Comparison of Routing Protocols for Data Fault Tolerance in Sensor Networks

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Why data fault-tolerance?

Sensor networks are used in:
- Life critical applications
- Battlefield scenarios
- Intrusion detection

Goal: Accurate measurement and observation in the face of data faults.

Data faults are the results of:
- Natural sources (Failures of nodes or links)
- Malicious sources
  - Electromagnetic jamming techniques
  - Masquerading nodes

Fault Masking instead of Error Correction

- Error control code /ARQ
  - Inappropriate in high error rates scenarios
  - Wastes energy in transmitting extra bits
- Use error masking
  - Sending multiple copies at the source and undertaking voting at the sink node
- Examine error masking with three protocols: broadcast, gossip, and directed diffusion
- Performance metrics: reliability, convergence time, and energy consumption

Simulation Parameters

- Failure Mode
  - Transient link failure with 5% probability of failure at each transmission
- Static placement of nodes in a regular grid
- Directed diffusion has a 90° funnel and sense of direction is perfect
Directed Diffusion

Gossip

Simulation Results

- Convergence Time
- Energy in packets sent

Reliability

<table>
<thead>
<tr>
<th>Grid Size</th>
<th>3x3</th>
<th>4x4</th>
<th>5x5</th>
<th>6x6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energies</td>
<td>0</td>
<td>2000</td>
<td>4000</td>
<td>6000</td>
</tr>
</tbody>
</table>

Reliability of the 3 protocols

<table>
<thead>
<tr>
<th>Grid Size</th>
<th>3x3</th>
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<th>5x5</th>
<th>6x6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>0</td>
<td>0.4</td>
<td>0.8</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Conclusion

- Error Masking makes sense in sensor networks
- Between error masking schemes, directed diffusion is more suitable in a sensor network environment
Future Work

- Topologies
  - Different topologies
  - Irregular topologies
- Voting schemes could be varied
- Nodes with inexact sense of direction
  - What fraction of such nodes could directed diffusion tolerate?