PROTEUS

ADAPTIVE MICROFLUIDIC - AND NANO - ENABLED SMART SYSTEMS FOR WATER QUALITY SENSING

Project PROTEUS

AdaPtative micROfluidic and nano-enabled smart systems for waTEr qUality Sensing

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Focus on micro- and nanoenabled sensing

Bérengère Lebental

26/09/2017 Porto, Portugal

www.proteus-sensor.eu

IFSTTAR UNINOVA PONSEL ESIEE PARIS NiPS Laboratory Noise in Physical Systems

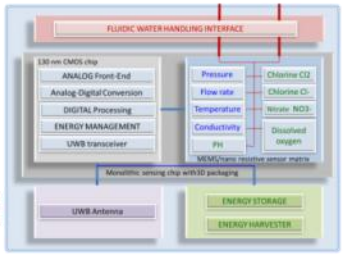
Water stakes in Europe

- Water scarcity – water stress
  - in EU: 11% of population; 17% of territory
  - Worldwide: half of the world (FAO, 2007)

- Stakes associated to drinkwater:
  - Detection of health-threatening pollution levels (continuous, accidental or intentional)
  - Detection/mitigation of losses

➔efficient and sustainable water management and monitoring tools

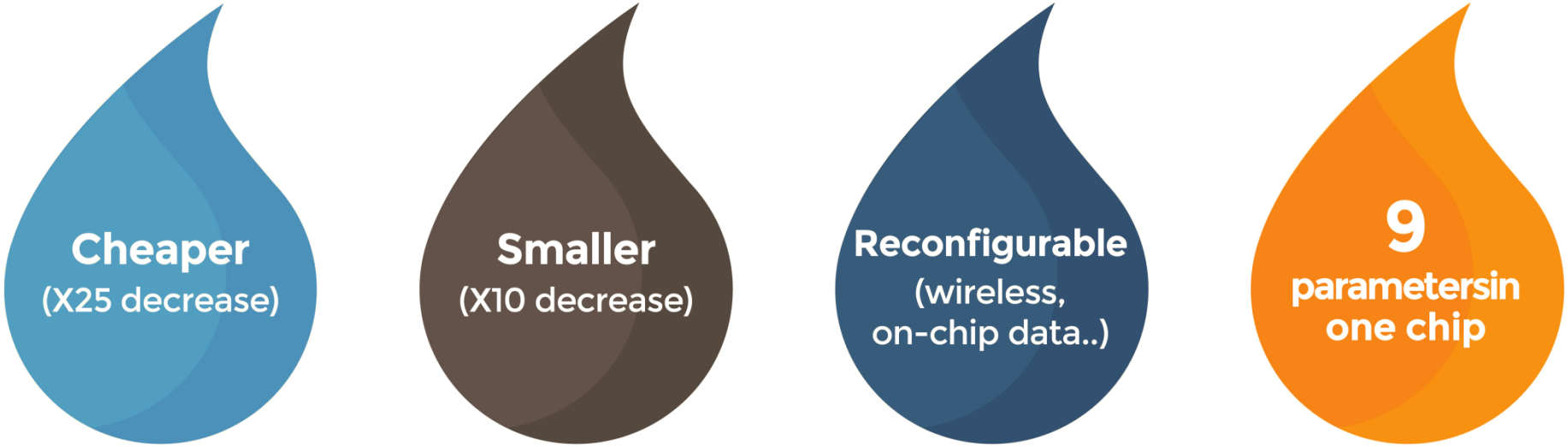
Water monitoring: the challenges

	Market state of the art	PROTEUS product
Product	TRIPOD from AQUALABO 	PROTEUS Smart sensor system 
Volume	1700cm3	10x decrease in volume
Measured parameters	7 multiplexed sensors	30 multiplexed sensors
	Predefined application	Application adaptability
Lifetime	<3months	>2years
Communicating	Wired	Wireless
Data processing	No data processing	Cognitive node
Autonomy	Wired power	Full energy autonomy
Selling price	2500€	500€

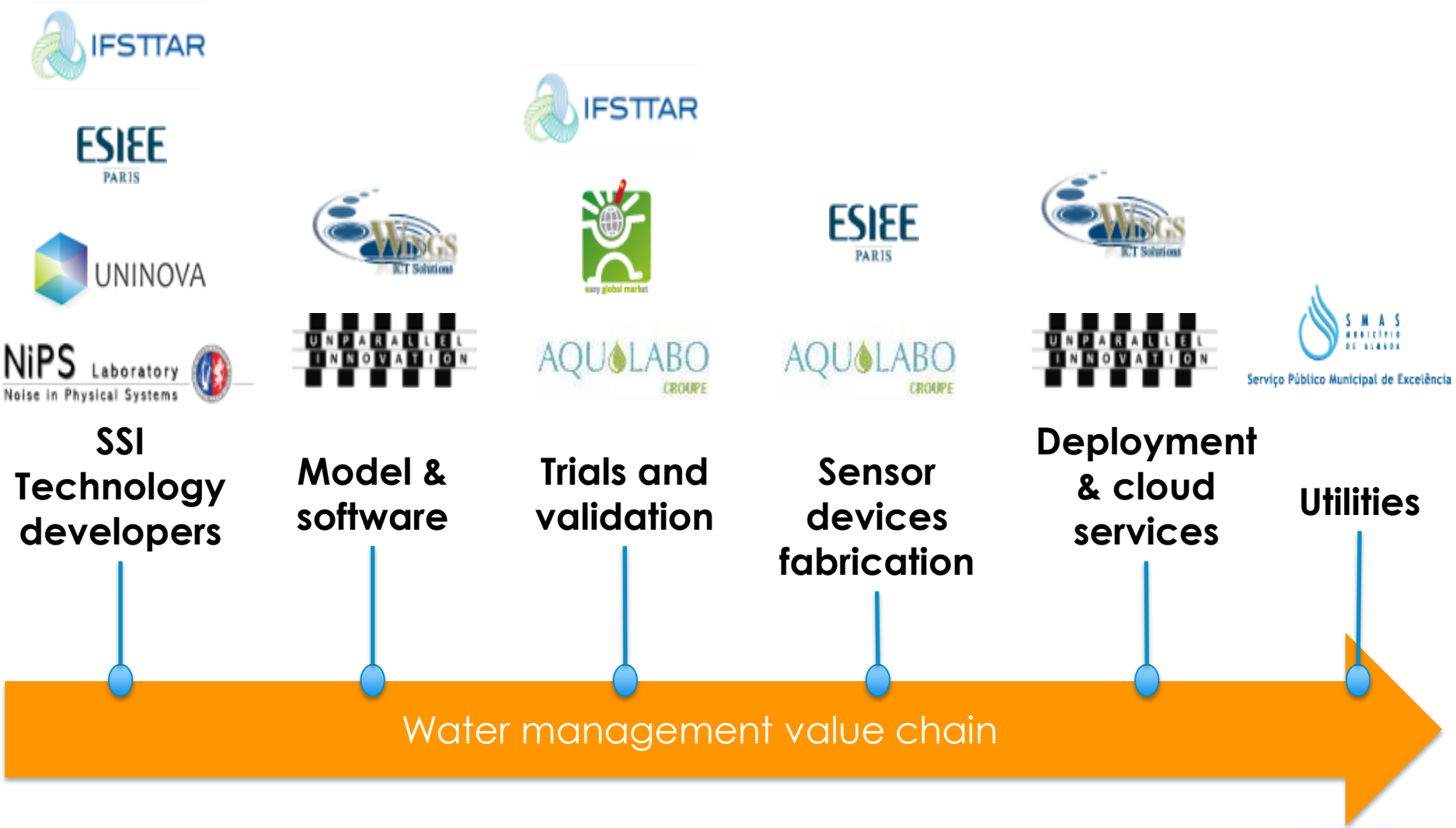
- Enhanced sensing capabilities
- Multifunctionality
- Miniaturization
- Autonomy
- Resilience/ Reliability
- Manufacturability at low cost
- Reduced market penetration & technology transfer

PROTEUS Objectives

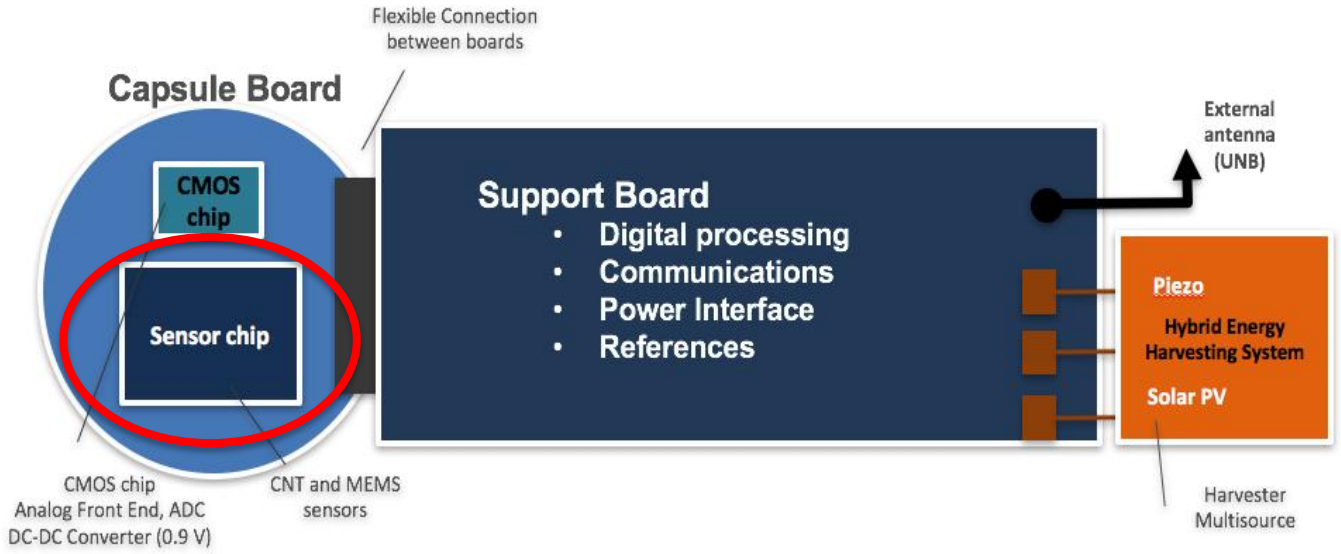
Delivering an **autonomous,** highly **multifunctional MEMS- and nano-enabled** sensor node for **adaptive and cognitive** drink & waste water quality monitoring.

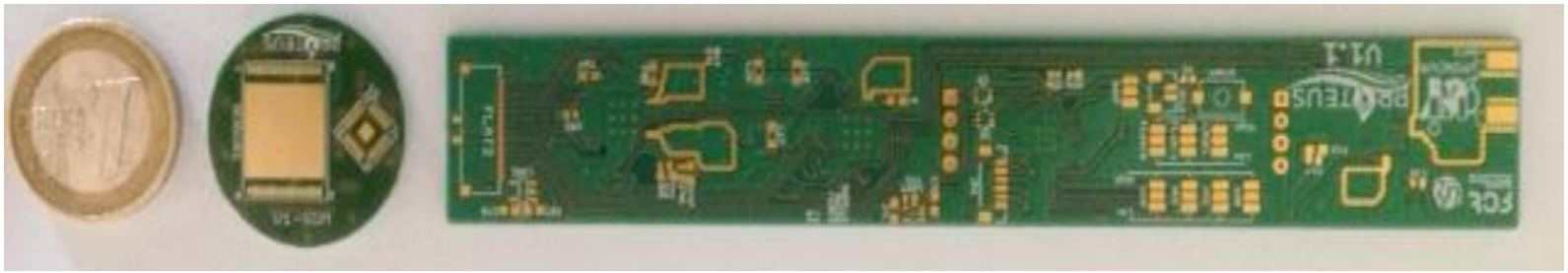


Proteus consortium



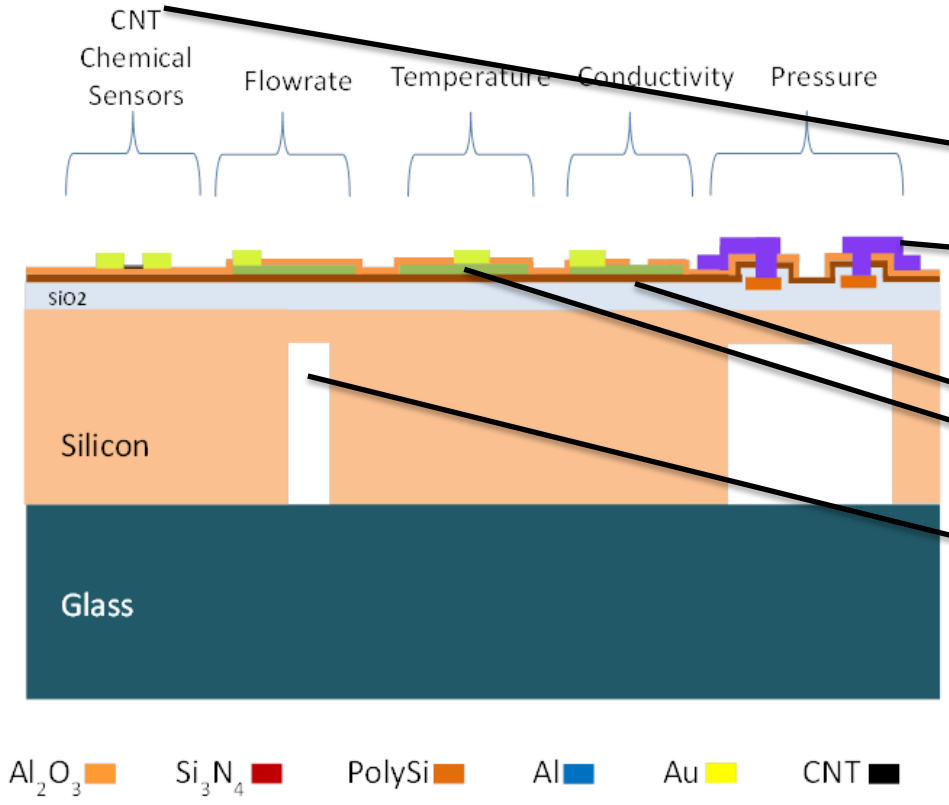
Proteus Node Functionalities



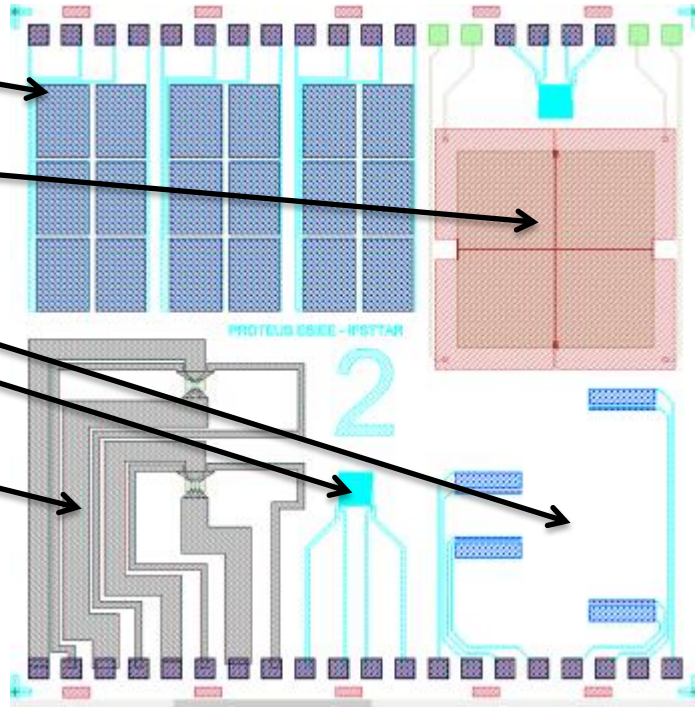


Heterointegration of Nanosensors on a MEMS platform

MEMS sensors : temperature, Conductivity, Flow rate, Pressure



Small footprint MEMS based conductivity sensor



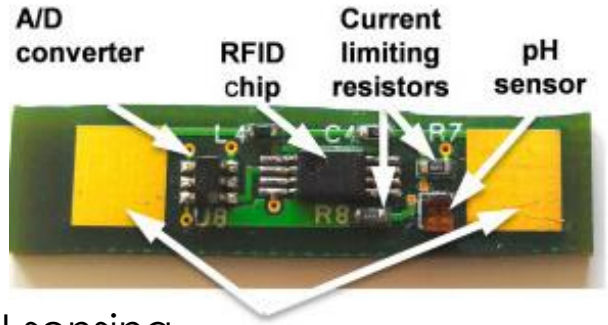
Chemical nanosensors

Carbon nanotubes based chemical sensors: potential for low cost and compactness

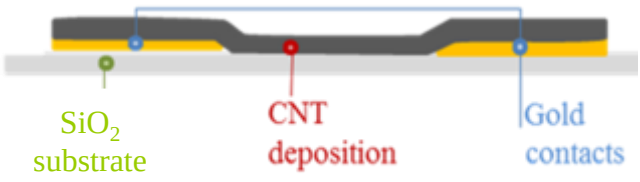
✓ Advantages: high sensitivity & a large range analytes

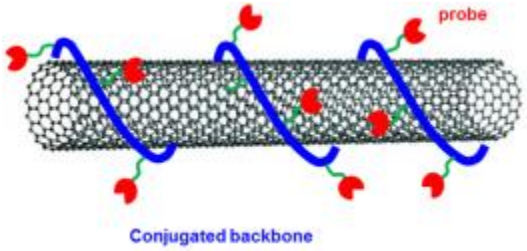
xMain drawback: the lack of selectivity

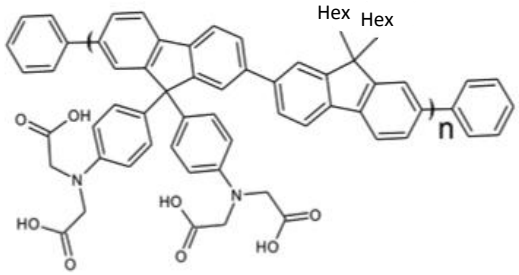
→ solution: functionnalization



pH sensing
Scientific Reports 4 (2014): 4468



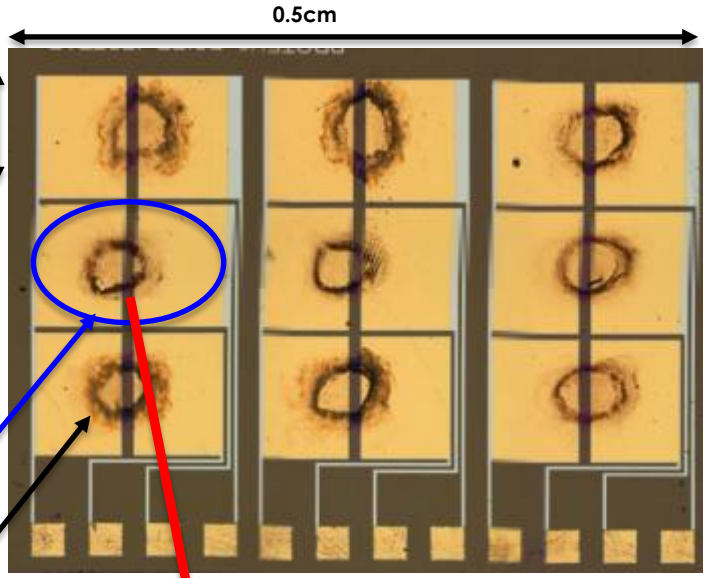




FR1753131 Zuchi et al

CNT sensors : pH, chlorine, chloride, hardness, nitrates

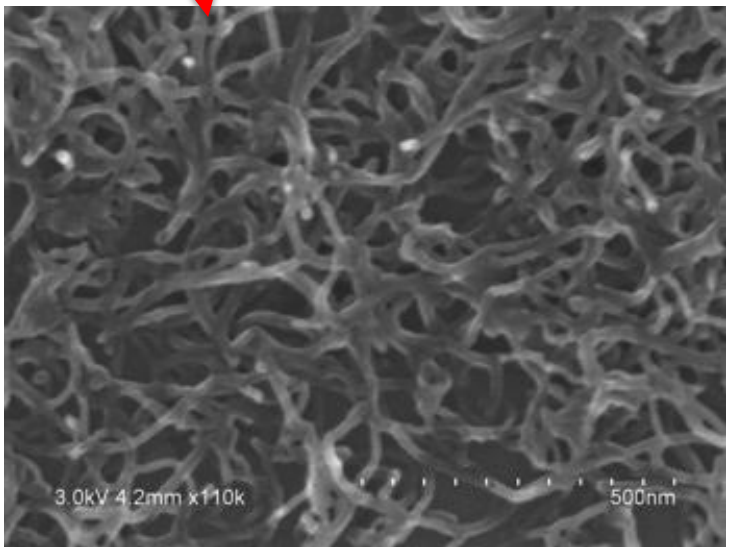
Selective chemical nanosensors

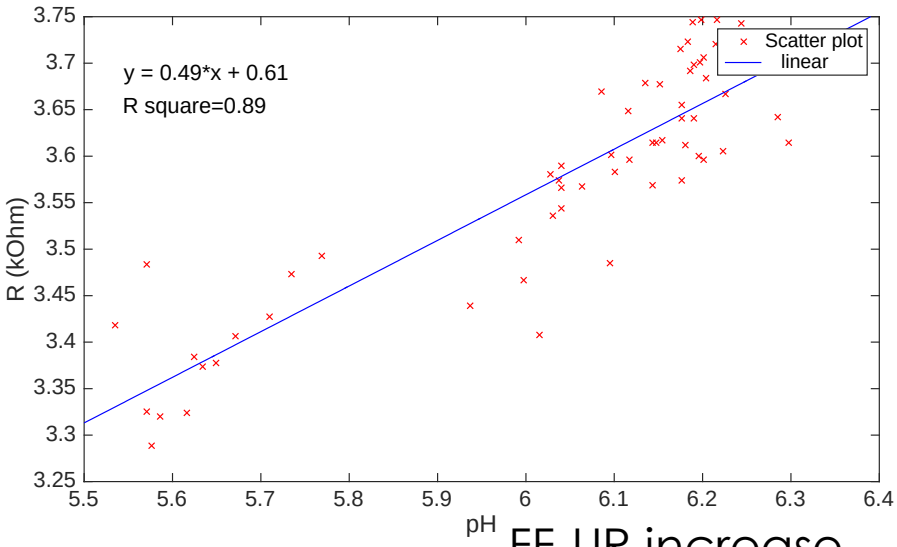


3 polymers,
4 types of CNT sensors,
multiplexing
9 devices

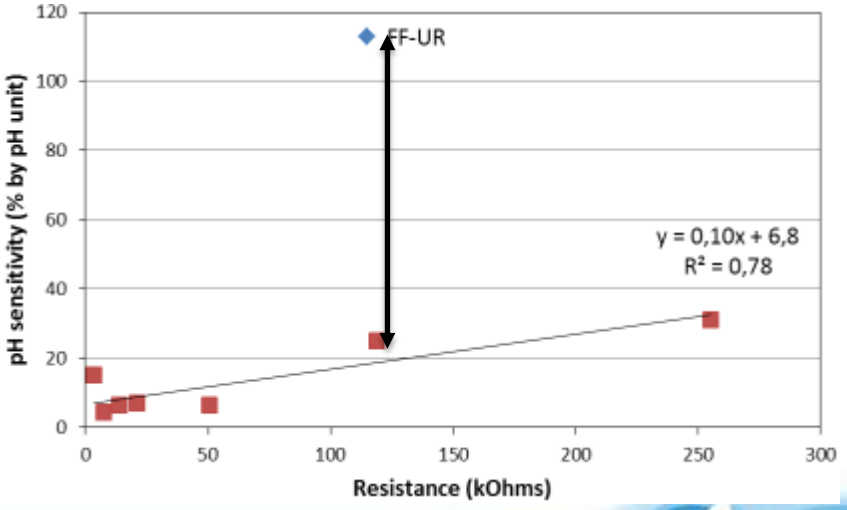
device
0,1mmx1 mm

CNT deposition

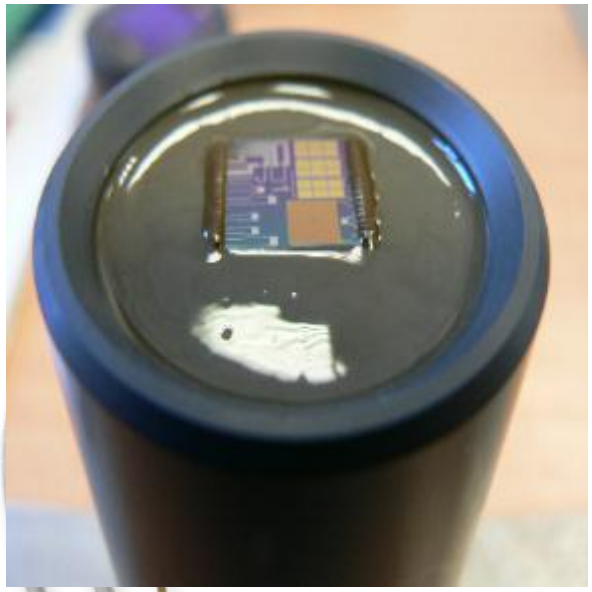




FF-UR increase pH sensitivity 10x

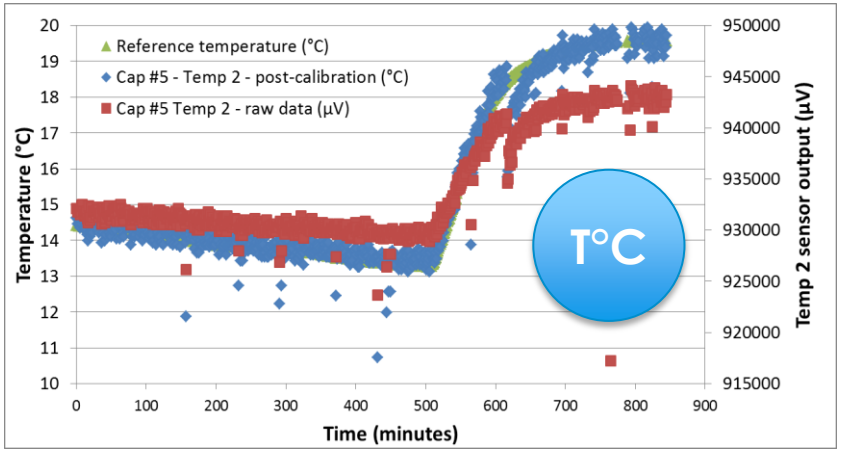


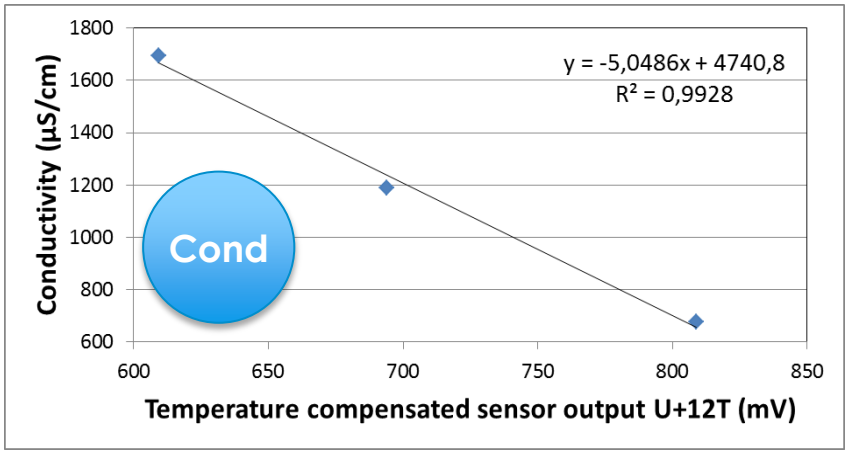
From the lab to the field: system integration in Sense-city (TRL5)

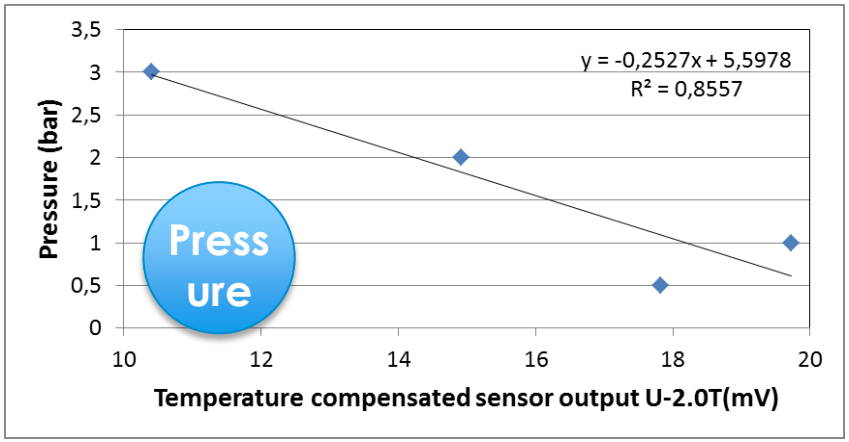


sense CITY

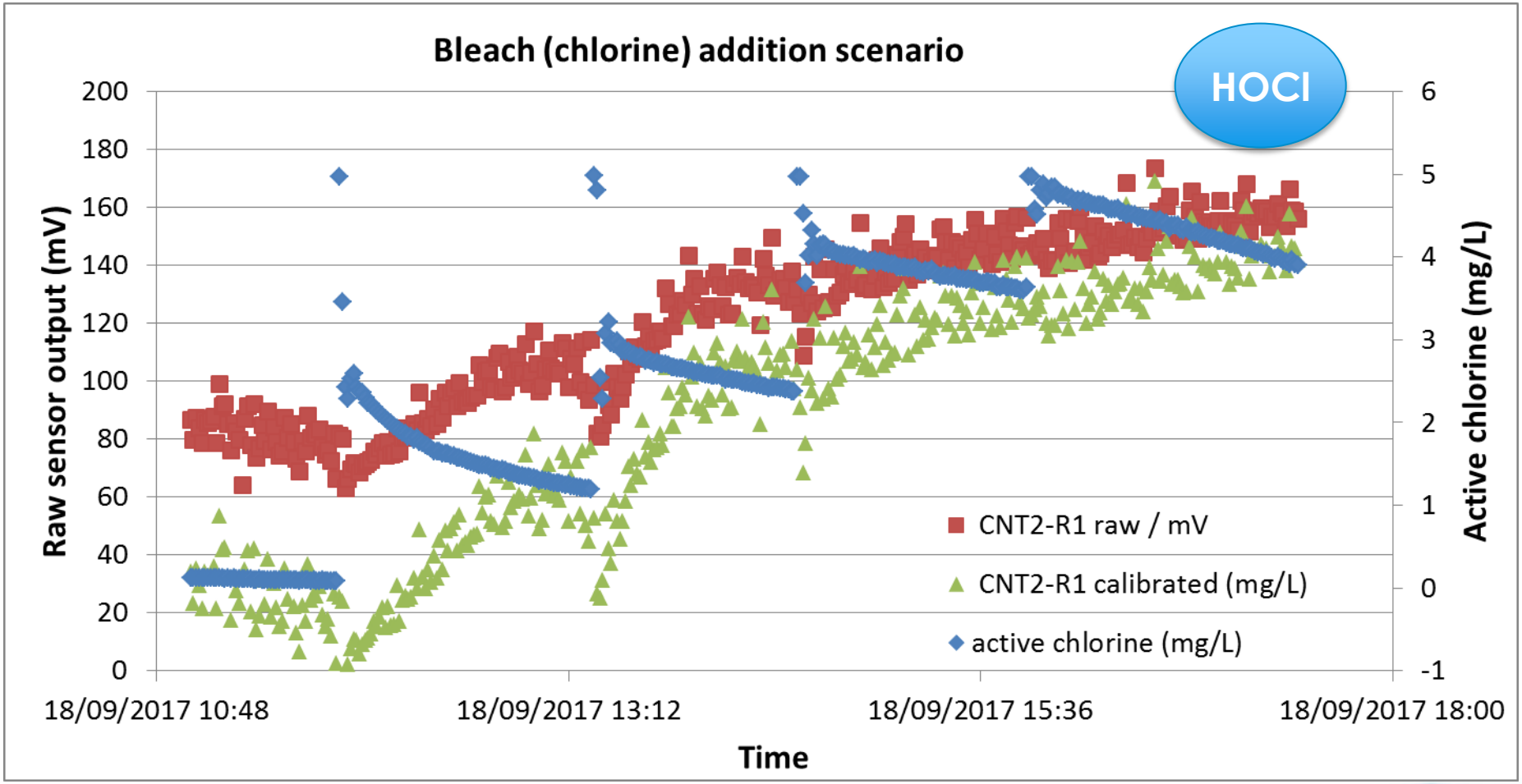
System-level sensitivity validation







System-level sensitivity validation



Conclusions and prospects

- Proteus overcomes the classical challenges of Internet of Things and Nanotechnologies
  - Multiplexing and heterointegration of nanosensors
  - End-to-end system integration up to cloud-based data management with field deployement
  - Field trials of highly innovative technologies (TRL 5)
- Prospects & future challenges
  - City deployment in Almada
  - Analysis of lifetime/reliability/reproducibility

➔industrial transfer in progress

Thank You

Bérengère LEBENTAL

PROTEUS Project Coordinator