

Architectural Challenges in Underwater Wireless Sensor Networks



UCONN

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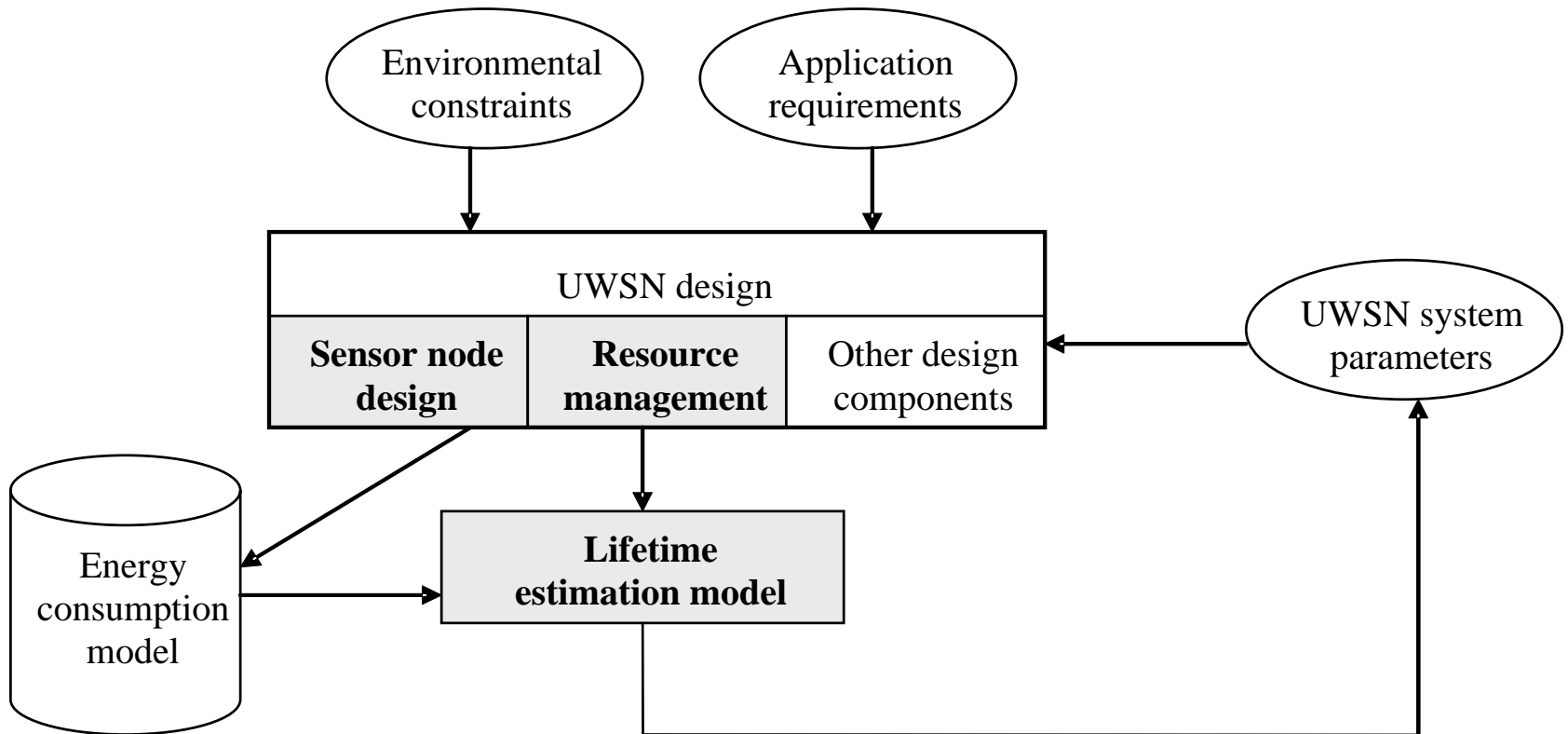
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Building UWSN requires interdisciplinary collaborations

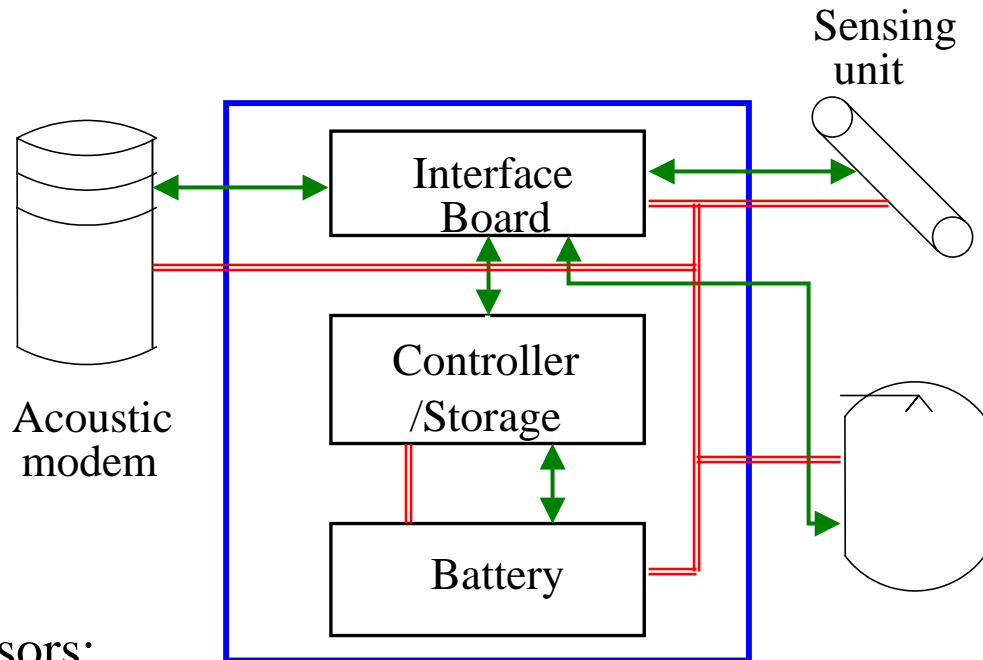
- Design challenges in UWSNs
 - Communications
 - Networking algorithms/protocols
- Architectural issues in UWSNs
 - Workload characterization
 - Energy-efficient design and resource management
 - Lifetime estimation

System design of UWSNs



Typical structure of a sensor node

- Sensor probes
 - Interface circuitry
- Controller (processors)
- Trans-receiver
 - Acoustic modem
- Storage
- Battery
- Triggerable air-bladder



Different from land-based sensors:

- Larger and more expensive
- More power hungry
- Prone to failures

Triggerable air-bladder
for low-cost reusability purpose

Goals of underwater sensor nodes

- Easy to customize for different applications: workload characterization
 - Satisfying performance
 - Computing capacity
 - Storage
 - Bandwidth
- Long operation time: low power
 - Energy becomes more critical
 - Acoustic communications, memory, air-bladder, etc., more power-hungry
 - Energy harvesting difficult: solar and wind energy are not available
- Reliable operations
 - Fault tolerant
 - Secure
- Low cost: allows deployment of large amounts of nodes
 - Decomposable or retrievable

Energy-efficient design at the node level

- Design choices: ASIC, ASIP, FPGA, microcontroller
- Power-efficient design of individual components
 - Acoustic communication modules
 - Flexible packet relaying circuit
 - Only wake up the microcontroller when needed
- Proper task assignments and scheduling
 - Sampling, processing, storing, transmitting, receiving, and forwarding
- Exploiting opportunities in the underwater environment
 - Long and frequent sleep mode due to the long delay of acoustic channels

In the near future, ...

- Prototype node built with off-the-shelf parts
 - PDA
 - Acoustic modem
 - Sensor
 - Interface board
- Investigating simulators for workload characterization
 - Data types and traffic patterns of specific applications
 - Routing and localization algorithms
 - Processors
 - Performance, power, etc.