Evaluation of Peer-to-Peer Overlays for First Response

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Agenda

Use Case Investigation

Identified Use Cases

Overlay Evaluation

Outlook

Use Case Investigation

Use cases are findings from:

- Phone interviews (41)
- Personal interviews (8)

The following organizations were contacted:

- RedCross
- „Innenministerium“ (Department of the Interior)
- THW (Technisches Hilfswerk) (disaster relief)
- Fire department (Berlin, Darmstadt, Frankfurt)
- Bundeswehr (German Federal Armed Forces, department for battle simulation)

Use Case Investigation

Some statements from the interviews:

- Current approach is often „pen and paper“ based (THW)
- „If someone needs communication, I will give him a satelite phone“ (department of the interior)
- „In my opinion every communication solution is better than our radio handset“ (fire department Darmstadt)
- „We don‘t need security, we don‘t have any secrets“ (fire department Frankfurt)

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Identified Use Cases

Name	Description	Example
Broadcast/Multicast	Messages need to be sent to groups of peers, optionally with ack.	Operation Control sends evacuation message to first response team
Shift Change	Immediate churn occurs, due to massive logins of new shift and leaving peers of old shift	Firefighter team A needs to rest and responsibility is taken over by firefighter Team B
Locality Awareness	Mobile user enters a certain area and is automatically receiving location aware news	A first response team is searching for an available medic nearby

Identified Use Cases

Name	Description	Example
Resource Awareness	*Additional hardware is provided, the network adapts to the new resources and optimally utilizes the additional hardware*	*Operation control provides additional hardware, the network re structures itself using the new hardware for stabilizing the overlay*
Active Search	Search for an object, optionally within location range	A medic is walking toward a building and receives a warning not to enter the building
Hierarchy Maintenance	In all catastrophic scenarios there is a strict organization hierarchy for all helpers.	A new team at the site it is immediately assigned to a supervisor and is able to receive orders

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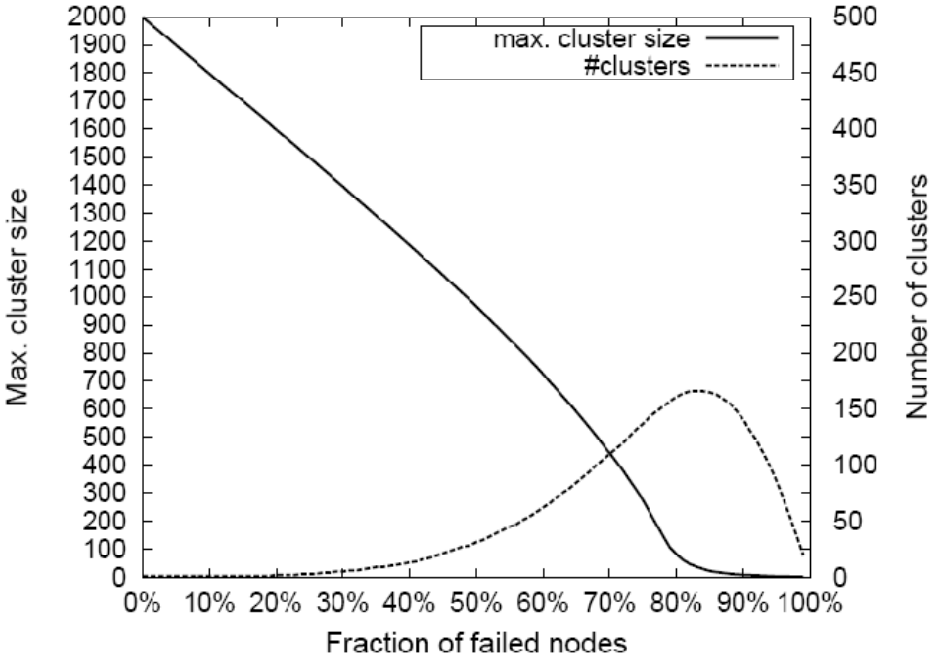
Overlay Evaluation

- Idea: How do „classic“ P2P overlays perform in first response (high churn) situations?
- Simulations performed with PeerSim
- Results are averaged over 20 simulation cycles

- Definition:
  Overlay is considered operational if 70%-100% of all messages are routed correctly.
  An overlay is in failed state if <50% of messages are routed correctly

Overlay Evaluation / Random

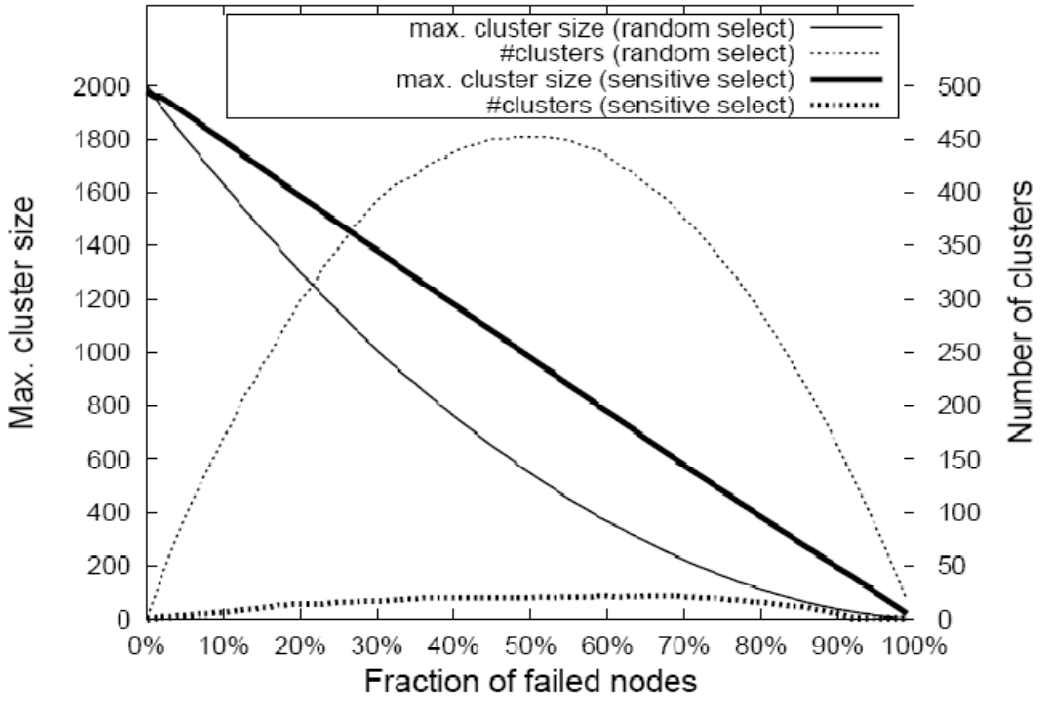


Massive fail in Unstructured P2P Overlay

- Fixed Node Degree = 3
- Undirected connections
- 2000 Nodes

	Operational	Failed
Random	<72%	>76%

Superpeer Evaluation

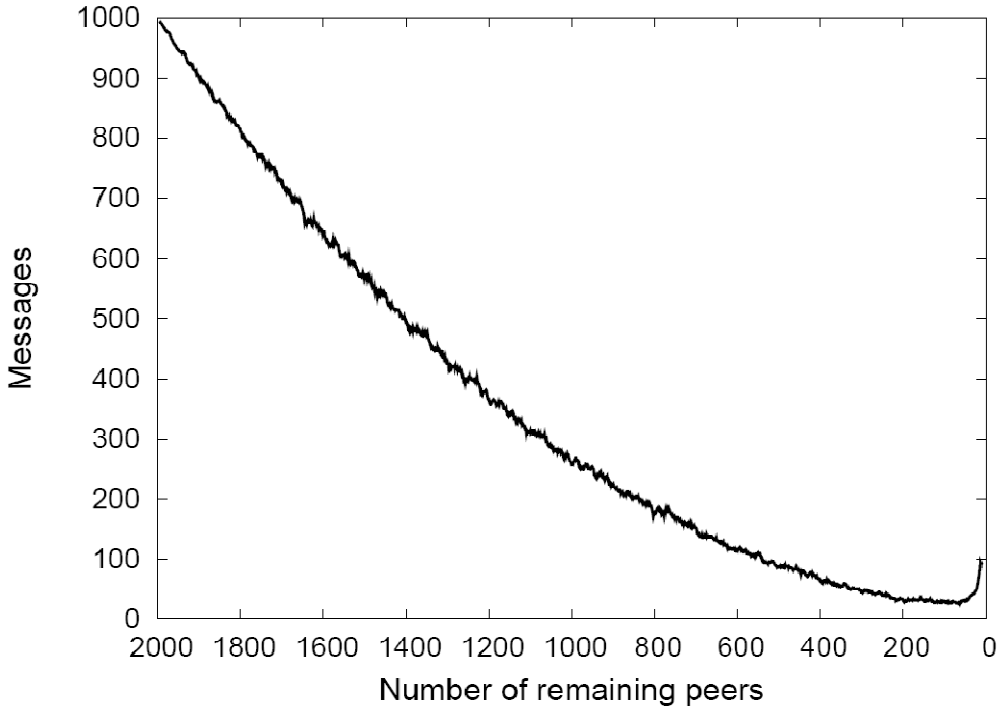


Massive fail in Superpeer P2P Overlay

- Superpeer fail probability 1/30
- 2000 nodes
- 200 superpeers (fully meshed)

	Operational	Failed
Superpeer	Always	Never
SP/Random	<27%	>50%

Tapestry Evaluation



Massive fail in Tapestry P2P Overlay

- 2000 Nodes
- 1000x pairs of random nodes in each cycle
- No reorganization

	Operational	Failed
Tapestry	<15%	>30%

Agenda

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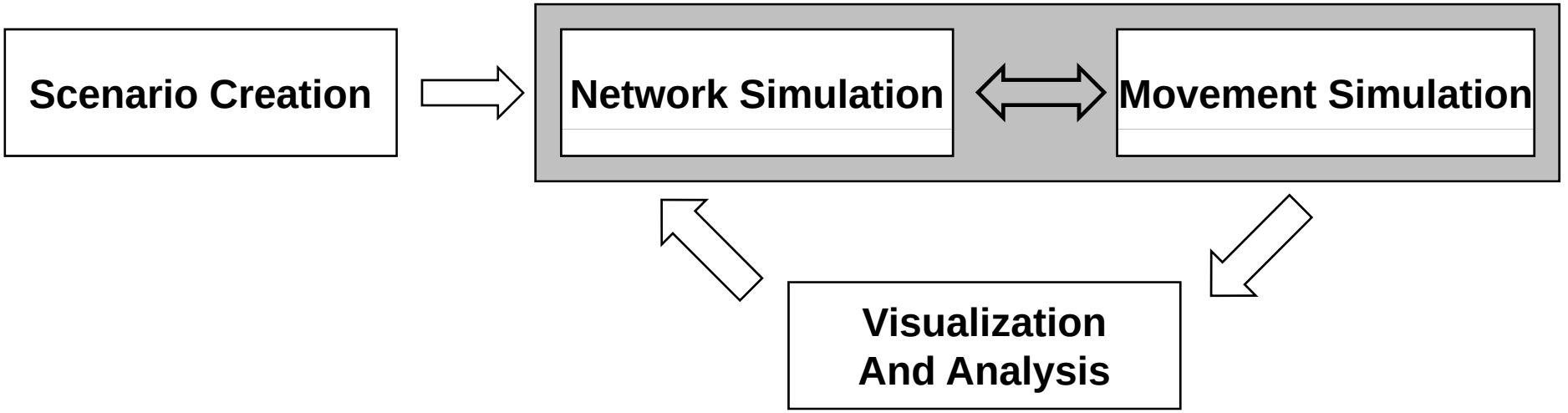
Identified Use Cases

Evaluation Concept

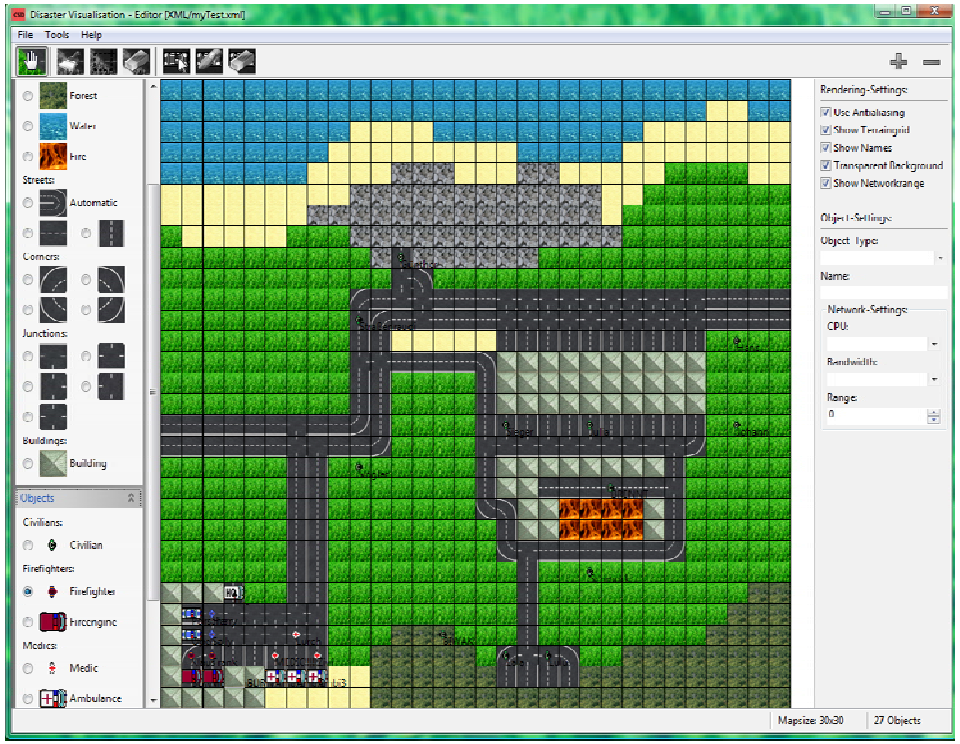
Outlook

Outlook

- Combination of 2 simulation approaches
- PlanetSim/Peersim P2P Simulator
- FRCS Movement Simulator



Outlook



FRCS Scenario Editor

Movement Simulation

Video

Thank you

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Questions?

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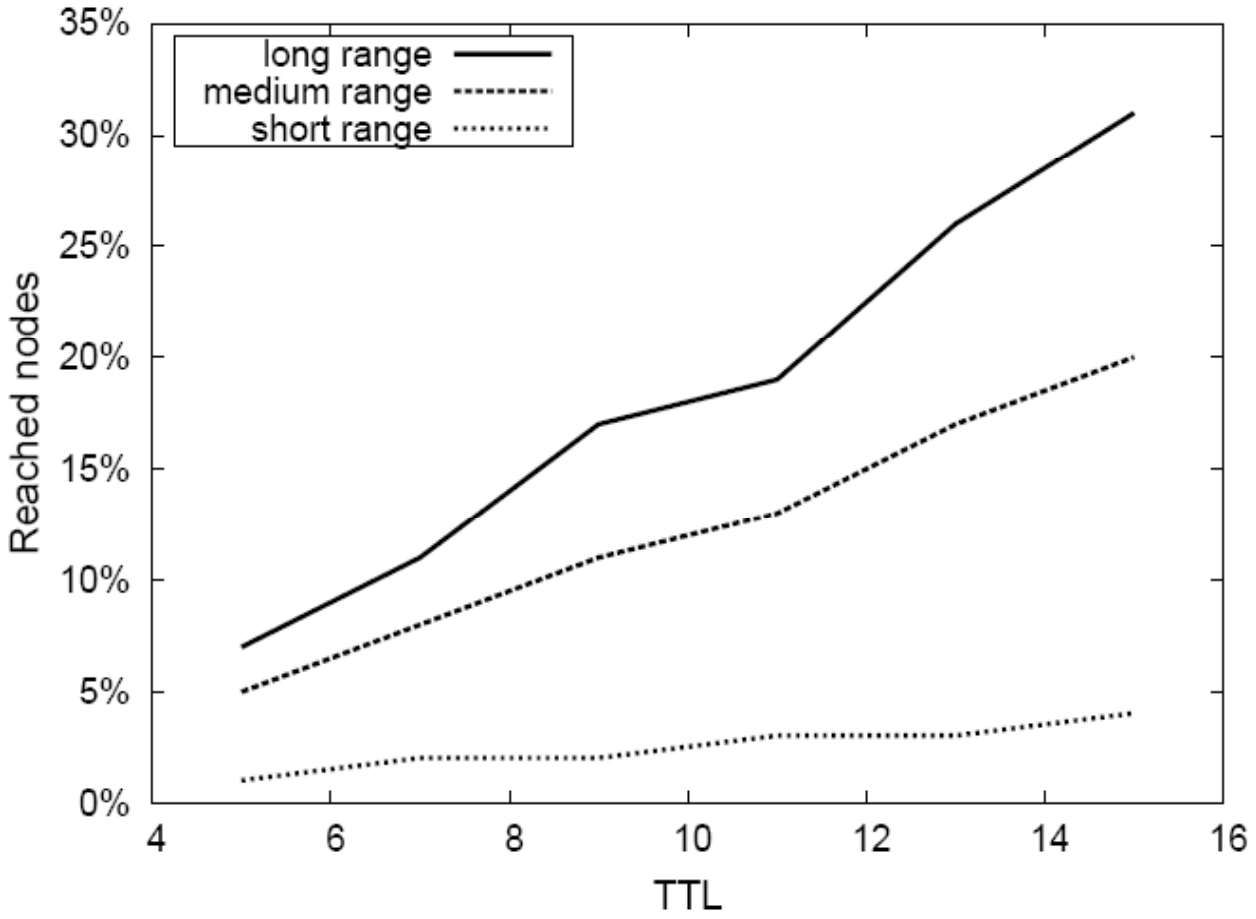
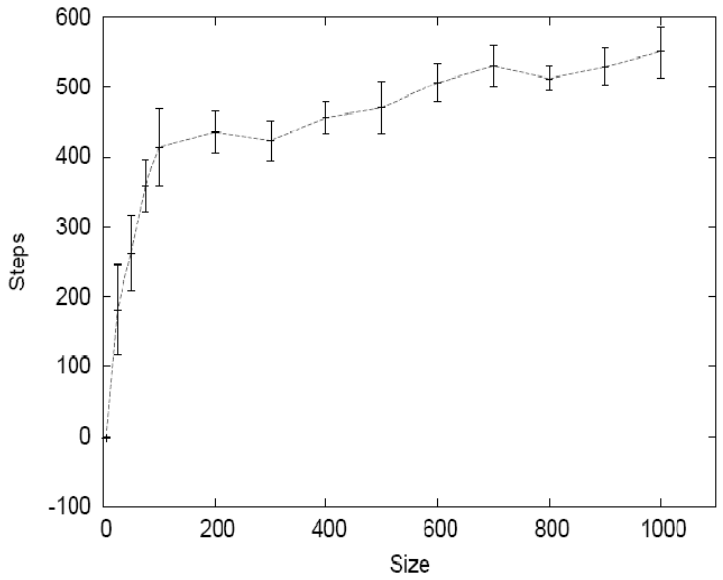
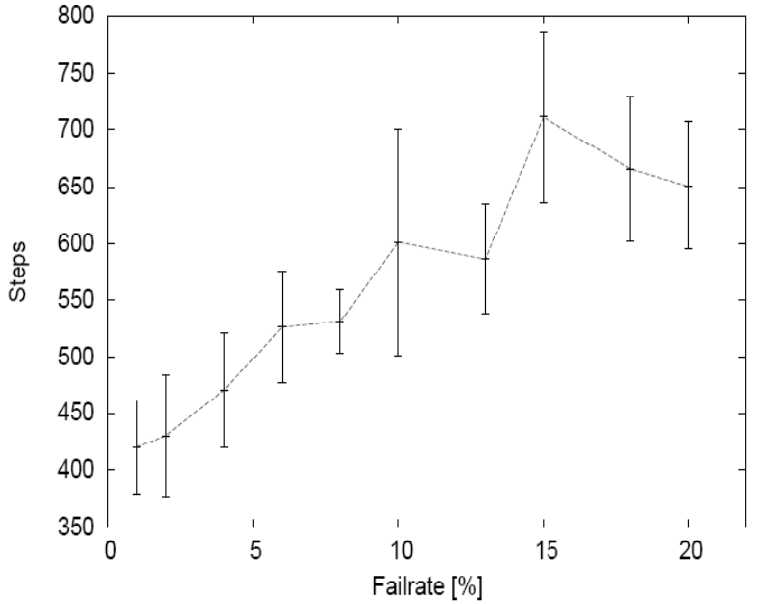

long range
medium range
short range
Reached nodes
TTL
35%
30%
25%
20%
15%
10%
5%
0%
4
6
8
10
12
14
16

Results for Hierarchy Maintenance on Chord



Hierarchy Maintenance at 5% fail rate



Hierarchy Maintenance at increasing fail rate

Simulation of Chord Hierarchy Maintenance (average of 10 runs)