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Floating Content:
Information Sharing in Urban Areas

Jörg Ott <jo@acm.org>

Esa Hyytiä, Pasi Lassila
Jussi Kangasharju
Tobias Vaegs

Infrastructure-less Content Sharing…

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

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…simple examples…

Coupling sharing in location, decoupling in time

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

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…in Urban Environments?!

- No connectivity (to infrastructure)
- Location privacy
- Content “privacy”
- Geographic validity
- Temporal validity
- No user identification

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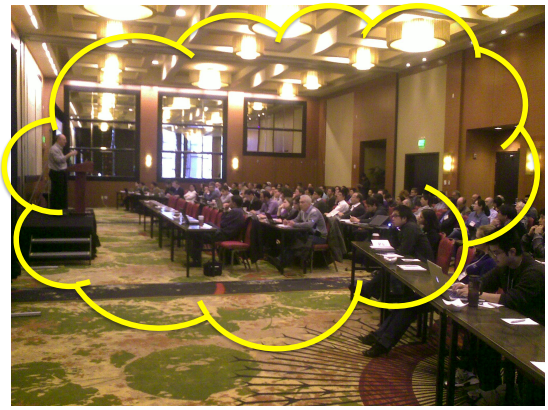
What for?

- Ride sharing
- Flea markets
- Ticket trading
- Photo sharing

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



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What's new?

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

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

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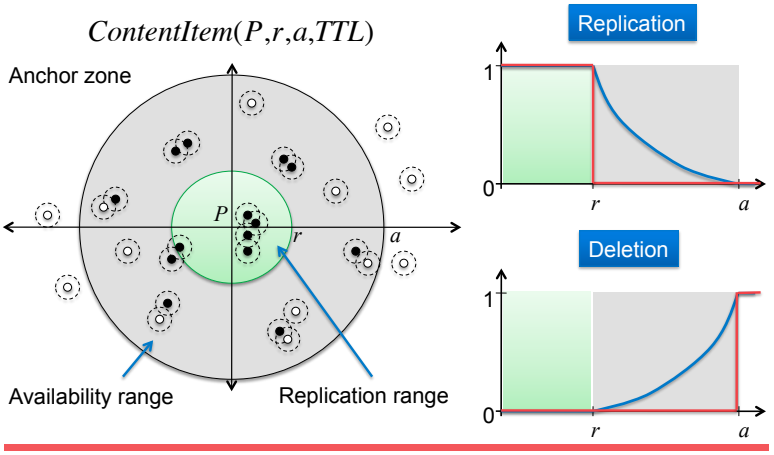
Floating Model



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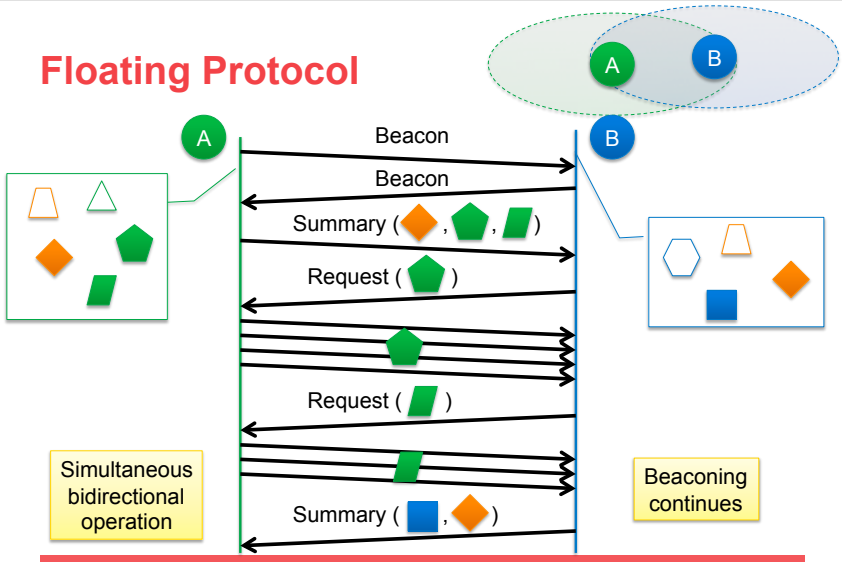
Floating Protocol



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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
  - First result: Need 1 person per 50m^2 on average [PerCom 2010]
  - This agrees with the analytical criticality condition
  - Criticality validation + parameter space exploration [Percom 2011]
  - Buffer zone exploration + VANETS in progress

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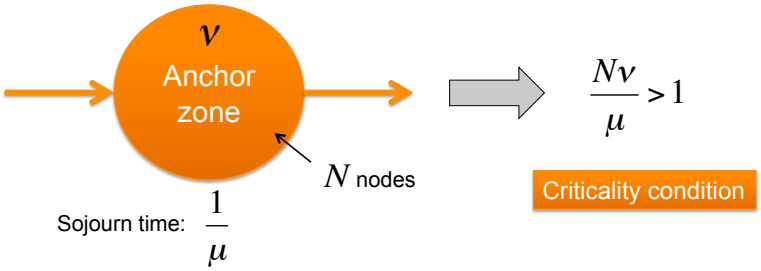
Simple Analytical Model: Black Box



Average number of contacts of each node while in the anchor zone.

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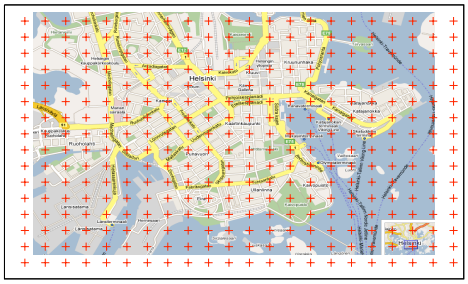
Evaluation Setup

- 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



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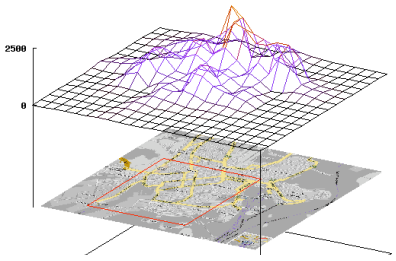
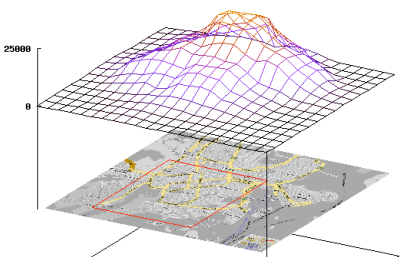
Contact density distribution

- Example: 252 nodes, 10m radio

a=r=200m



a=r=500m



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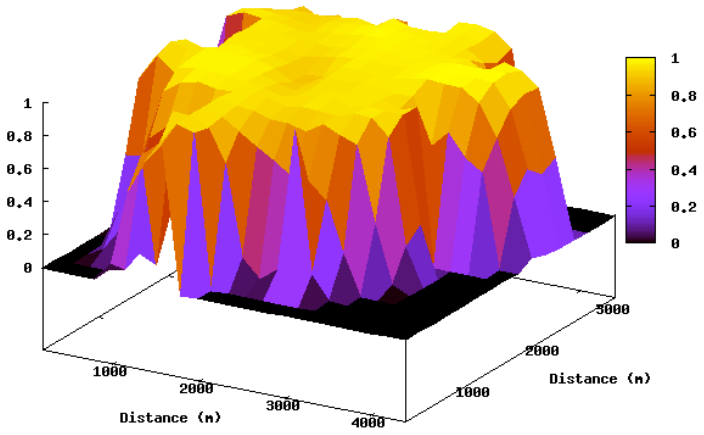
Feasibility

504 nodes r=a=500m



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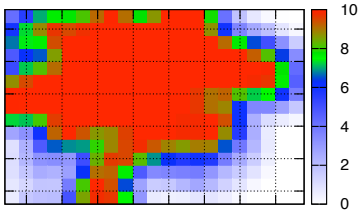
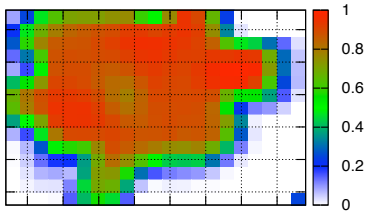
Feasibility: Analytical Model Validation

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



Criticality value



Floating success

- Correlates equally well for other parameter settings

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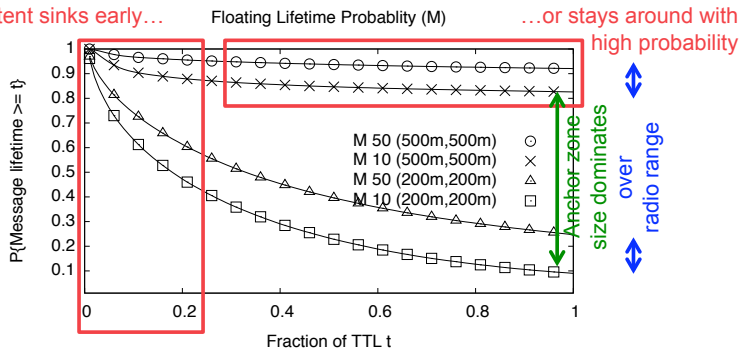
Feasibility: Floating over time

Content sinks early…



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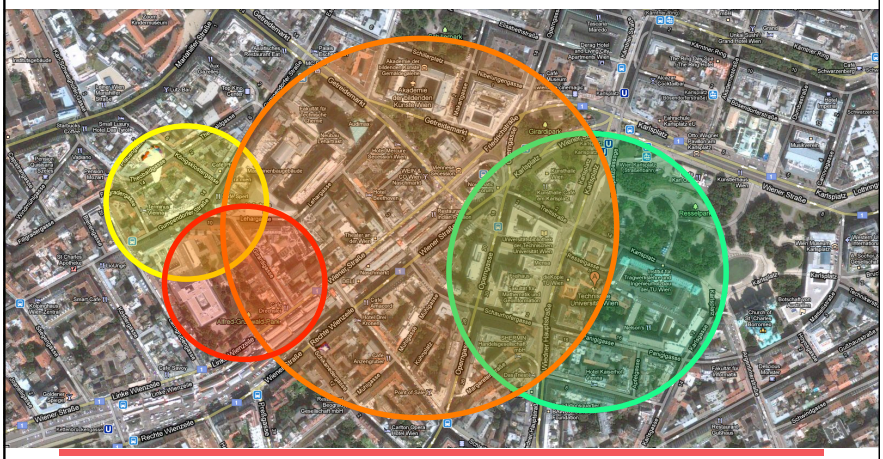
Operational Considerations: DoS



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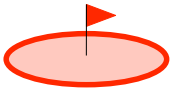
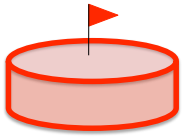
Operational Considerations: DoS

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



  - Smallest Volume First: f(a × size)
    - a=r vs. a=r^2



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

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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]

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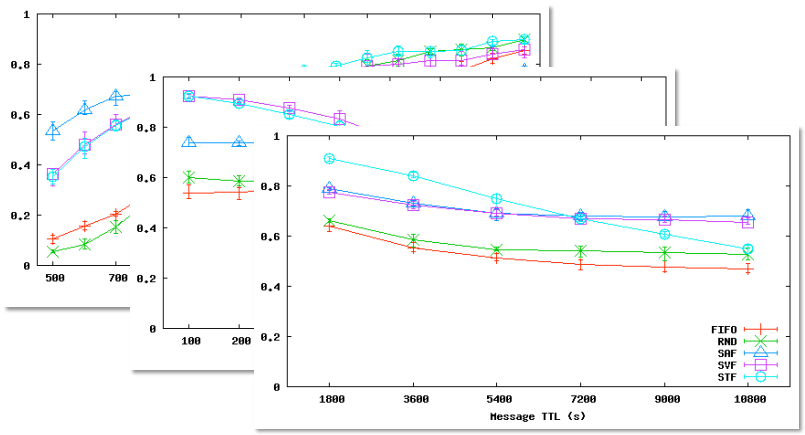
Findings for 4 Messages/node/hour



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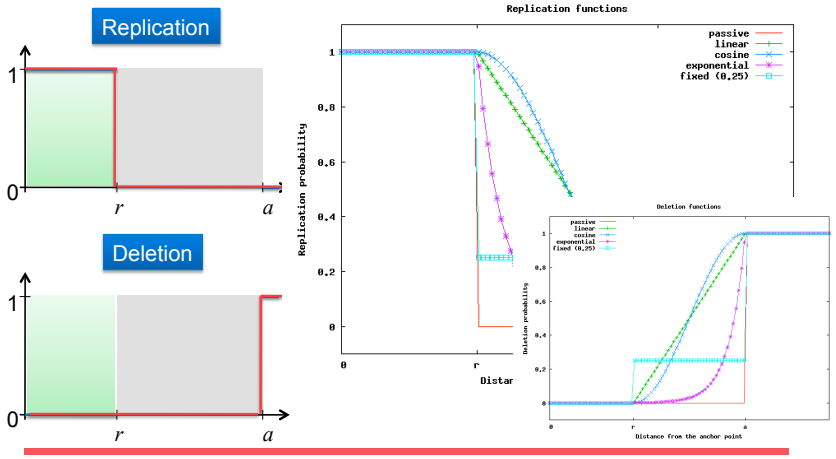
Sneak Preview: Buffer Zone (1)



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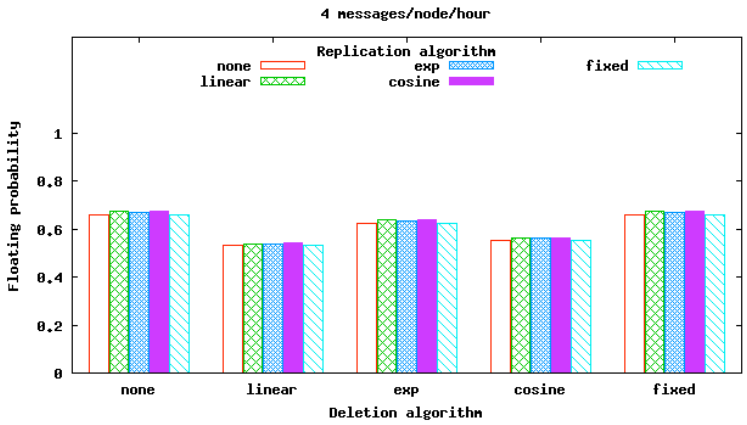
Sneak Preview: Buffer Zone (2)



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Conclusion and Next Steps

- Simple, yet appealing best effort 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: devices, mobility, traffic
- Implementation for Android: real-world experiments

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