Context-based Topology Management for Wireless Sensor Networks

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Start

Wireless Sensor Networks (WSNs) are typically composed of a number of sensor nodes, which are capable of sensing, signal processing and wireless communication.

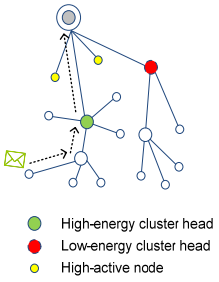
Classification of WSNs:
- Small scale: centralized topology management
- Large scale: distributed topology management

Context information in WSNs:
- Sensor nodes: power profile, storage and processing capability, mobility, activity rate, etc.
- Network: topology, bandwidth, communication traffic, etc.

Centralized Topology Management

For a WSN of small physical dimension, nodes are statically connected in a hierarchical structure, with the data sink as the tree root.

According to the context, we construct sub-trees with dynamic cluster sizes to satisfy both end-to-end delay and load balance in the network.



Example: Centralized hierarchical clustering

Our centralized clustering (CDB; ICDB):
- Inter-connected tree backbone
- Use context as clustering parameters
  - Cluster member selection
  - Cluster head selection
  - Dynamic cluster size estimation
- Objectives
  - Load balance/max. lifetime
  - Routing/energy efficiency, etc.

The Management Process

Start

WSNs with different scales

Centralized Topology Management

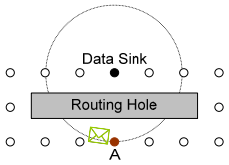
Forming of centralized backbone structure for small-scale WSNs.

Distributed Topology Management

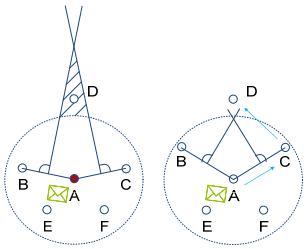
Forming of distributed clusters for large-scale WSNs

Distributed Topology Management

Local Minimum (node A) in Greedy Forwarding: Node with no neighbor that is nearer to the data sink, which often cause failures in traditional geographic routing algorithms.

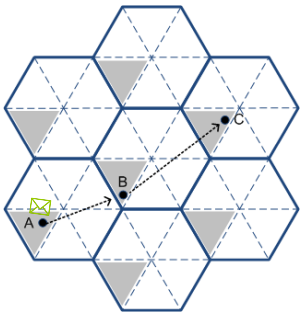


The TENT rule:
- Examine local minimums
- A node is a stuck node if an angle between its 2 angular adjacent neighbors is greater than 120°



Our distributed clustering (GAF&Co):
- Clustering with hierarchical hexagonal cells
- Schedule redundant nodes into energy-saving (sleeping) mode
- Maintain the connectivity of a network
- Avoid local minimums of Greedy Forwarding

- Objectives
  - Load balance/max. lifetime
  - Routing/energy efficiency, etc.



Example: GAF with COnnectivity-awareness (GAF&Co)

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