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Experiment 2

Aim: To study basic network utilities.

Ping [1]:

- **PING (Packet Internet Groper)** command is used to check the network connectivity between host and server/host.
- This command takes as input the **IP address** or the URL and sends a data packet to the specified address with the message "PING" and get a response from the server/host this time is recorded which is called **latency**.
- Fast ping low latency means faster connection.
- Ping uses **ICMP(Internet Control Message Protocol)** to send an ICMP echo message to the specified host if that host is available then it sends ICMP reply message.
- Ping is generally measured in **millisecond**

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.
    1. 64 bytes

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\ping>ping -n 10 -l 64 google.com

Pinging google.com [172.217.27.206] with 64 bytes of data:
Reply from 172.217.27.206: bytes=64 time=5ms TTL=119
Reply from 172.217.27.206: bytes=64 time=5ms TTL=119
Reply from 172.217.27.206: bytes=64 time=5ms TTL=119
Reply from 172.217.27.206: bytes=64 time=5ms TTL=119
Reply from 172.217.27.206: bytes=64 time=6ms TTL=119
Reply from 172.217.27.206: bytes=64 time=4ms TTL=119
Reply from 172.217.27.206: bytes=64 time=6ms TTL=119
Reply from 172.217.27.206: bytes=64 time=6ms TTL=119
Reply from 172.217.27.206: bytes=64 time=8ms TTL=119
Reply from 172.217.27.206: bytes=64 time=6ms TTL=119

Ping statistics for 172.217.27.206:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 4ms, Maximum = 8ms, Average = 5ms
```

2. 100 bytes

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\ping>ping -n 10 -l 100 google.com

Pinging google.com [172.217.27.206] with 100 bytes of data:
Reply from 172.217.27.206: bytes=68 (sent 100) time=5ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 100) time=7ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 100) time=7ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 100) time=6ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 100) time=7ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 100) time=6ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 100) time=6ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 100) time=5ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 100) time=7ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 100) time=7ms TTL=119

Ping statistics for 172.217.27.206:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 5ms, Maximum = 7ms, Average = 6ms
```

3. 500 bytes

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\ping>ping -n 10 -l 500 google.com

Pinging google.com [172.217.27.206] with 500 bytes of data:
Request timed out.
Reply from 172.217.27.206: bytes=68 (sent 500) time=8ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 500) time=11ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 500) time=6ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 500) time=5ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 500) time=4ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 500) time=5ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 500) time=8ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 500) time=7ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 500) time=78ms TTL=119

Ping statistics for 172.217.27.206:
    Packets: Sent = 10, Received = 9, Lost = 1 (10% loss),
Approximate round trip times in milli-seconds:
    Minimum = 4ms, Maximum = 78ms, Average = 14ms
```

4. 1000 bytes

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\ping>ping -n 10 -l 1000 google.com

Pinging google.com [172.217.27.206] with 1000 bytes of data:
Request timed out.
Request timed out.
Reply from 172.217.27.206: bytes=68 (sent 1000) time=6ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1000) time=7ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1000) time=14ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1000) time=6ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1000) time=6ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1000) time=14ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1000) time=43ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1000) time=21ms TTL=119

Ping statistics for 172.217.27.206:
    Packets: Sent = 10, Received = 8, Lost = 2 (20% loss),
Approximate round trip times in milli-seconds:
    Minimum = 6ms, Maximum = 43ms, Average = 14ms
```

5. 1400 bytes

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\ping>ping -n 10 -l 1400 google.com

Pinging google.com [172.217.27.206] with 1400 bytes of data:
Reply from 172.217.27.206: bytes=68 (sent 1400) time=7ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1400) time=18ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1400) time=8ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1400) time=6ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1400) time=5ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1400) time=7ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1400) time=9ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1400) time=5ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1400) time=10ms TTL=119
Reply from 172.217.27.206: bytes=68 (sent 1400) time=8ms TTL=119

Ping statistics for 172.217.27.206:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 5ms, Maximum = 18ms, Average = 8ms
```

Questions about latency

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

   Ans:

   The average RTT vary between different hosts.

   The following aspects of latency might impact this:

   - **Propagation delay**: It is the time taken by the first bit to travel from sender to receiver end of the link. In other words, it is simply the time required for bits to reach the destination from the start point. Factors on which Propagation delay depends are Distance and propagation speed.
     Different hosts can be situated at different locations hence there can be difference in the distances.

   - **Queuing delay**: Queuing delay is the time a job waits in a queue until it can be executed. It depends on congestion. It is the time difference between when the packet arrived Destination and when the packet data was processed or executed. It may be caused by mainly three reasons i.e. originating switches, intermediate switches or call receiver servicing switches.
     The processing time can be different for each host.

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

Ans:

The average RTT vary with different packet sizes.

The following aspects of latency might impact this:

- **Transmission delay**: Time taken to put a packet onto link. In other words, it is simply time required to put data bits on the wire/communication medium. It depends on **length of packet** and bandwidth of network.

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).

1. uw.edu

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\ping>ping uw.edu

Pinging uw.edu [128.95.155.198] with 32 bytes of data:
Reply from 128.95.155.198: bytes=32 time=568ms TTL=51
Reply from 128.95.155.198: bytes=32 time=253ms TTL=51
Reply from 128.95.155.198: bytes=32 time=256ms TTL=51
Reply from 128.95.155.198: bytes=32 time=251ms TTL=51

Ping statistics for 128.95.155.198:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 251ms, Maximum = 568ms, Average = 332ms
```

2. cornell.edu

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\ping>ping cornell.edu

Pinging cornell.edu [128.253.173.245] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 128.253.173.245:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

3. berkeley.edu

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\ping>ping berkeley.edu

Pinging berkeley.edu [35.163.72.93] with 32 bytes of data:
Reply from 35.163.72.93: bytes=32 time=347ms TTL=38
Reply from 35.163.72.93: bytes=32 time=407ms TTL=38
Reply from 35.163.72.93: bytes=32 time=281ms TTL=38
Reply from 35.163.72.93: bytes=32 time=282ms TTL=38

Ping statistics for 35.163.72.93:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 281ms, Maximum = 407ms, Average = 329ms
```

4. uchicago.edu

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\ping>ping uchicago.edu

Pinging uchicago.edu [34.200.129.209] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 34.200.129.209:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

5. ox.ac.uk (England)

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\ping>ping ox.ac.uk

Pinging ox.ac.uk [151.101.130.133] with 32 bytes of data:
Reply from 151.101.130.133: bytes=32 time=317ms TTL=60
Reply from 151.101.130.133: bytes=32 time=10ms TTL=60
Reply from 151.101.130.133: bytes=32 time=7ms TTL=60
Reply from 151.101.130.133: bytes=32 time=8ms 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 = 7ms, Maximum = 317ms, Average = 85ms
```

6. yahoo.co.jp (Japan)

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\ping>ping yahoo.co.jp

Pinging yahoo.co.jp [182.22.59.229] with 32 bytes of data:
Reply from 182.22.59.229: bytes=32 time=224ms TTL=43
Reply from 182.22.59.229: bytes=32 time=139ms TTL=43
Reply from 182.22.59.229: bytes=32 time=141ms TTL=43
Reply from 182.22.59.229: bytes=32 time=141ms TTL=43

Ping statistics for 182.22.59.229:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 139ms, Maximum = 224ms, Average = 161ms
```

Observations:

- The round trip time depends on the distance between source and destination of the network requests.
- The RTT is more for the universities located in US than UK because distance for US is more than UK from India.
- The RTT for host in Japan is more than UK and less than US because its distance from India is more than UK and less than US.

nslookup [2]

- nslookup (stands for "**Name Server Lookup**") is a useful command for getting information from DNS server.
- It is a network administration tool for querying **the Domain Name System (DNS)** to obtain domain name or IP address mapping or any other specific DNS record.
- It is also used to **troubleshoot DNS related problems**.

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2>nslookup yahoo.com
Server:  www.routerlogin.com
Address:  192.168.1.1

Non-authoritative answer:
Name:    yahoo.com
Addresses:  2001:4998:44:3507::8001
          2001:4998:24:120d::1:1
          2001:4998:124:1507::f000
          2001:4998:44:3507::8000
          2001:4998:24:120d::1:0
          2001:4998:124:1507::f001
          98.137.11.164
          74.6.143.25
          74.6.231.20
          74.6.231.21
          74.6.143.26
          98.137.11.163
```

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2>nslookup google.com
Server:  www.routerlogin.com
Address:  192.168.1.1

Non-authoritative answer:
Name:    google.com
Addresses:  2404:6800:4009:800::200e
          172.217.27.206
```

ifconfig/ipconfig [3]

- **ifconfig(interface configuration)** command is used to configure the kernel-resident network interfaces.
- It is used at the **boot time** to set up the interfaces as necessary.
- After that, it is usually used when needed during **debugging** or when you need system tuning.
- Also, this command is used to **assign the IP address** and netmask to an interface or to enable or disable a given interface.

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2>ipconfig

Windows IP Configuration


Ethernet adapter Ethernet:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Ethernet adapter Ethernet 2:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::d4fc:98a3:828c:17ee%9
   IPv4 Address. . . . . . . . . . . : 192.168.56.1
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . :

Wireless LAN adapter Local Area Connection* 1:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Wireless LAN adapter Local Area Connection* 3:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Wireless LAN adapter Wi-Fi:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::341a:9220:3ce8:d61a%12
   IPv4 Address. . . . . . . . . . . : 192.168.1.7
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : 192.168.1.1
```

netstat [4]

Netstat command displays various network related information such as network connections, routing tables, interface statistics, masquerade connections, multicast memberships etc.

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2>netstat -t -n

Active Connections

  Proto  Local Address          Foreign Address        State           Offload State
  TCP    127.0.0.1:49671        127.0.0.1:49908        ESTABLISHED     InHost
  TCP    127.0.0.1:49671        127.0.0.1:50096        ESTABLISHED     InHost
  TCP    127.0.0.1:49675        127.0.0.1:49682        ESTABLISHED     InHost
  TCP    127.0.0.1:49675        127.0.0.1:49683        ESTABLISHED     InHost
  TCP    127.0.0.1:49675        127.0.0.1:49684        ESTABLISHED     InHost
  TCP    127.0.0.1:49675        127.0.0.1:49685        ESTABLISHED     InHost
  TCP    127.0.0.1:49675        127.0.0.1:49714        ESTABLISHED     InHost
  TCP    127.0.0.1:49675        127.0.0.1:49724        ESTABLISHED     InHost
  TCP    127.0.0.1:49675        127.0.0.1:49750        ESTABLISHED     InHost
  TCP    127.0.0.1:49675        127.0.0.1:49919        ESTABLISHED     InHost
  TCP    127.0.0.1:49682        127.0.0.1:49675        ESTABLISHED     InHost
  TCP    127.0.0.1:49683        127.0.0.1:49675        ESTABLISHED     InHost
  TCP    127.0.0.1:49684        127.0.0.1:49675        ESTABLISHED     InHost
  TCP    127.0.0.1:49685        127.0.0.1:49675        ESTABLISHED     InHost
  TCP    127.0.0.1:49692        127.0.0.1:49807        ESTABLISHED     InHost
  TCP    127.0.0.1:49692        127.0.0.1:49861        ESTABLISHED     InHost
  TCP    127.0.0.1:49692        127.0.0.1:50082        ESTABLISHED     InHost
  TCP    127.0.0.1:49693        127.0.0.1:49694        ESTABLISHED     InHost
  TCP    127.0.0.1:49694        127.0.0.1:49693        ESTABLISHED     InHost
  TCP    127.0.0.1:49710        127.0.0.1:49711        ESTABLISHED     InHost
  TCP    127.0.0.1:49711        127.0.0.1:49710        ESTABLISHED     InHost
  TCP    127.0.0.1:49714        127.0.0.1:49675        ESTABLISHED     InHost
  TCP    127.0.0.1:49724        127.0.0.1:49675        ESTABLISHED     InHost
  TCP    127.0.0.1:49726        127.0.0.1:49727        ESTABLISHED     InHost
  TCP    127.0.0.1:49727        127.0.0.1:49726        ESTABLISHED     InHost
  TCP    127.0.0.1:49728        127.0.0.1:61900        ESTABLISHED     InHost
  TCP    127.0.0.1:49729        127.0.0.1:49730        ESTABLISHED     InHost
  TCP    127.0.0.1:49730        127.0.0.1:49729        ESTABLISHED     InHost
  TCP    127.0.0.1:49731        127.0.0.1:49732        ESTABLISHED     InHost
  TCP    127.0.0.1:49732        127.0.0.1:49731        ESTABLISHED     InHost
  TCP    127.0.0.1:49733        127.0.0.1:61900        ESTABLISHED     InHost
  TCP    127.0.0.1:49734        127.0.0.1:49735        ESTABLISHED     InHost
  TCP    127.0.0.1:49735        127.0.0.1:49734        ESTABLISHED     InHost
  TCP    127.0.0.1:49736        127.0.0.1:49737        ESTABLISHED     InHost
  TCP    127.0.0.1:49737        127.0.0.1:49736        ESTABLISHED     InHost
  TCP    127.0.0.1:49738        127.0.0.1:61900        ESTABLISHED     InHost
```

Experiments with Traceroute

From your machine traceroute to the following hosts:

1. mscs.mu.edu

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\traceroute>tracert mscs.mu.edu

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

  1     2 ms     2 ms     1 ms  www.routerlogin.com [192.168.1.1]
  2     4 ms     3 ms     5 ms  103.209.38.170
  3     *        *        *     Request timed out.
  4    10 ms     5 ms     6 ms  38-97-87-183.mysipl.com [183.87.97.38]
  5     *        *        *     Request timed out.
  6     5 ms     5 ms     6 ms  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [180.87.38.5]
  7   127 ms   128 ms   126 ms  if-ae-5-2.tcore1.wyn-marseille.as6453.net [80.231.217.29]
  8   131 ms   131 ms   130 ms  if-ae-21-2.tcore1.pye-paris.as6453.net [80.231.154.208]
  9   121 ms   118 ms   119 ms  if-ae-11-2.tcore1.pvu-paris.as6453.net [80.231.153.49]
 10     *        *        *     Request timed out.
 11     *      219 ms     *     ae-2-3603.ear3.Chicago2.Level3.net [4.69.159.186]
 12   219 ms   221 ms   221 ms  MARQUETTE-U.ear3.Chicago2.Level3.net [4.16.38.70]
 13   221 ms   220 ms   221 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.
```

2. csail.mit.edu

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\traceroute>tracert csail.mit.edu

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

  1  2545 ms     2 ms     1 ms  www.routerlogin.com [192.168.1.1]
  2     5 ms     3 ms     3 ms  103.209.38.170
  3     *        *        *     Request timed out.
  4     6 ms     6 ms     3 ms  42-97-87-183.mysipl.com [183.87.97.42]
  5     *        *        *     Request timed out.
  6     5 ms     5 ms     5 ms  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [180.87.38.5]
  7   212 ms   213 ms   212 ms  if-ae-5-2.tcore1.wyn-marseille.as6453.net [80.231.217.29]
  8   203 ms   200 ms   203 ms  if-ae-2-2.tcore2.wyn-marseille.as6453.net [80.231.217.2]
  9   201 ms   202 ms   202 ms  if-ae-9-2.tcore2.l78-london.as6453.net [80.231.200.14]
 10   206 ms   201 ms   202 ms  if-ae-15-2.tcore2.ldn-london.as6453.net [80.231.131.118]
 11   211 ms   218 ms   209 ms  if-ae-32-3.tcore2.nto-newyork.as6453.net [80.231.20.107]
 12   217 ms   209 ms   240 ms  if-ae-12-2.tcore1.n75-newyork.as6453.net [66.110.96.5]
 13   210 ms   209 ms   211 ms  66.110.96.150
 14   216 ms   213 ms   211 ms  be-10390-cr02.newyork.ny.ibone.comcast.net [68.86.83.89]
 15   214 ms   208 ms     *     be-1302-cs03.newyork.ny.ibone.comcast.net [96.110.38.41]
 16   214 ms   216 ms   236 ms  96.110.42.10
 17   218 ms   215 ms   218 ms  ae0-0-eg-bstpmall74w.boston.ma.boston.comcast.net [68.86.238.34]
 18   214 ms   222 ms   213 ms  50-201-57-174-static.hfc.comcastbusiness.net [50.201.57.174]
 19   226 ms   218 ms   218 ms  dmz-rtr-1-external-rtr-3.mit.edu [18.0.161.13]
 20   216 ms   215 ms   216 ms  dmz-rtr-2-dmz-rtr-1-1.mit.edu [18.0.161.6]
 21   216 ms   221 ms   217 ms  mitnet.core-1-ext.csail.mit.edu [18.4.7.65]
 22     *        *      215 ms  core-1-ext.bdr.csail.mit.edu [128.30.13.26]
 23   216 ms   216 ms   217 ms  bdr.core-1.csail.mit.edu [128.30.0.246]
 24   216 ms     *      215 ms  inquir-3ld.csail.mit.edu [128.30.2.109]

Trace complete.
```

3. cs.stanford.edu

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\traceroute>tracert cs.stanford.edu

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

  1   340 ms     3 ms     2 ms  www.routerlogin.com [192.168.1.1]
  2     4 ms     3 ms     3 ms  103.209.38.170
  3     *        *        *     Request timed out.
  4     6 ms     6 ms     5 ms  42-97-87-183.mysipl.com [183.87.97.42]
  5     *        *        *     Request timed out.
  6     *        *        *     Request timed out.
  7    22 ms    22 ms    21 ms  ix-ae-4-2.tcore2.cxr-chennai.as6453.net [180.87.37.1]
  8   232 ms     *        *     if-ae-10-4.tcore2.svw-singapore.as6453.net [180.87.67.16]
  9   228 ms   240 ms   228 ms  if-ae-7-2.tcore2.lvw-losangeles.as6453.net [180.87.15.26]
 10   323 ms   231 ms   266 ms  if-ae-2-2.tcore1.lvw-losangeles.as6453.net [66.110.59.1]
 11   232 ms   233 ms   392 ms  las-b24-link.telia.net [80.239.128.214]
 12     *      244 ms     *     palo-b24-link.telia.net [62.115.119.90]
 13   244 ms   245 ms   244 ms  palo-b1-link.telia.net [62.115.122.169]
 14   241 ms   240 ms   238 ms  hurricane-ic-308019-palo-b1.c.telia.net [80.239.167.174]
 15   262 ms   277 ms   252 ms  stanford-university.100gigabitethernet5-1.core1.pao1.he.net [184.105.177.238]
 16   251 ms   261 ms   265 ms  csee-west-rtr-vl3.SUNet [171.66.255.140]
 17   243 ms   251 ms   246 ms  CS.stanford.edu [171.64.64.64]

Trace complete.
```

4. cs.manchester.ac.uk

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\traceroute>tracert cs.manchester.ac.uk

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

  1  1965 ms   158 ms   128 ms  www.routerlogin.com [192.168.1.1]
  2    81 ms    28 ms    68 ms  103.209.38.170
  3     *        *       26 ms  237-62-106-27.mysipl.com [27.106.62.237]
  4     9 ms     8 ms     6 ms  38-97-87-183.mysipl.com [183.87.97.38]
  5     *        *        *     Request timed out.
  6     5 ms     6 ms     4 ms  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [180.87.38.5]
  7   126 ms     *      126 ms  if-ae-5-2.tcore1.wyn-marseille.as6453.net [80.231.217.29]
  8   131 ms     *      130 ms  if-ae-21-2.tcore1.pye-paris.as6453.net [80.231.154.208]
  9   123 ms   120 ms   121 ms  if-ae-11-2.tcore1.pvu-paris.as6453.net [80.231.153.49]
 10     *      281 ms   164 ms  80.231.153.66
 11     *        *        *     Request timed out.
 12     *      131 ms   131 ms  JANET.bear1.Manchester1.Level3.net [212.187.174.238]
 13   135 ms   131 ms   133 ms  ae22.manckh-sbr2.ja.net [146.97.35.189]
 14   140 ms   132 ms   131 ms  ae23.mancrh-rbr1.ja.net [146.97.38.42]
 15     *        *        *     Request timed out.
 16   138 ms   135 ms     *     130.88.249.194
 17     *        *        *     Request timed out.
 18   134 ms   134 ms   143 ms  gw-jh.its.manchester.ac.uk [130.88.250.32]
 19   136 ms   143 ms   133 ms  eps.its.man.ac.uk [130.88.101.49]

Trace complete.
```

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

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\traceroute>tracert math.hws.edu

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

  1    79 ms     2 ms     2 ms  www.routerlogin.com [192.168.1.1]
  2     8 ms     3 ms     3 ms  103.209.38.170
  3   166 ms     *        *     237-62-106-27.mysipl.com [27.106.62.237]
  4    11 ms     *       44 ms  46-97-87-183.mysipl.com [183.87.97.46]
  5     *        *        *     Request timed out.
  6     5 ms     6 ms     5 ms  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [180.87.38.5]
  7   127 ms   126 ms     *     if-ae-5-2.tcore1.wyn-marseille.as6453.net [80.231.217.29]
  8   130 ms   131 ms   131 ms  if-ae-8-1600.tcore1.pye-paris.as6453.net [80.231.217.6]
  9   121 ms   120 ms   120 ms  if-ae-11-2.tcore1.pvu-paris.as6453.net [80.231.153.49]
 10     *        *        *     Request timed out.
 11   134 ms   130 ms   129 ms  ae-1-3104.edge3.Paris1.Level3.net [4.69.161.110]
 12   129 ms   128 ms   128 ms  global-crossing-xe-level3.paris1.level3.net [4.68.63.230]
 13   212 ms   213 ms   212 ms  roc1-ar5-xe-11-0-0-0.us.twtelecom.net [35.248.1.162]
 14   210 ms   213 ms   225 ms  66-195-65-170.static.ctl.one [66.195.65.170]
 15   218 ms   210 ms   210 ms  nat.hws.edu [64.89.144.100]
 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\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\traceroute>tracert hws.edu

Tracing route to hws.edu [64.89.144.22]
over a maximum of 30 hops:

  1    13 ms     2 ms     2 ms  www.routerlogin.com [192.168.1.1]
  2     3 ms     4 ms     3 ms  103.209.38.170
  3     *        *       30 ms  237-62-106-27.mysipl.com [27.106.62.237]
  4    29 ms     4 ms     5 ms  46-97-87-183.mysipl.com [183.87.97.46]
  5     *        *        *     Request timed out.
  6     *     3358 ms  1596 ms  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [180.87.38.5]
  7   147 ms   127 ms   156 ms  if-ae-5-2.tcore1.wyn-marseille.as6453.net [80.231.217.29]
  8   173 ms     *      129 ms  if-ae-21-2.tcore1.pye-paris.as6453.net [80.231.154.208]
  9   118 ms   119 ms     *     if-ae-11-2.tcore1.pvu-paris.as6453.net [80.231.153.49]
 10     *      127 ms   127 ms  80.231.153.66
 11   133 ms   134 ms   129 ms  ae-1-3104.edge3.Paris1.Level3.net [4.69.161.110]
 12   129 ms   135 ms   126 ms  global-crossing-xe-level3.paris1.level3.net [4.68.63.230]
 13   206 ms   207 ms   206 ms  roc1-ar5-xe-11-0-0-0.us.twtelecom.net [35.248.1.162]
 14   216 ms   208 ms   211 ms  66-195-65-170.static.ctl.one [66.195.65.170]
 15   215 ms   211 ms   212 ms  nat.hws.edu [64.89.144.100]
 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.
```

1. IP address for 8th hop in hws.edu is 80.231.217.29 and in hws.edu it is 80.231.154.208

IP Address	Country	Region	City
80.231.217.29	France	Provence-Alpes-Cote-d'Azur	Marseille
ISP	**Organization**	**Latitude**	**Longitude**
TATA Communications (Canada) Ltd.	Not Available	43.2970	5.3811

IP Address	Country	Region	City
80.231.154.208	France	Ile-de-France	Paris
ISP	**Organization**	**Latitude**	**Longitude**
TATA Communications (Canada) Ltd.	Not Available	48.8534	2.3488

2. In traceroute for math.hws.edu, the request to 10th node was timed out whereas in traceroute for hws.edu, 10th node is present as 80.231.153.66

IP Address	Country	Region	City
80.231.153.66	France	Ile-de-France	Paris
ISP	**Organization**	**Latitude**	**Longitude**
TATA Communications (Canada) Ltd.	Not Available	48.8534	2.3488

3. Rest all hops are same for both.

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.

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\traceroute>tracert hws.edu

Tracing route to hws.edu [64.89.144.22]
over a maximum of 30 hops:

  1    13 ms     2 ms     2 ms  www.routerlogin.com [192.168.1.1]
  2     3 ms     4 ms     3 ms  103.209.38.170
  3     *        *       30 ms  237-62-106-27.mysipl.com [27.106.62.237]
  4    29 ms     4 ms     5 ms  46-97-87-183.mysipl.com [183.87.97.46]
  5     *        *        *     Request timed out.
  6     *     3358 ms  1596 ms  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [180.87.38.5]
  7   147 ms   127 ms   156 ms  if-ae-5-2.tcore1.wyn-marseille.as6453.net [80.231.217.29]
  8   173 ms     *      129 ms  if-ae-21-2.tcore1.pye-paris.as6453.net [80.231.154.208]
  9   118 ms   119 ms     *     if-ae-11-2.tcore1.pvu-paris.as6453.net [80.231.153.49]
 10     *      127 ms   127 ms  80.231.153.66
 11   133 ms   134 ms   129 ms  ae-1-3104.edge3.Paris1.Level3.net [4.69.161.110]
 12   129 ms   135 ms   126 ms  global-crossing-xe-level3.paris1.level3.net [4.68.63.230]
 13   206 ms   207 ms   206 ms  roc1-ar5-xe-11-0-0-0.us.twtelecom.net [35.248.1.162]
 14   216 ms   208 ms   211 ms  66-195-65-170.static.ctl.one [66.195.65.170]
 15   215 ms   211 ms   212 ms  nat.hws.edu [64.89.144.100]
 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\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2\traceroute>tracert hws.edu

Tracing route to hws.edu [64.89.144.22]
over a maximum of 30 hops:

  1  2542 ms     3 ms    25 ms  www.routerlogin.com [192.168.1.1]
  2     6 ms     6 ms     3 ms  103.209.38.170
  3     *        *       25 ms  237-62-106-27.mysipl.com [27.106.62.237]
  4     6 ms     7 ms     8 ms  46-97-87-183.mysipl.com [183.87.97.46]
  5     *        *        *     Request timed out.
  6    11 ms     4 ms     9 ms  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [180.87.38.5]
  7     *      119 ms     *     if-ae-5-2.tcore1.wyn-marseille.as6453.net [80.231.217.29]
  8   137 ms   132 ms   141 ms  if-ae-8-1600.tcore1.pye-paris.as6453.net [80.231.217.6]
  9   150 ms   130 ms   127 ms  if-ae-11-2.tcore1.pvu-paris.as6453.net [80.231.153.49]
 10     *      120 ms   204 ms  80.231.153.66
 11   159 ms   130 ms   139 ms  ae-2-3204.edge3.Paris1.Level3.net [4.69.161.114]
 12   163 ms   140 ms   135 ms  global-crossing-xe-level3.paris1.level3.net [4.68.63.230]
 13   289 ms   224 ms   228 ms  roc1-ar5-xe-11-0-0-0.us.twtelecom.net [35.248.1.162]
 14   208 ms   208 ms   210 ms  66-195-65-170.static.ctl.one [66.195.65.170]
 15   630 ms   866 ms   517 ms  64.89.144.100
 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.
```

The 8th hop is different in both the routes. All other hops are same

In the first route, the 8th hop is 80.231.153.49 where as in the second route it is 80.231.217.6

Both these IP addresses are from same region.

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?

   Ans:

   1. www.routerlogin.com [192.168.1.1]
   2. 103.209.38.170
   3. 237-62-106-27.mysipl.com [27.106.62.237]

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?

   Ans: More the distance more the number of hops.

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?

   Ans: If latency of the host is more, it can be because of the distance between.1 source and destination host. If the distance is more, number of nodes in traceroute will be more too.

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.

```
Domain Name: google.com
Registry Domain ID: 2138514_DOMAIN_COM-VRSN
Registrar WHOIS Server: whois.markmonitor.com
Registrar URL: http://www.markmonitor.com
Updated Date: 2019-09-09T08:39:04-0700
Creation Date: 1997-09-15T00:00:00-0700
Registrar Registration Expiration Date: 2028-09-13T00:00:00-0700
Registrar: MarkMonitor, Inc.
Registrar IANA ID: 292
Registrar Abuse Contact Email: abusecomplaints@markmonitor.com
Registrar Abuse Contact Phone: +1.2083895770
Domain Status: clientUpdateProhibited (https://www.icann.org/epp#clientUpdateProhibited)
Domain Status: clientTransferProhibited (https://www.icann.org/epp#clientTransferProhibited)
Domain Status: clientDeleteProhibited (https://www.icann.org/epp#clientDeleteProhibited)
Domain Status: serverUpdateProhibited (https://www.icann.org/epp#serverUpdateProhibited)
Domain Status: serverTransferProhibited (https://www.icann.org/epp#serverTransferProhibited)
Domain Status: serverDeleteProhibited (https://www.icann.org/epp#serverDeleteProhibited)
Registrant Organization: Google LLC
Registrant State/Province: CA
Registrant Country: US
Registrant Email: Select Request Email Form at https://domains.markmonitor.com/whois/google.com
Admin Organization: Google LLC
Admin State/Province: CA
Admin Country: US
Admin Email: Select Request Email Form at https://domains.markmonitor.com/whois/google.com
Tech Organization: Google LLC
Tech State/Province: CA
Tech Country: US
Tech Email: Select Request Email Form at https://domains.markmonitor.com/whois/google.com
Name Server: ns1.google.com
Name Server: ns3.google.com
Name Server: ns4.google.com
Name Server: ns2.google.com
```

```
Domain Name: amazon.com
Registry Domain ID: 281209_DOMAIN_COM-VRSN
Registrar WHOIS Server: whois.markmonitor.com
Registrar URL: http://www.markmonitor.com
Updated Date: 2019-08-26T12:19:56-0700
Creation Date: 1994-10-31T21:00:00-0800
Registrar Registration Expiration Date: 2024-10-30T00:00:00-0700
Registrar: MarkMonitor, Inc.
Registrar IANA ID: 292
Registrar Abuse Contact Email: abusecomplaints@markmonitor.com
Registrar Abuse Contact Phone: +1.2083895770
Domain Status: clientUpdateProhibited (https://www.icann.org/epp#clientUpdateProhibited)
Domain Status: clientTransferProhibited (https://www.icann.org/epp#clientTransferProhibited)
Domain Status: clientDeleteProhibited (https://www.icann.org/epp#clientDeleteProhibited)
Domain Status: serverUpdateProhibited (https://www.icann.org/epp#serverUpdateProhibited)
Domain Status: serverTransferProhibited (https://www.icann.org/epp#serverTransferProhibited)
Domain Status: serverDeleteProhibited (https://www.icann.org/epp#serverDeleteProhibited)
Registry Registrant ID:
Registrant Name: Hostmaster, Amazon Legal Dept.
Registrant Organization: Amazon Technologies, Inc.
Registrant Street: P.O. Box 8102
Registrant City: Reno
Registrant State/Province: NV
Registrant Postal Code: 89507
Registrant Country: US
Registrant Phone: +1.2062664064
Registrant Phone Ext:
Registrant Fax: +1.2062667010
Registrant Fax Ext:
Registrant Email: hostmaster@amazon.com
Registry Admin ID:
Admin Name: Hostmaster, Amazon Legal Dept.
Admin Organization: Amazon Technologies, Inc.
Admin Street: P.O. Box 8102
Admin City: Reno
Admin State/Province: NV
```

The whois command gives detailed information about domain names, domain status, registrant and admin status, etc.

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.

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2>nslookup spit.ac.in
Server:  www.routerlogin.com
Address:  192.168.1.1

Non-authoritative answer:
DNS request timed out.
    timeout was 2 seconds.
Name:    spit.ac.in
Address:  43.252.193.19
```

Ans:

- nslookup is a useful command for getting information from DNS server.
- It is a network administration tool for querying the Domain Name System (DNS) to obtain domain name or IP address mapping or any other specific DNS record.
- Therefore, to obtain the IP address of spit.ac.in domain, I used nslookup command.
- The IP address for spit.ac.in is 43.252.193.19

Curl

curl is a command line tool to transfer data to or from a server, using any of the supported protocols (HTTP, FTP, IMAP, POP3, SCP, SFTP, SMTP, TFTP, TELNET, LDAP or FILE).

```
C:\Users\Namrata Bhorade\Desktop\TE-COMPS\DCCN\Exp2>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"
}
```

Conclusion:

1. In this experiment, I learned about basic network utilities such as ping, traceroute, ipconfig, etc.
2. I learned about their implementation and variation in them depending upon different factors such as distance, packet size, etc.

References:

1. https://www.geeksforgeeks.org/ping-command-in-linux-with-examples/
2. https://www.geeksforgeeks.org/nslookup-command-in-linux-with-examples/
3. https://www.geeksforgeeks.org/ifconfig-command-in-linux-with-examples/
4. https://www.geeksforgeeks.org/netstat-command-linux/?ref=lbp