

Name: Parshwa Shah
UID:-2019230071

CEL 51, DCCN, Monsoon 2020

Lab 2: 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 receive 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 response 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

```
Command Prompt
Microsoft Windows [Version 10.0.19041.450]
(c) 2020 Microsoft Corporation. All rights reserved.

C:\Users\Shah Parshwa Prakash>ping -n 10 -l 64 amazon.in

Pinging amazon.in [52.95.116.115] with 64 bytes of data:
Reply from 52.95.116.115: bytes=64 time=211ms TTL=224
Reply from 52.95.116.115: bytes=64 time=143ms TTL=224
Reply from 52.95.116.115: bytes=64 time=144ms TTL=224
Reply from 52.95.116.115: bytes=64 time=144ms TTL=224
Reply from 52.95.116.115: bytes=64 time=143ms TTL=224
Reply from 52.95.116.115: bytes=64 time=143ms TTL=224
Reply from 52.95.116.115: bytes=64 time=143ms TTL=224
Reply from 52.95.116.115: bytes=64 time=144ms TTL=224
Reply from 52.95.116.115: bytes=64 time=144ms TTL=224
Reply from 52.95.116.115: bytes=64 time=143ms TTL=224

Ping statistics for 52.95.116.115:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 143ms, Maximum = 211ms, Average = 150ms

C:\Users\Shah Parshwa Prakash>ping -n 10 -l 100 amazon.in

Pinging amazon.in [52.95.116.115] with 100 bytes of data:
Reply from 52.95.116.115: bytes=100 time=143ms TTL=224
Reply from 52.95.116.115: bytes=100 time=143ms TTL=224
Reply from 52.95.116.115: bytes=100 time=143ms TTL=224
Reply from 52.95.116.115: bytes=100 time=143ms TTL=224
Reply from 52.95.116.115: bytes=100 time=143ms TTL=224
Reply from 52.95.116.115: bytes=100 time=143ms TTL=224
Reply from 52.95.116.115: bytes=100 time=145ms TTL=224
Reply from 52.95.116.115: bytes=100 time=143ms TTL=224
Reply from 52.95.116.115: bytes=100 time=144ms TTL=224
Reply from 52.95.116.115: bytes=100 time=143ms TTL=224

Ping statistics for 52.95.116.115:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 143ms, Maximum = 145ms, Average = 143ms

C:\Users\Shah Parshwa Prakash>ping -n 10 -l 500 amazon.in

Pinging amazon.in [52.95.116.115] with 500 bytes of data:
```

```
Command Prompt

Pinging amazon.in [52.95.116.115] with 500 bytes of data:
Reply from 52.95.116.115: bytes=500 time=144ms TTL=224
Reply from 52.95.116.115: bytes=500 time=144ms TTL=224
Reply from 52.95.116.115: bytes=500 time=144ms TTL=224
Reply from 52.95.116.115: bytes=500 time=151ms TTL=224
Reply from 52.95.116.115: bytes=500 time=144ms TTL=224
Reply from 52.95.116.115: bytes=500 time=145ms TTL=224
Reply from 52.95.116.115: bytes=500 time=143ms TTL=224
Reply from 52.95.116.115: bytes=500 time=146ms TTL=224
Reply from 52.95.116.115: bytes=500 time=144ms TTL=224
Reply from 52.95.116.115: bytes=500 time=143ms TTL=224

Ping statistics for 52.95.116.115:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 143ms, Maximum = 151ms, Average = 144ms

C:\Users\Shah Parshwa Prakash>ping -n 10 -l 1000 amazon.in

Pinging amazon.in [52.95.116.115] with 1000 bytes of data:
Reply from 52.95.116.115: bytes=1000 time=144ms TTL=224
Reply from 52.95.116.115: bytes=1000 time=146ms TTL=224
Reply from 52.95.116.115: bytes=1000 time=148ms TTL=224
Reply from 52.95.116.115: bytes=1000 time=148ms TTL=224
Reply from 52.95.116.115: bytes=1000 time=149ms TTL=224
Reply from 52.95.116.115: bytes=1000 time=145ms TTL=224
Reply from 52.95.116.115: bytes=1000 time=144ms TTL=224
Reply from 52.95.116.115: bytes=1000 time=147ms TTL=224
Reply from 52.95.116.115: bytes=1000 time=144ms TTL=224
Reply from 52.95.116.115: bytes=1000 time=144ms TTL=224

Ping statistics for 52.95.116.115:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 144ms, Maximum = 149ms, Average = 145ms

C:\Users\Shah Parshwa Prakash>ping -n 10 -l 1400 amazon.in

Pinging amazon.in [52.95.116.115] with 1400 bytes of data:
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=153ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=144ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=147ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=148ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=147ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224
```

```
Command Prompt

C:\Users\Shah Parshwa Prakash>ping -n 10 -l 1400 amazon.in

Pinging amazon.in [52.95.116.115] with 1400 bytes of data:
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=153ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=144ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=147ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=148ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=147ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224

Ping statistics for 52.95.116.115:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 144ms, Maximum = 153ms, Average = 146ms

C:\Users\Shah Parshwa Prakash>
```

```
Command Prompt

Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 144ms, Maximum = 149ms, Average = 145ms

C:\Users\Shah Parshwa Prakash>ping -n 10 -l 1400 amazon.in

Pinging amazon.in [52.95.116.115] with 1400 bytes of data:
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=153ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=144ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=147ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=148ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=147ms TTL=224
Reply from 52.95.116.115: bytes=1400 time=145ms TTL=224

Ping statistics for 52.95.116.115:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 144ms, Maximum = 153ms, Average = 146ms

C:\Users\Shah Parshwa Prakash>ping -n 10 -l 1400 google.com

Pinging google.com [216.58.203.142] with 1400 bytes of data:
Reply from 216.58.203.142: bytes=68 (sent 1400) time=527ms TTL=118
Reply from 216.58.203.142: bytes=68 (sent 1400) time=3ms TTL=118
Reply from 216.58.203.142: bytes=68 (sent 1400) time=5ms TTL=118
Reply from 216.58.203.142: bytes=68 (sent 1400) time=2ms TTL=118
Reply from 216.58.203.142: bytes=68 (sent 1400) time=3ms TTL=118
Reply from 216.58.203.142: bytes=68 (sent 1400) time=12ms TTL=118
Reply from 216.58.203.142: bytes=68 (sent 1400) time=3ms TTL=118
Reply from 216.58.203.142: bytes=68 (sent 1400) time=7ms TTL=118
Reply from 216.58.203.142: bytes=68 (sent 1400) time=4ms TTL=118
Reply from 216.58.203.142: bytes=68 (sent 1400) time=2ms TTL=118

Ping statistics for 216.58.203.142:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 527ms, Average = 56ms

C:\Users\Shah Parshwa Prakash>
```

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?

Yes, RTT varies between different hosts. The factors which affect this are:

- Distance – The length a signal has to travel correlates with the time taken for a request to reach a server and a response to reach a browser.
- Transmission medium – The medium used to route a signal (e.g., copper wire, fiber optic cables) can impact how quickly a request is received by a server and routed back to a user.
- Number of network hops – Intermediate routers or servers take time to process a signal, increasing RTT. The more hops a signal has to travel through, the higher the RTT.

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

Yes, RTT varies with different packet sizes.

Transmission medium as well as propagation distance affect this because more the size of packets, more time it takes to transmit.

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).

```
Command Prompt
C:\Users\Shah Parshwa Prakash>ping www.uw.edu

Pinging www.washington.edu [128.95.155.198] with 32 bytes of data:
Reply from 128.95.155.198: bytes=32 time=370ms TTL=45
Reply from 128.95.155.198: bytes=32 time=252ms TTL=45
Reply from 128.95.155.198: bytes=32 time=252ms TTL=45
Reply from 128.95.155.198: bytes=32 time=241ms TTL=45

Ping statistics for 128.95.155.198:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 241ms, Maximum = 370ms, Average = 278ms

C:\Users\Shah Parshwa Prakash>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\Shah Parshwa Prakash>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\Shah Parshwa Prakash>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=257ms TTL=32
Reply from 35.163.72.93: bytes=32 time=257ms TTL=32
Reply from 35.163.72.93: bytes=32 time=257ms TTL=32

Ping statistics for 35.163.72.93:
```



```
Command Prompt
Ping statistics for 35.163.72.93:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 257ms, Maximum = 257ms, Average = 257ms

C:\Users\Shah Parshwa Prakash>ping berkeley.edu

Pinging berkeley.edu [35.163.72.93] with 32 bytes of data:
Reply from 35.163.72.93: bytes=32 time=257ms TTL=32
Reply from 35.163.72.93: bytes=32 time=263ms TTL=32
Reply from 35.163.72.93: bytes=32 time=257ms TTL=32
Reply from 35.163.72.93: bytes=32 time=258ms TTL=32

Ping statistics for 35.163.72.93:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 257ms, Maximum = 263ms, Average = 258ms

C:\Users\Shah Parshwa Prakash>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\Shah Parshwa Prakash>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\Shah Parshwa Prakash>ping www.ox.ac.uk

Pinging www.ox.ac.uk [151.101.130.133] with 32 bytes of data:
Reply from 151.101.130.133: bytes=32 time=137ms TTL=60
```

```
Command Prompt
Reply from 151.101.130.133: bytes=32 time=137ms TTL=60
Reply from 151.101.130.133: bytes=32 time=7ms TTL=60
Reply from 151.101.130.133: bytes=32 time=5ms TTL=60
Reply from 151.101.130.133: bytes=32 time=5ms TTL=60

Ping statistics for 151.101.130.133:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 5ms, Maximum = 137ms, Average = 38ms

C:\Users\Shah Parshwa Prakash>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.
Reply from 192.168.1.1: Destination net unreachable.

Ping statistics for 210.152.243.234:
    Packets: Sent = 4, Received = 1, Lost = 3 (75% loss),

C:\Users\Shah Parshwa Prakash>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.

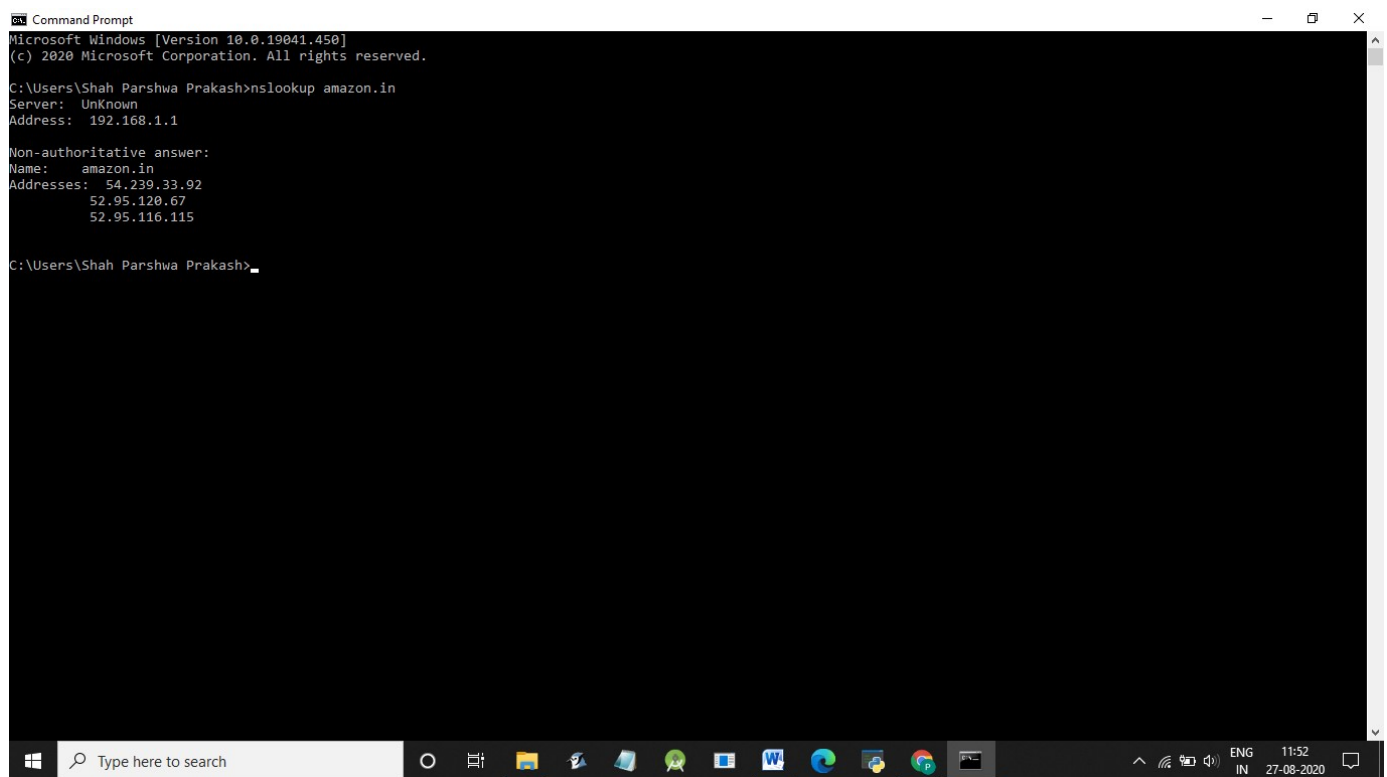
Ping statistics for 210.152.243.234:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\Users\Shah Parshwa Prakash>
```

The distance, a signal has to travel correlates with the time taken for a request to reach a server and a response to reach a browser. One interesting observation is while making ping to u-

tokyo.ac.jp.I got output as 'Destination net unreachable' which means packet has stopped somewhere between the network.

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 `nslookup` by adding the server name or IP address to the command:
`nslookup <host> <server>`



```
Command Prompt
Microsoft Windows [Version 10.0.19041.450]
(c) 2020 Microsoft Corporation. All rights reserved.

C:\Users\Shah Parshwa Prakash>nslookup amazon.in
Server:      Unknown
Address:     192.168.1.1

Non-authoritative answer:
Name:   amazon.in
Addresses:  54.239.33.92
            52.95.120.67
            52.95.116.115

C:\Users\Shah Parshwa Prakash>
```

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)

```
Command Prompt
C:\Users\Shah Parshwa Prakash>netstat
Active Connections
Proto Local Address Foreign Address State
TCP 127.0.0.1:46624 kubernetes:59806 ESTABLISHED
TCP 127.0.0.1:59806 kubernetes:46624 ESTABLISHED
TCP 192.168.1.133:59574 221:https ESTABLISHED
TCP 192.168.1.133:59710 bom05s08-in-f14:https ESTABLISHED
TCP 192.168.1.133:59722 bom07s20-in-f3:https ESTABLISHED
TCP 192.168.1.133:59723 74.125.24.188:https ESTABLISHED
TCP 192.168.1.133:59725 whatsapp-cdn-shv-02-bom1:https ESTABLISHED
TCP 192.168.1.133:59726 bom05s15-in-f2:https ESTABLISHED
TCP 192.168.1.133:59732 13.94.40.40:https ESTABLISHED
TCP 192.168.1.133:59735 40.74.219.49:https ESTABLISHED
TCP 192.168.1.133:59741 bom07s18-in-f14:https ESTABLISHED
TCP 192.168.1.133:59757 40.90.189.152:https ESTABLISHED
TCP 192.168.1.133:59764 bom07s11-in-f22:https ESTABLISHED
TCP 192.168.1.133:59769 bom07s15-in-f3:https ESTABLISHED
TCP 192.168.1.133:59772 161.69.226.26:https ESTABLISHED
TCP 192.168.1.133:59778 customer205:https LAST_ACK
TCP 192.168.1.133:59780 173.194.14.135:https LAST_ACK
TCP 192.168.1.133:59781 a-0001:https ESTABLISHED
TCP 192.168.1.133:59783 204.79.197.222:https ESTABLISHED
TCP 192.168.1.133:59785 40.115.22.134:https LAST_ACK
TCP 192.168.1.133:59788 117.18.237.29:https ESTABLISHED
TCP 192.168.1.133:59789 204.79.197.254:https ESTABLISHED
TCP 192.168.1.133:59790 20.140.56.68:https ESTABLISHED
TCP 192.168.1.133:59791 40.90.22.192:https ESTABLISHED
TCP 192.168.1.133:59792 40.90.22.192:https ESTABLISHED
TCP 192.168.1.133:59793 a23-57-12-70:https CLOSE_WAIT
TCP 192.168.1.133:59795 stackoverflow:https ESTABLISHED
TCP 192.168.1.133:59799 20.150.29.228:https ESTABLISHED
TCP 192.168.1.133:59800 74.125.169.169:https ESTABLISHED
TCP 192.168.1.133:59801 52.114.159.23:https ESTABLISHED
TCP 192.168.1.133:59802 52.114.159.23:https ESTABLISHED
TCP 192.168.1.133:59803 51.138.106.75:https ESTABLISHED
TCP 192.168.1.133:59804 a23-57-13-138:https ESTABLISHED
TCP 192.168.1.133:59805 a23-46-9-99:https ESTABLISHED
TCP 192.168.1.133:59807 server-13-225-84-221:https ESTABLISHED
TCP 192.168.1.133:63265 40.90.189.152:https ESTABLISHED
```

Arp :

Most of the computer programs/applications use logical address (IP address) to send/receive messages, however the actual communication happens over the physical address (MAC address) i.e from layer 2 of OSI model. So our mission is to get the destination MAC address which helps in communicating with other devices. This is where ARP comes into the picture, its functionality is to translate IP address to physical address.

ARP finds the hardware address, also known as Media Access Control (MAC) address, of a host from its known IP address.


```
Command Prompt
Microsoft Windows [Version 10.0.19041.450]
(c) 2020 Microsoft Corporation. All rights reserved.

C:\Users\Shah Parshwa Prakash>arp -a

Interface: 192.168.1.133 --- 0x16
Internet Address      Physical Address      Type
192.168.1.1           50-c7-bf-7c-46-56    dynamic
192.168.1.255         ff-ff-ff-ff-ff-ff    static
224.0.0.2             01-00-5e-00-00-02    static
224.0.0.22            01-00-5e-00-00-16    static
224.0.0.251           01-00-5e-00-00-fb    static
224.0.0.252           01-00-5e-00-00-fc    static
239.255.255.250       01-00-5e-7f-ff-fa    static
255.255.255.255       ff-ff-ff-ff-ff-ff    static

Interface: 172.27.208.1 --- 0x38
Internet Address      Physical Address      Type
172.27.223.255        ff-ff-ff-ff-ff-ff    static
224.0.0.2             01-00-5e-00-00-02    static
224.0.0.22            01-00-5e-00-00-16    static
224.0.0.251           01-00-5e-00-00-fb    static
224.0.0.252           01-00-5e-00-00-fc    static
239.255.255.250       01-00-5e-7f-ff-fa    static

C:\Users\Shah Parshwa Prakash>
```



Type here to search



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: `telnet <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 $n = 1, 2, 3, \dots$, `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`).

1.2.1 EXPERIMENTS WITH TRACEROUTE

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

1. `ee.iitb.ac.in`
2. `mcs.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`).

```
Command Prompt
C:\Users\Shah Parshwa Prakash>tracert -h 10 iitb.ac.in

Tracing route to iitb.ac.in [103.21.127.114]
over a maximum of 10 hops:

 1  1 ms  <1 ms  1 ms  192.168.1.1
 2  2 ms  1 ms  *  customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
 3  *  *  *  Request timed out.
 4  4 ms  3 ms  *  103.27.170.25
 5  7 ms  3 ms  4 ms  aip1-40.65-179-202.ankhnet.net [202.179.65.49]
 6  4 ms  *  3 ms  218.100.48.78
 7  14 ms  4 ms  *  115.110.234.170.static.Mumbai.vsnl.net.in [115.110.234.170]
 8  *  *  *  Request timed out.
 9  *  *  *  Request timed out.
10  *  *  *  Request timed out.

Trace complete.

C:\Users\Shah Parshwa Prakash>tracert -h 10 mscs.mu.edu

Tracing route to mscs.mu.edu [134.48.4.5]
over a maximum of 10 hops:

 1  269 ms  <1 ms  <1 ms  192.168.1.1
 2  2 ms  *  2 ms  customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
 3  *  *  *  Request timed out.
 4  71 ms  5 ms  2 ms  customer50.7stardigitalnetwork.com.140.233.103.in-addr.arpa [103.233.140.50]
 5  70 ms  4 ms  *  182.73.178.125
 6  265 ms  199 ms  199 ms  182.79.222.233
 7  262 ms  198 ms  201 ms  core1.nyc4.he.net [198.32.118.57]
 8  287 ms  221 ms  *  100ge2-1.core2.chi1.he.net [184.104.193.173]
 9  *  *  *  Request timed out.
10  290 ms  226 ms  223 ms  r-222mwash-isp-ae6-3926.wiscnet.net [140.189.8.126]

Trace complete.

C:\Users\Shah Parshwa Prakash>tracert mscs.mu.edu

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

 1  1 ms  <1 ms  <1 ms  192.168.1.1
 2  2 ms  4 ms  *  customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
 3  *  *  *  Request timed out.
```

```
Command Prompt
C:\Users\Shah Parshwa Prakash>tracert mscs.mu.edu

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

 1  1 ms  <1 ms  <1 ms  192.168.1.1
 2  2 ms  4 ms  *  customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
 3  *  *  *  Request timed out.
 4  3 ms  3 ms  *  customer50.7stardigitalnetwork.com.140.233.103.in-addr.arpa [103.233.140.50]
 5  3 ms  3 ms  *  182.73.178.125
 6  201 ms  201 ms  199 ms  182.79.222.233
 7  202 ms  201 ms  201 ms  core1.nyc4.he.net [198.32.118.57]
 8  230 ms  221 ms  *  100ge2-1.core2.chi1.he.net [184.104.193.173]
 9  *  *  *  Request timed out.
10  225 ms  224 ms  230 ms  r-222mwash-isp-ae6-3926.wiscnet.net [140.189.8.126]
11  306 ms  224 ms  224 ms  r-milwaukee1-809-isp-ae3-0.wiscnet.net [140.189.8.230]
12  290 ms  224 ms  224 ms  MarquetteUniv.site.wiscnet.net [216.56.1.202]
13  291 ms  224 ms  224 ms  134.48.10.27
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\Shah Parshwa Prakash>tracert -h 16 www.cs.grinnell.edu

Tracing route to www.cs.grinnell.edu [132.161.132.159]
over a maximum of 16 hops:

 1  1002 ms  2 ms  1 ms  192.168.1.1
```

```
Command Prompt
C:\Users\Shah Parshwa Prakash>tracert -h 16 www.cs.grinnell.edu

Tracing route to www.cs.grinnell.edu [132.161.132.159]
over a maximum of 16 hops:

 1  1002 ms    2 ms    1 ms  192.168.1.1
 2      4 ms    *      2 ms  customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
 3      *      *      *      Request timed out.
 4      3 ms    3 ms    *      customer50.7stardigitalnetwork.com.140.233.103.in-addr.arpa [103.233.140.50]
 5      4 ms    4 ms    *      182.73.178.125
 6  444 ms  205 ms  206 ms  182.79.222.237
 7  205 ms  206 ms  206 ms  core1.nyc4.he.net [198.32.118.57]
 8  463 ms    *      *      100ge9-1.core2.chi1.he.net [184.105.223.161]
 9  475 ms  237 ms  238 ms  100ge14-2.core1.msp1.he.net [184.105.223.178]
10  474 ms  241 ms  240 ms  auron-network-services-inc.e0-26.switch1.msp1.he.net [216.66.77.218]
11      *      475 ms  240 ms  peer-as5056.br02.msp1.tfbnw.net [157.240.76.37]
12  476 ms  240 ms  244 ms  167.142.58.40
13  587 ms  241 ms  239 ms  67.224.64.62
14      *      *      *      Request timed out.
15      *      *      *      Request timed out.
16      *      *      *      Request timed out.

Trace complete.

C:\Users\Shah Parshwa Prakash>tracert csail.mit.edu

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

 1  238 ms    <1 ms    <1 ms  192.168.1.1
 2      2 ms    *      2 ms  customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
 3      *      *      *      Request timed out.
 4      3 ms    *      3 ms  customer50.7stardigitalnetwork.com.140.233.103.in-addr.arpa [103.233.140.50]
 5      4 ms    *      5 ms  182.73.178.125
 6  374 ms  135 ms  138 ms  116.119.35.229
 7  374 ms  126 ms  126 ms  be4728.ccr22.mrs01.atlas.cogentco.com [149.6.154.97]
 8  363 ms  127 ms  128 ms  be3003.ccr42.par01.atlas.cogentco.com [130.117.50.165]
 9  375 ms  134 ms  137 ms  be12489.ccr42.lon13.atlas.cogentco.com [154.54.57.69]
10  443 ms  206 ms    *      be2101.ccr32.bos01.atlas.cogentco.com [154.54.82.38]
11  442 ms  207 ms  207 ms  38.104.186.186
12  451 ms  217 ms  207 ms  dmz-rtr-1-external-rtr-3.mit.edu [18.0.161.13]
13  442 ms  208 ms  205 ms  dmz-rtr-2-dmz-rtr-1-2.mit.edu [18.0.162.6]
14  448 ms  208 ms  208 ms  mitnet.core1-ext.csail.mit.edu [18.4.7.65]
15      *      *      *      Request timed out.

Type here to search
```

```
Command Prompt
15      *      *      *      Request timed out.
16  443 ms  208 ms  208 ms  bdr-core-1.csail.mit.edu [128.30.0.246]
17  211 ms  207 ms  206 ms  inquir-3ld.csail.mit.edu [128.30.2.109]

Trace complete.

C:\Users\Shah Parshwa Prakash>tracert cs.stanford.edu

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

 1  243 ms    1 ms    2 ms  192.168.1.1
 2      2 ms    *      2 ms  customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
 3      *      *      *      Request timed out.
 4      3 ms    *      5 ms  customer50.7stardigitalnetwork.com.140.233.103.in-addr.arpa [103.233.140.50]
 5      4 ms    4 ms    *      182.73.178.125
 6  209 ms  209 ms  208 ms  182.79.222.233
 7  208 ms  208 ms  208 ms  core1.nyc4.he.net [198.32.118.57]
 8  499 ms    *      255 ms  100ge8-1.core1.sjc2.he.net [184.105.81.218]
 9  486 ms  253 ms  252 ms  100ge1-1.core1.pao1.he.net [72.52.92.158]
10  494 ms  259 ms  258 ms  stanford-university.100gigabitethernet5-1.core1.pao1.he.net [184.105.177.238]
11  492 ms  260 ms  254 ms  csee-west-rtr-vl3.SUNet [171.66.255.140]
12  256 ms  256 ms  256 ms  CS.stanford.edu [171.64.64.64]

Trace complete.

C:\Users\Shah Parshwa Prakash>tracert cs.manchester.ac.uk

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

 1  3166 ms    1 ms    1 ms  192.168.1.1
 2      1 ms    *      2 ms  customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
 3      *      *      *      Request timed out.
 4      5 ms    *      3 ms  customer50.7stardigitalnetwork.com.140.233.103.in-addr.arpa [103.233.140.50]
 5      4 ms    8 ms    15 ms  182.73.178.125
 6  372 ms  134 ms  144 ms  182.79.154.0
 7      *      *      *      Request timed out.
 8  378 ms  135 ms  137 ms  jisc-ic-345131-ldn-b4.c.telina.net [62.115.175.131]
 9  372 ms  135 ms  135 ms  ae24.londhx-sbr1.ja.net [146.97.35.197]
10  372 ms  136 ms  134 ms  ae29.londpg-sbr2.ja.net [146.97.33.2]
11  365 ms  141 ms  130 ms  ae31.erdiss-sbr2.ja.net [146.97.33.22]
12  376 ms  139 ms  145 ms  ae29.manckh-sbr2.ja.net [146.97.33.42]
13  378 ms  139 ms  140 ms  ae23.mancrh-rbr1.ja.net [146.97.38.42]

Type here to search
```

```
Command Prompt
over a maximum of 30 hops:
 1  243 ms  1 ms  2 ms  192.168.1.1
 2  2 ms  *  2 ms  customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
 3  *  *  *  Request timed out.
 4  3 ms  *  5 ms  customer50.7stardigitalnetwork.com.140.233.103.in-addr.arpa [103.233.140.50]
 5  4 ms  4 ms  *  182.73.178.125
 6  209 ms  209 ms  208 ms  182.79.222.233
 7  208 ms  208 ms  208 ms  core1.nyc4.he.net [198.32.118.57]
 8  499 ms  *  255 ms  100ge8-1.core1.sjc2.he.net [184.105.81.218]
 9  486 ms  253 ms  252 ms  100ge1-1.core1.pao1.he.net [72.52.92.158]
10  494 ms  259 ms  258 ms  stanford-university.100gigabitethernet5-1.core1.pao1.he.net [184.105.177.238]
11  492 ms  260 ms  254 ms  csee-west-rtr-v13.SUNet [171.66.255.140]
12  256 ms  256 ms  256 ms  CS.stanford.edu [171.64.64.64]

Trace complete.

C:\Users\Shah Parshwa Prakash>tracert cs.manchester.ac.uk

Tracing route to cs.manchester.ac.uk [130.88.101.49]
over a maximum of 30 hops:
 1  3166 ms  1 ms  1 ms  192.168.1.1
 2  1 ms  *  2 ms  customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
 3  *  *  *  Request timed out.
 4  5 ms  *  3 ms  customer50.7stardigitalnetwork.com.140.233.103.in-addr.arpa [103.233.140.50]
 5  4 ms  8 ms  15 ms  182.73.178.125
 6  372 ms  134 ms  144 ms  182.79.154.0
 7  *  *  *  Request timed out.
 8  378 ms  135 ms  137 ms  jisc-ic-345131-ldn-b4.c.telia.net [62.115.175.131]
 9  372 ms  135 ms  135 ms  ae24.londhx-sbr1.ja.net [146.97.35.197]
10  372 ms  136 ms  134 ms  ae29.londpg-sbr2.ja.net [146.97.33.2]
11  365 ms  141 ms  130 ms  ae31.erdiss-sbr2.ja.net [146.97.33.22]
12  376 ms  139 ms  145 ms  ae29.manckh-sbr2.ja.net [146.97.33.42]
13  378 ms  139 ms  140 ms  ae23.manckh-rbr1.ja.net [146.97.38.42]
14  *  *  397 ms  universityofmanchester.ja.net [146.97.169.2]
15  376 ms  142 ms  142 ms  130.88.249.194
16  *  *  *  Request timed out.
17  *  *  *  Request timed out.
18  132 ms  132 ms  132 ms  eps.its.man.ac.uk [130.88.101.49]

Trace complete.

C:\Users\Shah Parshwa Prakash>
```

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.

```
Command Prompt

C:\Users\Shah Parshwa Prakash>tracert math.hws.edu

Tracing route to math.hws.edu [64.89.144.237]
over a maximum of 30 hops:
 1  300 ms  1 ms  1 ms  192.168.1.1
 2  3 ms  *  2 ms  customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
 3  *  *  *  Request timed out.
 4  2 ms  *  3 ms  customer50.7stardigitalnetwork.com.140.233.103.in-addr.arpa [103.233.140.50]
 5  5 ms  *  4 ms  182.73.178.125
 6  294 ms  244 ms  226 ms  182.79.217.217
 7  287 ms  220 ms  220 ms  xe-9-1-0.edge1.LosAngeles6.Level3.net [4.26.0.61]
 8  *  *  *  Request timed out.
 9  *  300 ms  *  GBLX-level3-400G.LosAngeles1.Level3.net [4.68.73.189]
10  317 ms  245 ms  244 ms  roc1-ar5-xe-0-0-0-0.us.twtelecom.net [35.248.1.158]
11  323 ms  251 ms  247 ms  66-195-65-170.static.ct1.one [66.195.65.170]
12  331 ms  250 ms  247 ms  64.89.144.100
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\Shah Parshwa Prakash>tracert www.hws.edu

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



```
Command Prompt
C:\Users\Shah Parshwa Prakash>tracert www.hws.edu

Tracing route to www.hws.edu [64.89.145.159]
over a maximum of 30 hops:
  0  67 ms    1 ms    <1 ms   192.168.1.1
  1  4 ms     4 ms    *      customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
  2  *        *      *      Request timed out.
  3  2 ms     2 ms    *      customer50.7stardigitalnetwork.com.140.233.103.in-addr.arpa [103.233.140.50]
  4  5 ms     4 ms    *      182.73.178.125
  5  *        *      *      Request timed out.
  6  309 ms   236 ms  241 ms  xe-5-1-0.edge1.LosAngeles6.Level3.net [4.26.0.89]
  7  *        *      *      Request timed out.
  8  *        *      237 ms  GBLX-level3-400G.LosAngeles1.Level3.net [4.68.73.189]
  9  255 ms   254 ms  254 ms  roc1-ar5-xe-0-0-0-0.us.twtelecom.net [35.248.1.158]
 10  256 ms   258 ms  256 ms  66-195-65-170.static.ct1.one [66.195.65.170]
 11  255 ms   257 ms  257 ms  64.89.144.100
 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\Shah Parshwa Prakash>
```

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.


```
Command Prompt

over a maximum of 30 hops:
 1  243 ms    1 ms    2 ms  192.168.1.1
 2  2 ms      *      2 ms  customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
 3  *         *      *      Request timed out.
 4  3 ms      *      5 ms  customer50.7stardigitalnetwork.com.140.233.103.in-addr.arpa [103.233.140.50]
 5  4 ms      4 ms    *      182.73.178.125
 6  209 ms    209 ms  208 ms 182.79.222.233
 7  208 ms    208 ms  208 ms core1.nyc4.he.net [198.32.118.57]
 8  499 ms    *      255 ms 100ge8-1.core1.sjc2.he.net [184.105.81.218]
 9  486 ms    253 ms  252 ms 100ge1-1.core1.pao1.he.net [72.52.92.158]
10  494 ms    259 ms  258 ms stanford-university.100gigabitethernet5-1.core1.pao1.he.net [184.105.177.238]
11  492 ms    260 ms  254 ms csee-west-rtr-v13.SUNet [171.66.255.140]
12  256 ms    256 ms  256 ms CS.stanford.edu [171.64.64.64]

Trace complete.

C:\Users\Shah Parshwa Prakash>tracert cs.manchester.ac.uk

Tracing route to cs.manchester.ac.uk [130.88.101.49]
over a maximum of 30 hops:
 1  3166 ms    1 ms    1 ms  192.168.1.1
 2  1 ms      *      2 ms  customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
 3  *         *      *      Request timed out.
 4  5 ms      *      3 ms  customer50.7stardigitalnetwork.com.140.233.103.in-addr.arpa [103.233.140.50]
 5  4 ms      8 ms    15 ms 182.73.178.125
 6  372 ms    134 ms  144 ms 182.79.154.0
 7  *         *      *      Request timed out.
 8  378 ms    135 ms  137 ms jisc-ic-345131-ldn-b4.c.telia.net [62.115.175.131]
 9  372 ms    135 ms  135 ms ae24.londhx-sbr1.ja.net [146.97.35.197]
10  372 ms    136 ms  134 ms ae29.londpg-sbr2.ja.net [146.97.33.2]
11  365 ms    141 ms  130 ms ae31.erdiss-sbr2.ja.net [146.97.33.22]
12  376 ms    139 ms  145 ms ae29.manckh-sbr2.ja.net [146.97.33.42]
13  378 ms    139 ms  140 ms ae23.mancrih-rbr1.ja.net [146.97.38.42]
14  *         *      397 ms universityofmanchester.ja.net [146.97.169.2]
15  376 ms    142 ms  142 ms 130.88.249.194
16  *         *      *      Request timed out.
17  *         *      *      Request timed out.
18  132 ms    132 ms  132 ms eps.its.man.ac.uk [130.88.101.49]

Trace complete.

C:\Users\Shah Parshwa Prakash>
```

```
Command Prompt

C:\Users\Shah Parshwa Prakash>tracert cs.manchester.ac.uk

Tracing route to cs.manchester.ac.uk [130.88.101.49]
over a maximum of 30 hops:
 1  425 ms    <1 ms    <1 ms  192.168.1.1
 2  7 ms      5 ms    11 ms customer52.7stardigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
 3  *         *      *      Request timed out.
 4  9 ms      1 ms    5 ms  customer50.7stardigitalnetwork.com.140.233.103.in-addr.arpa [103.233.140.50]
 5  6 ms      4 ms    3 ms  182.73.178.125
 6  130 ms    128 ms  132 ms 182.79.154.0
 7  181 ms    *      130 ms ldn-b4-link.telia.net [62.115.162.232]
 8  130 ms    130 ms  130 ms jisc-ic-345131-ldn-b4.c.telia.net [62.115.175.131]
 9  130 ms    133 ms  138 ms ae24.londhx-sbr1.ja.net [146.97.35.197]
10  423 ms    281 ms  206 ms ae29.londpg-sbr2.ja.net [146.97.33.2]
11  133 ms    134 ms  134 ms ae31.erdiss-sbr2.ja.net [146.97.33.22]
12  135 ms    135 ms  138 ms ae29.manckh-sbr2.ja.net [146.97.33.42]
13  135 ms    136 ms  138 ms ae23.mancrih-rbr1.ja.net [146.97.38.42]
14  *         *      *      Request timed out.
15  135 ms    135 ms  135 ms 130.88.249.194
16  *         *      *      Request timed out.
17  *         *      *      Request timed out.
18  482 ms    323 ms  277 ms eps.its.man.ac.uk [130.88.101.49]

Trace complete.

C:\Users\Shah Parshwa Prakash>
```

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?

Yes. Upto 5 hops from my machine its same for all hosts.

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?

No significant relationship.

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?

The more the number of nodes, the more is the latency for the packet to travel.

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`. *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.)

```
Command Prompt
C:\Users\Shah Parshwa Prakash>curl ipinfo.io/129.64.99.200
{
  "ip": "129.64.99.200",
  "hostname": "websrv-prod.unet.brandeis.edu",
  "city": "Waltham",
  "region": "Massachusetts",
  "country": "US",
  "loc": "42.3765,-71.2356",
  "org": "AS10561 Brandeis University",
  "postal": "02453",
  "timezone": "America/New_York",
  "readme": "https://ipinfo.io/missingauth"
}
C:\Users\Shah Parshwa Prakash>ping spit.ac.in

Pinging spit.ac.in [43.252.193.19] with 32 bytes of data:
Request timed out.
Request timed out.

Ping statistics for 43.252.193.19:
    Packets: Sent = 2, Received = 0, Lost = 2 (100% loss),
Control-C
^C
C:\Users\Shah Parshwa Prakash>tracert spit.ac.in

Tracing route to spit.ac.in [43.252.193.19]
over a maximum of 30 hops:

  0  1 ms  <1 ms  <1 ms  192.168.1.1
  1  3 ms  2 ms   *    customer52.7standigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
  2  *    *    *    Request timed out.
  3  77 ms  5 ms   *    103.27.170.50
  4  88 ms  4 ms   *    27.109.1.150
  5  81 ms  6 ms   4 ms  103.205.124.82
  6  83 ms  4 ms   5 ms  43.252.192.230
  7  *    *    *    Request timed out.
  8  *    *    *    Request timed out.
  9  *    *    *    Request timed out.
 10  *    *    *    Request timed out.
 11  *    *    *    Request timed out.
 12  *    *    *    Request timed out.
 13  *    *    *    Request timed out.
 14  *    *    *    Request timed out.
 15  *    *    *    Request timed out.
```

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.

```
Command Prompt
Ping statistics for 43.252.193.19:
Packets: Sent = 2, Received = 0, Lost = 2 (100% loss),
Control-C
^C
C:\Users\Shah Parshwa Prakash>tracert spit.ac.in

Tracing route to spit.ac.in [43.252.193.19]
over a maximum of 30 hops:

  1  1 ms  <1 ms  <1 ms  192.168.1.1
  2  3 ms  2 ms   *    customer52.7standigitalnetwork.com.152.134.202.in-addr.arpa [202.134.152.52]
  3  *    *    *    Request timed out.
  4  77 ms  5 ms   *    103.27.170.50
  5  88 ms  4 ms   *    27.109.1.150
  6  81 ms  6 ms   4 ms  103.205.124.82
  7  83 ms  4 ms   5 ms  43.252.192.230
  8  *    *    *    Request timed out.
  9  *    *    *    Request timed out.
 10  *    *    *    Request timed out.
 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\Shah Parshwa Prakash>
```

Conclusion:

Hence, from this experiment I implemented various network commands and also got to know the use of each command.