



***'Integrated Intelligent  
Sensor System for  
Improved Security of  
Water Supply'***



[WWW.isis\\_project.eu](http://WWW.isis_project.eu)

*This project has received funding  
from the European Union's Seventh  
Framework Programme for  
research, technological  
development and demonstration  
under grant agreement no. 312330*



In modern society citizens expect and rely upon a constant and low-cost supply of clean water that is fit to consume directly from the tap.

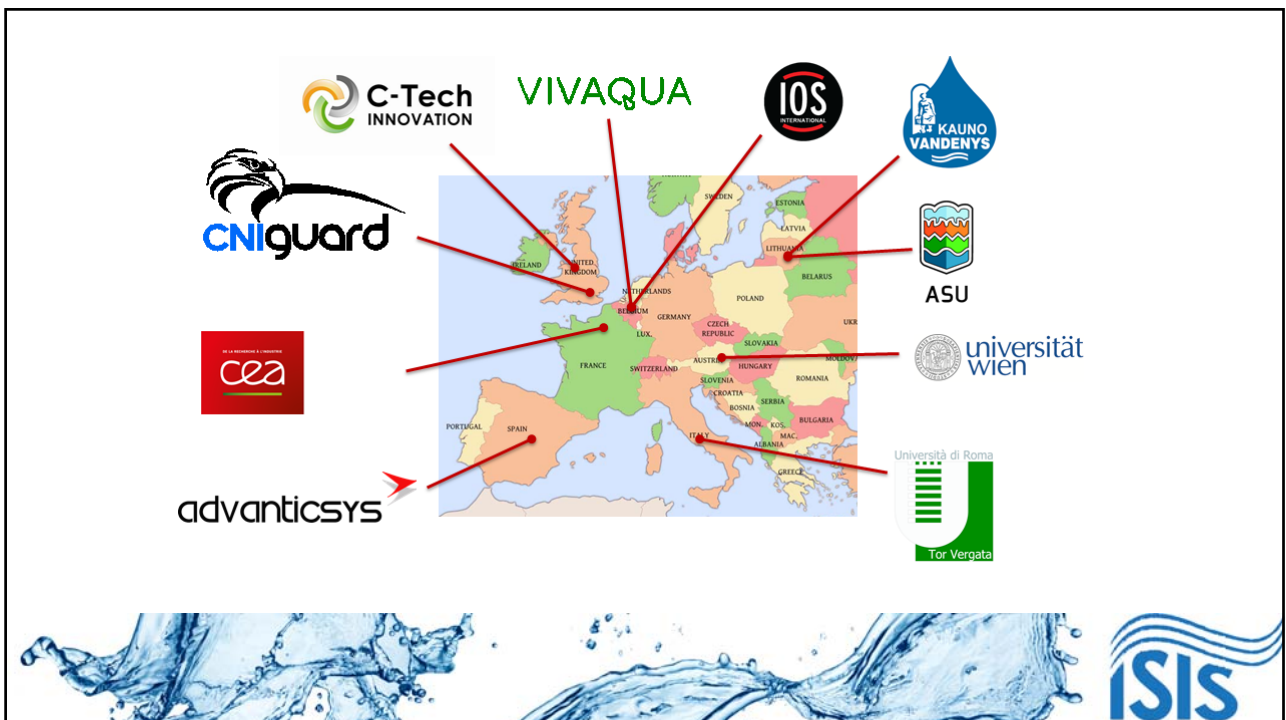


## Project aim

The ISIS project will provide public security by developing an advanced monitoring system for drinking water networks that can detect abnormal chemical or biological contamination and provide a rapid, clear indication of the risk level detected to the responsible authorities.

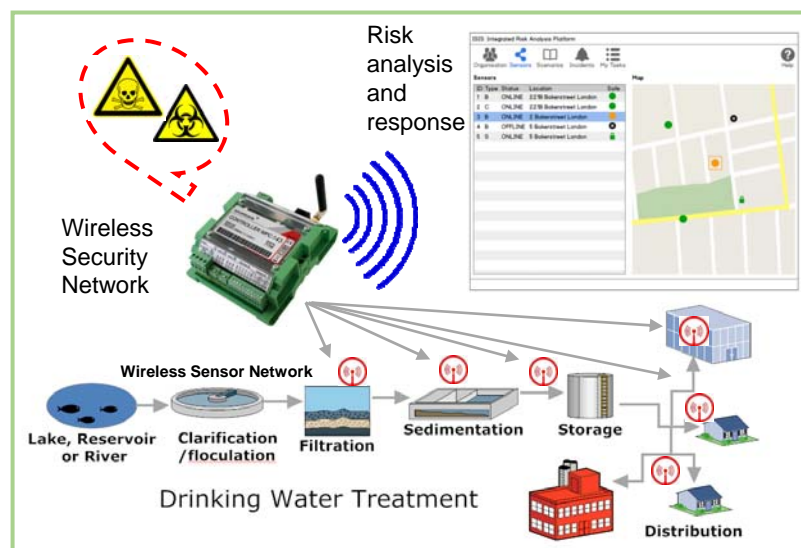
The project has developed and combined advances in the state-of-the-art in:

- Sensors
- Wireless networks
- Integrated risk analysis software.



## Strategic objectives:

- Advance the understanding of security threats in water supply networks;
- Provide a sensor-based water network monitoring capability that gives early warning of contamination;
- Incorporate an intelligent architecture that is capable of analysing the risk and reliably advising directions for an appropriate response.



# Assessing the Risk

## Risk :

- High number of possible entry points
- Higher when closer to the consumer

## Uncertainties :

- Predicting the spreading of the contaminant
- No guarantee to reach the target in a short time



# The dose makes the poison

Toxic Category	LD50 (mg/kg)	Probable lethal Dose (70 kg adult)	Example compounds
Super toxic	<5	<0.35 g	Botulin, Aflatoxins, organophosphorus agents, Hg compounds
Extremely toxic	5-50	0.35-3.5 g	Cyanide

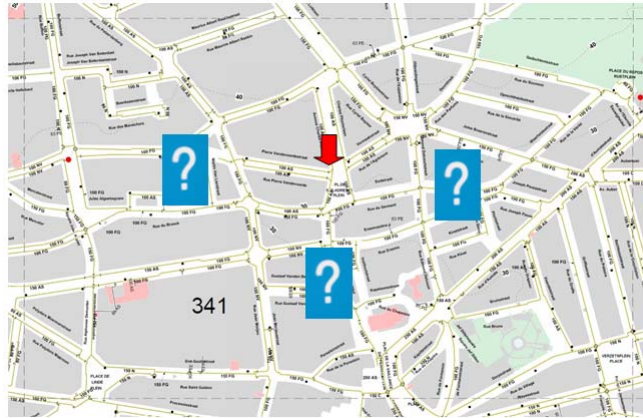
- The levels of the toxic materials in the water must be sufficient to provide a harmful dose “threat” to humans.
- **But,** presence may be sufficient to achieve terror aims





# Understanding the distribution network

- Real time monitoring of substance injected into network
- Modelling of hydraulic network



## How to be quickly aware of an event?

1. Detection: Sensor system
  - *Needs research to develop inexpensive selective, robust sensors/detectors*
2. Transmission of data: gathering the data
  - *Secure wireless transmission from multiple sites to central point*
3. Alarm trigger: warning indication
  - *Interpretation and response*



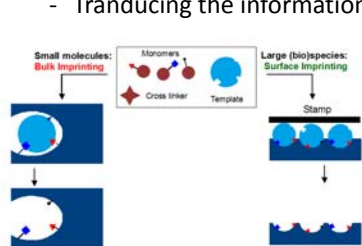
## Challenge 1: Detection

- **ISIS focuses on potential chemical and biological threat materials**
- **Requiring:**
  - Low levels of detection.
  - Detection of a wide range of contaminants (biological, chemical).
  - Some selectivity/discrimination of the contaminants.
  - Fast measurement.
  - Reversibility of detector.
  - Fast transfer of information (for efficient decision-making).
  - Low cost sensors – greater implementation of monitoring

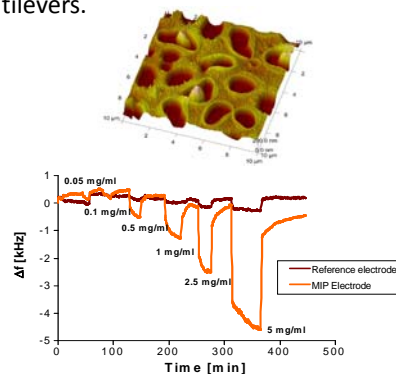


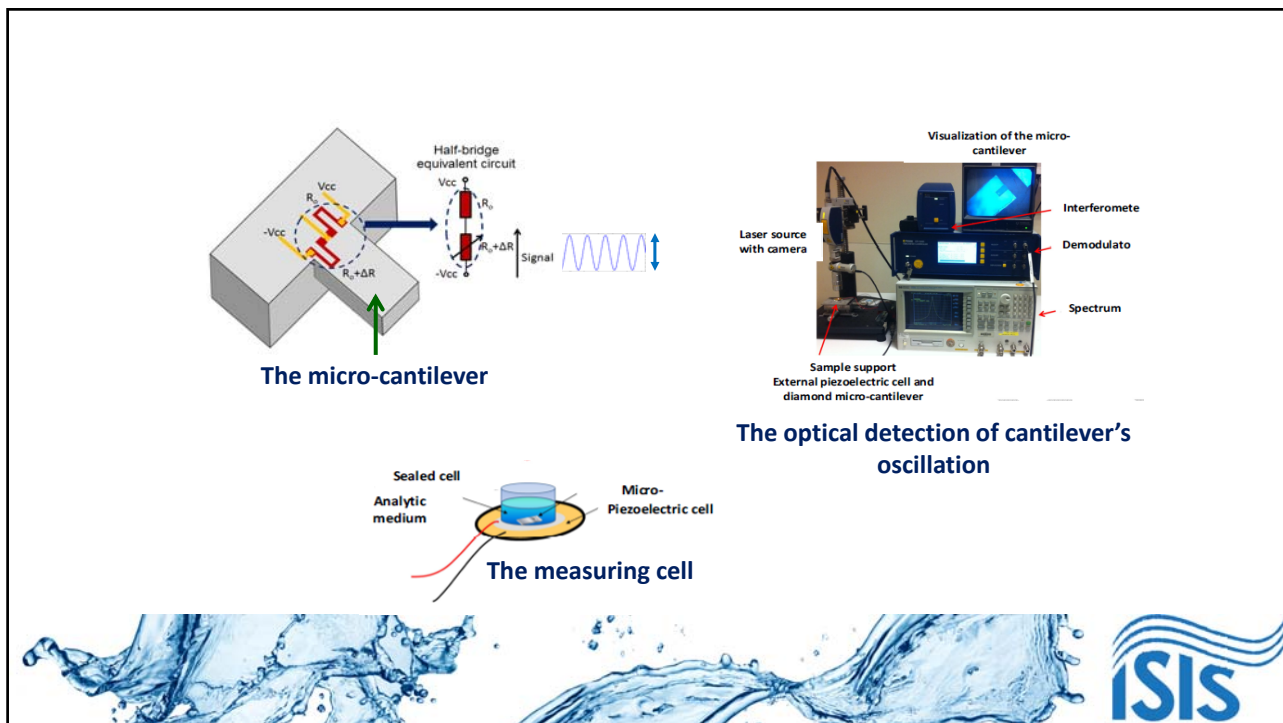
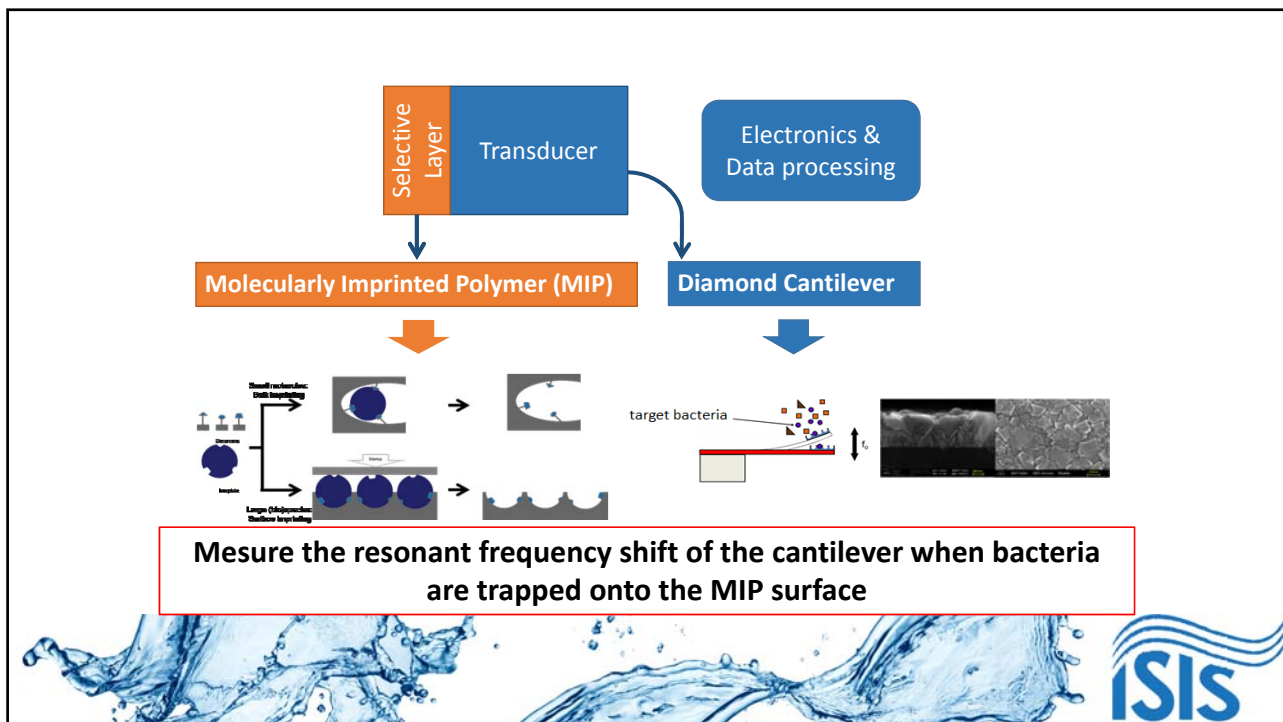
## Challenge 1: Detection

- **Biological sensors:**
  - Capturing biological traces by molecularly imprinted polymers (MIP).
  - Transducing the information using diamond cantilevers.



Size/shape selection for chosen  
Surrogate organisms  
e.g. *Bacillus Cereus* (rod shaped)





## Challenge 1: Detection

**Chemical sensors:** The large number of potential target analytes requires a flexible sensor system able to detect the presence of at least one contaminant. Array of sensors to meet the challenge.

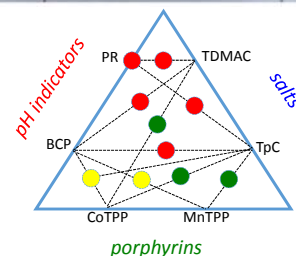
Selection of sensors technologies:

- Opto-electronic tongue
- MOx sensors



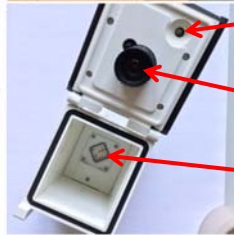
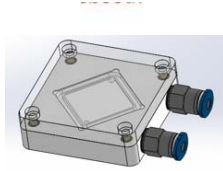
## Opto-electronic tongue

- Measure the change of color of sensing spots
- Sensing array made of combinatorial blends of
  - porphyrins
  - pH indicators
  - ionic salts
- Disposable substrates, no possible reuse
- Can be easily built at high throughput and low-cost





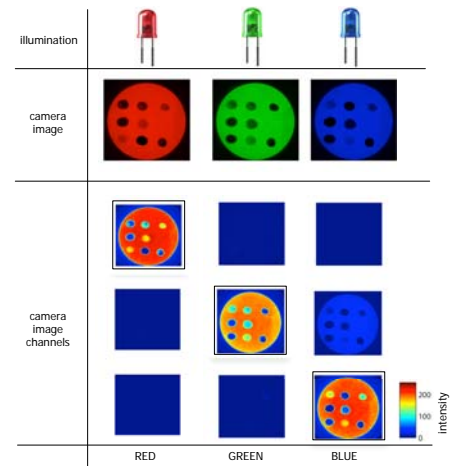
## Opto-electric tongue



Light source

Camera

Sensing array



## Challenge 2: Transmission of data

Sensor Prototypes



Final Rugged Version



Ensure Electronics Compatibility  
Integration into system

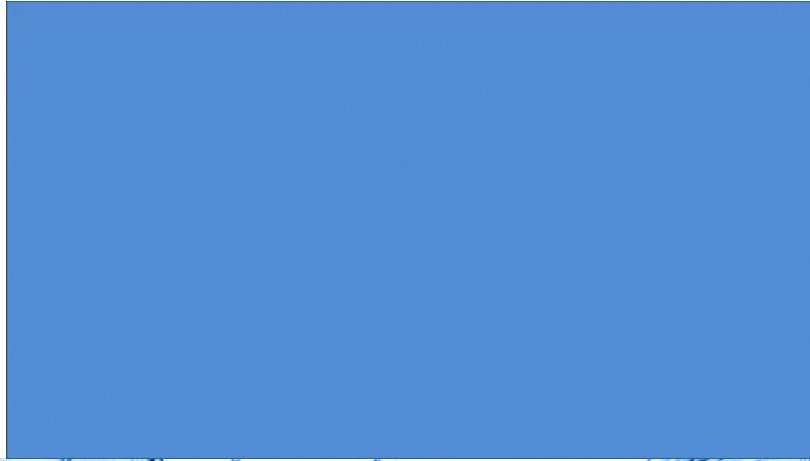


Internet

Remote Access Tests

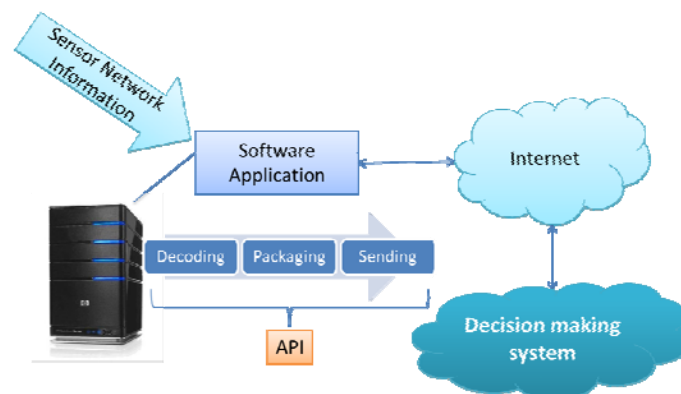


## Challenge 2: Transmission of data



## Challenge 3: Alarm trigger

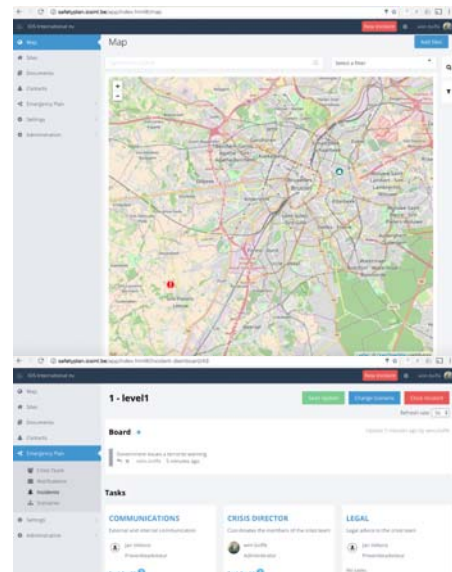
Development of risk analysis algorithms for the integrated security system platform.



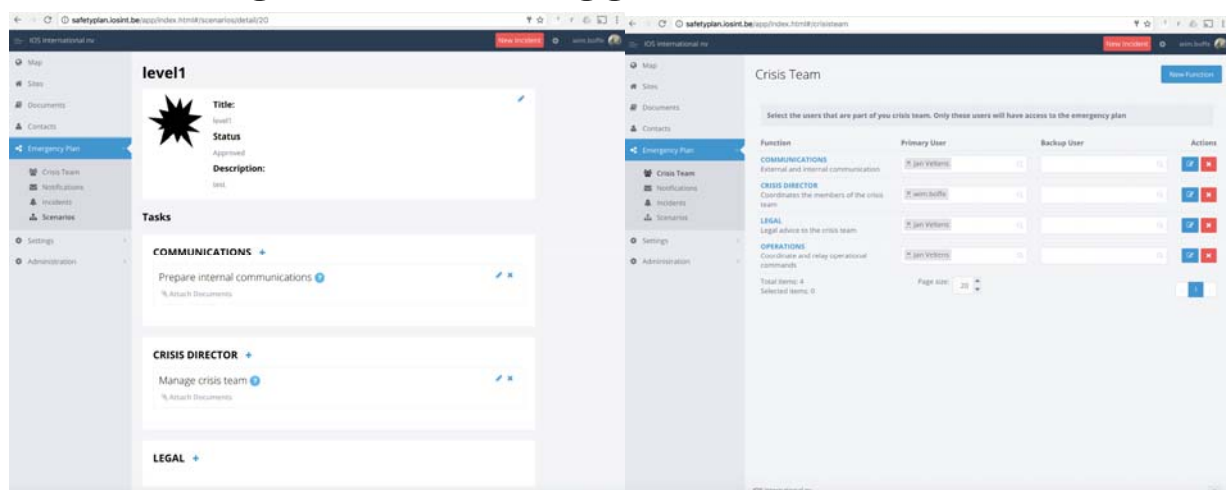
## Challenge 3: Alarm trigger

### INTERPRETATION AND RESPONSE

- Application for the crisis team to:
  - Enable fast response in case of detection (alerting, dispatching)
  - Using actionable information (Impacted zones – local level information)
  - By triggering emergency planning procedures from live sensor data



## Challenge 3: Alarm trigger



## Summary

To protect water supplies the suppliers/authorities need to:

- Understand the potential threats and vulnerabilities to the water network system.
- Have the tools to detect abnormalities over a wide area (low cost sensors).
- Be able to securely receive the data in real time (fast reliable data transfer).
- Have intelligent systems capable of monitoring and interpreting the data.

**The ISIS project has paved the way to new chemical and microbiological sensor systems for water**



**Thank you for  
your attention**



VIVAQUA



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