

Microsystems and Smart Integrated Systems: A key enabling technology for AAL

Dr Andreas Lymberis
andreas.lymberis@ec.europa.eu

*Information Society Technologies and Media,
Micro-systems
European Commission, Brussels*

1. Smart Systems: Definition and Technological Aspects

From the Past to the Future: from Microsystems to Smart Systems

Microsystems...

are miniaturised devices combining

- **sensing**
- **signal processing**
- **actuation**

through monolithic or hybrid integration.



Smart implant



Smart RFID

Smart Systems...

- are able to describe a situation and diagnose it,
- are predictive,
- are able to decide or help to decide,
- enable the product to interact with the environment.

They are as small as possible, networked & energy autonomous

Smart Systems is not
Electronics !



Smart tire

2. Applications -> Functionalities -> Heterogeneous Tech Integration

Microsystems is an enabling technology, bringing together separate technologies and sciences

- **Inter-disciplinarity**

Mechanics, electronics, fluidics, biology, magnetism, optics, photonics, chemistry,

- **Convergence of heterogeneous technologies**

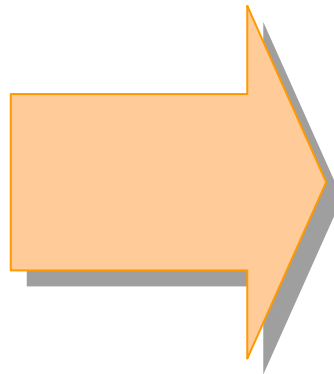
Micro/nanotechnologies, ICT, bioengineering

- **Heterogeneous Materials**

Semiconductors, ceramic, glass, organics and polymers, metals

- **Multiple functionalities**

Sensing, processing, actuating, energy harvesting and storage, communication, memory, logic



Applications

- **Biomedical**
- **Transport**
- **Telecommunications**
- **Automotive**
- **Safety**
- **Environment**
- **Smart textiles**
- **Conformable Flexible Systems**



Application Fields of Smart Systems vs Key Functions

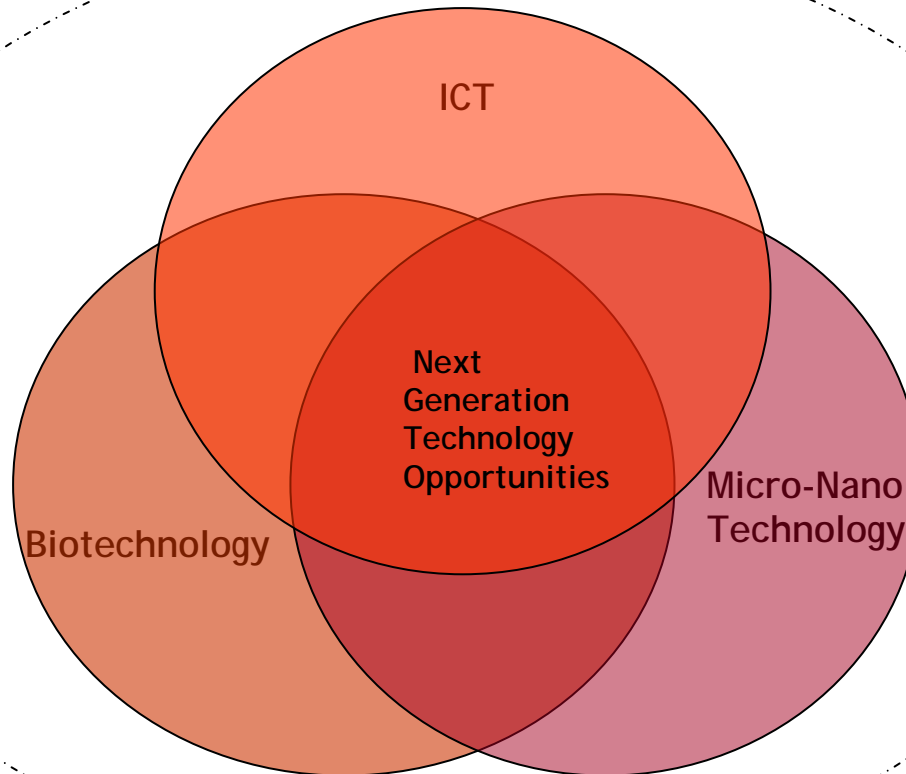
	Medtech & Healthcare	Internet of Things	Telco	Security	Aeronautics	Automotive
Energy Conversion		Green ICT	Green ICT		All Electric Plane	Hybrid & Electrical Vehicle
Smart Power Management	Wireless Implants & Autarktic Sensors	Wireless Sensor Networks	Power Management			Wireless Sensor for Smart Road
Chemical & biological sensing	Point of Care Systems Breath Analysis			NRBCE Detection	Cabin Air Quality	Power Train Control, Air Quality Monitoring
Conformable Flexible Systems (OLAE)	Disposable Band Aids & Tests	Low Cost RFID	Low Cost Antenna Systems	Smart Cloths	Maintenance Fleets	Instrument cluster & Energy scavenging
Smart Textiles and Foils	Smart Clothes, Home Monitoring			First responder Safety		
Vision Systems	Sensors for fluorescence, 3D vision		Imager for Mobile phone	All in one Camera		Pedestrian Detection

3. Cluster of Activities Relevant to AAL: MNBS (Micro Nano Bio systems), SFIT (Smart Fabrics & Interactive Textiles)

Converging MicroNano- Bio-ICT Systems

Highly Interdisciplinary

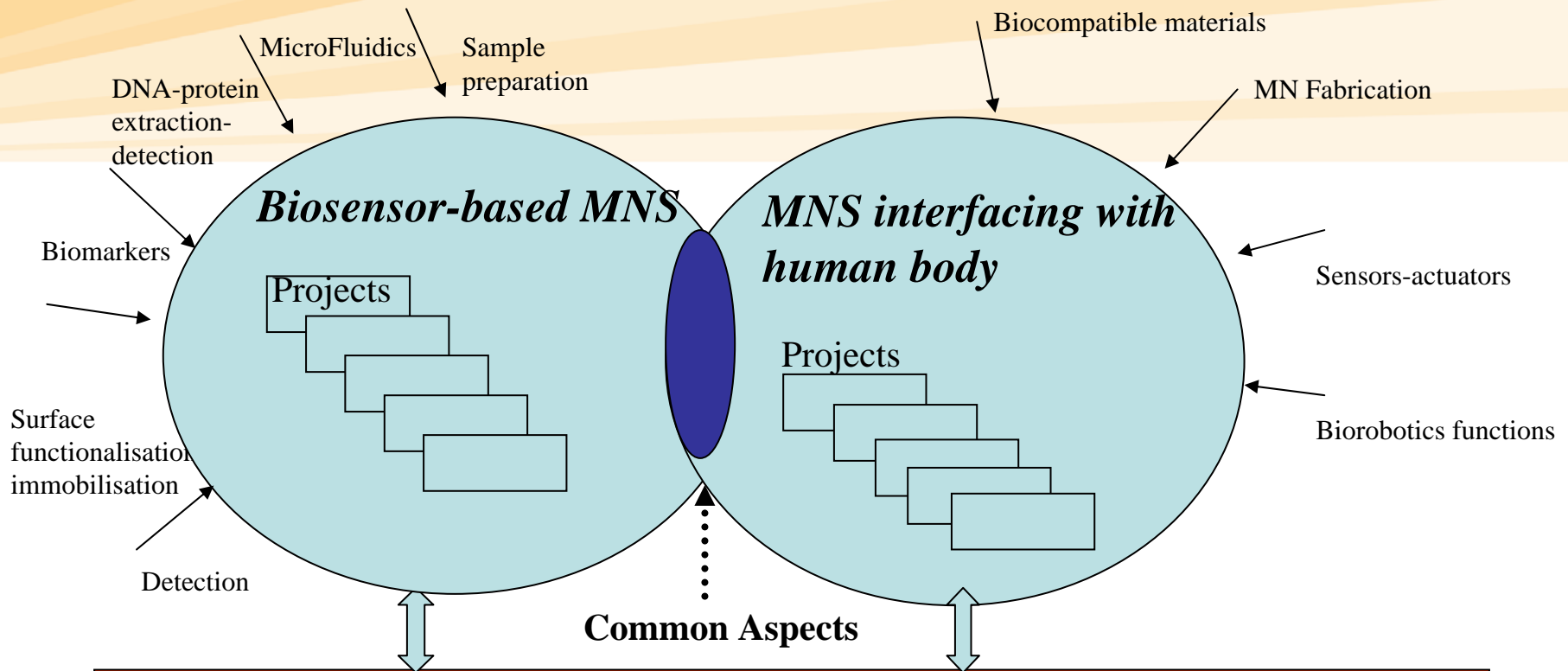
System miniaturization
(wearability, implantability)
High volume/low cost
production



New or increased
functionality
(DNA, protein, cell
detection)

Medical research
& Unprecedented
possibilities

MNBS group Projects: Structure, links and content



Power, Signal Processing, Telecoms, Packaging, Manufacturing, Standardization, Ethics, Testing-Validation, Business, IPR, Certification, Dissemination, Awareness, Education.

- 36 Projects, 2 Service Actions
- 145 M€, 390 Organisations, 27 MS & AS + China, Australia, USA, Korea, Mexico
- 80 Universities, 60 R&D Centers & Institutes, 85 companies (Research & product development)

Technological and Application Areas Focus

Biosensors & Lab on Chip Components and Systems, e.g.:

DNA & protein arrays, LoC (e.g. MNT, surface chemistry, biomarkers, microfluidics, modelling, instrumentation, sample preparation, detection, integration/packaging and cost reduction)

Smart Micro Nano Systems on & inside the body, e.g.:

BioMEMS, BioRobots, Actuator-Sensor ("closed loop" systems), Drug delivery systems, Biochemical Wearable Sensing and Active low power implants

Business and driving forces, e.g.:

Driving applications: Healthcare/biomedicine, food, environment, security, leisure
Mass production (cost), user needs, ethical and societal issues.

Smart Fabrics and Interactive Textiles (SFIT): Driven by the e-textile vision

Full integration of sensing,
processing, actuating,
communicating and power sourcing
functions in a woven (or hybrid)
structure.

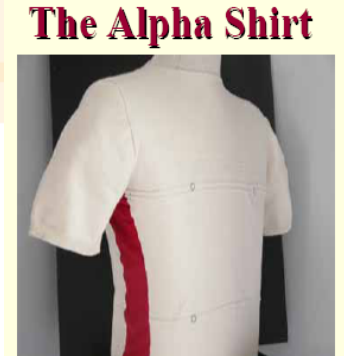
Recent R&D in Smart textile and garments



2000



2005



2008

Wearable sensors/computing

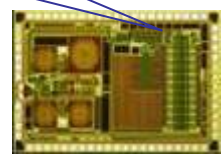
- Developing & testing yarns as sensors and electrodes
- Knitted integrated connections to measure resistance values in the same fabric
- Testing for several biophysical and mechanical parameters
- Piezoresistive fabrics → First integrated prototypes

Research on new materials for active functions and integration with patches/textile

Towards full integration of sensors, actuators, telecom & power

Development & Integration of innovative sensing, MNT, textile and ICT towards functionalised Smart Fabrics and Interactive Textile

Micro-communicating:
sensor interface,
processing and
wireless



Microsystems physical sensors
(attitude, fall, health, ...)



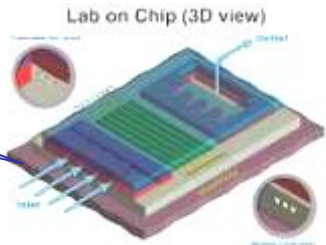
Flexible displays



Picture: Courtesy of Plastic Logic Ltd

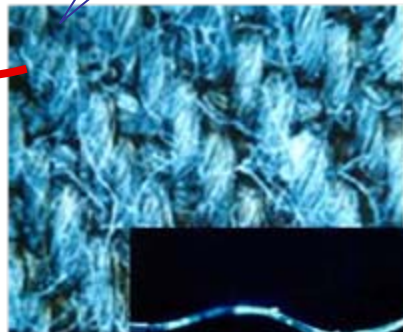
- Nanoengineered surfaces
- Conductive fabrics
- Micro-interfaces

Point of care



Micro-energy
generators

u-fuel cell 1



An (expandable) group (7 Projects, 40 M€ Funding)

www.csem.ch/sfit

PROETEX: Protection e-Textiles: MicroNanostructured fibre systems for Emergency-Disaster Wear, (1/02/2006 - 31/1/2010)

STELLA: Stretchable Electronics for Large Area Applications (1/1/2006 – 31/1/ 2010)

BIOTEX: Bio-Sensing Textiles to Support Health Management (1/7/2006-29/05/2008)

CONTEXT: Contact less sensors for body monitoring incorporated in textiles, (1/01/2006-30/6/2008)

MyHeart: Fighting cardio-vascular diseases by preventive lifestyle & early diagnosis, (1/12/2003-30/8/2008)

OFSETH: Optical Fibre Sensors Embedded into technical Textile for Healthcare, (1/3/2006- 30/9/2009)

SYSTEX (FP7): enhancing the breakthrough of intelligent textile systems, Coordinated Action (1/5/08-30/4/2010)

4. Running AAL projects (from FP6 Call 6)



SIXTH FRAMEWORK PROGRAMME
PRIORITY 2.6.2
INFORMATION SOCIETY TECHNOLOGIES (IST)
AMBIENT ASSISTED LIVING (AAL) IN THE AGEING SOCIETY



SPECIFIC TARGETED RESEARCH PROJECT

Project acronym:

SENSACTION-AAL

Project full title:

**SENSing and ACTION to support mobility in
Ambient Assisted Living**

Contract no.: **045622**

Start date: **January 1st 2007**

Scientific Coordinator: **Lorenzo Chiari – DEIS – Università di Bologna (I)**

lchiari@deis.unibo.it

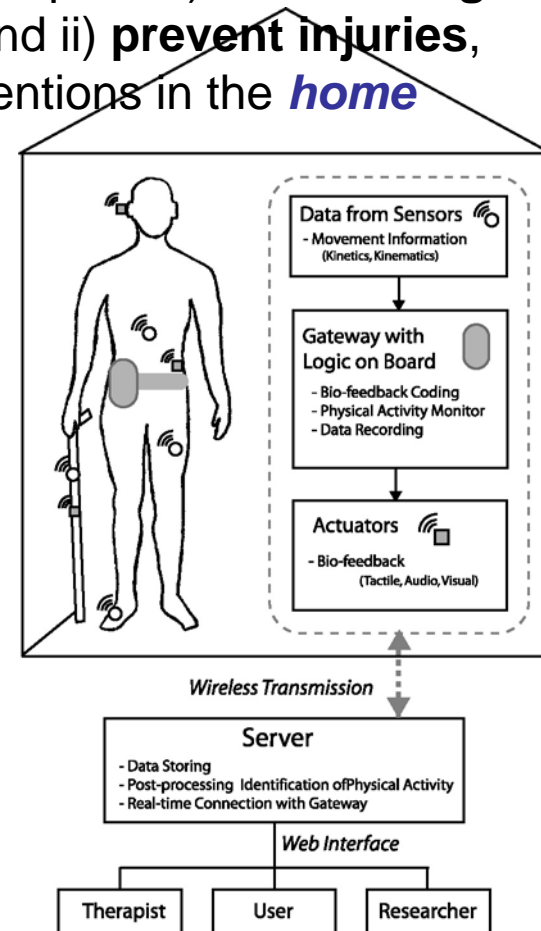
Project objective(s)

General goal of the project

The ultimate goal of the project is to assist older people in i) **maintaining independent mobility and daily life activities**, and ii) **prevent injuries**, by allowing medical professionals to initiate interventions in the **home environment**.

The project objective

The consortium will contribute to this goal by: *developing, testing, validating, and making ready for the market, a body area networked system for mobility monitoring and conditioning*, where network nodes incorporate miniaturized **sensors and actuators**.





Ambient Assisted Living
for the
Aging Society

Contract number: 045508

A **NET**worked multisensor system
for elderly people:
health **CAR**e, safety and and secur**ITY** in home
environment

Acronym: **NETCARITY**
Integrated Project

3. Future Call 5 for proposals under FP7

Opening in July 31st and closing in November 3rd



Call 5/ ICT-2009.3.9: Microsystems and Smart Miniaturised Systems

(I) Heterogeneous Integration (IP, STREP)

- Innovative concepts of industrial relevance
- Technological challenges that limit industrial take-up

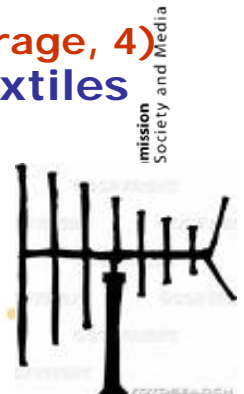
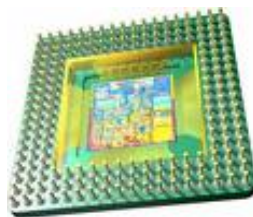
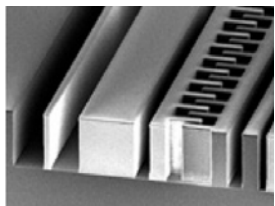


(II) Autonomous energy efficient smart systems (STREP)

- energy challenge
- communication challenge

(III) Application specific microsystems and smart miniaturised systems (IP, STREP)

- 1) **Biomedical** 2) telecommunications, 3) environment and food/beverage, 4) transport-safety and security, 5) **smart fabrics and interactive textiles**



European Technology Platform on Smart Systems Integration-EPoSS: Key Priorities and R&D focus :

Long term

EPoSS Joint Initiative

Smart Systems
for
Sustainable
Mobility

Clean &
Full-Electric Car,
All-Electric
Aircraft,
Energy
Efficiency

Smart Systems
for
Ambient
Intelligence

Internet of
Things,
Future
Communication
& Networking

**Smart Systems
for
Health**

Health
Monitoring
and Control,
Artificial
Organs,
More Comfort for
the Patient

Smart Systems
for
Safety &
Security

Chemical,
Biological,
Radioactive,
Nuclear &
Explosives
Detection

- European research on the web:
 - http://cordis.europa.eu/fp7/home_en.html
 - <http://ec.europa.eu/comm/research/future/>
- Information Society and Media:
 - http://cordis.europa.eu/fp7/ict/programme/home_en.html
- Directorate G:
 - http://cordis.europa.eu/fp7/ict/programme/challenge3_en.html
- Challenge ICT-2007.3.9:
Microsystems and Smart Miniaturised Systems :
http://cordis.europa.eu/fp7/ict/micro-nanosystems/home_en.html
- Challenge ICT-2007.3.2:
Organic and large-area electronics, visualisation & display systems :
http://cordis.europa.eu/fp7/ict/organic-elec-visual-display/home_en.html



Contact:
andreas.lymberis@ec.europa.eu

The views expressed in this presentation are the personal views of the author and do not necessarily reflect the official view of the European Commission on the subject matter.