CS 331 Name _____

Computer Networks Date _____

LAB 3 – Ping and Traceroute

Due Beginning of class February 11, 2014 (week 6)

Simple Network Diagnostic Tools: Ping and Traceroute (taken from Hans Kruse and Carl Bruggeman)

Both ping and traceroute (tracert) use ICMP to give study whether our network provides the desired connectivity.
All operating systems provide a version of the ping and traceroute programs (however, as we will see, the implementations are not all identical).

The ping command

The term "ping" comes from the way you "look out of" a submarine, which after all has no windows. Submarines use their sonar equipment to send out short bursts of sound (a ``ping'') and listen to see if an echo comes back. If you hear an echo you know something is out there, and from the time it took the echo to come back you can guess how far away the object is. Not much information, but it keeps submarines from running into things.

You give ping the address of the host to which you want to test connectivity. Ping then creates an ICMP Echo Request packet, and sends it to that address. If the Echo Request packet reaches its destination, the target host is required to respond with an ICMP Echo Reply packet, which it sends to the address from which the Echo Request came. Assuming that the Echo Reply packet makes it back to your machine, ping lets you know that the reply came back, and tells you how much time elapsed between sending the Request and getting the Reply back (remember the submarine?).

What does the ping output mean?

Example 1: The command ping www.google.com might produce this output:

```
ping www.google.com

Pinging www.google.com [64.233.167.99] with 32 bytes of data:

Reply from 64.233.167.99: bytes=32 time=31ms TTL=239
Reply from 64.233.167.99: bytes=32 time=31ms TTL=239
Reply from 64.233.167.99: bytes=32 time=31ms TTL=239
Reply from 64.233.167.99: bytes=32 time=33ms TTL=239

Ping statistics for 64.233.167.99:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 31ms, Maximum = 33ms, Average = 31ms
```

The first line of output confirms the command you issued
Lets look at the first such output line:

bytes = 32 is the size of the ICMP Echo reply

time=... -- This is the time between the Echo Request and Reply. Since networks are dynamic, this time will probably be different for each reply received.

ttl=239 -- ``TTL'' means Time to Live. This is a counter in every IP packet. The sender (ping in this case) sets it to whatever it thinks a reasonable number is (the maximum is 255). Each router subtracts one, and packets get thrown out if TTL ever reaches 0. Assuming we started with TTL=255, this report gives us an estimate of the number of routers we passed through (16 in our example).

NOTE: Unfortunately, ping does not quite behave the same on all systems.

Questions: Write your answers and bring them to the next class.

1) What do the statistics at the end of the command output represent? What type of insight does it give you about the network?

2) What type of delay can we use ping to estimate?

3) Pick a host in the east coast (i.e., www.mit.edu) and try to ping it. Write your output?

4) Pick a host in the west coast (i.e., www.w3.berkeley.edu) and try to ping it. Write your output?

5) Compare (i.e., TTL, time) the results from questions 3 and 4? Which one has a greater delay? Explain in detail your answer. (i.e., output from the ping command)

6) Repeat questions 3, 4 and 5 for universities outside of the North America? How does your results compare with the previous results? Write the output of the command.

7) Calculate delays for propagation and transmission by estimating the set of numerical values used by the formulas.

8) Research the command traceroute and describe what it is used for?

9) Use traceroute for the host of questions 3 and 4. What insight can you conclude from the results?

10) Wait a day or more until executing trace route for question 9 again. Do the results differ from the ones obtained previously? If so, why or why not?

11) How can you use the traceroute and ping command to explain an operational approach to packet switched networks and the idea of a hierarchical networks of networks.

NOTE: You can use http://network-tools.com/ to execute ping and traceroute from web browser.