

e-SENSE

IST-4-IP-027227

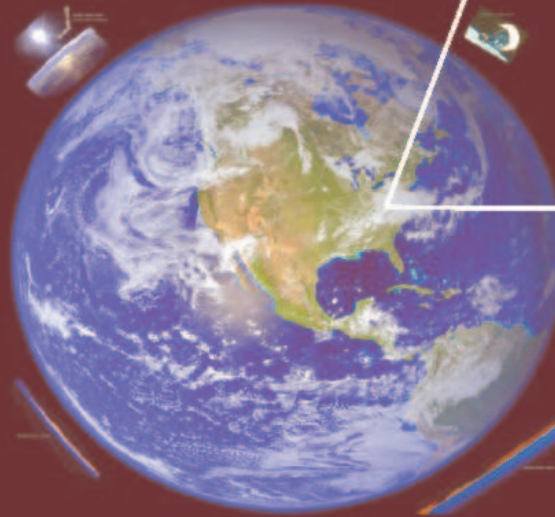
Capturing Ambient Intelligence for Mobile Communications through Wireless Sensor Networks

Pierre R. Chevillat
IBM Research
Zurich Research Laboratory
Rüschlikon, Switzerland



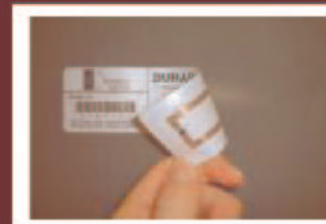
Data Being Captured at Increasing Spatiotemporal Resolution

- **People sensors:** location (inferred from that of their devices), activities (inferred from calendar and desktop information), biometrics, etc.
- **Place sensors:** room status (inferred from anonymous motion/sound detectors), presence (of people and things), congestion (inferred from pressure pads or camera images), etc.
- **Thing sensors:** location (RFID), status (monitoring sensors such as telematics, desktop), etc.
- **Business sensors:** context from databases (medical data, credit history, location history), context from processes



Being Watched

The number of surveillance cameras throughout Manhattan is growing.





User-Centric Scenario: 'Store of the Future'

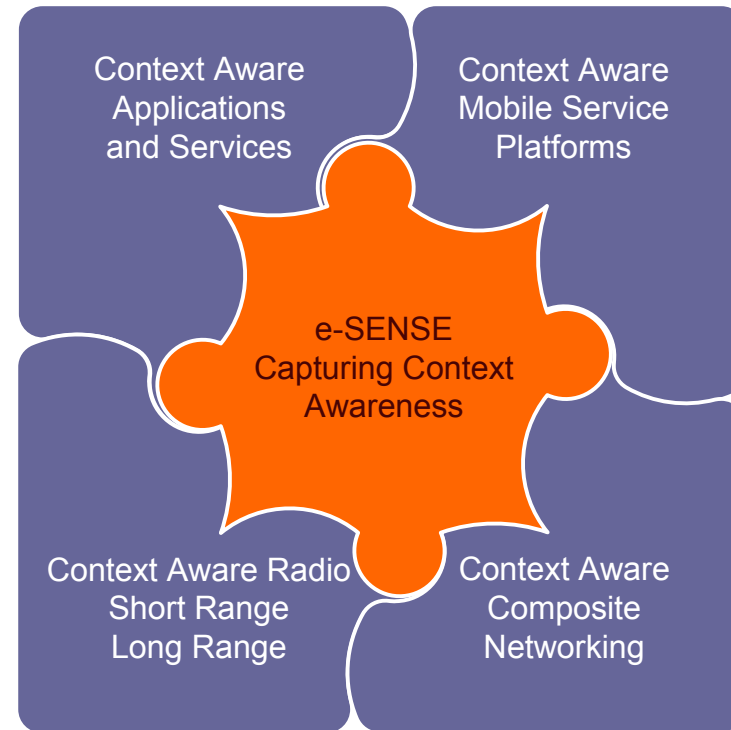
- Customer device
 - Tablet, PDA (initially), later: smart phone
 - Full multimedia capabilities
 - Multiple communication interfaces:
 - cellular, 802.11x, BT, ZigBee, infrared ...
 - Geolocation functionality (1m accuracy, indoor)
 - RFID reader
 - Digital camera / video recorder

- Shopping applications
 - Downloaded / updated at store entrance
 - Personal shopping list
 - Display advertising
 - Location sensing – direction finding
 - Event processing and correlation
 - Automatic sensor-based check out

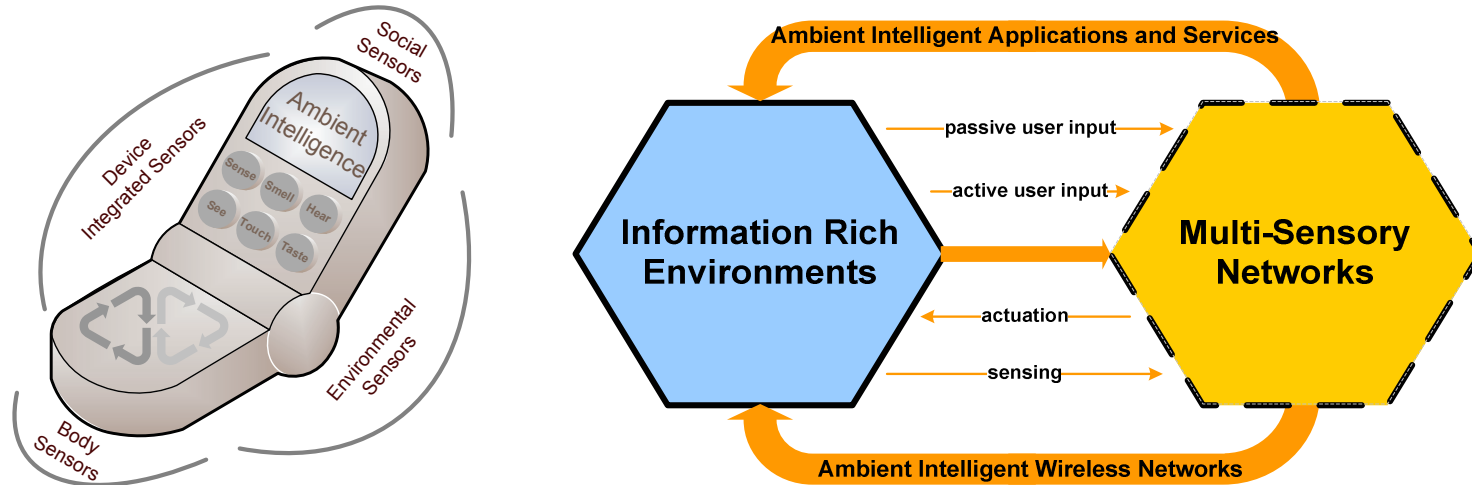
- Tagged merchandise (RFIDs)



- Application Domains:
 - Personal Service Space
 - Lifestyle Assistant
 - Community Service Space
 - Wireless Hospital
 - Industrial Service Space
 - Remote Asset Monitoring
- Provide the missing piece of the Beyond 3G puzzle
- EU competitiveness in WSN
- EU and International wireless standards



e-SENSE in B3G



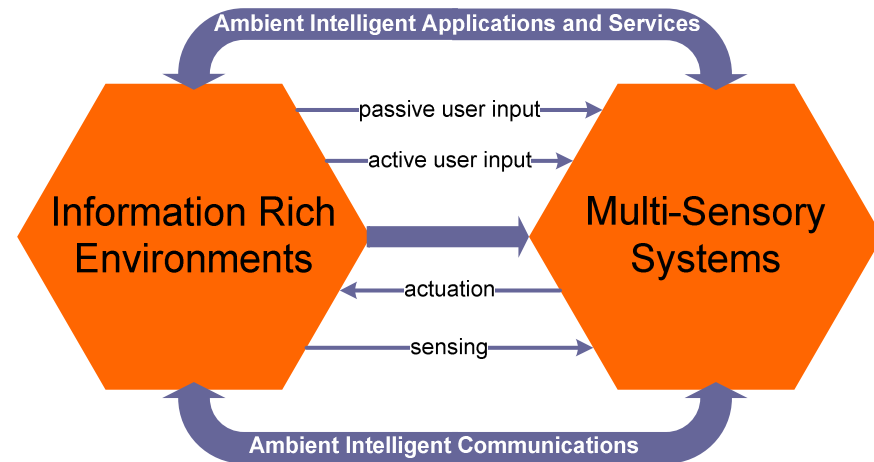
- **Person-to-Anything (Physical) Interaction**
 - leading to more natural means of interactions
- **Sensor Networks** (actuators and sensors) are Enablers for
 - ubiquitous computing
 - ‘*disappearing technologies*’
- **Context Information** for
 - Context aware applications and services
 - Context aware communications

- **Long Life**
 - The assumption is that recharging a sensor node is not possible (number, location, access problem)
 - Long life = months to years depending on the application
- **Small Size**
 - The assumption is that sensor nodes could be anywhere and 'invisible'
 - Small size = potentially less than a few cubic millimetres
- **Inexpensive**
 - The assumption is large scale disposable deployment
 - Inexpensive = a few cents per unit
- **Integrated**
 - Sensors in everyday objects, on the person and in the environments
 - Interfaces integrating sensors into B3G systems and platforms

**There is a strong trade-off between performance
and these high level constraints.**

It depends strongly on the application what an optimal solution requires.

e-SENSE enables capturing of Ambient Intelligence for Beyond 3G Mobile Communication Systems through Wireless Sensor Networks

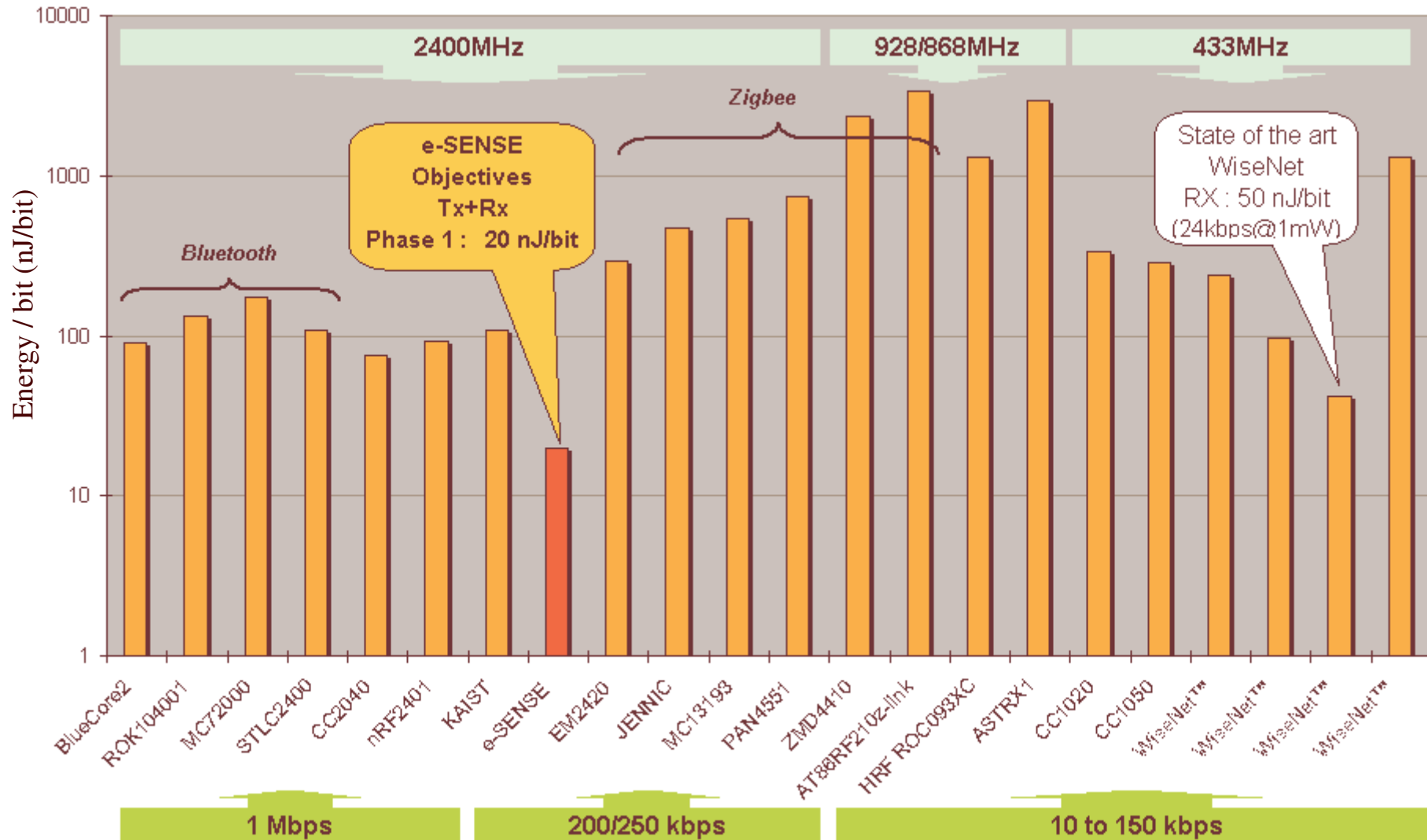


Project Main Objectives:

- 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**

- Energy efficiency with respect to wireless sensor node architectures
- Ultra low power and bandwidth efficient air-interfaces and data transport and networking protocols for wireless sensors, clusters and gateways through cross-layer optimisation
- Distributed resource management for wireless sensors
- Co-existence with other radio interference / signals
- Distributed data processing and collaborative aggregation
- Intelligent data centric interface
- Self organising sensor networks in mobile and dynamic heterogeneous wireless sensor systems and integration into B3G systems and platforms
- Privacy for personal or sensitive information

Energy Efficiency Definition: E_b (nJ/bit) = DC power (mW) / Bit rate (Mb/sec)

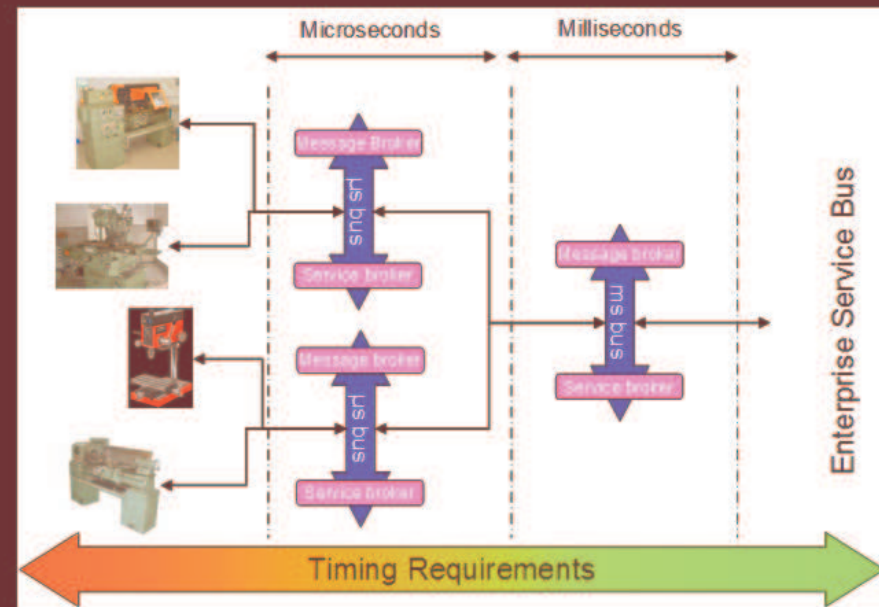
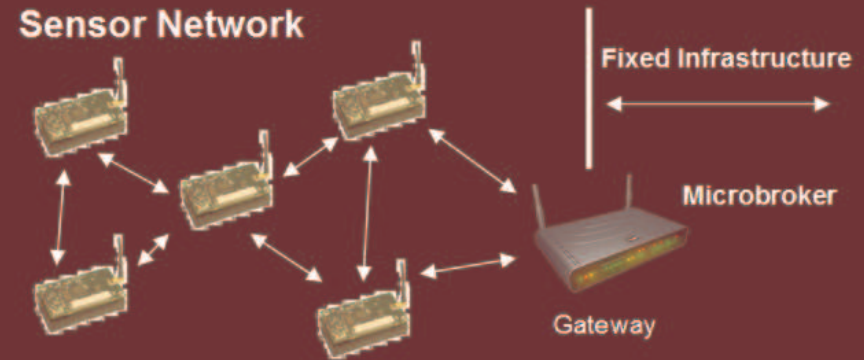




Networking Challenges

- Communication and connectivity functionalities for Sensor and Actuator Networks
 - Low-footprint stack for sensor networking
 - Multi-hop communication and relaying
 - Self-configuration, self-healing
 - Power optimization
 - ...

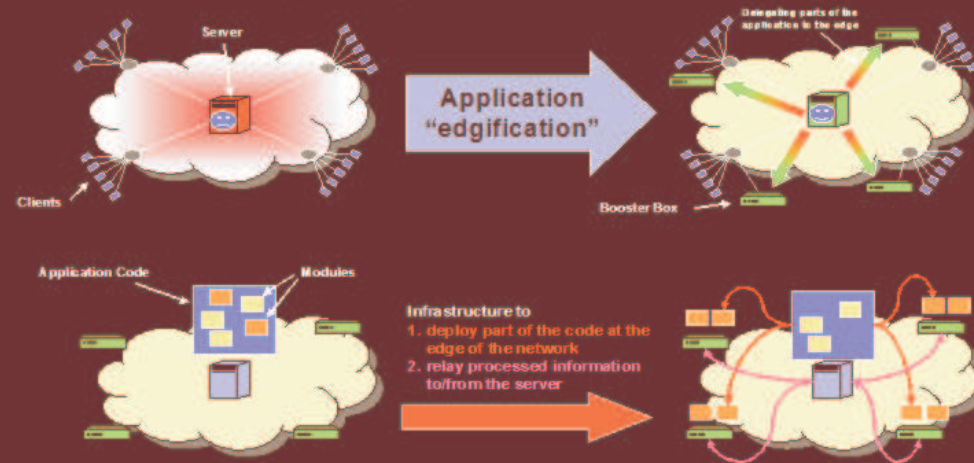
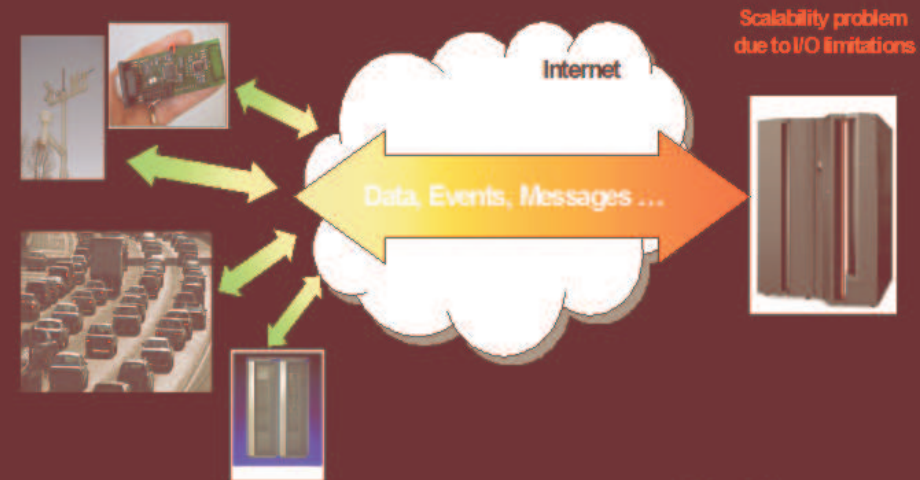
- Connecting S&A networks with applications and services
 - Publish/subscribe messaging protocols
 - Real-time messaging
 - Resource reservation
 - Admission control





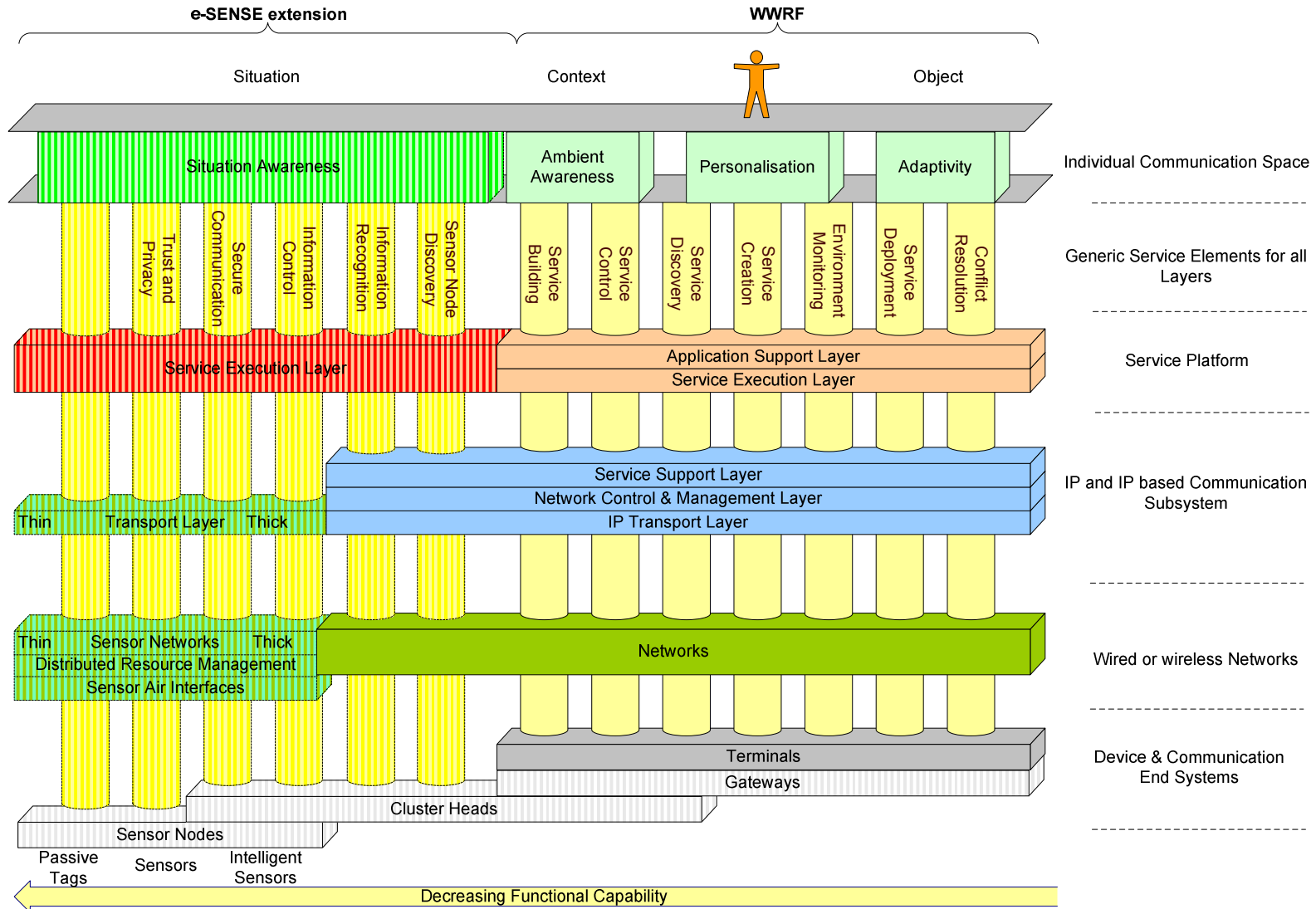
Scalability Challenges

- The massive deployment of smart, networked sensors will dramatically affect network volume and traffic patterns
- Significant architectural changes to global IT infrastructure expected
- Processing moves to network edge to aggregate and filter
 - Distributed application processing
 - Code distribution and management



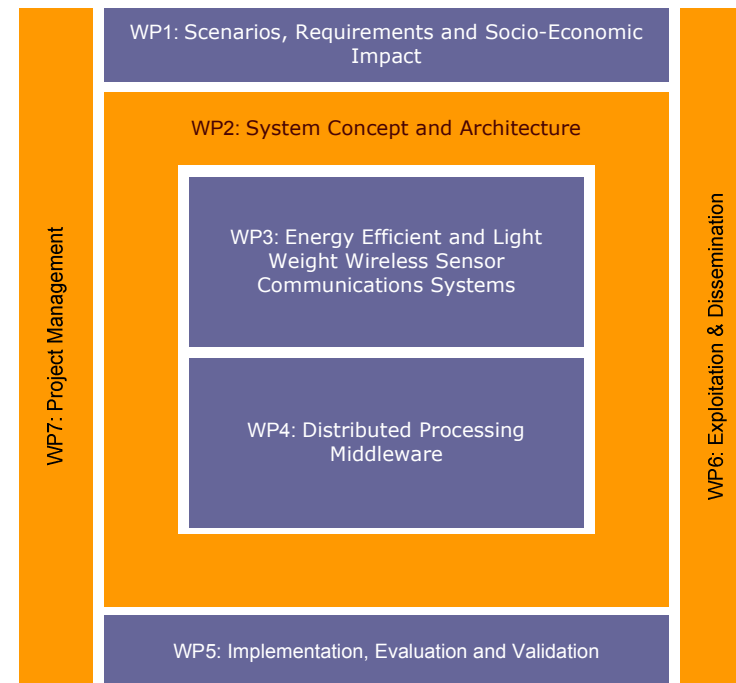
e-SENSE addresses

- Sensor Node Architecture
- Sensor Networking Architecture
- Gateway Architecture – linking SNs to beyond 3G
- ‘Reconfigurable’ Communication Framework (Toolbox)
- Secure Communication Architecture
- Privacy and Trust for Sensor Networks



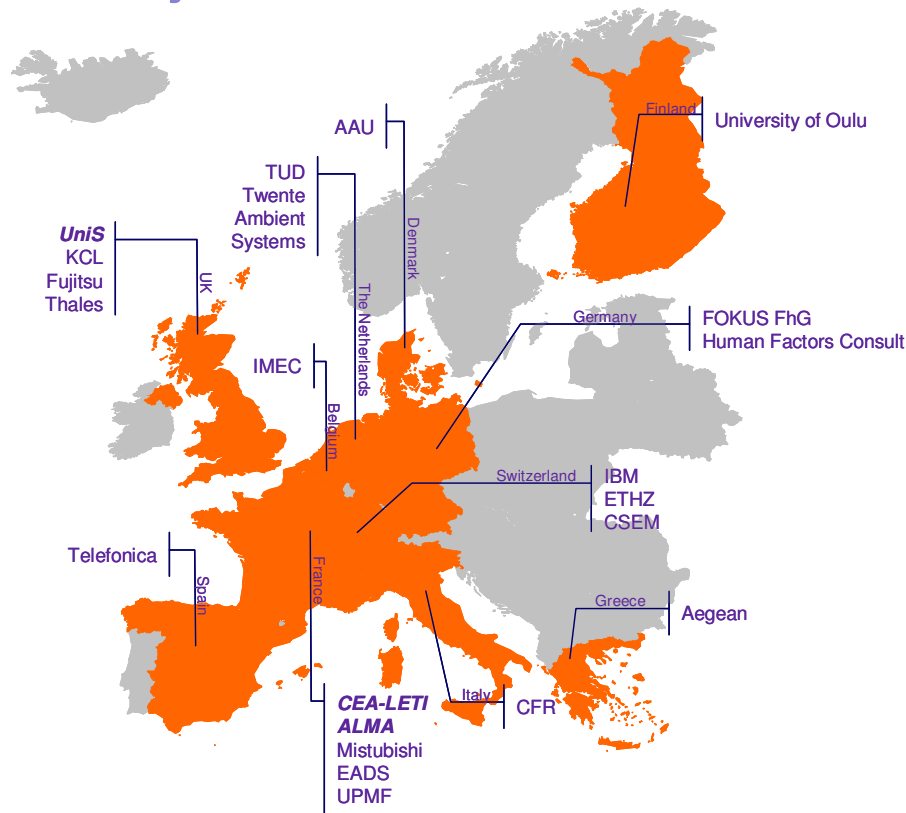
- End to End Sensor Networking
 - from the sensor output, the communication system, the collaborative aggregation and pre-processing to the context classification and binding into the Service Platform
- Scope:
 - WSNs with distances up to one hundred meters
 - Body Sensor Networks up to high-density large-scale networks (e.g. Campus-Wide SN)

- e-SENSE is organised into 7 Workpackages:
 - Scenarios, Requirements and Socio-Economic Impact
 - System Concept and Architecture
 - Efficient and Light Weight Wireless Sensor Communications
 - Distributed Processing
 - Middleware
 - Implementation, Evaluation and Validation
 - Dissemination and Exploitation
 - Project Management



Project Duration 1st Phase 24 months, Kick Off: January 2006
 EU Project IST-4-IP, 027227

23 Project Partners in 11 Countries



Project Finance

EU contribution
 6,300,000 Euros
Total estimated cost
 10,000,000 Euros
Total Effort over 24 months
 947.5 Person Months

Project Lead

Project Coordinator
 CEA-LETI Laurent Herault
Technical Management
 UniS Derek Babb
Administrative Manager
 ALMA Giuseppe Candela



Backup




DCIS Department
CEA -LETI
Laurent HERAULT, PhD
Head of Telecommunications Program

email: laurent.herault@cea.fr

Centre de Grenoble
 17 rue des Martyrs
 38054 Grenoble Cedex 9
 France

tel: +33 (0)4 38 78 95 15

fax: +33 (0)4 38 78 51 82

Acronym	e-SENSE
Title of the project	Capturing Ambient Intelligence for Mobile Communications through Wireless Sensor Networks
Proposal number	IST-4-027227
Contract number	027227
Starting date - End date	01/01/2006 – 31/12/2007
Duration (in months)	24
Total Budget	10 276 398,65 €
Total Manpower (mm)	947.5
Community Financial Contribution	6 300 000 €
Project Officer(s)	Paulo DE SOUSA
Logo	 e-sense
Website	www.ist-e-sense.org