Route Update and Repair in Wireless Sensor Networks

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CCNC 2004
Outline

♦ Introduction
♦ Route Dynamics in wireless sensor networks
♦ Efficient Route Update Protocol (ERUP)
♦ Simulation
♦ Conclusion
Introduction

♦ Wireless sensor networks
  ✔ a large number of sensors, some relay devices, and a few data collectors (named “sinks”)
  ✔ Restriction: energy, transmission range
  ✔ sources have to build and maintain multihop routes toward sinks to report sensory data
Introduction (cont.)

♦ wireless ad hoc networks
  ✔ mobility
  ✔ Omni-directional flooding

♦ wireless sensor networks
  ✔ topology is assumed to change infrequently and slowly
  ✔ energy conservation and power balancing are more important
Introduction (cont.)

♦ Route Update and Repair in wireless ad hoc networks

☑ AODV
omni-directionally

☑ Query Localization (QL)
hard to discover a new fresh route
Route Dynamics

♦ Endpoint (Sink and Target) Mobility
♦ Death of Individual Sensors
♦ Route-wide Power Depletion
Efficient Route Update Protocol

- Route update process is called
  1. sink moves
     - sink initiates process
  2. target leaves
     - broadcast – backoff – new source
     - cannot contact the downstream neighbor of the old source
  3. most nodes along the route are running out of power
     - warning signal
     - 70% nodes
     - source initiates process
  4. individual sensor exhausts its power or drifts away
     - the upstream node of the failed sensor
Efficient Route Update Protocol

♦ Definition of Route Discovery Region
♦ New Route Discovery
Efficient Route Update Protocol

Definition of Route Discovery Region
1. initiator marks itself as IN_REGION node
2. broadcasts a Route Discovery Region (RDR) packet with TTL value
   - case 1, 2, 4 => the TTL value is 2
   - case 3 => the TTL value is 1
3. node on the old route => resets TTL to 1 and rebroadcast
   node not on the old route => check, decreases the TTL value, rebroadcast
4. All nodes receiving the RDR mark themselves as IN_REGION nodes
Efficient Route Update Protocol

- New Route Discovery
  - initiator broadcasts a RRQ packet
  - Only nodes with the IN_REGION marked and have residual battery larger than a threshold can rebroadcast the RRQ.
Efficient Route Update Protocol

- densely deployed around the old route
  - the RRQ should be able to propagate to the RD_Dest
- the sparse area
  - blocks the propagation of RDR or RRQ toward the RD_Dest
  - Route Request Confirmation (RRC)
  - new RDR with increased TTL
Efficient Route Update Protocol
Efficient Route Update Protocol
Simulation

♦ OPNET 7.0
♦ compare the performance with AODV and QL
♦ transmission range of each node is 30m.
♦ simulation time is 200 second
♦ Each source generates one data packet per second
Simulation

676 sensors in a 500m by 500m square
the speed of the mobile sink is 2m/s
Simulation

![Graph showing control overhead vs number of nodes for ERUP and ERS-AODV protocols.](image)
Simulation

841 sensors in a 500m by 500m square
Simulation

[Graph showing average delay versus number of sources for two different methods: ERUP and Omnidirectional Flooding.]
Simulation
Conclusion

♦ provide energy-efficient and scalable routing in large-scale sensor networks
♦ reduce communication overheads of route reconstruction