Dr. Ralf Popp (edacenter Gmbh, DE)
10:40	NANOFUNCTION: Beyond CMOS Nanodevices for Adding Functionalities to CMOS	Dr. Androula Nassiopoulou (National Centre for Scientific Research "Demokritos", GR)
11:00	***Coffee break***	
11:20	RF2THZ: From RF to MMW and THz silicon SoC technologies	tbc (IHP)
11:40	NANO RF: Carbon-based Nanosystems for Wireless Applications	Dr. Afshin Ziaei (Thales, FR)
12:00	ARASCOM: MEMS and Liquid Crystal based, Agile Reflectarray Antennas for Security and COMunication	Mariano Barba (UPM, ES); Flavio Giacomozzi (FBK, IT)
12:20	EPAMO: Energy-efficient Piezo-MEMS tunable RF front-end Antenna systems for MObile devices	Thomas Lisec (ISIT-Fraunhofer, DE)
12:40	SARABAND: Smart Antenna & Radio for Access and Backhaul for Advanced Network noDes	Alain Le Fevre (Thales, FR)
13:00	***Lunch break***	
14:00	MEMS-4-MMIC: Enabling MEMS-MMIC technology for cost-effective multifunctional RF-system integration	Rens Baggen (IMST Gmbh, DE)
14:20	NANOTEC: Nanostructured materials and RF-MEMS RFIC/MMIC technologies for highly adaptive and reliable RF systems	Dr. Afshin Ziaei (Thales, FR)
14:40	MINIMEMS: High-Reliability, High-Power & High Speed Rf Tuning Applications Based On Miniaturised Mems. Switched Capacitors	Dr. Afshin Ziaei (Thales, FR)

15:00	FLEXWIN: Flexible Microsystem Technology for Micro- and Millimeter Wave Antenna Arrays with Intelligent Pixels	Volker Ziegler (EADS, DE)
15:20	SUCCESS: Silicon-based Ultra-Compact Cost-Efficient System Design for mm-Wave Sensors	Yaoming Sun (IHP-Microsystem Gmbh, DE)
15:40	ARTEMOS: Agile RF Transceivers and Front-Ends for Future Smart Multi-Standard Communications Application	Cor Schepens (Cavendish Kinetics, NL)
16:00	***Coffee break***	
16:20	MERCURE: Micro- and nanotechnologies based on wide band gap materials for future communication and sensing systems	Dr. Afshin Ziaei (Thales, FR)
16:40	NANOCOM: Reconfigurable microsystem based on wide band gap materials, miniaturised and nano-structured RF-MEMS	Dr. Afshin Ziaei (Thales, FR)
17:00	Go4Time: GlObal, Flexible, On-demand and Resourceful Timing IC & MEMS Encapsulated System	tbc
17:20	iPHOS: Integrated photonic transceivers at sub-terahertz wave range for ultra-wideband wireless communications	Dr. Guillermo Carpintero (UCM, ES)
17:40	WiserBAN: Smart miniature low-power wireless microsystem for Body Area Networks	Dr Dionysios Manessis (IZM-Fraunhofer, DE)
18:00	Conclusions	Prof. Michel Declercq (Chairman, EPFL, CH)
18:10	***End of the workshop***	

In parallel: COWIN Marketplace – face-to-face meetings with industrial companies

Annex-II : Abstract of some the projects presented at the workshop (according to availability on CORDIS)

COWIN

Converging resources to support the value creation in Europe of Microsystems and Smart Miniaturized Systems research projects

FP7-ICT CSA

Coordinator

YOLE DEVELOPPEMENT SARL
FRANCE

Project details

Project Acronym: COWIN
Project reference: 258898
Start date: 2010-10-01 End date: 2013-09-30
Duration. 36 months
Total cost: EUR 2 911 197
EU contribution: EUR 2 729 982
Project Status: Execution
Contract type: Coordination and support actions (CSA)

ABSTRACT

COWIN will optimize commercial exploitation of EU RTD projects, based on the setting up of a dedicated network reinforcing collaborations and joint value of existing resources supporting microsystems and smart miniaturized systems competitiveness in Europe.

COWIN s objectives are:

- To facilitate better commercial exploitations of EU RTD projects. Our objectives are that over the 91 FP6 and FP7 research projects funded by the EU, about 35 ones reach further development milestones following a value creation roadmap, about 15 projects start collaborations with strategic industrial partners for IP licensing and technology transfer and that about 10 new companies are identified and proposed to the investors.
-To set up a dedicated network for value creation. We will converge available resources in facilitating interactions and collaborations of academic, industrial, public and private investors. A specific action will be conducted in the diagnostic and food/beverage quality fields.
- To close the research, industry, and private investment gaps. We will provide with recommendations of actions identified by consultation of all the different parties.

COWIN actions will be undertaken by partners with complementary technical, market and RTD financing expertise with the support of a strategic committee of experts composed of technology platforms, industrials, VC s and RTD financing programs representatives.

The FET (Future and Emerging Technologies) Flagship GRAPHENE

Source: http://www.graphene-flagship.eu/GFfiles/130124_PresseText_A4.pdf

The European Commission has chosen Graphene as one of Europe's first 10-year, 1,000 million euro FET flagships. The mission of Graphene is to take graphene and related layered materials from academic laboratories to society, revolutionize multiple industries and create economic growth and new jobs in Europe. Graphene has been subject to a scientific explosion since the groundbreaking experiments on the novel material less than ten years ago, recognized by the Nobel Prize in Physics in 2010 to Professor Andre Geim and Professor Kostya Novoselov, at The University of Manchester.

Graphene's unique combination of superior properties makes it a credible starting point for new disruptive technologies in a wide range of fields. With today's announcement Europe is launching a new form of joint, coordinated research initiative of unprecedented scale. The Graphene Flagship brings together an academic-industrial consortium aiming at a breakthrough for technological innovation. The research effort will cover the entire value chain from materials production to components and system integration, and targets a number of specific goals that exploit the unique properties of graphene. Key applications are for instance fast electronic and optical devices, flexible electronics, functional lightweight components and advanced batteries. Examples of new products enabled by graphene technologies include fast, flexible and strong consumer electronics such as electronic paper and bendable personal communication devices, and lighter and more energy efficient airplanes. On the longer term, graphene is expected to give rise to new computational paradigms and revolutionary medical applications such as artificial retinas.

From the start in 2013 the Graphene Flagship will coordinate 126 academic and industrial research groups in 17 European countries with an initial 30-month-budget of 54 million euro. The consortium will be extended with another 20-30 groups through an open call, issued soon after the start of the initiative, which will further strengthen the engineering aspects of the flagship. The flagship will be coordinated by Chalmers University of Technology based in Gothenburg, Sweden. Director is Professor Jari Kinaret who will lead the research activities together with the leaders of the 15 work packages. The management team is supported by a Strategic Advisory Council that includes the European Nobel Laureates Sir Andre Geim (chairman), Albert Fert, Klaus von Klitzing and Sir Kostya Novoselov, industrial representatives from Nokia and Airbus, and two representatives of the global grapheme research community. "Although the flagship is extremely extensive, it cannot cover all areas. For example, we don't intend to compete with Korea on graphene screens", says the Professor Jari Kinaret at Chalmers University of Technology, Sweden, Flagship Director. "Graphene production, however, is obviously central to our project."

During the 30 month ramp-up phase, the Graphene Flagship will focus on the area of communications, concentrating on ICT and on the physical transport sector, and supporting applications in the fields of energy technology and sensors. After the ramp-up phase, the flagship will grow to full size and include many new groups and activities. The details of flagship implementation after the ramp-up phase are still open and form a part of the discussions on the Horizon 2020 research program of the European Union.

NANO-TEC

Beyond CMOS Roadmap – RF technologies

FP7-ICT CSA

Coordinator

Prof. Dr. Clivia M Sotomayor Torres
Catalan Institute for Nanotechnology

Project details

Duration: Sep. 2010 – Feb. 2013
Funding scheme: CA
Total Cost: € 795.124
EC Contribution € 720.000
Contract Number: INFSO-ICT-257964

Web sites:

http://www.ite.waw.pl/docs/pl/inne/nano-tec-recommendation_2013-02.pdf
http://cordis.europa.eu/fp7/ict/components/documents/nanotec-factsheet.pdf

ABSTRACT

NANO-TEC is a community of academic researchers which has two objectives. Firstly to identify the next generation of nanoelectronic device concepts and technologies for ICT and secondly to build an academic community in nanoelectronics, addressing specifically research in Beyond CMOS from the combined technology and design perspectives. The objectives of NANO-TEC will be pursued through a series of activities aiming for a continued consultation and analysis of research needs and trends

A workshop series with invited experts, discussants and rapporteurs is the main technique to meet the first objective. The workshops will count with experts from the Americas, Asia and Europe. The workshops will cover several topics such as beyond CMOS device concepts and design,benchmarking and a SWOT analysis of new devices. They will culminate with a report and or Roadmap to be disseminated to the academic nanoelectronics community, the European

Commission and other stakeholders, such as ENIAC, other projects and networks. Simultaneously, an interactive web platform is being set up to encourage discussions on web fora on specific topics such as, examining ways in which benchmarking could be carried out. These networking activities will ultimately stimulate new collaborations and ideas and offer suggestions at national and European level, based on the workshop results on trends

NANOFUNCTION

Beyond CMOS Nanodevices for Adding Functionalities to CMOS
FP7-ICT Network of Excellence

Coordinator:

Institut Polytechnique de Grenoble (INPG), FR

Project details

Start date:2010-09-01
End date:2013-08-31
Duration:36 months
Project Reference:257375
Project cost:3528006 EURO
Project Funding:2800000 EURO

Web sites :
http://www.nanofunction.eu/nanofunction/
http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_RCN=11414406

ABSTRACT

The NANOFUNCTION Network of Excellence aims to integrate at the European level the excellent European research laboratories in order to strengthen scientific and technological excellence in the field of novel nano-electronic materials, devices and circuits for developing new integrated functions and disseminate the results in a wide scientific and industrial community.

This proposal will focus on the convergence of Advanced More than Moore devices (Analogue-RF-sensors-actuators-biochips-energy harvesters, etc.) for adding functionalities to ICs and Beyond-CMOS nanostructures (nano-wires, nano-structured materials, etc.) which could be integrated on CMOS platforms. In particular, the interest of these nano-devices for the development of innovative applications with increased performance in the field of nano-sensing, energy harvesting, nano-cooling and RF will be thoroughly investigated.

This work will be carried out through a network of joint processing, characterisation and modelling platforms. The consortium will work closely with European industry and will feed back data and know-how on devices that deliver the required performance. This interaction will strengthen European integration in nano-electronics, help in decision-making and ensure that Europe remains at the forefront of nano-electronics for the next decades.

RF2THz : From RF to MMW and THz silicon SoC technologies

CATRENE project CT209

http://www.catrene.org/web/downloads/profiles_catrene/CT209-RF2THZ%20SISOC-project%20profile-outCatrene%20%2821-3-12%29.pdf

To meet the needs of future radio frequency (RF) and high-speed equipment, the CATRENE RF2THz project aims to develop silicon technology platforms for emerging RF, millimetre-wave (MMW) and THz consumer applications such as 77/120GHz automotive radars, MMW imaging and sensing, fast measurement equipment, 60GHz wireless networking and fast downloading systems, 400 Gbit/s fibre optics data communications systems, 4G photonic mobile communications and high performance RF wireless communication systems as well as two-way satellite communications systems. It also targets MMW and THz applications in health science, materials science, genetic screening, security and industrial automation.

Until now, relatively little effort has been made to close the THz frequency gap in the application spectrum of microelectronics communications technologies. The CATRENE CT209 RF2THZ SISOC project will focus on the technological and design-related prerequisites for the necessary THz-range applications. As this discipline is still in itsinfancy, it is necessary to prepare the foundations. The close co-operation of experts from technology development, design methodology and application areas will accelerate the necessary process enormously. Consequently, European manufacturers may be able to gain a leading position and be the first to place applications on this important future market.

RF2THZ SISOC will involve development of new bipolar plus CMOS (BiCMOS) technologies. For this purpose, one of the partners will integrate and optimise silicon-germanium (SiGe) heterojunction bipolar transistor (HBT) and back-end modules developed in previous projects in an advanced 55nm CMOS technology. This will make possible a 0.5 THz 55nm SiGe BiCMOS platform suitable for RF, MMW and THz system-on-chip (SoC) applications. One partner will follow an integral approach to focus on improvements and breakthroughs in BiCMOS technology for the essential high-performance passive RF components. The necessary MMW packaging and the required RF testing solutions will also form part of this project. Another partner will develop silicon photonics devices for future silicon photonics foundry offerings.After optimisation, characterisation of the THz, MMW and RF components will be carried out and models will be adapted and model parameters extracted. Design blocks will be developed both for full function integration and for design-for-test (DfT) or built-in self-test (BIST) introduction and full demonstrators will be assembled. Exploration of some promising advanced applications will also take place.
Three project partners have complementary technologies so they aim to collaborate to address directly different portions of the THz, MMW, RF and photonic markets. Furthermore, the development of high performance passive devices will be used as input for benchmarking back-end performance of 55nm BiCMOS technology. Two project partners will co-operate on photonics device development in the new BiCMOS technology to preserve the future integration of such components together with the high level digital integration required for SoC applications in an European foundry.

NANO RF

Carbon Based Smart Systems For wireless applications

FP7-ICT Project

Coordination: Thales

Web sites :
http://www.imec.be/NANO-RF/
http://project-nanoRF.com/

ABSTRACT

The main concept of NANO-RF is the development of CNT & graphene based advanced component technologies for the implementation of miniaturised electronic systems for 2020 and beyond wireless communications and radars.
The objectives of NANO-RF can be listed as follows:

- Explore and evaluate CNT properties operating in arrays, as solid-state FETs and RF NEMS, in the 2 to 80 GHz frequency range;
- Explore and evaluate graphene properties as solid-state FETs, mixers and detectors in the 2 to 80 GHz frequency range.
- Develop, calibrate and validate CNT NEMS and CNT FET and graphene FET models for the design of microwave circuits;
- Introduce a new class of antennas based on CNTs and graphene
- Demonstrate the concept of NEMS RF to introduce more versatility and increased performance within the future analog RF front-end
- Fabrication of capacitive CNT NEMS switches for power application.
- Demonstration of CNT vertical interconnects in 3D integrated systems
- Demonstration of a graphene detector able to demodulated RF signals
- Demonstration of a LNA based on graphene
- Demonstrate the integration of graphene, CNT ICs, and CNT-based interconnects with
- CNT NEMS to realize smart systems through System on Chip (SoC) and/or System in package (SiP) scheme

ARASCOM

MEMS and liquid crystal based, agile reflectarray antennas for security and communication

FP7-ICT Project

Coordinator

THALES ALENIA SPACE FRANCE
FRANCE

Project details

Project Acronym: ARASCOM
Project Reference: 222620
Start Date: 2008-05-15
Duration: 36 months
Project Cost: 3.91 million euro
Contract Type: Collaborative project (generic)
End Date: 2011-05-14
Project Status: Completed
Project Funding: 2.6 million euro

Web sites:
ftp://ftp.cordis.europa.eu/pub/fp7/ict/docs/micro-nanosystems/g2-microsystems-proj-portfolio-07-08-24-arascom_en.pdf
ftp://ftp.cordis.europa.eu/pub/fp7/ict/docs/micro-nanosystems/20080630-arascom_en.pdf

ABSTRACT

Our project is focused on Research & Development for efficient use of micro-nano devices as basis of agile antennas with moderate cost, that are more and more required in advanced systems for Communication, Safety and Security. We will assess this until representative prototypes at a very large and innovative level:
- very large because the developed agile "reflectarray" antennas for Communication (to be implemented in base-stations and satellites) will comprise thousands of RF-MEMS switches integrated in the radiating board for phase-controlling the reflected waves
- innovative: first because such quantities will require both accurate & safe design, and setting-up industrial processes including on-wafer packaging and automatic assembling, to reach higher reproducibility in top-level performances (improving reliability) than previous European projects on RF-MEMS
- innovative especially because to operate at the very high frequencies suited to security imaging, safe-landing & anti-collision radar (typically around 77 GHz), will be developed new phase-shifters combining MEMS with nematic Liquid Crystals ; the latter provide variable permittivity by adjusting molecules orientation, so may be called "nano-scale control devices".

So both Micro (MEMS) & Nano (nematic LC) technologies will be deeply investigated, for their best properties in agile antennas.

EPAMO

Energy-efficient **P**iezo-MEMS tunable RF front-end **A**ntenna systems for MO**bile devices**

ENIAC JU Project

Coordinator:

Fraunhofer Gesellschaft – Institut für Silicon Technologie (FhG ISiT)
Germany

Project Details

Duration: 3 years (April 2011 – March 2014).

ABSTRACT

Future wireless communication systems need to cope with the increased number of frequency bands and advanced mobile phone standards supporting high data rates. At the same time mobile phone systems have to become more energy-efficient in order to contribute to the Grand Challenge "CO_2-reduction". The EPAMO project will address both aspects by exploring and implementing multiple innovative processes and testing technologies to realize an adaptive antenna front-end system for 4G mobile phones. Due to closed-loop antenna tuning the radio power levels can be reduced in the mobile phone by more than 50%, in the base stations by at least 10%. It is estimated that the implementation of this technology has a global energy saving potential of more than 10.000 GWh per year.

EPAMO has the objective to explore the potential of unprecedented ultra-high density RF-MEMS switch arrays to be integrated in an energy-efficient agile RF transceiver with reconfigurable antenna. Key crosscutting More-than-Moore and heterogeneous integration technologies are high-force piezoelectric MEMS actuators based on Lead Zirconate Titanate (PZT) thin films, high reliability metallic contact switches, and low-loss silicon and composite glass-silicon 8" wafer substrates.

Fine pitch through-wafer vias will allow high-density 3D system integration in ultra-small RF module substrates with integrated components.

SARABAND

Smart Antenna & Radio for Access and Backhaul for Advanced Network Nodes

FP7-ICT Project

Coordinator:

THALES COMMUNICATIONS & SECURITY SA, France

Project Details

Start date:2011-10-03 End date:2014-10-02
Project Reference:288267
Project cost:5072542 EURO
Project Funding:3111285 EURO

Web sites:

http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_RCN=12347147
http://www.ntc.upv.es/english/projects/saraband_en.html

Abstract

SARABAND project aims to take advantage of the Q-band frequency (40,5 to 43,5 GHz) in a cost effective way to provide higher performing and integrated network nodes for wireless backhaul of future mobile radio and last mile access for the digital divide by developing smart antennas and front-end radio modules. The use of millimeter waves, particularly the Q-band where 3GHz bandwidth has been regulated by EU, can bring large capacity with high throughputs, fast deployment, with lightweight and discrete equipment.

As mobile operators face increasing density of base stations as well as growing bandwidth requirements backhaul has become the new challenge. To reduce the digital divide and as a complement to the Fiber to the Home, especially where cost to deploy fiber cannot be justified, it is proposed to deliver capacity to enterprises and households over the last miles at much more reasonable cost. High throughputs & capacities can be delivered with GHz bandwidth compact radios with advanced antennas and front ends radios. Performances and cost target will be met with: on the one hand low profile high gain and programmable multi-beam antennas and very high performance miniaturized analogue steerable antennas, on other hand advanced packaged Q-band circuits.

Lens antennas are an attractive and inexpensive solution to produce highly shaped radiation patterns. The SARABAND lens shape will be designed in order to transform the feed pattern to the desired radiation pattern. Other very attractive concept proposed in SARABAND for electronic beam steering studies is the Circular Switched Parasitic Array (CSPA) antenna that is proposed as one solution for the agile Q-Band antenna in the repeaters. SARABAND will propose very advance packaging and interconnection process for Q-band radio front-end modules achieving high thermal efficiency performances, high reliability and lifetime and low costs.

MEMS-4-MMIC

Enabling MEMS-MMIC technology for cost-effective multifunctional RF-system integration

FP7-ICT Project

Coordinator

IMST GMBH
GERMANY

Project details

Project Reference: 224101
Start Date: 2008-05-01, End Date: 2011-10-31
Duration: 42 months
Project Cost: 3.8 million euro
Project Status: Completed
Project Funding: 2.9 million euro

Web site:
http://www.mems4mmic.com/
http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_RCN=10062151

ABSTRACT

The MEMS-4-MMIC proposal aims at the integration of RF-MEMS switches onto Monolithic Microwave Integrated Circuits (MMIC) creating highly integrated multifunctional building blocks for high-value applications. RF-MEMS will be an essential building block of next-generation smart systems that are characterised by cost-effective and compact designs, high performance, flexibility and configurability.

MEMS-4-MMIC will consider the whole value chain of RF-MEMS MMIC components starting at the materials and suitable foundry processes, the RF-design, packaging of RF-MEMS MMIC, and last but not least, the testing and reliability which plays a very important role in the whole manufacturing/commercialisation process. For this purpose one of Europe's leading GaAs MMIC foundries is part of the consortium. The definition of first RF-MEMS MMIC components starts with the selection of the correct requirements that are dictated by next-generation wireless smart applications, automotive radar, satellite terminals, 60 GHz WLAN and cognitive radio front-ends. As a proof-of-concept an RF-MEMS MMIC based antenna module will be realised at the end of project showing the innovative character and possibilities for commercial exploitation.

The MEMS-4-MMIC project will significantly contribute to the knowledge and competence to include RF-MEMS switches on existing GaAs MMIC foundry processes. The project aims to provide the enabling technology platform needed for the future establishment of an RF-MEMS MMIC manufacturing base within Europe.
The project has been concluded successfully and a whole range of RF-MEMS MMIC components has been realized. All components have been packaged successfully at wafer (0-) level.

NANOTEC

Nanostructured materials and RF-MEMS RFIC/MMIC technologies for highly adaptive and reliable RF systems

FP7-ICT Project

Coordinator:

THALES RESEARCH & TECHNOLOGY, FRANCE

Project details

Project Reference: 288531
Start Date: 2011-09-01 **End Date:** 2014-08-31
Duration: 36 months
Project Cost: 9.69 MEUR
EC Contribution: 6.63 MEUR

Web site:
http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_RCN=12198449

ABSTRACT

RF communication and remote sensing (radar/radiometric) systems are facing the demands of increasing complexity/number of frequency bands, increased bandwidths and higher frequencies for higher data throughput, while at the same time the power consumption, the form factor of the systems, and the overall system costs must decrease. Future smart micro-/mm-wave systems will have to achieve self-reconfigurable operations for real-time efficient self-optimization of their performance. For such adaptive systems, high-performance tuning/switching components and strategies for building monolithically integrated (miniaturised) reconfigurable active RF circuits and front-ends are needed.The NANO-TEC project aims to generate innovative approaches towards novel RF/mm-wave systems with increased functionality and potentially lower cost addressing future needs of European industry.

NANO-TEC will develop 4 Demonstrators (1:10-24 GHz reflect arrays for aerospace, 2:71-86 GHz frequency-agile LNA/PA for E-band PtP communication, 3:94 GHz high-sensitivity front-ends for passive imaging and 4:140 GHz radar front-ends for active imaging) with advanced functionalities based on enabling technologies and via monolithic integration of high-performance RF-MEMS switches in GaN/GaAs/SiGe IC foundry processes.NANO-TEC will aim to improve reliability of RF-MEMS by using NANOstructured materials and to demonstrate added-value by employing the proposed GaN/GaAs/SiGe MEMS-ICs for 10-140 GHz applications.The emergence of European sources (SiGe/GaAs/GaN MEMS-IC foundries) will play a key role towards increasing the availability of RF-MEMS TEChnology and related products (thus shorten time-to-market).
If successful, NANO-TEC will also lead to improved safety/security thus creating novel business opportunities/jobs for existing/new companies in Europe.The NANO-TEC consortium consists of 18 partners (7 countries) incl. some European stakeholders in the field of communications, avionics, space and security

MINIMEMS

HighReliability, HighPower & HighSpeed RF Tuning Applications Based on Miniaturised MEMS Switches
Eureka – Euripides Project 09-703

Coordination: Thales

Project details:
Start: 01-Jan-2010 End: 01-Jan-2013
Total cost: € 4,23 Million

Web site: http://www.minimems.org/

Abstract:
For the past ten years, RF-MEMS have received a lot of interest because of their promising performances such as low loss, high linearity, and very low dc power consumption. RF-MEMS switches are commonly used for routing purposes, while switched capacitors are mostly used in tunable filters and reconfigurable networks. Currently, the long-term reliability problems associated with RF-MEMS devices have delayed their use in commercial applications. There are two main problems associated with standard MEMS capacitive devices, which are: (i) dielectric charging and (ii) temperature sensitivity of the movable membrane, especially for fixed-fixed beam designs. The relatively low-temperature handling of fixed beams has also limited the available hermetic packaging techniques. Another drawback compared to their equivalent in solid-state technology (Pin diode, GaAs FET) is the switching time of the RF-MEMS which remains above 1 µs.

The main objective of MiniMEMS is to develop the design methodologies and technological process to achieve the integration of the miniaturised switched capacitors in tunable filters and phase shifters, which will allow the demonstration of low cost and high yield adaptive receiver and reflect arrays antennas for weather and wake vortex detection radars.
Two routes will be followed for the development of the miniaturized MEMS fabrication process :
Based on the existing know-how of the consortium, a secure and low-risk fabrication process will be developed to fabricated the demonstrators using standard MEMS. This process will be compliant with a short time-to-market transfer to the foundry UMS.
The second route will consist in developing the MiniMEMS process, adapted to the fabrication of miniaturized MEMS. It is more risky and challenging but the economic impact of such a successful process will be huge and will allow to address massive civilian markets.
Low losses and high linearity are key drivers for microwave tunable filters and phase shifters. The insertion of miniaturized MEMS in such functions will bring them to unrivalled levels of agility and reliability. In the MiniMEMS project, tunable (multi-bits) matching/ filtering circuits on silicon and GaN substrates will be implemented in order to realize a frequency-agile (multi-band) LNA using the technologies depicted above. 3-bit and 6-bit phase-shifting cells for X-Band reflect array antennas will also be fabricated on the basis of MiniMEMS process flows.

FLEXWIN

Flexible Microsystem Technology for Micro- and Millimeter Wave Antenna Arrays with Intelligent Pixels

FP7-ICT Project

Coordinator

HOFMANN, Dieter (Mr)
EADS DEUTSCHLAND GMBH

Project details

Project Reference: 257335
Start Date: 2010-10-01 **End Date:** 2013-09-30
Duration: 36 months
Project Cost: 4.64 million euro
Project Status: Execution
Project Funding: 3.1 million euro

Web sites:
http://www.flexwin.eu/
http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_RCN=11413643

ABSTRACT

FLEXWIN proposes a significant advance towards smart RF microsystems by combining:
1) an RFMEMS switch process monolithically integrated with a Si/SiGe BiCMOS process.
2) highly reconfigurable mm-wave building blocks, able to be used over a broad frequency range and for different applications.
3) a new RF-system design paradigm built around the concepts of reusability, multifunctionality and reconfigurability
. 4) environmental sensing and control built into multifunctional RF ICs with digital control.

As a first demonstrator of the proposed highly innovative ***FLEXWIN*** technology platform, a smart reflectarray architecture for broadband communication links will be realized. In fact, the core ***FLEXWIN*** ICs will be used as intelligent pixels providing spatial power combining with full individual amplitude and phase settings of each pixel in transmit and receive mode controlled by a serial bus. Together with the monolithic integration of the environmental sensors on the very same IC, it dramatically reduces the antennas control system complexity providing significant advances in RF frontend adaptability.
The validity of the design paradigm will be further explored in two reconfigurable IC demonstrators using the RF MEMS SiGe BiCMOS technology and deliberately spaced in the radio spectrum: reconfigurable commodity building blocks up to 5 GHz, addressing mobile and wireless data applications, and for the 30-64 GHz range, addressing point-to-point, and emerging wireless LAN applications.
Overall, ***FLEXWIN*** will demonstrate enhanced and smart capabilities of mm-wave systems due to built-in intelligence allowing convenient and flexible control of important parameters, and the use in harsh environments due to built-in sensing and autonomous parameter adjustment in each module. Further, it will establish reconfigurable multi-functional millimetre-wave ICs as an off-the-shelf commodity which will ease mm-wave system implementation and shorten the time-to-market.

SUCCESS

Silicon-based Ultra-Compact Cost-Efficient System Design for mm-Wave Sensors

FP7-ICT Project

Coordinator

GEORGE, Uwe (Mr)
INSTITUT FUR INNOVATIVE MIKROELEKTRONIK, GERMANY

Project details

Project Reference: 248120
Start Date: 2009-12-01
Duration: 42 months
Project Cost: 4.81 million euro
Contract Type: Collaborative project (generic)
End Date: 2013-05-31
Project Status: Execution
Project Funding: 2.99 million euro

Web sites:
http://www.success-project.eu/
http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_RCN=11157011

ABSTRACT

SUCCESS targets to develop a technology platform and best-practice design methods to enable the breakthrough of silicon mm-Wave SoCs for high-volume applications. Silicon technology (CMOS, SiGe) has made tremendous progress towards ever higher device cut-off frequencies. Nowadays all RF components for mm-Wave sensing applications up to 120 GHz can be realized in silicon. Silicon technology hence allows integration of mm-Wave circuitry and digital logic for the realization of a true mm-Wave System-on-Chip (SoC).

The mm-wavelengths allow mm-size antennas which potentially enable miniaturized wireless sensors systems with the size and form factor of an IC package. However several challenges make it difficult to arrive at real low cost. Firstly no true low-cost mm-wave packaging technologies with antenna-integration are available. Furthermore challenges in mm-wave SoC design arise in form of imprecise modelling and device variations. In addition production testing at such high-frequency is extremely expensive, time consuming, and error prone. ***SUCCESS*** is an initiative of 9 major industrial and excellent academic organisations. It represents a vertically integrated consortium bringing together semiconductor foundries, design houses, high-frequency packaging experts and industrial end users

The consortium encompasses universities, research institutions, SMEs and large industrial entities. Three topics will be addressed in the project: 1. Development of a low-cost System-In-Package (SiP) technology and design platform with integrated antennas 2. mm-Wave System-on-Chip (SoC) design methodology 3. mm-Wave Built-In Self Test (BIST) and novel SiP test methodology The results will be demonstrated in a 122 GHz miniaturized sensor system, realized as surface mount component using plastic package technology.

ARTEMOS
Agile RF Transceivers and Front-Ends for Future Smart Multi-Standard Communications ApplicationS

ENIAC Project

Project Coordinator
DMCE GmbH & Co KG
4040 Linz | Austria

Project details:
Start date: April 1st, 2011
End date: March 31st, 2014
Duration 36 months
Project reference nr: 270683-2
Project cost: € 40'934'495
Project funding (JU): 6'836'061
Project funding (National): € 8'543'956

Web sites:
http://www.artemos.eu/
http://www.eniac.eu/web/downloads/projectprofiles/call3_artemos.pdf

ABSTRACT
This project aims at developing architecture and technologies for implementing agile radio frequency (RF) transceiver capacities in future radio communication products. These new architecture and technologies will be able to manage multi-standard (multi-band, multi-data-rate, and multi-waveform) operation with high modularity, low-power consumption, high reliability, high integration, low costs, low PCB area, and low bill of material (BOM).
This will not just require smart RF architectures in advanced CMOS and BiCMOS technology, but also need incorporating of e.g. MEMS technologies and novel simulation methodology for achieving these complex optimizations.

The ARTEMOS consortium with partners in the full value-chain from semiconductor suppliers, system houses, application domain, research and universities, is confident that the realization of its ambitious objectives will assist Europe to achieve technological leadership in domains that are targeted by ENIAC.

MERCURE

Micro and Nano Technologies Based on Wide Band Gap Materials for Future Transmitting Receiving and Sensing Systems

ENIAC project

Coordination : Thales

Web site:
http://www.project-mercure.com/

ABSTRACT

Smart and Integrated Micro and Nano Systems represent the next electronic evolutionary step for the simultaneous integration of sensing, processing, actuation and power management, in order to achieve advanced functions such as multi-spectral processing, real time data analysis and adaptability. Future smart systems will have to achieve autonomous and self-reconfigurable operations, for real-time and efficient self-optimization of their performance. The needs for such systems are not only to overcome the design trade-offs that current analog components must endure, but also to realize new and more efficient systems with reduced size, weight, power and cost.
Two technologies are now emerging to face these challenges:

- **Wide Band Gap (WBG) semiconductors** such as GaN and AlN are expected to play a fundamental role in the development of future smart systems, exhibiting unprecedented power performance along with suitable reconfigurable architectures, and adaptability to operational changes. WBG materials in fact exhibit unique physical properties that make them very attractive, on the one hand, for microwave and millimetre wave applications thanks to high power handling and robustness, and, on the other hand for creating a new generation of sensing devices (high sound velocity, strong piezoelectric effects, etc) capable of working in harsh environments and temperatures higher than 600 °C. It makes them very attractive for numerous applications, ranging from automotive to aeronautics and aerospace, sensors for intelligent energy control to reduce electrical energy consumption, etc. WBG Semiconductors will be the key material for future smart systems.
- **RF MEMS switches** and **RF NEMS switches** (used for single pole double throw, SPDT) appear as complementary technologies in order to achieve the re-configurability required for future smart systems, thanks to their high RF performances (power handling, insertion loss or isolation), low power consumption, high linearity and high level of integration.

The route towards re-configurability of high power systems requires the merging of these technologies and functions, but they are not co-integrated up to now.
The ultimate target of this project is to develop the necessary design and technological skills for integrating WBG devices with RF MEMS and RF NEMS active interconnections and with III-Nitride based sensors.

NANOCOM

Reconfigurable microsystem based on wide band gap materials, miniaturised and nano-structured RF-MEMS

ENIAC Project
Coordination: Thales

Web sites: http://project-nanocom.com/
http://www.eniac.eu/web/downloads/projectprofiles/call3_nanocom.pdf

ABSTRACT

Future electronic systems will use self-reconfigurability for real-time efficiency optimisation to achieve dramatic performance and functionality improvements. The ENIAC JU project NANOCOM will assess the benefits of introducing wide band-gap (WBG) materials such as gallium nitride (GaN) in monolithic microwave integrated circuits (MMIC) and radio-frequency microelectromechanical systems (RF MEMS) to demonstrate agile RF transceivers, agile radios, reconfigurable reflect array aerials and piezo-MEMS sensors and actuators with unprecedented levels of functionality, performance and integration.

Smart and Integrated Micro and Nano Systems represent the next electronic evolutionary step for the simultaneous integration of sensing, processing, actuation and power management, in order to achieve advanced functions such as multi-spectral processing, real time data analysis and adaptability. Future smart systems will have to achieve autonomous and self-reconfigurable operations, for real-time and efficient self-optimization of their performance. The needs for such systems are not only to overcome the design trade-offs that current analog components must endure, but also to realize new and more efficient systems with reduced size, weight, power and cost.

The route towards future smart systems requires the achievement of new components, able to manage simultaneously high power and re-configurability properties. To solve this strategic issue, two solutions will be considered in parallel during this project. They are considered by the consortium as the best technical alternatives today, to the best of our knowledge, and are foreseen to level up the performances while keeping the costs at the lowest level, by their full compatibility with collective processes:

- Integration of WBG devices with RF MEMS technology.
- Integration of WBG devices with RF NEMS technology based on carbon nanotubes.

Each of the above technological solutions has their own advantages and drawbacks. This is why the project will conduct research in the two domains. NEMS are expected to achieve very low switching times (down to a few ns) and actuation voltage (down to a few V) whereas MEMS promise very high power handling capabilities.

One objective is to develop the design methodologies and technological steps necessary to achieve the integration of WBG RF devices such as GaN based MMICs with III-Nitrides (GaN, AlN) sensors for the realization of subsystems required for future smart systems. The potential of WBG based micro and nano devices as sensors and their integration with WBG RF electronics will be demonstrated.

The successful implementation of the objective mentioned above (Integration of WBG MMICs, RF-MEMS/NEMS and sensors) will lead to the production of four demonstrators in order to prove the feasibility of the various technologies and their integration

Go4Time

Global, Flexible, On demand and Resourceful Timing IC & MEMS Encapsulated System

FP 7-ICT project

Project leader : CSEM, CH

Project details

Start date:2010-09-01
End date:2013-08-31
Duration:36 months
Project Reference:257444
Project cost:4526205 EURO
Project Funding:3199980 EURO

Web sites:

http://www.go4time.eu/
http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=IT&PJ_RCN=11416387&pid=156&q=119507B76612115BF7C0A68267FF0D4C&type=pro

ABSTRACT

Go4Time will target the realization of a generic miniature timing module relying on the combination of an integrated circuit together with different MEMS resonators assembled hermetically in a single package. One of the main system feature is a temperature compensated low power real time clock mode with a power consumption below 1µW and a very tight frequency stability better than +-2ppm over an industrial temperature range. Owing to its combination with a higher frequency resonator and PLL techniques, the accurate reference is used to provide on-demand, a reconfigurable low jitter clock of high spectral purity at any frequency below 50MHz that could serve as a reference frequency for communication systems such as Bluetooth, GSM or wireless sensor networks.

Owing to its combination with a higher frequency resonator and PLL techniques, the accurate reference is used to provide on-demand, a reconfigurable low jitter clock of high spectal purity at any frequency below 50MHz that could serve as a reference frequency for communication systems such as Bluetooth, GSM or wireless sensor networks, as well as in future Software-defined Radio (SDR) and cognitive radio transceivers, which must support multiple standards, rates and frequency bands. Another application of Go4Time is in the time and frequency synchronization of wireless networks, which is currently limited by clock accuracy.

The project achievements will strengthen the global competitiveness of European industries in Microsystems and smart miniaturized systems. The power aware scheme that is proposed will help meeting the green electronic challenge in consumer products and strengthen the competitiveness of the user industries by providing a generic solution with a much reduced bill of material.

iPHOS

Integrated photonic transceivers at sub-terahertz wave range for ultra-wideband wireless communications

Coordinator

GARCIA BEATO, Regina (Dr)
UNIVERSIDAD CARLOS III DE MADRID

Project details

Project Reference: 257539
Start Date: 2010-06-01
Duration: 36 months
Project Cost: 4.48 million euro
Contract Type: Collaborative project (generic)
End Date: 2013-05-31
Project Status: Execution
Project Funding: 3.1 million euro

Web sites:
http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_RCN=11411398
http://www.iphos-project.eu/project_overview

ABSTRACT
This project targets the development of compact and low power transceivers that enable wireless data transfer at sub-terahertz carrier frequencies and their application to future high data-rate short-distance communication links. The interest of the topic relies in the fact that advances in semiconductor technology, favourable spectrum policy and demand for gigabit throughput capabilities have created an opportunity for millimetre wave radio technology above 100GHz. The ***iPHOS*** research plan aims to address what has been identified as the Achilles heel of systems operating in this frequency range: the lack of reliable, compact low cost sources which can give rise to commercially successful products.
We propose optical techniques to generate the carrier wave, enabling us to integrate a high level of functionality such as tunability of the carrier wave and modulation to superimpose data. The carrier frequency will result from beating two optical modes from dual mode laser on a high speed photodiode with an integrated antenna. The technical challenge that ***iPHOS*** is going to address is the integration of all of these elements on a single chip, including dual-wavelength sources, passive waveguide for optical couplers and connecting waveguides, electro-optical modulators for data encoding and high speed photodiode for electro-optical conversion. This challenge will require a strong effort on chip integration. In addition, advanced packaging technology will contribute to the goal of providing a compact and rugged system.

The first application field targeted by ***iPHOS*** is future on-board flight entertainment systems, effort led by partner THALES. Nevertheless ***iPHOS*** impact strategy includes channeling the designs and devices obtained through licensing design libraries within the European manufacturing platforms of JePPIX and ePIXpack, opening up the possibility for other companies and consortiums to incorporate the mm-wave sources in other fields of applications.

WISERBAN

Smart miniature low-power wireless microsystem for Body Area Networks

Coordinator

PEIRIS, Vincent (Dr)
CSEM SWITZERLAND

Project details

Project Acronym: *WISERBAN*
Project Reference: 257454
Start Date: 2010-09-01
Duration: 36 months
Project Cost: 9.58 million euro
Contract Type: Collaborative project (generic)
End Date: 2013-08-31
Project Status: Execution
Project Funding: 6.9 million euro

Web sites: **http://cordis.europa.eu/fp7/ict/micro-nanosystems/docs/mnbs2011-workshop-mondragon/wiserban-presentation_en.pdf**
http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_RCN=11442484

ABSTRACT

The ***WiserBAN*** project will create an ultra-miniature and ultra low-power RF micro-system for wireless Body Area Networks (BAN) targeting primarily wearable and implanted devices for healthcare, biomedical and lifestyle applications.

The proposed research concerns the extreme miniaturization of the BAN with primarily the areas of ultra low-power radio SoC (System on Chip), RF and Low-frequency MEMS, miniature reconfigurable antennas, miniaturized SiP (System in Package), sensor signal processing and flexible communication protocols.

The ***WiserBAN*** micro-system will be 50 times smaller than today s radio modules for Personal Area Networks (PAN) solutions, e.g. Bluetooth, that can simply not be embedded in a variety of tiny implants and wearable applications. ***WiserBAN*** will thus enable significant take up by the European SME s and industries in healthcare, bio-medical and lifestyle.

WiserBAN will also create a major impact on the quality of life of the European Citizens, in particular for improving the comfort and access to ICT for impaired and disabled people of all ages carrying implants or wearing medical devices, hence reducing the risk of social exclusion.