



Energy Efficient Data Collection in Sensor Network



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Data Collection in Sensor Network

Monitoring Applications deployed upon Wireless Sensor Networks

- Require long network lifetime and connectivity of the deployed sensor network

Observations

- Burst of *priority* data generated, with QoS requirements
- Path from source to sink breaks due to variations in channel quality and mobility
- Need dynamic monitoring and application of channel state characteristics

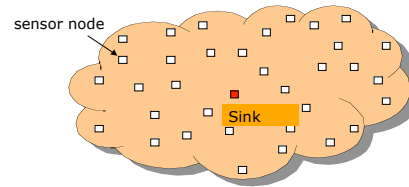
Energy Saving Schemes at

- Physical + MAC Layer – e.g. SMAC
- Network Layer – e.g. GAF
- Application Layer – e.g. TAG

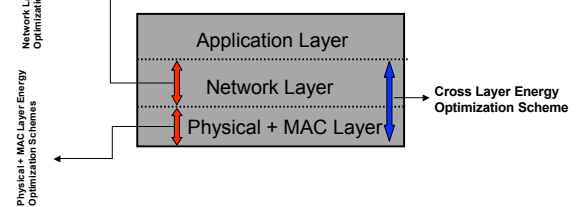
Goal

Cross layer algorithm to increase network lifetime and connectivity of wireless sensor networks

Deployment Overview



Architectural Overview



Network Layer Scheme - Congestion Zone Algorithm

Observations

- Congestion exists in Sensor Networks
- Low lifetime of congested nodes

Implication

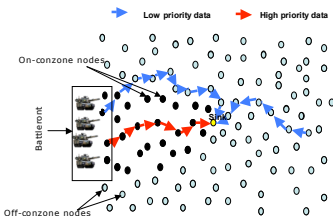
- Battlefront may lose connectivity to sink, while rest of the network remains connected

Goals

- Increase lifetime of connectivity to battlefront
- Provide QoS to high priority data generated at battlefront

Methods

- Data Prioritization
- Dynamic Congestion Zone formation
- Differentiated Routing



Network Layer Scheme - Multipath Routing Algorithm

Why multi-path routing?

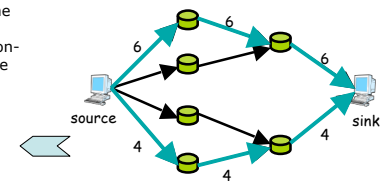
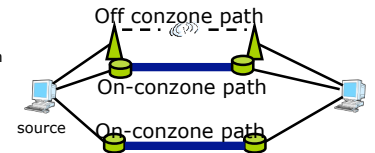
- Fault tolerant – wireless links are prone to failure in a harsh environment
- Secure – to combat purposeful destruction of the routes
- Load balancing – balance the load and the energy across the network
- Differentiated QoS

Approaches:

- Multipaths between the source and destination are calculated inside conzone and outside conzone
- High priority data travel through the on-conzone paths, and low priority data use outside-conzone paths

Path metrics

- Bandwidth
- Energy
- Reliability



Physical + MAC Layer Scheme – CDMA and TDMA Solutions

Observations

- Important factors in physical & MAC layer design:
 - Channel State Information
 - Residual battery energy of the sensors
- Inherent correlation of the sensor data

Goals

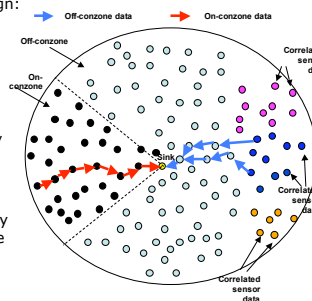
- On-conzone: minimize the transmission energy while providing the QoS target (throughput requirement) at each hop
- Off-conzone: increase network lifetime by utilizing the spatial correlation of the data sent by the sensors while providing the QoS target at the sink

- CDMA Solution: random codes; interference suppression

- TDMA Solution: decide which sensors should transmit

Methods

- On-conzone: Optimum energy efficient scheduling
- Off-conzone: Correlated Data Transmission



Challenges and Future Research Directions

Challenges

- Aggressive Sleeping Schemes for on-conzone nodes
- Tradeoff between the effectiveness (packet delivery delay) of low priority data and guaranteed QoS for high priority data
- Tradeoff between network lifetime and QoS for high priority data
- Reduction of computational complexity of proposed schemes
- Distributed algorithm to obtain the desirable multipaths

Future Research Directions

- Optimal exploitation of the spatial correlation
- Co-operative transmission strategies for on-conzone and off-conzone nodes
- QoS metrics for video transmission

