Evading Cellular Data Monitoring With Human Movement Networks

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Motivation

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Iran 'lifts block on SMS texting'

Reports from Iran say that SMS text messaging services have been unblocked for the first time since disputed presidential elections.

However, Iranian news agencies say there are still technical problems.

Text messaging and social networks were widely used by

Pro-reformist supporters used mobile phones to spread their message

Goal

Out-of-Band communication

Unmonitored and *completely* decentralized

HumaNet

Human-to-Human Mobile Ad-Hoc Network

Humans + Smartphones

HumaNet


4
To Utica Av, Bklyn
Late nights on
local track
To Bowling Green
Rush hours to Flatbush Av, Bklyn
Late nights take
7088

Design Trade-offs

Regularity of Movement Patterns

Return-to-Home Principle

A person is likely to return to places frequented in the past

HumaNet Protocol Idea

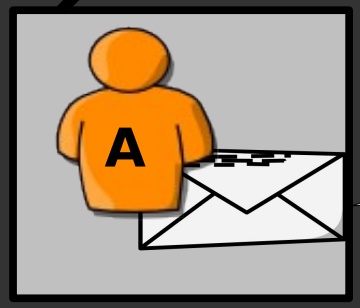
No further duplication of messages

Address message to recipient's likely future locations

Local routing decision based on movement history

Alice and Bob ...

?

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Walnut St
Locust St
Delancey St
Pine St
Rittenhouse Square
South St
Hospital
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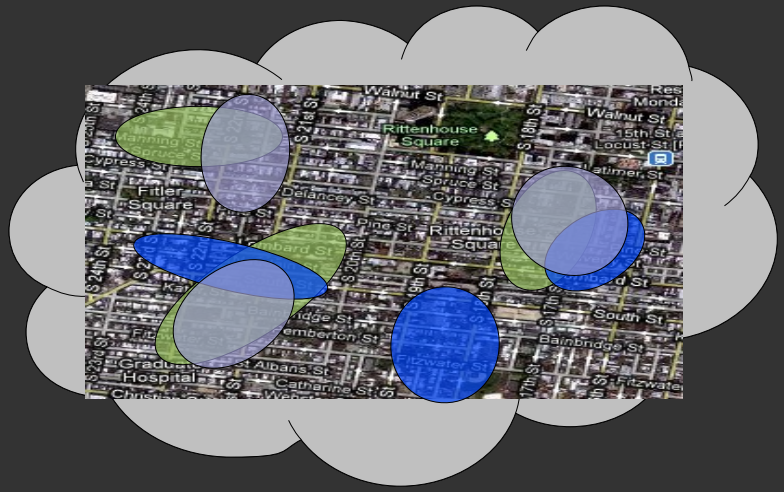
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To Bowling Green
Rush hours to Flatbush Av, Brkyn
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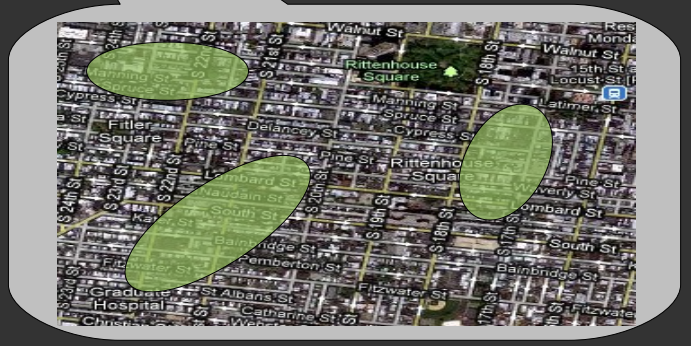
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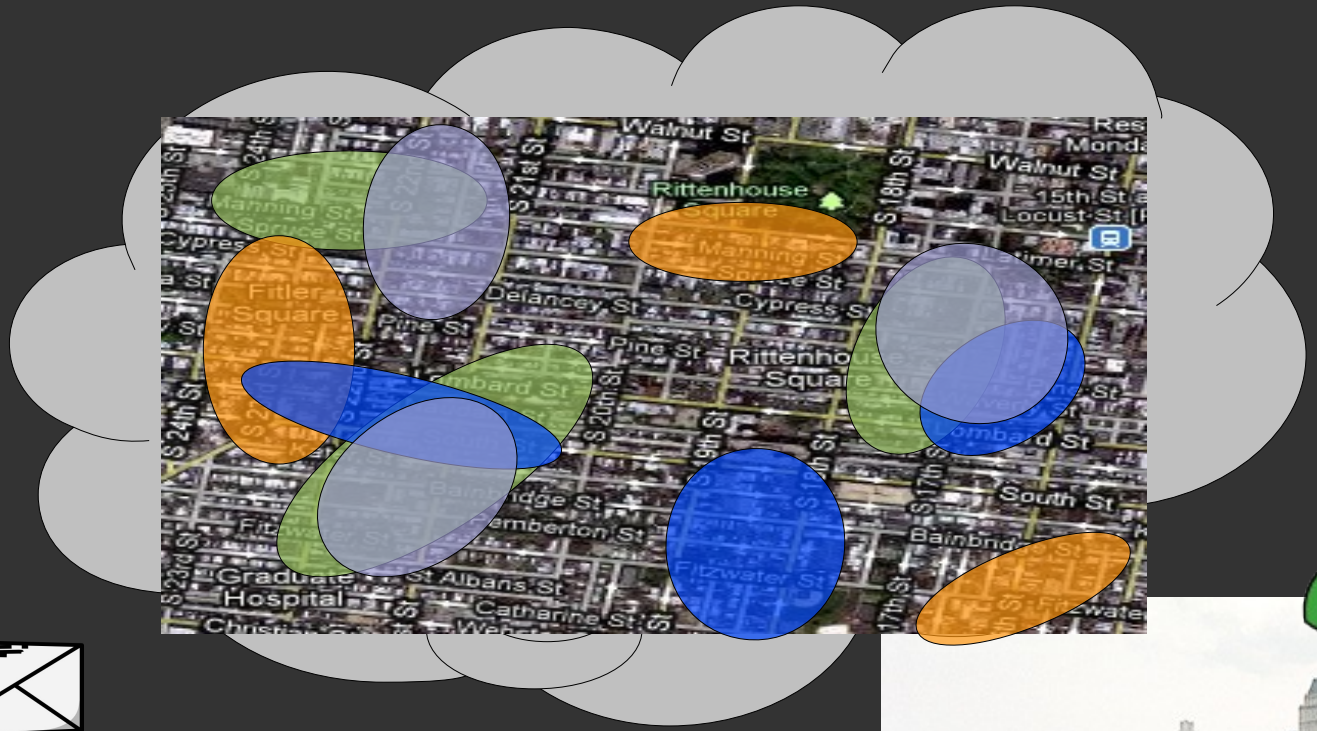
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Fitzwater St
St Albans St
Catherine St
Hospital
Fitler Square
15th St
Locust St

A

B


STARBUCKS
COFFEE

C


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7088

D

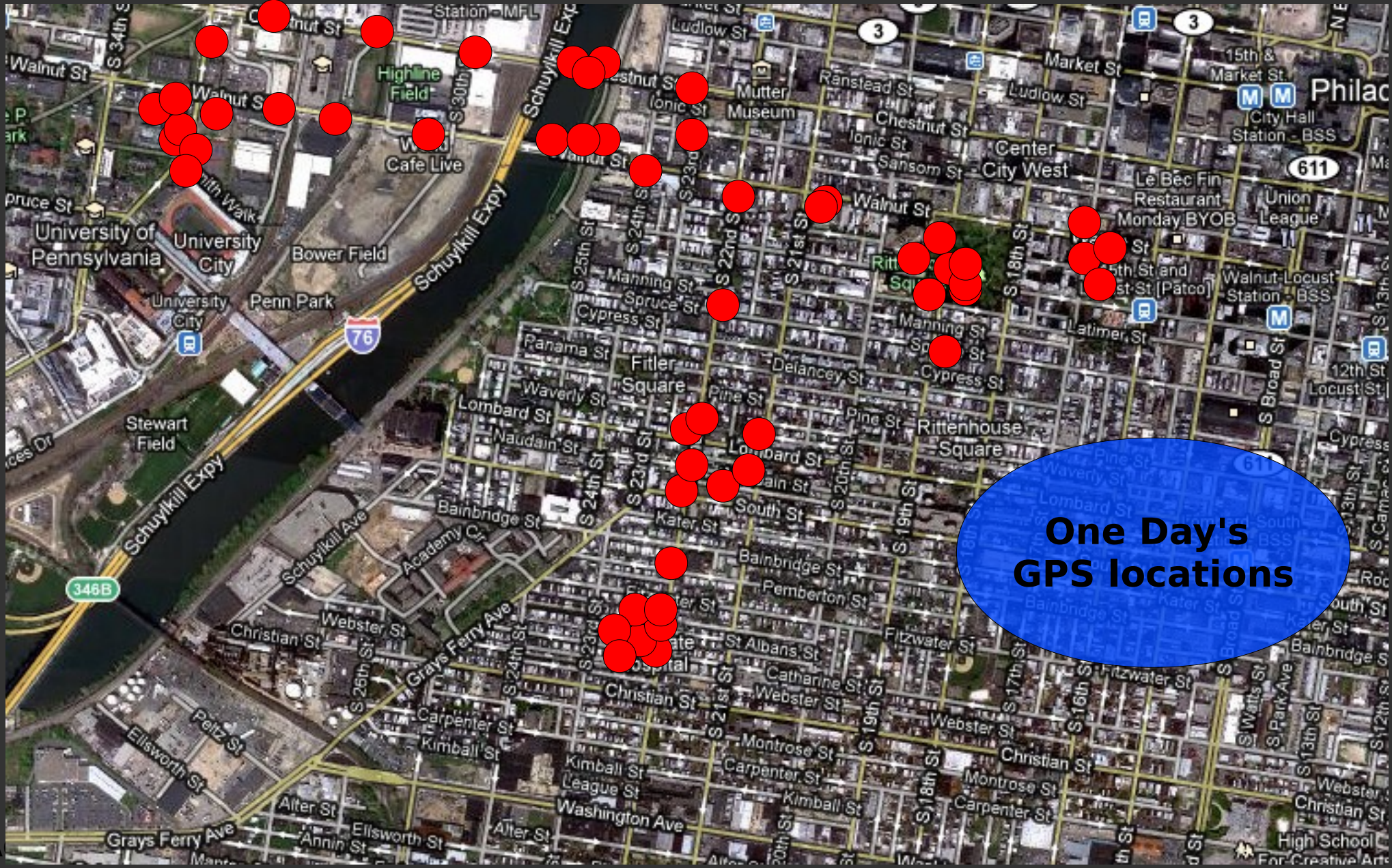
Routing Refinements

Local Timeout

Global Timeout

Last Mile Flooding

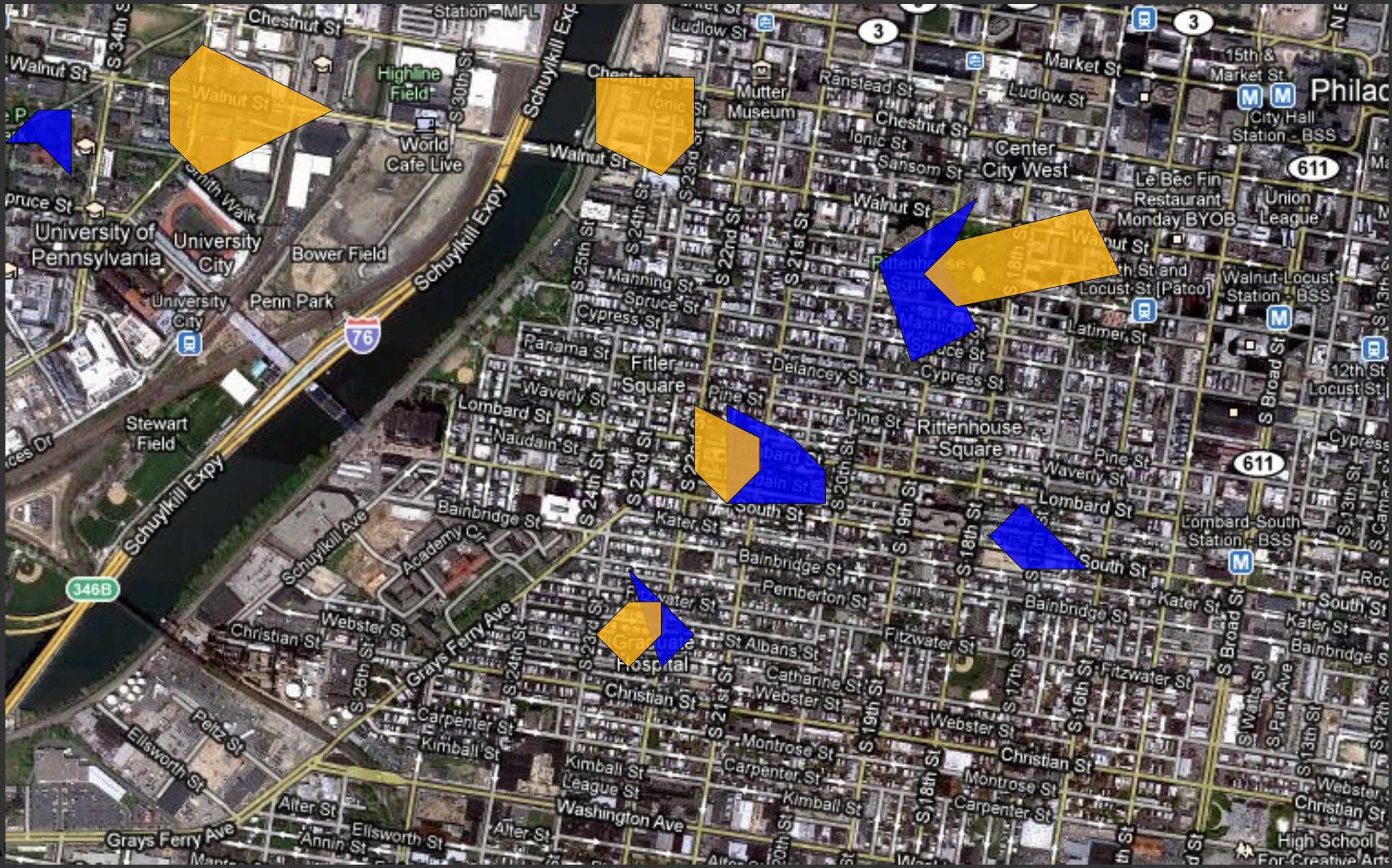
Constructing a Profile



Cluster Points

One Day's Homes

Combine With Other Days



Trace Driven Simulation

Data Source

Cabspotting Dataset

20 days, 536 Cabs in San Francisco

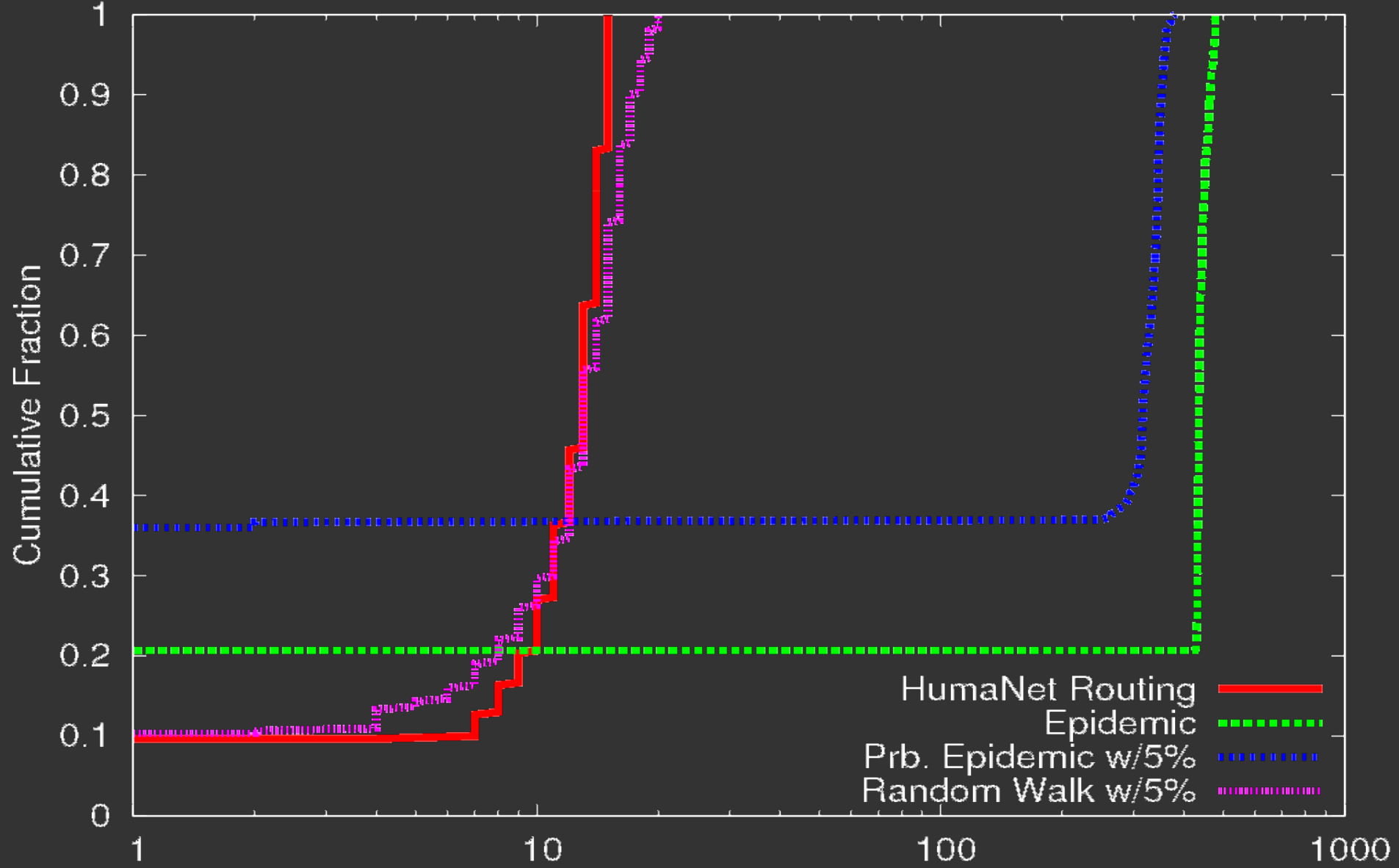
Comparison

Epidemic Flooding

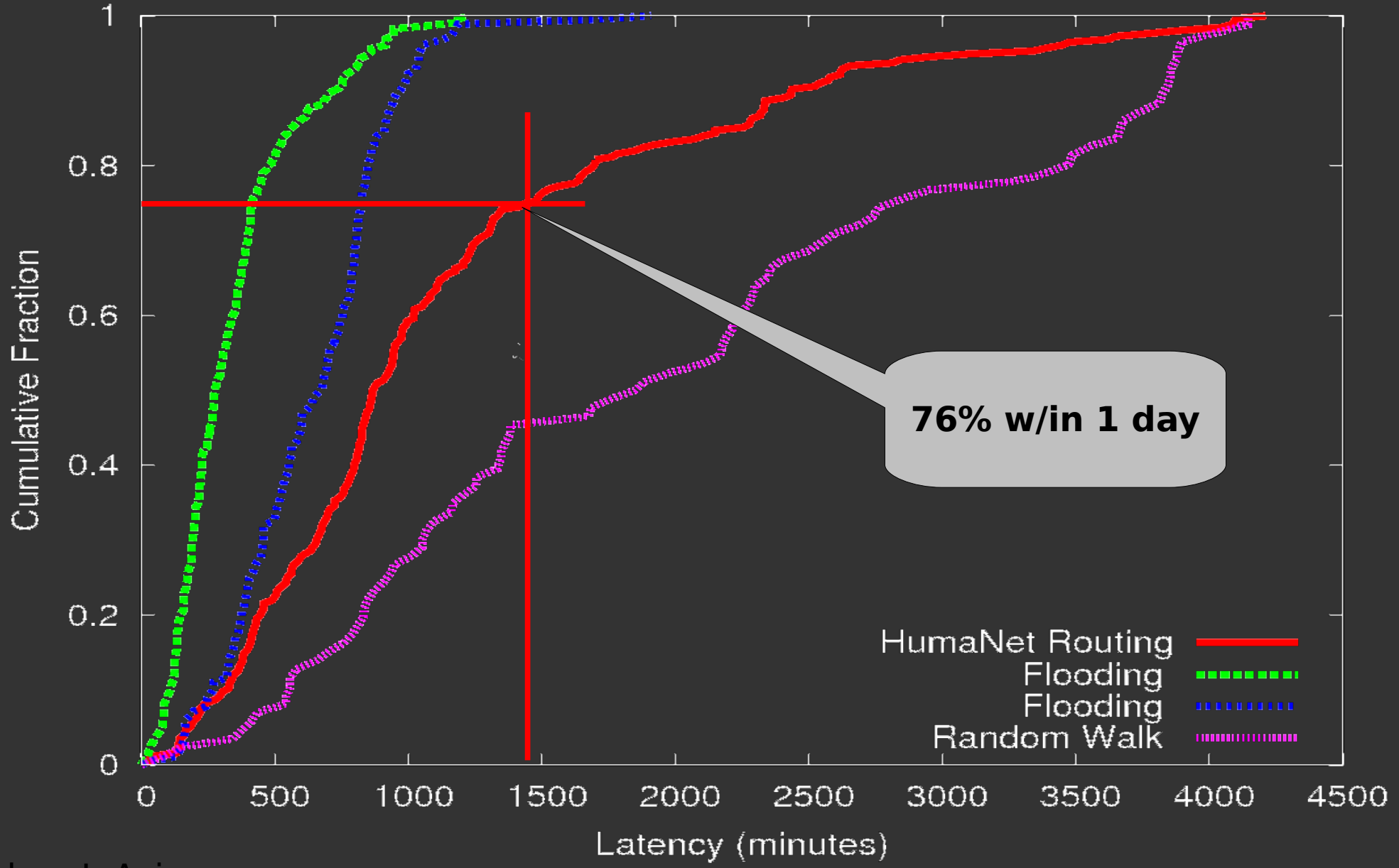
Probabilistic Flooding

Random Walk

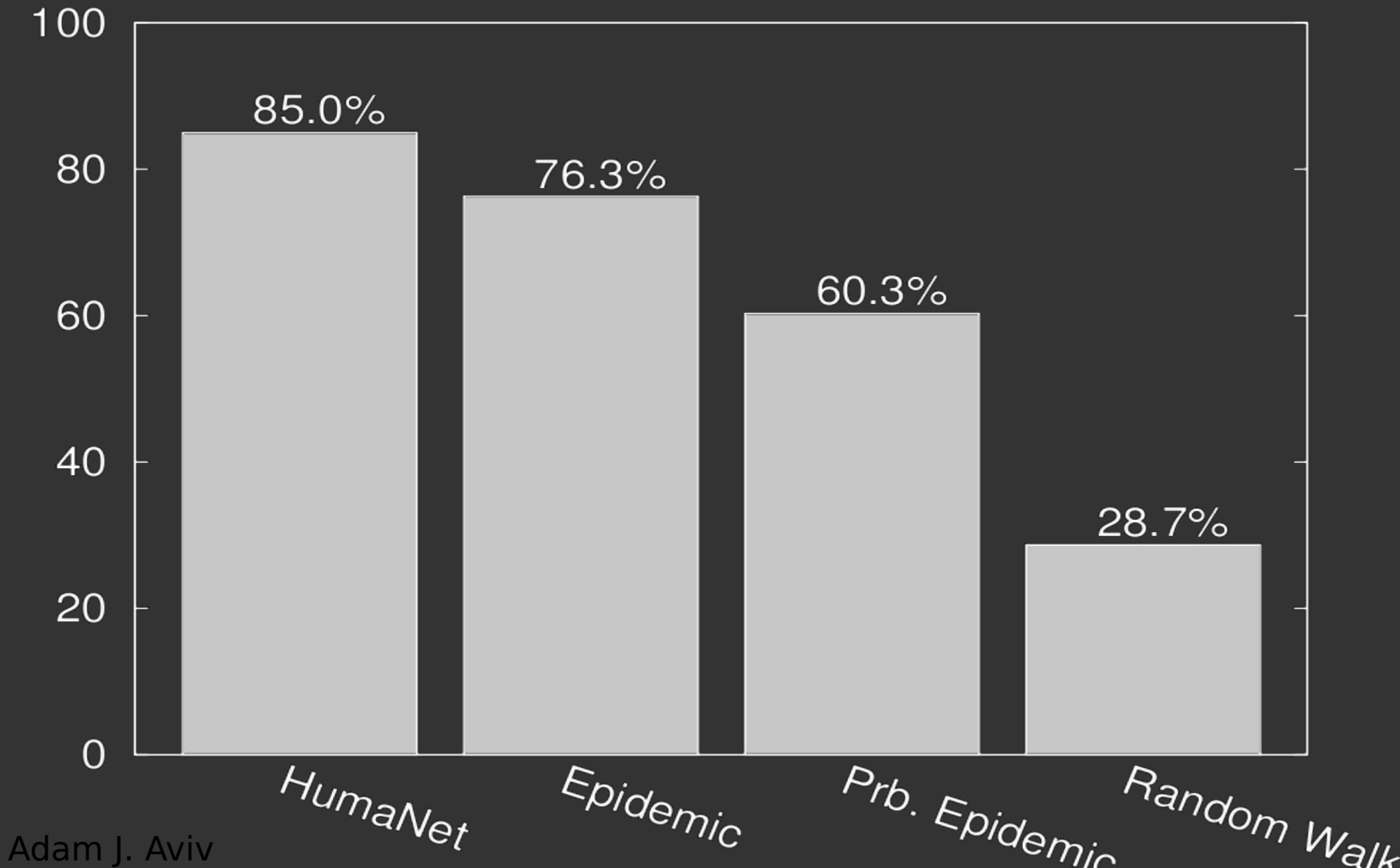
#Messages Required



Message Latency



Successful Delivery



Challenges

Reliability

Routing Attacks

Location Privacy

Anonymity

Reliability and Routing Attacks

- Best-Effort routing
  - How reliable would we need?
- Peer-to-Peer System
  - Vulnerable to same class of attacks, but how feasible are they here?

Location Privacy

- Periodic broadcasts of location information
  - Peoples willingness to participate?
  - Reveal surprising locations?

Anonymity

Can this system provide Anonymity?

- Sender Anonymity
  - `message timeout` leaks info
- Receiver Anonymity
  - Message no longer being passed
- Broadcast in crowds (k-anonymity)

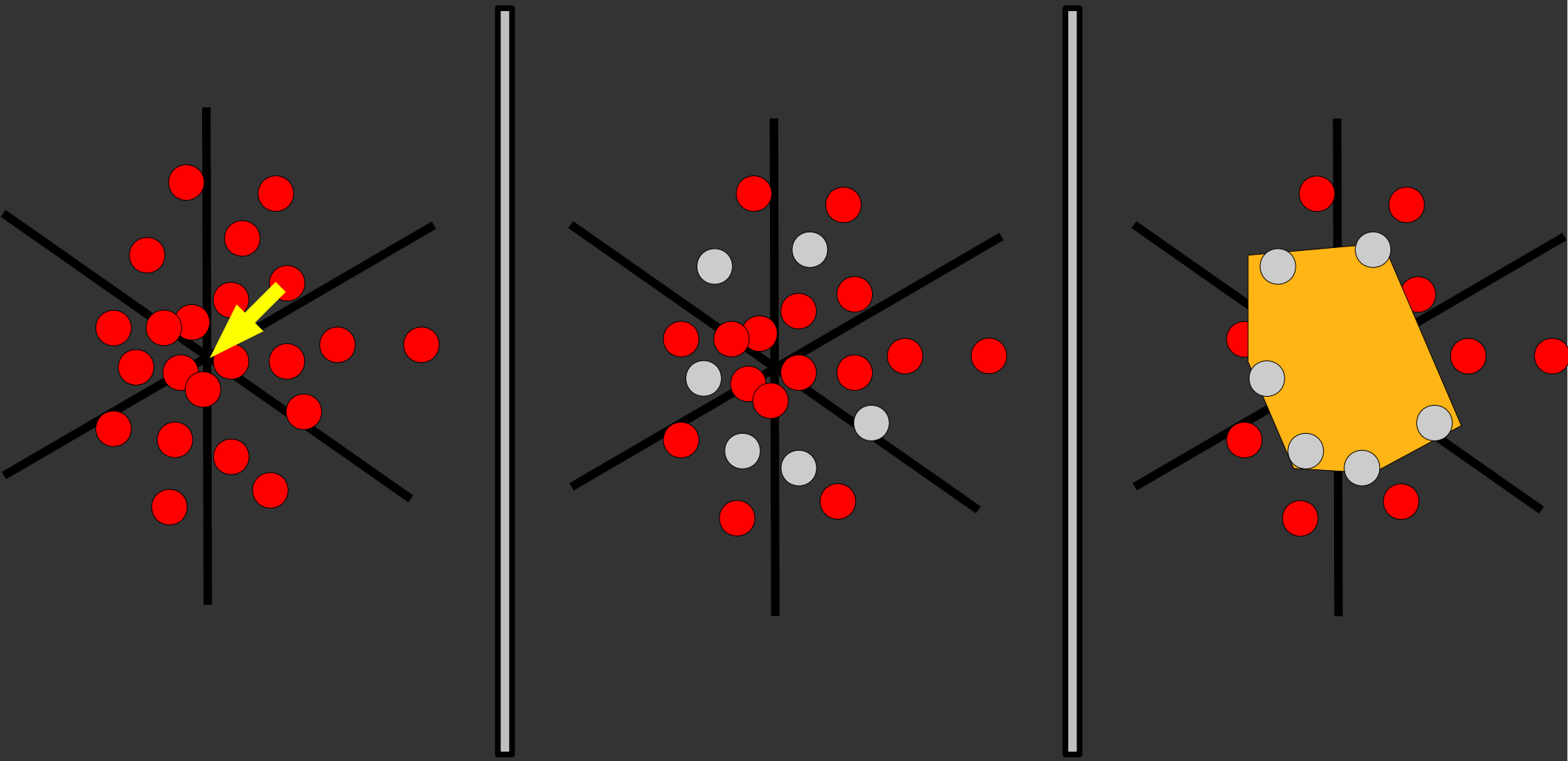
Brain Storming ...

- Attacking HumaNet, how would you do it?
  - Necessary resources? Feasible?
- Would you participate?
  - If not, what would you need to say yes?

Thanks

Questions, Discussion?

Generate a Home



How Predictive?

Average:

- 65% of GPS coordinates fell within homes
- 65% of the day (time)

Worst Case:

- 39% of GPS coordinates fell within homes
- 45% of the day (time)

Other Routing Protocols

- Epidemic
  - Pocket Switched Networks [CHCDGS'07]
  - Pollen [GSM'01]
- Ad-Hoc
  - DREAM [BCSW'98]
  - GPSR [KK'00]
- Geographic Ad Hoc'ish