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Experiment-2

Aim: To study the basic network utilities

This lab introduces some basic network monitoring/analysis tools. There are a few exercises along the way. You should write up answers to the ***ping*** and ***traceroute*** exercises and turn them in next lab. (You should try out each tool, whether it is needed for an exercise or not!).

Prerequisite: Basic understanding of command line utilities of Linux Operating system.

Some Basic command line Networking utilities

Start with a few of the most basic command line tools. These commands are available on Unix, including Linux (and the first two, at least, are also for Windows). Some parameters or options might differ on different operating systems. Remember that you can use man <command> to get information about a command and its options.

ping — The command ping <host> sends a series of packets and expects to receieve a response to each packet. When a return packet is received, ping reports the round trip time (the time between sending the packet and receiving the response). Some routers and firewalls block ping requests, so you might get no reponse at all. Ping can be used to check whether a computer is up and running, to measure network delay time, and to check for dropped packets indicating network congestion. Note that <host> can be either a domain name or an IP address. By default, ping will send a packet every second indefinitely; stop it with Control-C

Network latency, specifically round trip time (RTT), can be measured using ping, which sends ICMP packets. The syntax for the command in Linux or Mac OS is:

```
ping [-c <count>] [-s <packetsize>] <hostname>
```

The syntax in Windows is:

```
ping [-n <count>] [-l <packetsize>] <hostname>
```

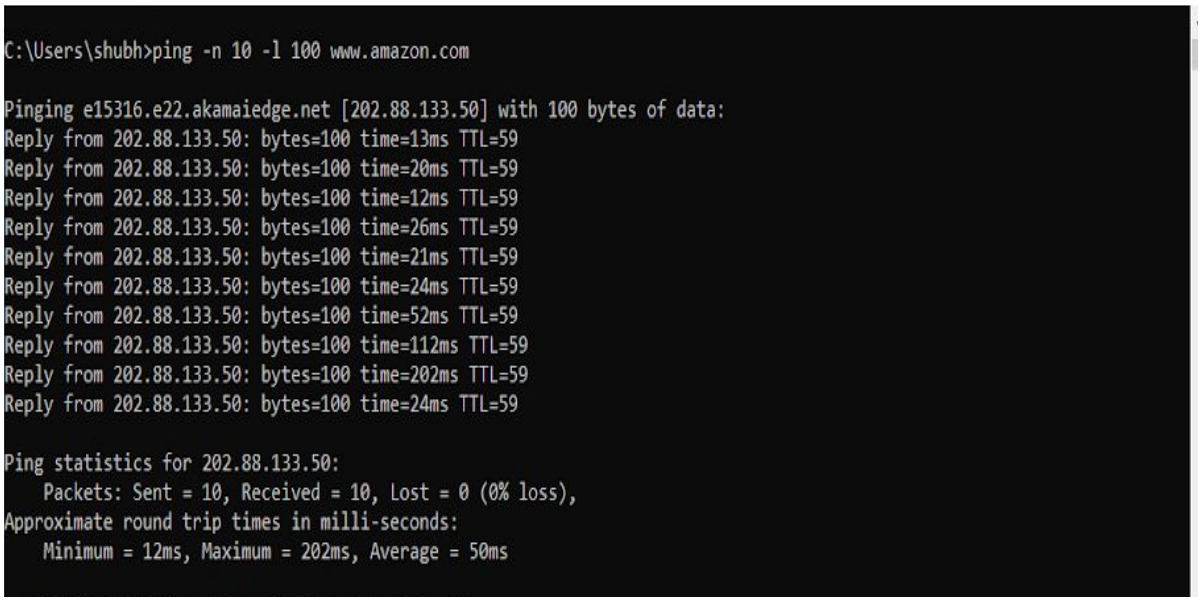
The default number of ICMP packets to send is either infinite (in Linux and Mac OS) or 4 (in Windows). The default packet size is either 64 bytes (in Linux) or 32 bytes (in Windows). You can specify either a hostname (e.g., spit.ac.in) or an IP address.

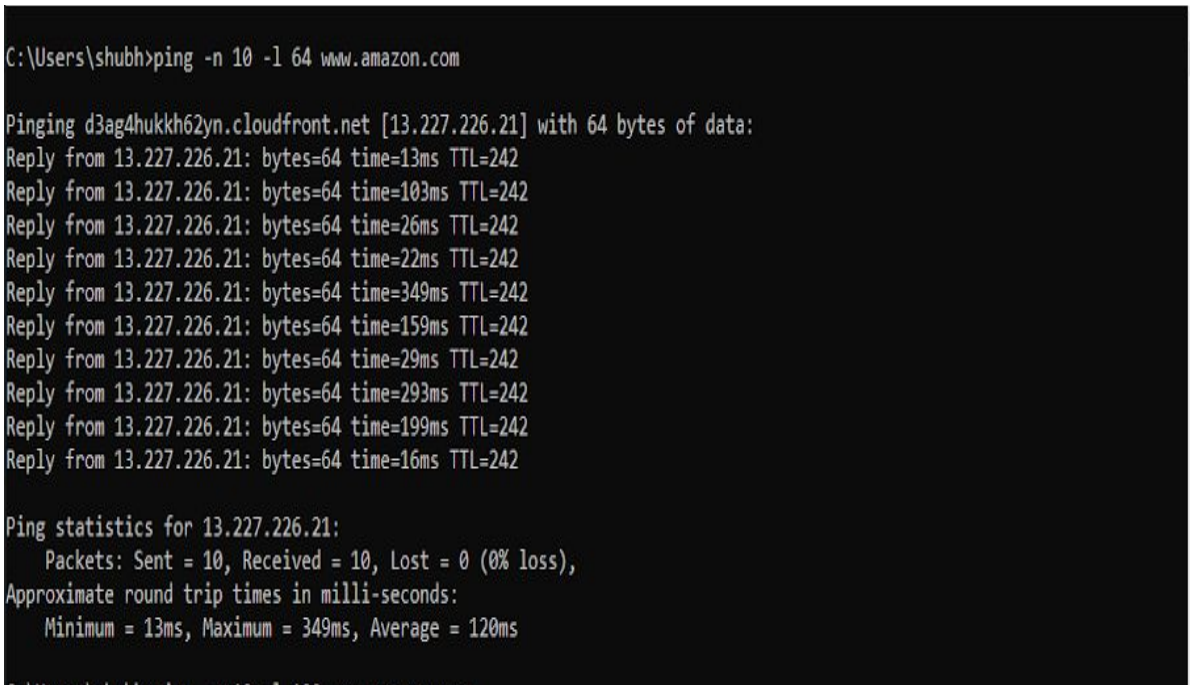
To save the output from ping to a file, include a greater than symbol and a file name at the end of the command. For example:

```
ping -c 10 google.com > ping_c10_s64_google.log
```

EXPERIMENTS WITH PING

1. Ping the any hosts 10 times (i.e., packet count is 10) with a packet size of 64 bytes, 100 bytes, 500 bytes, 1000 bytes, 1400 bytes





```
C:\Users\shubh>ping -n 10 -l 500 www.amazon.com

Pinging e15316.e22.akamaiedge.net [202.88.133.50] with 500 bytes of data:
Reply from 202.88.133.50: bytes=500 time=14ms TTL=59
Reply from 202.88.133.50: bytes=500 time=11ms TTL=59
Reply from 202.88.133.50: bytes=500 time=11ms TTL=59
Reply from 202.88.133.50: bytes=500 time=9ms TTL=59
Reply from 202.88.133.50: bytes=500 time=31ms TTL=59
Reply from 202.88.133.50: bytes=500 time=32ms TTL=59
Reply from 202.88.133.50: bytes=500 time=12ms TTL=59
Reply from 202.88.133.50: bytes=500 time=10ms TTL=59
Reply from 202.88.133.50: bytes=500 time=12ms TTL=59
Reply from 202.88.133.50: bytes=500 time=21ms TTL=59

Ping statistics for 202.88.133.50:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 9ms, Maximum = 32ms, Average = 16ms
```

```
C:\Users\shubh>ping -n 10 -l 1000 www.google.com

Pinging www.google.com [172.217.26.228] with 1000 bytes of data:
Reply from 172.217.26.228: bytes=68 (sent 1000) time=59ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1000) time=24ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1000) time=24ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1000) time=15ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1000) time=226ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1000) time=137ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1000) time=25ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1000) time=942ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1000) time=22ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1000) time=112ms TTL=113

Ping statistics for 172.217.26.228:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 15ms, Maximum = 942ms, Average = 158ms
```

```
C:\Users\shubh>ping -n 10 -l 1400 www.google.com

Pinging www.google.com [172.217.26.228] with 1400 bytes of data:
Reply from 172.217.26.228: bytes=68 (sent 1400) time=97ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1400) time=20ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1400) time=134ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1400) time=143ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1400) time=28ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1400) time=161ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1400) time=177ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1400) time=78ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1400) time=26ms TTL=113
Reply from 172.217.26.228: bytes=68 (sent 1400) time=98ms TTL=113

Ping statistics for 172.217.26.228:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 20ms, Maximum = 177ms, Average = 96ms
```

Questions About Latency

Now look at the results you gathered and answer the following questions about latency. Store your answers in a file named ping.txt.

1. **Does the average RTT vary between different hosts? What aspects of latency (transmit, propagation, and queueing delay) might impact this and why?**

   Answer:
   Average RTT can vary between different hosts due to Processing delay, queuing delay, Transmission delay , and Propagation delay.

   • **Processing delay** – time it takes a router to process the packet header, depends on the
   processing speed of the switch
   • **Queuing delay** – time the packet spends in routing queues depends on the number of packets, size of the packet and bandwidth
   • **Transmission delay** – time it takes to push the packet's bits onto the link depends on size of the packet and the bandwidth of the network.
   • **Propagation delay** – time for a signal to reach its destination depends on distance and propagation speed.
   Thus the different average RTT values of amazon.com and google.com can be because of the above mentioned factors.

2. **Does the average RTT vary with different packet sizes? What aspects of latency (transmit, propagation, and queueing delay) might impact this and why?**

   Answer:

   Yes, the average RTT increases with packet size as queuing, transmission delay increases as they rely on size of packets eventually increasing the average RTT.

Exercise 1: Experiment with ping to find the round trip times to a variety of destinations. Write up any interesting observations, including in particular how the round trip time compares to the physical distance. Here are few places from who to get replies: www.uw.edu, www.cornell.edu, berkeley.edu, www.uchicago.edu, www.ox.ac.uk (England), www.u-tokyo.ac.jp (Japan).

```
C:\Users\shubh>ping www.uw.edu

Pinging www.washington.edu [128.95.155.134] with 32 bytes of data:
Reply from 128.95.155.134: bytes=32 time=391ms TTL=47
Reply from 128.95.155.134: bytes=32 time=497ms TTL=47
Reply from 128.95.155.134: bytes=32 time=403ms TTL=47
Reply from 128.95.155.134: bytes=32 time=315ms TTL=47

Ping statistics for 128.95.155.134:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 315ms, Maximum = 497ms, Average = 401ms

C:\Users\shubh>ping www.cornell.edu

Pinging ucomm-gw1.cornell.media3.us [20.42.25.107] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 20.42.25.107:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\Users\shubh>ping berkeley.edu

Pinging berkeley.edu [35.163.72.93] with 32 bytes of data:
Request timed out.
Reply from 35.163.72.93: bytes=32 time=937ms TTL=36
Reply from 35.163.72.93: bytes=32 time=2945ms TTL=36
Reply from 35.163.72.93: bytes=32 time=375ms TTL=36

Ping statistics for 35.163.72.93:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 375ms, Maximum = 2945ms, Average = 1419ms
```

```
C:\Users\shubh>ping www.uchicago.edu

Pinging wsee2.elb.uchicago.edu [54.89.29.50] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 54.89.29.50:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\Users\shubh>ping www.uchicago.edu

Pinging wsee2.elb.uchicago.edu [3.224.151.213] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 3.224.151.213:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\Users\shubh>ping www.u-tokyo.ac.jp

Pinging www.u-tokyo.ac.jp [210.152.243.234] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 210.152.243.234:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

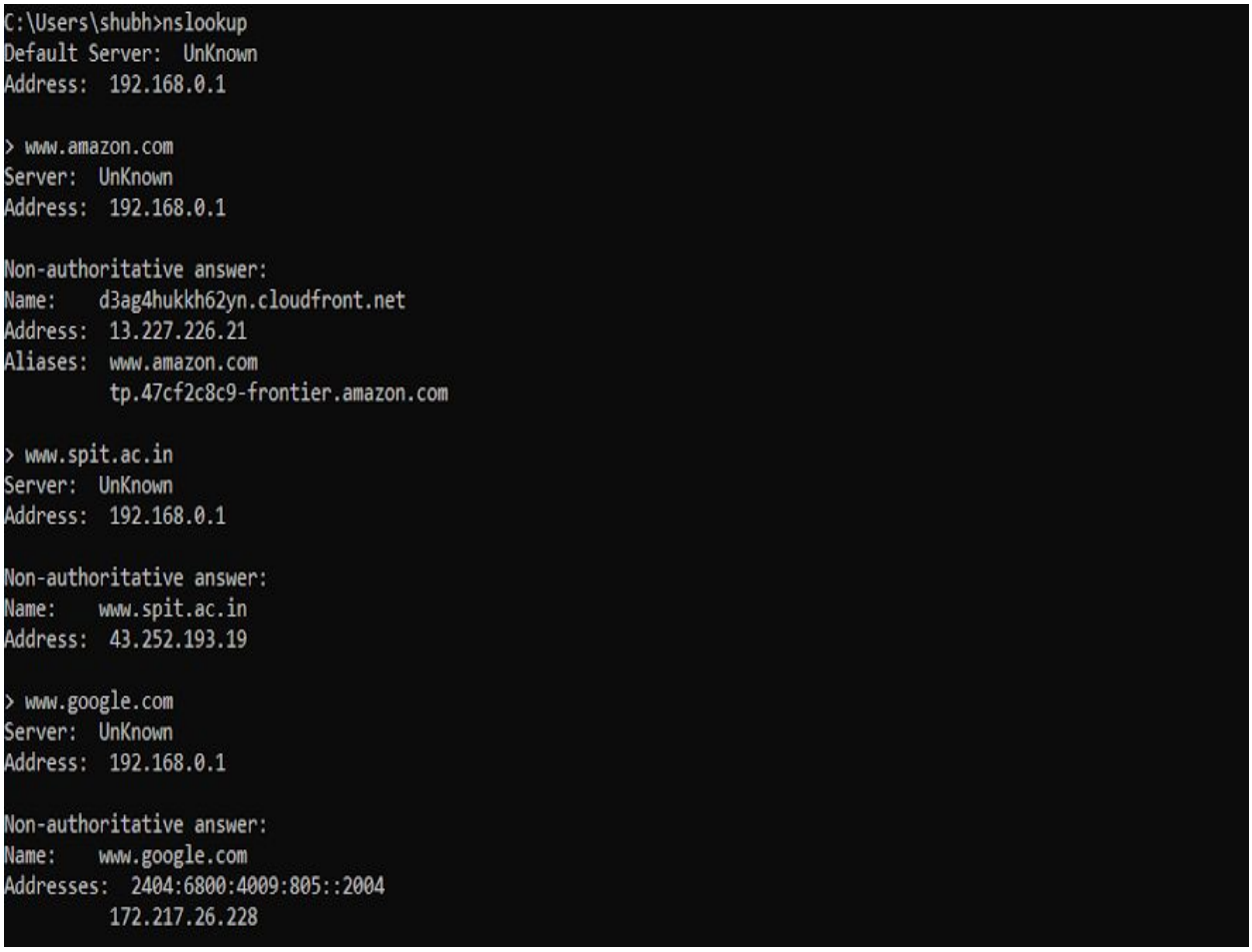
Factors that influences RTT: **Ref - [1]**

There are certain factors that can bring huge changes in the value of RTT. These are enlisted below:

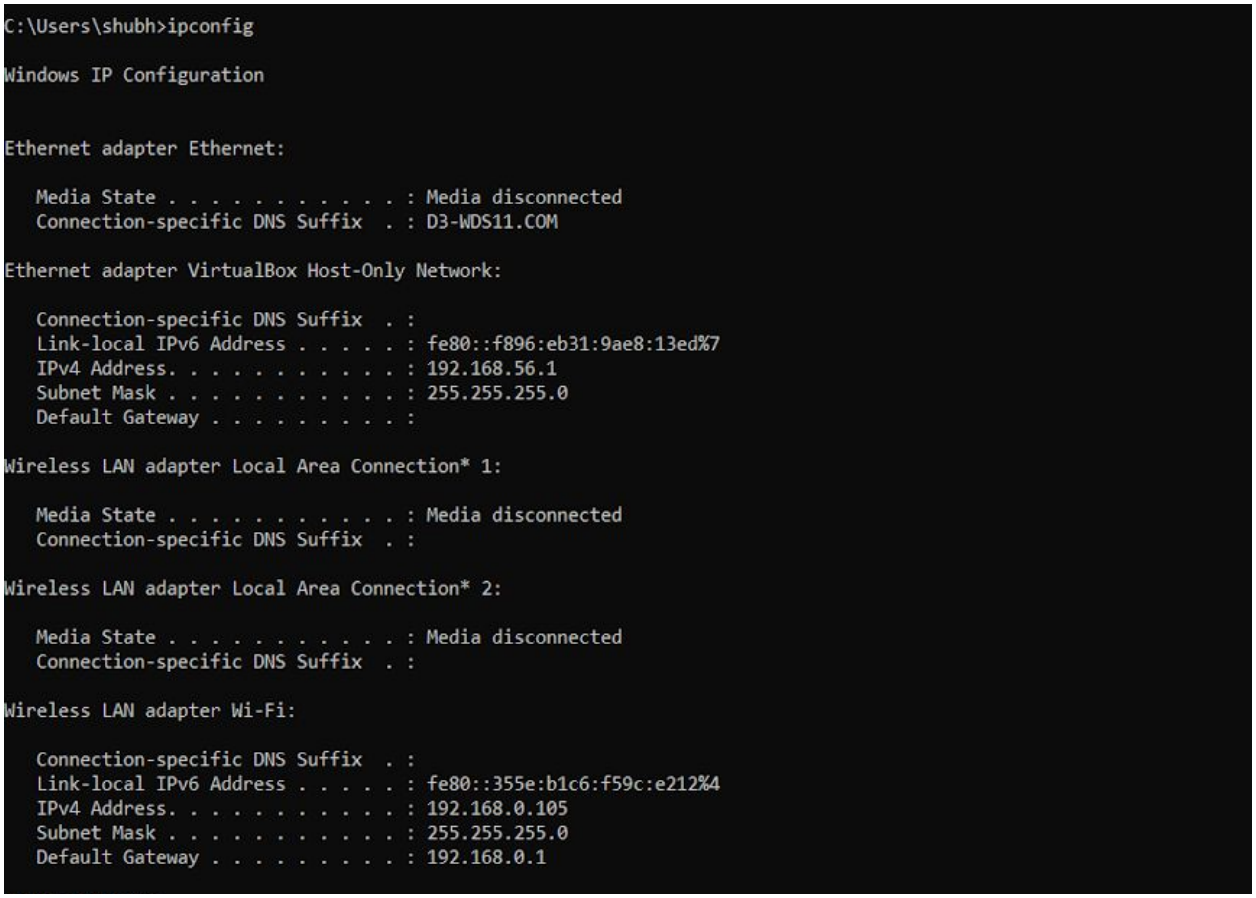
- The nature of the transmission medium - the way in which connections are made affects how fast the connection moves; connections made over optical fiber will behave differently than connections made over copper. Likewise, a connection made over a wireless frequency will behave differently than that of a satellite communication.
- Local area network (LAN) traffic - the amount of traffic on the local area network can bottleneck a connection before it ever reaches the larger Internet. For example, if many users are using streaming video service simultaneously, round-trip time may be inhibited
  even though the external network has excess capacity and is functioning normally.
- Server response time – the amount of time it takes a server to process and respond to a request is a potential bottleneck in network latency. When a server is overwhelmed with
  requests, such as during a DDoS attack, its ability to respond efficiently can be inhibited, resulting in increased RTT.
- Node count and congestion – depending on the path that a connection takes across the Internet, it may be routed or “hop” through a different number of intermediate nodes. Generally speaking, the greater the number of nodes a connection touches the slower it will be. A node may also experience network congestion from other network traffic, which will slow down the connection and increase RTT.
- Physical distance – although a connection optimized by a CDN can often reduce the number of hops required to reach a destination, there is no way of getting around the limitation imposed by the speed of light; the distance between a start and end point is a limiting factor in network connectivity that can only be reduced by moving content closer to the requesting users. To overcome this obstacle, a CDN will cache content closer to the requesting users, thereby reducing RTT.

Thus the round trip times varies due to these factors.

nslookup — The command nslookup <host> will do a DNS query to find and report the IP address (or addresses) for a domain name or the domain name corresponding to an IP address. To do this, it contacts a "DNS server." Default DNS servers are part of a computer's network configuration. (For a static IP address in Linux, they are configured in the file /etc/network/interfaces that you encountered in the last lab.) You can specify a different DNS server to be used by nslokup by adding the server name or IP address to the command:
nslookup <host> <server>



ifconfig — You used ifconfig in the previous lab. When used with no parameters, ifconfig reports some information about the computer's network interfaces. This usually includes lo which stands for localhost; it can be used for communication between programs running on the same computer. Linux often has an interface named eth0, which is the first ethernet card. The information is different on Mac OS and Linux, but includes the IP or "inet" address and ethernet or "hardware" address for an ethernet card. On Linux, you get the number of packets received (RX) and sent (TX), as well as the number of bytes transmitted and received. (A better place to monitor network bytes on our Linux computers is in the GUI program System Monitor, if it is installed!!!.)



netstat — The netstat command gives information about network connections. I often use netstat -t -n which lists currently open TCP connections (that's the "-t" option) by IP address rather than domain name (that's the "-n" option). Add the option "-l" (lower case ell) to list listening sockets, that is sockets that have been opened by server programs to wait for connection requests from clients: netstat -t -n -l. (On Mac, use netstat -p tcp to list tcp connections, and add "-a" to include listening sockets in the list.). **Ref - [2]**

```
C:\Users\shubh>netstat

Active Connections

  Proto  Local Address          Foreign Address        State
  TCP    127.0.0.1:9012         LAPTOP-REIB9DR4:53152  ESTABLISHED
  TCP    127.0.0.1:9487         LAPTOP-REIB9DR4:53148  ESTABLISHED
  TCP    127.0.0.1:53148        LAPTOP-REIB9DR4:9487   ESTABLISHED
  TCP    127.0.0.1:53152        LAPTOP-REIB9DR4:9012   ESTABLISHED
  TCP    192.168.0.105:49816    40.100.140.18:https    ESTABLISHED
  TCP    192.168.0.105:51422    ec2-54-191-221-88:https  ESTABLISHED
  TCP    192.168.0.105:51427    ec2-54-244-7-118:https  ESTABLISHED
  TCP    192.168.0.105:51430    ec2-54-191-221-88:https  ESTABLISHED
  TCP    192.168.0.105:51459    ec2-52-11-231-199:https  ESTABLISHED
  TCP    192.168.0.105:51561    52.139.250.253:https   ESTABLISHED
  TCP    192.168.0.105:51575    172.217.194.188:https  ESTABLISHED
  TCP    192.168.0.105:51576    192.168.0.106:8008     ESTABLISHED
  TCP    192.168.0.105:51577    172.217.194.188:5228   ESTABLISHED
  TCP    192.168.0.105:51578    192.168.0.106:8009     ESTABLISHED
  TCP    192.168.0.105:51582    bom05s09-in-f3:https   ESTABLISHED
  TCP    192.168.0.105:51589    74.125.24.189:https    ESTABLISHED
  TCP    192.168.0.105:51618    51.138.106.75:https    TIME_WAIT
  TCP    192.168.0.105:51619    51.138.106.75:https    TIME_WAIT
  TCP    192.168.0.105:51620    51.138.106.75:https    TIME_WAIT
  TCP    192.168.0.105:51622    13.107.6.171:https     ESTABLISHED
  TCP    192.168.0.105:51623    13.107.6.171:https     ESTABLISHED
  TCP    192.168.0.105:51625    51.138.106.75:https    ESTABLISHED
  TCP    192.168.0.105:51626    51.138.106.75:https    ESTABLISHED
  TCP    192.168.0.105:51627    51.138.106.75:https    ESTABLISHED
  TCP    192.168.0.105:51628    a104-74-143-169:https  ESTABLISHED
  TCP    192.168.0.105:53333    202.88.133.129:https   CLOSE_WAIT
  TCP    192.168.0.105:53334    202.88.133.129:https   CLOSE_WAIT
  TCP    192.168.0.105:53335    202.88.133.129:https   CLOSE_WAIT
  TCP    192.168.0.105:53336    202.88.133.129:https   CLOSE_WAIT
  TCP    192.168.0.105:53337    202.88.133.129:https   CLOSE_WAIT
  TCP    192.168.0.105:53338    202.88.133.129:https   CLOSE_WAIT
  TCP    192.168.0.105:53339    117.18.237.29:http     CLOSE_WAIT
  TCP    192.168.0.105:57531    52.98.42.226:https     ESTABLISHED
```

```
C:\Users\shubh>netstat -t

Active Connections

  Proto  Local Address          Foreign Address        State           Offload State

  TCP    127.0.0.1:9012         LAPTOP-REIB9DR4:53152  ESTABLISHED     InHost
  TCP    127.0.0.1:9487         LAPTOP-REIB9DR4:53148  ESTABLISHED     InHost
  TCP    127.0.0.1:53148        LAPTOP-REIB9DR4:9487   ESTABLISHED     InHost
  TCP    127.0.0.1:53152        LAPTOP-REIB9DR4:9012   ESTABLISHED     InHost
  TCP    192.168.0.105:49816    40.100.140.18:https    ESTABLISHED     InHost
  TCP    192.168.0.105:51422    ec2-54-191-221-88:https  ESTABLISHED     InHost
  TCP    192.168.0.105:51427    ec2-54-244-7-118:https  ESTABLISHED     InHost
  TCP    192.168.0.105:51430    ec2-54-191-221-88:https  ESTABLISHED     InHost
  TCP    192.168.0.105:51459    ec2-52-11-231-199:https  ESTABLISHED     InHost
  TCP    192.168.0.105:51561    52.139.250.253:https   ESTABLISHED     InHost
  TCP    192.168.0.105:51575    172.217.194.188:https  ESTABLISHED     InHost
  TCP    192.168.0.105:51576    192.168.0.106:8008     ESTABLISHED     InHost
  TCP    192.168.0.105:51577    172.217.194.188:5228   ESTABLISHED     InHost
  TCP    192.168.0.105:51578    192.168.0.106:8009     ESTABLISHED     InHost
  TCP    192.168.0.105:51582    bom05s09-in-f3:https   ESTABLISHED     InHost
  TCP    192.168.0.105:51589    74.125.24.189:https    ESTABLISHED     InHost
  TCP    192.168.0.105:51626    51.138.106.75:https    TIME_WAIT       InHost
  TCP    192.168.0.105:51627    51.138.106.75:https    TIME_WAIT       InHost
  TCP    192.168.0.105:51630    20.189.73.166:https    TIME_WAIT       InHost
  TCP    192.168.0.105:51632    20.44.239.154:https    TIME_WAIT       InHost
  TCP    192.168.0.105:51634    lga25s70-in-f3:http    ESTABLISHED     InHost
  TCP    192.168.0.105:51635    lga25s70-in-f3:http    ESTABLISHED     InHost
  TCP    192.168.0.105:51636    lga25s70-in-f3:http    ESTABLISHED     InHost
  TCP    192.168.0.105:51657    13.107.6.171:https     ESTABLISHED     InHost
  TCP    192.168.0.105:51659    13.107.6.171:https     ESTABLISHED     InHost
  TCP    192.168.0.105:53333    202.88.133.129:https   CLOSE_WAIT      InHost
  TCP    192.168.0.105:53334    202.88.133.129:https   CLOSE_WAIT      InHost
  TCP    192.168.0.105:53335    202.88.133.129:https   CLOSE_WAIT      InHost
  TCP    192.168.0.105:53336    202.88.133.129:https   CLOSE_WAIT      InHost
  TCP    192.168.0.105:53337    202.88.133.129:https   CLOSE_WAIT      InHost
  TCP    192.168.0.105:53338    202.88.133.129:https   CLOSE_WAIT      InHost
  TCP    192.168.0.105:53339    117.18.237.29:http     CLOSE_WAIT      InHost
  TCP    192.168.0.105:57531    52.98.42.226:https     ESTABLISHED     InHost
```

```
C:\Users\shubh>netstat -n

Active Connections

  Proto  Local Address          Foreign Address        State
  TCP    127.0.0.1:9012         127.0.0.1:53152        ESTABLISHED
  TCP    127.0.0.1:9487         127.0.0.1:53148        ESTABLISHED
  TCP    127.0.0.1:53148        127.0.0.1:9487         ESTABLISHED
  TCP    127.0.0.1:53152        127.0.0.1:9012         ESTABLISHED
  TCP    192.168.0.105:49816    40.100.140.18:443      ESTABLISHED
  TCP    192.168.0.105:51422    54.191.221.88:443      ESTABLISHED
  TCP    192.168.0.105:51427    54.244.7.118:443       ESTABLISHED
  TCP    192.168.0.105:51430    54.191.221.88:443      ESTABLISHED
  TCP    192.168.0.105:51459    52.11.231.199:443      ESTABLISHED
  TCP    192.168.0.105:51561    52.139.250.253:443     ESTABLISHED
  TCP    192.168.0.105:51575    172.217.194.188:443    ESTABLISHED
  TCP    192.168.0.105:51576    192.168.0.106:8008     ESTABLISHED
  TCP    192.168.0.105:51577    172.217.194.188:5228   ESTABLISHED
  TCP    192.168.0.105:51578    192.168.0.106:8009     ESTABLISHED
  TCP    192.168.0.105:51589    74.125.24.189:443      ESTABLISHED
  TCP    192.168.0.105:51634    172.217.165.131:80     ESTABLISHED
  TCP    192.168.0.105:51635    172.217.165.131:80     ESTABLISHED
  TCP    192.168.0.105:51636    172.217.165.131:80     ESTABLISHED
  TCP    192.168.0.105:53333    202.88.133.129:443     CLOSE_WAIT
  TCP    192.168.0.105:53334    202.88.133.129:443     CLOSE_WAIT
  TCP    192.168.0.105:53335    202.88.133.129:443     CLOSE_WAIT
  TCP    192.168.0.105:53336    202.88.133.129:443     CLOSE_WAIT
  TCP    192.168.0.105:53337    202.88.133.129:443     CLOSE_WAIT
  TCP    192.168.0.105:53338    202.88.133.129:443     CLOSE_WAIT
  TCP    192.168.0.105:53339    117.18.237.29:80       CLOSE_WAIT
  TCP    192.168.0.105:57531    52.98.42.226:443       ESTABLISHED
```

telnet — Telnet is an old program for remote login. It's not used so much for that any more, since it has no security features. But basically, all it does is open a connection to a server and allow server and client to send lines of plain text to each other. It can be used to check that it's possible to connect to a server and, if the server communicates in plain text, even to interact with the server by hand. Since the Web uses a plain text protocol, you can use telnet to connect to a web client and play the part of the web browser. I will suggest that you to do this with your own web server when you write it, but you might want to try it now. When you use telnet in this way, you need to specify both the host and the port number to which you want to connect: telent <host> <port>. For example, to connect to the web server on www.spit.ac.in: telnet spit.ac.in 80

traceroute — Traceroute is discussed in man utility. The command traceroute <host> will show routers encountered by packets on their way from your computer to a specified <host>. For each n = 1, 2, 3,..., traceroute sends a packet with "time-to-live" (ttl) equal to n. Every time a router forwards a packet, it decreases the ttl of the packet by one. If the ttl drops to zero, the router discards the packet and sends an error message back to the sender of the packet. (Again, as with ping, the packets might be blocked or might not even be sent, so that the error messages will never be received.) The sender gets the identity of the router from the source of the error message. Traceroute will send packets until n reaches some set upper bound or until a packet actually gets through to the destination. It actually does this three times for each n. In this way, it identifies routers that are one step, two steps, three steps, ...

away from the source computer. A packet for which no response is received is indicated in the output as a *.

Traceroute is installed on the computers. If was not installed in your virtual server last week, but you can install it with the command sudo apt-get install traceroute

The path taken through a network, can be measured using traceroute. The syntax for the command in Linux is:

```
traceroute <hostname>
```

The syntax in Windows is:

```
tracert <hostname>
```

You can specify either a hostname (e.g., cs.iitb.ac.in) or an IP address (e.g., 128.105.2.6).

Ref - [3]

1.2.1 Experiments with Traceroute

From **your machine** traceroute to the following hosts:

1. ee.iitb.ac.in
2. mscs.mu.edu
3. www.cs.grinnell.edu
4. csail.mit.edu
5. cs.stanford.edu
6. cs.manchester.ac.uk

Store the output of each traceroute command in a separate file
named traceroute_HOSTNAME.log, replacing HOSTNAME with the hostname for end-host you pinged
(e.g., traceroute_ee.iitb.ac.in.log).

```
C:\Users\shubh>tracert www.iitb.ac.in

Tracing route to www.iitb.ac.in [103.21.127.114]
over a maximum of 30 hops:

  1     2 ms     1 ms     1 ms  192.168.0.1
  2    25 ms    77 ms    11 ms  10.140.0.1
  3    22 ms   113 ms   101 ms  192.168.3.65
  4   204 ms    64 ms   233 ms  203.212.193.34
  5   185 ms    70 ms    12 ms  202.88.130.237
  6   137 ms    16 ms   174 ms  136.232.27.245.static.jio.com [136.232.27.245]
  7    28 ms   102 ms   101 ms  115.110.206.73.static-Mumbai.vsnl.net.in [115.110.206.73]
  8     *        *        *     Request timed out.
  9     *        *        *     Request timed out.
 10    22 ms    17 ms   129 ms  115.110.234.170.static.Mumbai.vsnl.net.in [115.110.234.170]
 11     *        *        *     Request timed out.
 12     *        *        *     Request timed out.
 13     *        *        *     Request timed out.
 14     *        *        *     Request timed out.
 15     *        *        *     Request timed out.
 16     *        *        *     Request timed out.
 17     *        *        *     Request timed out.
 18     *        *        *     Request timed out.
 19     *        *        *     Request timed out.
 20     *        *        *     Request timed out.
 21     *        *        *     Request timed out.
 22     *        *        *     Request timed out.
 23     *        *        *     Request timed out.
 24     *        *        *     Request timed out.
 25     *        *        *     Request timed out.
 26     *        *        *     Request timed out.
 27     *        *        *     Request timed out.
 28     *        *        *     Request timed out.
 29     *        *        *     Request timed out.
 30     *        *        *     Request timed out.

Trace complete.
```

```
C:\Users\shubh>tracert mscs.mu.edu

Tracing route to mscs.mu.edu [134.48.4.5]
over a maximum of 30 hops:

  1     1 ms     2 ms     2 ms  192.168.0.1
  2    15 ms    22 ms    16 ms  10.140.0.1
  3    80 ms   394 ms   205 ms  192.168.3.65
  4   163 ms    59 ms    50 ms  203.212.193.34
  5    74 ms   111 ms    51 ms  202.88.130.237
  6   109 ms   100 ms   103 ms  136.232.27.245.static.jio.com [136.232.27.245]
  7    21 ms    88 ms   109 ms  49.45.4.253
  8   133 ms   199 ms   194 ms  103.198.140.29
  9   268 ms   202 ms   123 ms  103.198.140.29
 10   216 ms   205 ms   203 ms  hurricane-electric.telecity2.nl-ix.net [193.239.116.14]
 11   317 ms   204 ms   202 ms  100ge8-1.core1.lon3.he.net [184.104.193.193]
 12   176 ms   323 ms   203 ms  100ge14-1.core1.lon2.he.net [184.105.64.237]
 13   320 ms   510 ms   220 ms  100ge13-2.core1.nyc4.he.net [72.52.92.166]
 14   253 ms   247 ms   310 ms  100ge9-1.core2.chi1.he.net [184.105.223.161]
 15     *        *        *     Request timed out.
 16   343 ms   297 ms   406 ms  r-222wwash-isp-ae6-3926.wiscnet.net [140.189.8.126]
 17   370 ms   304 ms   410 ms  r-milwaukeeci-809-isp-ae3-0.wiscnet.net [140.189.8.230]
 18   379 ms   305 ms   388 ms  MarquetteUniv.site.wiscnet.net [216.56.1.202]
 19   303 ms   396 ms   305 ms  134.48.10.26
 20     *        *        *     Request timed out.
 21     *        *        *     Request timed out.
 22     *        *        *     Request timed out.
 23     *        *        *     Request timed out.
 24     *        *        *     Request timed out.
 25     *        *        *     Request timed out.
 26     *        *        *     Request timed out.
 27     *        *        *     Request timed out.
 28     *        *        *     Request timed out.
 29     *        *        *     Request timed out.
 30     *        *        *     Request timed out.

Trace complete.
```

```
C:\Users\shubh>tracert www.cs.grinnell.edu

Tracing route to www.cs.grinnell.edu [132.161.132.159]
over a maximum of 30 hops:

  1     1 ms     1 ms     1 ms  192.168.0.1
  2    96 ms     9 ms    92 ms  10.140.0.1
  3    21 ms    14 ms   225 ms  192.168.3.65
  4    27 ms    18 ms    10 ms  203.212.193.34
  5    20 ms   118 ms   103 ms  202.88.130.237
  6   113 ms    13 ms    52 ms  136.232.27.245.static.jio.com [136.232.27.245]
  7    31 ms    47 ms   220 ms  49.45.4.253
  8   232 ms   121 ms   179 ms  103.198.140.54
  9   322 ms   306 ms   309 ms  103.198.140.54
 10   209 ms   204 ms   204 ms  hurricane-electric.telecity2.nl-ix.net [193.239.116.14]
 11   220 ms   203 ms   203 ms  100ge8-1.core1.lon3.he.net [184.104.193.193]
 12   167 ms   356 ms   199 ms  100ge14-1.core1.lon2.he.net [184.105.64.237]
 13   309 ms   309 ms   270 ms  100ge13-2.core1.nyc4.he.net [72.52.92.166]
 14   277 ms   235 ms   277 ms  100ge2-1.core2.chi1.he.net [184.104.193.173]
 15   379 ms   301 ms   302 ms  100ge14-2.core1.msp1.he.net [184.105.223.178]
 16     *      338 ms   303 ms  216.66.77.218
 17   306 ms   307 ms   303 ms  peer-as5056.br02.msp1.tfbnw.net [157.240.76.37]
 18   415 ms   316 ms   405 ms  167.142.58.40
 19   292 ms   262 ms   255 ms  67.224.64.62
 20   377 ms   310 ms   307 ms  grinnellcollege1.desm.netins.net [167.142.65.43]
 21     *        *        *     Request timed out.
 22     *        *        *     Request timed out.
 23     *        *        *     Request timed out.
 24     *        *        *     Request timed out.
 25     *        *        *     Request timed out.
 26     *        *        *     Request timed out.
 27     *        *        *     Request timed out.
 28     *        *        *     Request timed out.
 29     *        *        *     Request timed out.
 30     *        *        *     Request timed out.

Trace complete.
```

```
C:\Users\shubh>tracert csail.mit.edu

Tracing route to csail.mit.edu [128.30.2.109]
over a maximum of 30 hops:

  1     2 ms     1 ms     1 ms  192.168.0.1
  2   136 ms    95 ms   203 ms  10.140.0.1
  3    16 ms   110 ms    83 ms  192.168.3.65
  4    23 ms    62 ms   186 ms  203.212.193.34
  5   208 ms    18 ms   398 ms  202.88.130.237
  6    30 ms    11 ms   129 ms  136.232.27.245.static.jio.com [136.232.27.245]
  7     *        *        *     Request timed out.
  8     *        *        *     Request timed out.
  9     *        *        *     Request timed out.
 10     *        *        *     Request timed out.
 11   276 ms   248 ms   260 ms  103.198.140.89
 12   332 ms   307 ms   407 ms  4.7.26.61
 13     *        *      361 ms  ae-2-3.bear1.Boston1.Level3.net [4.69.159.249]
 14   478 ms   407 ms   307 ms  MASSACHUSET.bear1.Boston1.Level3.net [4.53.48.98]
 15   463 ms   408 ms   409 ms  dmz-rtr-1-external-rtr-1.mit.edu [18.0.161.17]
 16   385 ms   409 ms   325 ms  dmz-rtr-2-dmz-rtr-1-2.mit.edu [18.0.162.6]
 17   499 ms   512 ms   326 ms  mitnet.core-1-ext.csail.mit.edu [18.4.7.65]
 18     *        *        *     Request timed out.
 19   382 ms   399 ms   409 ms  bdr.core-1.csail.mit.edu [128.30.0.246]
 20   403 ms   404 ms   411 ms  inquir-3ld.csail.mit.edu [128.30.2.109]

Trace complete.
```

```
C:\Users\shubh>tracert cs.stanford.edu

Tracing route to cs.stanford.edu [171.64.64.64]
over a maximum of 30 hops:

  1     1 ms     1 ms     1 ms  192.168.0.1
  2   191 ms    10 ms   174 ms  10.140.0.1
  3   348 ms    16 ms    41 ms  192.168.3.65
  4    27 ms    18 ms    12 ms  203.212.193.34
  5    16 ms   101 ms    16 ms  202.88.130.237
  6    16 ms    84 ms    98 ms  136.232.27.245.static.jio.com [136.232.27.245]
  7    16 ms   106 ms   100 ms  103.198.140.58
  8   141 ms   245 ms   148 ms  103.198.140.27
  9   226 ms   202 ms   206 ms  103.198.140.27
 10   216 ms   212 ms   193 ms  hurricane.mrs.franceix.net [37.49.232.13]
 11   203 ms   203 ms   204 ms  100ge4-2.core1.par2.he.net [184.105.222.21]
 12   215 ms   588 ms   432 ms  100ge10-2.core1.ash1.he.net [184.105.213.173]
 13   299 ms     *        *     100ge7-2.core1.pao1.he.net [184.105.222.41]
 14   314 ms   407 ms   511 ms  stanford-university.100gigabitethernet5-1.core1.pao1.he.net [184.105.177.238]
 15   281 ms   285 ms   317 ms  csee-west-rtr-vl3.SUNet [171.66.255.140]
 16   302 ms   408 ms   305 ms  CS.stanford.edu [171.64.64.64]

Trace complete.
```

```
C:\Users\shubh>tracert cs.manchester.ac.uk

Tracing route to cs.manchester.ac.uk [130.88.101.49]
over a maximum of 30 hops:

  1     1 ms    11 ms     2 ms  192.168.0.1
  2   565 ms    12 ms    11 ms  10.140.0.1
  3   114 ms   100 ms   102 ms  192.168.3.65
  4    30 ms   116 ms    12 ms  203.212.193.34
  5   165 ms    10 ms    10 ms  202.88.130.237
  6   104 ms   100 ms    65 ms  136.232.27.245.static.jio.com [136.232.27.245]
  7    19 ms    20 ms    11 ms  49.45.4.253
  8   198 ms   234 ms   205 ms  103.198.140.45
  9   158 ms   182 ms   203 ms  103.198.140.54
 10   295 ms   290 ms   198 ms  103.198.140.45
 11   145 ms   144 ms   183 ms  hu0-4-0-1.agr21.lhr01.atlas.cogentco.com [149.14.196.81]
 12   184 ms   203 ms   164 ms  be3671.ccr51.lhr01.atlas.cogentco.com [130.117.48.137]
 13   267 ms   201 ms   202 ms  be3487.ccr41.lon13.atlas.cogentco.com [154.54.60.5]
 14   150 ms   159 ms   144 ms  be2870.ccr22.lon01.atlas.cogentco.com [154.54.58.174]
 15   234 ms   309 ms   203 ms  ldn-b1-link.telia.net [62.115.185.38]
 16   197 ms   202 ms   204 ms  ldn-bb4-link.telia.net [62.115.122.180]
 17     *      209 ms   202 ms  ldn-b2-link.telia.net [62.115.120.239]
 18   250 ms   241 ms   205 ms  jisc-ic-345131-ldn-b4.c.telia.net [62.115.175.131]
 19   152 ms   195 ms   204 ms  ae24.londhx-sbr1.ja.net [146.97.35.197]
 20   359 ms   269 ms   243 ms  ae29.londpg-sbr2.ja.net [146.97.33.2]
 21   219 ms   306 ms   207 ms  ae31.erdiss-sbr2.ja.net [146.97.33.22]
 22   272 ms   410 ms   303 ms  ae29.manckh-sbr2.ja.net [146.97.33.42]
 23   390 ms   408 ms   515 ms  ae23.mancrh-rbr1.ja.net [146.97.38.42]
 24     *      317 ms     *     universityofmanchester.ja.net [146.97.169.2]
 25   335 ms   304 ms   305 ms  130.88.249.194
 26     *        *        *     Request timed out.
 27   241 ms   202 ms   203 ms  gw-jh.its.manchester.ac.uk [130.88.250.32]
 28   321 ms   306 ms   304 ms  eps.its.man.ac.uk [130.88.101.49]

Trace complete.
```

Exercise 2: (Very short.) Use traceroute to trace the route from your computer to math.hws.edu and to www.hws.edu. Explain the difference in the results.

```
C:\Users\shubh>tracert math.hws.edu

Tracing route to math.hws.edu [64.89.144.237]
over a maximum of 30 hops:

  1   112 ms     3 ms     3 ms  192.168.0.1
  2    85 ms   101 ms    79 ms  10.140.0.1
  3    28 ms   171 ms   101 ms  192.168.3.65
  4    20 ms    13 ms    14 ms  203.212.193.34
  5    38 ms    36 ms   167 ms  202.88.130.237
  6    23 ms   130 ms    98 ms  136.232.27.245.static.jio.com [136.232.27.245]
  7    13 ms    41 ms    17 ms  49.45.4.253
  8   145 ms   145 ms   136 ms  103.198.140.45
  9   273 ms   223 ms   183 ms  103.198.140.54
 10   136 ms   157 ms   134 ms  103.198.140.45
 11   150 ms   130 ms   149 ms  hu0-4-0-1.agr21.lhr01.atlas.cogentco.com [149.14.196.81]
 12   158 ms   140 ms   128 ms  be3671.ccr51.lhr01.atlas.cogentco.com [130.117.48.137]
 13   151 ms   136 ms   151 ms  be3487.ccr41.lon13.atlas.cogentco.com [154.54.60.5]
 14   135 ms   148 ms   147 ms  be2868.ccr21.lon01.atlas.cogentco.com [154.54.57.154]
 15     *        *        *     Request timed out.
 16   297 ms   308 ms   295 ms  ae-225-3601.edge3.London15.Level3.net [4.69.167.90]
 17   223 ms   247 ms   328 ms  ae-225-3601.edge3.London15.Level3.net [4.69.167.90]
 18   219 ms   222 ms   221 ms  ae4.ar8.lon15.Level3.net [4.68.111.254]
 19   333 ms   610 ms   311 ms  roc1-ar5-xe-11-0-0-0.us.twtelecom.net [35.248.1.162]
 20   331 ms   301 ms   305 ms  66-195-65-170.static.ctl.one [66.195.65.170]
 21   311 ms   305 ms   305 ms  nat.hws.edu [64.89.144.100]
 22     *        *        *     Request timed out.
 23     *        *        *     Request timed out.
 24     *        *        *     Request timed out.
 25     *        *        *     Request timed out.
 26     *        *        *     Request timed out.
 27     *        *        *     Request timed out.
 28     *        *        *     Request timed out.
 29     *        *        *     Request timed out.
 30     *        *        *     Request timed out.

Trace complete.
```

```
C:\Users\shubh>tracert www.hws.edu

Tracing route to www.hws.edu [64.89.145.159]
over a maximum of 30 hops:

  1     2 ms     2 ms     1 ms  192.168.0.1
  2    19 ms    10 ms   111 ms  10.140.0.1
  3    21 ms    57 ms   138 ms  192.168.3.65
  4   136 ms    20 ms    38 ms  203.212.193.34
  5   318 ms   135 ms    25 ms  202.88.130.237
  6    26 ms   252 ms    12 ms  136.232.27.245.static.jio.com [136.232.27.245]
  7   149 ms   202 ms   202 ms  103.198.140.58
  8   138 ms   157 ms   140 ms  103.198.140.45
  9   178 ms   186 ms   157 ms  103.198.140.27
 10   146 ms   138 ms   146 ms  103.198.140.107
 11   267 ms   306 ms   203 ms  103.198.140.45
 12   161 ms   183 ms   200 ms  hu0-4-0-1.agr21.lhr01.atlas.cogentco.com [149.14.196.81]
 13   214 ms   204 ms   202 ms  be3672.ccr52.lhr01.atlas.cogentco.com [130.117.48.145]
 14   156 ms   141 ms   158 ms  be3488.ccr42.lon13.atlas.cogentco.com [154.54.60.13]
 15   151 ms   148 ms   162 ms  be2869.ccr22.lon01.atlas.cogentco.com [154.54.57.162]
 16   377 ms   300 ms   314 ms  ae-7.edge7.London1.Level3.net [4.68.62.41]
 17   559 ms   308 ms   512 ms  ae-227-3603.edge3.London15.Level3.net [4.69.167.98]
 18   290 ms   303 ms   351 ms  ae-227-3603.edge3.London15.Level3.net [4.69.167.98]
 19   230 ms   261 ms   262 ms  ae4.ar8.lon15.Level3.net [4.68.111.254]
 20   283 ms   296 ms   283 ms  roc1-ar5-xe-11-0-0-0.us.twtelecom.net [35.248.1.162]
 21   286 ms   286 ms   280 ms  66-195-65-170.static.ctl.one [66.195.65.170]
 22   287 ms   288 ms   283 ms  nat.hws.edu [64.89.144.100]
 23     *        *        *     Request timed out.
 24     *        *        *     Request timed out.
 25     *        *        *     Request timed out.
 26     *        *        *     Request timed out.
 27     *        *        *     Request timed out.
 28     *        *        *     Request timed out.
 29     *        *        *     Request timed out.
 30     *        *        *     Request timed out.

Trace complete.
```

Results:
When we connect to another computer, traffic does not go directly to the machine we are attempting to connect to. Instead it goes through multiple machines on the Internet known as routers. These machines serve the sole purpose of controlling how your traffic gets to your destination. If any one connection fails, we will not be able to connect to the intended destination. Hence it is used for diagnostics. Each hop displays the time taken for each hop during its route to the destination. If a hop comes back with request timed out it denotes network congestion.
From the above results, we can see that the source i.e. the first 6 hops are the same and some variations in the round trip time can be observed.

Exercise 3: Two packets sent from the same source to the same destination do not necessarily follow the same path through the net. Experiment with some sources that are fairly far away. Can you find cases where packets sent to the same destination follow different paths? How likely does it seem to be? What about when the packets are sent at very different times? Save some of the outputs from traceroute. (You can copy them from the Terminal window by highlighting and right-clicking, then paste into a text editor.) Come back sometime next week, try the same destinations again, and compare the results with the results from today. Report your observations.

Observations on 20/08/2020

```
C:\Users\shubh>tracert cs.manchester.ac.uk

Tracing route to cs.manchester.ac.uk [130.88.101.49]
over a maximum of 30 hops:

  1   250 ms     2 ms     1 ms  192.168.0.1
  2     8 ms    93 ms   104 ms  10.140.0.1
  3    15 ms    10 ms   195 ms  192.168.3.65
  4    12 ms    11 ms    14 ms  203.212.193.34
  5    25 ms   100 ms   102 ms  202.88.130.237
  6    14 ms    95 ms    11 ms  136.232.27.245.static.jio.com [136.232.27.245]
  7    20 ms   402 ms   202 ms  49.45.4.253
  8   209 ms   209 ms   196 ms  103.198.140.45
  9   192 ms   172 ms   139 ms  103.198.140.54
 10   238 ms   205 ms   200 ms  103.198.140.45
 11   203 ms   204 ms   204 ms  hu0-4-0-1.agr21.lhr01.atlas.cogentco.com [149.14.196.81]
 12   218 ms   384 ms   432 ms  be3671.ccr51.lhr01.atlas.cogentco.com [130.117.48.137]
 13   153 ms   292 ms   198 ms  be3487.ccr41.lon13.atlas.cogentco.com [154.54.60.5]
 14   212 ms   206 ms   198 ms  be2870.ccr22.lon01.atlas.cogentco.com [154.54.58.174]
 15   215 ms   207 ms   198 ms  ldn-b1-link.telia.net [62.115.185.38]
 16   207 ms     *      282 ms  ldn-bb4-link.telia.net [62.115.122.180]
 17   288 ms     *      231 ms  ldn-b2-link.telia.net [62.115.120.239]
 18   133 ms   141 ms   138 ms  jisc-ic-345131-ldn-b4.c.telia.net [62.115.175.131]
 19   234 ms   207 ms   196 ms  ae24.londhx-sbr1.ja.net [146.97.35.197]
 20     *      138 ms   136 ms  ae29.londpg-sbr2.ja.net [146.97.33.2]
 21   143 ms   146 ms   144 ms  ae31.erdiss-sbr2.ja.net [146.97.33.22]
 22   157 ms   268 ms   199 ms  ae29.manckh-sbr2.ja.net [146.97.33.42]
 23   146 ms   155 ms   145 ms  ae23.mancrh-rbr1.ja.net [146.97.38.42]
 24     *        *      147 ms  universityofmanchester.ja.net [146.97.169.2]
 25   177 ms   238 ms   201 ms  130.88.249.194
 26     *        *        *     Request timed out.
 27   253 ms   204 ms   202 ms  gw-jh.its.manchester.ac.uk [130.88.250.32]
 28   214 ms   145 ms   277 ms  eps.its.man.ac.uk [130.88.101.49]

Trace complete.
```

Observations on 26/08/2020

```
C:\Users\shubh>tracert cs.manchester.ac.uk

Tracing route to cs.manchester.ac.uk [130.88.101.49]
over a maximum of 30 hops:

  1     1 ms    <1 ms    <1 ms  192.168.0.1
  2     8 ms     8 ms    16 ms  10.140.0.1
  3    24 ms    20 ms    11 ms  192.168.3.65
  4    15 ms    11 ms    12 ms  203.212.193.34
  5    12 ms    12 ms    10 ms  202.88.130.237
  6    13 ms    11 ms    11 ms  136.232.27.245.static.jio.com [136.232.27.245]
  7    20 ms    13 ms    16 ms  49.45.4.253
  8   148 ms   144 ms   154 ms  103.198.140.45
  9   135 ms   134 ms   133 ms  103.198.140.54
 10   144 ms   145 ms   144 ms  103.198.140.45
 11   156 ms   142 ms   142 ms  hu0-4-0-1.agr21.lhr01.atlas.cogentco.com [149.14.196.81]
 12   132 ms   133 ms   135 ms  be3671.ccr51.lhr01.atlas.cogentco.com [130.117.48.137]
 13   156 ms   143 ms   150 ms  be3487.ccr41.lon13.atlas.cogentco.com [154.54.60.5]
 14   145 ms   148 ms   145 ms  be2870.ccr22.lon01.atlas.cogentco.com [154.54.58.174]
 15   136 ms   137 ms   266 ms  ldn-b1-link.telia.net [62.115.185.38]
 16   150 ms   158 ms     *     ldn-bb4-link.telia.net [62.115.122.180]
 17   135 ms   135 ms   148 ms  62.115.120.239
 18   135 ms   135 ms   147 ms  jisc-ic-345131-ldn-b4.c.telia.net [62.115.175.131]
 19   141 ms   135 ms   147 ms  ae24.londhx-sbr1.ja.net [146.97.35.197]
 20   135 ms   138 ms   134 ms  ae29.londpg-sbr2.ja.net [146.97.33.2]
 21   137 ms   142 ms   137 ms  ae31.erdiss-sbr2.ja.net [146.97.33.22]
 22   170 ms   146 ms   146 ms  146.97.33.42
 23   144 ms   140 ms   141 ms  ae23.mancrh-rbr1.ja.net [146.97.38.42]
 24     *        *        *     Request timed out.
 25   140 ms   139 ms   138 ms  130.88.249.194
 26     *        *        *     Request timed out.
 27   141 ms   146 ms   141 ms  gw-jh.its.manchester.ac.uk [130.88.250.32]
 28   164 ms   145 ms   146 ms  eps.its.man.ac.uk [130.88.101.49]

Trace complete.
```

Through this we get to know that in spite of the source and destination being the same it is not necessary that the path of the route or the intermediate nodes and their respective RTTs will also be the same.

Questions About Paths

Now look at the results you gathered and answer the following questions about the paths taken by your packets. Store your answers in a file named traceroute.txt.

1. **Is any part of the path common for all hosts you tracerouted?**

   Answer: Yes, the first one which is the source's IP address.

2. **Is there a relationship between the number of nodes that show up in the traceroute and the location of the host? If so, what is this relationship?**

   Answer: No, the number of nodes and the location of the host are not related to each other. It even depends on the physical interface that is being used.

3. **Is there a relationship between the number of nodes that show up in the traceroute and latency of the host** (from your ping results above)? **Does the same relationship hold for all hosts?**

   Answer - There is a direct relationship between the number of nodes and the latency of the host. The amount of latency is largely dependent on how far the visitor is from the server location and how many nodes the signal has to travel through.

Whois — The *whois* command can give detailed information about domain names and IP addresses. If it is not installed on the computers then install it with command sudo apt-get install whois in. *Whois* can tell you what organization owns or is responsible for the name or address and where to contact them. It often includes a list of domain name servers for the organization.

When using *whois* to look up a domain name, use the simple two-part network name, not an individual computer name (for example, *whois spit.ac.in*).

Exercise 4: (Short.) Use *whois* to investigate a well-known web site such as google.com or amazon.com, and write a couple of sentences about what you find out.

Exercise 5: (Should be short.) Because of NAT, the domain name *spit.ac.in* has a different IP address outside of SPIT than it does on campus. Using information in this lab and working on a home computer, find the outside IP address for spit.ac.in. Explain how you did it.

Geolocation — A geolocation service tries to tell, approximately, where a given IP address is located physically. They can't be completely accurate—but they probably get at least the country right most of the time.

This geolocation program is not installed on our computers, but you can access one on the command line using the *curl* command, which can send HTTP requests and display the response. The following command uses *curl* to contact a public web service that will look up an IP address for you: curl ipinfo.io/<IP-address>. For a specific example:

curl ipinfo.io/129.64.99.200

(As you can see, you get back more than just the location.)

Exercise 6: Find a few IP addresses that are connected to the web server on spit.ac.in right now, and determine where those IP addresses are located. (I'm expecting that there will be several; if not, try again in a few minutes or sometime later.) Find one that is far from Geneva, NY. Explain how you did it.

Conclusion:

I learnt that the main difference between Ping and Traceroute is that Ping is a quick and easy utility to tell if the specified server is reachable and how long will it take to send and receive data from the server whereas Traceroute finds the exact route taken to reach the server and time taken by each step (hop).

References:

- https://www.cloudflare.com/learning/cdn/glossary/round-trip-time-rtt/
- https://docs.microsoft.com/en-us/windows-server/administration/windows-commands/netstat
- https://www.inmotionhosting.com/support/website/ssh/read-traceroute/