

# Managing catastrophic events by wearable mobile systems

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&

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**Mobile Response 2007  
St. Augustin, 22-23 February 2007**



## *Summary*

- The PROETEX Concept
- The PROETEX Team
- Rationale: why wearable systems for emergencies?
- The end-user requirements
- An overview of the employed technologies



## *Rationale*



**Major emergencies such as forest fires, earthquakes or terrorist incidents require the intervention of specialized personnel at a high and protracted level of damage.**

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## *Rationale*



Progress in

- Micro- and nano- technologies
- Wireless communication
- Long distance transmission

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# The PROETEX Concept

## A) Inner Garment Wearable:

- Life signs monitoring
- Temperature, internal
- Biochemicals sensing
- Posture and activity
- Power generation and storage
- Low power local communications



## B) Outer Garment Wearable:

- External chemicals sensing
- Posture and activity
- Visibility enhancement
- Power generation and storage
- Low power local communications



**Local communicating network.**  
Each wearables/portable acts as a node.



Local Communication



## C) Civilian Monitoring Jerkin: (or chest band)

- Life signs monitoring
- Temperature, internal
- Biochemicals sensing
- Posture and activity
- Power generation and storage
- Low power local communications



Long Range Communication



## D&E) Portable Communications Units:

- 6 axis INS; GPS;
- External temperature
- Additional sensors
- On board battery storage
- Low power local communication
- Long range communications
- Data input ; Display and audio, alarms




## Ambient Environment:

- Communications
- Planning
- Coordination
- Monitoring
- Prediction
- Situation awareness



# The PROETEX Team

-  Coordinator
-  Research Centres
-  Companies
-  End Users

Participant Role	Participant N.	Participant Name	Participant short name	Country	Date enter project	Date exit project
CO	1	National Institute of Physics of Matter – CNR	CNR-INFN	Italy	1	48
CR	2	Technical University of Lodz	UNILODZ	Poland	1	48
CR	3	University of Ghent	UNIGENT	Belgium	1	48
CR	4	Smartex s.r.l.	SMARTEX	Italy	1	48
CR	5	Milior s.p.a.	MILIOR	Italy	1	48
CR	6	Sofileta SA	SOFILETA	France	1	48
CR	7	Thuasne France	THUASNE	France	1	48
CR	8	University of Pisa	UNIPISA	Italy	1	48
CR	9	Dublin City University	DCU	Ireland	1	48
CR	10	Commissariat a l'Energie Atomique	CEA	France	1	48
CR	11	Centre Suisse de Electronique et de Microtechnique SA	CSEM	Switzerland	1	48
CR	12	Sensor Technology and Devices Ltd.	STD	United Kingdom	1	48
CR	13	Steiger	STEIGER	Switzerland	1	48
CR	14	Philips Research	PHILIPS	Germany	1	48
CR	15	Ciba Specialty Chemicals	CIBA	Switzerland	1	48
CR	16	Diadora/Invicta Group	DIADORA	Italy	1	48
CR	17	iXscient Ltd.	IXSCIENT	United Kingdom	1	48
CR	18	Zarlink Semiconductor	ZARLINK	United Kingdom	1	48
CR	19	Brunet-Lion	BRUNET	France	1	48
CR	20	- Brigade de Sapeurs-Pompiers de Paris	BSPP	France	1	48
CR	21	INSA-LPM	INSA	France	1	48
CR	22	Protezione Civile	Eucentre	Italy	1	48
CR	23	Department de la Defense et de la Securite Civile	DDSC	France	1	48

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# The user requirements

To fit the operator needs, the systems must be:

- Unobtrusive
- Easy communication
- Only necessary alarms

→ *E - textiles*



BSPP/R.DOSNES



# The user requirements

3 end-user groups have been involved in PROETEX: Italian Civil Protection (IT), Brigade des Sapeurs Pompiers de Paris (FR), Direction de la Defense et de la Sécurité Civile (FR).

The end-user needs have been identified by submitting a series of questionnaires:

- OPMod (Operator module)
- SPMod (Specialist module)

Different working conditions

Different needs

Different European Standards to comply with





# OPMOD

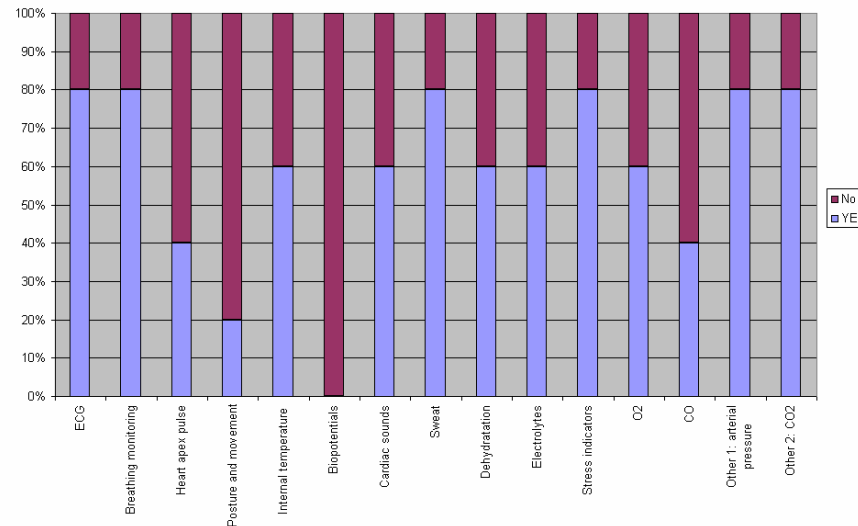
- *Who provides the warning of the intervention?*
- *By what technological means (cellular, radio, telephone,..)?*
- *How is the intervention prepared for?*
- *How is the intervention carried out?*
- *Is the intervention monitored by a local operative station?*
- *Is the intervention monitored by a central operative station?*
- *If yes to 5 or 6, how is the connection maintained during the intervention?*
- *What operational difficulties can one foresee during the intervention ?*
- *What environmental difficulties (water, fire, gas, ..) can one foresee in this intervention?*
- *Historically, what are the accidents that have happened to the rescuers?*
- *What are the typical morbidities that can result for the rescuers?*
- *When is an intervention considered technically closed?*
- *Is the intervention recorded in a data base?*
- *If yes, what is the information that is recorded concerning the intervention?*

*Routine interventions / Critical situations / Very dangerous interventions*

- *Main characteristics of the intervention (e.g. working in a smoking environment)*
- *How physiological conditions can be related to these characteristics (e.g. respiratory difficulty)?*
- *Symptoms*
- *Parameters to monitor*

*Routine interventions / Critical situations / Very dangerous interventions*

## Data Collection → Data Analysis



## *Variety of scenarios*

5 Emergency scenarios have been defined:



**Volcano activity  
and earthquake**



**Flood**



**Mountain  
earthquake**



**Industrial fire**



**Wild-land fire**



## Civil Protection Scenarios:

### Violent earthquake and volcano activity

Presence of fire, structural collapses, toxic materials and gas escapes



### Heavy rains or flooding

Low temperature environment, hypothermia risk, flood and drowning danger

### Night earthquake on a snowy mountain zone

Frost bite, snow, humidity, poor visibility, risk of structural collapses, toxic materials



### Common requirements

- Many consecutive hours of use
- High number of operators and civilians
- Huge dimension of the catastrophe area



## Fire-Fighters Scenarios:

### Large industrial fire

Presence of fire, of possible explosions, of inflammable or toxic materials. High temperature, dark, noisy and smoky environments

### Wild land fire

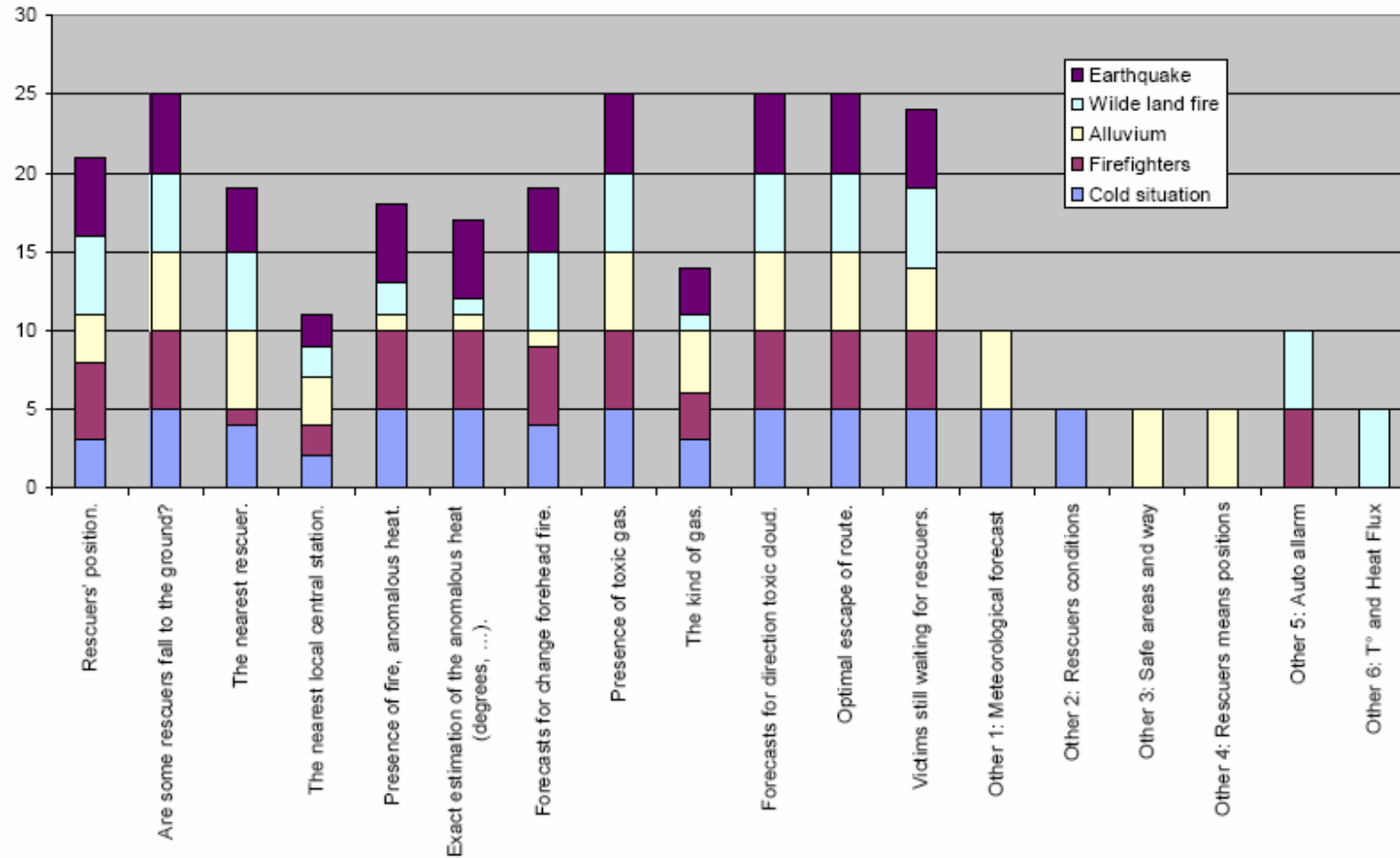
Need for a quick intervention, heat, noise, presence of water and chemical additives for flame retardancy

### Common requirements

- Use of garments and devices for **few hours**
- **Very harsh conditions**



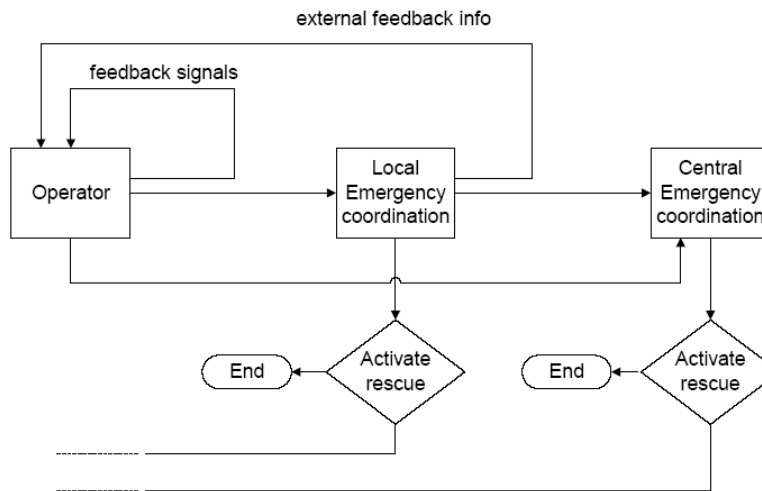
# Variety of scenarios



## Variety of scenarios

Each scenario has its own requirements in terms of:

- Data collection
- Robustness of systems
- Communication requirements
- Victims location and medical needs





# 12 month objectives

**Textile**



**Non Textile**





# Functions and technologies

**Physiological measurements**



**Heart rate, respiratory rate, ECG, temperature**

**by means of:**

- Textile electrodes for impedance pneumography**
- Piezoresistive, piezoelectric sensors**
- Temperature sensors**



**Problems, needs: comfort, washability (for the inner garment), no existing standards**



# Functions and technologies

Potential problems:  
interference with other  
equipments.

Good contact with the skin





# Functions and technologies



Potential problems: position of the systems (where and how deep)

Robustness against external conditions and wearer position

Transpirability, insulation



# Standards

EN 469 Protective clothing for firefighters –  
Performance requirements for protective  
clothing for firefighting

EN 1486 Test methods and  
requirements for reflective  
clothing for speialized fire fighting

EN 471 High-visibility warning  
clothing for professional use

EN 466 Protection against  
liquid chemicals

EN 11047 Guidelines for selection  
and use of personal protective  
equipment used for wideland  
firefighting

EN 659 Protective gloves  
for fire figthers



EN 20344 Personal protective equipment  
Test methods for footwear

EN 15090 Footwear for firefighters

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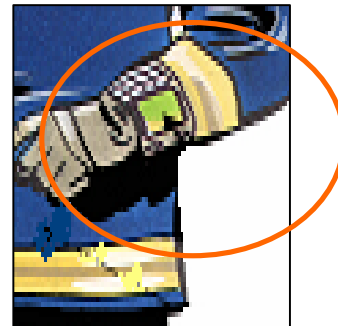
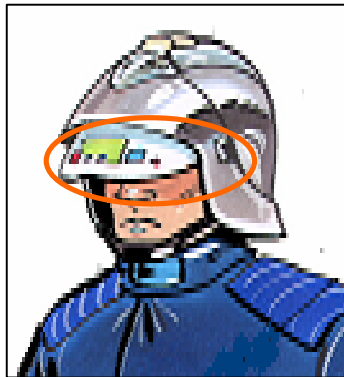
# Non textile systems



## Major challenges:

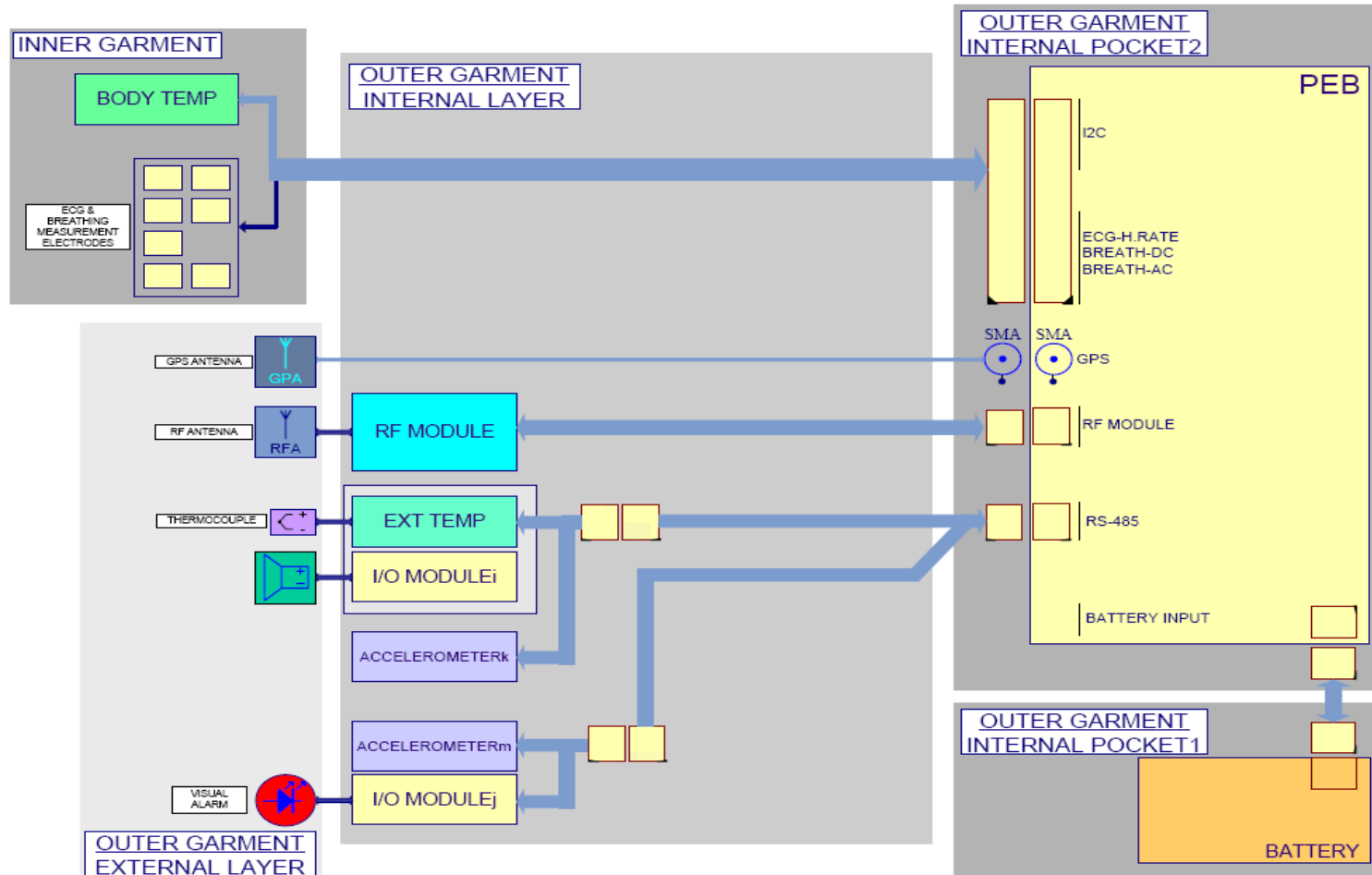
- *Many signals, coming from many sensors*
- *Redundancy in transmission*
- *Many data to send, many feedbacks to generate, but:*

## How to efficiently display alarm signals?



*Link*

# Non textile systems: Electronic Boxes





## Non textile systems: Transmission

- 1<sup>st</sup> prototype must provide a peer to peer wireless link.
- Capable of up to and over 10 meter range.
- Low power.
- Operate in the 2.45GHz band.
- Use a proven technology.



## Non textile systems Transmission

- Bluetooth was chosen due to its wide availability, low power and 2.45GHz operating frequency.
- Use class 1 devices (up to 100m).
- Use the Serial Port Profile (SPP).
- Use a pair of devices for each wireless link that automatically connect to each other.



# 1<sup>st</sup> Prototype RF module 1

- Professional Electronic Box (PEB) connects to RF module 1 via a UART.
- RF module 1 connects to a Textile Antenna developed by the University of Ghent.
- RF module 1 is situated close to the textile antenna to reduce RF losses.





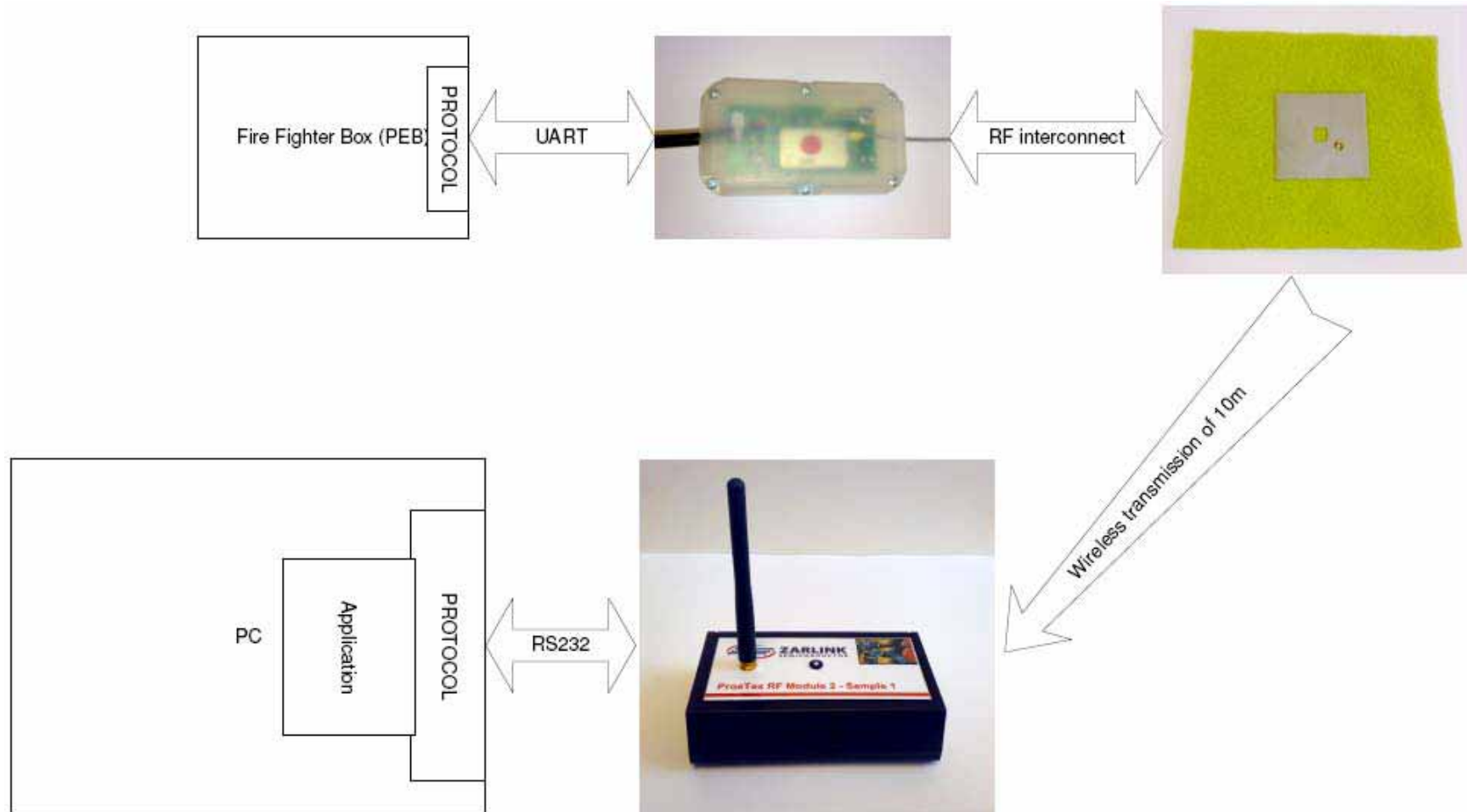
# 1<sup>st</sup> Prototype – RF module 2

- Connects to PC via RS232.
- Uses 2.45GHz Monopole antenna.





# Complete System Link



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## Acknowledgements

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**A cluster of Research and Technology Development Projects  
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*Further integration of micro-nano technologies & flexible systems in textile material, aiming at the implementation of the “e-textile” paradigm, where sensing, actuating, communicating, processing and power sourcing are seamlessly integrated on a textile: a key future R&D area with large amount of potential applications and business opportunities.*



## An (expandable) group of 7 Projects

**PROETEX:** Protection e-Textiles: MicroNanostructured fibre systems for Emergency-Disaster Wear, (1/02/2006 - 31/1/2010), [www.proetex.org](http://www.proetex.org)

**STELLA:** Stretchable Electronics for Large Area Applications (1/1/2006 – 31/1/ 2010) [christopher.klatt@freudenberg.de](mailto:christopher.klatt@freudenberg.de)

**BIOTEX:** Bio-Sensing Textiles to Support Health Management (1/7/2006-29/02/2008), [www.biotex-eu.com/](http://www.biotex-eu.com/)

**CONTEXT:** Contact less sensors for body monitoring incorporated in textiles, (1/01/2006-30/6/2008), [geert.langereis@philips.com](mailto:geert.langereis@philips.com)

**MyHeart:** Fighting cardio-vascular diseases by preventive lifestyle & early diagnosis, (1/12/2003-30/8/2007), [www.hitech-projects.com/euprojects/myheart/](http://www.hitech-projects.com/euprojects/myheart/)

**OFSETH:** Optical Fibre Sensors Embedded into technical Textile for Healthcare, (1/3/2006- 30/9/2009), [grillet@multitel.be](mailto:grillet@multitel.be)

**MERMOTH:** Medial Remote Monitoting of Clothes (2003-2006), <http://pi.ijs.si/PiBrain.exe?Cm=Project&Project=MERMOTH&Reference=508272>



Commission Contact details

## **DG Information Society and Media,– Micro-nanosystems (Unit G2)**

<http://www.cordis.lu/ist/so/micro-nano/home.html>

<http://www.cordis.lu/ist/mnd/events.htm>

## **DG Information Society and Media, ICT for Health (Unit H1)**

[http://europa.eu.int/information\\_society/activities/health/index\\_en.htm](http://europa.eu.int/information_society/activities/health/index_en.htm)

[http://www.cordis.lu/ist/directorate\\_c/ehealth/index.html](http://www.cordis.lu/ist/directorate_c/ehealth/index.html)



**Thank you!**

For further infos:

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