CSCI 558L – Laboratory Assignment #4: Measuring Network Performance

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Due date: September 12, 2011 at 11:55pm

1. Exploring Bandwidth and Throughput on DETER

This exercise will let you explore measuring bandwidth and throughput on the DETER testbed. The format of the results will not be strictly proscribed. Your report should contain tables or graphs that show your results in a meaningful manner, and more importantly your thoughts and conclusions as to what the results mean. Remember, never perform an experiment just once, make sure to collect several runs and average the results. Please include any .ns files you create as an addendum to your report. Have fun!

You'll need to familiarize yourself with the iperf tool. The experiments below should be done with the FreeBSD62-STD operating system image. The path for iperf is:
/usr/local/etc/emulab/emulab-iperf

1.1. Bandwidth-Delay Product.

(1) Create an experiment in DETER with two computers connected with a 1Mbit/s link with about 25ms round-trip delay (remember when setting the delay on a link in DETER, you're specifying the one-way delay). Use the ping tool to verify the round-trip delay is approximately 25ms. Use iperf in UDP mode to measure the maximum bandwidth across the link. Now use iperf in TCP mode to measure the TCP throughput.

(2) Now repeat the above experiment with the link set to 10 and 100Mbit/s. Leave the delay at 25ms (hint: you can change the traffic-shaping properties of your experiment without restarting it).

(3) Comment on the results at this point. Were you surprised at all? What is the default send/receive window size?

(4) Set the maximum size for the send/receive windows to 2Mbyte:

```
shell> sudo sysctl -w kern.ipc.maxsockbuf=2097152
```

(5) Now use the -w option for iperf to change the send and receive windows to 64, 128 and 256 kilobytes while again measuring the TCP throughput.

(6) Comment on your new results. You might want to put all of these results in a table. At 100Mbit/s and 25ms of delay, what is the theoretically optimal send/receive window size? If you run your experiment at this size, do you get 100Mbit/s of throughput? If yes, why? If not, what could cause your link to run at less than full bandwidth?

1.2. Gigabit links.

In this section we'll briey look at gigabit links in DETER. The way DETER adds delay to a link tops out at about 150Mbit/s, so we can't use delays if we want to play around with gigabit links.

(1) Create an experiment in DETER with two computers connected with a gigabit-LAN. Use ping to determine the average RTT delay between the computers.

(2) What is the bandwidth-delay product for this link? Use iperf in UDP mode to measure the bandwidth. Use iperf in TCP mode to measure the TCP throughput.

(3) If you left the send/receive windows at their default values, would this link perform well?

(4) Since we can't scale delay, can we scale the send/receive windows to see the effect of a bandwidth-delay product/TCP window size mismatch? Does it make sense to do so?

(5) Set the send/receive window values to something too small (i.e. about the value calculated in (2). Now measure the TCP throughput. What happened?

(6) Comment on these results. Specifically, what happens if we have a gigabit speed link with 1ms of delay? 5ms? Would you be happy with a 1GB DSL connection knowing you can only control the receive window size (hint: the RTT to the east coast of the US from Los Angeles can be 50ms or greater)?

1.3. Testing hints.

- To test the available bandwidth using iperf in UDP mode, use the following on the server machine:

```
shell> iperf –s –u –p <port num>
```

Where `<port num>` is any port number you choose > 1024

- Then on the client:

```
shell> iperf –c <server name> –u –p <port num> –b <BW>
```

Where `<server name>` is the name of the server (defined in your experiment setup), and <port num> is the same as chosen above. `<BW>` is the attempted bandwidth. Keep increasing this number towards the link speed until you see packet loss. Report the highest bandwidth possible with no packet loss.

- To test TCP throughput using iperf use the following server line:

```
shell> iperf –s –p <port num> –w <window size>
```

- And the following client:

```
shell> iperf –c <server name> –p <port num> –w <window size>
```

Where `<server name>` and `<port num>`are defined as above. `<window size>` is the window size you would like to use for send (on the client) and receive (on the server).