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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 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>
```

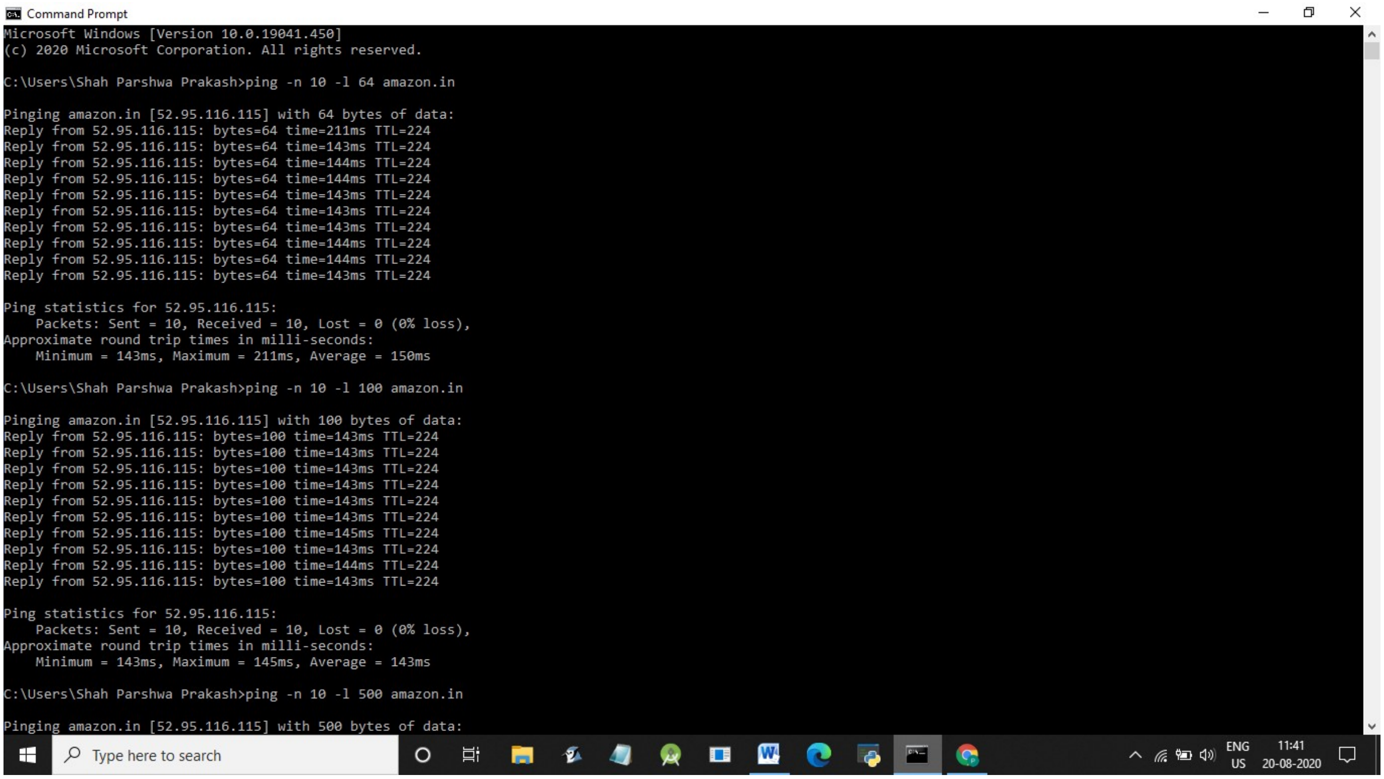
The default number of ICMP packets to send is either infinite (in Linux and Mac OS) or 4 (in Windows). The default packet size is either 64 bytes (in Linux) or 32 bytes (in Windows). You can specify either a hostname (e.g., `spit.ac.in`) or an IP address.

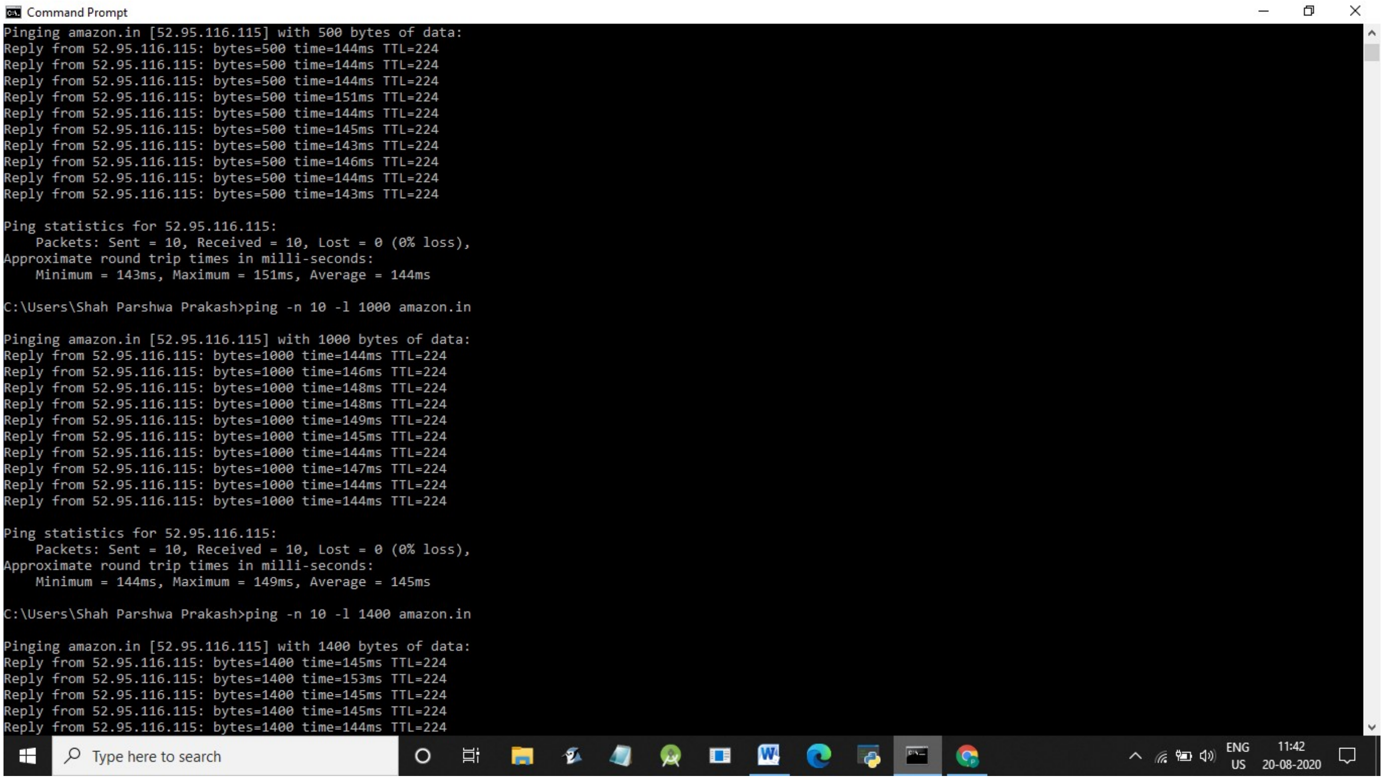
To save the output from `ping` to a file, include a greater than symbol and a file name at the end of the command. For example:

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

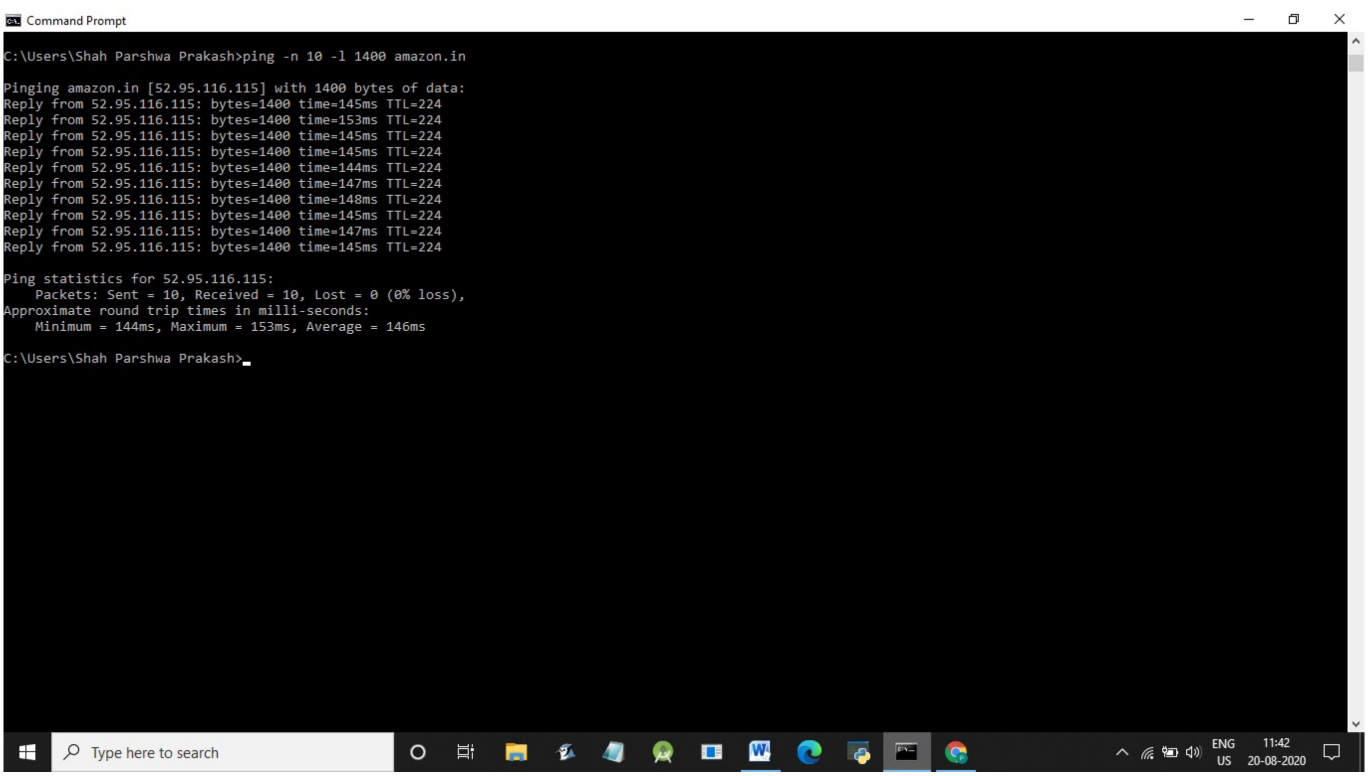
EXPERIMENTS WITH PING

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

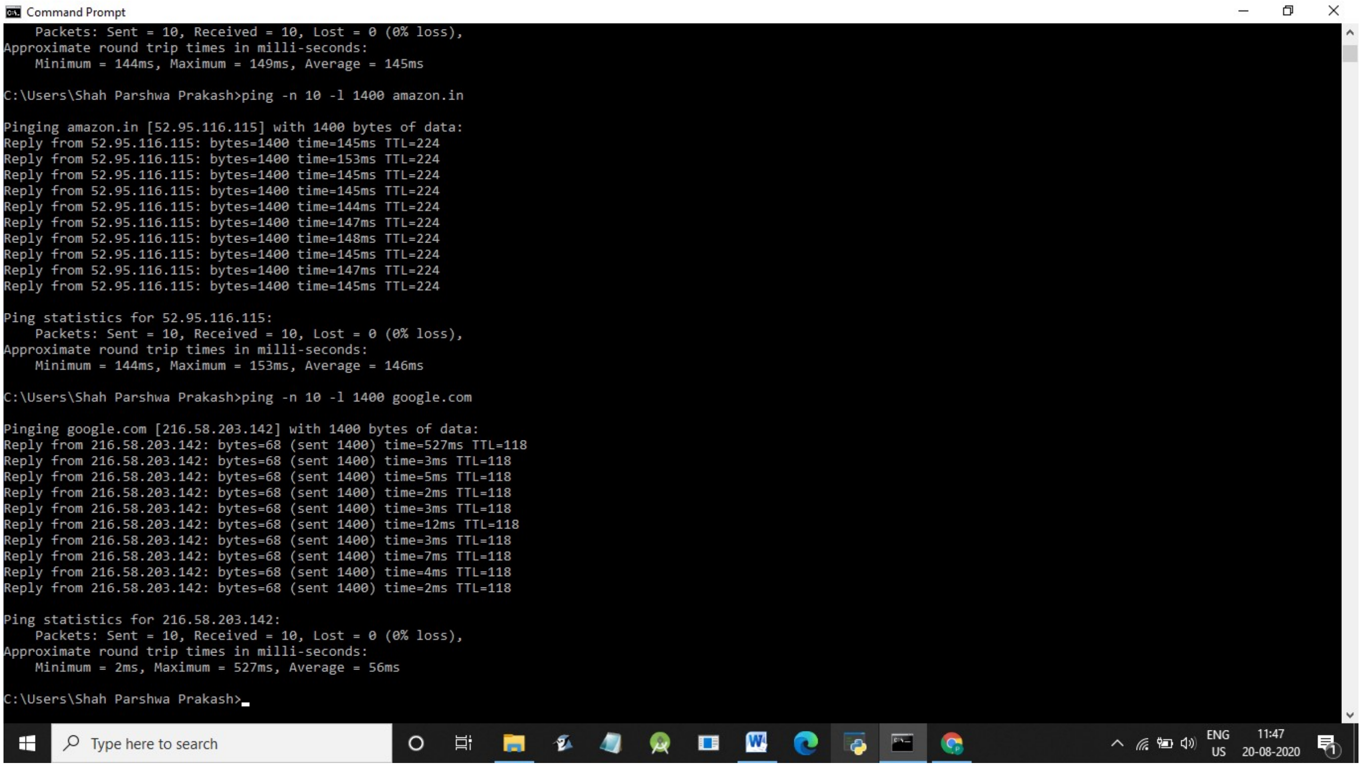




```
Pinging amazon.in [52.95.116.115] with 500 bytes of data:
Reply from 52.95.116.115: bytes=500 time=144ms TTL=224
Reply from 52.95.116.115: bytes=500 time=144ms TTL=224
Reply from 52.95.116.115: bytes=500 time=144ms TTL=224
Reply from 52.95.116.115: bytes=500 time=151ms TTL=224
Reply from 52.95.116.115: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

```
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>
```



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:

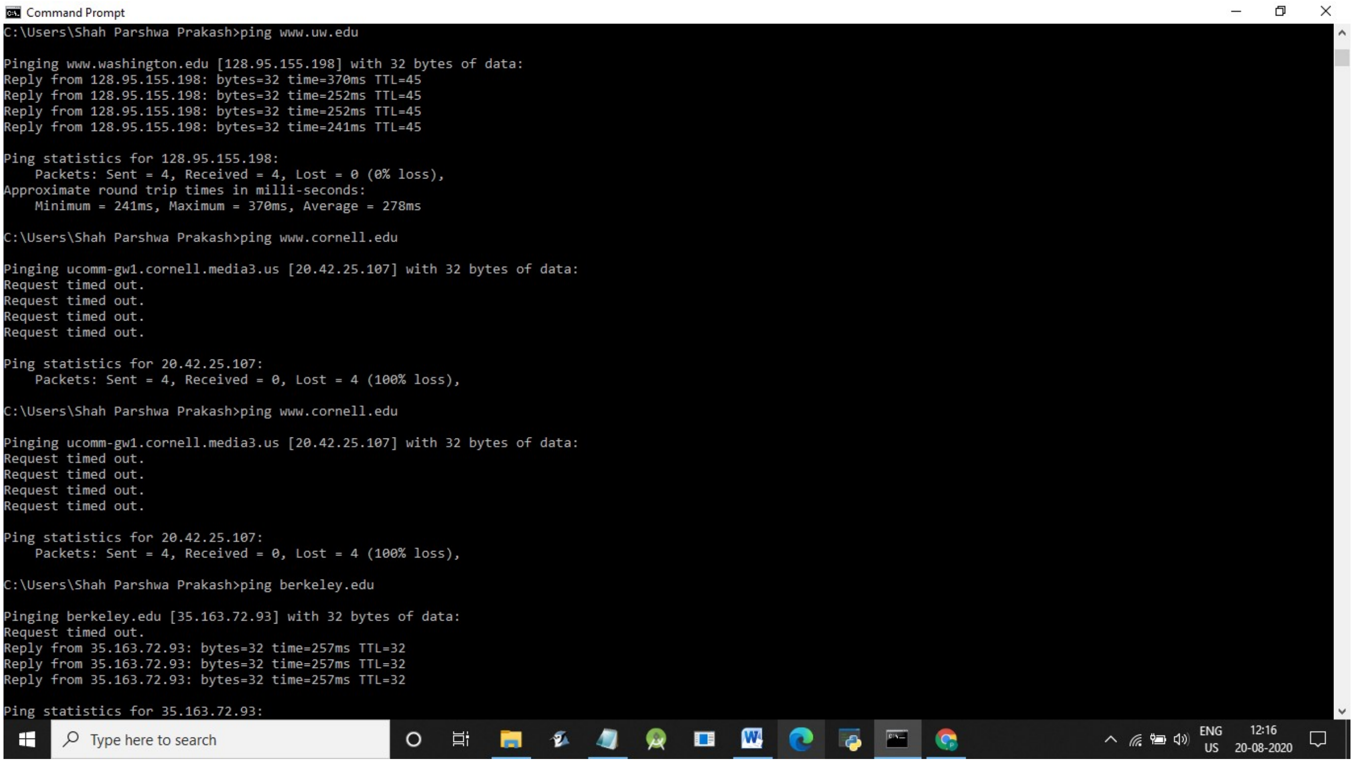
- Distance – The length a signal has to travel correlates with the time taken for a request to reach a server and a response to reach a browser.
- Transmission medium – The medium used to route a signal (e.g., copper wire, fiber optic cables) can impact how quickly a request is received by a server and 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.

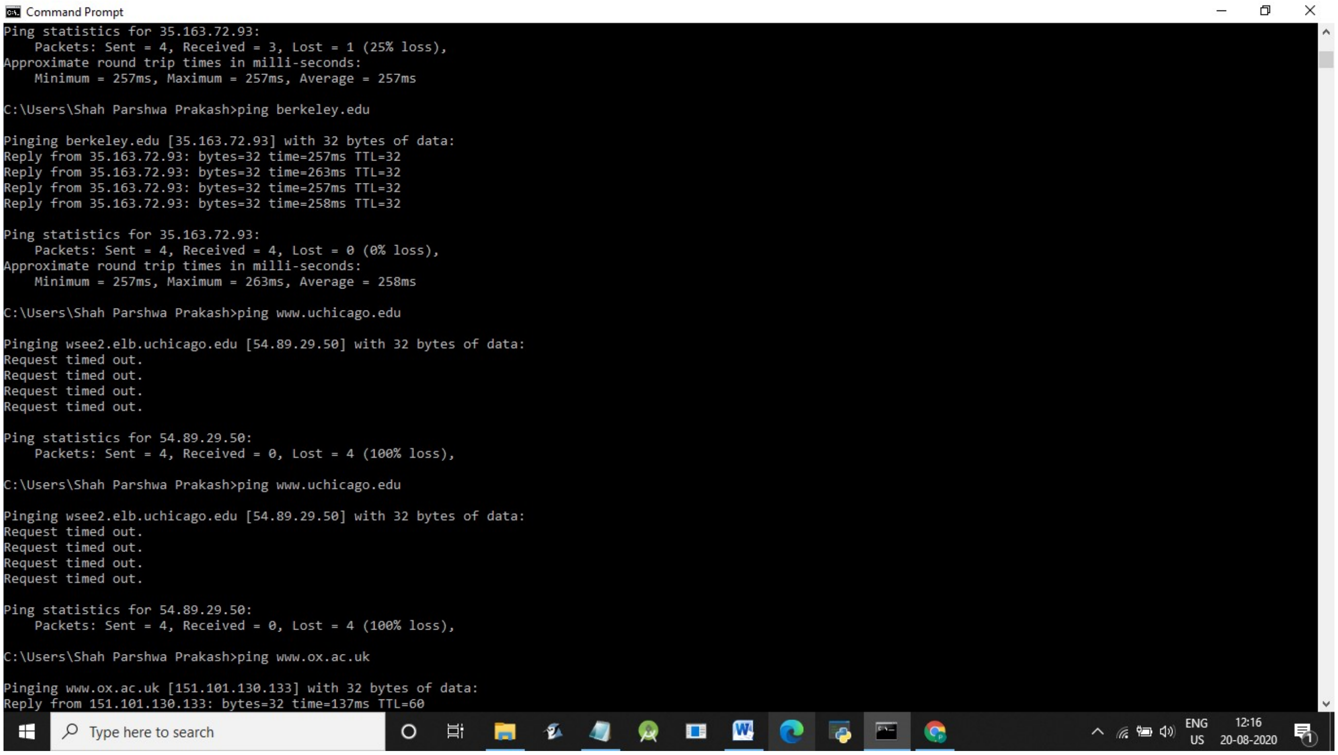
2. Does the average RTT vary with different packet sizes? What aspects of latency (transmit, propagation, and queueing delay) might impact this and why?

   Yes,RTT varies with different packet sizes.

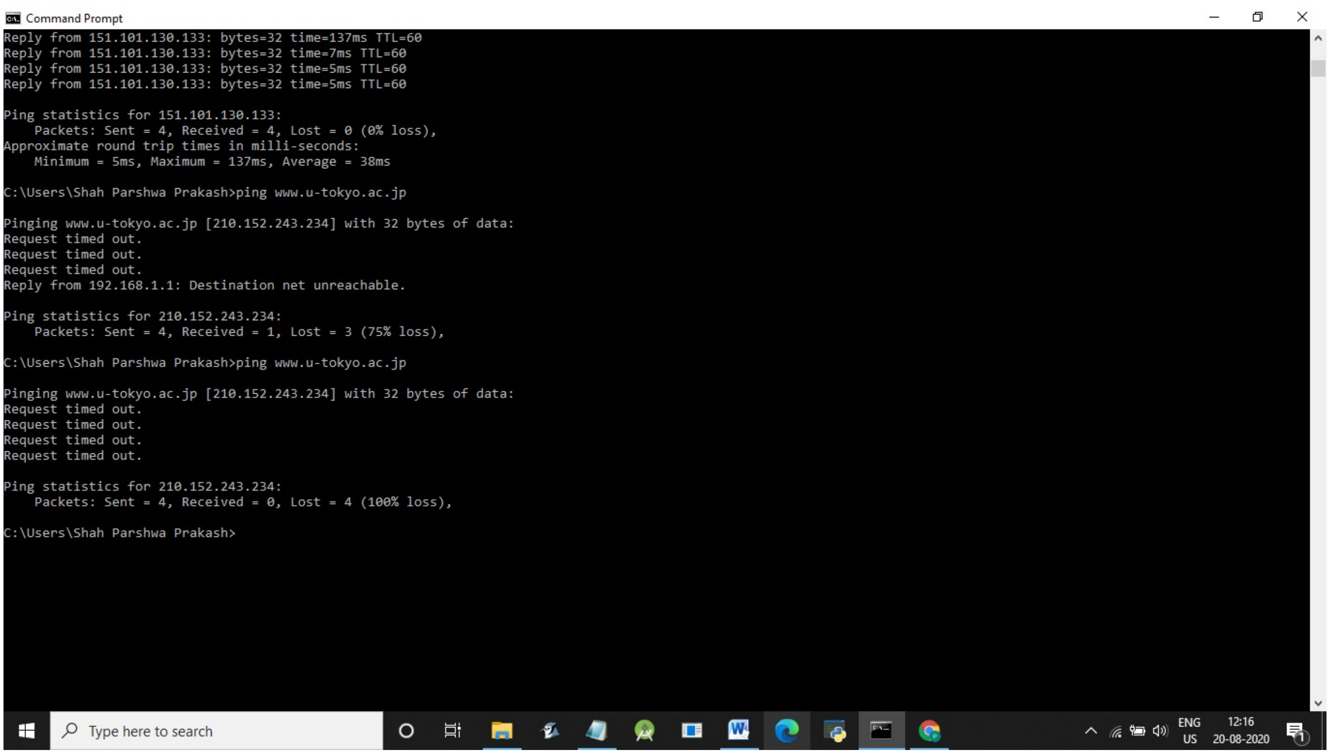
   Transmission medium as well as propagation distance affect this because more the size of packets,more time it takes to transmit.

<u>Exercise 1</u>: 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).





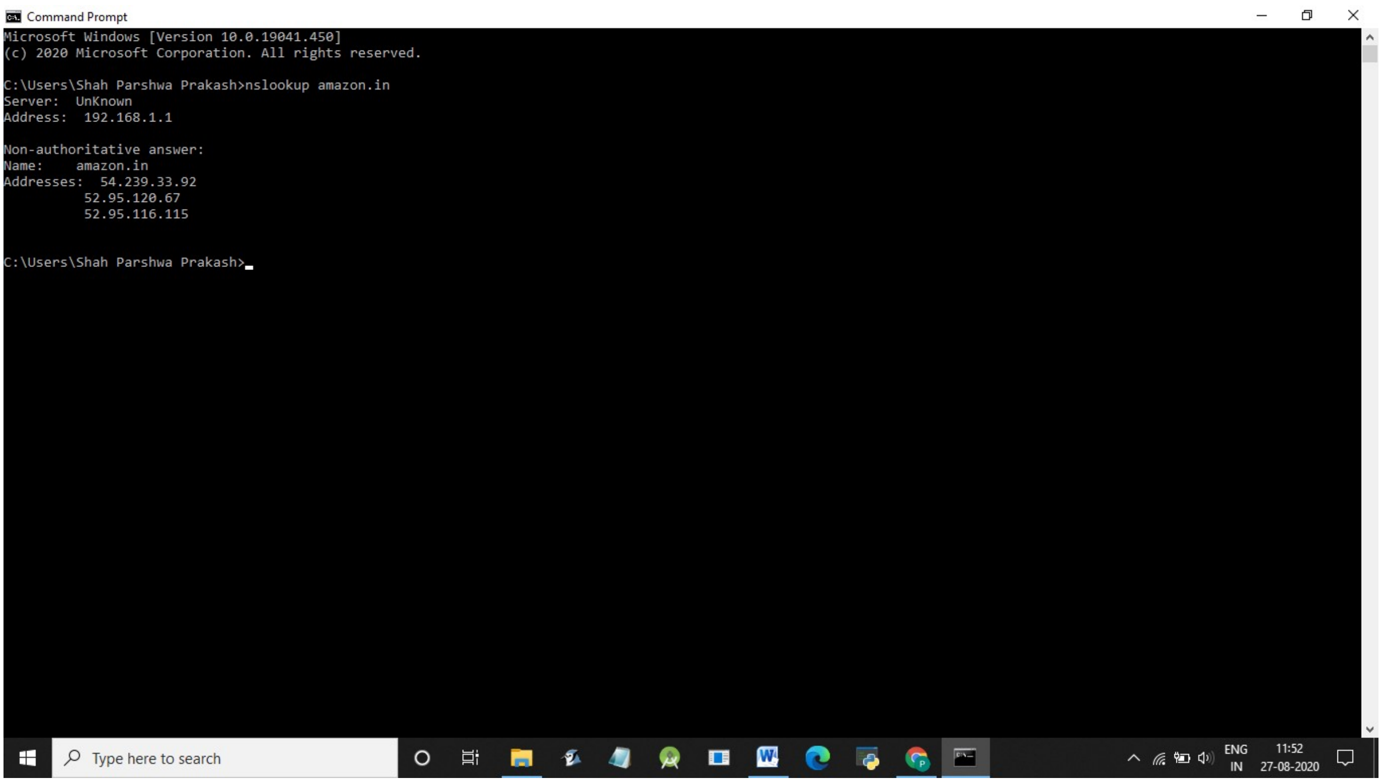
```
Command Prompt
Ping statistics for 35.163.72.93:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 257ms, Maximum = 257ms, Average = 257ms

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.
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 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!!!.)

Command Prompt

```
Microsoft Windows [Version 10.0.19041.508]
(c) 2020 Microsoft Corporation. All rights reserved.

C:\Users\Shah Parshwa Prakash>ipconfig/all

Windows IP Configuration

   Host Name . . . . . . . . . . . . : DESKTOP-S6H5PNR
   Primary Dns Suffix  . . . . . . . :
   Node Type . . . . . . . . . . . . : Hybrid
   IP Routing Enabled. . . . . . . . : No
   WINS Proxy Enabled. . . . . . . . : No

Unknown adapter Local Area Connection:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : TAP-Windows Adapter V9
   Physical Address. . . . . . . . . : 00-FF-E1-5C-82-70
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Ethernet adapter Ethernet:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Realtek PCIe FE Family Controller
   Physical Address. . . . . . . . . : F8-CA-B8-61-AB-34
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Ethernet adapter vEthernet (WSL):

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Hyper-V Virtual Ethernet Adapter
   Physical Address. . . . . . . . . : 00-15-5D-8A-AB-DB
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes
   Link-local IPv6 Address . . . . . : fe80::2545:60e8:aa2f:ad06%60(Preferred)
   IPv4 Address. . . . . . . . . . . : 172.26.0.1(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.240.0
   Default Gateway . . . . . . . . . :
   DHCPv6 IAID . . . . . . . . . . . : 1006638429
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-1E-55-7B-BF-F8-CA-B8-61-AB-34
```

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Command Prompt

```
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-1E-55-7B-BF-F8-CA-B8-61-AB-34
   DNS Servers . . . . . . . . . . . : fec0:0:0:ffff::1%1
                                       fec0:0:0:ffff::2%1
                                       fec0:0:0:ffff::3%1
   NetBIOS over Tcpip. . . . . . . . : Enabled

Unknown adapter Local Area Connection 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : TAP-Windows Adapter V9 #2
   Physical Address. . . . . . . . . : 00-FF-DF-FB-13-7F
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Local Area Connection* 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Microsoft Wi-Fi Direct Virtual Adapter
   Physical Address. . . . . . . . . : 18-3D-A2-F8-2D-C6
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Local Area Connection* 3:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Microsoft Wi-Fi Direct Virtual Adapter #3
   Physical Address. . . . . . . . . : 1A-3D-A2-F8-2D-C6
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Local Area Connection* 14:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Microsoft Hosted Network Virtual Adapter #2
   Physical Address. . . . . . . . . : 1A-3D-A2-F8-2D-C5
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Wi-Fi:
```

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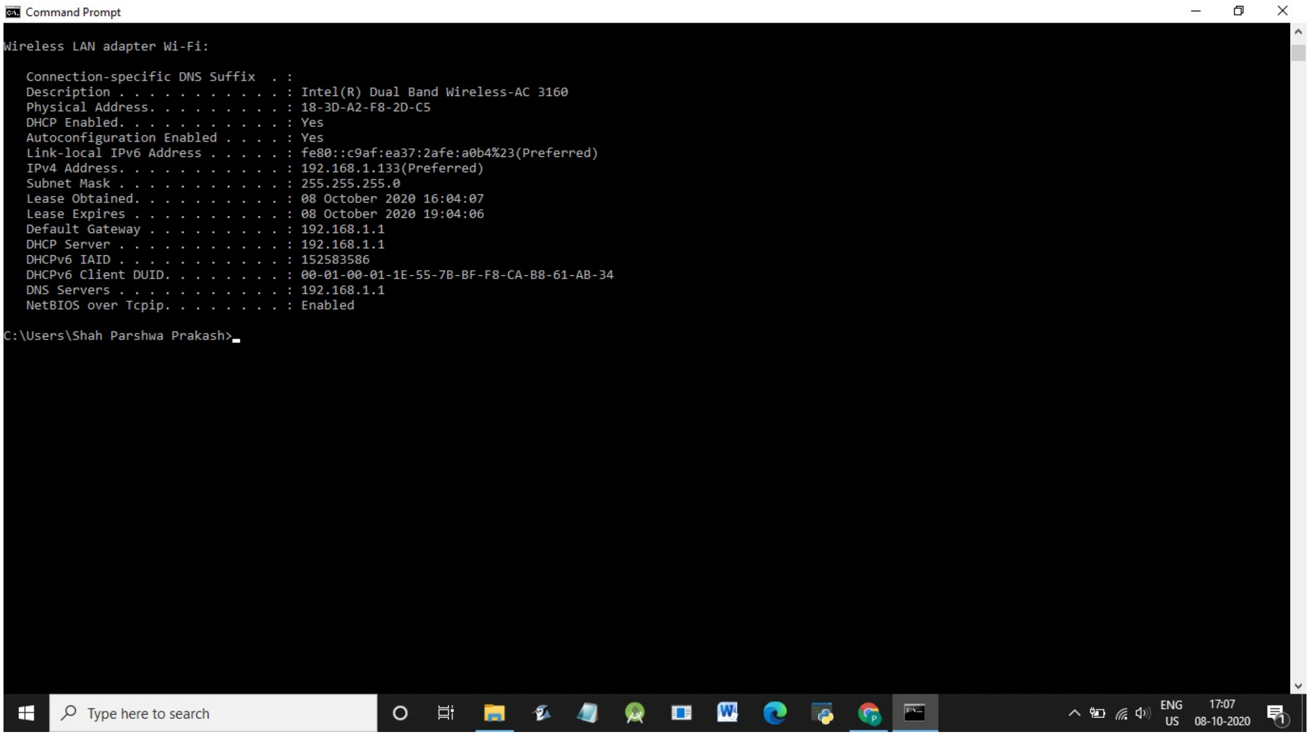
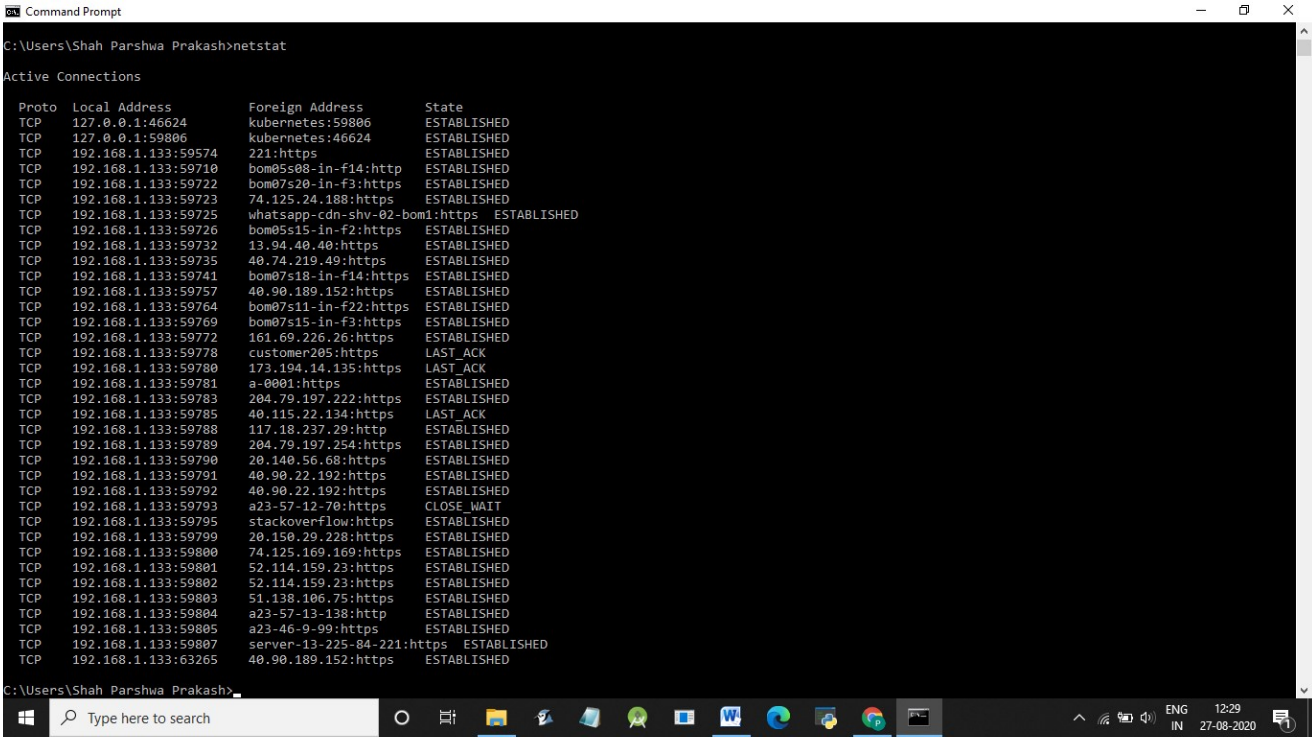


netstat — The netstat command gives information about network connections. I often use netstat -t -n which lists currently open TCP connections (that's the "-t" option) by IP address rather than domain name (that's the "-n" option). Add the option "-l" (lower case ell) to list listening sockets, that 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



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

ENG IN 16:27 27-08-2020

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`).

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`).

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  aipl-49-65-179-202.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-222wwash-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.
```

Type here to search   ENG US   13:46 20-08-2020

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-222wwash-isp-ae6-3926.wiscnet.net [140.189.8.126]
 11   306 ms   224 ms   224 ms  r-milwaukeeci-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
```

Type here to search   ENG US   13:46 20-08-2020

Command Prompt

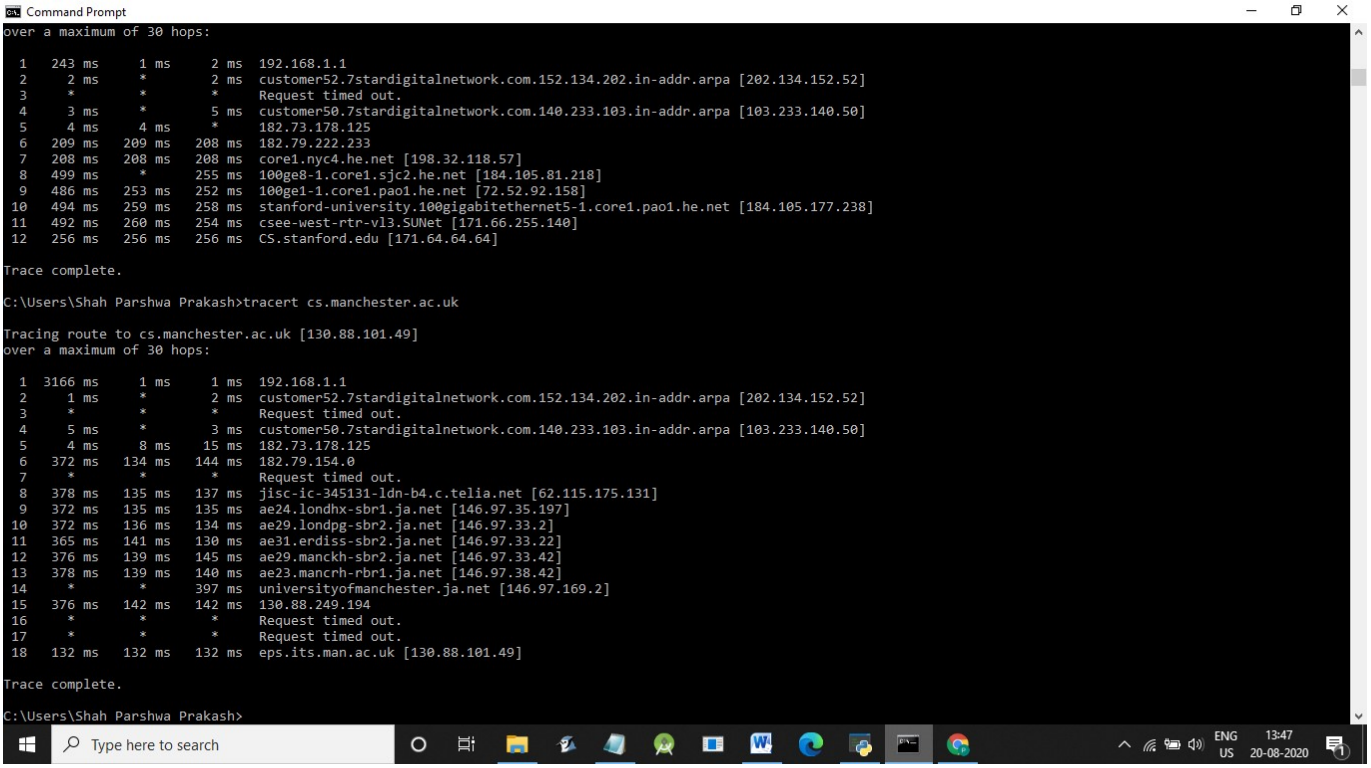
```
C:\Users\Shah Parshwa Prakash>tracert -h 16 www.cs.grinnell.edu

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  aureon-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  be3093.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.core-1-ext.csail.mit.edu [18.4.7.65]
 15     *        *        *     Request timed out.
```

Type here to search   ENG US   13:46 20-08-2020

Command Prompt

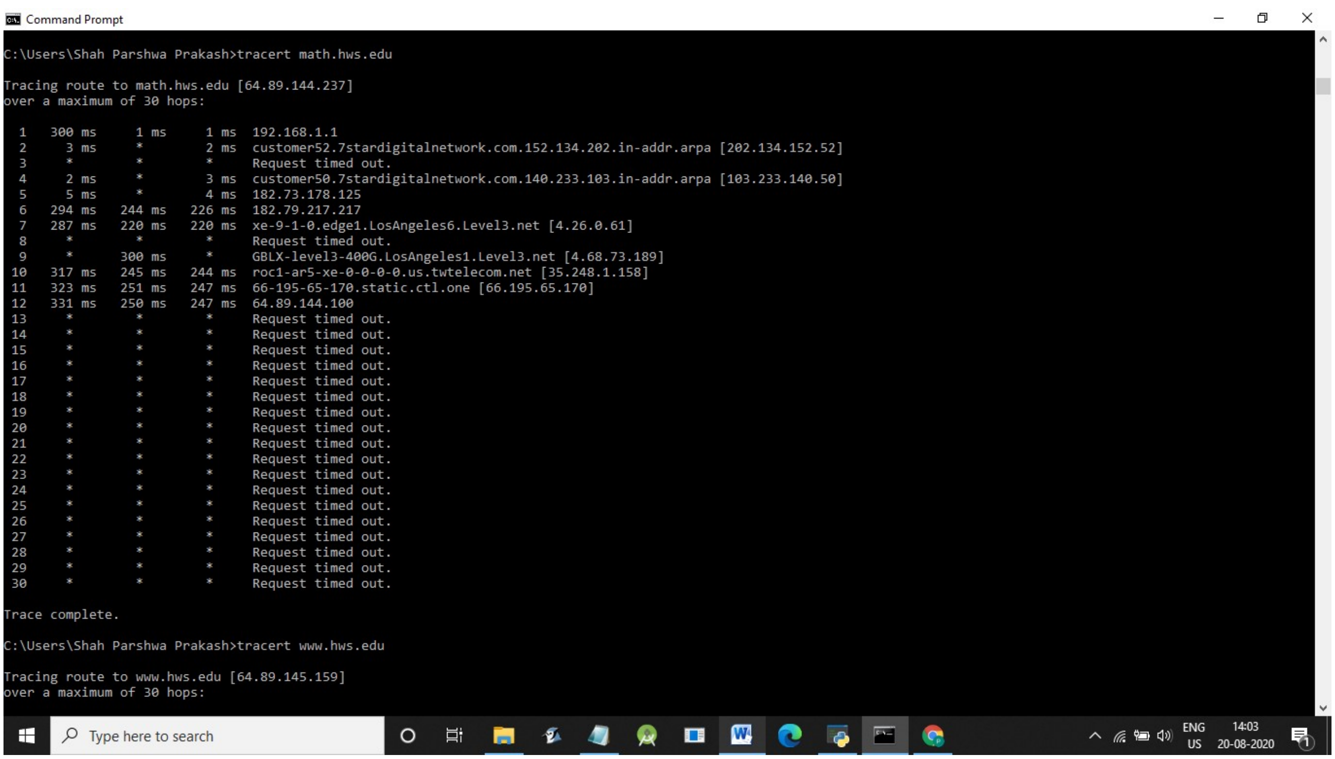
```
 15     *        *        *     Request timed out.
 16   443 ms   208 ms   208 ms  bdr.core-1.csail.mit.edu [128.30.0.246]
 17   211 ms   207 ms   206 ms  inquir-3ld.csail.mit.edu [128.30.2.109]

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.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.mancrh-rbr1.ja.net [146.97.38.42]
```

Type here to search   ENG US   13:46 20-08-2020

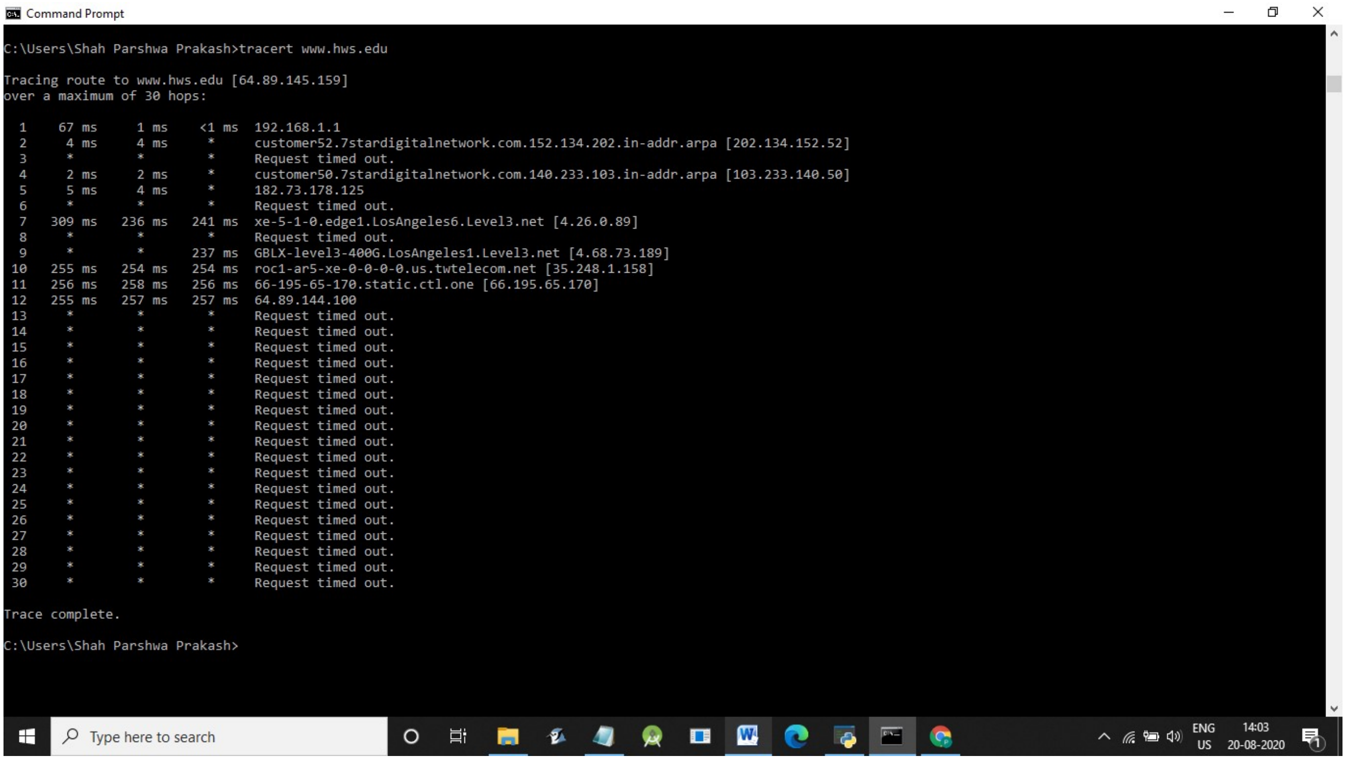


```
Command Prompt
over a maximum of 30 hops:

  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-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.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.mancrh-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>
```


<u>Exercise 2:</u> (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.ctl.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:
```



There was a slight difference. I could see change in IP address of both the links. The destination for math.hws.edu was 64.89.144.237 and the one for www.hws.edu was 64.89.145.159.
And, also there was a change in the route.

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-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.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.mancrh-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.mancrh-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?

   There is a proportional 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 packer 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 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.

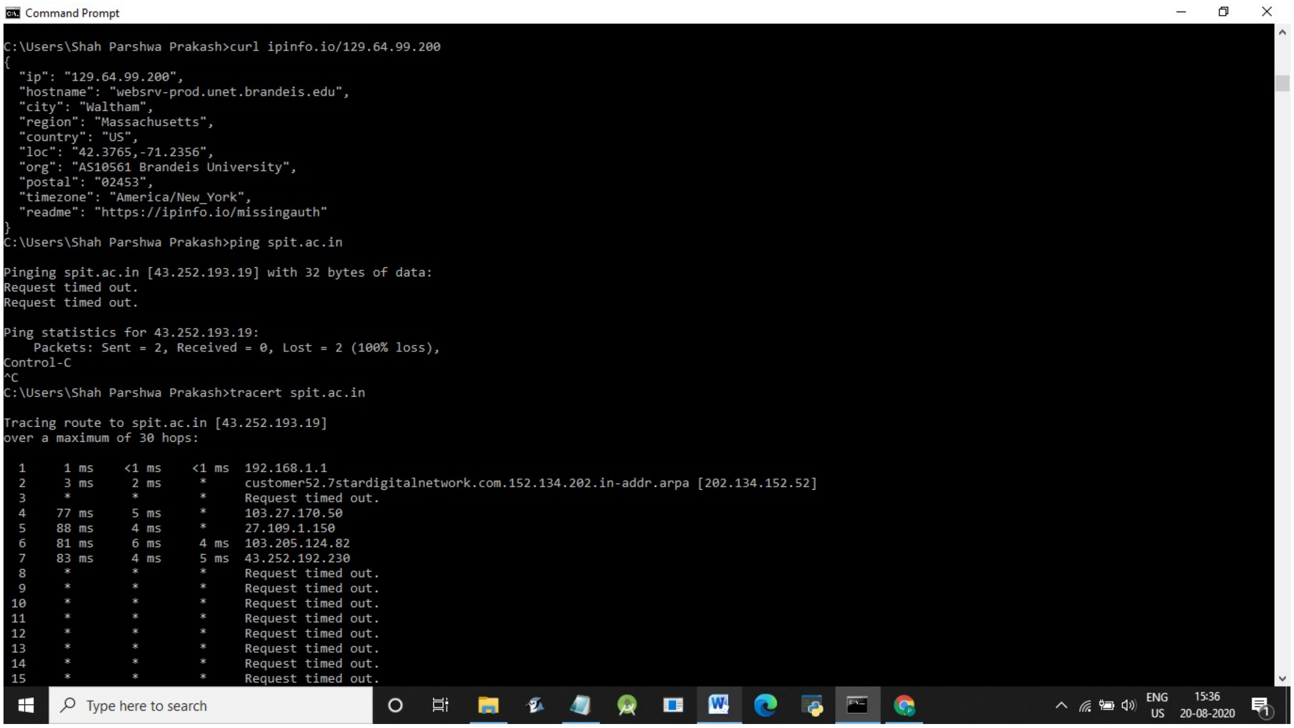
Exercise 5: (Should be short.) Because of NAT, the domain name *spit.ac.in* has a different IP address outside of SPIT than it does on campus. Using information in this lab and working on a home computer, find the outside IP address for spit.ac.in. Explain how you did it.

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:

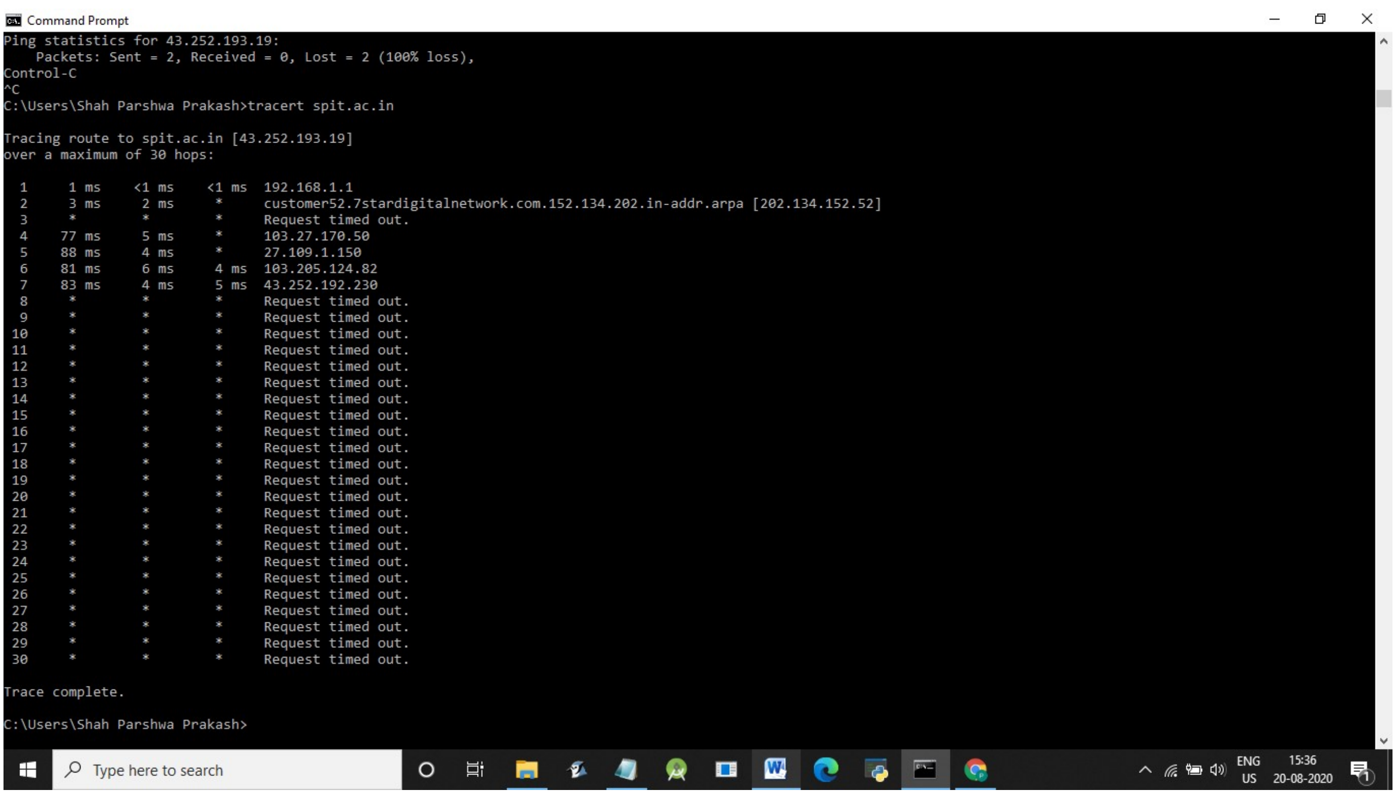
curl ipinfo.io/129.64.99.200

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


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:

  1     1 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    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.
```


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     *     customer52.7stardigitalnetwork.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.