Wireless Sensor Networks and Cooperating Objects: Trends and Challenges

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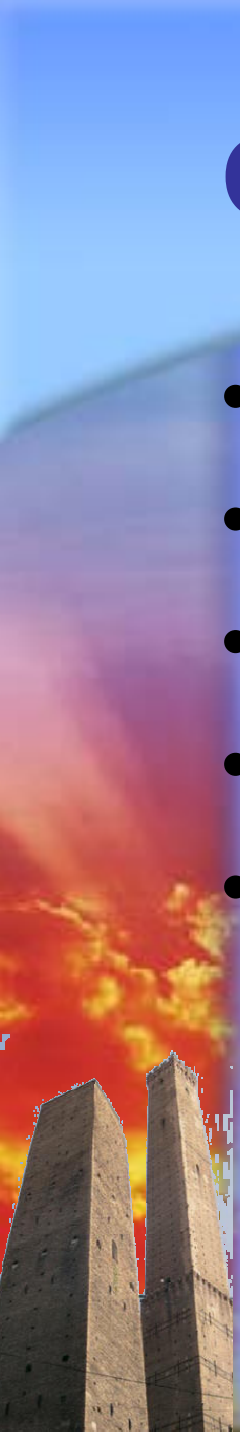
DG Information Society and Media

G3 Embedded Systems and Control

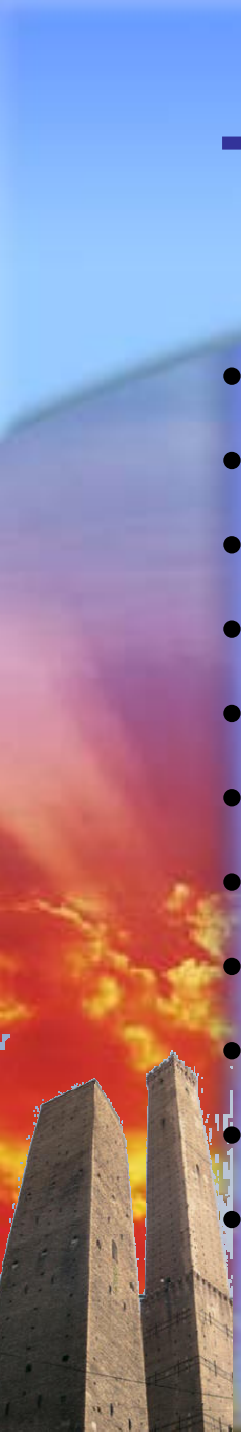
Outline

- Trends
- Challenges
- Applications
- EU-funded Research
- Open Consultation



Trends in WSNs

- Mobility
- Large Scale Deployments
- Complexity
- Heterogeneity
- Varying Data Rate/Duty Cycle
- Localisation
- Miniaturization
- Lower Cost
- Drop-and-Forget
- Energy Management
- Energy Harvesting/Scavenging



Trends in WSNs:
from Monitoring to effective Control

From (Heterogeneous) **Sensing** to…

… **understanding** of the underlying phenomena to…

… **modelling and simulation** to…

… informed data fusion to…

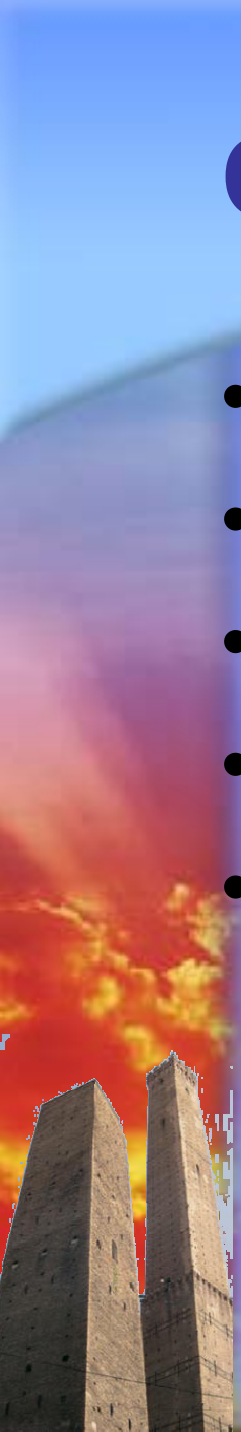
… **expert systems** to…

… effective **control** (open or closed loop)

Characteristics of a WSN

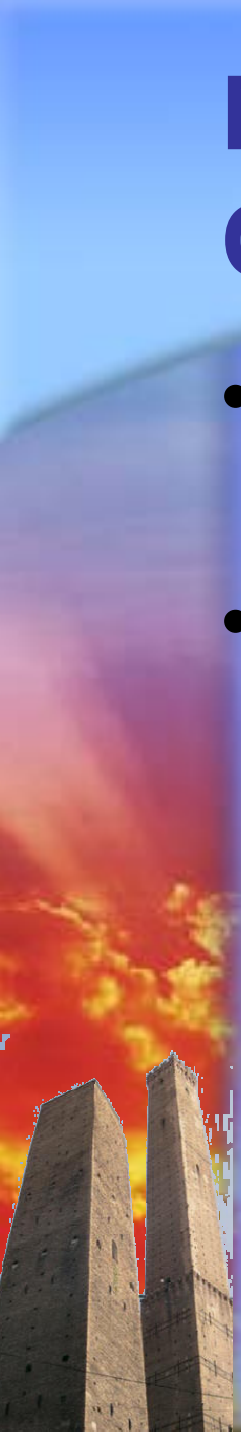
- Unattended operation
- Harsh environmental conditions
- Node failures
- Dynamic network topology
- Communication failures

➢Intrinsic need for cooperation…



Most critical Trend in WSNs: Cooperation

- From independently operating to cooperating sensors
- Making the most of Heterogeneity and “Diversity” in order to improve sensing… and eventually actuation



The ultimate Trend: *The Internet of Things*

- The Internet is exploding
  - 10^9 computers
  - 10^{10} mobile devices
  - **10^{12} Smart Things**
- Their level of connectivity will vary tremendously, the same with their requirements
- Most of the traffic will be peer-to-peer (but it will not be music) and remain rather local

The future of the Internet?

- It is NOT about a new protocol (beyond IP), and it is NOT about standardisation (a la ITU)
- It is all about HEREROGENEITY and controlled/on demand connectivity

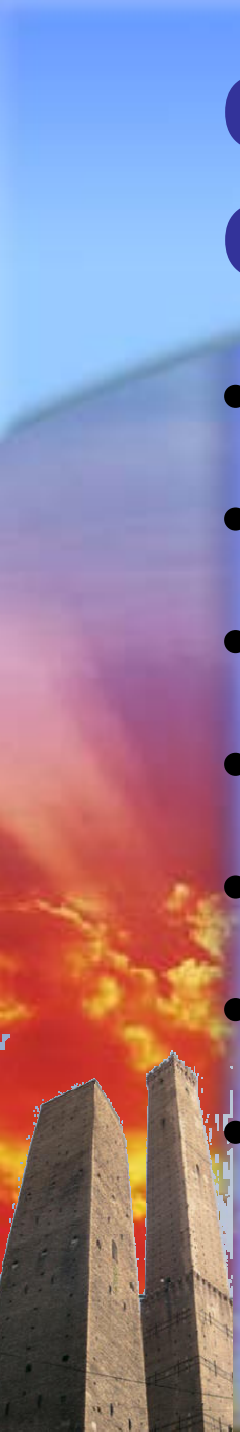
WSNs and Cooperating Objects have a major role to play!

Challenges

- Lifetime maximization
- Robustness and fault tolerance
- Self-configuration
- Security
- Mobility
- Middleware
- Localisation
- Privacy
- Data Visualisation

Challenge #1: Operations and Management

- Pre-configuration
- Deployment
- Operations
- Maintenance
- Management
- Re-configuration
- (Disposal)



Applications

- Medical
- Environment Monitoring
  - Air/water/soil Quality
  - Agriculture and Forestry
- Protection of Critical Infrastructures
  - Power Grid
  - Gas
  - Communications
  - Water
- Security and Safety

R&D on a ubiquitous sensor network

Budget in FY2005:400 million yen, R&D Period: 3 years from FY2005 to 2007

What is a Ubiquitous Sensor Network?

To realize an autonomous wireless distribution of information among sensors by embedding ultra-compact wireless devices in various sensors.
(Features) Can recognize the situation by using sensors and can apply necessary applications in real time.

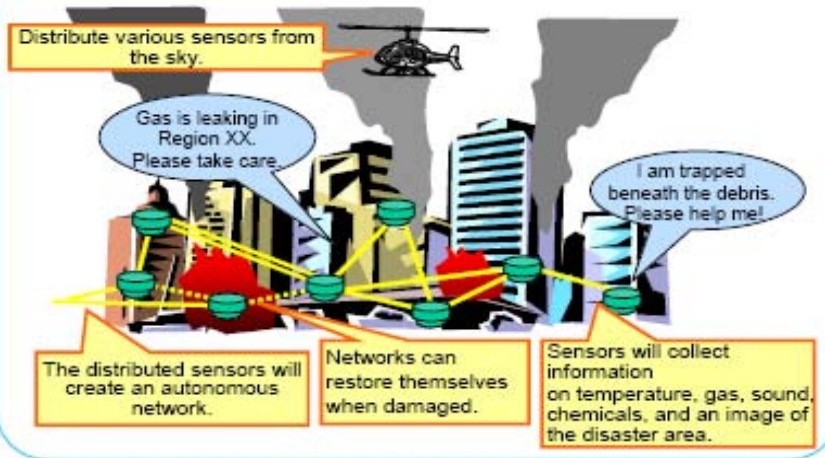
Features and Images of Use

1)Recognize the environment by combining the information from various sensors that are linked.

2)Use the network to control the networked area without constraints.

3)Can place sensors anywhere and construct a network wherever sensors are placed to offer services and maintenance. (No need to consider construction elements)

4)Used widely as a life supportive tool by anyone.



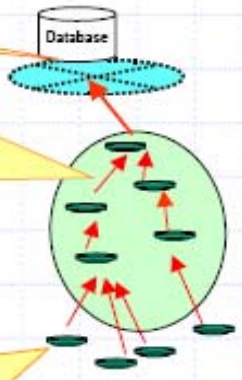
Contents of Technological Developments

Execute R&D for basic technologies for three years from FY05. R&D will be on an autonomous distribution of information among the sensors.

Processing and controlling large capacity data in real time
- -Control and search sensored data
- -Extract meaning of real time information
- -Process the sensored information appropriately in the sensor, network and upper system levels

Control and monitor the sensor network
- -High speed tracing to diagnose defects in a large number of remote sensors, and self-restoration of networks.
- -Identify the location of sensors and control their ID codes
- -Find and construct a network automatically with communicative sensors.

Technologies for ubiquitous sensor nodes
- -Prevents interference and unnecessary communications
- -Self-corrects errors
- -Synchronizes data
- -Implements Micro-electro Mechanical Systems (MEMS)



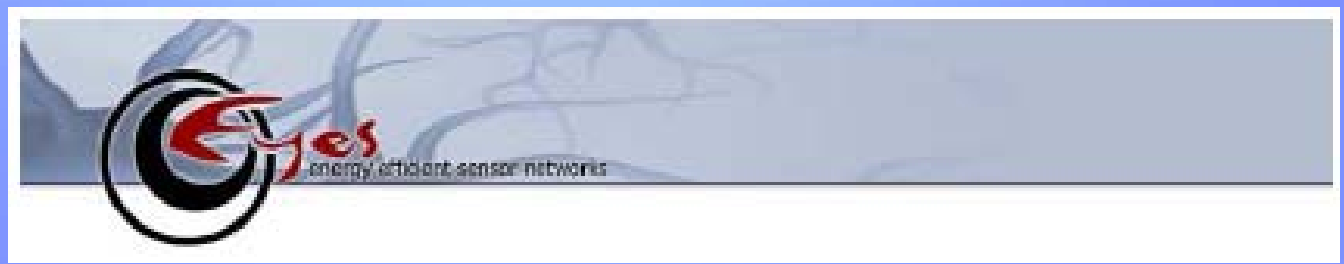
Source: Ministry of Internal Affairs and Communications

R&D in WSNs

- Ad hoc and Meshed Networks
- Wireless Sensor Networks
  - *IEEE ComSoc Conf. on Sensor, Mesh and Ad Hoc Communications and Networks – SECON*
  - *IEEE Intl. Workshop on Wireless Ad-hoc and Sensor Networks – IWWAN*

EU-funded Research in FP5

- Mobile and Wireless Communications
  - Ad hoc and Meshed Networks
- Computing, Communications and Networks
  - WSN
    - EYES: Energy Efficient Sensor Networks



EU-funded Research in FP6

- Mobile and Wireless
  - Ad hoc, Meshed
    - AdHocSys
    - Fireworks
  - WSNs
    - e-SENSE
    - CRUISE
    - NEWCOM
- Embedded Systems
  - WSNs
    - ANGEL
    - Embedded WiSeNts
    - RUNES
    - SENSE
    - µSWN
    - WASP
  - Cooperating Objects
    - AWARE
    - CoBis
    - GREX

Strategic Objective
WSNs and Cooperating Objects

- WSNs
  - TWO orders of magnitude more sensors
  - HALF the maintenance time and cost
  - ONE order of magnitude less effort
- Cooperating Objects
  - spontaneous cooperation of objects in spatial proximity in order to jointly execute a given task
- New services and applications tailored to specific needs

EU-funded Research in FP7

Call 1 – Challenge 1

- **WSNs**
  - **SENSEI**

Call 2 – Challenge 3

Networked Embedded and Control Systems

- **WSNs Applications**
  - **Smart Homes and Home-care**
  - **Video Surveillance; Underwater inspection**
  - **Home Automation and Energy-Efficient Buildings**
  - **Automotive and Aerospace**
  - **Plant control; Traffic Management; Crisis management**
  - **Energy distribution**
  - **Airports**
- **Cooperating Objects**
  - **Cooperative Hybrid Objects**
  - **Opportunistic Behaviour in Heterogeneous Object Communities**

Open Consultation on WSNs and Cooperating Objects

- Towards **Workprogramme 09-10**
  - INFSO-CONSULT08-WSN-CO@ec.europa.eu

- Contributions are requested on
  - Weight, Potential and Impact of the area
  - Industrial R&D investment
  - European Expertise/Excellence
  - Trends and Challenges
  - Priorities

  - Email, White Papers, articles, presentations, …

Contact

- Embedded Systems and Control
  - http://cordis.europa.eu/ist/embedded
- Cooperating Objects
  - http://cordis.europa.eu/ist/embedded/objects.htm
- ARTEMIS Technology Platform
  - http://www.artemis-office.org

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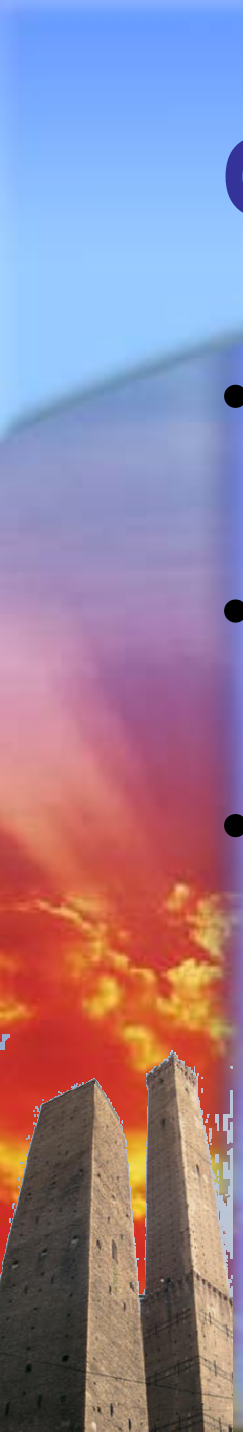

Thank You!

Questions?