Geocast Messaging for Wearable Smart Devices using Mesh Networking and Geographical Routing

Technical Presentation

Panacea's Cloud

Overview

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A Typical Mesh Topology
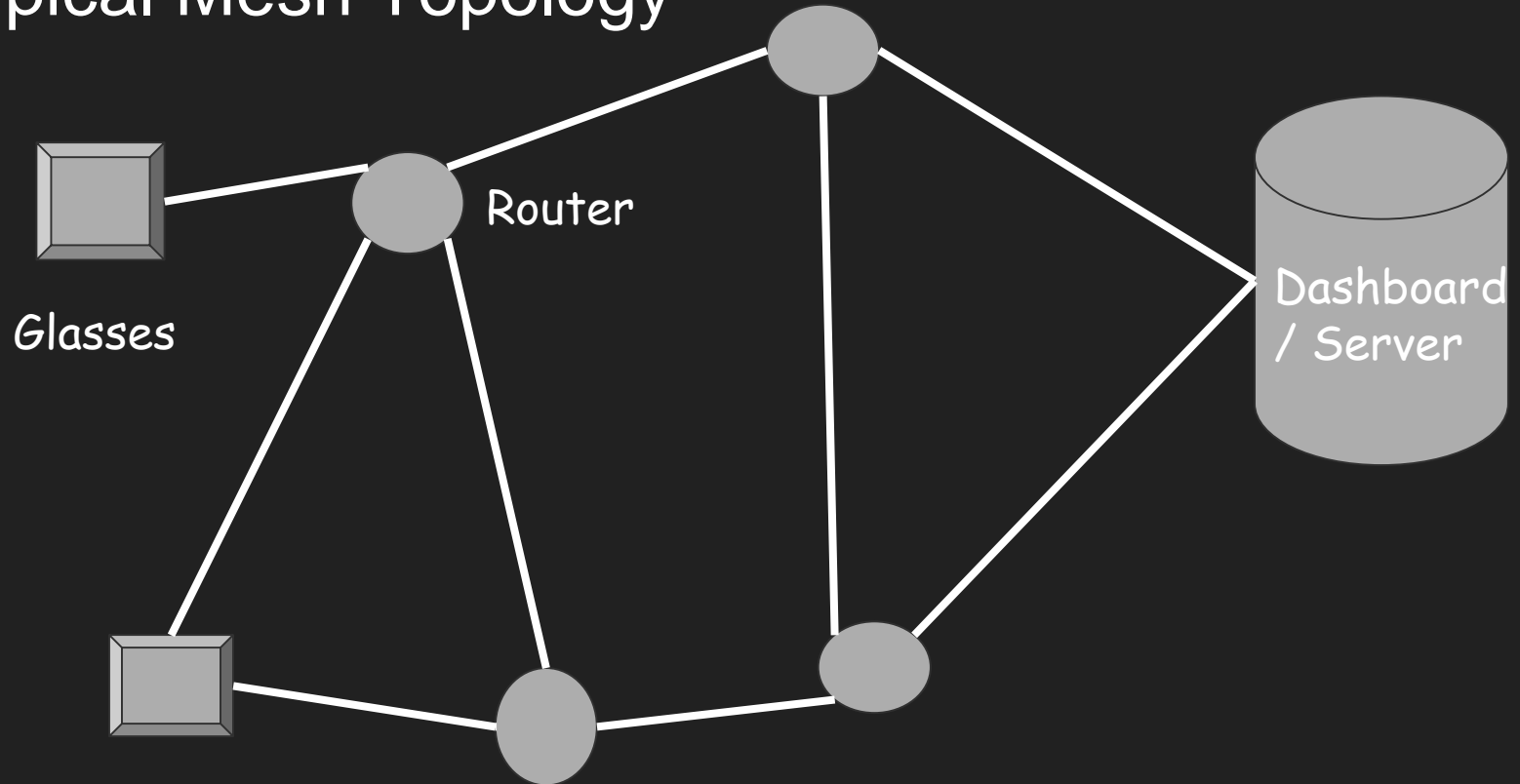

Router

Glasses

Dashboard / Server

Mesh Networks

Problems

- High failure rate

- Changing topology

- High bandwidth, low latency applications

Goal: High, sustained throughput over wide area

Solution: Geographic Routing Protocol

Overview

1. Mesh Networks

2. Protocols

   a. HWMP

   b. GPSR

3. Simulation

4. Results

5. Future Work and Summary

5

802.11s Standard

802.11s defines a standard for mesh networking protocols

- Hybrid Wireless Mesh Protocol (HWMP) is default routing mechanism

    - Maintains location tables of which routers can see each other

    - Large overhead to setup and discover the network

    - Repeats overhead when the network topology changes

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Geographic Routing

Makes use of GPS coordinates of the destination and one-hop neighbors to find routing paths

- Stateless*

- Resistant to topology changes

Greedy Perimeter Stateless Routing (GPSR)

Greedy Forwarding

- Forwards packets to the node closest to the destination

- Requires state of one-hop neighbors

  - "Virtually Stateless"

Perimeter mode

- When no closer node is found, route the perimeter of the network

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Overview

Mobility Scenes

🔵 Sender

🟢 Receiver

🔴 Mesh Point
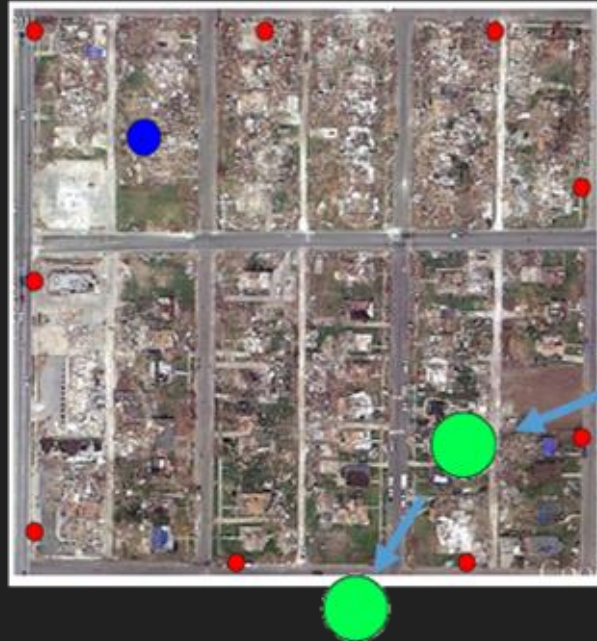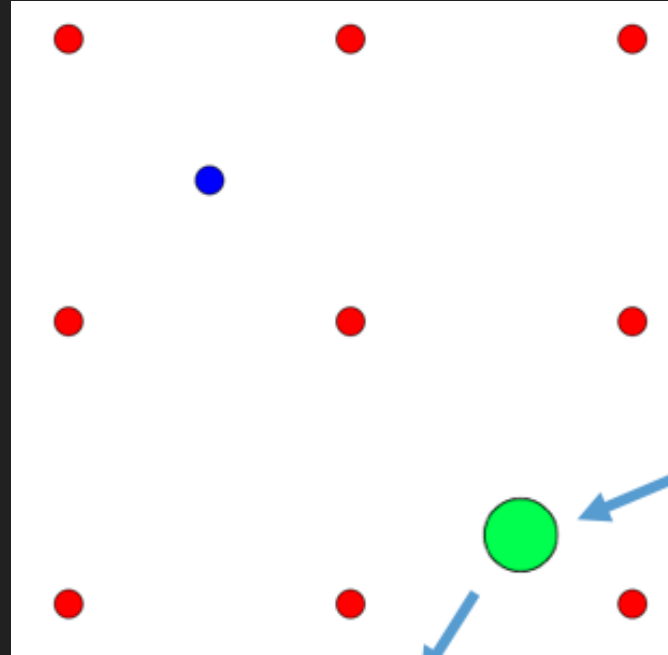
Joplin, MO Disaster Area

Mobility Scenes

Sender
Receiver
Mesh Point

Full Grid

Mobility Scenes
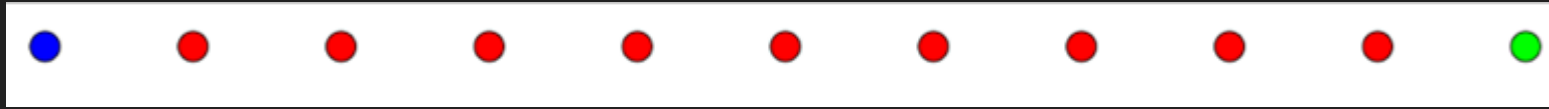
Straight Line

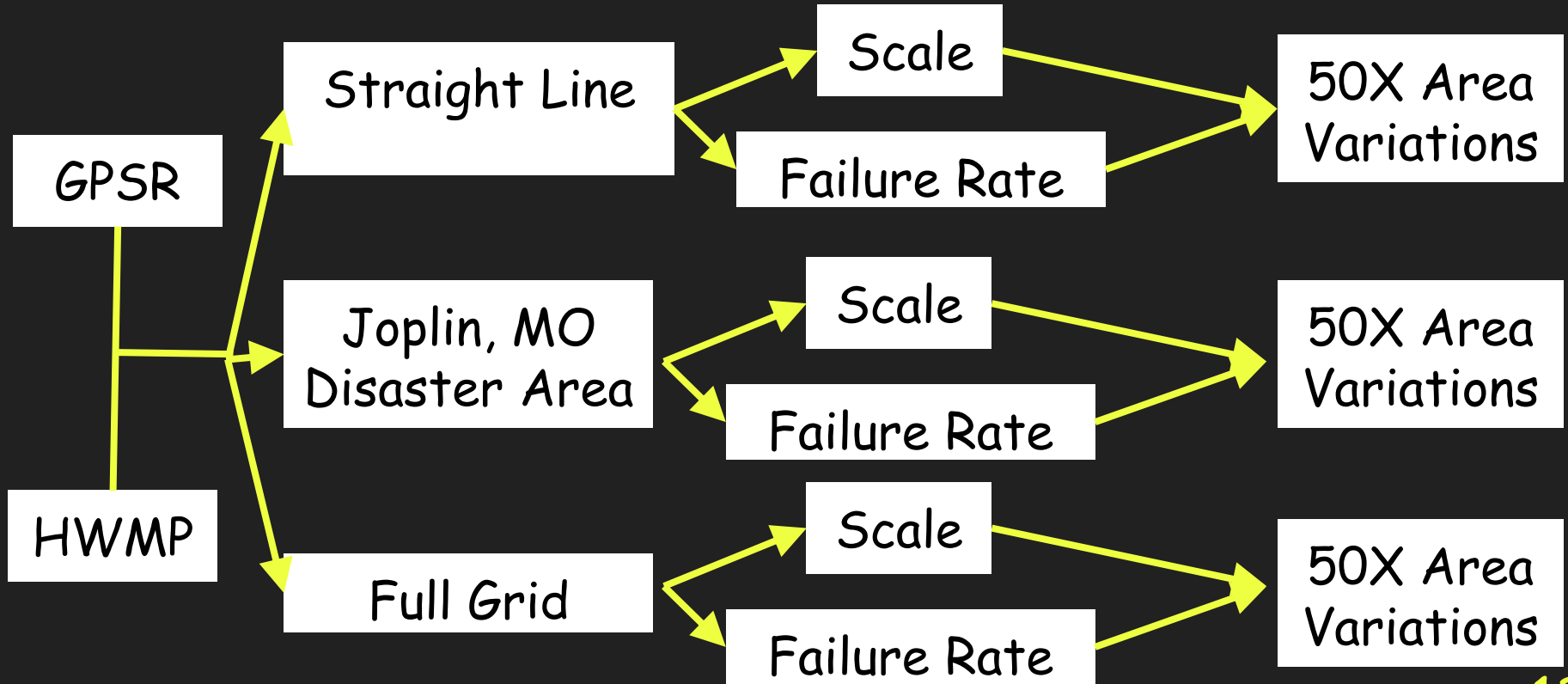Sender   Receiver   Mesh Point

Experiment Setup

```
GPSR ─┐
      ├─→ Straight Line ─┬─→ Scale ──────→ 50X Area
HWMP ─┘                  └─→ Failure Rate ─→ Variations
      │
      ├─→ Joplin, MO ────┬─→ Scale ──────→ 50X Area
      │   Disaster Area  └─→ Failure Rate ─→ Variations
      │
      └─→ Full Grid ─────┬─→ Scale ──────→ 50X Area
                         └─→ Failure Rate ─→ Variations
```

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Building the Experiment

NS-3 Network Simulation Software

- Current standard for research applications

- Library support* for mesh protocols

- C++ Monster

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```
for algorithm in 'GPSR' 'HWMP'; do
    for mobilityScene in 'full-grid' 'city-block' 'straight-line'; do
        for variation in 'scale' 'failure'; do
            for experiment in 1 2 3 4 5 6; do
                for trial in $(seq 1 $numTrials); do
                    ./waf --run # Run the experiment
                    tshark -r $srcFile -q -z "io,stat,1,($tsharkFilter)" > "tshark-out.txt"
                    awk "..." # Compute mean, standard deviation
                    ls mp--* | xargs rm # Recycle, save a hard disk
                done
                awk '{a+=$1} END{print a/NR}' > 'average-io.txt'
                awk '{a+=$1} END{print a/NR}' > 'std-io.txt'
            done
        done
    done
done
```
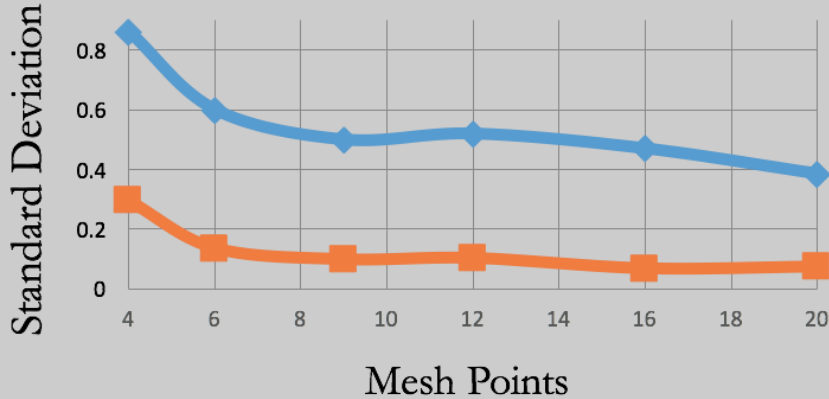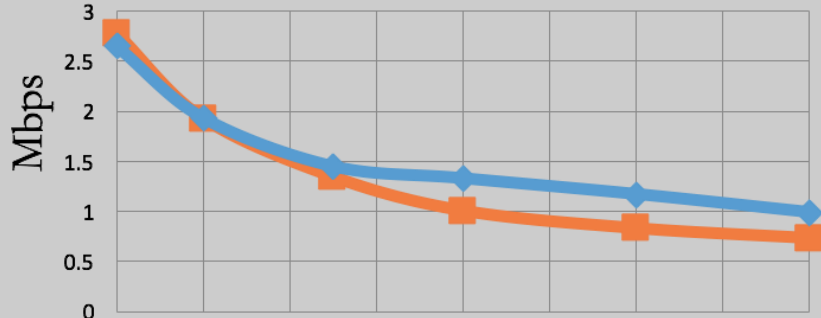
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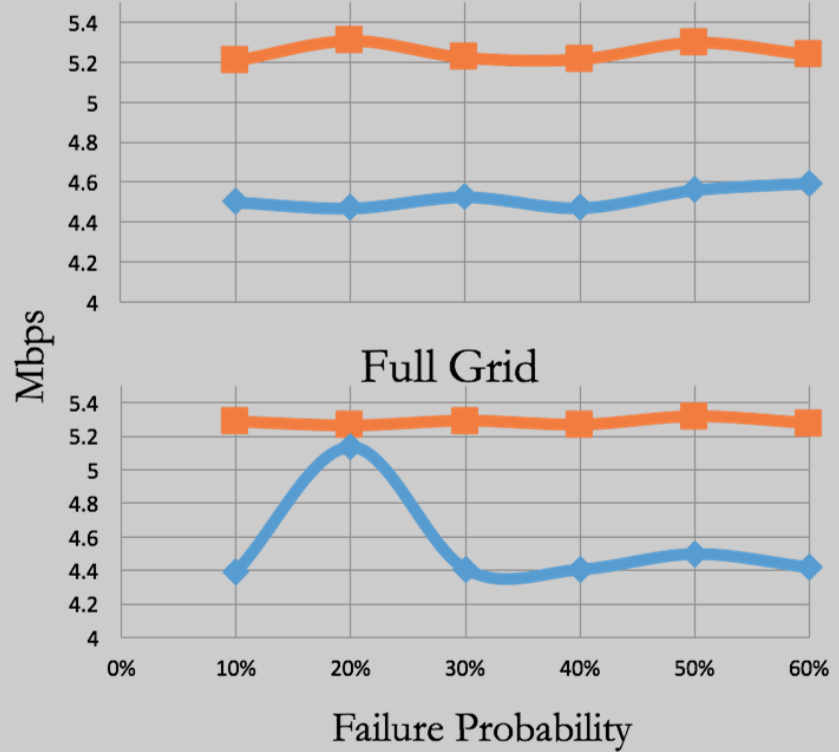
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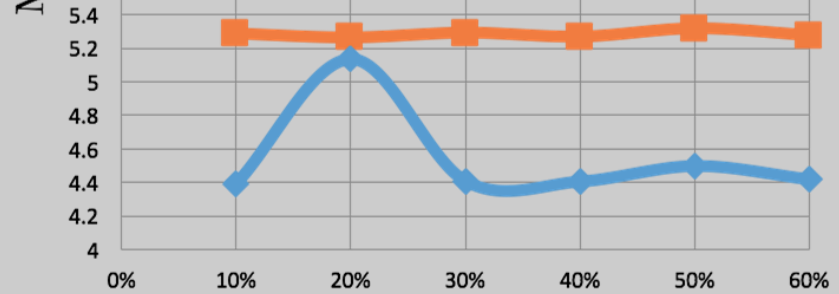
Results

OKR

Objectives

Improve Network Reliability 100%

Publish a paper on effects of Geographic
    Routing in a triage system 75%

75%

-> 83%

Implement Geocast Messaging System 50%

Overview

1. Mesh Networks

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Future Work: Hardware Prototype

- Language

  - Android

  - OpenFlow

  - RouterOS script

    package

OpenWRT Router

- Hardware

  - Android devices (including glasses)

    - Battery draining and not powerful enough

  - Raspberry PI with GPS WIFI chip

  - Cheap OpenWRT router

    - Can get multiple, easy to setup

  - Mikrotik rugged routers

    - Best solution for Panacea's Cloud

Mikrotik rugged router

Lessons Learned

Talk to the experts first

Automate now, save time later

Source control everything

Thank You!

Josiah Burchard

josiah@jburchard.com