Location-Based Routing
An overview and possible directions for GeoCRON

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Introduction

- Traditional routing
  - Unique address: IP, MAC, Peer ID, etc.
  - Source routing: next hop address, neighbor index
  - Local routing: distance-vector, link state, label-switching

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- Why location information?
    - Geocast: message all (or some) nodes in target region
    - Latency: request from closer server, route locally when possible
    - Congestion: confine route requests to smaller regions (MANETs)
    - Energy: closer nodes need less radio power to reach
    - Sensors: regional event detection, spatial querying
    - Planning: paths (robots), surveillance cameras (focus on area target will appear next)
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  - Recovery: avoid problematic areas of the network
    - our primary interest!

Roadmap

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Location Service

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- Distribute load
  - In **?**, node updates
    location servers
    distributed throughout
    network
  - Divide network into
    hierarchical grid
  - Choose location server
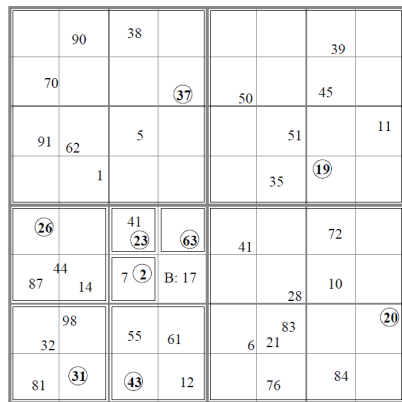   from 3 external grids at
    each level

Figure: Hierarchical grid with 4
order-i squares in order-i+1 square

Location Service for GeoCRON

- Grid ⇔ CSN's *geocells*
- Location servers → sensor's overlay contacts
- Natural geographic diversity → more robust!
- Location servers hold address, NOT just location!
- Region ID ← quad tree path
  - *ex: B* at 203 (count like Cartesian plane)
- Region similarity → prefix match region ID

Figure: Hierarchical grid closely resembles CSN's *geocells*

Roadmap

Source Routing

Roadmap

Greedy Forwarding

- In Young-bae Ko et al. (1999), source defines a *multicast region* and *forwarding zone*
  - Message delivered to all nodes in multicast region
  - Defined as a rectangle, coordinates inside message
  - Includes source, destination, plus error
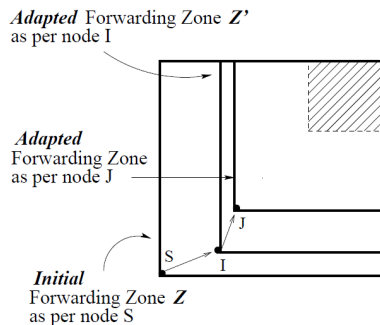 - Message flooded within forwarding zone until target reached

Figure: Depiction of adaptive multicast region and forwarding zone

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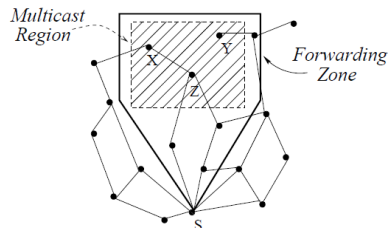 - Message flooded within forwarding zone until target reached

Figure: Depiction of multicast region and forwarding zone

Greedy Forwarding

- Adapt forwarding region at each hop Young-bae Ko et al. (1999)
  - Intermediate (closer) nodes know topology better
  - Change region shape
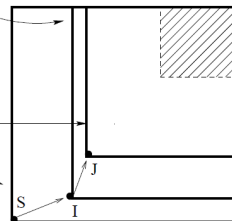
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Geometric Routing

- Network topology $\rightarrow$ graph
  - Vertices $=$ nodes
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- Network topology $\rightarrow$ graph
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- Forward based on geometry of graph
- *Compass routing* first proposed in Kranakis et al. (1999)
  - *Right-hand rule*
    - Forward packet along next counter-clockwise edge
    - Analogous to following the right hand wall in a maze
  - Also called *face routing*
  - Also used in Kuhn et al. (2003), ADD OTHERS HERE!!!!!!!!!!!!!

-

right-hand rule introduced in Compass Routing on Geometric Networks

Roadmap

In Joa-Ng and Lu (1999), an inter-zone clustering protocol is periodically run to update with information about inter-zone links. Does not give information about exact location of destination within a zone and so still need to find that.

Clustering - LABAR

- LABAR Zaruba et al. (2003)

  - GPS-enabled nodes →
    backbone G-nodes
  - Nodes near G-nodes
    belong to a *zone*
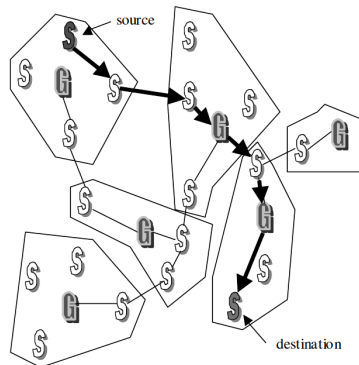 - G-nodes give sender
    vector towards
    intermediary zones

Figure: Routing in LABAR

Roadmap

Hybrid

- In Kuhn et al. (2003); Huang et al. (2005); Karp and Kung (2000), greedy forwarding until *void* reached
  - *Face routing* within a bounded region
  - Enlarge bounded region if destination unreachable
  - FAR Huang et al. (2005) introduced *mobicast*: mobile geocast
    - Application: mobile regional sensing
    - *Just in time* forwarding: packet arrives right before mobicast region
    - Decreases *lag time* (how long nodes hold data before mobicast region arrives)

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