

# Overview of Sensor Network Routing Protocols

WeeSan Lee  
weesan@cs.ucr.edu  
11/1/04

# Outline

---

- Background
- Data-centric Protocols
  - Flooding & Gossiping
  - SPIN
  - Directed Diffusion
  - Rumor Routing
- Hierarchical Protocols
  - LEACH
- Location-based Protocols
- QoS-based Protocols

# Background

---

- Sensor nodes
  - Small, wireless, battery powered
  - Energy, bandwidth constrained
  - Data sensing, relaying, aggregating
  - No global addressing scheme
- Sink nodes
  - More powerful nodes
  - Usually gateway to wired networks
  - Data collecting and processing

# The Goal

---

- To disseminate data from sensor nodes to the sink node in energy-awareness manner, hence, maximize the lifetime of the sensor networks.

# Data-centric Protocols

---

- The ability to query a set of sensor nodes
- Attribute-based naming
- Data aggregation during relaying
- For example:
  - Flooding & Gossiping
  - SPIN
  - Directed Diffusion
  - Rumor Routing

# Flooding & Gossiping

---

- In flooding, sensor broadcasts packets to all its neighbors till dst reached or packets' ttl == 0
- In gossiping, sensor sends packets to a randomly selected neighbor which does the same

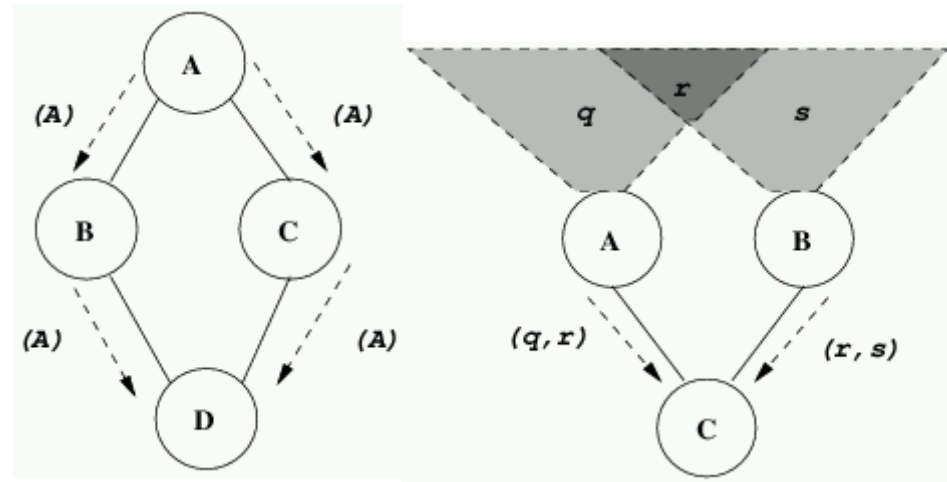
# Flooding & Gossiping (cont)

## ■ Pros

- Simple
- No routing, no state maintenance

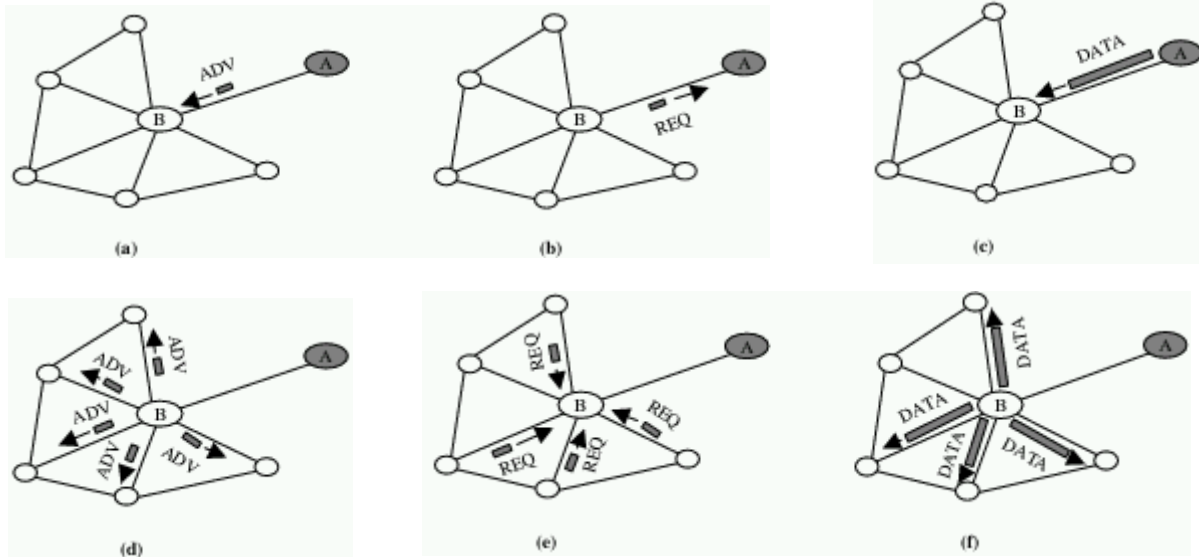
## ■ Cons

- Implosion
- Overlap
- Resource blindness
- Delay in Gossiping



# SPIN – Sensor Protocols for Information via Negotiation

- 3-way handshake: ADV, REQ, DATA
- Event-driven





# SPIN – Sensor Protocols for Information via Negotiation (cont)

---

## ■ Pros

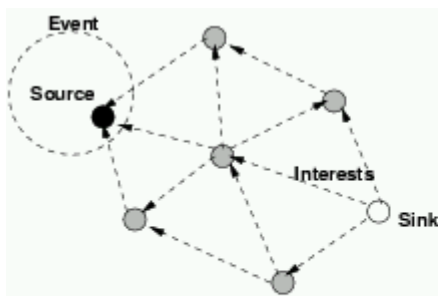
- Solve the classic problems
- Topological changes are localized

## ■ Cons

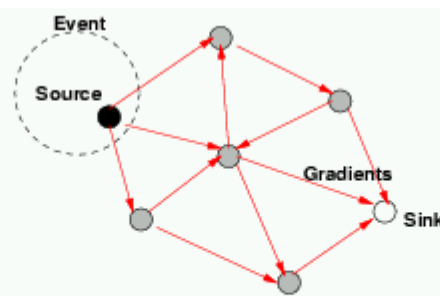
- No guarantee on the delivery of data

# Directed Diffusion

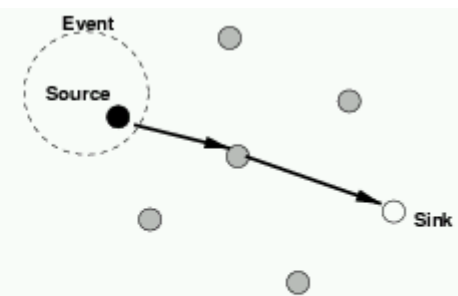
- Sink node floods named “interest” with larger update interval
- Sensor node sends back data via “gradients”
- Sink node then sends the same “interest” with smaller update interval
- Query-driven



(a) Interest propagation



(b) Initial gradients set up



(c) Data delivery along reinforced path

# Directed Diffusion (cont)

---

## ■ Pros

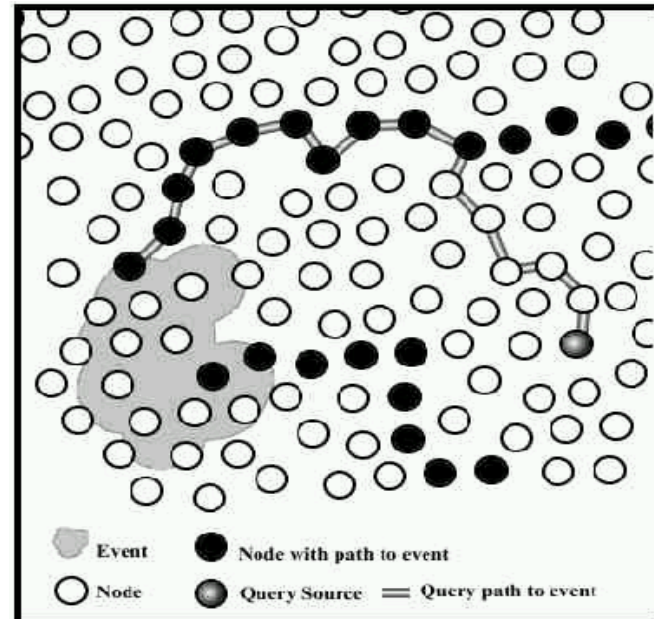
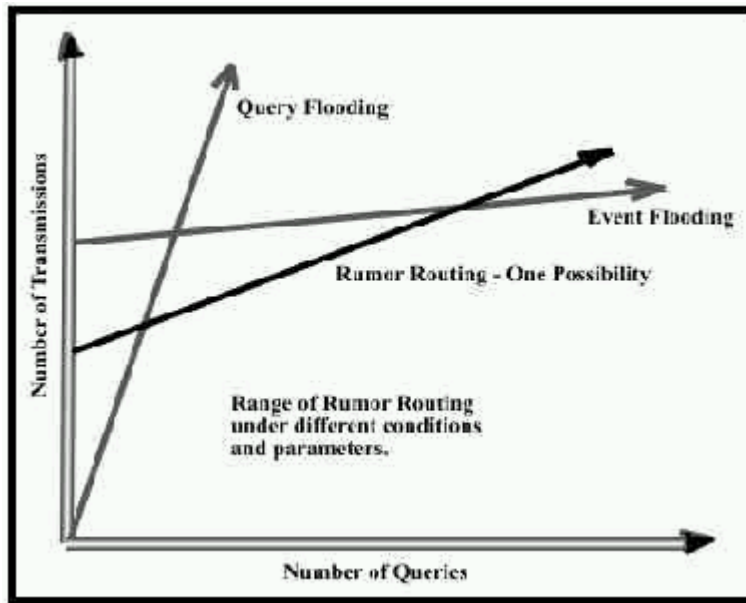
- On demand route setup
- Each node does aggregation and caching, thus good energy efficiency and low delay

## ■ Cons

- Query-driven, not a good choice for continuous data delivery
- Extra overhead for data matching and queries

# Rumor Routing

- A trade-off between Query & Event flooding
- An agent, a long-lived packet, is generated when events happen
- The agent propagate the event to distant nodes



# Rumor Routing (cont)

---

- Pros

- Avoid query flooding

- Cons

- Performs well only when # of events is small
- Overhead to maintain agents and event-tables

# Hierarchical Protocols

---

- Form a cluster, have sensor nodes communicate with cluster head
- Cluster head aggregates and relays data to the sink node
- For example:
  - LEACH
  - PEGASIS
  - TEEN & APTEEN

# LEACH – Low-Energy Adaptive Clustering Hierarchy

---

- Each node decides if it becomes a cluster-head randomly
- Cluster-head broadcasts Adv, other nodes decide which cluster they belong to based on the strength of Adv signal
- Cluster-head creates xmit schedule
- Nodes can sleep when not their turn to xmit
- Cluster-head aggregates data & sends to sink
- Cluster head rotates randomly

# LEACH – Low-Energy Adaptive Clustering Hierarchy (cont)

---

## ■ Pros

- Distributed and no global knowledge of network required

## ■ Cons

- Extra overhead to do dynamic clustering



# Location-based Protocols

---

- Use location information to route data in an energy efficient way
- Mostly for MANET, applicable to Sensor Nets
- For example:
  - MECN & SMECN
  - GAF
  - GEAR

# QoS-based Protocols

---

- Consider e2e delay
- Some enforce soft real-time
- For example:
  - Maximum lifetime energy routing
  - Maximum lifetime data gathering
  - Minimum cost forwarding
  - SAR
  - Energy-Aware QoS Routing Protocol
  - SPEED

# References

---

- A Survey on Routing Protocols for Wireless Sensor Networks:  
[http://www.cs.umbc.edu/~kemal1/mypapers/Akkaya\\_Younis\\_JoAdHocRevised.pdf](http://www.cs.umbc.edu/~kemal1/mypapers/Akkaya_Younis_JoAdHocRevised.pdf)
- SPIN: <http://wind.lcs.mit.edu/papers/spin-mobicom99.ps.gz>
- Directed Diffusion:  
<http://lecs.cs.ucla.edu/~estrin/papers/diffusion.ps>
- Rumor Routing:  
<http://lecs.cs.ucla.edu/~daveey/work/lecs/rumorroute.pdf>
- LEACH: <http://wind.lcs.mit.edu/papers/leach-hicss.ps>