Power Issues in Underwater Wireless Sensor Networks

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Data issues in UWSNs

- Design goal of UWSN: Long operation time
  - low power

  - Energy saving becomes more critical
    - Acoustic communications, memory, air-bladder, etc., more power-hungry
    - Energy harvesting difficult: solar and wind energy are not available

- Energy-efficient design and resource management

- Lifetime estimation
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
Power management at the network level

- Power-aware routing algorithms
  - Short-range vs. long-range communications
  - Reliability vs. energy trade-offs
- Power-aware localization algorithms
  - Accuracy vs. energy trade-offs
- Configuration strategy
  - Choosing working parameters adaptively in the field
- In-network computations
  - Utilizing short-range one-hop communications
  - Balance the power consumption of nodes located in different areas
Lifetime estimation model

Impact of network design parameters on power consumption
- Average one-hop signal transmission distance
- Data transmission period
- Acoustic channel frequency
- Network topology (3-D, distances, clustering, etc.)
- Sensor lifetime

Simulation of UWSNs
- Hierarchical energy model
- Output: statistic information, e.g., data communication throughput, retransmission rate, data drop rate, average power consumption, and sensor network lifetime.
- Current practice: PowerTOSSIM adaptation by Jeff Wroten (CompE senior)