

An Energy*Delay Efficient Routing Scheme for Wireless Sensor Networks

Wireless Sensor Networks

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An Energy*Delay Efficient Routing Scheme for Wireless Sensor Networks

Performance metrics

- Energy consumption
- Network Lifetime
- Packet Delay
- **Energy * Delay**

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C²E²S – Cluster and Chain Based Energy*Delay Efficient Routing Scheme

Decentralized (LEACH)

- Node centric
- Heuristic
- Low overhead

Centralized (C²E²S)

- Knowledge of whole network
- Data gathering overhead

Uses geographical information

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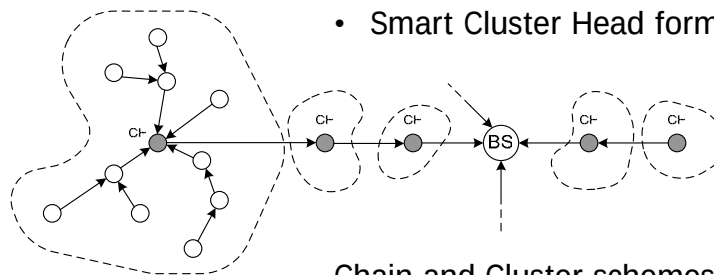
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Improvements over LEACH

- Multi-Hop
- Smart Cluster Head formation



Chain and Cluster schemes

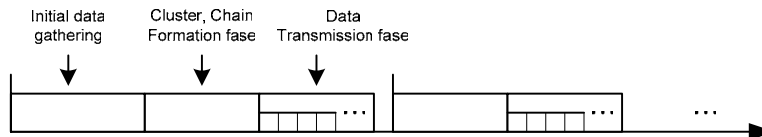
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C²E²S: Operation

- Base Station decides chain- and cluster formations every round



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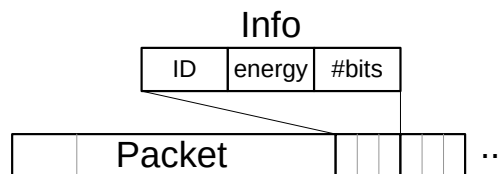
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C²E²S: Data Gathering

Passive BS approach

Every time a packet is routed, information is appended to the end of the packet:

- Node ID
- Node energy
- #bits sent



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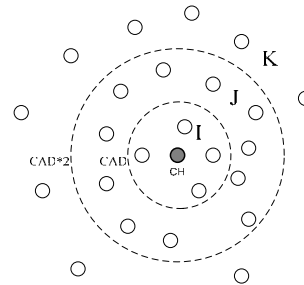
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C²E²S: Cluster formation & routing

Cluster Head probability based on energy and transmission range.

Nodes divided in rings

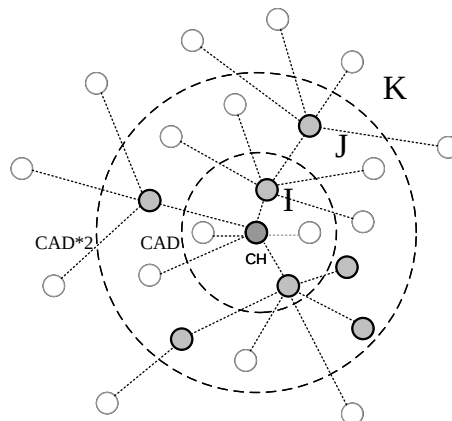
- Geographic based routing



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C²E²S: Cluster formation & routing



Only high energy sensors used for routing

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C²E²S: Cluster formation & routing

Routing through Dijkstra's shortest distance algorithm.

Distance is weighed sum of

- Communication cost
- Delay
- Residual energy
- The existing connections

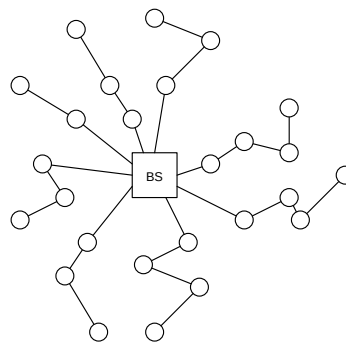
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C²E²S: Chain formation & Routing

BS forms inter-cluster Chains between the Cluster Heads.

- Nearest Neighbor
- Based on distance only



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Results

Simulation Setup

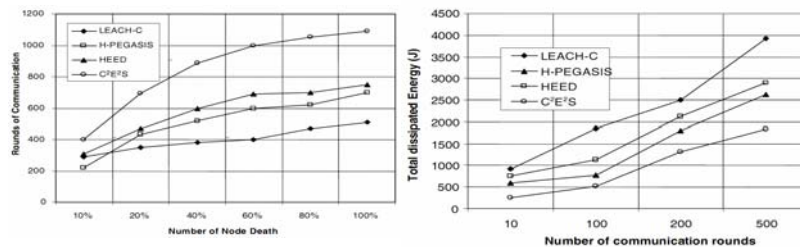
- 100x100m²
- 2000 sensors
- Base Station at (75,125)
- Packet rate: 1 packet / sec
- Initial Energy per node: 2 Joule
- Transmission cost for 1 bit: $50 + 10 \cdot d^2$ nJ
- Data size: 500 bytes
- Header size: 25 bytes
- Info packet size: 25 bytes
- Cluster Info packet size: 50 bytes

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Results

Comparing lifetime with LEACH-C, H-PEGASIS, HEED

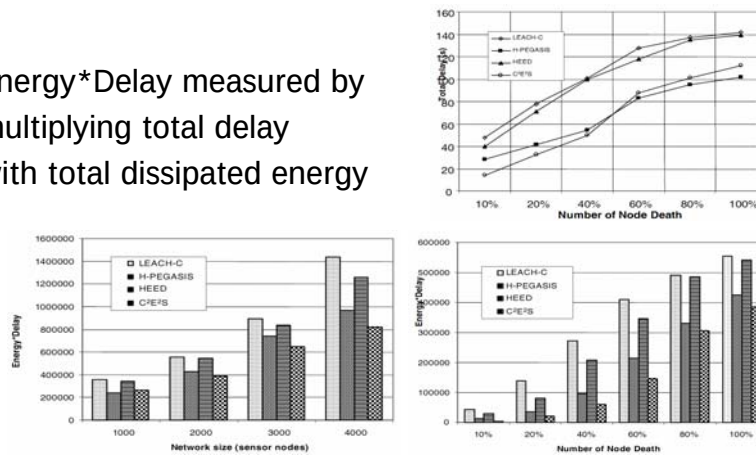


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Results

Energy*Delay measured by multiplying total delay with total dissipated energy

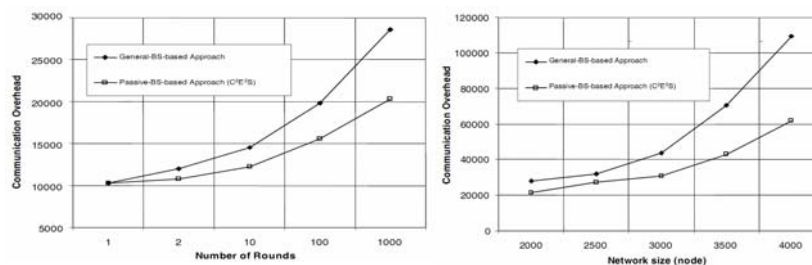


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Results

The effect of the Passive-BS approach on overhead



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Conclusions & Thoughts

- Energy*Delay can be interesting for big networks that monitor immediate threats or interact with the sensor readings.
- Only works with a BS that can reach all nodes and knows their locations
- C²E²S algorithms can be improved
 - “Smart” Cluster Head choices
 - 3-hop with Dijkstra seems an odd choice
 - Current chain formation only depends on distance

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