Tools for Peer-to-Peer Network Simulation
draft-irtf-p2prg-core-simulators-00.txt

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Overview

• Provide survey of tools to P2P research community
  – Simulators and topology generators

• Goal
  – Share experiences
  – Improve tools
    • increased scalability
  – Add new models for P2PRG Core group use

• Note
  – We have not tested these tools
  – Only reporting what tool authors provide
  – Feedback welcomed!
Outline

- Overlay Network Simulators
- Packet-level Network Simulators
- Topology generators
Packet level vs Overlay sim.

- P2P overlay networks need to be scalable
- Experimenting with large networks is important
- Memory constraints
- Level of detail in simulations
- Distributed simulations
- Multi-processor architectures
- Topology Generators
Narses

• http://sourceforge.net/projects/narses
• Flow-based network simulator
• Simulated aggregated flows rather than individual packets → reduce the number of events/memory requirements
• Assumes available bandwidth on the first link for the remaining ones
• Largest model found consists of 600 nodes transmitting 200kB flows of data
• No evidence found of existing overlay networks models
3LS

• Simulator is separated into three models
  – Network (Describes distance between nodes)
  – Protocol (Describes the P2P protocol used)
  – User (User input via GUI or file)
• Some models exist in a library
• Gnutella 0.4 model exists, but only with 20 nodes
• To get simulator email authors: Nyik Ting (nyt431@mail.usask.ca) and Ralph Deters (deters@cs.susask.ca)
P2PSim

- http://pdos.csail.mit.edu/p2psim
- Event Simulator, multi-threaded
- Supports Chord, Accordion, Koorde, Kelips, Tapestry, Kademlia
- Tested with up to 3000 nodes using Chord
NeuroGrid

- http://sourceforge.net/projects/neurogrid
- Event Simulator, single threaded
- Designed for file sharing systems
- Simulations exists for Gnutella, Freenet, Pastry
- Can simulate up to 300,000 nodes on a 4GB PC
PlanetSim

- http://ants.etse.urv.es/planetsim
- Splits simulations into overlay networks and their services
- Services can be re-used for other overlay networks
- Chord and Symphony simulations exists
- Simulations can consist up to 100,000 nodes
PeerSim

- http://sourceforge.net/projects/peersim
- Offers predefined models for P2P simulation
  - OverStat (aggregation protocols to provide statistical information on network)
  - SG-1 (self organising and maintaining a superpeer based topology)
  - T-Man (used to built topologies using a ranking function defining the preference of each node for neighbours)
- Two simulation engines (cycle and event based), cycle based engine does not consider transport layer
- 1,000,000 nodes possible with cycle engine
Omnet++

- http://www.omnetpp.org
- Open source
- Mainly used for network simulations, but also for queuing networks, and multiprocessors
- GUI
- Available models: TCP, UDP, IP, Ethernet, MPLS, RSVP, 802.11
- P2P swarming simulation exists with 1000 nodes
- Can run distributed simulations across a number of machines
NS2

• http://www.isi.edu/nsnam/ns
• Discrete event network simulator
• Supports many network protocols, multicasting, MAC layer protocols
• Consists of many packages
• Large community of users, but little work in ns2 for P2P reported
• Protocols are implemented in C++, networks in OTcl
• One P2P simulation exists (Gnutella)
SSFNet

• http://www.ssfnet.org
• Java and C++ APIs
  – Java is commercial version free to universities
  – Now unsupported though
• Hosts are described by deriving from base classes
• DML is used for configuration of networks
• Parallel simulations on multiprocessor PC possible
• Supports Windows/Linux/Solaris
• Network sizes of 33,000 nodes have been achieved
Georgia Tech Network Simulator

- GTNets allows to define nodes, links, bandwidth, applications
- Supports layer 2 (802.3/802.11), IP, TCP, UDP
- Simulations may be animated
- Good scalability with network sizes up to 480,000 nodes
## Summary

<table>
<thead>
<tr>
<th>SIMULATOR</th>
<th>P2P PROTOCOLS</th>
<th>MAX NODES</th>
<th>DISTRIBUTION SIMULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narses</td>
<td>None</td>
<td>600</td>
<td>No</td>
</tr>
<tr>
<td>3LS</td>
<td>Gnutella</td>
<td>&lt; 1,000</td>
<td>No</td>
</tr>
<tr>
<td>NeuroGrid</td>
<td>Gnutella, NeuroGrid, Pastry, FreeNet</td>
<td>300,000</td>
<td>No</td>
</tr>
<tr>
<td>PeerSim</td>
<td>Collection of internally developed P2P models</td>
<td>&gt; 10^6</td>
<td>No</td>
</tr>
<tr>
<td>P2PSim</td>
<td>Chord, Accordion, Koorde, Kelips, Tapestry, Kademlia.</td>
<td>3,000</td>
<td>No</td>
</tr>
<tr>
<td>Omnet++</td>
<td>None</td>
<td>1,000*</td>
<td>Yes</td>
</tr>
<tr>
<td>NS2</td>
<td>Gnutella</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>SSFNet</td>
<td>None</td>
<td>33,000</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Topology Generators

- Generate networks with certain characteristics, based on sampled network traffic
- Especially useful for large networks
- Packet-level simulators
- Brite
  - Topologies based on RouterWaxman and RouterBarabasiAlbert models
- GT-ITM
  - Generates flat random graphs and also hierachical graphs
- INET
  - Generates autonomous system level network models which do not contain information on bandwidth, traffic, latency
- TIERs
  - Generates structured, hierachical models reproducing LANs, MANs and WANs
### Topology Generators

<table>
<thead>
<tr>
<th>Generator</th>
<th>Input-Formats</th>
<th>Output-Formats</th>
<th>Supported Simul.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brite</td>
<td>GT-ITM, INET, NLANR-AS</td>
<td>DML, Brite, Otcl, NED</td>
<td>NS2, Omnet++, SSFNet</td>
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<tr>
<td>GT-ITM</td>
<td>n/a</td>
<td>GT-ITM, Otcl*, DML*, Omnet++, NED*</td>
<td>NS2, P2PSim, SSFNet, GTNets</td>
</tr>
<tr>
<td>INET</td>
<td>n/a</td>
<td>INET, Otcl*, DML*, NED*</td>
<td>NS2, Omnet++, SSFNet</td>
</tr>
<tr>
<td>TIERS</td>
<td>n/a</td>
<td>Otcl*</td>
<td>NS2</td>
</tr>
</tbody>
</table>
Next Steps

• Update the draft based on
  – New tools available
  – Experience reports from P2PRG community

• Comments?