Title
Packet Delivery Performance in Dense Wireless Sensor Networks

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Understanding Packet Delivery Performance In Dense Wireless Sensor Networks

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Introduction: Radio Frequency Wireless Communication in Sensor Networks

- Notoriously Unpredictable
  - Variable Environment Noise
  - Non-linear Signal Strength Decay
  - Multi-path Effect
  - Inter-node Collision
  - Additional Constraints for Sensor Network
    - Energy Efficiency (Low Power Radio)
    - Possibly High Density Deployment
  ⇒ High Packet Loss, Asymmetry, High Temporal Variance

Impact on System Design

- Hardware/Physical Layer
  - Modulation Scheme
  - Base-band Frequency
  - Encoding Scheme
- MAC Protocol
- Reliable Data Delivery
- Path Selection in Routing
- Congestion Control
- “Soft-state” Maintenance

Problem Description: Systematic Measurement of Packet Delivery Performance

Experimentation Setup

- ~60 MICA Motes with RFM Radio(433Mhz)/TinyOS 1.0
- Packet Delivery Performance on Physical Layer(Single-hop)
  - Regular Placement (Line) for Detailed Spatial Profile
  - Long Term (8-hour) Measurement
- Packet Delivery Performance on MAC Layer(Multi-hop)
  - Dense and “Realistic” Deployment
  - Artificial Traffic Load
  - Acknowledgment and Retransmission
- Impact from Environment
  - In-Door(ISI office), Habitat(State Park), Unobstructed(Parking Lot)

Results: Pessimistic Packet Delivery Performance Can’t Be Ignored

Single-Hop Experiments

- Spatial Profile of Packet Loss in Different Environments
  - In-Door (Left), Out-Door (Center), Habitat (Right), High Tx Power, 46bb Coding

Multiple Hop Experiments

- Packet Loss Distribution
- Efficiency with Retransmission

Future Work

- Measurement on MICA-II with CHIPCON Radio
- Measurement on S-MAC in Dense Network
- Topology Control Protocols re. packet loss.
- Reliable Link Layer Protocols
- A Test Suit to Evaluate Next Generation Platforms

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