Networks II – CS 184	Professor: Dr. Jonathan Stanton
Exercise 2 – Emulab and Network Measurement	Due. March 12th or 22nd

Submission Requirements

If any of these requirements create a problem for you or are unclear, come talk to me.

- Your exercise submission must consist of the writeup of your answers to the questions and copies of the program output. You should not include any additional material.
- You must do this assignment by yourself. You should not discus the questions, traces, or solutions with other students. You may discuss them with the TA or me.
- The assignment is due **either** on Friday March 12th at Midnight (worth 2 extra-credit points), or Monday March 22nd at Midnight. You should turn it in through email.
- If you discover any ambiguities in this assignment, send email to the class email list (`cs184-2004@hermes.gwu.edu`) and I will clarify it.

Goals

The goal of this assignment is to learn how TCP/IP behaves on networks with differing characteristics and how to use network benchmarking tools in order to understand and diagnose network behaviors.

Assignment

For this assignment you will need to setup an account on Emulab, initiate an experiment, use different network configurations, measure network performance using iperf and answer questions based on the measurements.

Instructions

Use the experiment I have setup on Emulab (called ex2) in order to answer the following questions. The network configuration can been seen in Figure 1. Emulab documentation can be found through the Documentation link on the left panel of the website.

To answer each question, you need to provide the text of your descriptive answer and a cut-and-paste of the screen showing the iperf output that justifies your answer. For all of the iperf options you can use "k" or "m" to represent Kilo or Mega for uints. so -b 30m is a setting of 30 megabits per second.

Documentation for iperf can be found on the web page `http://dast.nlanr.net/Projects/Iperf/iperfdocs_1.7.0.html`.

Questions

Please make sure you are logged into the correct nodes for each question and use the correct options for each question.

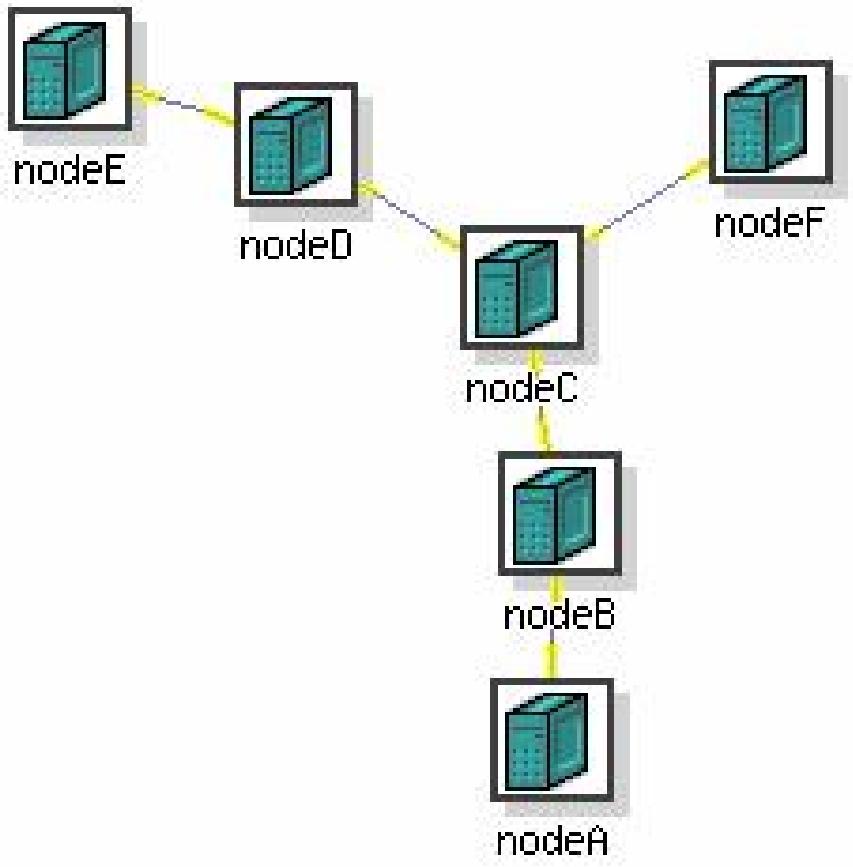

Figure 1: Exercise 2 Network configuration

1. Use iperf to calculate the basic throughput of a tcp stream between each of the sequential pairs of nodes (A-B, B-C, C-D, D-E, C-F). Report each value. To do this, run iperf with the -s option on one machine and with the -c nodeX option on the other machine.

2. Now use the iperf UDP option to find what the available bandwidth is on the B-C link and on the C-D link. You will use the -u option to send UDP packets, and the -b option to increase the bandwidth that is sent until you experience packet losses. The highest bandwidth that does not trigger packet loss is the value you should report.

3. Lets examine the TCP bandwidth of the C-D link. This link is interesting because it has a large latency (RTT) and bandwidth. Try to maximize the bandwidth that iperf can use for one TCP connection by varying the window size at both ends (server and client) using the -w option. Report the highest TCP bandwidth you can get and what the settings were to achieve it.

4. The way iperf works is to send data for about 10 seconds and time how much data is sent during that time. You can change the duration of the test using the -t option to set a larger number of seconds. Report how the bandwidth of the C-D link (at your best settings) changes if the test runs for 30 seconds, 60 seconds, and 5 minutes. Why does this occur?

5. For the same link (C-D) try both the -d and -r options using the 'good' settings that you discovered in the last two questions. What are the results? Why do you think they are different?

6. Compare the behavior of link C-D to the behavior of link C-F. Use both the UDP and TCP mode to show how the links differ in performace. Explain **why** the behavior is different and how you can document that difference using network tools like iperf, ping and tcpdump (which captures network traffic just like ethereal, but without the GUI).

7. Now let's look at some multi-hop paths. Use iperf to discover the available TCP bandwidth between A and C, A and E, and E-F. Report those values and identify where the bottleneck link is in each path. What other observations can you make about these paths?