

MIMOSA Workshop on:

# Invisible Electronics for Ambient Intelligence Applications

Date: September 16<sup>th</sup>, 2005

Place: Alpes Congrès – AlpExpo

Avenue d'Innsbruck, Grenoble, France

Room: Meije, 9:00 am – 5:00 pm

This **workshop** is organized by the European Integrated Project MIMOSA (*Microsystem Platform for Mobile Services and Applications*: <http://www.mimosa-fp6.com/>), which aims at making Ambient Intelligence (Aml) a reality by developing a mobile-phone centric open technology platform. MIMOSA extends the area of telecommunication business to ambient intelligence and thus further supports the strong competitive edge of European industry. In the MIMOSA vision, the personal mobile phone is chosen as the trusted intelligent user interface to Ambient Intelligence and a gateway between the sensors, the network of sensors, the public network and the Internet. MIMOSA develops an open technology platform for implementing ambient intelligence in different application areas. The well-defined platform allows a fast and focused development of both basic technology solutions as well as system-level applications and services. MIMOSA focuses to develop micro- and nano-systems in several areas of a selected open platform. Examples of micro and nanosystems developments by MIMOSA are (environment domain) wireless remote-powered and autonomous sensors exploiting RFID, low-power radios exploiting RFMEMS, (user domain) microsystem-based intuitive user interfaces, MEMS based user-activity and physiological sensors, (phone domain) MEMS-based inertial, magnetic and audio sensors.

More information about the detailed program and workshop registration are available on: <http://mimosa2005.epfl.ch>

People are encouraged to register to the workshop in advance, by **Monday, September 5<sup>th</sup>**, using forms available on website registration forms. A *very limited* number of places for *on site* registration will be available.

- Registration fee: **200Euros**
- Special *PhD student* registration fee: **50Euros** (sponsored by IST MIMOSA)
- Special *MIMOSA partner* registration fee: **150Euros**

For MIMOSA workshop registration please use the forms provided on the ESSDERC website (download available at: <http://www.essderc2005.com/bulletin.pdf>) and register by fax to the ESSDERC office. For special registration fees (student and MIMOSA partner) you can use the same form and *modify yourself* the respective amount by mentioning in the last column of the registration table the type of special registration (*student* or *MIMOSA partner*). Please note that online registration via Internet is not possible for the special PhD and Mimosa fees, so please send your registration via fax to MCI.

Registration fees include:

- Access to the workshop oral presentation session and rump session
- Handouts with slides of presentations and CD with electronic versions of all presentations
- Lunch and coffee breaks

## **MIMOSA Workshop secretariat:**

Isabelle Buzzi and Marie Halm  
EPFL STI IMM LEG, ELB 339 (Bâtiment ELB)  
Station 11, CH-1015 Lausanne, Switzerland  
Email: [mimosa@epfl.ch](mailto:mimosa@epfl.ch)  
Phone: +41 21 693 3975, Fax: +41 21 693 3640

# Final programme of the workshop

## Morning session

**Chair:** Adrian Ionescu, Ecole Polytechnique Fédérale Lausanne

**9:00-9:20**

### **"MIMOSA: short overview"**

Pascal Ancy, ST Microelectronics, Crolles, France

**9:20-10:00**

### **"The Holy Grail of Truly Disappearing Electronics" (Keynote)**

Jan M. Rabaey, University of California at Berkeley, USA.

**Abstract** - The ambient intelligence, ubiquitous computing and sensor networks concepts all have one thing in common: they rely on computation and communication nodes that are so small, cheap and low-power that they can literally be embedded into our daily living environment. While much progress has been made over the last half decade or so and a new community of researchers has been formed, some fundamental challenges remain. In this presentation, we will examine the state of the field and explore opportunities for future advances.

**Keynote speaker bio** – Jan M. Rabaey received the EE and Ph.D degrees in applied sciences from the Katholieke Universiteit Leuven, Belgium, respectively in 1978 and 1983. From 1983 till 1985, he was connected to the University of California, Berkeley as a Visiting Research Engineer. From 1985 till 1987, he was a research manager at IMEC, Belgium, and in 1987, he joined the faculty of the Electrical Engineering and Computer Science department of the University of California, Berkeley, where he is now holds the Donald O. Pederson Distinguished Professorship. He has been a visiting professor at the University of Pavia (Italy), Waseda University (Japan), Technical University Delft (Netherlands), Victoria Technical University and the University of New South Wales (Australia). He was the Associate Chair (EE) of the EECS Dept. at Berkeley from 1999 till 2002, and is currently the Scientific co-director of the Berkeley Wireless Research Center (BWRC, as well as the director of the GigaScale Systems Research Center (GSRC). Jan Rabaey authored or co-authored a wide range of papers in the area of signal processing and design automation. He received numerous scientific awards, including the 1985 IEEE Transactions on Computer Aided Design Best Paper Award (Circuits and Systems Society), the 1989 Presidential Young Investigator award, and the 1994 Signal Processing Society Senior Award, and the 2002 ISSCC Jack Raper Award. In 1995, he became an IEEE Fellow. He is past chair of the VLSI Signal Processing Technical Committee of the Signal Processing Society and chaired the executive committee of the Design Automation Conference. He is serving on the Technical Advisory Board of a wide range of companies. His current research interests include the conception and implementation of next-generation integrated wireless systems. This includes the analysis and optimization of communication algorithms and networking protocols, the study of low-energy implementation architectures and circuits, and the supporting design automation environments.

**10:00-10:30**

### **"WiseNET - An Ultralow-Power Solution for Wireless Sensor Networks" (Invited)**

Christian Enz, CSEM, Neuchâtel, Switzerland

**Abstract** - WiseNET offers an ultralow-power platform for the implementation of wireless sensor networks. This low-power operation is achieved thanks to a careful co-design approach of a new medium access control (MAC) protocol called WiseMAC and a dedicated duty-cycled radio. WiseMAC is based on CSMA with an adaptive preamble sampling. It is particularly well suited to ad-hoc and hybrid infrastructure networks. The 1st-generation WiseNET transceiver allowed to demonstrate the feasibility of integrating ultralow-power transceivers in a standard digital CMOS process. It operates in the 434MHz band and consumes only 1mW from a 1V supply, while achieving a -95dBm sensitivity for a 24kb/s data rate with a 10E-3 BER. A 2nd-generation WiseNET transceiver was designed and specifically optimized for the new WiseMAC protocol. This new WiseNET radio runs from a single 1.5V battery and operates down to 0.9V while consuming only 1.8mW in receive mode. It achieves a -104dBm sensitivity for 25kb/s data rate with a 10E-3 BER. In addition to this low-power radio, the WiseNET system-on-chip (SoC) also includes all the functions required for data acquisition, processing and storage of the information provided by the sensor. The WiseNET solution consumes about 100 times less power than comparable solutions available today.

**Invited speaker bio** - Christian Enz, PhD, Swiss Federal Institute of Technology (EPFL), 1989. He joined the Swiss Center for Electronics and Microtechnology (CSEM) in Neuchâtel, Switzerland, in April 1999. He is currently VP and is heading the Microelectronics Division. Since 1999, he is also Professor at EPFL, where he is lecturing and supervising undergraduate and graduate students in the field of analog and RF IC design. Prior to joining the CSEM, he was Principal Senior Engineer at Conexant (formerly Rockwell Semiconductor Systems), Newport Beach, CA, where he was responsible for the modeling and characterization of MOS transistors for RF applications. From 1992 to 1997, he was an Assistant Professor at EPFL, working in the field of low-power analog CMOS IC design and device modeling. In 1989 he was one of the founders of Smart Silicon Systems S.A. (S3), where he developed several low-noise and low-power ICs, mainly for high energy physics application. His technical interests and expertise are in the field of wireless sensor networks, very low-power analog IC design and semiconductor device modeling. He is the author and co-author of more than 100 scientific papers and has contributed to numerous conference presentations and advanced engineering courses.

10:30-10:50

Coffee break

Chair: Pascal Ancey, ST Microelectronics

10:50-11:20

### "RF-MEMS for frequency agile software defined RF Systems" (Invited)

Georg Fischer, Lucent Technologies - Bell Labs Innovations, Germany

**Abstract** - Work on Software defined radio technology has been carried out for a long time but with main focus on air interface protocol agility that has to be handled by a flexible baseband processor. On the RF side the focus has been on classical TX/RX switched and semiduplex systems where either the transmitter or the receiver is active. But given today's sophisticated air interface protocols, it is required that the transmitter and receiver operate in parallel. With transmitter being active in parallel with the receiver it is required that wideband noise generated inside the transmitter doesn't desensitize the receiver. As no longer a TX/RX switch can be used, huge sized and costly Duplex filters based on coaxial resonators are typically used to isolate the transmitter from the receiver. The talk will present an alternative RF system design approach named a distributed filter approach, where filtering based on variable RF-MEMS elements is distributed along the transmit and receive chain. This has the benefit that the duplex filter requirements can strongly be relaxed and alternative filter technologies can be used that can be tuned over several octaves to support a high degree of frequency agility. It will show up that metamaterial based filter structures, that are tuned by RF-MEMS components have interesting characteristics and offer superior performance while at the same time being very flexible.

Overall it will turn out that RF-MEMS elements can be used at various places inside a frequency agile RF system, but with different requirements. The talk will highlight from an RF system design perspective what are the specific benefits of RF-MEMS over alternative switching and tuning techniques and will also address the expectations RF-MEMS have to meet to be successfully implemented in frequency agile RF Systems.

*Invited speaker bio* - Georg Fischer was born in 1965 and studied electrical engineering at University of Aachen (RWTH) from 1986 till 1992 with special focus on communications and microwave. From 1993 to 1996 he was a research assistant at University of Paderborn, from where he received his Ph.D. in 1997. During this time he worked on a receiving system comprising an adaptive antenna array at 12 GHz for mobile satellite reception. End of 1996 he joined the department of base station forward looking at Lucent Technologies in Germany. He became a physical layer expert and as such acted as a chairman in ETSI during the physical layer standardization of the GSM-EDGE system. His professional interest is in base station RF technology and physical layer techniques for coverage and capacity enhancement of wireless networks. In 2000 he got promoted a Lucent DMTS (Distinguished Member of Technical Staff) and in 2001 a Lucent CMTS (Consulting Member of Technical Staff). End of 2003 he moved to the Bell Labs Europe organization of Lucent. Since 2001 he is holding lectures at University of Erlangen on basestation RF technology with specific focus on receiver and transmitter architectures. He holds various patents in the area of RF Technology, specifically RF-MEMS, power amplifiers and transceiver architectures and published various papers on RF technologies for reconfigurable, frequency agile RF systems.

11:20-11:50

### "RF MEMS for Ambient Intelligence Applications"

J r mie Bouchaud<sup>1</sup> and Adrian Ionescu<sup>2</sup>, WTC, Germany, <sup>2</sup>Ecole Polytechnique F d rale de Lausanne, Switzerland.

**Abstract** – RF MEMS state-of-the-art technology, device and circuit applications and their potential for ambient intelligence applications will be detailed. Low power consumption, high performance, new functionality and reliability issues related to the use of RF MEMS, as well as the role of RF MEMS as complementary and/or alternative solution to more conventional technologies will be discussed. A market study and identification of the main players and trends in the field will complement the technical part of the presentation.

11:50-12:10

### "RFID as a key element in Ambient Intelligence"

Heikki Seppa, VTT Information Technology, Finland

**Abstract** - We consider RFID as a key technology for ambient intelligence. Cheap and small electrical tags embedded in our environment including products, packages and even newspapers could enable us to realize physical or intuitive browsing of our environment. Pointing (PointMe) touching (TouchMe) and sweeping (SweepMe) objects around us with a handset could make it possible to have easy access to information, measurement data or services. When starting to make research and to promote RFID based ambient intelligence we soon recognized that the weak point is the lack of the handsets carrying a RFID reader. Only possibility to introduce physical browsing for everyday life is to have short and long distance RFID readers in mobile phones. This is easy to say but it is very difficult to convince mobile phone manufactures to do that. In this paper we briefly describe the basic features of the RFID technologies and current status in it. One of the most important contradictions in the field is that 13.56 MHz RFID technology has already now very strong position in the markets but UHF RFID is only hope for long distance reading required by logistics. It is very clear now that UHF will take its place as a most important technology in industry and logistics. This problem could be solved by introducing multi frequency tags or to have both 13.56 MHz and UHF readers in handsets. Within next 5 – 10 years very low cost printable passive codes and RFID will be commercially available. In addition, I believe that even long distance UHF tags fabricated using roll-to-roll technology will be seen in the market places. The future printable tags will make passive RFID even more important key for realizing ambient intelligence.

**12:10-13:30**

**Lunch break**

**After-noon session**

**Chair:** Vladimir Ermolov, Nokia, Finland

**13:30-13:50**

**"BT LEE radio for ambient intelligence"**

**Antti Lappeteläinen, Mauri Honkanen and Kalle Kivekäs, Nokia, Finland**

**Abstract** – Low End Extension (LEE) for Bluetooth is a technology to solve a simple mismatch. There are several small devices that could add value by having wireless radio connection to mobile terminal but cannot bear the power consumption and cost associated to Bluetooth. However, mobile terminals will have Bluetooth as the short-range wireless solution. LEE tackles the mismatch by introducing minor additions to the Bluetooth chip in mobile terminals that allows major saving in power consumption and cost in the chips embedded into small devices. Examples of the small devices include watches, wireless sensors, toys, etc. The presentation addresses the principles of LEE radio technology, highlights some implementation issues and commercial maturity.

**13:50-14:10**

**"Research trends in wireless communications: focus on 4G systems and their links to AmI visions"**

**Laurent Herault and Hughes Metras, LETI-CEA Grenoble, France**

**Abstract** – Based on a general overview of wireless communication techniques and the presentation of user scenarios an overview of the main challenges in Telecommunication R&D for Ambient Intelligence will be highlighted with a specific focus on short-range connectivity (wireless sensors, RFID tags) and interoperability issues. Some of the main European initiatives in the field will be presented.

**14:10-14:30**

**"User acceptance of AmI solutions"**

**Eija Kaasinen, Veikko Ikonen and Marketta Niemelä; VTT, Finland**

**Abstract** – Ambient Intelligence visions and scenarios often present a “brave new world” that proactively provides information and services to people but also threatens their privacy and their right to make their own decisions. Is technology research and development proceeding towards practical Ambient Intelligence solutions that would be accepted by end users? Based on user evaluations of Ambient Intelligence scenarios and proof of concepts in the MIMOSA project, this presentation gives an overview of major user acceptance factors of Ambient Intelligence solutions.

**14:30-14:50**

**"Microsensors and actuators for Ambient Intelligence applications"**

**J. Eichholz, B. Wagner, U. Hofmann, G. Piechotta, Fraunhofer Institute for Silicon Technology, Itzehoe, Germany**

**Abstract** – In MIMOSA novel sensor and actuator technologies are developed for context awareness and intuitive user interfaces to Ambient Intelligence. The talk will present three MEMS examples for different scenarios, a lactate sensor for fitness monitoring, a 3D-gyroscope as part of an inertial measurement unit (IMU) and a scanning micromirror to be integrated in a laser microprojector.

**14:50-15:10**

**"SOI Platform for MEMSIC & MEMS"**

**Xavier Gagnard<sup>1</sup>, Daniel Grogg<sup>2</sup>, Panu Pekko<sup>3</sup>, Eric Ollier<sup>4</sup>, <sup>1</sup>STMicroelectronics, France, <sup>2</sup>Swiss Federal Institute of Technology, Electronics Laboratories, Switzerland, <sup>3</sup>VTT Information Technology, Tietotie, Finland, <sup>4</sup>CEA, LETI/DIHS/LCMS, Grenoble, France.**

**Abstract** – In the frame of the MIMOSA project, many partners have worked on solutions, to develop stand-alone MEMS on thin SOI substrates, then on it integration with other MEMS and/or SOI-IC. This presentation summarizes all the potential of the SOI integration solutions, mainly horizontal but also vertical or at packaging level.

15:10-15:30

Coffee break

15:30-17:00

## Panel session on: Ambient intelligence – from technology to real applications

Moderators: [Hermann Schumacher](#), [Francisco Ibanez](#)

Panelists:

- Jan M. Rabaey, University of California at Berkeley, USA
- Georg Fischer, Lucent Technologies - Bell Labs Innovations, Germany
- Christian Enz, CSEM, Neuchâtel, Switzerland
- Pascal Ancy, ST Microelectronics, France
- Antti Lappetelainen, Nokia, Finland
- Heikki Seppa, VTT, Finland
- Jérémie Bouchaud, WTC, Germany

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