PANEL Ubiquitous Systems Ubiquity for Everyone: What is Missing?

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Challenges in Mobile Industry

- Growing demand for new services and applications
- Physical limitations of the single-module mobile devices
- Sophistication of the consumer electronics functionality, e.g. processing power, memory, communication abilities
- General trend toward use of multiple devices together
- Success of the distributed service, e.g. image repositories
- Need for flexible solution to adopt new business models

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Ubiquitous Systems: Properties and Challanges

Computers….

- **Yesterday**
  - The ***"computers that we know"***
  - Primary artefacts
    - physical shape size, established appearance, purpose and use
  - Explicitly perceived
- **Tomorrow**
  - The ***"computers that we don't know"***
  - Secondary artecrafts
  - Embedded in primary artefacts
  - Digital artefacts encompassing ALL SORTS of devices and things
  - Our environment digitally enhanced
  - Divergence from the "computer alike" notion
  - Enabling added value through digital information processing

Introduction

- **Digital artifacts**
  - Limited size, computational, memory and processing power
  - Ad hoc sharing and awareness of the surrounding real world environment
  - Very different from self-contained embedded systems (SHARING, COLLABORATION)
  - Emerging additional functionality – through networking
  - Don Norman – *"The Invisible Computer", MIT Press 1998*
    - *"communication is the precondition to reintroduce the versatility of a device originally traded in to make it more specific and easier to use"*

Limitations and Expectations

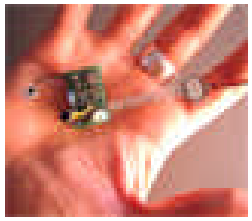
- Digital artifacts
  - Relate to their physical environment
  - Context and location awareness are key issues
  - Mark Weiser – *"The computers of the 21st century", Scientific American September 1991*
    - *all computers will know where they are and instead of traditional interfaces there will be "places to get things done"*
  - Smart environments
    - What is behind?

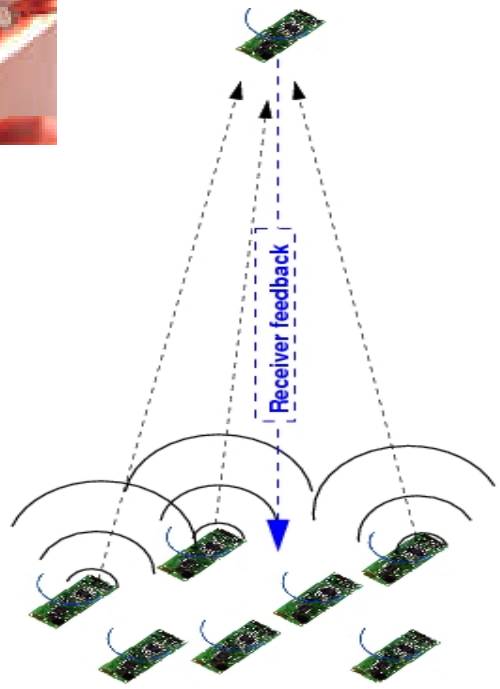
Challenges

- Low Powered Devices
  - Very, very low powered that can scavenge energy from their surroundings
- Self Configuration
  - Self-organizing, self-managing, self healing
  - Discovery of resources and services
- Seamless Communication
  - Interaction between very diverse systems
  - Switching between different operation modes
- Scalability and Heterogeneity
  - Very dense networks, nodes with different capabilities
  - …list can go on and on…

Sounds Familiar??

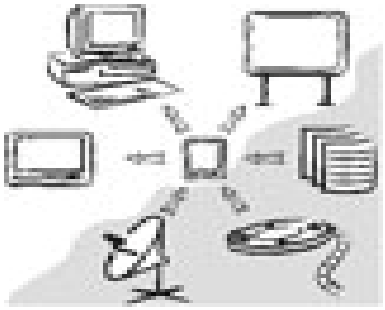
- Wireless sensor and actuators (Actors) – WSAN
- Lot of applications in WSN
- But few actors…
  - We need more…





So to summarize..

- Protocol Design Requirements
  - Enabling synchronization between sensor and actors, and actors themselves
  - Designing and implementing self-stabilizing algorithms in the presence of great number of failures
  - Enabling application to express interest and collect data relevant to the task within the context of the infrastructure
  - Find minimal approach for the data structures and their semantics that allows interaction between ***intended*** and ***derived*** properties
- Protocol Design Approaches
  - Current layered design
  - Cross layer design



Personal Smart Spaces in Social Networking

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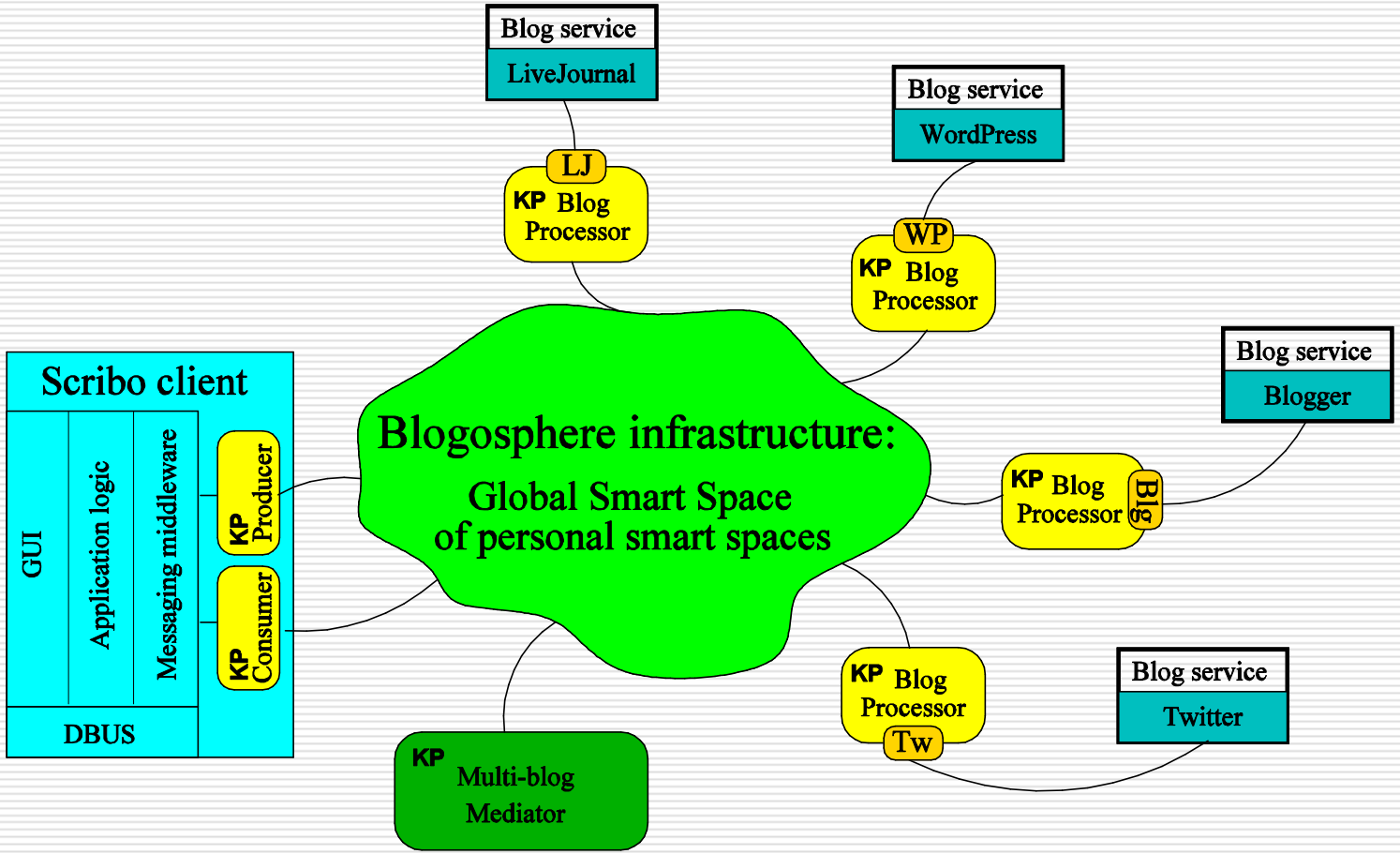
Case Study: Blogging



Dimensions of a Personal Smart Space

- User profile (long-term personal data)
- Context info (e.g., location, notifications)
- History (previous behavior)
- Data from Services (e.g., blogging)
- Relations to other personal smart spaces
- Derivative knowledge

- Multidimensional space
- Dimensions are dependent

Why Ranking?

- A lot of heterogeneous resources and participants related to a single user
- Economics & Trust
  - Recommendations
  - Incentives for participation
  - More ???

Dimensions for Ranking

- Long-term interests (user profile)
- Short-term interests (context)
- Reputation (history)
- Social network topology (relations)
- More ???

- **Composite multi-criteria ranking is still missing**

PANEL Ubiquitous Systems

Ubiquity for Everyone: What is Missing?

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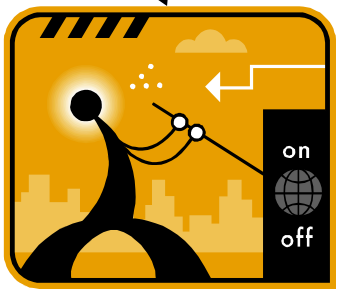
Proliferation of Wireless Sensor Networks

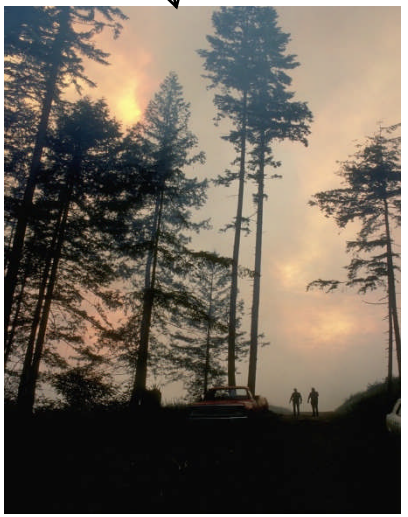
Security and Defense Systems

Health Care

Industrial Automation



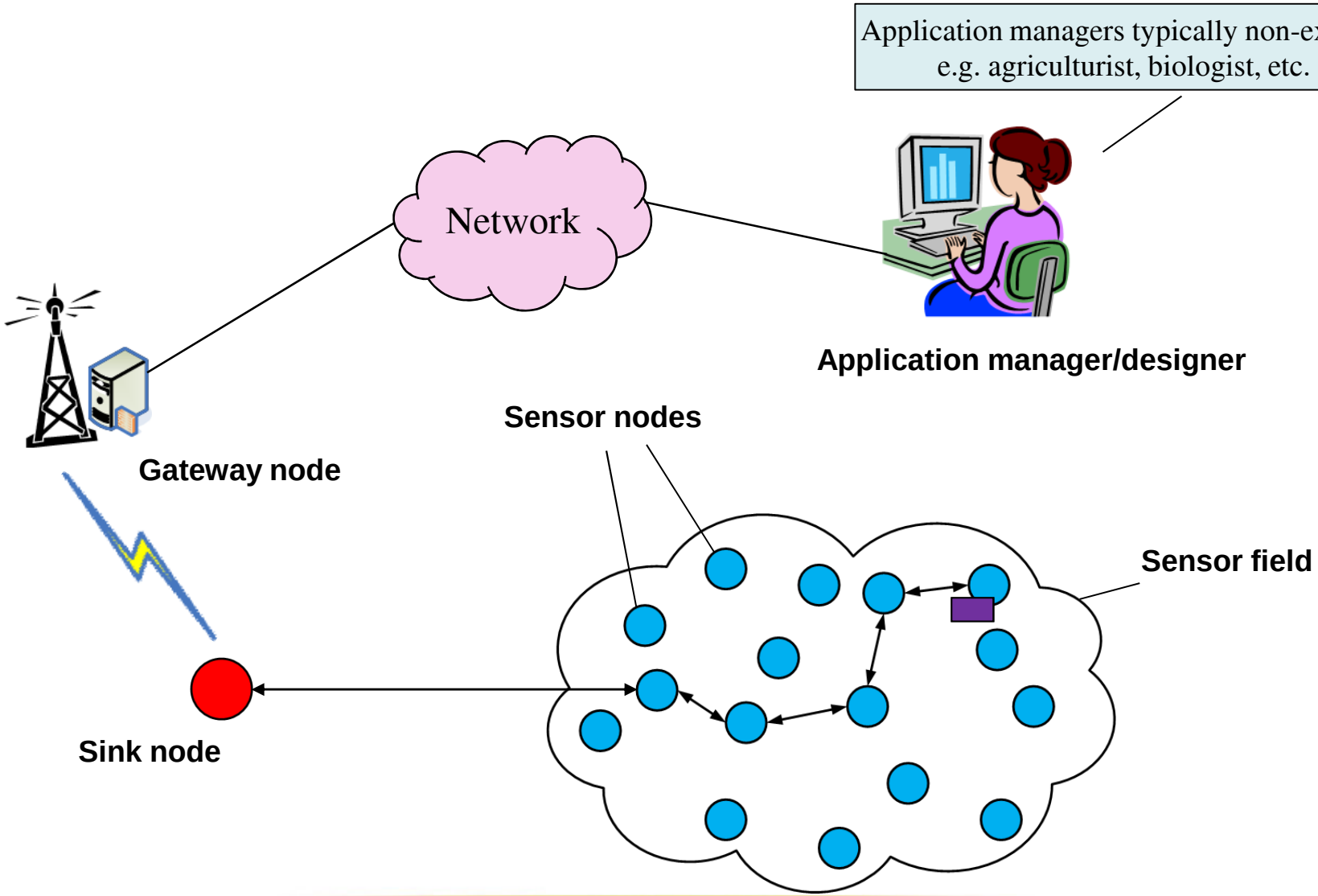
Ambient conditions monitoring e.g. forest fire detection



Logistics

Space

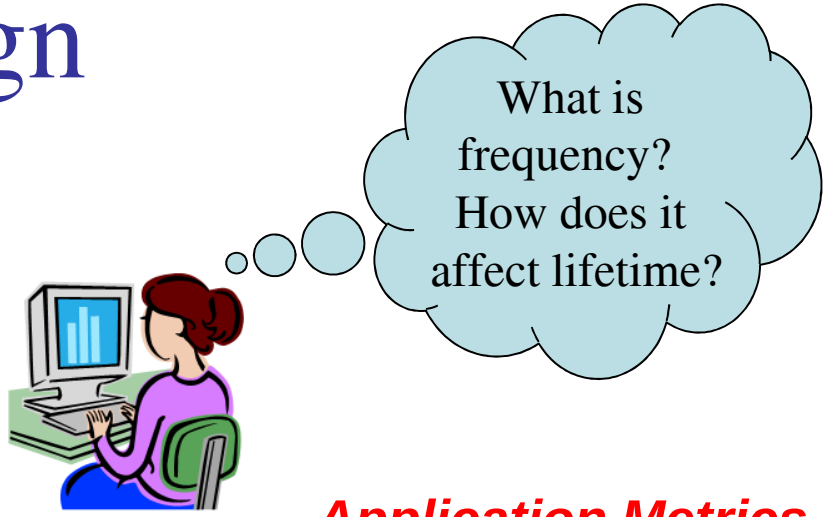
Typical Wireless Sensor Network



Challenges in Wireless Sensor Network Design

Commercial off-the-shelf sensor nodes

Characteristics
- Generic Design
- Not Application Specific
- Few Tunable Parameters



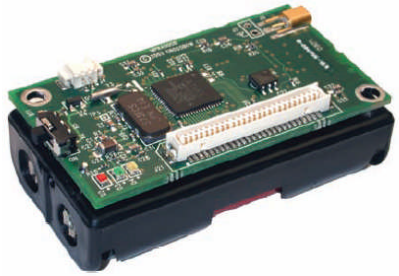
Tunable Parameters

Processor Voltage

Processor Frequency

Sensing Frequency

Radio Transmission Power



Values

Application Metrics

Lifetime

Reliability

Security

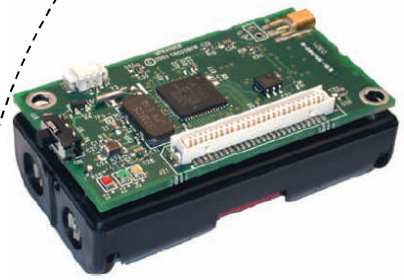
Responsiveness

Ubiquity in Wireless Sensor Network Design

- Lifetime = High Importance
- Reliability = Medium Importance
- Security = Low Importance
- Responsiveness = High Importance

Conceptually Ideal

CHALLENGING!!



Dynamically Optimize Tunable Parameter Values to Meet Application Metrics With Respect to the Operating Environment

- Processor Voltage = 2.7 V
- Processor Frequency = 4 MHz
- Sensing Frequency = 1 sample per second
- Radio Transmission Power = -17 dBm