Experiment 1

Introduction

This experiment is designed to introduce you to the tools that we will be using in the computer-based experiments in the remainder of the semester. Two-thirds of this experiment revolves around familiarizing yourselves with the network simulator that we will use for network performance analysis. The remaining third of the experiment explores the use of a set of network measurement tools. These tools can be used to examine how networking principles are implemented in the Internet and in LANs.

Throughout this experiment description, instructions are bulleted. At the end of the document, there are two sections: *Demonstration Requirements* and *Report Instructions*.

The demonstration requirements are indicated throughout this document as in the following example:
> ➢ *Prepare for demonstration.*

The report instructions/questions are indicated throughout this document as in the following example:
> ❖ *Address this question; include this figure; tabulate your results*

Part 1: OpNet

In the first meeting of the class, you will be provided with instructions on how to run OpNet. This experiment focuses on some of the online tutorials.

Preparation: OpNet Introduction

- Run the Online Tutorial in OpNet Modeler (Help Menu).
- Choose the *Core Lessons: Introduction* option and read the introduction.
- Make sure you understand the concepts. Focus on the following editors: Project, Node, Process Model, Link Model, PDF, Probe, Simulation Sequence.

> ❖ *Include a section in your report addressing the following questions:*
> > ❖ *What is the OpNet workflow?*
> > ❖ *What are the key functions of the editors listed above?*

1.A Small Internetworks

- Run the Online Tutorial in OpNet Modeler (Help Menu).
- Choose the *Core Lessons: Small Internetworks* option and complete the tutorial.

> ➢ **Demo:** *Simulate and display the Individual Statistic Traffic Received (in packets/second) by the server node 31 in the first floor scenario.*
> ❖ **Report:** *Add a third floor segment with the same parameters as the second floor segment (create a new scenario). Join the new segment via a Cisco 2514 router with 10BaseT links to Node 30. Simulate, recording the server load and delay statistics. Plot the comparison between this scenario and the first two. Is the network still stable?*

1.B LAN Modeling

- Run the Online Tutorial in OpNet Modeler (Help Menu).
- Choose the *Core Lessons: LAN Modeling* option and complete the tutorial.

> ➢ **Demo:** *Add a LAN in Montreal.*
> ❖ **Report:** *Plot the time-average utilization of the Montreal-Washington link.*

1.C Importing Traffic

- Run the Online Tutorial in OpNet Modeler (Help Menu).
- Choose the *Core Lessons: Importing Traffic* option and complete the tutorial.

> ❖ **Report:** *Scale the traffic by 150 % and plot the comparative average of point-to-point utilization and FTP Download Response. Comment on the results.*

1.D Modeler Lessons: Basic Processes

- Run the Online Tutorial in OpNet Modeler (Help Menu).
- Choose the *Modeler Lessons: Basic Processes* option and complete the tutorial.

> ➢ **Demo:** *Create a new scenario with a Weibull traffic interarrival distribution (shape parameter = 2, scale parameter = 2).*

> ❖ **Report:** *Plot the packet count graph for the Weibull scenario. Comment on how the results differ from the exponential and constant scenarios.*

Part 2: Measurement Tools

2.A Visualroute and traceroute

Traceroute is a tool that reports the routers that are traversed by packets travelling from a source to a destination.

- Go to *www.traceroute.org*.

- Choose Carleton University (Canada) – you will get a traceroute from Canada to McGill.
- Choose a host in another country and run a traceroute – if you get to choose the destination, set it as cochise.WCG.McGill.CA

➢ **Demo:** *Run a traceroute of your choice and explain the meaning of the results.*

❖ **Report:** *Briefly describe how traceroute works (search the web, look in a reference book).*
❖ **Report:** *Include and interpret your results from the traceroutes you ran. What do the *** entries mean? What do the numbers mean? How many hops do you see for each case? Does traceroute necessarily show all the switching elements that are traversed? Why, or why not?*

Visualroute combines a geographical mapping functionality with traceroute.

- Go to *http://www.visualware.com/visualroute/index.html.*
- Go to the live demo.
- Run a traceroute from Virginia to cochise.WCG.McGill.CA

❖ **Report:** *How do you think Visualroute acquires geographical information? Is it accurate in the Virginia->McGill case? Suggest reasons for any inaccuracies or missing information.*
❖ **Report:** *How do you think traffic is predominantly routed from Europe to Australia? Why?*

2.B tcpdump

tcpdump is a tool that prints out the headers of packets on a network interface that match a user-supplied boolean expression.

- Visit the website http://www.ethereal.com/tcpdump.8.html to learn about the syntax and structure of **tcpdump**. (ethereal provides a graphical interface for interpreting and managing the results of tcpdumps).
- Initiate tcpdump on your computer, set to terminate after receiving 50 packets, and connect to www.cnn.com.
- Look at the results and interpret the lines in the output. In your interpretation, you should break down packets by type and size (TCP, UDP, acknowledgement, etc), arrival/departure times, and port numbers.

➢ **Demo:** *Run a tcpdump of 20 packets, connecting to a website of your choice, and interpret the output for us.*
❖ **Report:** *Run a tcpdump of 40 packets, connect to* www.mcgill.ca *and interpret the output.*
❖ **Report:** Run a tcpdump of 40 packets, connect to www.afl.com.au and comment on the arrival/departure times of packets.

Demonstration Requirements

Part 1 OpNet

1. OpNet Small Internetworks: Simulate and display the Individual Statistic Traffic Received (in packets/second) by the server node 31 in the first floor scenario.

2. LAN Modeling: Add a LAN in Montreal.

3. Basic Processes: Create a new scenario with a Weibull traffic interarrival distribution (shape parameter = 2, scale parameter = 2).

Part 2 Measurement Tools

4. Run a traceroute of your choice at www.traceroute.org and explain the meaning of the results.

5. Run a tcpdump of 20 packets, connecting to a website of your choice, and interpret the output for us.

Report Instructions/Questions

Part 1 OpNet

1. Include a section in your report addressing the following questions: What is the OpNet workflow? What are the key functions of the following editors: Project, Node, Process Model, Link Model, PDF, Probe, Simulation Sequence?

2. Small Internetworks: Add a third floor segment with the same parameters as the second floor segment (create a new scenario). Join the new segment via a Cisco 2514 router with 10BaseT links to Node 30. Simulate, recording the server load and delay statistics. Plot the comparison between this scenario and the first two. Is the network still stable?

3. LAN Modeling: Plot the time-average link utilization of the Montreal-Washington link.

4. Importing Traffic: Scale the traffic by 150 % and plot the comparative average of point-to-point utilization and FTP Download Response. Comment on the results.

5. Plot the packet count graph for the Weibull scenario. Comment on how the results differ from the exponential and constant scenarios.

Part 2 Measurement Tools

Traceroute/Visualroute

1. Briefly describe how traceroute works (search the web, look in a reference book).

2. Include and interpret your results from the traceroutes you ran. What do the *** entries mean? What do the numbers mean? How many hops do you see for each case? Does traceroute necessarily show all the switching elements that are traversed? Why, or why not?

3. How do you think Visualroute acquires geographical information? Is it accurate in the Virginia->McGill case? Suggest reasons for any inaccuracies or missing information.

4. How do you think traffic is predominantly routed from Europe to Australia? Why?

tcpdump

6. Run a tcpdump of 40 packets, connect to www.mcgill.ca and interpret the output.

7. Run a tcpdump of 40 packets, connect to www.afl.com.au and comment on the arrival/departure times of packets.