

# COL334 Computer Networks Assignment-1

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## 1. Network Analysis

### (a) Running traceroute

```
(base) soham@SVG-Ubuntu:~/workspace$ traceroute www.iitd.ac.in
traceroute to www.iitd.ac.in (103.27.9.24), 30 hops max, 60 byte packets
 1 * _gateway (192.168.43.149) 6.930 ms 6.944 ms
 2 * * *
 3 10.50.90.201 (10.50.90.201) 75.574 ms 87.678 ms 75.794 ms
 4 10.61.37.62 (10.61.37.62) 50.064 ms 10.61.37.54 (10.61.37.54) 63.206 ms 10.61.37.58 (10.61.37.58) 62.740 ms
 5 125.19.2.41 (125.19.2.41) 62.826 ms 62.698 ms 62.894 ms
 6 116.119.57.56 (116.119.57.56) 68.372 ms 61.974 ms 116.119.50.12 (116.119.50.12) 61.680 ms
 7 115.248.111.9 (115.248.111.9) 41.298 ms 40.966 ms 52.753 ms
 8 * * *
 9 115.249.198.97 (115.249.198.97) 70.688 ms 84.038 ms 83.489 ms
10 10.255.222.3 (10.255.222.3) 83.345 ms 10.255.221.3 (10.255.221.3) 83.631 ms 83.469 ms
11 10.255.222.245 (10.255.222.245) 83.642 ms 10.255.221.245 (10.255.221.245) 69.307 ms 75.558 ms
12 10.25.245.206 (10.25.245.206) 70.035 ms 10.25.245.202 (10.25.245.202) 72.230 ms 10.25.245.206 (10.25.245.206) 70.355 ms
13 10.1.200.142 (10.1.200.142) 82.908 ms 110.186 ms 89.368 ms
14 10.119.233.65 (10.119.233.65) 95.544 ms 88.434 ms 69.478 ms
15 10.119.233.66 (10.119.233.66) 90.264 ms 83.990 ms 69.090 ms
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```

Figure 1: tracerouting to www.iitd.ac.in

```
(base) soham@SVG-Ubuntu:~/workspace$ traceroute www.google.com
traceroute to www.google.com (216.58.203.4), 30 hops max, 60 byte packets
 1 _gateway (192.168.43.149) 4.135 ms 4.290 ms 4.373 ms
 2 * * *
 3 10.50.90.201 (10.50.90.201) 42.051 ms 53.529 ms 53.550 ms
 4 10.61.37.62 (10.61.37.62) 53.598 ms 10.61.37.54 (10.61.37.54) 55.863 ms 10.61.37.58 (10.61.37.58) 166.990 ms
 5 125.19.2.41 (125.19.2.41) 53.685 ms 53.747 ms 53.814 ms
 6 116.119.44.117 (116.119.44.117) 59.340 ms 182.79.177.95 (182.79.177.95) 52.380 ms 116.119.44.113 (116.119.44.113) 47.050 ms
 7 72.14.212.48 (72.14.212.48) 52.284 ms 46.564 ms 65.501 ms
 8 10.252.57.126 (10.252.57.126) 64.978 ms 10.252.169.190 (10.252.169.190) 65.022 ms 10.252.226.30 (10.252.226.30) 53.278 ms
 9 209.85.242.124 (209.85.242.124) 70.453 ms 108.170.248.209 (108.170.248.209) 65.440 ms 72.14.236.74 (72.14.236.74) 65.111 ms
10 108.170.248.194 (108.170.248.194) 62.943 ms 59.367 ms 108.170.248.202 (108.170.248.202) 59.934 ms
11 hkg12s09-in-f4.1e100.net (216.58.203.4) 59.157 ms 44.238 ms 59.540 ms
```

Figure 2: tracerouting to www.google.com

### (b) Observations/Findings

- First hop goes to the gateway of the LAN having a private IP address followed by a host which does not respond but still passes on the packets ahead and also their responses back.
- Many private IP addresses like 10.0.225.133, 192.168.65.75 were observed.
- traceroute to www.google.com finished in only 11 hops whereas traceroute to www.iitd.ac.in stop responding after 15 hops. Most probably, the packets reached host somewhere after 15 hops but the host did not respond and traceroute kept continuing.
- No default IPv6 paths were observed. For forcing IPv4 or IPv6 tracerouting, options `-4` or `-6` can be used with the `traceroute` command respectively.

### (c) Maximum size of ping packet able to send was 65527 but response time was large.

2. The bash script `traceroute_using_ping` replicates traceroute functionality using ping.  
Usage: `./traceroute_using_ping <destination>`  
Example: `./traceroute_using_ping.sh 216.58.203.4`
3. (a) Number of hops from 3 traceroute sources to 5 destinations. Note that in the following table,  $\geq n$  hops suggests that the last host which responded was  $n$  hops away and the destination host will be somewhere after this, but it didn't respond and traceroute kept continuing.

Destination	My device	USA	Germany
University of Utah (US mid-west)	29	20	30
University of Cape Town (South Africa)	$\geq 14$	$\geq 11$	$\geq 14$
IIT Delhi (India)	$\geq 15$	$\geq 10$	$\geq 11$
Google	11	9	9
Facebook	10	14	9

Table 1: Number of hops from 3 traceroute sources to 5 destinations

The number of hops when the destination was University of Utah (US mid-west) were fewer when tracerouting from US but was comparatively higher in other continents (Asia & Europe). But the number of hops in case of Google and Facebook were almost the same from every continent. This is because these large companies resort to methods like CDNs, direct over-sea links etc. for reducing number of hops while providing their services.

- (b) Latencies between the traceroute sources and the web-servers (in ms)

Destination	My device	USA	Germany
University of Utah (US mid-west)	333.479	52.066	153.855
University of Cape Town (South Africa)	$\geq 315.986$	$\geq 200.395$	$\geq 213.942$
IIT Delhi (India)	$\geq 83.84$	$\geq 231.395$	$\geq 156.705$
Google	44.285	3.74	4.277
Facebook	45.596	39.798	3.86

Table 2: Corresponding latencies (in ms)

In general, latency seem to be related to the number of hops, being higher when there are more hops. This is because there is high transmission and modulation delays due to the high number of routers while hopping. Also, large distances induce higher propagation delays.

- (c) The destination web-servers of all three educational institutes are resolved to the same IP address irrespective of from where tracerouting is done to them whereas Google and Facebook resolved to different IP addresses. This is because they have set up servers all over the world which keep copies of the same data so that they can provide their services from the nearest location with low latency.
- (d) When tracerouting from the same starting point to different IP addresses for the same web-server, the paths appear different. For instance, when tracerouting from my device to Google's different IP addresses: 216.58.203.4 took 12 hops (38 ms), 172.217.3.100 took 22 hops (364 ms) and 216.58.208.36 took 25 hops (312 ms).
- (e) While tracerouting to Google and Facebook from different countries, it seemed that every country have their local ISPs peered with Google and Facebook. All of the traceroutes to Google and Facebook finished within 10-12 hops and took less than 50 ms irrespective of the starting point.