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
  $\rightarrow$ 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

SIMULATOR	P2P PROTOCOLS	MAX NODES	DISTRIBUTED SIMULATION
Narses	None	600	No
3LS	Gnutella	< 1,000	No
NeuroGrid	Gnutella, NeuroGrid, Pastry, FreeNet	300,000	No
PeerSim	Collection of internally developed P2P models	> 10^6	No
P2PSim	Chord, Accordion, Koorde, Kelips, Tapestry, Kademlia.	3,000	No
Omnet++	None	1,000*	Yes
NS2	Gnutella	N/A	Yes
SSFNet	None	33,000	Yes

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

Generator	Input-Formats	Output-Formats	Supported Simul.
Brite	GT-ITM, INET, NLANR-AS	DML, Brite, Otcl, NED	NS2, Omnet++, SSFNet
GT-ITM	n/a	GT-ITM, Otcl*, DML*, Omnet++*, NED*	NS2, P2PSim, SSFNet, GTNets
INET	n/a	INET, Otcl*, DML*, NED*	NS2, Omnet++, SSFNet
TIERS	n/a	Otcl*	NS2

Next Steps

- Update the draft based on
  - New tools available
  - Experience reports from P2PRG community
- Comments?