

# GENESI



## Green sEnsor NETworks for Structural monitoring

*GENESI develops structural health monitoring systems for critical infrastructures such as tunnels, bridges, dams, private and public buildings, providing cutting edge green wireless sensor networks technology*

**KEYWORDS:** structural health monitoring, energy harvesting, wireless sensor networks

## Introduction

*Monitoring systems* are common place wherever a building or a structure is built and an invaluable tool where surveillance and hazard detection are needed. Production plants, bridges, tunnels and other transportation structures, as well as building for public and private dwelling, are often provided with heterogeneous, collaborating devices capable of *sensing* the current condition of the structure, *report* information to data collection and elaboration points, and sometimes even *enact* needed maintenance, repair or other suitable actions.

*Wireless sensor networks (WSNs)* provide the right technology for enabling structural health monitoring systems that are more pervasive and more easily deployable than current (wired and expensive) systems. However, in current WSN-based monitoring systems nodes are battery powered, which limits the *lifetime* of the network, i.e., the duration of the services it provides.

The **GENESI** project has the ambitious goal of bringing WSN technology to the level where it can provide the core of the next generation of **systems for structural health monitoring** that are **long lasting, pervasive** and totally **distributed** and **autonomous**. This goal requires embracing engineering and scientific challenges never successfully tackled before. Sensor nodes will be redesigned to overcome their current limitations, especially concerning energy storage and provisioning (we need devices with virtually infinite lifetime) and resilience to faults and interferences (for reliability and robustness). New software and protocols will be defined to fully take advantage of the new hardware, providing new paradigms for cross-layer interaction at all layers of the protocol

stack and satisfying the requirements of a new concept of *Quality of Service (QoS)* that is application-driven, truly reflecting the end user perspective and expectations.

## Objectives

GENESI will:

- Develop *long lasting* sensor nodes by *combining* cutting edge technologies for energy generation from the environment (*energy harvesting*) and green energy supply (*small factor fuel cells*).
- Achieve *robustness* and *energy efficiency* through the integration of low power radio front ends, radio triggering circuit, and energy-efficient, fault tolerant, robust to interference, adaptive protocols and algorithms.
- Define *models* for energy harvesting, energy conservation in super-capacitors and energy availability through fuel cells.
- Design new *algorithms* and *protocols* for dynamic allocation of sensing and communication tasks to the sensors.
- Design *communication protocols* for large scale heterogeneous wireless sensor/actuator networks with energy-harvesting capabilities.
- Define distributed *mechanisms for context assessment* and *situation awareness* enabling a node to collaboratively determine the status of the environment in its particular region of the network and whether something new and important for the application has happened.
- Develop light machine learning-based mechanisms for predicting environmental behaviour and its possible changes, triggering adaptation in the

system behaviour.

These objectives will be achieved bringing the *end users into the research cycle* from the get go. Gather requirements from their experience, receive continuous feedback through all the research phases and assist them on the exploitation of the developed monitoring systems is the methodology followed by GENESI.

## Expected Results

- A new generation of GENESI wireless sensor nodes including multi-source energy harvesters, small factor fuel cells, and energy efficient RF front end with radio triggering capability.
- Protocols and algorithms exploiting the new HW features, performing HW/SW joint optimizations to maximize user perceived satisfaction and to meet application driven QoS requirements.

## Partners and their roles

**University of Rome La Sapienza:** project coordinator, leader of WP4 on "Collaborative and Reliable Networking"

**University of Twente:** leader of WP5 on "Collaborative in-network data processing and reasoning"

**University of Bologna:** leader of WP3 on "Green Sensor Platforms"

**ST Microelectronics:** leader of WP7 on "Dissemination and Exploitation"

**Tyndall:** leader of WP2 on "System architecture and requirements"

**Solexperts:** leader of WP6 on "Integration, deployment, and validation"

**Treesse:** end user

## CONTRACT NUMBER

Project number: 257916

## FULL NAME

Green sEnsor NETworks for Structural monitoring

## TYPE OF PROJECT

STREP

## PROJECT PARTICIPANTS

University of Rome La Sapienza  
University of Twente  
University of Bologna  
ST Microelectronics  
Tyndall  
Solexperts  
Treesse

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## PROJECT WEBSITE

<http://genesi.di.uniroma1.it/index.php>

## BUDGET

Total cost: € 3.009.859  
Funding: € 2.000.000

## TIMETABLE

Starting date: April 1<sup>st</sup> 2010  
Duration: 36 months

This project is part of the portfolio of the

Embedded Systems Unit – G3  
Directorate General Information Society

For more information please check:

<http://cordis.europa.eu/ist/embedded>