



Redes de sensores e actuadores sem fios: exemplos de aplicações industriais e de experimentação remota

*Wireless Sensor and Actuator Networks:
examples of industrial applications and remote experimentation*

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Overview

- WSAN overview
- GINSENG FP7 Project
- Industrial Application - Petrogal Refinery (Sines)
- Remote Experimentation
- Conclusions

WSAN overview

– New challenges

- ▶ Internet is increasing
- ▶ Remote access
- ▶ Quality of Service
- ▶ Security
- ▶ Multicasting
- ▶ Mobility
- ▶ ...

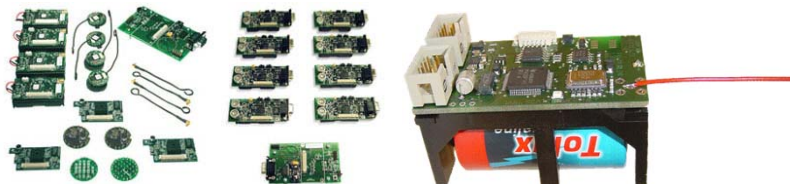
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WSAN overview

– Wireless sensors and actuators

Example: **Crossbow's TelosB mote** (TPR2400):

- ▶ an open source platform designed to enable cutting-edge experimentation
- ▶ The TPR2400 bundles all the essentials for lab studies into a single platform including:
 - USB programming capability,
 - an IEEE 802.15.4 radio with integrated antenna,
 - a low-power MCU with extended memory
 - and an optional sensor suite (TPR2420).



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WSAN overview

– Sensor nodes

- ▶ One or more integrated sensors
- ▶ ADC with inputs for external sensors
- ▶ DAC with outputs for external actuators
- ▶ Small processors
- ▶ Low memory
- ▶ Low battery
- ▶ Low transmission rates

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WSAN overview

– What is a WSAN?

- ▶ New class of distributed systems
- ▶ Physical-world-aware networked systems
- ▶ Networks of many different types of sensors and actuators
 - Seismic
 - Magnetic
 - Thermal
 - Visual
 - Infrared
 - Acoustic
- ▶ Able to monitor and supervise a wide variety of distributed systems

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WSAN overview

– Wired or Wireless?

- ▶ Critical infrastructures rely on wired sensors for monitoring and control operations

- Chemical manufacturing plants
- Oil refinery
- Burglar alarms
- Fire alarms
- ...

- ▶ They are expensive

- To deploy
- To maintain (upgrade, replace)
- Wires introduce failures
- Wires are Costly



- ▶ **Wireless Networks are more cost effective**

GINSENG FP7 Project



– GINSENG Role and Strategic Objectives

- ▶ **Considering** that WSAN is lower-cost, easy to deploy and reconfigure solution for monitoring and control
 - Must operate deterministically and integrate with IT systems infrastructure
- ▶ **Problem** with today's technology it is not possible to control and give guarantees regarding essential performance parameters of wireless sensor networks!
- ▶ **Solution** with the contribution of GINSENG.

GINSENG is developing WSN technology that:

- ▶ meets *application-specific performance targets*,
- ▶ integrates with *industry resource management systems*,
- ▶ *is proven in a real industrial setting* where performance is critical.



The performance-focused goal of GINSENG means that the project scientific objectives are naturally amenable to being both measured and verified.

GINSENG FP7 Project – Industrial Application



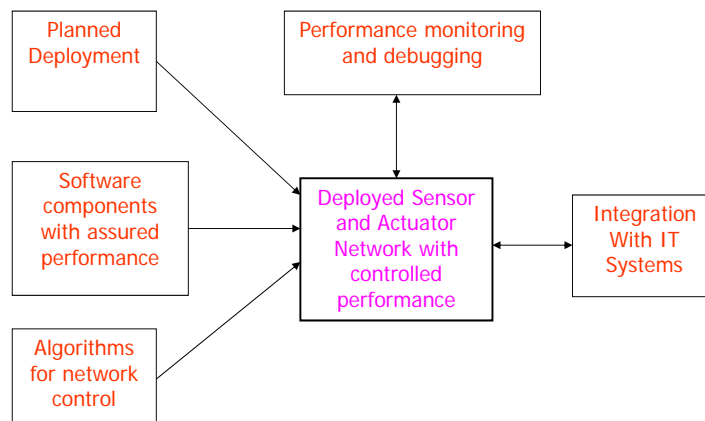
▶ Petrochemical Industry – monitoring and actuating

- Constant monitoring of pipes (e.g. pressure)
- Close valves before critical condition is reached
- Reduces maintenance effort and production cost



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GINSENG FP7 Project – GINSENG Approach



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GINSENG FP7 Project

– GINSENG Challenges



- ▶ Definition of appropriate performance metrics and a network architecture that embodies performance control
- ▶ Conceiving algorithms for network design and operation that are performance-aware, especially in regard to topology and quality of service (including overload management)
- ▶ Developing operating system and protocol software that offers predictable response times
- ▶ Design of new tools for network lifetime estimation and performance debugging
- ▶ Middleware to integrate with IT systems in a seamless manner, and application-aware algorithms for data processing
- ▶ Planning, managing and measuring a real-world deployment

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GINSENG FP7 Project

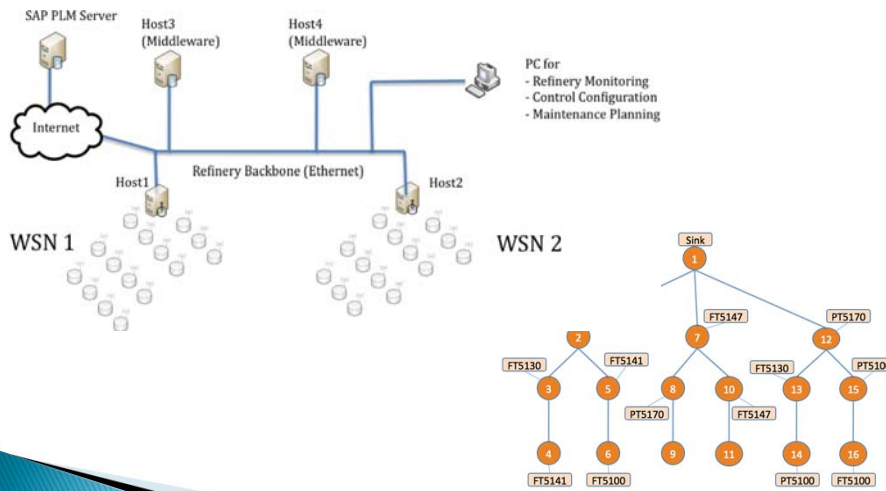
– Testbed at LIIS – FCTUC



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GINSENG FP7 Project

- Industrial Application, Testbed at Petrogal

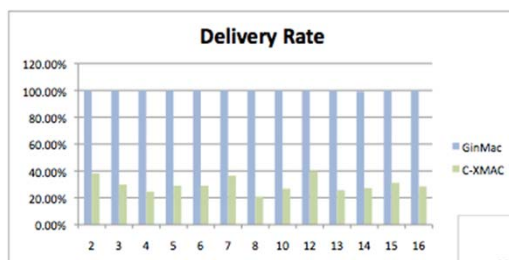


PC for
- Refinery Monitoring
- Control Configuration
- Maintenance Planning

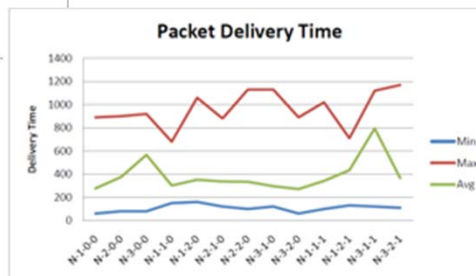
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GINSENG FP7 Project

- Industrial Application, Some results



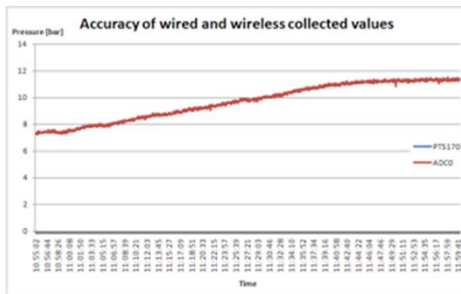
Delivery Rate and Time



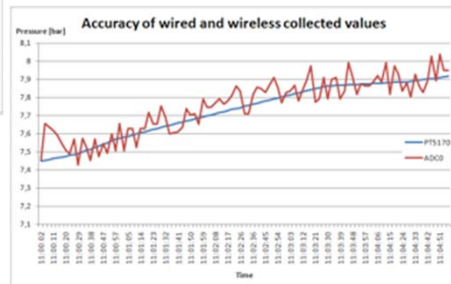
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GINSENG FP7 Project

- Industrial Application, Some results



Accuracy



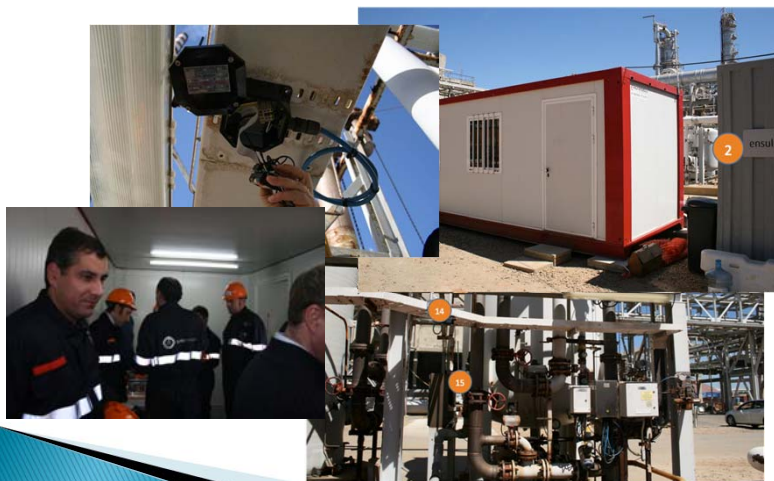
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GINSENG FP7 Project

- Industrial Application, Petrogal



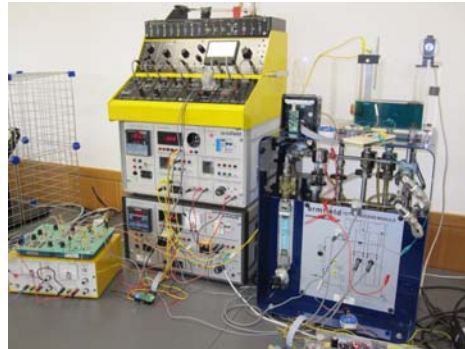
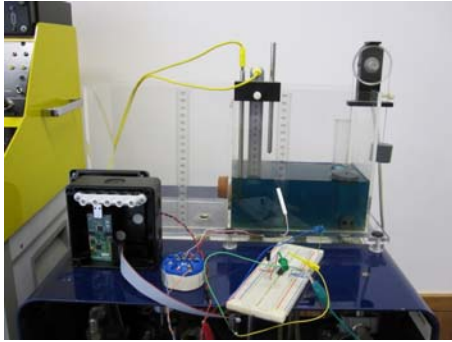
Scenario scenes



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Remote Experimentation – Example of Application

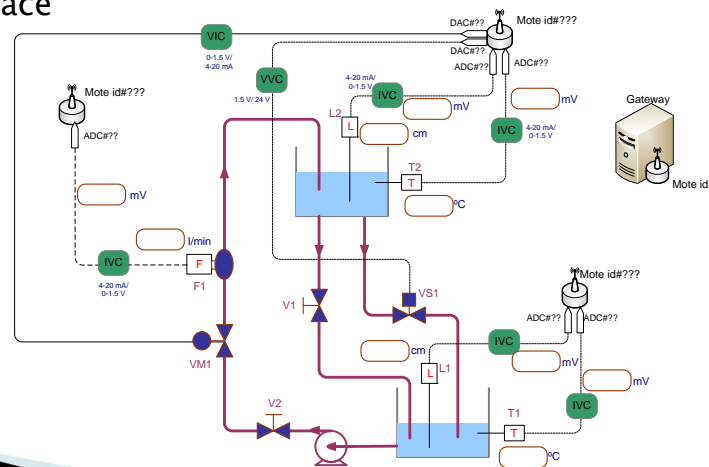
- ▶ Monitoring and controlling systems



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Remote Experimentation – Example of Application

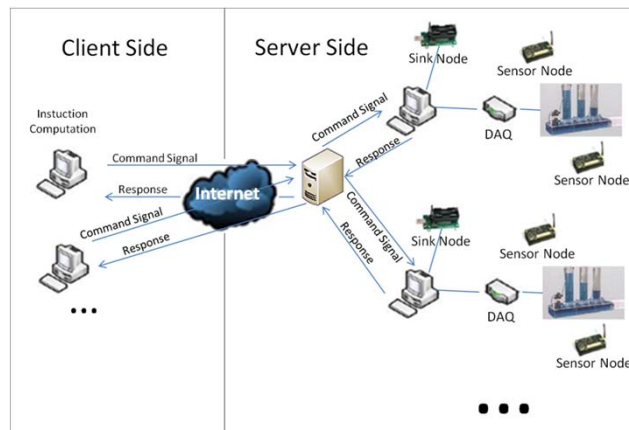
- ▶ Interface



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Remote Experimentation – Example of Application

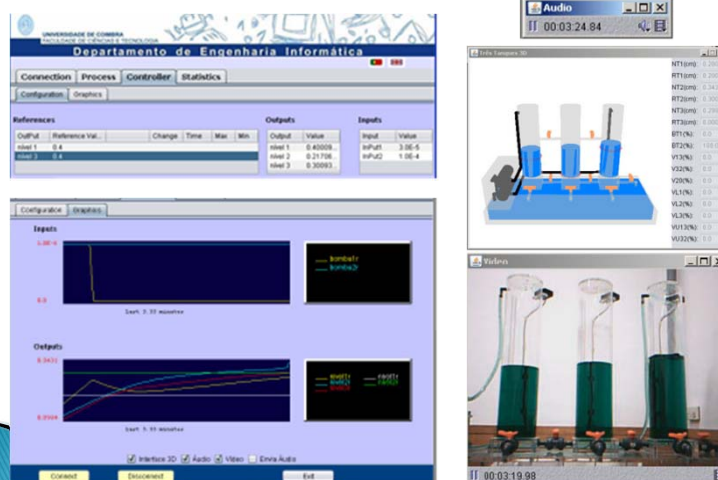
- ▶ Server - Client topology for Remotely Controlled Systems



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Remote Experimentation – Example of Application

- ▶ Remote Control of the three-tank system



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Conclusions

- ▶ WSN more reliable, secure and robust
- ▶ Increased use in different scenarios
- ▶ Several industrial applications
- ▶ Various applications for remote experimentation
- ▶ New developments are needed

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Thank you for your attention.

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