Routing protocols in Wireless Sensor Networks

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Introduction

- Routing challenges
- Classification of routing protocols
- Properties of routing protocols
- Network structure based routing protocol
- Routing protocols based on Protocol Operation
Routing Challenges

- Node deployment
- Energy consumption without losing accuracy
- Network dynamics
- Fault tolerance
- Scalability
Classification of routing protocols

- **Network structure based protocol**
  - Flat-based routing, Hierarchical-based routing and Location-based routing

- **Routing protocols based on Protocol Operation**
  - Multipath routing protocols, Query based routing, Negotiation based routing protocol, QoS based routing
Properties of Routing protocol

- Adaptivity
  Adapt to current network conditions and available energy levels
- Proactive
  Routes are computed in advance
- Reactive
  Routes are computed on demand
- Hybrid
  Combination of two above types
Network structure based protocols

Flat routing
Sensor Protocol for Information via Negotiation (SPIN)

- disseminate all the information at each node to every node in the network assuming that all nodes in the network are potential base-station
- only distribute to nodes that do not possess similar data
- address deficiencies of classic flooding by negotiation and resource adaptation
- SPIN is 3-stage protocol as sensor nodes uses three types of messages ADV, REQ and DATA to communicate
Network structure based protocols

Flat routing
Directed Diffusion

- data-centric and application-aware paradigm (data generated by sensor nodes is named by attribute-value pairs)
- combine data from different sources enroute by eliminating redundancy, minimizing the number of transmission; thus saving network energy
- find routes from multiple sources to a single destination that allows in-network consolidation of redundant data
- All sensor nodes in directed diffusion-based network are application aware which can enable energy savings by selecting empirical good paths and by caching and processing data in the network
Network structure based protocols

Hierarchical routing

- advantages of scalability and efficient communication
- higher energy nodes used to process and send information
- lower energy nodes used to perform the sensing in the proximity of the target
- importance of creation of clusters and assigning special tasks to cluster heads
Network structure based protocols

Hierarchical routing
Low Energy Adaptive Clustering Hierarchy LEACH protocol

- cluster-based protocol which includes distributed cluster formation
- randomly selects few sensor nodes as clusterheads
- rotate the role of clusterheads to evenly distribute the energy load among the sensors in the network
- clusterhead node compress arriving data from nodes that belong to the respective cluster and send an aggregated packet to the base station in order to reduce the amount of information that must be transmitted to the base station
Network structure based protocols

Location based routing protocols

- sensor nodes are addressed by their locations
- distance between neighbouring nodes can be estimated on the basis of incoming signal strengths
- relative coordinates of neighbouring nodes can be obtained by exchanging information between neighbours
- nodes can go to sleep if there is no activity
Network structure based protocols

Location based routing protocols
Geographic Adaptive Fidelity GAF

- energy-aware location based routing algorithm
- Network area is divided into fixed zones and form a virtual grid
- Each zone will elect one node for monitoring and reporting data to the BS on behalf of the nodes in the zone
- Each node uses it GPS-indicated location to associate itself with a point in the virtual grid
- Three states defined in the GAF: discovery, active and sleep
Routing protocols based on Protocol Operation

- Multipath routing protocol
  Maintaining multiple paths between the source and the destination
- Query based routing
- Negotiation based routing protocol
- QoS based routing
Conclusion

- Network structure based protocols classified into three types: flat, hierarchical and location based routing protocol.
- Furthermore it is classified into multipath based, query based, negotiation based and QoS based.
- Further research: exploit redundancy, tiered architectures, data processing inside the network and exploit computation near data resources to reduce communication.