





A Self-organizing Concurrent Global Information Dissemination Scheme for Sensor Networks

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Overview


- What is self-organization and why it's a good idea?
- Proposed Protocol
- Simulations
- Results
- Conclusion

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Self-organizing systems

- In biological systems, individual entities react by following some common rules, generally based on the state of their neighbors and environment (using feedback) without any centralized control
 - Purely distributed, and no single point of failure!
- In our model:
 - Feedback using exchange of messages between neighboring nodes.
 - All nodes follow the same rules, and define their state.

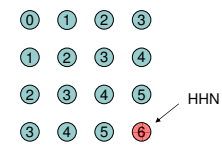


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Proposed Protocol

- A self-organizing *concurrent global information dissemination* scheme for wireless sensor networks:
 - Identifies *highest hopcount nodes* (HHNs) from the sink, from which their local (one-hop) broadcast can traverse the whole network.
 - Obtains global extremities in a pseudo-concurrent manner.



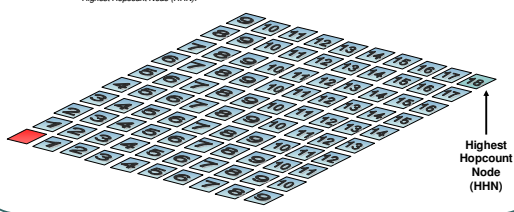
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Highest Hopcount Nodes (HHNs)

The highest hopcount nodes of the network are discovered after the *hopcount initialization phase*.

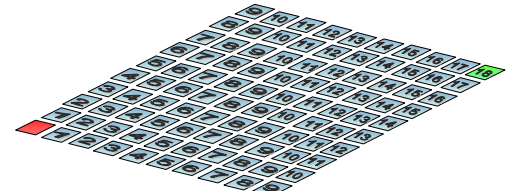
1. Sink broadcasts a "S" message to neighbors.
2. Neighbors of sink update their hopcount to sink to 1 and broadcast a "1" hopcount message to their own neighbors.
3. Neighbors which have not received any hopcount messages previously will increment their hopcount to $k+1$ where k is the hopcount message number. (minimum hopcount among those received)
4. When a node does not receive a hopcount message with a larger hopcount than its own, it assumes itself as the Highest Hopcount Node (HHN).



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Highest Hopcount Node Initiated Broadcast



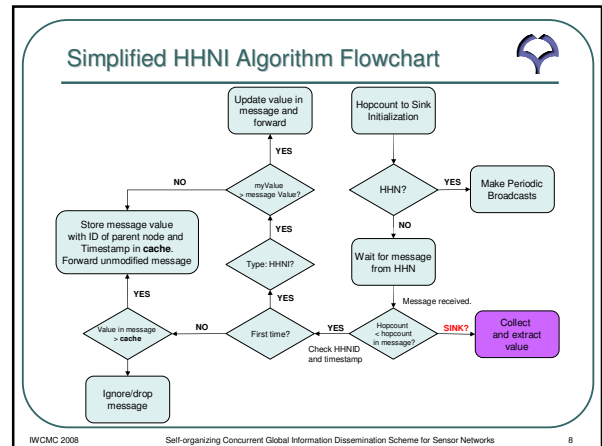
Local broadcast of a HHN will reach all nodes in the network, towards the sink...

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Simplified HHNI Algorithm

1. If I am the Highest Hopcount Node (HHN), I make periodic broadcasts.
2. If I am an ordinary node and I receive a message, I will first check whether my hopcount is **less than** that of the parent node from which the message is coming from. Then if I am receiving the message for the **first time** (check HHNIID and timestamp) and the message is of type HHNI, if my value is more extreme than the one in the message, I will update the value in the message and forward it on. Else I will store the value of the message together with the ID of the *parent* node and corresponding timestamp in cache, and forward the unmodified message.
3. If I am an ordinary node and I receive a message (identical timestamp) **again**, I will only forward it if the value in the message is more extreme than the one stored at node, otherwise I will ignore the message. Before forwarding however, I will wait for a random time and if I do not hear my neighbors broadcasting this message, I will broadcast it.
4. If I am the sink I will collect and evaluate the messages, obtaining/extracting the desired value or extremity and broadcasting this to all sensor nodes.
5. If I am an ordinary node and I receive a sink extreme value broadcast (SXVB) message, I will set the Extreme Value and Threshold. I then monitor the node's sensed data against these values. If the threshold is compromised then I will send an SNI message with my current value.

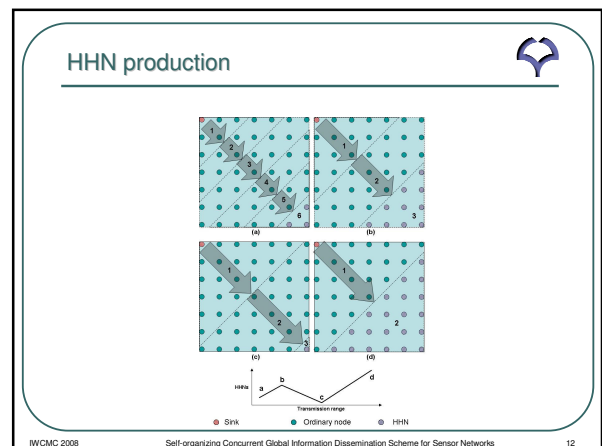
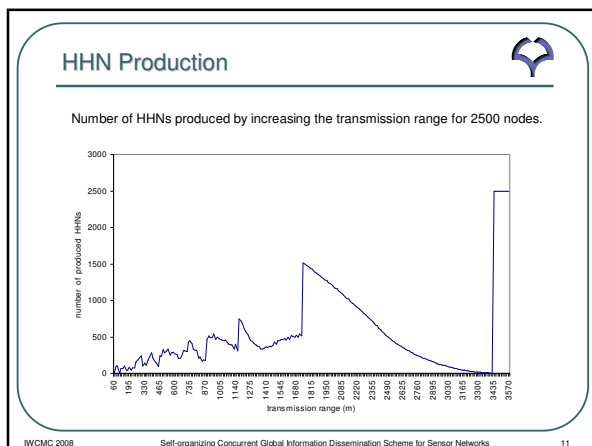
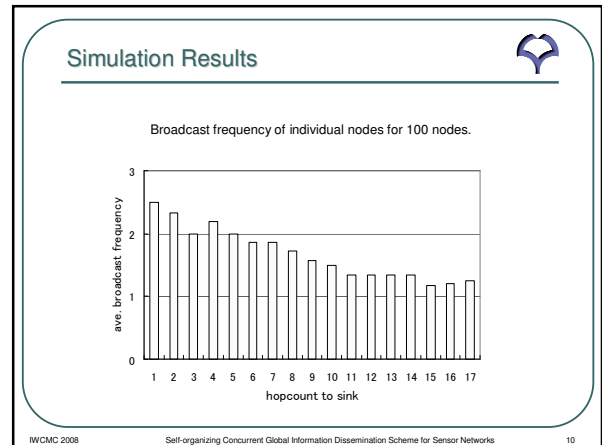
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Simulation

- 100 – 10000 node scenarios.
- Static topology (not mobile nodes)
- Uniform distribution of nodes 50 m apart.
- Randomly distributed node scenarios.
- Communication range varies from 60m to 540m
- Energy model: 100 pJ/bit/m² for the transmitter amplifier.

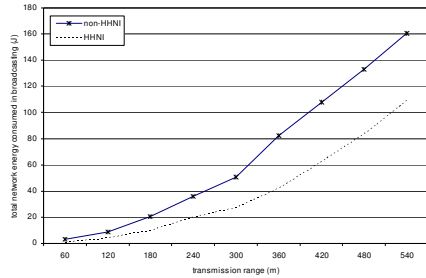
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Simulation Results



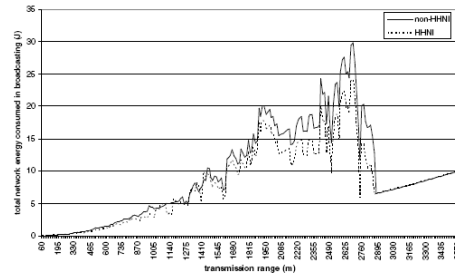
Energy consumption vs transmission range for HHNI and non-HHNI routing for 10000 nodes after 30 reports



Simulation Results



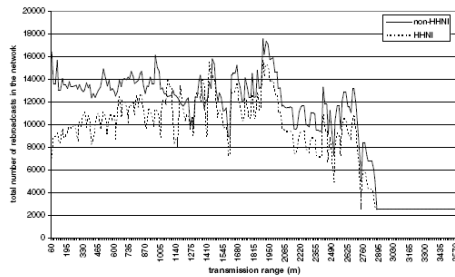
total network energy with varying transmission range.



Simulation Results



Total number of rebroadcasts in the network.



Conclusion



In this presentation

- Proposed a routing protocol for wireless sensor networks which efficiently retrieves extreme values of the network.
- Simulation results show that the proposed highest hopcount node initiated (HHNI) broadcasting effectively retrieves the maximum value of the network in an energy-efficient manner.
- Future work should focus on the effect of randomness and mobility on the protocol, and efficient synchronization.

Thank You.

