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Floating Content:
Information Sharing in Urban Areas

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Infrastructure-less Content Sharing…

- Ad-hoc local social network-style information sharing: Digital graffiti w/o servers and infrastructure
- Leaves notes, comments, stories, etc. in places
- Define reach (area of interest) and lifetime
- Leverage delay-tolerant ad-hoc communication between mobile devices for information replication & acquisition

…in Urban Environments?!

- Connectivity (to infrastructure)
- Location privacy
- Content “privacy”
- Geographic validity
- Temporal validity
- User identification

What for?

Coupling in location, decoupling in time

- Tourists and locals, sharing context information
- Going out with friends (bars, theme parks, hiking)

What for?

- Ride sharing
- Flea markets
- Ticket trading
- Content sharing

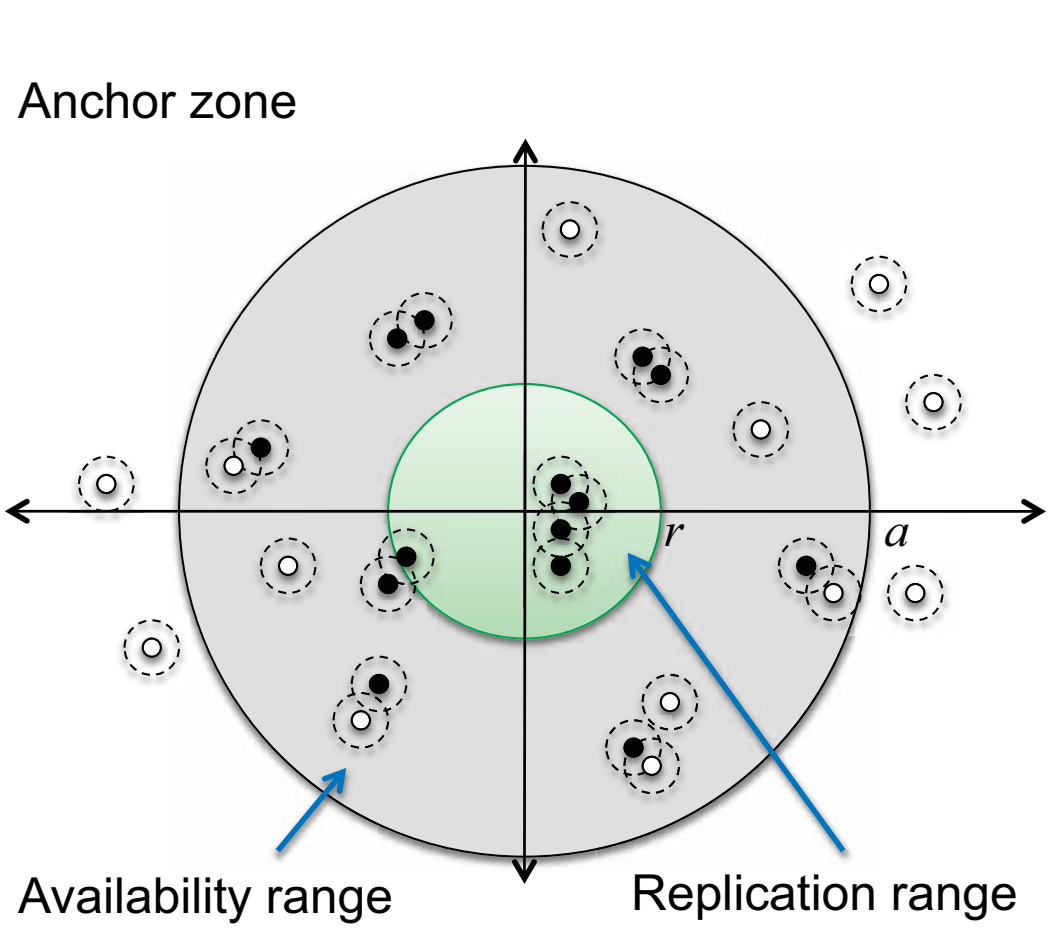
- Anything
  - ephemeral
  - co-located
  - loss-tolerant
  - (time-insensitive)

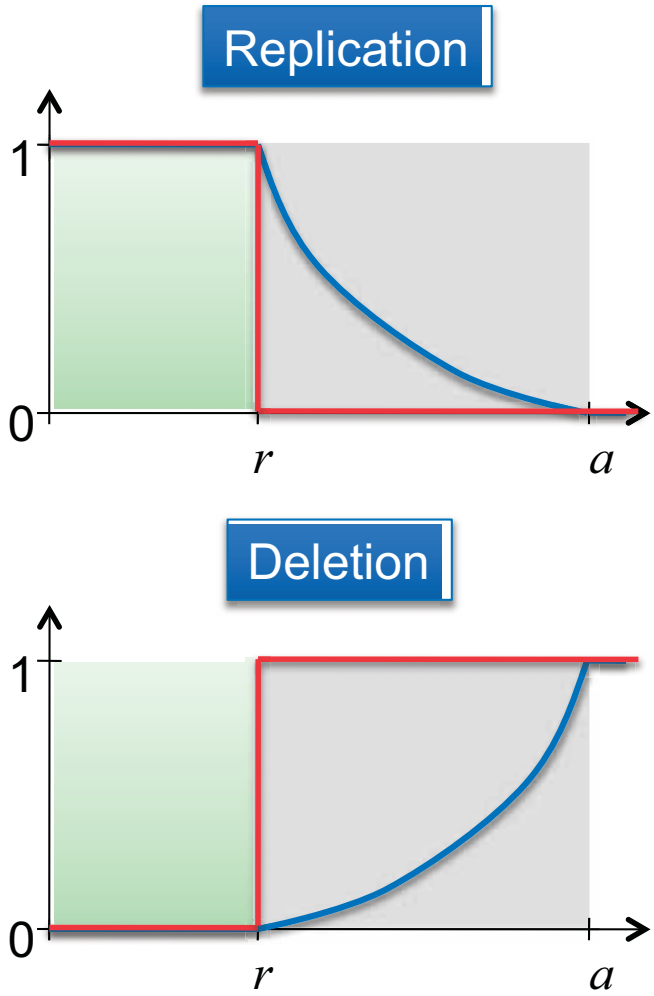
What's new?

- Similar concepts have been "floating" around
  - Digital graffiti
  - At least as early as 2005 on something similar to floating content
  - Geocasting and other approaches in the late 1990's
- Often limited in scope

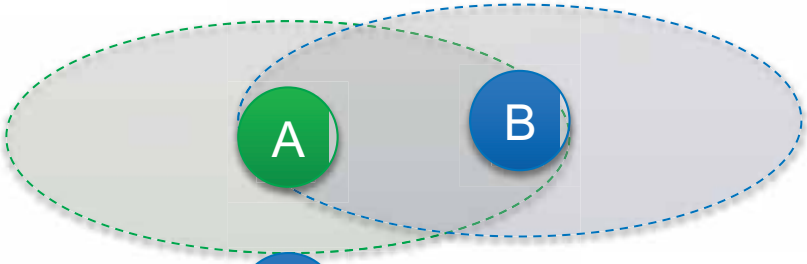
- Our contribution
  - Extended notion of floating content [PerCom 2010 WiP]
  - Analytical modeling [Infocom 2011]
  - Thorough evaluation of feasibility
  - Figuring out how to make this work in practice

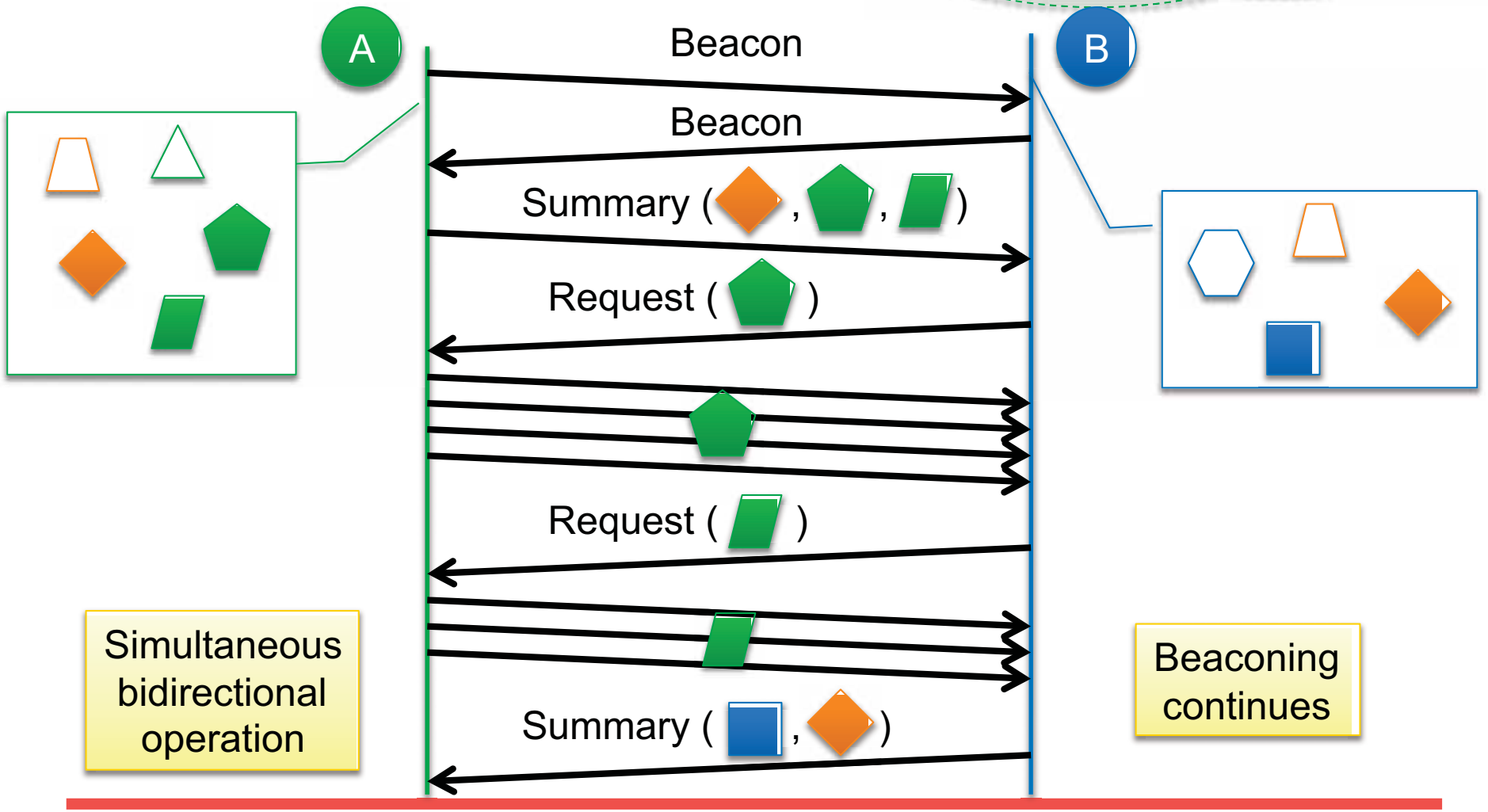
Floating Model





Floating Protocol





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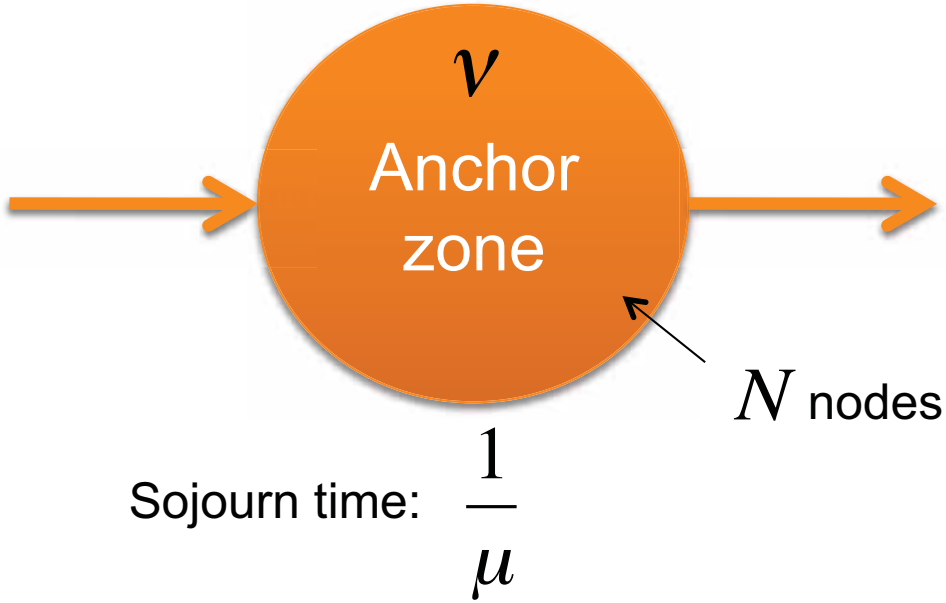
Two-Pronged Approach to Evaluation

- Analytical modeling
  - Not really covered in this talk [Infocom 2011]
  - Different scenarios, different mobility models
  - Main result: criticality condition

- Simulations
  - Initially simple simulations to test feasibility [PerCom 2010 WiP]
  - First result: Need 1 person per 50m^2 on average
  - This agrees with the analytical criticality condition
  - In this paper: criticality validation + parameter space exploration

Simple Analytical Model: Black Box



$$\frac{N\nu}{\mu} > 1$$

Criticality condition

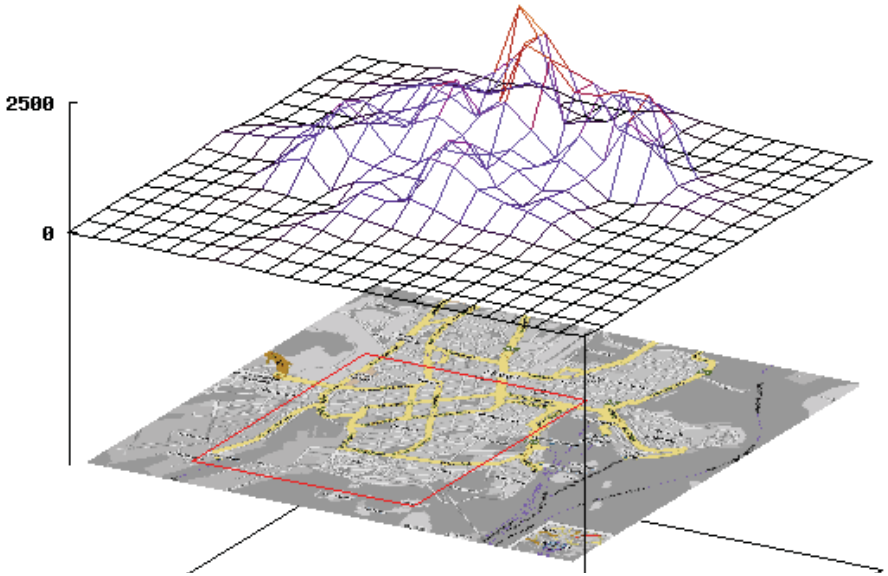
Evaluation Setup

- The ONE Simulator: 4500 x 3400m simulation area
  - Helsinki City Scenario
  - Restless nodes (tourists)
    - Moving around along shortest paths between points of interest
    - On foot, by car
    - Some trams following regular routes
  - 126, 252, 504 nodes
  - 10m, 50m radio range
  - r = a = 200m, 500m

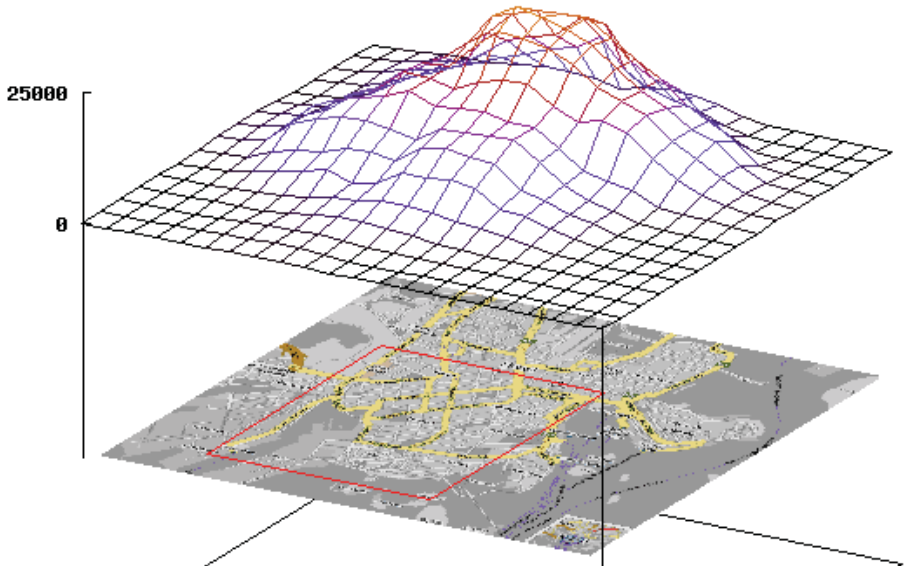
Contact density distribution

- Example: 252 nodes, 10m radio

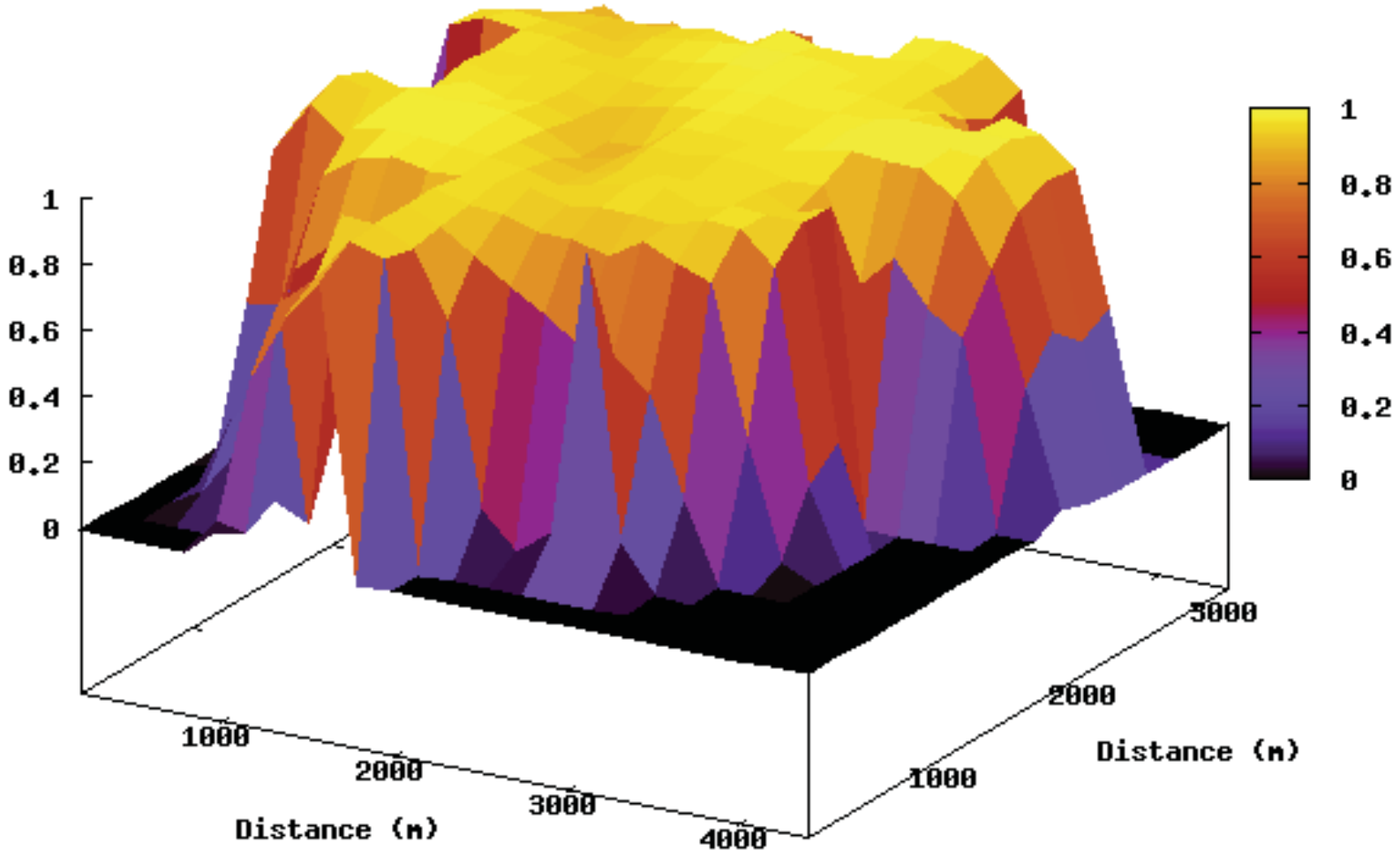
a=r=200m



a=r=500m

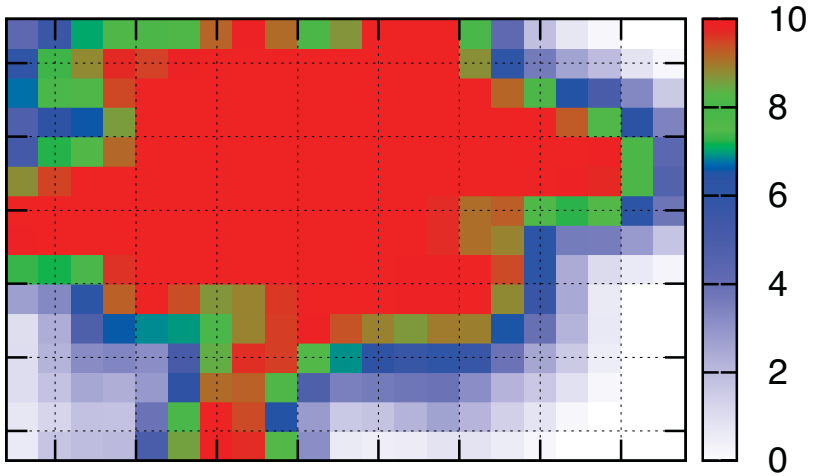


Feasibility

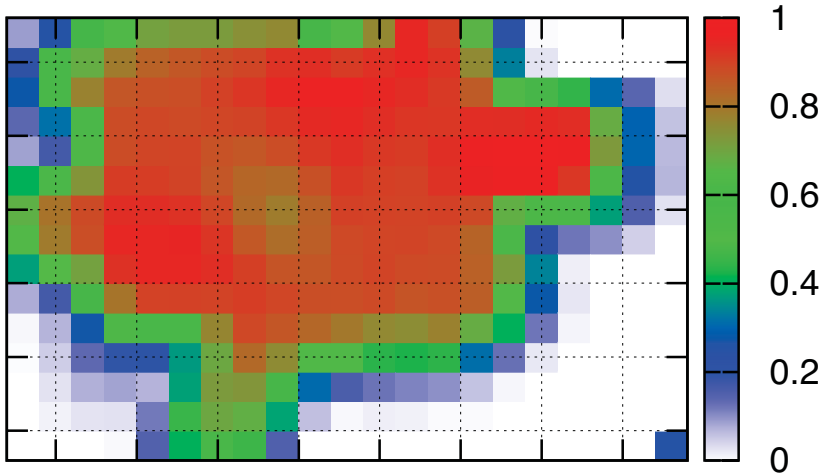


Feasibility: Analytical Model Validation

- Tiny messages, de-facto infinite buffer, one location only
- Example: 252 nodes, 10m radio, r=a=500m, TTL=1h



Criticality value

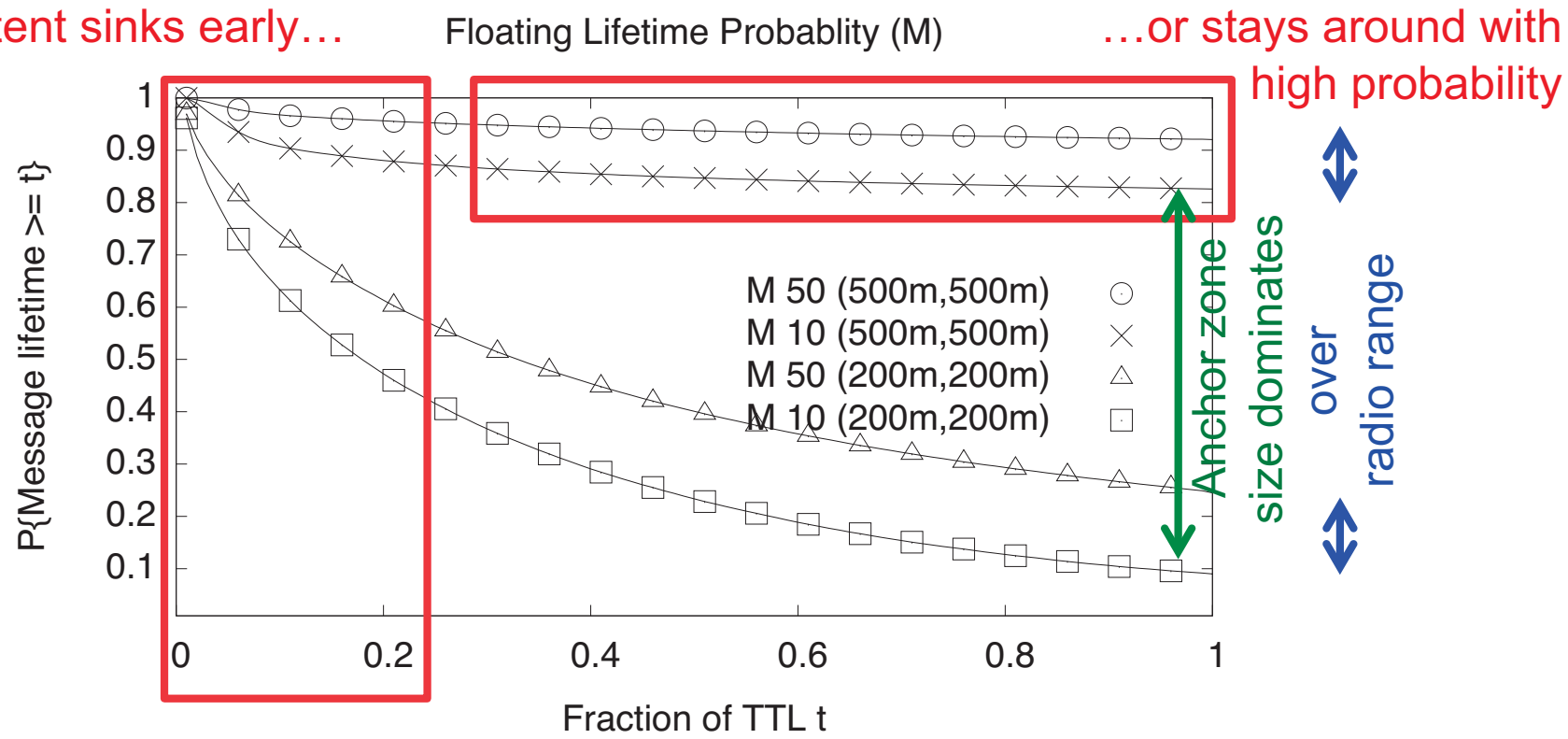


Floating success

- Holds equally well for other parameter settings

Feasibility: Floating over time

Content sinks early…



…or stays around with high probability

Operational Considerations: DoS

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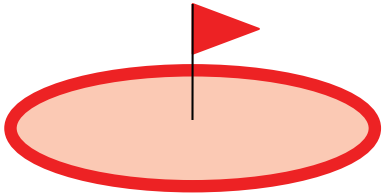
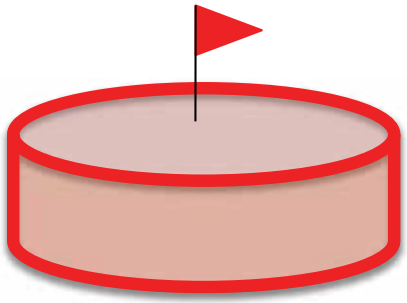
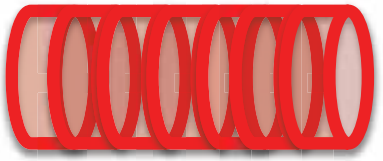
- Prioritization functions to encourage locality and modesty for replication and deletion
  - FIFO
  - RaNDom
  - Smallest Area First: f(a)



  - Smallest Volume First: f(a × size)



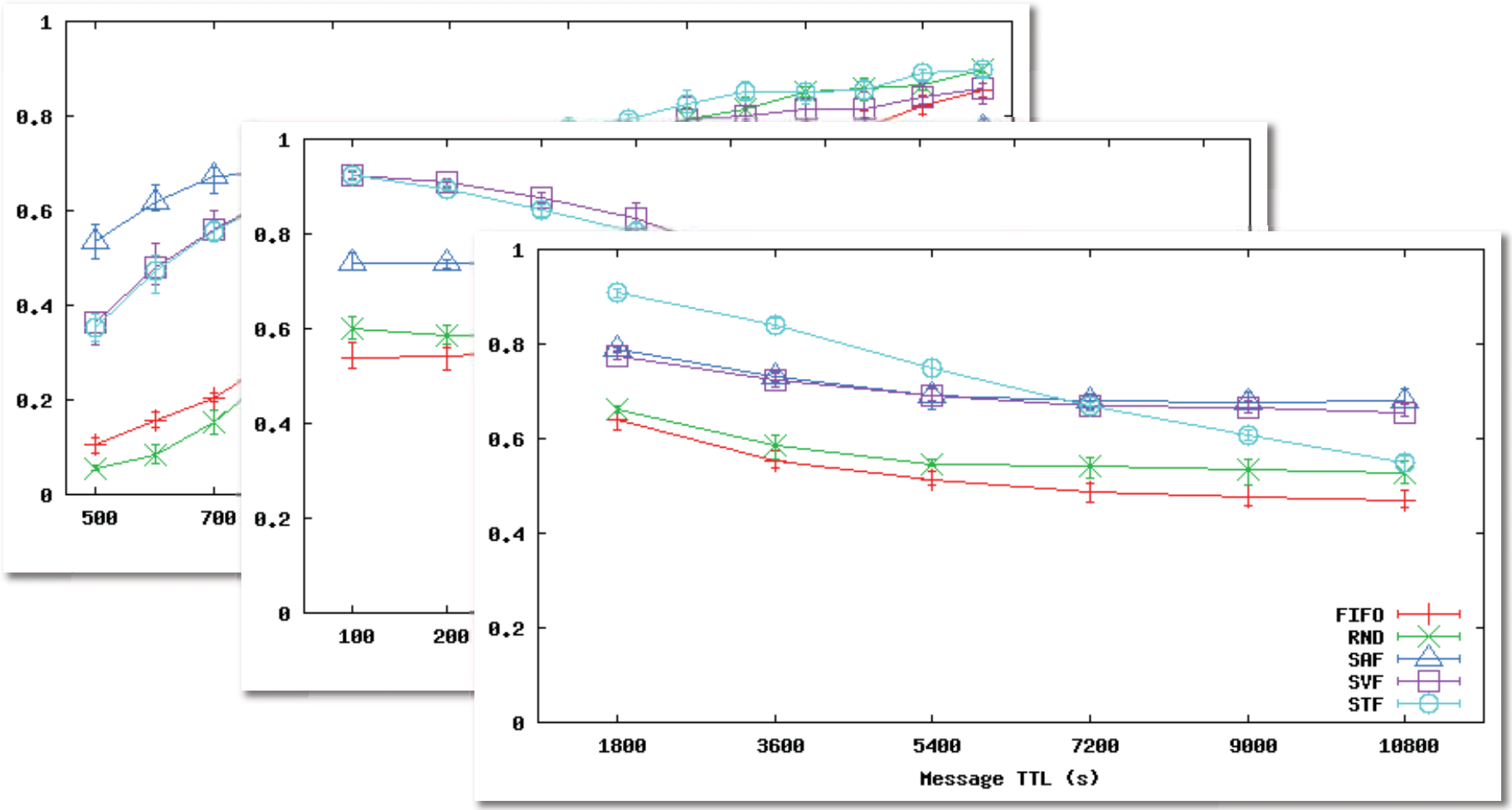
  - Small Total resources First: f(a × size × TTL)



Performance characterization

- Helsinki City Scenario
- Parallel content posted at arbitrary locations
  - 126 nodes, 50m radio, 2 Mbit/s net data rate
  - Message rates: 1, 2, 4 messages per node per hour
- Mix of floating content messages
  - Random message sizes: [100 KB … 1000 KB]
  - TTL [30min … 3 hours]
  - Anchor zones [500m … 2000m]

Findings for 4 Messages/node/hour



Conclusion and Next Steps

- Simple, yet appealing geo cooperation model
- Workable already for modestly dense scenarios
  - Simulations agree well with theoretical modeling
- Some built-in DoS protection and garbage collection
- Probabilistic operation and user acceptance?
- More extensive simulation studies
- Implementation for Android: real-world experiments