Middleware Challenges for Wireless Sensor Networks

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Outlines

1. **Introduction to Wireless Sensor Network (WSN)**
   - Overview of WSN
   - Basic Operation
   - WSN characteristics

2. **Middleware Challenges**
   - Scope and Functionality
   - Design Principles
In this section

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Overview of WSN

Introduction to Wireless Sensor Network

- To bridge the gap between the physical and the virtual world
- Consists of large numbers of cooperating small-scale nodes limited in sensing, wireless communication, computation
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- Has wide range of applications such as:
  - Geophysical monitoring (seismic activity)
  - Precision agriculture (soil management)
  - Habitat monitoring (tracking of animal herds)
  - Transportation (traffic monitoring)
  - Military systems, business processes (supply chain management)
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Basic Operation

1. **Deploy sensor:**
   - Attach sensors to items.
   - Place sensors manually.
   - Deploy from aircraft.

Tasks deployment:
Tasks can be issued by an external entity connected to the sensor network, such as PDA, an aircraft flying by, or some device on the Internet.

Split the task:
Complex high-level sensing tasks are divided to limited-capability sensors. The readings of the individual sensors then have to be merged in order to obtain a high-level sensing result.
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Limited energy

Subject to failures due to depleted batteries or environmental influences.
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Purpose of middleware

Support the development, maintenance, deployment, and execution of sensing-based applications

- Mechanisms for formulating complex high-level sensing tasks, communicating this task to the WSN.
- Coordination of sensor nodes to split the task and distribute it to the individual sensor nodes
- Data fusion for merging and reporting the result back to the task issuer

Scope

Middleware for sensor networks should provide view on both WSN and traditional networks.
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Localized algorithms:

Work is divided to a number of nodes $\rightarrow$ **Scalability** and **robustness**.
Design Principles

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Data-centric communication:

- A new style of node addressing
- Event-based communication (not traditional request-reply schemes) matches the characteristics of WSN.
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Adaptive fidelity algorithms:
Provide mechanisms for selecting parameters or whole range of algorithms.
Design Principles

Operation mode: **Unattended.**

Requirements for **automatic** configuration and error handling.
Design Principles ... cont’d

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Support for time and location management:
Time and location of sensed real-world events are key elements for fusing individual sensor readings.
Design Principles … cont’d

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**Application knowledge in nodes:**
Can significantly improve the resource and energy efficiency.
Design Principles

Thank you

Q&A