Virginia Tech ■ ECE/CS 4570: Wireless Networks and Mobile Systems ■ Spring 2006

At-home Exercise 1 (E1)

Report Due: January 26, 2006 (at 4:00 PM)

Part I – Objectives and Lab Materials

Objective:

The objective of this exercise is to:

- Introduce various network monitoring utilities that will be needed in future labs and exercises for the course.

After completing the assignment, you should be able to:

- Use basic network monitoring utilities to measure performance.

Hardware to be used in this lab assignment:

- Any computer with an Internet connection.

Software to be used in this lab assignment:

- Ethereal running on a Microsoft Windows machine.

Part II – At-home Laboratory Assignment

You are expected to perform the following tasks.

- Read the following documents.
    1. W. Stallings, "IEEE 802.11: moving closer to practical wireless LANs," *IT Professional*, vol. 3, no. 3, pp. 17-23, May-June 2001 (available at the class Blackboard site).
    2. B. P. Crow, I. Widjaja, L. G. Kim, P. T. Sakai, "IEEE 802.11 Wireless Local Area Networks," *IEEE Communications Magazine*, vol. 35, no. 9, pp. 116-126, Sept. 1997 (available at the class Blackboard site)
    3. Ethereal introduction (available at http://www.ethereal.com/introduction.html).
    4. Ethereal manual (available at http://www.ethereal.com/docs/man-pages/ethereal.1.html).
- If Ethereal has not been installed on the Microsoft Windows computer you are using, download the packet capture utility Winpcap from http://winpcap.polito.it/install/default.htm and the Ethereal installation package for Windows from http://www.ethereal.com/distribution/win32. Winpcap provides the necessary library functions for Ethereal to perform packet capture. Install Winpcap first and, then, install Ethereal. (Ethereal is also available for Linux and you can complete this assignment using a computer running Linux.)
- Ping is a standard troubleshooting tool available on most network operating systems (http://www.usd.edu/trio/tut/start/ping.shtml). A ping utility sends Internet Control Message Protocol (ICMP) messages from the local computer to a remote device. Besides determining whether the remote computer is currently "alive," ping also provides indicators of the general *speed* or *reliability* of the network connection. Open a command window in Windows by entering *cmd* in the Start> Run field. Type *ping /?* to display the options available with *ping*. The ping command typically returns the round trip time (RTT) for an ICMP request to get a reply from the remote device. Using one of the appropriate options, use ping to send 50 packets to www.google.com for two different values of packet size, 32 bytes and 1000 bytes. On a Linux

system, the ping command has the same functionality, but the syntax is different. The options associated with ping on a Linux system can be determined by using *man ping*. This will be useful in a later lab related to ad-hoc routing.

- Measure the difference in round trip time for the two different values of packet size by observing the values returned by *ping* in the command window. Also, report the percentage of packets lost for the two *ping* sessions.
- Traceroute is a tool that can be used to trace the route that a packet takes from the originating host to a remote host. The utility normally uses ICMP echo messages and displays the time taken for the response from individual hops in the route up to the host. You may want to perform a web search to determine the exact syntax used by traceroute and interpret its output. Trace the path taken by a datagram sent to www.yahoo.com by running the *tracert* command in the command window.
- Ethereal is a network analyzer that can interactively analyze the traffic passing through your interface. Similar to other protocol analyzers, Ethereal's main window shows three views of a packet. It shows a summary line, briefly indicating the nature of the packet. A protocol tree is shown, allowing you to drill down to the exact protocol or field in which you are interested. Finally, a hexadecimal dump shows you exactly what the packet looks like when it goes over the network. Start Ethereal by clicking on the ethereal icon on the desktop. Start the capture of packets by clicking on Capture>Start in the menu bar. Ethereal shows the list of active interfaces on your computer. Select the interface that is currently active on the network and will be used to transfer data. Deselect the option "Capture packets in Promiscuous mode." Open Internet Explorer and access the URL http://www.hotmail.com/. Stop the capture when the website is completely displayed on your screen by clicking on "Stop" in the capture dialog box.
- From the trace obtained on your screen, calculate the time taken for the web server to respond to your HTTP request. This can be done by noting the time at which the HTTP request was sent to the server and at the time at which the browser received the first fragment of the response.
- Netstat is a command that can be used to monitor the network connections of a node. It also can be used to measure the traffic characteristics for that node. Open the command window and enter *netstat /?* to display the options. Start the collection of TCP statistics using netstat. Use the appropriate options to collect the network statistics every 50 seconds for the active TCP connections from your computer. While netstat runs on your machine monitoring the connections, open another command window and start a file transfer by invoking an FTP session to ftp.cs.purdue.edu. To invoke a session, type *ftp ftp.cs.purdue.edu*. Login as user anonymous and use your email address as the password. Once you are connected to the Purdue FTP server, change the present working directory to /pub/comer/labbook by typing *cd pub/comer/labbook*. Change the mode of data transfer to binary by typing *bin*. Now before downloading a file from the FTP server note (write down) the segments received under the TCP statistics displayed by netstat.
- Start Ethereal on your machine. Select the appropriate network interface and start the packet capture. Now download the file controller-schematic.ps from the Purdue FTP server. Report the change in the number of TCP segments received as shown by netstat. Also, make a note of the TCP segment size as shown by ethereal. Use this information in your report

Part III – Report

Your report should cover both the in-class and the at-home aspects of this week's work. The report will be graded for both form and content. The report must be submitted in electronic form to the "Dropbox" on the Blackboard site for this course. Each group must submit <u>one</u> report for the entire group.

Provide a report that answers each of the following questions in the order specified here.

Part I – In-class Experiments

1. Experiments with the *Xircom Client Utility*
   (a) What is the MAC address of the IEEE 802.11b access point used in the experiment?
   (b) How many bytes, as reported by the utility, were received when you accessed the IP address 192.0.2.100?
   (c) Report the variation in signal strength and link quality for 2 minutes at 30-second intervals.
   (d) Report the results of the link test performed.
2. Experiments with *wsttcp*
   (a) Report the throughput of the link between the transmitter and the receiver.
3. Experiments with *iwconfig*
   (a) Specify the command (including the appropriate options) used to set the SSID to "ECECS4570" and the transmit power to 1 mW.
4. Experiments with IEEE 802.11a access points
   (a) What is the MAC address of the IEEE 802.11a access point that you used in the experiment?
   (b) What is the signal level for the access point that you used in the experiment?

Part II – At-home Experiments

1. Experiments with *ping*
   (a) Specify the command (including the appropriate options) you used to perform a ping by sending 50 datagrams of size 50 bytes to www.vt.edu. Include the portion of the output that shows the ping statistics (do not include the entire output). What was the average round trip time? What percentage of the packets was lost?
   (b) Repeat part (a) for datagrams of size 1000 bytes.
   (c) Discuss the most likely reason for the difference in average round trip time in parts (a) and (b).
2. Experiments with *tracert*
   (a) Include the output from the traceroute to www.yahoo.com.
   (b) For each router in the path, your output probably includes three values of delay (in ms). What is the interpretation of each of these values?
3. Experiments with *netstat*
   (a) Report TCP statistics from netstat prior to the downloading of the file.
   (b) Report TCP statistics after the downloading of the file.
   (c) Report the number of bytes transferred and the throughput as reported by FTP.
   (d) Discuss how well the results in (c) match the results reported by netstat. Use the trace captured by Ethereal to answer this question.

4. Experiments with *Ethereal*

   (a) How long did it take the web server to respond to your request? Show your calculations.

   (b) Provide a representative screen capture of your experiment. The screen capture should contain enough information to answer part (a).

Part III – General Conclusions

This is the free-form portion of your report. Provide a summary of lessons learned in this lab, general observations on how each of the tools illustrated by the experiments can be used to configure and assess performance of the network, any unexpected results obtained, etc. Feel free to suggest improvements to the experiments performed in the in-class and at-home assignments.