

Capturing Ambient Intelligence for Mobile Communications through Wireless Sensor Networks

e-SENSE provides heterogeneous wireless sensor network solutions to enable Context Capture for Ambient Intelligence, in particular for mobile and wireless systems beyond 3G; thus enabling truly multi-sensory and personal mobile applications and services, as well as assisting mobile communications through sensor information.

At A Glance: e-SENSE

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Duration: 01/2006 – 12/2007

Total Cost: €10.3m

EC Contribution: €6.3m

Main Objectives:

Ambient Intelligence is a key component in the next epoch of mobile and wireless communication systems. However, the enabling technology that provides systems with information to allow for Ambient Intelligence has been neglected and currently consists of many independent modes of input, mainly relying on active user interactions or specialised sensor systems gathering information.



Therefore e-SENSE proposes a context capturing framework that enables the convergence of many input modalities, mainly focussing on **energy efficient wireless sensor networks** that are multi-sensory in their composition, heterogeneous in their networking, either mobile (e.g. Body Sensor Network) or integrated in the environment e.g. from single sensors to thousands or millions of sensors collecting information about the environment, a person or an object. This framework will be able to supply ambient intelligent systems with information in a transparent way hiding underlying technologies thus enabling simple integration.

The main technical objectives are summarised as;

- Energy-Efficient Sensor Node and Sensor Network Architecture
- Ultra Low-Power Air-Interface Designs
- Efficient Wireless Sensor Networking Protocols
- Distributed Processing Middleware
- Validation of Key Concepts with Test Beds

Technical Approach

The e-SENSE project is split into the following technology orientated research areas:

- Energy-Efficient Sensor Node and Sensor Network Architecture
- Energy and Bandwidth Efficient, wireless sensor air interface designs,
- Scalable and Reconfigurable Transport of Data (air-interfaces up to the transport layer in

- cross functional optimised approach), and
- **Distributed Processing Middleware** (preparation of data to be presented to upper layers, management of resources and pre-processing of data (e.g. synchronisation)), situation aware applications and services (e.g. positioning)
- Validation of key concepts using test beds.

e-SENSE is implemented in 6 technical work packages; WP7 is Project Management. The Technical Work Packages are;

- **WP1 Scenarios, Requirements and Socio-Economic Impact** - the aim of WP1 is to achieve a common vision of sensorised environments throughout the project and to identify the potential future developments that take into account user centric and technology road-mapping as well as business case perspectives.
- **WP2 System Architecture and Concept** - the objective of work package 2 is to develop an overall system concept and architecture for e-SENSE which translates user and application expectations and functional requirements into a technical requirement specification.
- **WP3 Efficient and Light Weight Wireless Sensor Communications** – the objective of the work package is to design a set of algorithms spanning from the physical to the transport layer, aimed at increasing the system efficiency in terms of energy savings and application performance.
- **WP4 Distributed Middleware Processing.** Currently, algorithms for sensor networks tend to be ad-hoc, hampering adequate data processing, WP4 will develop algorithms that are suitable for combining data that is being collected by heterogeneous sensor networks in such a way that they allow efficient, easy, and reliable operation of small to large scale sensor networks using an open architecture

for communities, context-aware systems, defining interchange and advertisement of context information.

- **WP5 Implementation, Evaluation and Validation.** The goal of WP5 is to provide platforms to evaluate the e-SENSE concept and consequently validate the approach.
- **WP6 Dissemination and Exploitation.** This WP, includes standardisation, dissemination and exploitation studies, is particularly concerned with the electromagnetic coexistence problematic foreseen to arise with the large scale deployment of wireless sensor networks. This will lead to implications on European spectrum management policy and standards

Key Issues

The main contribution made by this project is a key enabling technology for user interactions in the framework of Ambient Intelligence, namely Capturing Ambient Intelligence for Mobile Communications through very low power, highly efficient Wireless Sensor Networks. In order for Europe to be a leader in both the supply and exploitation of Ambient Intelligent systems, it must

be able to provide the entire end-to-end system. To date there has not been a concerted effort to produce a sensorised environment to interface to a mobile wireless network environment, where there are many additional challenges raised by the fact that the user is mobile.

Expected Impact

e-SENSE's objectives of improving the efficiency and the intelligence of the Wireless Sensor Network technology is expected to have impact in areas such as; Work and the Networked Home, Personal, Family and Society support, Personal, Family and Society support, Health and Safety and Personal Security as well as on EU competitiveness in this fast growing area and also an impact on EU and International Wireless standards.

