PROJECT PROFILE

# 2A204: Silicon platforms for wireless advanced networks of sensors (SWANS)

**NETWORKED ICE TERMINALS**

**Partners:**

Airbus
Ansem
Atmel
CEA-LETI
Conti Temic
Coronis Systems
CSEM (engineering school, Neuchatel)
EADS
EIVD (engineering school, Yverdon)
Energocontrol
EPFL
ESIEE (engineering school, Paris)
Fraunhofer Institute
France Telecom
IMEC
LMS
Melexis
Philips
Pro Engin
Robert Bosch
STMicroelectronics
Uni Bordeaux (IXL)
Verhaert
Y-Lynx

**Project leader:**

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**Key project dates:**

Start: March 2005
End: September 2008

**Countries involved:**

Belgium
France
Germany
The Netherlands
Poland
Switzerland

**Growing demand for autonomous sensing devices with wireless networking capabilities is driving a search for generic, low-cost devices capable of fulfilling both functions within a single package. Existing research in this area has long been the prerogative of the military and the high-investment defence sector, with requirements for dedicated functions and secrecy about the capabilities achieved. The SWANS project is focusing on developing a generic architecture for wireless sensors based on low-cost silicon devices and reusable intellectual property. Early beneficiaries of such sensors range from the European civilian aviation industry to forest fire monitoring and environmental control.**

Wireless networking is moving ever closer to the heart of the way we work. In addition to Wi-Fi and wireless hotspots, vehicles are being fitted with wireless network capabilities and hospital emergency departments are beginning to use wireless laptops to facilitate registration, diagnosis and treatment of patients as they arrive. Wireless networks are even appearing down on the farm, with wireless capabilities already available on some agricultural machinery.

The increasing sophistication of such networks is driving a demand for ever smaller and more efficient wireless devices. In one area alone – the gathering and reporting of information about the immediate environment surrounding an individual's person – there is a growing demand for wireless devices to act as both sensors and actuators. In many of these applications, sensors need to be both tiny and as autonomous as possible. Technological miniaturisation and package integration are taking care of the size and the cost angles but, in terms of autonomy and efficiency, there is still much to be done. This is the purpose of the MEDEA+ 2A204 SWANS project, to define a generic silicon platform capable of integrating analogue and digital intellectual property (IP) blocks for future wireless sensor nodes.

## Low-cost devices

Smart sensors today are almost autonomous components. They perform measurements, convert elementary information into more complex data – such as alarm signals or present status of a robot – or exchange information with other sensors. Yet to be smart, sensors need embedded intelligent data processing. This can be obtained by analogue signal processing, digital signal processors (DSPs) or embedded software. The first approach is the most promising in terms of reduced complexity, self-learning functions and power dissipation, and is the approach being investigated in SWANS.

Much of today's development of smart sensor networks is driven by defence applications, where secrecy is paramount and the requirements seldom include low-cost and high-volume dissemination. SWANS, by contrast, is focusing on the use of generic, low-cost silicon devices, particularly in CMOS, based on IP reuse.

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The MEDEA+ SWANS project is addressing two classes of applications:

1. Low-power, low-cost sensor nodes for applications in healthcare/fitness, automotive and aeronautic transportation, and home automation (environmental monitoring); and
2. Wireless connectivity for more complex sensors such as nuclear, radiological, biological and chemical (NRBC) sensors and video imagers for security applications.

A typical sensor node uses a system-on-chip (SoC) architecture which includes a sensor or actuator interface combined with an analogue-to-digital converter or a digital-to-analogue converter, some local signal processing capabilities using a low-power DSP and embedded memory, a power-management unit, and communication abilities including a complete radio frequency (RF) transceiver.

SWANS is looking at the entire architecture, focusing on critical blocks such as the sensor interface, the DSP, power management and the RF section. The aim is to develop a prototype platform capable of demonstrating functional IP blocks, macrocells and chipsets for applications in aeronautics, health/fitness, homeland security, automotive and environmental monitoring.

The consortium gathers 26 actors from six European countries, among which are world-leading chipmakers Atmel and STMicroelectronics, leading integrators and end-users in the various application fields. It also includes three European research institutes and small and medium-sized enterprises (SMEs) bringing state-of-the-art expertise to the project.

### Architecture established

Specific objectives include:

- Developing critical building blocks for highly integrated sensor-node subsystems;
- Exploring architectures for low-cost low-power implementation of short-range – 10 to 100 m – low data rate transmissions;
- Implementing baseband and RF wireless link building blocks for use in wireless sensor platforms;
- Developing low-power highly integrated chips for sensor readout functions;
- Developing low-power digital chips to manage sensor-node energy requirements; and
- Prototyping active nodes based on off-the-shelf sensors and batteries.

A potential platform architecture has already been established to focus on a tightly-defined range of scenarios for each application area. This architecture includes generic core functional blocks – such as data processing, RF part, analogue/digital baseband and digital sensor interfaces – and some specific application blocks that include security functions, configuration interface and clock. Certain off-the-shelf components are being selected for functions such as memory and energy management.

### Assured market

The market for low-cost autonomous sensor devices of this type is already assured. In the European aviation sector alone, every Airbus aircraft will embed a dozen systems developed within the framework of the SWANS project. The number of systems required can be estimated at 3,000 units a year for new aircraft and 50,000 units to re-equip the current Airbus fleet alone.

In the specialist environmental sector of fire prevention, autonomous sensors offer very many possibilities. Current forest fire prevention methods in Europe include regular checks on forested areas to analyse temperatures and humidity levels. Availability of low-cost, autonomous sensors will allow much more rapid gathering and reporting of data from such critical measurements. This capability will be most helpful in the countries around the Mediterranean that currently account for about 74% of all European forest fires and more than 90% of the forest area burnt annually across 31 European countries.

In the sector of pollution measurement and control, public authorities are becoming increasingly anxious about concentrations of specific pollutants. Currently, most measurements of such concentrations rely on passive sampling, in which carbon pills catch pollutants using gas diffusion. These pills have to be collected and sent for analysis to determine the pollutant levels. Small, low-cost silicon sensors make possible the use of new active samplers, which pump through known quantities of atmospheric air and analyse them at the same time. Such data can then be collected via wireless networks.

Lastly, SWANS will also deliver a key component to many other European research programmes, by supplying monitoring devices capable of answering demanding equipment reliability requirements. The SWANS platform, with its high level of integration, low power requirement and wireless communication capabilities, will also make possible the extension of monitoring capabilities to a wide range of new applications.

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MEDEA+ focuses on enabling technologies for the Information Society and aims to make Europe a leader in system innovation on silicon for the e-economy.