ultrasponder

ESSCIRC Workshop, 17th September 2010, Sevilla

In vivo ULTRAsonic Transponder System for Biomedical Applications

ULTRAsponder

FP7 Collaborative Project, STREP

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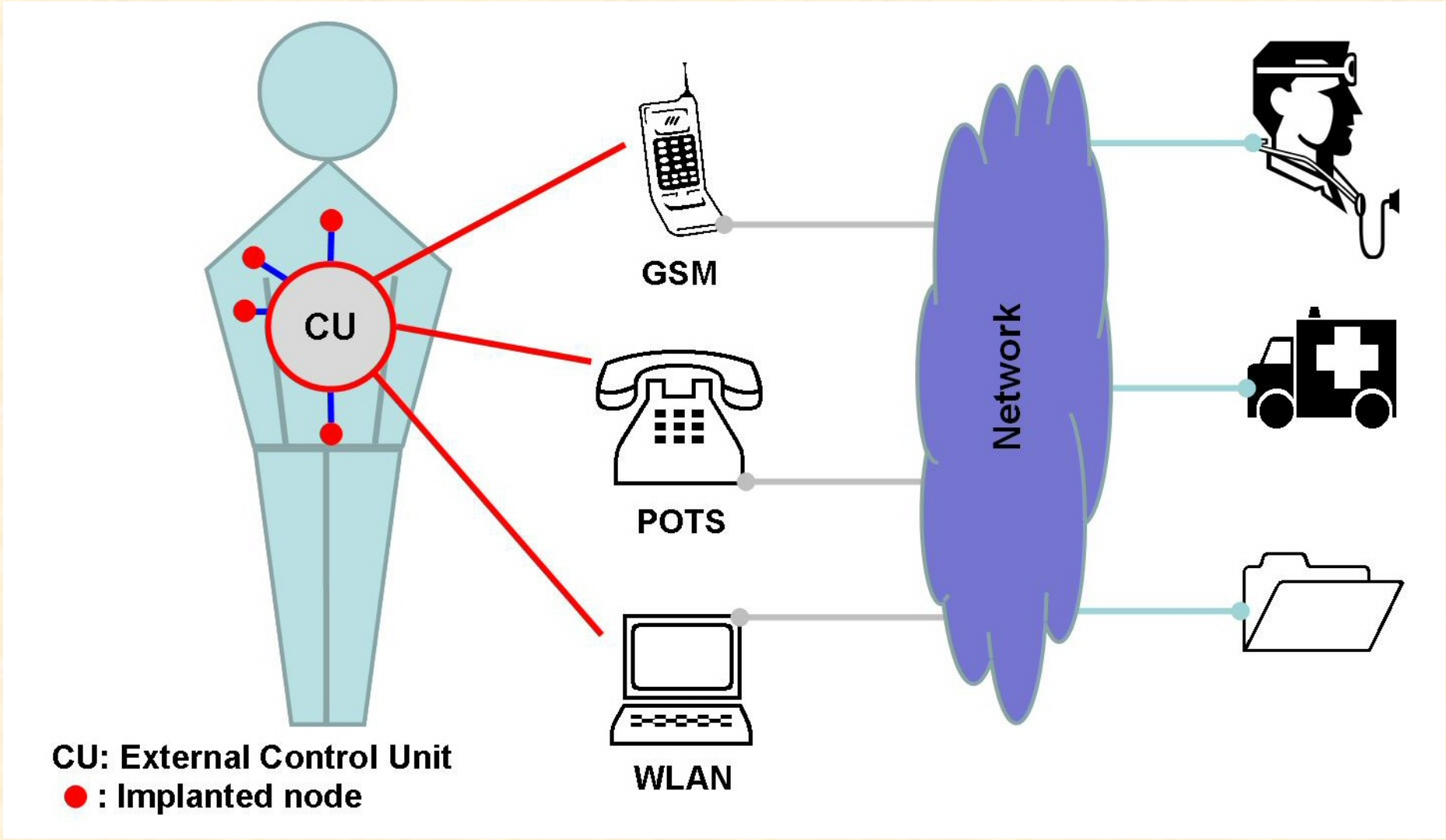
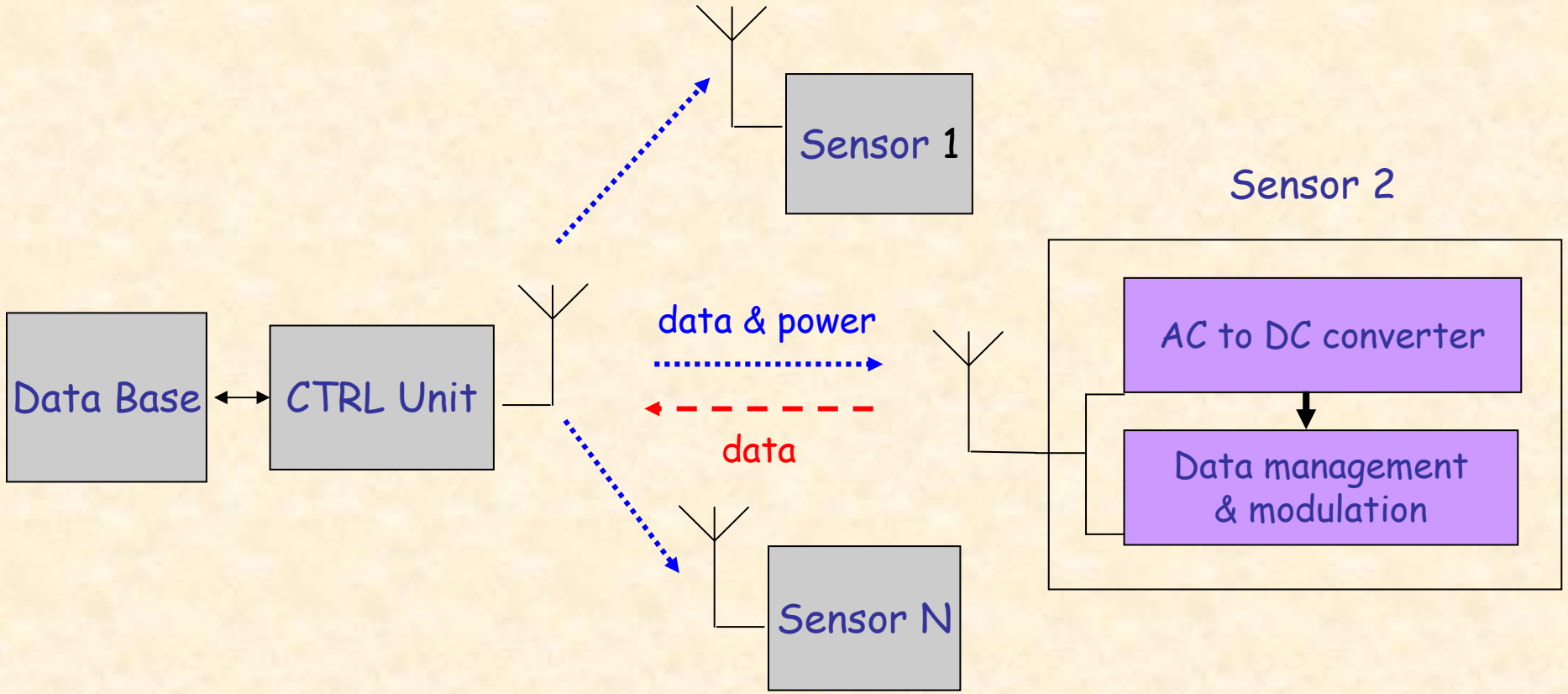
Implantable biosensing transponder network



Technology challenges

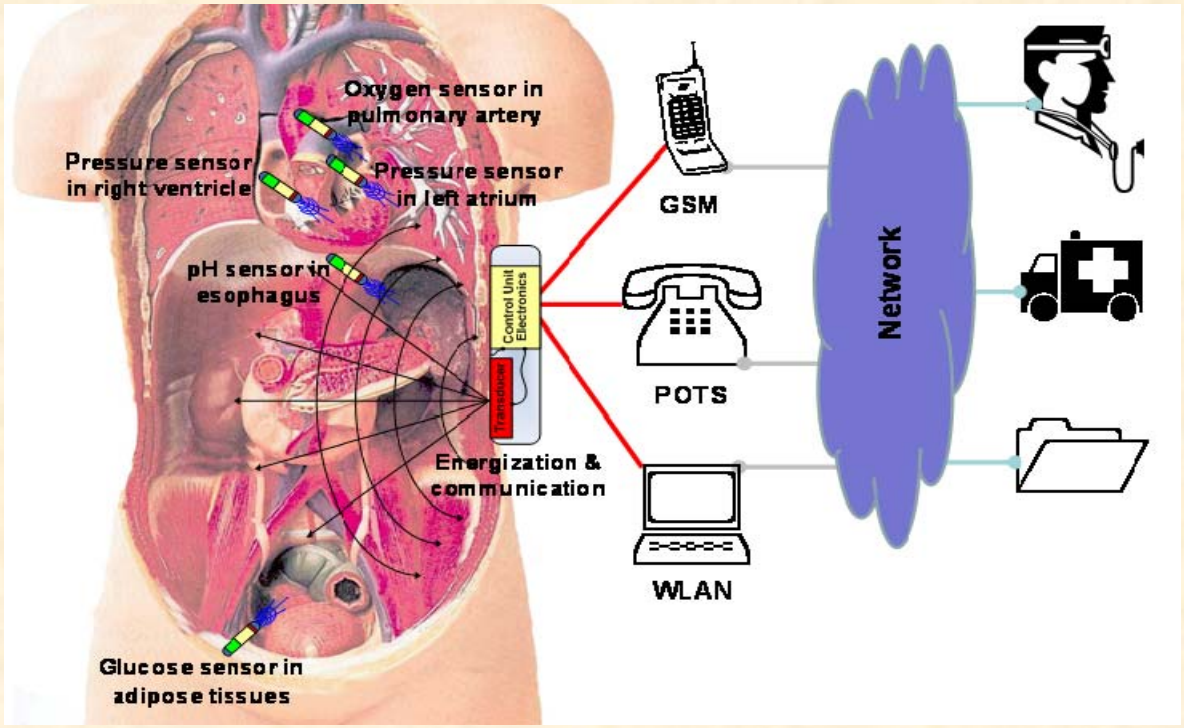
- To develop a new technology for ultra-low power **sensors deeply implanted inside the body**
- To develop innovative **half-duplex wireless communication and energy transmission** techniques
- To develop key innovative features
  - **Remote powering** through ultrasonic wave
  - Half-duplex ultrasonic **wireless data transmission**
  - **Local signal processing**
- **To develop a safe and recognized technology**
  - Healthcare professionals have been using acoustic communications for decades (ultrasonography)

Wireless communication and remote powering



Implanted Medical Device (IMD)

Implanted Medical devices (IMDs) for continuous monitoring are growing in importance



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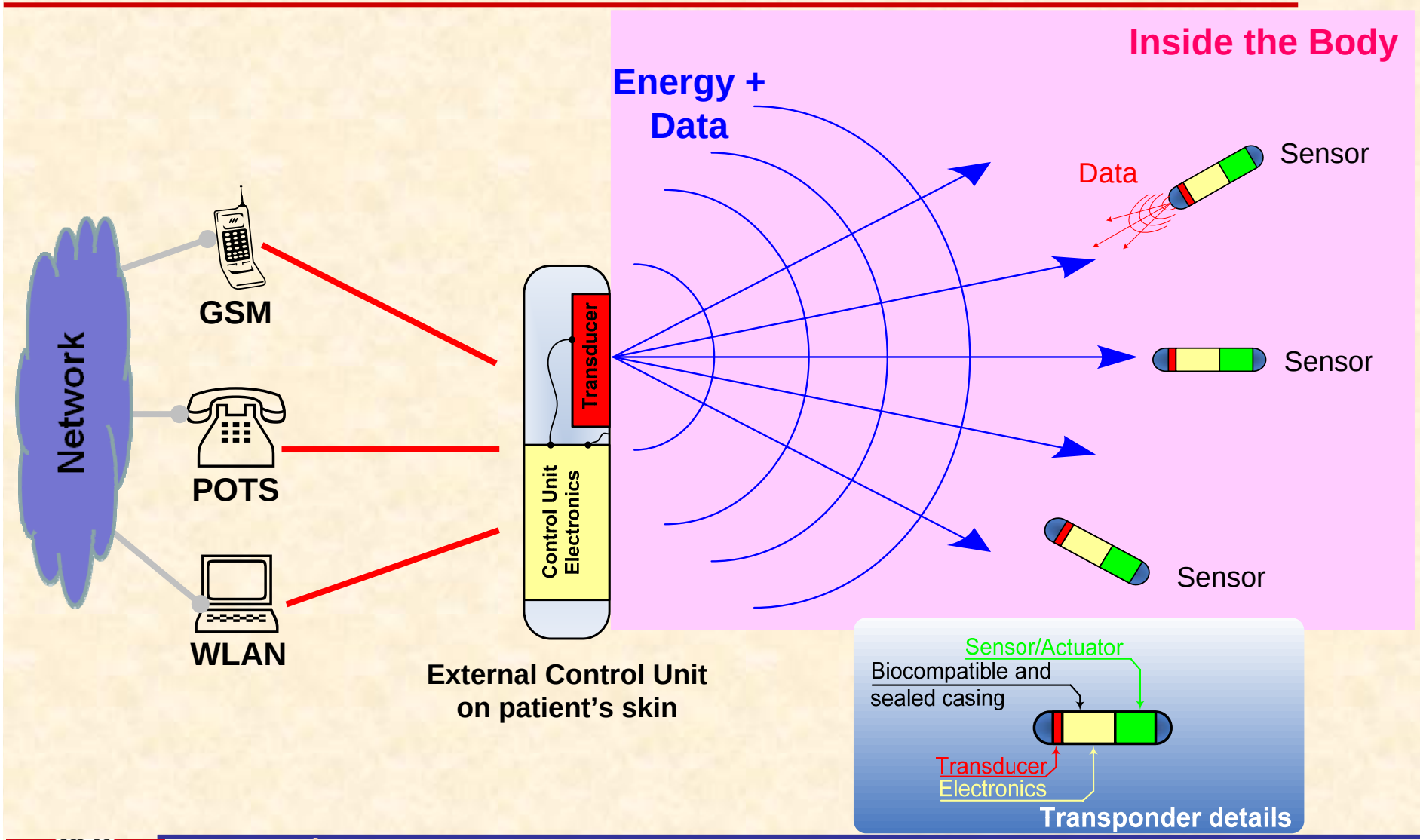
Communication between the CTRL unit and the body



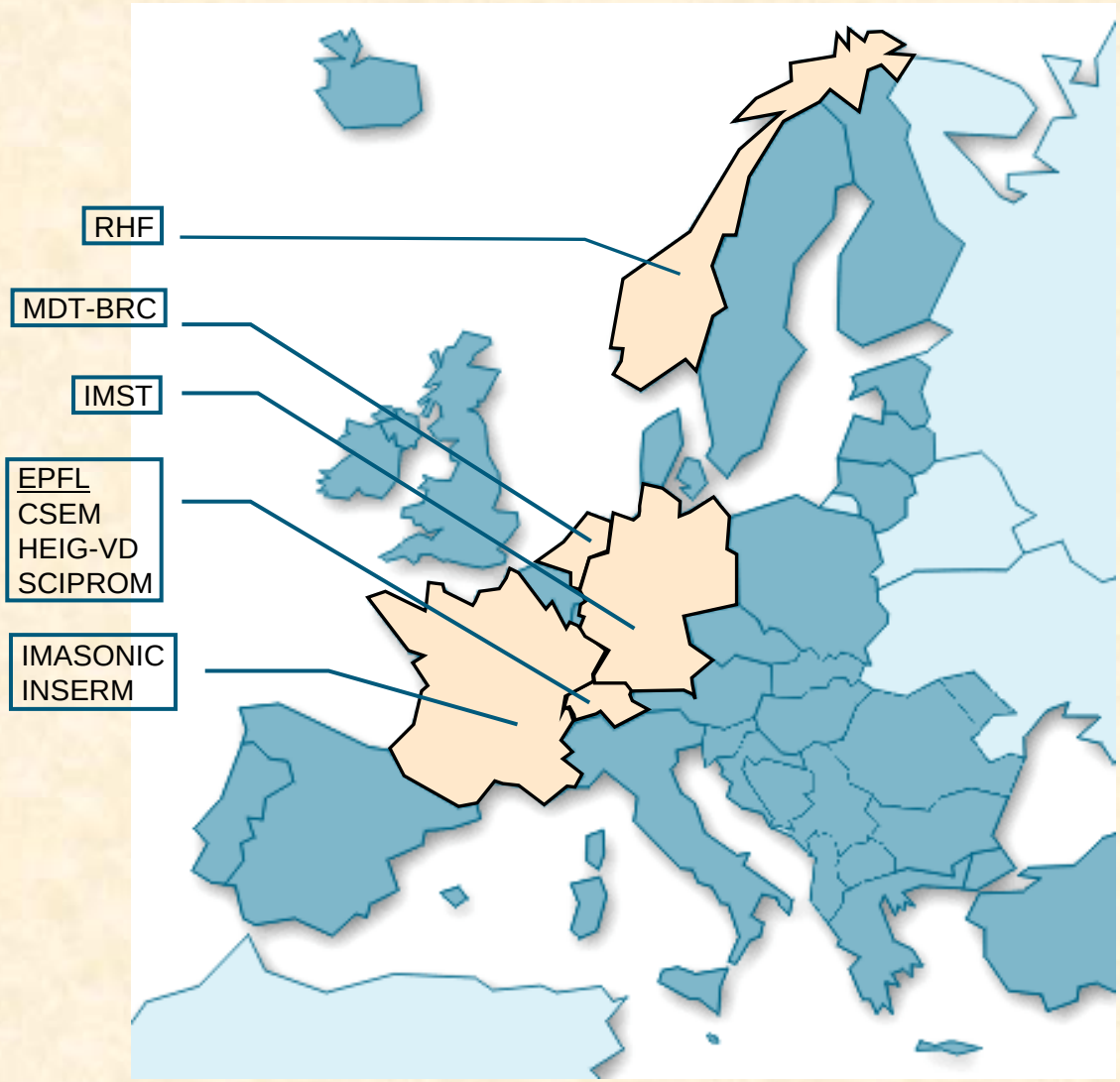
Main Application: CHF

- Continuous monitoring in the diagnosis and the treatment of **cardiac congestive heart failure (CHF)**
  - To follow the day and night heart activity
  - To see how the heart reacts to **stress**, to **physical activities** and to **medications**
  - To make a **direct comparison** of the actual patient condition with a past condition

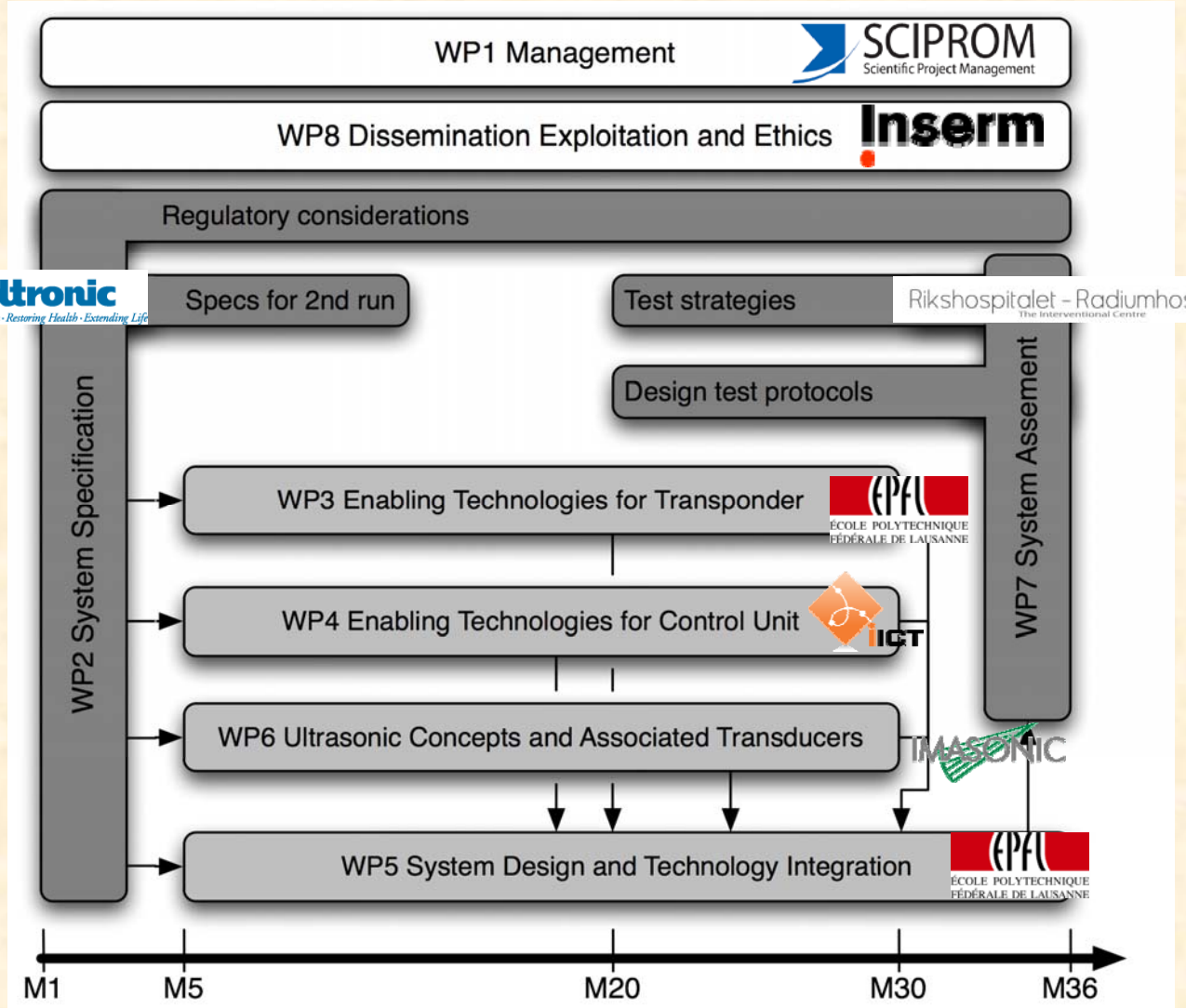
ULTRAsponder Consortium

Universities:	3
R&D Centres:	2
SMEs:	3
Industries:	1

Ultrasound propagation
Electro-acoustic transducers
Wireless communication
Remote powering
Low power A/D converters
Low power signal processing
System integration
Packaging
Clinical trials



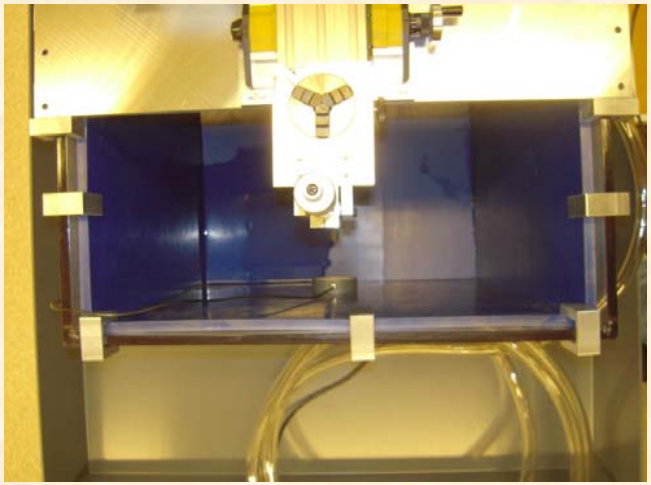
Workplan



Start: 01.09.2008

Achievements in Ultrasponder

- Determination of the main targeted application: monitoring of CHF
- Design and manufacturing of the in-vitro test bed
- Proof of concept of the wireless communication with in-vitro test bed
- Proof of concept of the recharge of the micro-battery with in-vitro test bed
- Design and test of the A/D CMOS converter
- Design and characterization of a CMOS low power System-on-Chip (SoC) circuit (called icycom)
  - Power management features
  - Icyflex1 32-bit processor with a mixed control and DSP architecture
  - Software and Hardware Development Kits to provide a complete platform for the use of the SoC circuit



Topics for potential collaboration (1)

- **Ultrasound propagation in the body**
  - The main parameters are the density, the sound speed and the attenuation in the tissues
  - To develop model to predict the ultrasonic pressure field in the body
- **Electro-acoustic transducer**
  - CAD tool to simulate the energy transformation in the transponder
  - Design and manufacturing of the transducer

- **Half-duplex wireless communication** through **ultrasonic wave**
- **Remote powering** through **ultrasonic wave**
  - Design of the AC to DC converter
  - Recharge of the micro-battery
- **Local signal processing**
  - Low power digital signal processing and energy management
- Low power **A/D converter**

- Small footprint, **high flexibility**, modular and generic

Topics for potential collaboration (2)

- **To provide an innovative medical survey conception**
  - Vital parameters are sensed in the deeply implanted transponder allowing for continuous monitoring.
  - The external control unit periodically communicates and energizes the sensor via ultrasound waves and relays data to the appropriate center.
- **To impact on the medical diagnosis and appropriate treatment**
  - Reliable and comprehensive monitoring of chronicle dysfunction brings present therapy to a personalized level.
  - Patients feel comfortable and receive a precise diagnosis and hence higher quality treatments.
- **Impact for medical industry**
  - Deeply implanted sensors will be produced and commercialized.

Dissemination

- www.ultrasponder.org
- RFIC 2010 Symposium
  - F. Mazzilli, P.E. Thoppay, N. Joehl, C. Dehollain, “Design Methodology and comparison of rectifiers for UHF-band RFIDs”, Proceedings of the 2010 IEEE Radio Frequency Integrated Circuits Symposium (RFIC), Anaheim (USA), 23rd to 25th May 2010, pp. 505-508.
- EMBC 2010 Conference
  - F. Mazzilli, M. Peisino, R. Mitouassiwou, B. Cotte, P. Thoppay, C. Lafon, P. Favre, E. Meurville, C. Dehollain, “In-Vitro Platform to Study Ultrasound as Source for Wireless Energy Transfer and Communication for Implanted Medical Devices”, Proc. of the Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), Buenos Aires (Argentina), 31st August to 4th Sept. 2010.
  - B. Cotté, C. Lafon, J.Y. Chapelon, C. Dehollain, “Suitable acoustic paths to transfer energy in depth using ultrasound”, Proc. of the Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), Buenos Aires (Argentina), 31st August to 4th Sept. 2010.
- ESSCIRC 2010 Workshop
- ISMICT 2011 Workshop on 30th March 2011 in Montreux, Switzerland
  - International Symposium on Medical Information and Communication Technology, 27th to 30th March 2011
  - www.ismict2011.org

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