Telecom Italia and WSN

WSN Project

| CLAUDIO BOREAN | T.IE.RT.RP |
Summary

- Telecom Italia & WSN
- From WSN nodes to services...
- Demonstrators
- Why a standard?
- Conclusion
WSN Lab by Pirelli & Telecom Italia in Berkeley

- Focus on developing Wireless Sensor Networks technologies that enable new advanced services in a world of networked intelligent objects interacting with humans
- Located in 1995 University Ave. Berkeley, 5 min from University of Berkeley Campus
- Opening date: June 2006

Building a more intelligent world

Sponsoring Companies

UC Berkeley
Local Companies

Collaborations

Courtesy of Marco Sgroi
Wireless Sensor Networks (WSN)

- The “many - tiny” principle:
  - wireless networks of thousands of inexpensive miniature devices
  - capable of computation, communication and sensing
  - which are low-size, low-cost, low-power
  - have substantial processing capability in the aggregate, but not individually
  - also called PAN (Pico Area Network) or BAN (Body Area Network)

- Their use throughout society “could well dwarf previous milestones in the information revolution”: U.S. National Research Council Report, 2001
  - Enable to instrument the physical world (close sensing)
  - at a fine resolution (dense sensing)
  - over large spatio-temporal scales (permanent sensing)
**Project Goal**

**AS_IS**

**Project overview**

- **3rd party application**
- **API**
- **Management Commissioning**
- **Application Management Commissioning**
- **IP Network**
- **API**
- **Gateway**
- **Z-SIM enabled mobile phone**
- **VDT**
- **STB**
- **AG**
- **Wireless Sensor Network**
Reference model

Not just the nodes to build the WSN real applications!

- Gateway
- WSN Platform (configuration, mgmt, data collection)
- Privacy & Trust management
- Wireless Sensor Networks nodes
Demo: Healthcare System architecture

Objective: design and build a flexible measurement system to enable health care services:
- Recognize behaviors on long-term scale
- Detect postures and transitions between states
- Lead and evaluate simple exercises on specific body parts (arm, leg)
- Value added functionalities to be inserted in gateways and/or WSN platform

Courtesy of Filippo Tempia
Demo: Healthcare service

- Rehabilitation / fitness exercise
- Patience follows a predefined pattern
- Nodes displaced on joints

- Mobile phone application shows:
  - Performance evaluation (is the patience following the given pattern?)
  - Position correctness (ex. arm lateral inclination)
  - Responsiveness to changing patterns (ex. given a sudden acceleration in the pattern, how responsive is the patient reaction?)

Visualization and feedback

Bridging through Intel Board

Nodes displacement

Courtesy of Filippo Templa
Demo: Firemen’s application

Sensors are integrated in a ZigBee sensor network:

- Self-configuring, self-healing wireless network infrastructure
- Antenna has been designed to emit signal outside the helmet (protect the firemen’s head);
- Routers form a mesh network and gather information from Body Area Network (e.g. external temperature sensors); Remote application can control and check node status and change report parameters
Why a Standard?

- Possibility to build both wireless sensor network and applications for different areas, sharing the ad-hoc infrastructure and data format:
  - Home Automation
  - Personal Health Care
  - Telecommunication Value added services
  - Building Automation
  - Advanced Metering Infrastructure
  - Wireless Sensor Application

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Standard for
network infrastructure

ZigBee™ Alliance

AMI

HA

TA

Standard for Application messages
ZigBee Alliance - Telecom Italia activities

- **Telecom Application group:**
  - Marketing requirements identified
  - Working on technical requirements (backward compatibility, QoS, fast joining)
  - Mobile terminal and WSNs

- **Gateway group:**
  - Proposal to enable Gateway with local applications (e.g. VDT)
  - Proposal to include functions as defined in Gateway abstraction layer

- **Wireless Sensor Network group:**
  - Telecom Italia (Turin + Berkeley) Proposals for enhanced features
ZigBee Telecom Applications Group

- **Scope**
  - Telecommunication applications application profile

- **Purpose**
  - Study the potential applications using network operator infrastructures and communications terminals, such as cell or fixed phone connectivity

- **COMPANIES:**
  - TELECOM ITALIA
  - HUAWEI
  - SAMSUNG
  - ORANGE-FT
  - ETRI
  - KDDI
  - OKI
  - MOTOROLA

*Telecom Italia leads the group (TLC applications)*

Application for pervasive low power computing
ZigBee Telco Devices

- Telco Devices
  - Cellular phones
  - Video Phone (VDT)
  - Set-top-box (e.g. DTT-STB)
  - Access Gateways
  - ZigBee SIM card
  - Plug-in ZigBee modules
  - Information nodes (advertisement services)
  - WSN nodes

- VDT
- STB
- AG
- USB ZigBee stick
- Z-SIM enabled mobile phone
- WSN/Information Node
Telecom Applications Use cases

INFO SERVICES

PAYMENTS SERVICES

VoZ SERVICES

GAMING SERVICES

...AND MORE..

Information delivery
Mobile Payments
P2P small data sharing
Location Based Services
Mobile Gaming

ZigBee Telco Devices – Video Telephone

Advantages:
- Large screen useful for commissioning and network configuration
- Availability of network interfaces (SDIO, Ethernet)

Disadvantages:
- Operating system dependency (driver side):
  - Full ZigBee stack into the VDT
  - Full ZigBee stack into the dongle
- API to be defined for Service platform interface

Addressed Applications:
- Tele monitoring, health care
- Configuration and WSN local management
- Home Automation
Gateway Abstraction Layer overview

- WSN Platform sees the gateway and uses its abstraction layer (GAL) in order to communicate with the WSN.
- Gateway implements the abstraction layer and supports the functionalities that can be used by WSN Platform and by the service above.
- Implementation of GAL implies the composition of low layer messages to be transmitted over-the-air to the WSN nodes.
Telecom Italia and ZigBee enhancements

- Proposal submitted to ZigBee for Low Power features to be introduced
  (Turin – Berkeley WSN Lab)
  - To be added to evolutions of ZigBee stacks (ZigBee 2007 and future)
  - Scheduling:
    - Proposal presentation in member meetings
    - Simulation validation of the proposal
    - Proposal Whitepaper (Borean, Giannantonio, Coleri)

Very important to add this feature to enable real ubiquitous computing
Conclusions

Key elements of WSN should be addressed:

- **Standard Interfaces** towards nodes (ZigBee profiles):
  - multi vendor reusability of the solution for service provisioning
  - Standard i/f for gateway devices (towards the ZigBee Net)

- **Standard Gateway products** (ZigBee Gateways):
  - Standard interconnection to operator network (data model)

- **Integrability** into devices (ZigBee SIM Card)

- **Security and Privacy**
  - Security Policy has to be carefully considered
  - Range has to be dynamically reduced considering the applications (e.g. payments)

- **Cost reduction of components**

- **Power consumption**
  - Energy Scavenging techniques and problem with battery life-time

**STANDARD is a MUST for a TELCO Operator**
Thank You & Questions?

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