16th FFV Workshop

Mobile Web Services in Health Care and Sensor Networks

Fahad Aijaz
Department of Communication Networks
RWTH Aachen University, Germany

FFV Workshop, March 13, 2009

Outline

- **Wireless Sensor Networks**
  - A General Introduction
  - Problem Statement
  - Scientific Framework
- **Service-Oriented Wireless Sensor Networks**
  - Use Cases and Requirements
- **Mobile Web Services**
  - Types and Interactions
- **Advanced Mobile Web Service Architecture**
- **Service-Oriented WSN Environments**
  - A Collector Node Scenario
  - Healthcare Scenario and Requirements – MEDICARE
  - Measurement of Power Consumption
- **Mobile Web Services Research at ComNets**

Wireless Sensor Networks (WSN)
(A General Introduction)

- A WSN is a wireless network consists of spatially distributed devices using sensors.
- Sensors monitor the physical or environmental conditions at different locations, e.g.
  - Temperature
  - Sound
  - Vibration
  - Pressure
  - Motion etc.
- Such networks are the key for gathering information in smart environments.
- Some application areas are;
  - Monitoring and Control Systems
  - Health care
  - Traffic control
  - Security
  - Home automation etc.

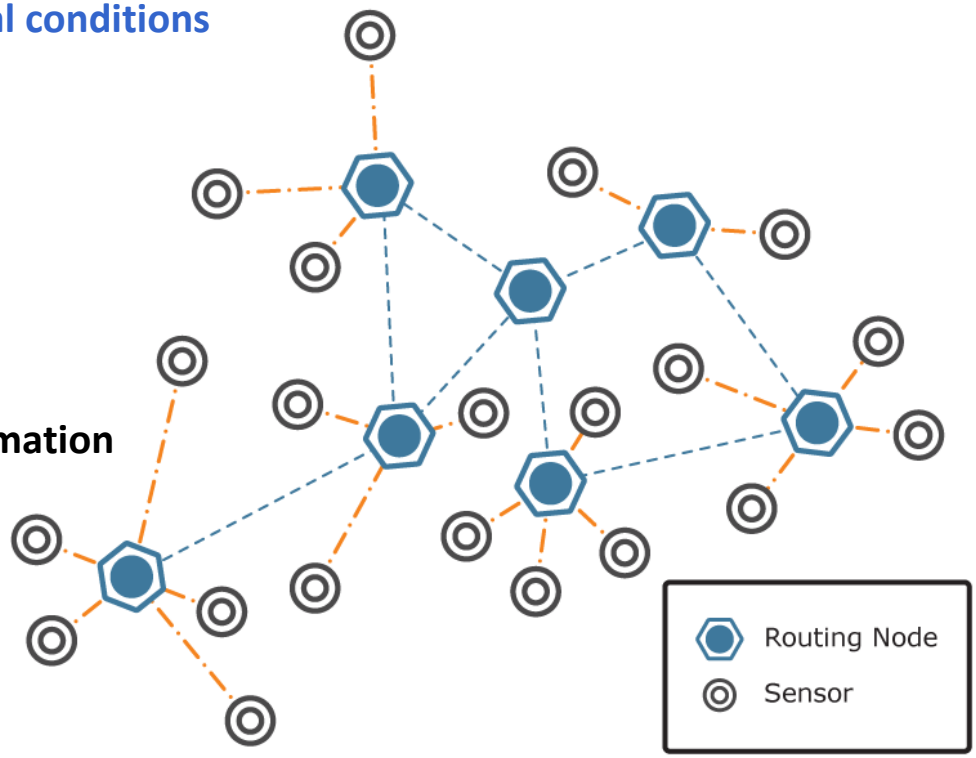
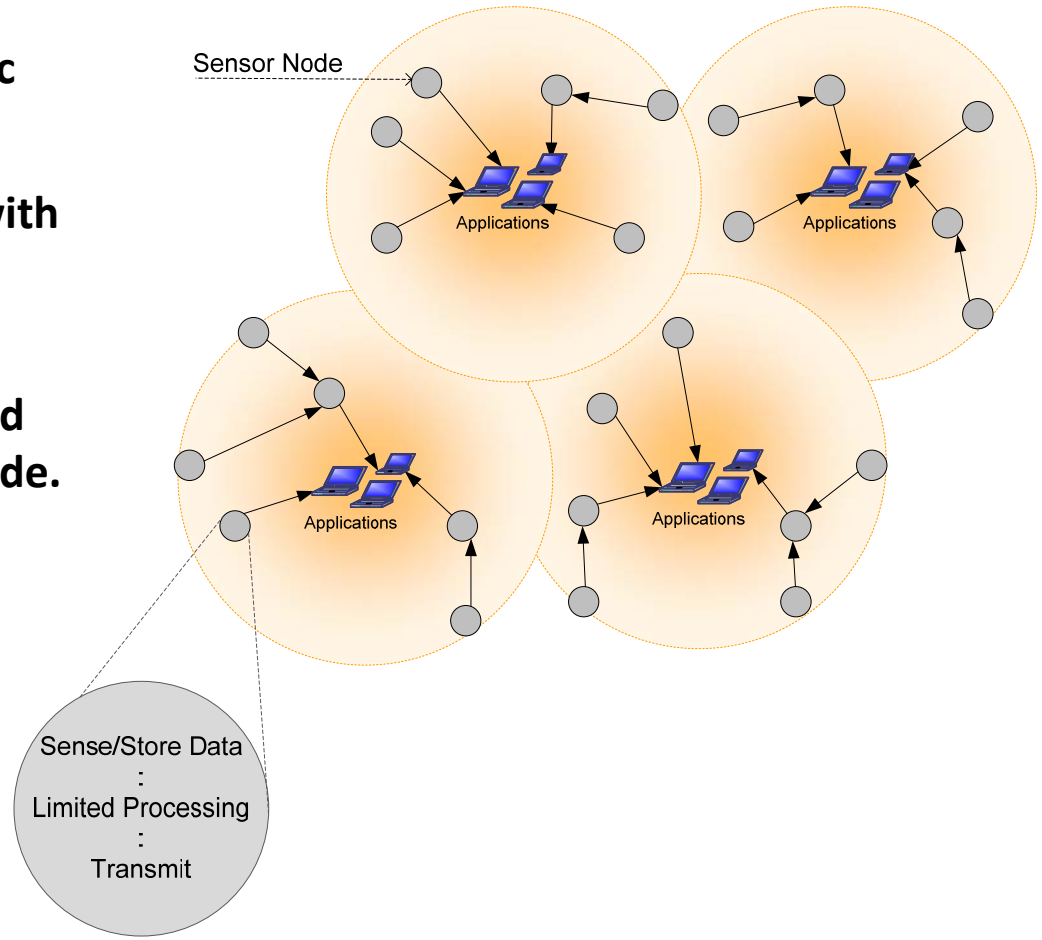


Image source: http://www.purelink.ca/images/sensor_network_big.gif

Wireless Sensor Networks (WSN) (Problem Statement)

- Typically, a WSN performs **distributed network computations** to meet its specific needs.
- Data received by sensors is processed with **limited processing capabilities** of a sensor node.
- Complex network computations demand **high processing power** within a sensor node.
- This results in **high power consumption** and affects network performance.



Issues: Low processing power, Battery consumption, Network performance

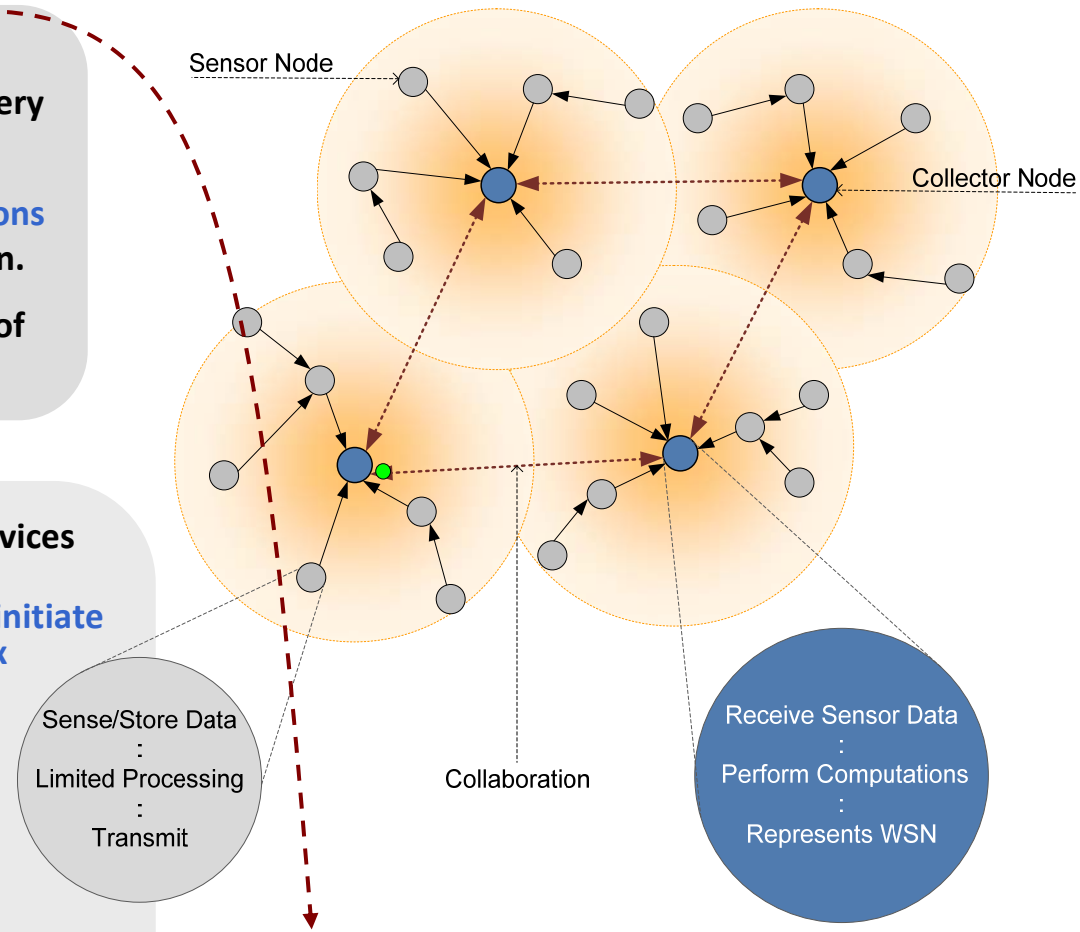
Wireless Sensor Networks (WSN) (Scientific Framework)

- Collector nodes introduced in [1] are better equipped in terms of processing power and battery consumption than ordinary sensors.
- High-valued distributed in-network computations can be achieved by collector nodes' collaboration.
- Collector nodes represent local neighborhood of sensors to higher hierarchy of WSN.

- Collector nodes equipped with Mobile Web Services to perform local computations.
- Cooperation among the collector nodes would initiate higher-valued Mobile Web Services for complex distributed in-network computations.
- Study new fields in the area of Mobile Web Services to identify realistic business and application scenarios.

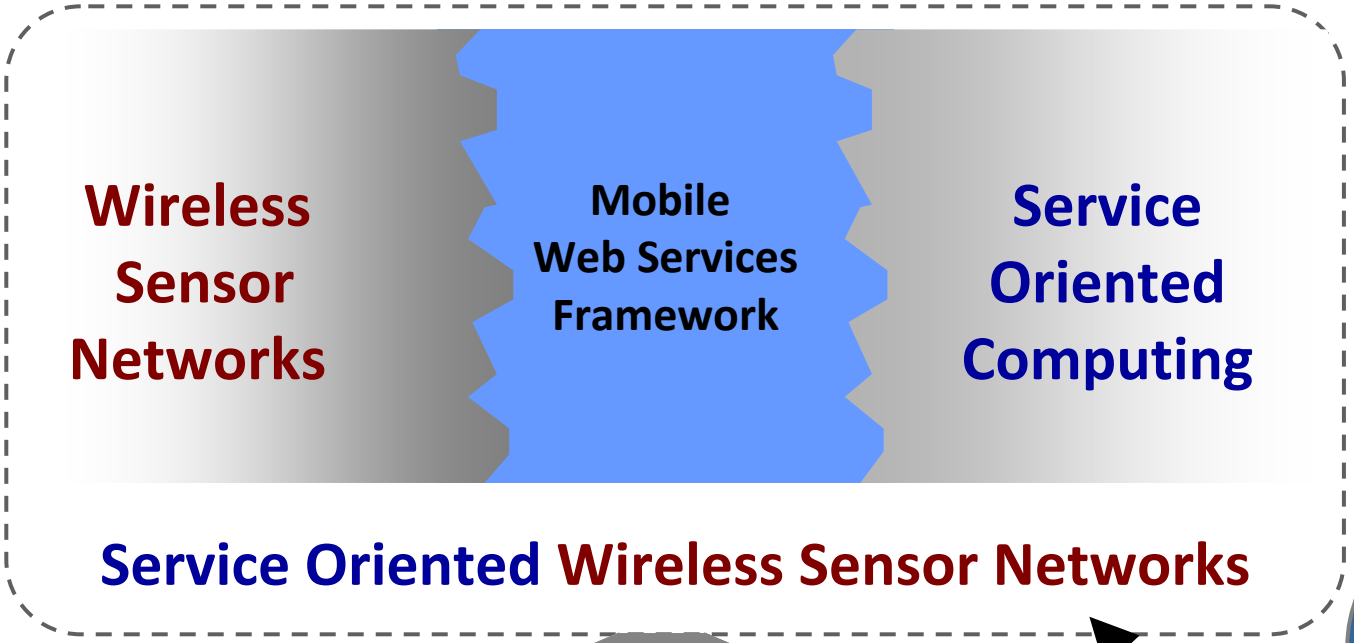
Scientific Challenges

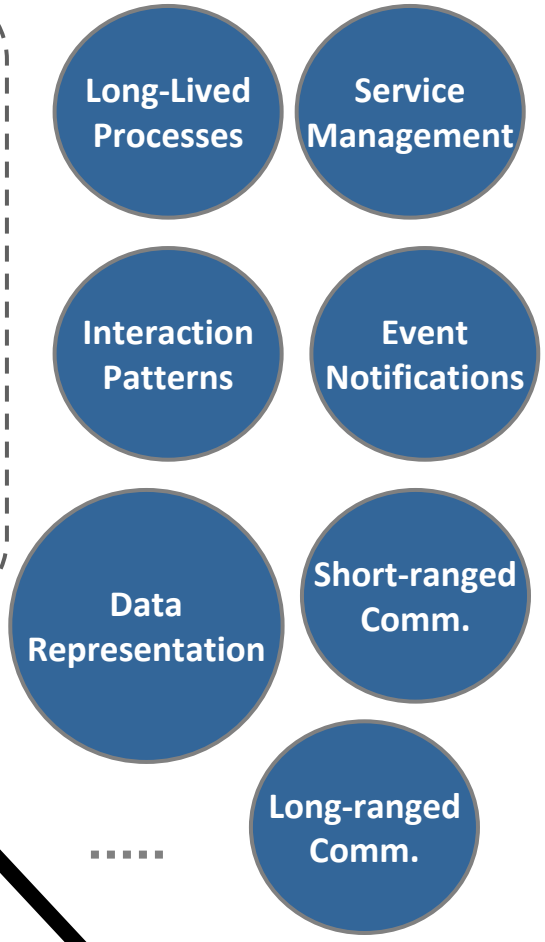
- Network computations in wireless networks.
- Organization of cooperative collector nodes owning Mobile Web Services.
- Gain a high-valued network based on Mobile Web Services.

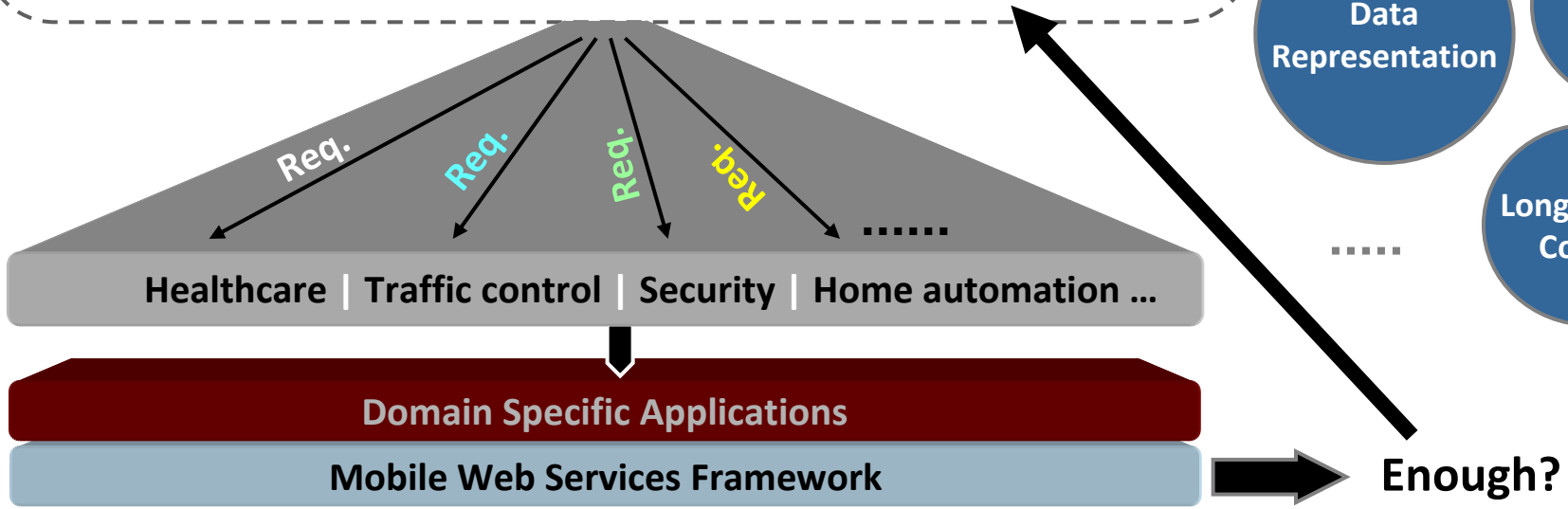


[1] Giridhar, A. Kumar, P.R., **Toward a theory of in-network computation in wireless sensor networks**, *Communications Magazine, IEEE*, Volume 44, Issue 4, p. 98- 107, ISSN: 0163-6804, 2006

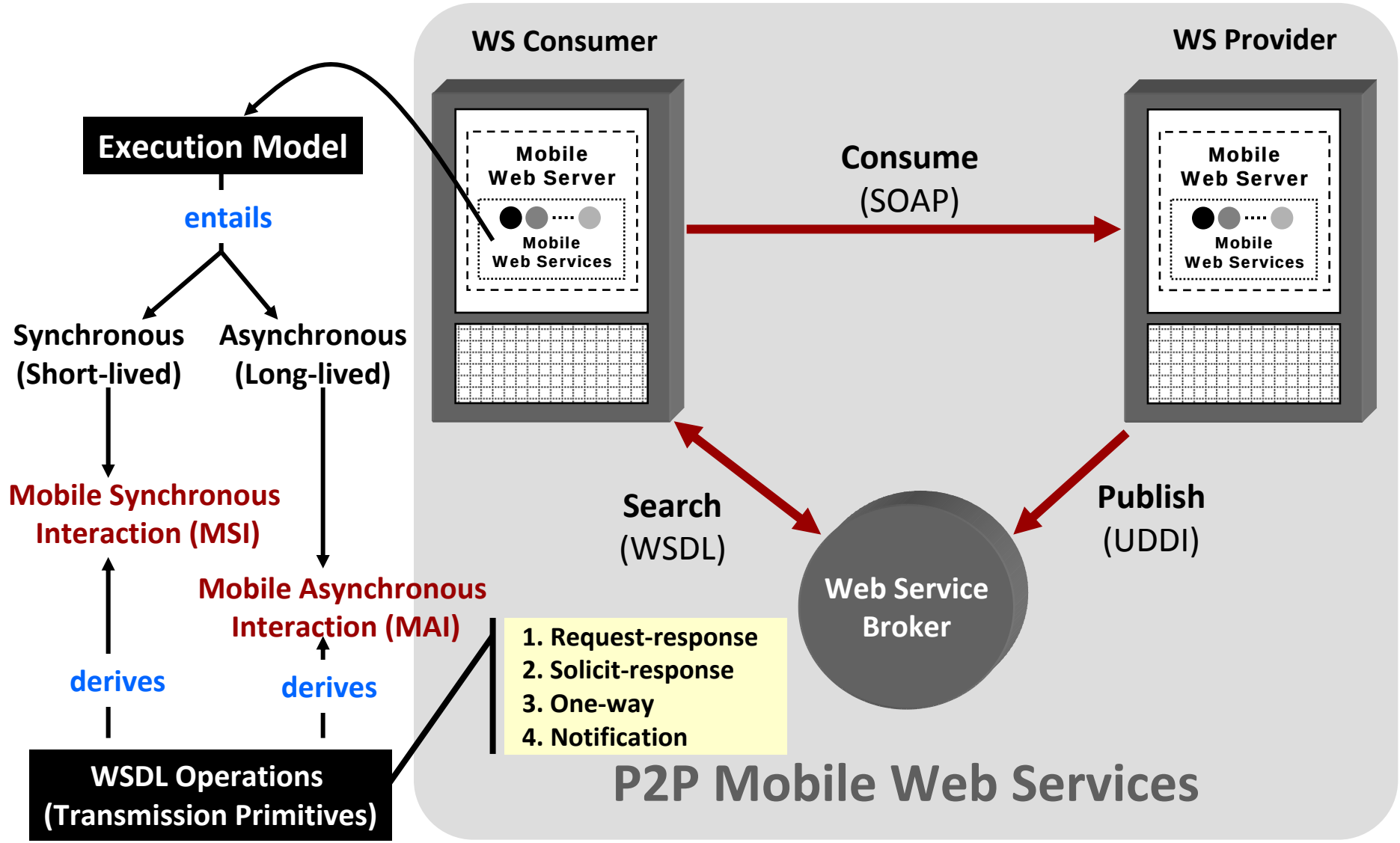
Service-Oriented Wireless Sensor Networks (Use Cases and Requirements)







Mobile Web Services (Types and Interactions)

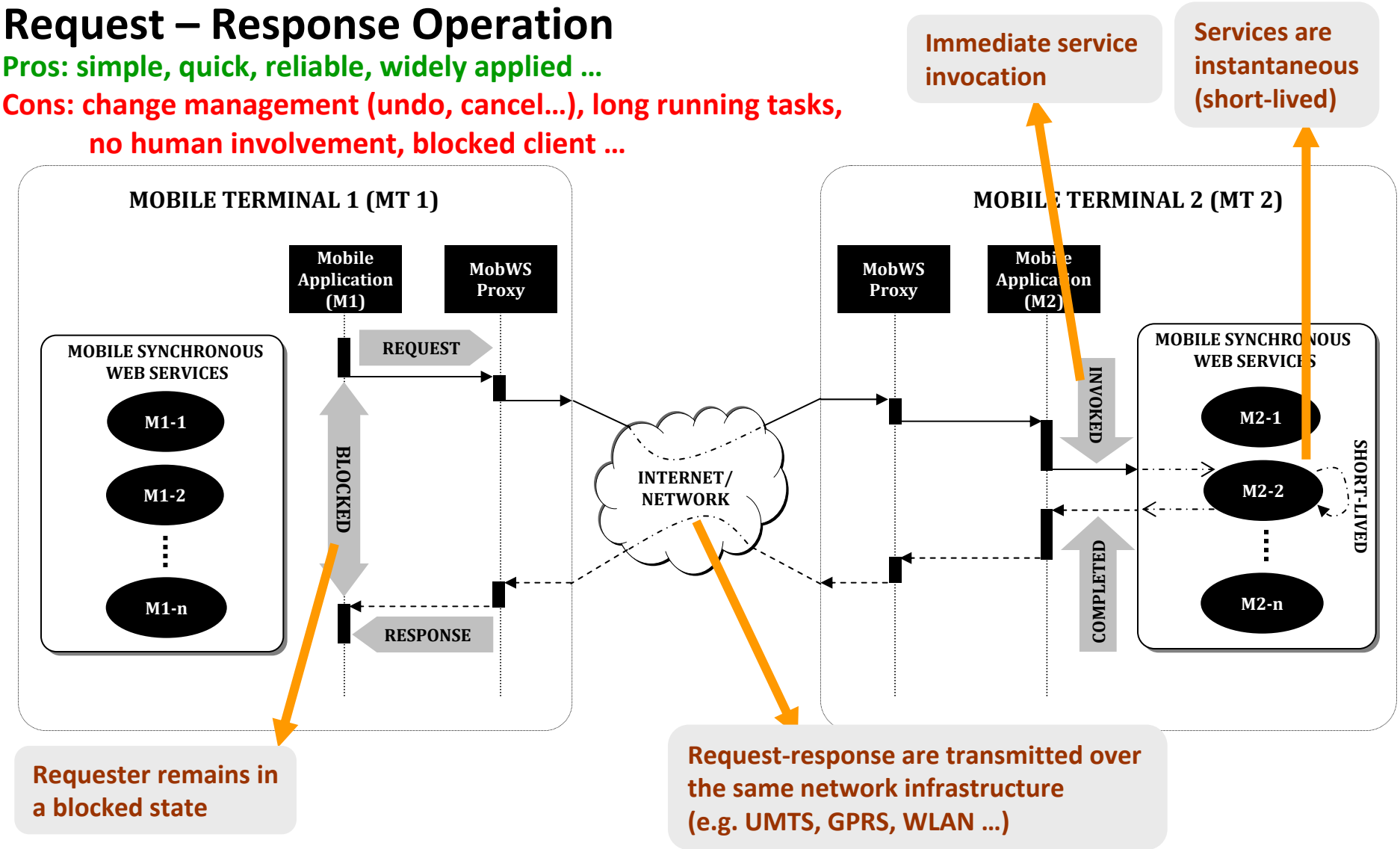


Mobile Web Services (Mobile Synchronous Interaction)

Request – Response Operation

Pros: simple, quick, reliable, widely applied …

Cons: change management (undo, cancel…), long running tasks, no human involvement, blocked client …



Mobile Web Services
(Mobile Asynchronous Interaction)

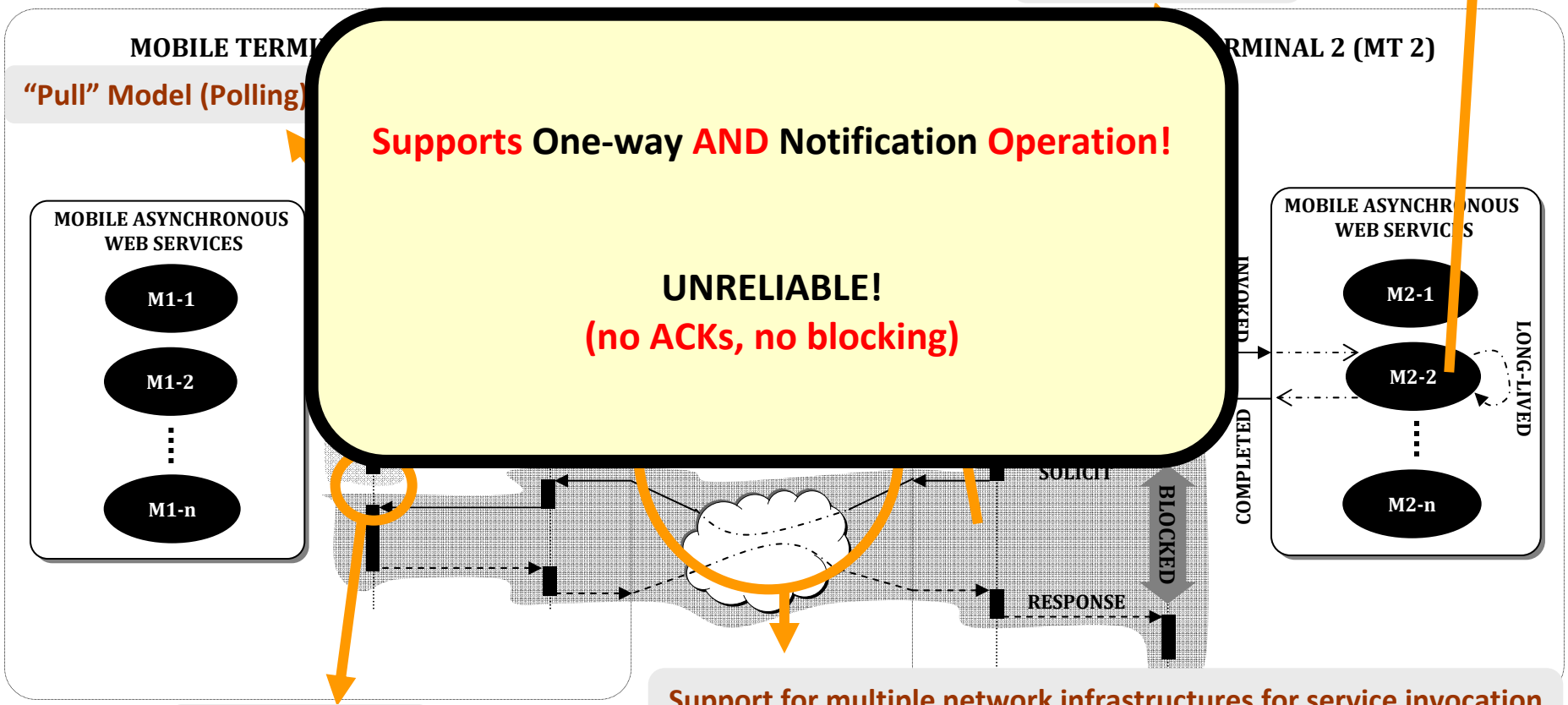
Request – Response AND Solicit – Response Operation

Pros: two-way control, long processes, unblocked client, back-end operations, human involvement, change management, reliable …

Cons: complex, blocked until ACKed, correlation, larger payloads …

Temporal service invocation possible

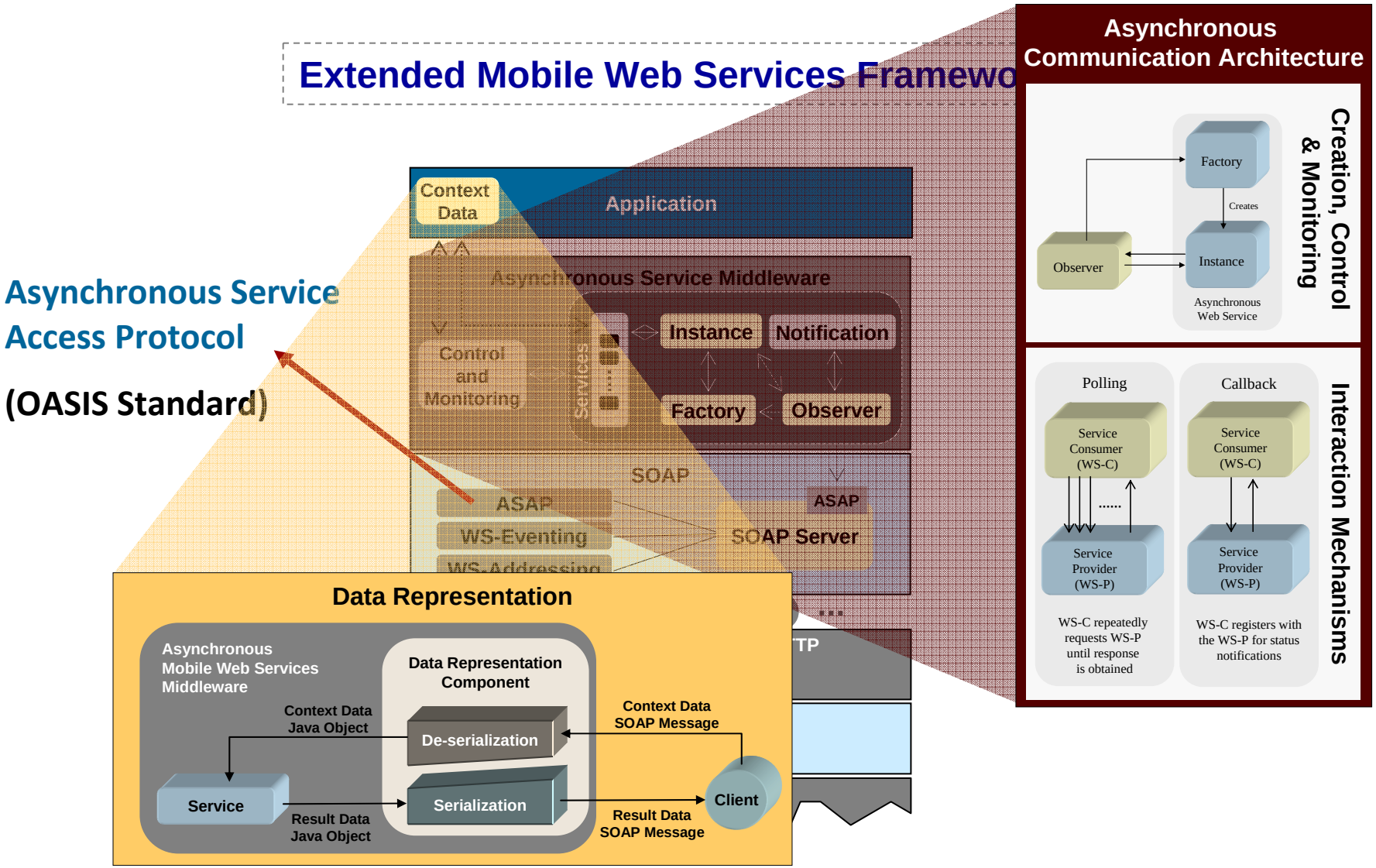
Services are not instantaneous (long-lived)



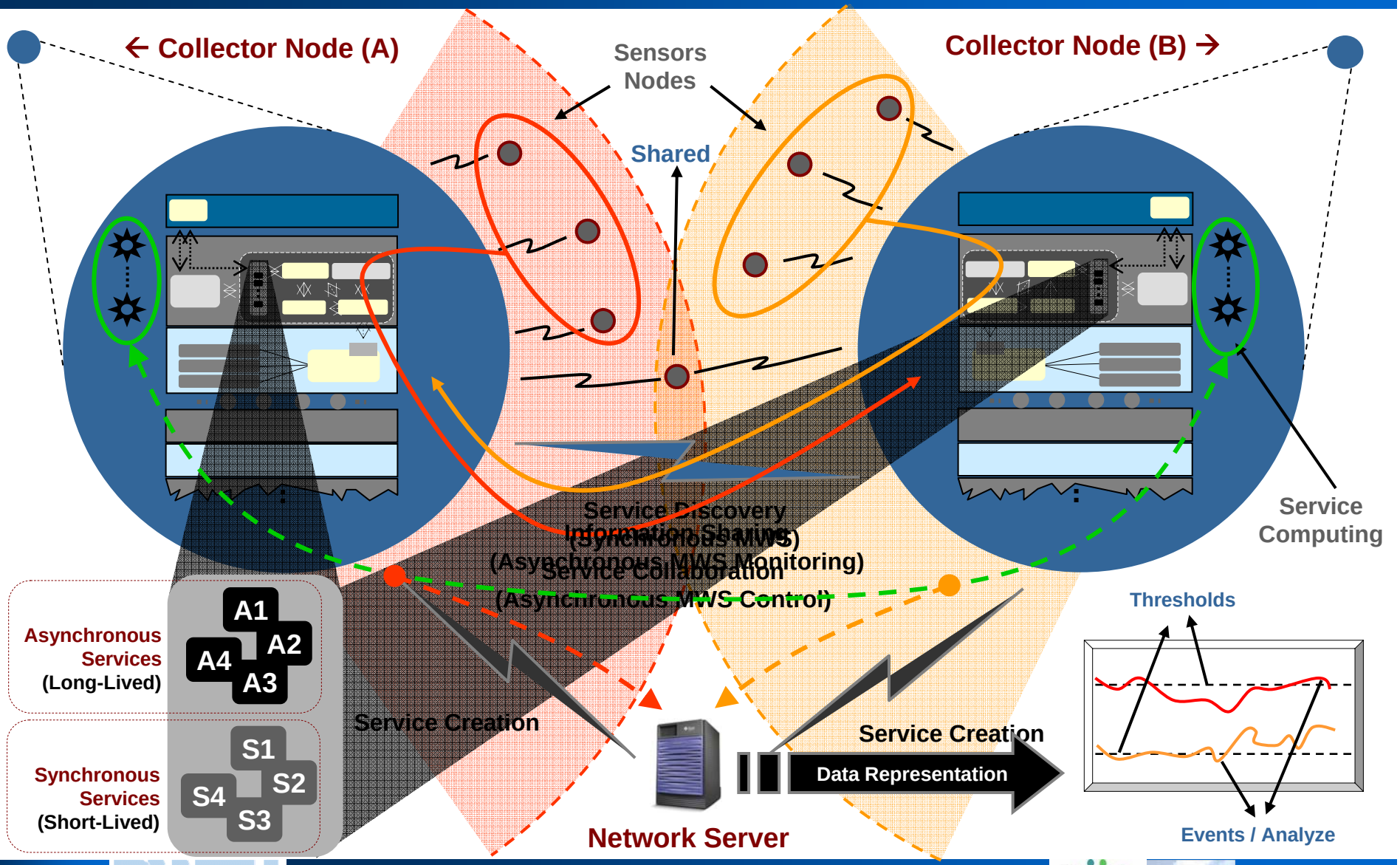
Unblocked client

Support for multiple network infrastructures for service invocation and response (e.g. request: UMTS, response: WLAN)

Advanced Mobile Web Services Architecture (General Overview)



Service-Oriented WSN Environments (1/2)
(A Collector Node Scenario)



Service-Oriented WSN Environments (2/2) (Health Care Scenario and Requirements - MEDICARE)

Sun Small Programmable Object Technology (SunSPOT)

SUNSPOT

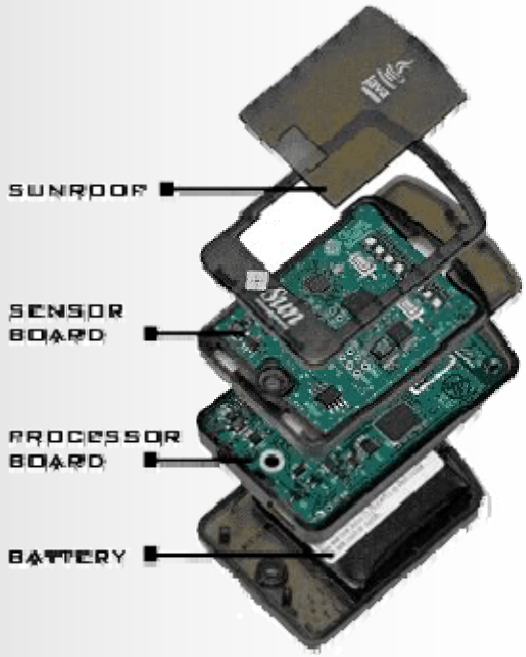
Specifications:

- 180 MHz 32 bit ARM920T core
- 512K RAM/4M Flash
- 2.4 GHz radio with integrated antenna
- 3.7V rechargeable 720 mAh lithium-ion battery
- IEEE 802.15.4 based radio communication
- Public Key Cryptography (Elliptical Curve Cryptography (ECC))

Sensor Board:

- 2G/6G 3-axis accelerometer
- Temperature sensor
- Light sensor
- 8 tri-color LEDs
- 2 momentary switches

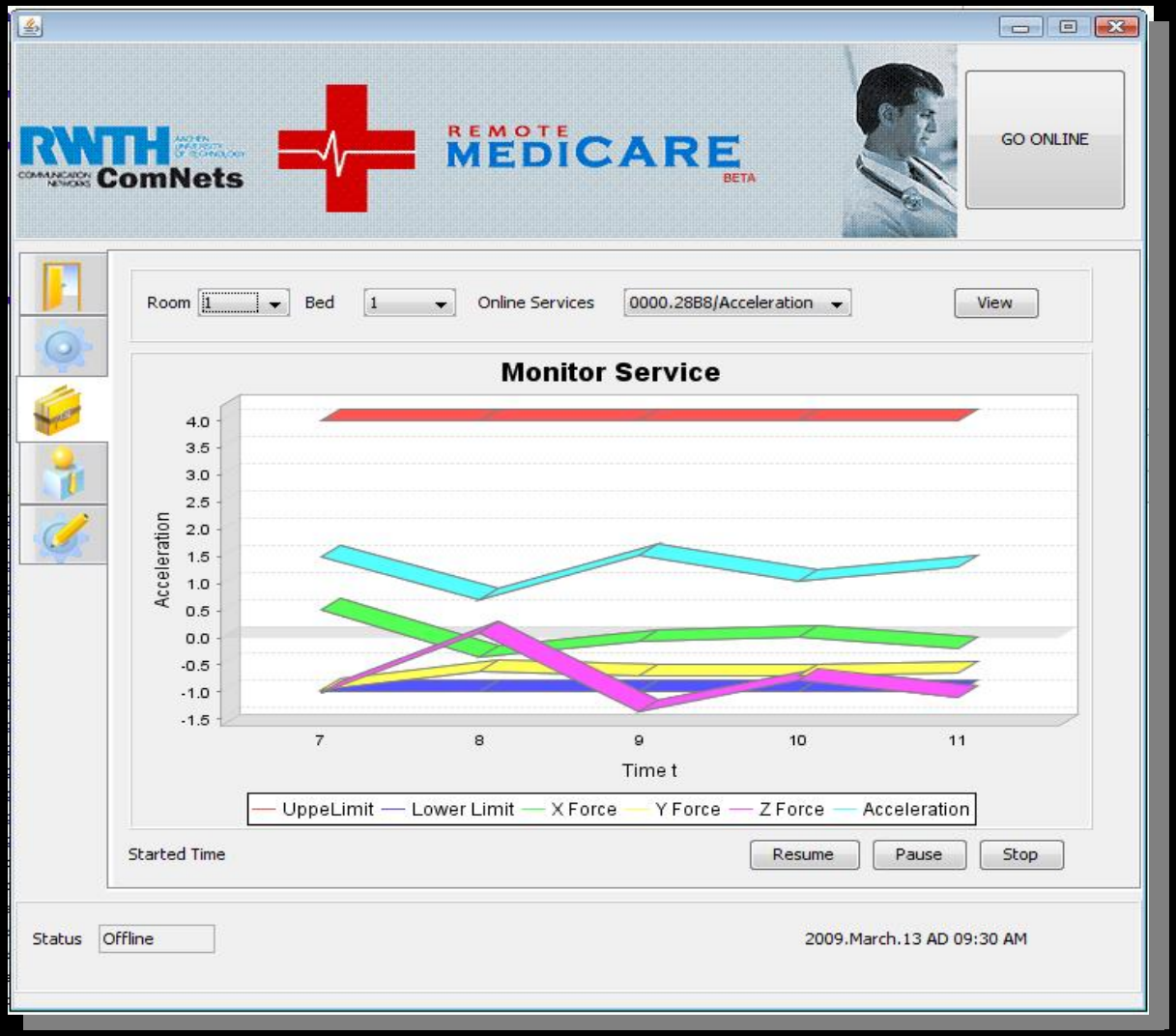
Extendable with general purpose I/O and high current output pins!



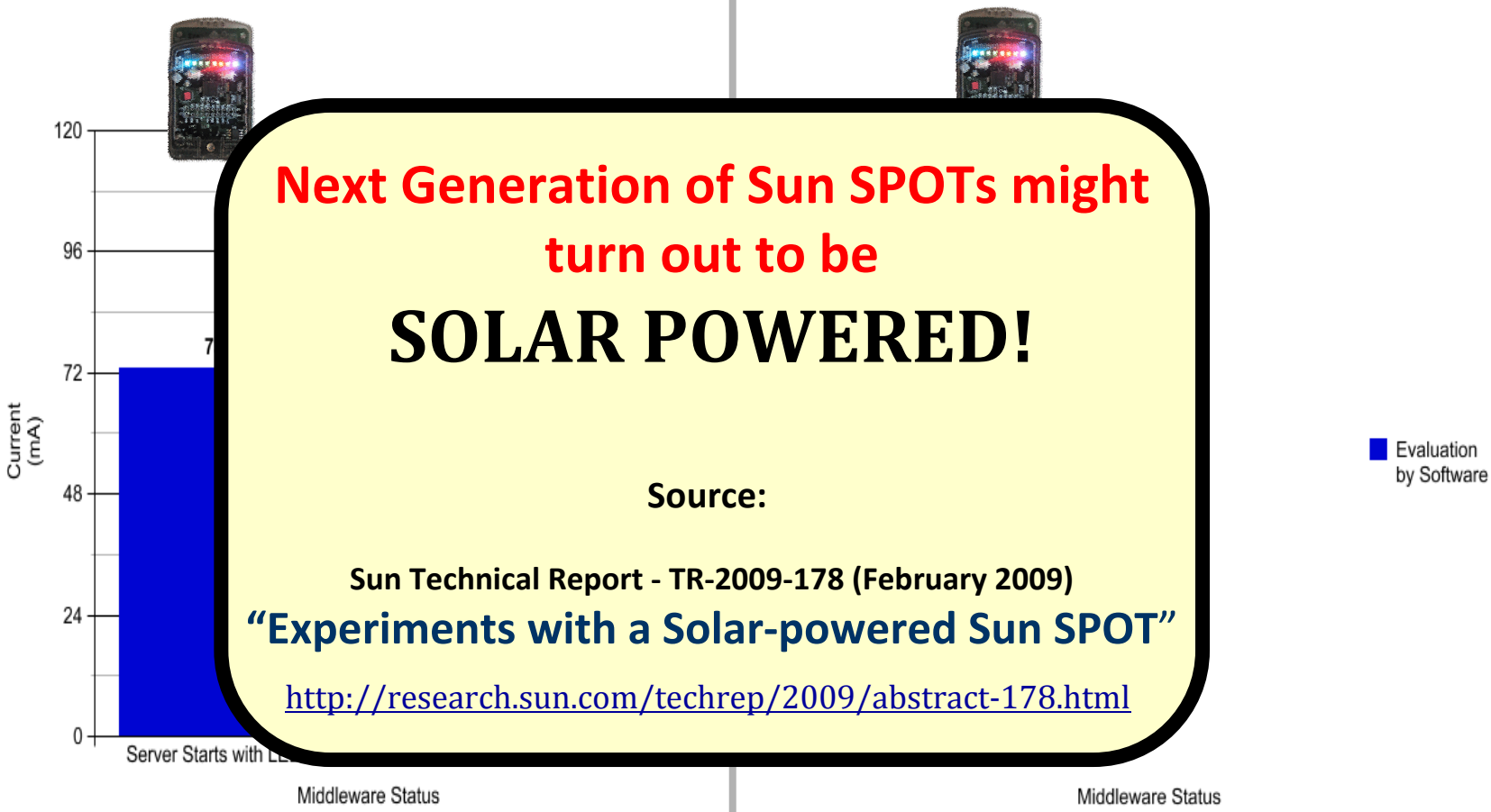
Operating Modes:

- Run mode: 70ma to 120ma (10.28 to 6 hrs)
- Idle Mode (Shallow sleep): 44ma (16.36 hrs)
- Deep Sleep: 32uA (22500 hrs/ 937.5 days/2.6 years)

Service-Oriented WSN Environments (2/2) (MEDICARE - A Health Care Prototype Screenshots)



Power Consumption of Sun SPOT Nodes



Next Generation of Sun SPOTs might turn out to be

SOLAR POWERED!

Source:

Sun Technical Report - TR-2009-178 (February 2009)

"Experiments with a Solar-powered Sun SPOT"

http://research.sun.com/techrep/2009/abstract-178.html

Switched off LEDs → 20 % optimized battery consumption

Further optimization is possible! (modes, payload, threads…)

Mobile Web Services Research at ComNets

- **P2P Service Level Agreements**
  - Negotiations
  - Active and pending agreements
  - Per service agreement templates
  - Service Guarantees
  - REST and SOA compatible

- **Service-oriented WSN Integration with IP Multimedia Subsystem (IMS)**
  - JCP's IMS Services API (JSR 281) for Java ME
  - Extended IMS integrated health care prototype
    - Server-side IMS application
    - IMS enabled Java ME application
  - High-valued context-sensitive IMS use case

Thank you for your attention !

RWTH AACHEN ComNets
RHEINISCH–WESTFÄLISCHE TECHNISCHE HOCHSCHULE AACHEN

RWTH Aachen University
Communication Networks
Kopernikusstr. 5
52074 Aachen
Germany

MSc.
Fahad Aijaz
Research Engineer

Tel +49 (0) 241 80 23923
Fax +49 (0) 241 80 22242
email fah@comnets.rwth-aachen.de
WWW http://www.comnets.rwth-aachen.de/fah.html

Questions are welcome!