RBMulticast: Receiver Based Multicast for Wireless Sensor Networks

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Presented by
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Outline

- Motivation and Goal
- Methodology
  - Unicast without routing table
  - RBMulticast without routing table/multicast tree
- Simulation Results
- Conclusions
Motivation

- Conventional routing in WSNs
  - (Proactive) Build table before sending packets
    - Routing overhead independent of data traffic
  - (Reactive) Build table when sending packets
    - Find route on-demand
    - Routing overhead is proportional to data traffic
Motivation

- Non-conventional routing in WSNs
  - Based on extra location information, routing table is not required
    - GeRaF [1]
    - XLM [2]
- Advantages of no routing table routing
  - (simple) No routing state maintenance
  - (efficient) No control traffic
Motivation

- Can we develop a multicast without routing table?
  - Yes

- RBMulticast is based on the work of XLM [2]
  - No routing table, no multicast tree
  - Receiver-based (or contention-based) protocol
  - NO state multicast
Unicast without routing table

- No routing table
  - Source node knows:
    - Its location
    - Sink node's location
  - Potential router nodes know:
    - Its location
  - Information are not enough to decide next hop by source node itself
    - All the neighbor nodes participate in the routing decision
    - Contention-based protocol (Receiver-based)
Routing decision in XLM [2]
Next hop decision in XLM [2]

RTS packet include Source and Sink location
Multicast without tree (table)

- Assumptions
  - Source node knows:
    - Its location
    - ALL Sink nodes' location
  - Potential router nodes know:
    - Its location
Example: Multicast with tree (table)

B's multicast table

<table>
<thead>
<tr>
<th>Source</th>
<th>Group</th>
<th>Next Hops</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Z</td>
<td>E,J</td>
</tr>
<tr>
<td>E</td>
<td>Z</td>
<td>C,J</td>
</tr>
<tr>
<td>J</td>
<td>Z</td>
<td>C,E</td>
</tr>
</tbody>
</table>
Critical problems

- How to decide routing if multiple sink nodes exist?
Trick

- Observation: existence of sink node is irrelevant in routing decision
  - Use a hypothetical node

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CTS
RTS
Virtual Node
Critical problems

- How routers know the multicast destinations if no multicast tree (table)?
  - Knowledge of Group ID is not enough in our case
Destination List

- Include all sinks' location inside the packet
  - All required information are included inside packet
  - No state at intermediate router nodes

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>14</th>
<th>15</th>
<th>16</th>
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</thead>
<tbody>
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<td></td>
<td>Protocol ID</td>
<td>TTL (Time To Live)</td>
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<td>TOS (Type Of Service)</td>
<td>DLL (Destination List Length)</td>
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<td>Source Address</td>
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<td>Destination List Address 1</td>
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</table>
Critical problems

- How an intermediate node decides when to split a packet?

![Diagram showing network nodes and connections with arrows indicating next hops.]

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</table>
Multicast Regions

- Split a packet if sinks are in different regions
RBMulticast example
Experimental Results

Success Rate ~ 1

# of packets ~ 500
Emulation Results

Success Rate \( \approx 85\% \)
Conclusions

- RBMulticast makes no state multicast possible with the help of location information
- The experiments show that RBMulticast is efficient enough for real applications
- Location provides strong information and we are still not fully utilizing its power

Thank you
Application

- Scenario
  - If more than two base-station are interested in a same sensor data

- Guide lines
  - Sink nodes must stationary
  - All other nodes must know its location but can randomly move without any restriction on the condition that it can update its own location.
Application
Hole problem
Water Flowing
Water Flowing