

Beacon Vector Routing

Scalable Point-to-Point Routing in Wireless Sensornets

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Wireless Sensor Networks (IN4181)



Overview

- Background
- Theory
 - Simulation Results
- Implementation
 - Experimental Results
- Conclusion

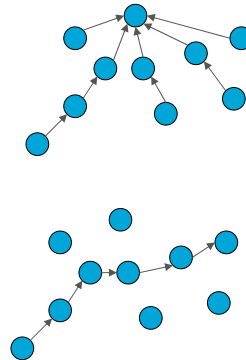
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Point to Point

- Traditional WSN communications are cluster or tree based
 - Communication with the sink
 - Many to one, one to many
- Point-to-point routing protocols
 - Communication between nodes



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Possible Solutions (1)

- Shortest Path
 - Complex initialisation
 - Large local data storage
- Hierarchical Addressing (Internet)
 - + Little local data storage
 - Requires layout knowledge before deployment

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Possible Solutions (2)

- Geographic Coordinates
 - + Little local data storage
 - Requires GPS
- Virtual Coordinates
 - + Do not require GPS
 - Current algorithms are complex
 - Relatively large local storage

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Beacon Vector Routing

- Combines a number of the previous ideas
 - Create simple virtual coordinates
 - Use 'Greedy' geographic-like algorithm
- Focus on The Real World
 - Simplicity
 - Scalability
 - Robustness

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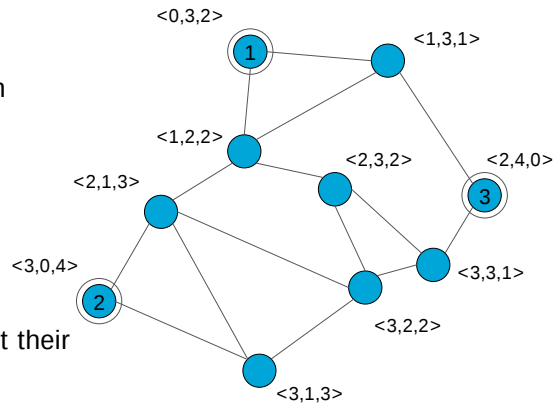
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Initialisation

- Choose Beacon Nodes
- Flood Beacon Information
- Node Address Generated
 - Coordinates of k closest beacons.
- Nodes regularly broadcast their address to neighbours



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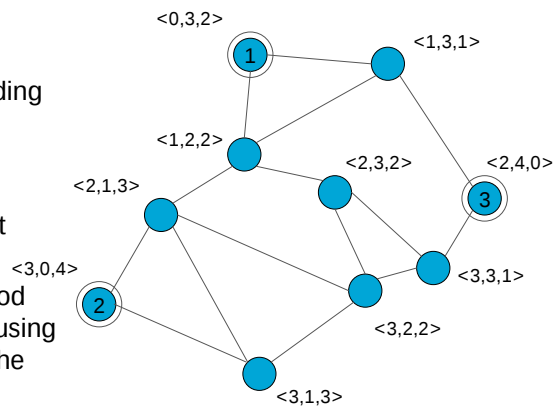
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Packet Forwarding

- Basic Algorithm:
 1. Try Greedy Forwarding
 - Largest Distance
 2. Else try fallback
 - Send towards destination's closest beacon
 3. Else Do Scoped Flood
 - Flood the packet using the distance from the beacon as scope



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Greedy Forwarding

- Moving towards a beacon is better than moving away from one.
 - Object might be on the other side of a beacon
- Head towards beacons that are closer than us first
- If there is a tie, start moving away

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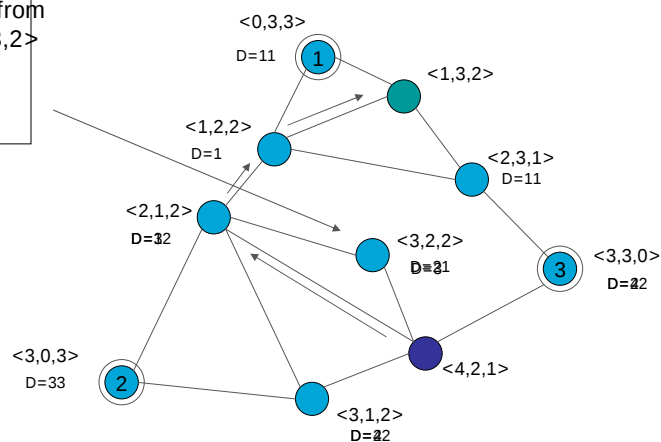
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Greedy Forwarding

- We want to go from node 1 to node 2, and therefore getting the same score



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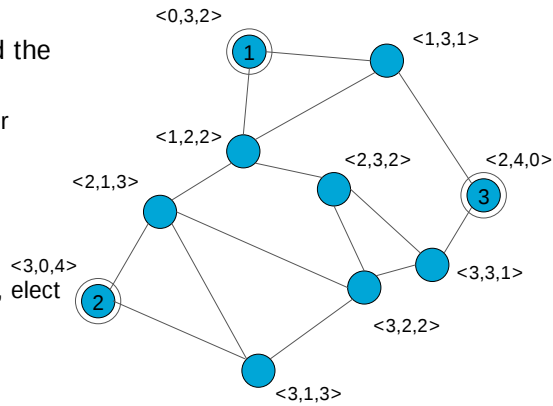
Network Maintenance

- Beacons periodically flood the network

- Use a Sequence Number

- Nodes periodically check number of beacons

- If there are too many, suppress yourself
 - If there are not enough, elect yourself



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Simulation Results

- Parameters:
 - 3200 nodes
 - Between 10 and 80 beacons
 - 10 Beacon addresses
 - Average of 16 nodes in radio range
- Measurements often done without flooding

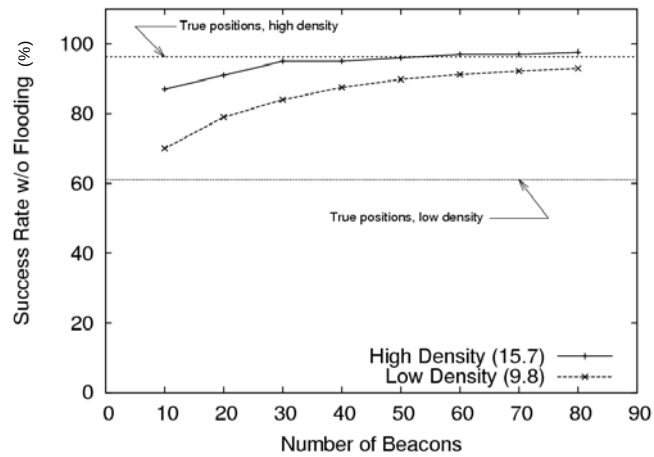
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Node Density



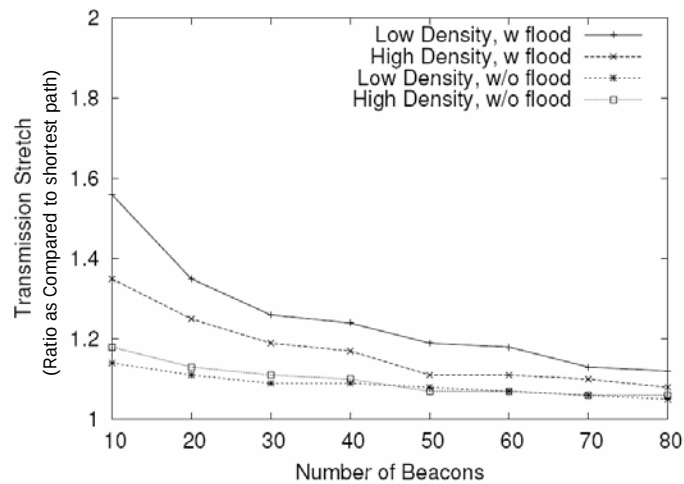
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Comparison to shortest path



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Implementation

- Prototype implementation in TinyOS
- Limited Memory
 - Strong links must be selected
- Lossy Links
 - Detect using beacon message serial numbers
 - Take them into account when selecting routes

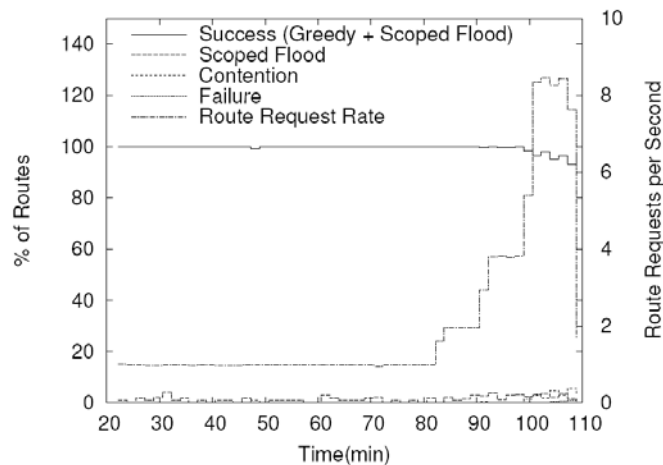
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Increasing data rates



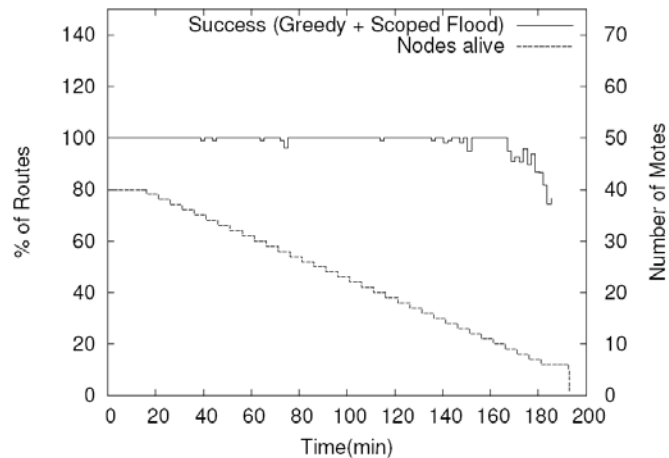
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Node Failure



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Conclusion

- Simple
 - Works on very limited nodes (4k RAM)
- Robust
 - Stands up to failure
- Efficient
 - Sometimes even more efficient than geographic routing
 - Low overhead

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