Simulation of Gradient-Based Data Dissemination in Wireless Sensor Networks

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Outline

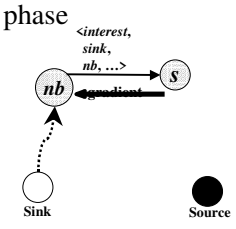
- Foreword on sensor networks
- Gradient directed diffusion
- Gradient calculation and aggregation
- Simulation
- Conclusion

Foreword on Sensor Networks

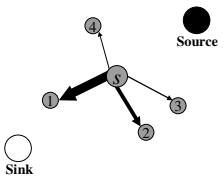
- Large number of sensors form an ad hoc network
- Communication is data centric
  - Do not care the identity or address of the target sensors as long as queries can be satisfied
- Each sensor can be a sink, a target, or a **router**
- Gradient-directed diffusion as the way to communicate[Estrin99].

Gradient-Directed Diffusion

- Interest propagation phase



- Data propagation phase

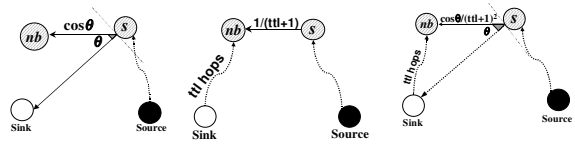


Gradient Calculation (I)

- Three example schemes
  - Direction-based
  - Distance-based
  - Gravity-based
- Energy as an important factor
  - If a sensor is low in energy, assign a low gradient towards the sensor.

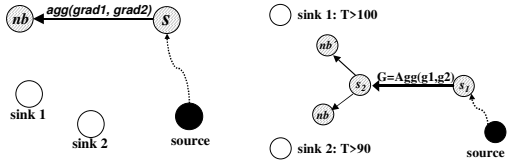
Gradient Calculation (II)

- Direction-Based
  - Each sensor forwards data with least deviation from the straight line towards the sink
- Distance-Based
  - Each sensor forwards data toward the neighbors nearest to the sink
- Gravity-Based
  - Each sensor assumes the sink is exerting a gravitation pull …..



Gradient Aggregation

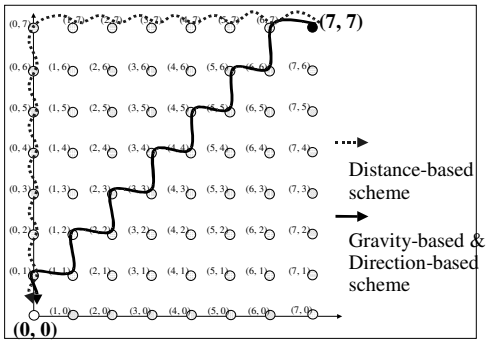
- Multiple-sink gradient aggregation
- Multiple-interest gradient aggregation



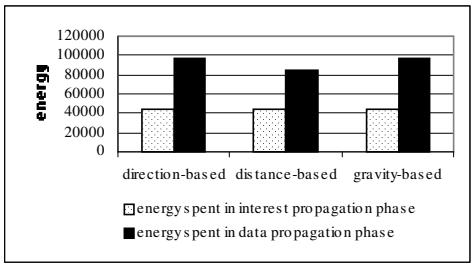
Simulation

- Assumption
  - Reception energy is measured as 1*packet size and transmission energy 3*packet size
  - All interests 128B and data packets 1024B
- Results
  - Diffusion procedure and spent energy
  - Diffusion with energy awareness and spent energy
  - Aggregation over multiple sinks and spent energy

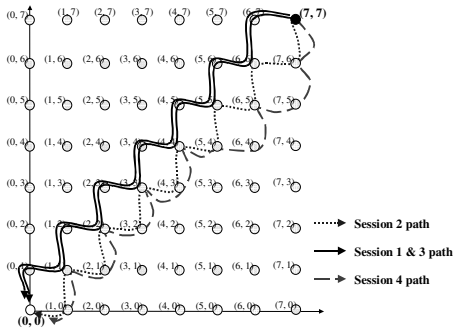
Diffusion in an 8x8 Mesh



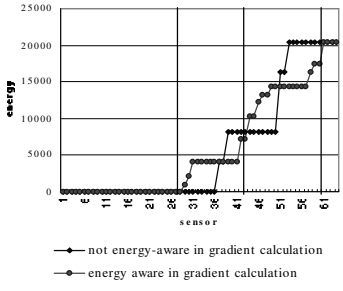
Energy Spent in the 8x8 Mesh



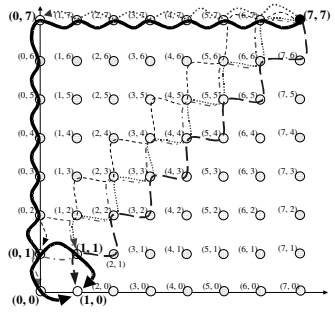
Diffusion with Energy Awareness



Energy Consumption Comparison



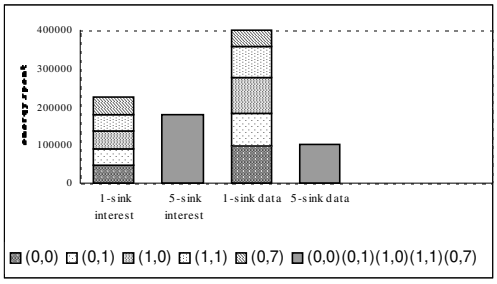
Aggregation Over Multiple Sinks



Single-sink diffusion with (0,0),(0,1),(1,0), (1,1),(0,7) as the sink respectively

Multiple-sink diffusion with (0,0),(0,1),(1,0), (1,1),(0,7) all being sinks

Energy spent in single-sink vs. multiple sink



Conclusion

- A sensor network is data centric and gradient-directed data dissemination helps
- Different schemes discussed
  - Energy usage as an important factor
  - Aggregation for improvement
- Many open questions