Location Oriented Networking

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Suppose you want to send a message to everyone in this room
Use location information on the network

- Message to location
- Host to location
Overview

Geocast

Location Management

Example Application

Application
  Experiments
Addressing places

- Location as address
- Location in routing
Building Geocast

- UUMAP
  - Geographical extension to DNS
  - No reverse function
Building Geocast

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- Naive flooding?
Building Geocast

- UUMAP
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- Naive flooding?
Building Geocast

- Directed flooding
  - LBM
  - Voronoi
  - Mesh
  - GeoGRID
Building Geocast

- Directed flooding
  - LBM
  - Voronoi
  - Mesh
  - GeoGRID
- Non-flooding
  - URAD
  - GeoNode
  - GeoTORA
Location Based Multicast – LBM

- Forwarding zone
  - Rectangle
  - Distance measure
Location Based Multicast – LBM

- Forwarding zone
  - Rectangle
  - Distance measure
- Weakness: empty zone
Voronoi

- Region division
  - No empty zone
  - Increased overhead
Mesh

- Flood: route request
- Unicast: route reply
GeoGrid

- Logical grid
  - Gateways
- Rectangular directed flooding
- Tickets
Unicast Routing with Area Delivery – URAD

- Family of protocols
- Unicast routing
- Example: Greedy Perimeter Stateless Routing – GPSR
  - Greedy forwarding
GeoNode

- Infrastructure-based
- Three approaches
  - DNS
  - GPS-Multicast
  - Integrated geographical information
- Core unit: GeoNode
  - Cellular structure
  - Message storage and transmission
GeoNode – DNS

- Geographical domain:

  .geo
GeoNode – DNS

- Geographical domain:
  california.geo
GeoNode – DNS

- Geographical domain:
  santacruz.california.geo
GeoNode – DNS

- Geographical domain: ucsc.santacruz.california.geo
GeoNode – DNS

- Geographical domain:
  ucsc.santacruz.california.geo
- Resolves to IP
GeoNode – DNS

- Geographical domain:
  ucsc.santacruz.california.geo
- Resolves to IP
- General format:
  <polygon>.<county>.<state>.geo
 GeoNode – GPS-Multicast

- IPv4 resolution limit
- Atoms: unique address
- Partition: group of atoms
GeoNode – Geographical Routing

- GeoRouters
  - Hierarchical
  - Forward packets
- GeoHosts
  - Geographical information for host
GeoTORA

- Directed Acyclic Graph (DAG)
  - DAG creation: flooding
    - Directed to target
  - DAG maintenance: no flooding
    - Edge reversal
Location Management

Purpose
Location Management

Purpose

Do you know where your children are?
How to find a host?

Location Management

- Origin: location aided routing
  - LAR
  - DREAM
  - GPRS
  - GRA
How to find a host?

Location Management

- Origin: location aided routing
  - LAR
  - DREAM
  - GPRS
  - GRA

- Exchange location information

- Core ideas:
  - Query as necessary
  - Update promiscuously
DREAM Location Service – DLS

- Location packets
  - Coordinates
  - Speed
  - Timestamp
- Differentiated transmission
  - Distance & Movement based
- Similar to OSPF
Simple Location Service – SLS

- Variable rate
- Location packet
  - Slice of location table
- Similar to RIP
Reactive Location Service – RLS

- Requests
  - Neighbors
  - Flood
- Full route
- Entries aging
- Similar to DSR
Experimental Results

- Speed influence: RLS
- Accuracy: SLS
Which problem could use those techniques?
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- Area reconnaissance
Which problem could use those techniques?

- Area reconnaissance
  - Monitoring
  - Lack of pattern
  - Robust

- UAV Communication
- IC-MANET
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Mobility Model
Pheromone based

- Bio-inspired
- Markers
- Purpose: reconnaissance
Mobility Model

Pheromone based

Local

Global
Geographical Routing – Gossip Based
Location Aware Routing for Delay-tolerant networks – LAROD

- Greedy forwarding
- Custodian
- Contention: delay timer
- Location Service
LAROD
Forwarding Zone

Custodian (a)
Sector

Custodian (b)
Reuleaux

Custodian (c)
Circle

Custodian (d)
Progress
LAROD
Custodian selection by delay
Location Service
Location Dissemination Service – LoDiS

- Location servers
  - Low memory cost
  - Routing integration
  - Gradual improvement
- Regular broadcasts
  - Slices
- SLS inspired
- Clock synchronization
LAROD-LoDiS

Example

Destination (at reception)

Destination (at pkt gen)

Destination (in source location server)

Source
LoDiS

Experiments

![Graph showing delivery ratio vs packet lifetime for LoDiS experiments.](image-url)
LoDiS Experiments

Packet life time (s)

Transmissions per data packet

LAROD−LoDiS 5
LAROD−LoDiS 15
LAROD−LoDiS 40
LAROD−LoDiS 100
LAROD−Oracle
Experiments

![Graph showing delivery ratio vs. node density for different protocols]

- **LAROD**
- **LoDiS**
- **Spray and Wait L=20**
- **Spray and Wait L=10**
Experiments

![Graph showing delivery ratio vs. node density]

- **LAROD−LoDiS**
- Spray and Wait $L=20$
- Spray and Wait $L=10$

Node density (nodes/km²)

Delivery ratio

- **LAROD−LoDiS**
- Spray and Wait $L=20$
- Spray and Wait $L=10$
Experiments

**Node density (nodes/km²)**

**Transmissions per data packet**

- **LAROD−LoDiS**
- **Spray and Wait L=20**
- **Spray and Wait L=10**
The End