

# Comp416 - Project 3 Report

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## Part 1. Network Layer Analysis

### Part-1.1 ICMP Analysis

```
Last login: Sat Jan 13 18:49:11 on console
(base) batuhanarat@Batuhan-MacBook-Pro ~ % traceroute ethz.ch
traceroute to ethz.ch (129.132.19.216), 64 hops max, 52 byte packets
 1  172.16.108.3 (172.16.108.3)  6.214 ms  4.044 ms  4.113 ms
 2  10.20.30.2 (10.20.30.2)  5.818 ms  5.567 ms  4.749 ms
 3  212.174.167.209 (212.174.167.209)  10.200 ms  15.901 ms  7.738 ms
 4  00-gayrettepe-sr14s-t2-1---00-buyukdere-t3-1.statik.turktelekom.com.tr (212.156.121.72)  9.319 ms  6.427 ms  6.148 ms
 5  * 41-gebze-t2-1---34-acibadem-xrs-t2-1.statik.turktelekom.com.tr (81.212.220.238)  7.409 ms  6.386 ms
 6  10-balika-sr12-t4-1---10-balikesir-sr12e-t3-3.statik.turktelekom.com.tr (81.212.209.182)  6.602 ms  7.000 ms  6.924 ms
 7  301-fra-col-2---00-ebgp-gayrettepe-k.statik.turktelekom.com.tr (212.156.101.196)  45.844 ms  49.567 ms  44.769 ms
 8  213.198.83.221 (213.198.83.221)  53.984 ms * 75.441 ms
 9  * * ae-7.r21.frnkge13.de.bb.gin.ntt.net (129.250.7.43)  57.695 ms
10  ae-0.a02.frnkge13.de.bb.gin.ntt.net (129.250.3.23)  57.421 ms
switch.ear2.frankfurt1.level3.net (213.19.204.142)  47.283 ms
ae-0.a02.frnkge13.de.bb.gin.ntt.net (129.250.3.23)  56.751 ms
11  swiez3-b5.switch.ch (130.59.37.6)  56.604 ms
ae11.cr7-fra2.ip4.gtt.net (46.33.83.253)  58.606 ms
swiez3-b5.switch.ch (130.59.37.6)  50.045 ms
12  rou-gw-lee-tengig-to-switch.ethz.ch (192.33.92.1)  50.465 ms
ae4.crl1-gva4.ip4.gtt.net (213.200.127.226)  56.774 ms
rou-gw-lee-tengig-to-switch.ethz.ch (192.33.92.1)  50.986 ms
13  ip4.gtt.net (154.14.130.98)  50.389 ms  49.263 ms
rou-fw-rz-rz-gw.ethz.ch (192.33.92.169)  51.988 ms
14  swibf1-b2.switch.ch (130.59.36.113)  54.268 ms * *
15  swiba3-b3.switch.ch (130.59.39.82)  62.344 ms  54.739 ms *
16  swiez3-b5.switch.ch (130.59.37.6)  62.617 ms * 55.184 ms
17  * * rou-gw-lee-tengig-to-switch.ethz.ch (192.33.92.1)  58.012 ms
18  rou-fw-rz-rz-gw.ethz.ch (192.33.92.169)  58.051 ms * *
19  * * *
20  * * *
21  * * *
```

My url is <https://ethz.ch/en.html> due to the pdf.

### 1)

Minimum TTL is 18. After the 18th hop we can see that it gives \*\*\* statement. Which means after that messages cannot reach because it is already arrived.

### 2)

Default number of probe is 3. We can see that it from the hop that 3 RTT values that means it has 3 messages.

I run with 4,5 and 10 probes. Here are the screenshots.

## Probe 4

```
((base) batuhanararat@Batuhan-MacBook-Pro ~ % traceroute q-4 ethz.ch
traceroute: "ethz.ch" bad value for packet length
(base) batuhanararat@Batuhan-MacBook-Pro ~ % traceroute q- 4 ethz.ch
Version 1.4a12+Darwin
Usage: traceroute [-adDefInrSvx] [-A as_server] [-f first_ttl] [-g gateway] [-i iface]
      [-M first_ttl] [-m max_ttl] [-p port] [-P proto] [-q nqueries] [-s src_addr]
      [-t tos] [-w waittime] [-z pauseseconds] host [packetlen]
(base) batuhanararat@Batuhan-MacBook-Pro ~ % traceroute -q 4 ethz.ch
traceroute to ethz.ch (129.132.19.216), 64 hops max, 52 byte packets
  1  172.16.108.3 (172.16.108.3)  12.183 ms  4.454 ms  4.131 ms  4.123 ms
  2  10.20.30.2 (10.20.30.2)  5.147 ms  5.104 ms  5.117 ms  4.857 ms
  3  212.174.167.209 (212.174.167.209)  7.115 ms  6.131 ms  6.436 ms  6.213 ms
  4  00-gayrettepe-sr14s-t2-1---00-buyukdere-t3-1.statik.turktelekom.com.tr (212.156.121.72)  6.514 ms  6.276 ms  5.895 ms  7.073 ms
  5  41-gehze-t2-1---34-acibadem-xrs-t2-1.statik.turktelekom.com.tr (81.212.220.238)  6.988 ms  6.087 ms  6.317 ms  5.913 ms
  6  10-baluya-sr12-t4-1---10-balikesir-sr12e-t3-3.statik.turktelekom.com.tr (81.212.209.102)  7.497 ms  6.615 ms  7.014 ms  7.307 ms
  7  301-fra-col-2---00-ebgp-gayrettepe-k.statik.turktelekom.com.tr (212.156.101.196)  45.903 ms  44.445 ms  44.670 ms  45.318 ms
  8  * 213.198.83.221. (213.198.83.221)  56.033 ms  * *
  9  ae-7.r21.frnkge13.de.bb.gin.ntt.net (129.250.7.43)  65.887 ms  *
ae-8.r20.frnkge13.de.bb.gin.ntt.net (129.250.7.17)  57.029 ms  57.498 ms
10 switch.ear2.frankfurt1.level3.net (213.19.204.142)  48.028 ms  47.027 ms
ae-1.a02.frnkge13.de.bb.gin.ntt.net (129.250.3.29)  55.341 ms  53.261 ms
11 swiez3-b5.switch.ch (130.59.37.6)  50.239 ms
ae11.cr7-fra2.ip4.gtt.net (46.33.83.253)  57.594 ms
swiez3-b5.switch.ch (130.59.37.6)  50.098 ms  49.526 ms
12 ae4.crl-gva4.ip4.gtt.net (213.200.127.226)  52.996 ms
rou-gw-lee-tengig-to-switch.ethz.ch (192.33.92.1)  56.299 ms
ae4.crl-gva4.ip4.gtt.net (213.200.127.226)  52.567 ms  52.576 ms
13 rou-fw-rz-rz-gw.ethz.ch (192.33.92.169)  52.455 ms
ip4.gtt.net (154.14.130.98)  50.026 ms
rou-fw-rz-rz-gw.ethz.ch (192.33.92.169)  52.229 ms  52.500 ms
14 swifb1-b2.switch.ch (130.59.36.113)  53.968 ms  53.598 ms  * *
15 swiba3-b3.switch.ch (130.59.39.82)  62.354 ms  * 59.323 ms  55.583 ms
16 * * swiez3-b5.switch.ch (130.59.37.6)  61.970 ms  54.064 ms
17 * rou-gw-lee-tengig-to-switch.ethz.ch (192.33.92.1)  62.934 ms  * *
18 rou-fw-rz-rz-gw.ethz.ch (192.33.92.169)  57.541 ms  55.073 ms  * *
19 * * * *
20 * * * *
```

## Probe 5

```
((base) batuhanararat@Batuhan-MacBook-Pro ~ % traceroute -q 5 ethz.ch
traceroute to ethz.ch (129.132.19.216), 64 hops max, 52 byte packets
  1  172.16.108.3 (172.16.108.3)  11.300 ms  3.615 ms  3.756 ms  3.718 ms  4.140 ms
  2  10.20.30.2 (10.20.30.2)  5.650 ms  7.765 ms  5.601 ms  5.018 ms  3.593 ms
  3  212.174.167.209 (212.174.167.209)  6.934 ms  13.022 ms  6.869 ms  5.987 ms  7.980 ms
  4  00-gayrettepe-sr14s-t2-1---00-buyukdere-t3-1.statik.turktelekom.com.tr (212.156.121.72)  7.135 ms  6.067 ms  6.190 ms  5.991 ms  5.870 ms
  5  * 41-gehze-t2-1---34-acibadem-xrs-t2-1.statik.turktelekom.com.tr (81.212.220.238)  899.174 ms  137.329 ms  9.827 ms  6.901 ms
  6  10-baluya-sr12-t4-1---10-balikesir-sr12e-t3-3.statik.turktelekom.com.tr (81.212.209.102)  8.107 ms  6.120 ms  6.533 ms  6.653 ms  7.033 ms
  7  301-fra-col-2---00-ebgp-gayrettepe-k.statik.turktelekom.com.tr (212.156.101.196)  45.231 ms  44.593 ms  44.189 ms  44.966 ms  44.269 ms
  8  213.198.83.221 (213.198.83.221)  50.822 ms  * *
  9  ae-7.r21.frnkge13.de.bb.gin.ntt.net (129.250.7.43)  221.340 ms
  ae-8.r20.frnkge13.de.bb.gin.ntt.net (129.250.7.17)  175.981 ms  * *
  ae-7.r21.frnkge13.de.bb.gin.ntt.net (129.250.7.43)  64.169 ms
10  ae-0.a02.frnkge13.de.bb.gin.ntt.net (129.250.3.23)  58.104 ms
switch.ear2.frankfurt1.level3.net (213.19.204.142)  48.299 ms  47.562 ms
ae-0.a02.frnkge13.de.bb.gin.ntt.net (129.250.3.23)  56.898 ms
switch.ear2.frankfurt1.level3.net (213.19.204.142)  47.848 ms
11  ae11.cr7-fra2.ip4.gtt.net (46.33.83.253)  59.227 ms  57.640 ms
swiez3-b5.switch.ch (130.59.37.6)  51.032 ms
ae11.cr7-fra2.ip4.gtt.net (46.33.83.253)  57.568 ms
swiez3-b5.switch.ch (130.59.37.6)  50.988 ms
12  rou-gw-lee-tengig-to-switch.ethz.ch (192.33.92.1)  50.993 ms
ae4.crl-gva4.ip4.gtt.net (213.200.127.226)  52.523 ms  65.883 ms
rou-gw-lee-tengig-to-switch.ethz.ch (192.33.92.1)  50.387 ms  50.619 ms
13  ip4.gtt.net (154.14.130.98)  50.054 ms  48.989 ms
rou-fw-rz-rz-gw.ethz.ch (192.33.92.169)  52.921 ms  52.003 ms
ip4.gtt.net (154.14.130.98)  49.058 ms
14  swifb1-b2.switch.ch (130.59.36.113)  55.067 ms  *  62.345 ms  *
15  swiba3-b3.switch.ch (130.59.39.82)  64.840 ms  55.492 ms  *  61.403 ms
16  swiez3-b5.switch.ch (130.59.37.6)  53.929 ms  *  61.544 ms  53.165 ms
17  * * rou-gw-lee-tengig-to-switch.ethz.ch (192.33.92.1)  62.976 ms  54.775 ms  *
18  rou-fw-rz-rz-gw.ethz.ch (192.33.92.169)  64.552 ms  *  63.941 ms  56.001 ms
19  * * * *
20  * * * *
21  * * * *
```

## Probe 6

```
(base) batuhanararat@Batuhan-MacBook-Pro ~ % traceroute -q 6 ethz.ch
traceroute to ethz.ch (129.132.19.216), 64 hops max, 52 byte packets
 1 172.16.108.3 (172.16.108.3) 4.436 ms 3.983 ms 3.676 ms 4.445 ms 3.978 ms 3.689 ms
 2 18.29.38.2 (18.29.38.2) 5.838 ms 5.023 ms 5.088 ms 5.212 ms 4.834 ms 5.010 ms
 3 212.174.167.289 (212.174.167.289) 6.126 ms 7.575 ms 9.831 ms 6.011 ms 6.485 ms 6.333 ms
 4 *#0-pavrettepe-srl4s-t2-1---00-buyukdere-t3-1.statik.turktelekom.com.tr (212.156.121.72) 7.225 ms 7.377 ms 7.284 ms 6.616 ms 6.340 ms 6.156 ms
 5 *#1-gebre-t2-1---34-acibadem-xrs-t2-1.statik.turktelekom.com.tr (81.212.220.238) 13.468 ms
 6 10-baluya-srl2-t4-1---10-balikesir-srl2e-t3-3.statik.turktelekom.com.tr (81.212.209.102) 6.489 ms 6.094 ms 5.891 ms 6.728 ms 7.168 ms 6.413 ms
 7 381-fra-col-2---00-ebgn-pavrettepe-k.statik.turktelekom.com.tr (212.156.101.196) 45.052 ms 44.388 ms 44.632 ms 45.316 ms 44.565 ms 44.298 ms
 8 213.198.83.221 (213.198.83.221) 50.687 ms 50.269 ms
 9 123.198.83.221 (213.198.83.221) 54.917 ms * *
10  ae-7.r21.frnkg13.de.bb.gin.ntt.net (129.258.7.43) 66.149 ms 59.586 ms
11  ae-8.r28.frnkg13.de.bb.gin.ntt.net (129.258.7.17) 80.429 ms 49.238 ms * *
12  ae-1.a02.frnkg13.de.bb.gin.ntt.net (129.258.3.23) 65.718 ms
13  ae-1.a02.frnkg13.de.bb.gin.ntt.net (129.258.3.29) 58.051 ms
14  switch.eaz2.frankfurt1.level3.net (213.19.284.142) 47.572 ms 46.891 ms 47.842 ms 47.496 ms
15  ae11.cr7-fra2.ip4.gtt.net (46.33.83.253) 60.578 ms 57.075 ms
16  swie23-b5.switch.ch (138.59.37.6) 49.982 ms 50.024 ms
17  rou-gw-lee-tengig-to-switch.ethz.ch (192.33.92.1) 51.699 ms 50.688 ms
18  ae4.crl-pv4.ip4.gtt.net (213.208.127.226) 246.253 ms 52.977 ms
19  rou-gw-lee-tengig-to-switch.ethz.ch (192.33.92.1) 56.691 ms 50.660 ms
20  ip4.gtt.net (154.14.136.98) 49.726 ms 48.621 ms 49.538 ms 49.363 ms
21  rou-TW-rz-rz-gw.ethz.ch (192.33.92.169) 53.084 ms
22  ip4.gtt.net (154.14.136.98) 49.280 ms
23  swibf1-b2.switch.ch (138.59.36.113) 54.342 ms 54.228 ms * * * *
24  swibd3-b3.switch.ch (138.59.39.82) 56.788 ms 54.522 ms * * 59.139 ms 52.958 ms
25  swie23-b5.switch.ch (138.59.37.6) 53.587 ms 52.695 ms * * 59.048 ms * *
26  rou-gw-lee-tengig-to-switch.ethz.ch (192.33.92.1) 62.990 ms 54.158 ms 53.602 ms 54.159 ms * 59.959 ms
27  rou-TW-rz-rz-gw.ethz.ch (192.33.92.169) 64.241 ms 55.827 ms 56.180 ms 55.698 ms
28  * * * rou-TW-rz-rz-gw.ethz.ch (192.33.92.169) 56.827 ms 56.180 ms 55.698 ms
29  * * * *
```

## Probe 10

```
(base) batuhanararat@Batuhan-MacBook-Pro ~ % traceroute -q 10 ethz.ch
traceroute to ethz.ch (129.132.19.216), 64 hops max, 52 byte packets
 1 172.16.108.3 (172.16.108.3) 4.971 ms 4.128 ms 4.004 ms 3.945 ms 4.078 ms 4.991 ms * 11.956 ms 2.918 ms 2.688 ms
 2 18.29.38.2 (18.29.38.2) 5.020 ms 5.211 ms 5.041 ms 5.210 ms 5.075 ms 5.104 ms 10.187 ms 5.737 ms 4.442 ms
 3 212.174.167.289 (212.174.167.289) 7.988 ms 6.228 ms 6.447 ms 6.193 ms 6.424 ms 6.178 ms 6.047 ms 7.299 ms 5.946 ms 6.154 ms
 4 *#0-pavrettepe-srl4s-t2-1---00-buyukdere-t3-1.statik.turktelekom.com.tr (212.156.121.72) 6.580 ms 6.948 ms 6.448 ms 6.253 ms 6.076 ms 6.196 ms 6.536 ms 6.629 ms 6.628 ms 5.721 ms
 5 *#1-gebre-t2-1---34-acibadem-xrs-t2-1.statik.turktelekom.com.tr (81.212.220.238) 6.939 ms 6.436 ms 6.390 ms 6.936 ms 6.640 ms 6.392 ms 6.397 ms
 6 10-baluya-srl2-t4-1---10-balikesir-srl2e-t3-3.statik.turktelekom.com.tr (81.212.209.102) 6.841 ms 6.423 ms 6.847 ms 6.649 ms 6.748 ms 6.573 ms 7.216 ms 6.371 ms 6.518 ms 6.433 ms
 7 381-fra-col-2---00-ebgn-pavrettepe-k.statik.turktelekom.com.tr (212.156.101.196) 45.000 ms 44.222 ms 45.118 ms 45.966 ms 44.221 ms 45.262 ms 43.569 ms 44.305 ms 44.004 ms 44.886 ms
 8 213.198.83.221 (213.198.83.221) 50.437 ms 50.144 ms * * 59.793 ms * 60.817 ms * 58.523 ms 50.568 ms
 9 *#1-ae-8.r28.frnkg13.de.bb.gin.ntt.net (129.258.7.17) 57.523 ms *
10  ae-7.r21.frnkg13.de.bb.gin.ntt.net (129.258.7.43) 67.585 ms
11  ae-8.r28.frnkg13.de.bb.gin.ntt.net (129.258.7.17) 67.585 ms
12  swie23-b5.switch.ch (138.59.37.6) 57.384 ms
13  ae-7.r21.frnkg13.de.bb.gin.ntt.net (129.258.7.43) 67.764 ms
14  switch.eaz2.frankfurt1.level3.net (213.19.204.124) 48.029 ms
15  ae-1.a02.frnkg13.de.bb.gin.ntt.net (129.258.3.29) 54.814 ms
16  switch.eaz2.frankfurt1.level3.net (213.19.284.142) 47.232 ms
17  ae-0.a02.frnkg13.de.bb.gin.ntt.net (129.258.3.23) 57.675 ms
18  switch.eaz2.frankfurt1.level3.net (213.19.284.142) 47.169 ms 47.590 ms
19  ae-1.a02.frnkg13.de.bb.gin.ntt.net (129.258.3.29) 63.589 ms 60.069 ms
20  switch.eaz2.frankfurt1.level3.net (213.19.204.142) 47.404 ms
21  ae-0.a02.frnkg13.de.bb.gin.ntt.net (129.258.3.23) 66.915 ms
22  swie23-b5.switch.ch (138.59.37.6) 56.428 ms
23  ae11.cr7-fra2.ip4.gtt.net (46.33.83.253) 57.415 ms
24  swie23-b5.switch.ch (138.59.37.6) 49.899 ms 50.041 ms
25  ae11.cr7-fra2.ip4.gtt.net (46.33.83.253) 57.392 ms 57.348 ms
26  swie23-b5.switch.ch (138.59.37.6) 49.469 ms
27  ae11.cr7-fra2.ip4.gtt.net (46.33.83.253) 56.958 ms
28  swie23-b5.switch.ch (138.59.37.6) 49.771 ms
29  ae11.cr7-fra2.ip4.gtt.net (46.33.83.253) 52.458 ms
30  swibf1-b2.switch.ch (138.59.36.113) 51.044 ms 52.480 ms
31  ae6.crl-pv4.ip4.gtt.net (213.208.127.226) 176.187 ms 55.289 ms
32  rou-gw-lee-tengig-to-switch.ethz.ch (192.33.92.1) 50.547 ms
33  ae6.crl-pv4.ip4.gtt.net (213.208.127.226) 51.903 ms
34  rou-gw-lee-tengig-to-switch.ethz.ch (192.33.92.1) 51.225 ms 50.880 ms
35  ae6.crl-pv4.ip4.gtt.net (213.208.127.226) 52.158 ms 52.232 ms
36  rou-fw-rz-rz-gw.ethz.ch (192.33.92.169) 52.615 ms 51.739 ms
37  ip4.gtt.net (154.14.138.98) 49.499 ms
38  rou-fw-rz-rz-gw.ethz.ch (192.33.92.169) 52.001 ms
39  ip4.gtt.net (154.14.138.98) 47.000 ms
40  rou-fw-rz-rz-gw.ethz.ch (192.33.92.169) 51.984 ms
41  ip4.gtt.net (154.14.138.98) 48.982 ms 49.299 ms
42  rou-fw-rz-rz-gw.ethz.ch (192.33.92.169) 52.710 ms 52.222 ms
43  swibf1-b2.switch.ch (138.59.36.113) 54.318 ms * * 60.478 ms * * 61.902 ms 53.968 ms * 64.103 ms
44  *#swibd3-b3.switch.ch (138.59.39.82) 60.483 ms * * 61.397 ms 53.208 ms * 61.919 ms * *
45  swie23-b5.switch.ch (138.59.37.6) 62.374 ms 53.708 ms * * 60.349 ms * 58.637 ms * 54.245 ms 53.444 ms
46  *#rou-fw-rz-rz-gw.ethz.ch (192.33.92.1) 63.020 ms * 53.716 ms 54.584 ms * 54.432 ms * *
47  rou-fw-rz-rz-gw.ethz.ch (192.33.92.169) 55.811 ms * 61.256 ms * 56.365 ms * * 57.034 ms * *
48  * * * *
```

When we are increasing the probe number we can effectively analyze on which hop our packets encounter with problem due to the network traffic. This happens because when we are increasing the packets it gives more information about the success .

Some analysis upon the resolution.

At probe number 6, on hop 8, 2 messages out of 6 messages cannot return

At probe number 10, we can see that on hop 8, 4 messages out of 10 messages cannot return.

At hop 10, we can say that we have less traffic issue because at probe numbers 4,5,6 and 10 it always reach.

We can do the similar analysis from the screenshots. Each \* at the rows means that packet cannot successfully tracoute.

### **3)**

I am not using Linux.

### **4)**

Routing Blackhole means that traffic connection is dropped or route is lost. It is usually happening without informing the source. Packet enters but don't reach to their destination.

#### **Use case:**

DDoS attacks are the attacks that when adversary doing many requests to the server which leads to other people cannot use the server because of the traffic. When this attack is detected, we can reroute the traffic from the attacking sources which makes a routing blackhole.

## **Part-1.2 Network Interface Analysis**

ip command won't work in my machine. So I am using ifconfig and netstat for this part. Those two commands together cover the functionality of the ip command.

#### **ifconfig en0**

**Usage:** Show information about en0 network interface.

```
[2017 command not found: ip
[(base) batuhanarat@Batuhan-MacBook-Pro ~ % ifconfig en0
en0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    options=6463<RXCSUM,TXCSUM,TSO4,TSO6,CHANNEL_IO,PARTIAL_CSUM,ZEROINVERT_CSUM>
    ether a4:cf:99:64:ff:bc
    inet 172.20.149.104 netmask 0xfffffff800 broadcast 172.20.151.255
    inet6 fe80::85c:3c82:4a74:9d99%en0 prefixlen 64 secured scopeid 0xc
    inet 172.16.111.72 netmask 0xffffffffc00 broadcast 172.16.111.255
    nd6 options=201<PERFORMNUD,DAD>
    media: autoselect
    status: active
(base) batuhanarat@Batuhan-MacBook-Pro ~ % ]
```

**sudo ifconfig en0 down and sudo ifconfig en0 up**

**Usage:** They enable or disable the network interface which can be used on the troubleshooting

```
[(base) batuhanarat@Batuhan-MacBook-Pro ~ % sudo ifconfig en0 down
[Password:
(base) batuhanarat@Batuhan-MacBook-Pro ~ % ]
```



```
[Password:
[(base) batuhanarat@Batuhan-MacBook-Pro ~ % sudo ifconfig en0 up
(base) batuhanarat@Batuhan-MacBook-Pro ~ % ]
```



**netstat -r**

**Usage:** It shows how my system routes traffic to different networks.

```
(base) batuhanar@Batuhan-MacBook-Pro ~ % netstat -r
Routing tables

Internet:
Destination      Gateway        Flags     Netif  Expire
default          172.16.108.1   UGScg    en0
127              localhost      UCS      lo0
localhost        localhost      UH       lo0
169.254          link#12       UCS      en0      !
169.254.68.252  26:0:ee:3e:6d:d6  UHLSW    en0    1171
169.254.91.161  14:7d:da:12:6b:19  UHLWI    en0    1167
169.254.136.183 be:95:14:26:45:32  UHLWI    en0    1179
172.16.108/22   link#12       UCS      en0      !
172.16.108.1/32 link#12       UCS      en0      !
172.16.108.1    0:1c:7f:64:19:f   UHLWIir  en0    1162
172.16.108.3    0:1c:7f:64:19:f   UHLWI    en0    1185
172.16.108.43   e8:2a:44:df:fd:dd UHLWII   en0    1040
172.16.108.115  f0:2f:4b:d:c2:78 UHLWI    en0    968
172.16.108.220  8e:ba:39:33:79:41 UHLWI    en0    1183
172.16.109.237  84:7b:57:4c:16:3e UHLWI    en0    1150
172.16.110.27   dc:a9:4:7f:bf:5b UHLWI    en0    1028
172.16.110.128  7c:7a:91:1d:3f:62 UHLWI    en0    1096
172.16.110.179  8c:c8:4b:94:77:e1 UHLWI    en0    1006
172.16.110.253  5c:fb:3a:54:a:ed UHLWI    en0    1162
172.16.111.30   a0:78:17:b3:af:53 UHLWI    en0    1087
172.16.111.71   5e:d0:85:14:97:cc UHLWI    en0    1116
172.16.111.72/32 link#12       UCS      en0      !
172.16.111.255  ff:ff:ff:ff:ff:ff UHLWbI   en0      !
172.20.144/21   link#12       UC       en0      !
172.20.151.255  ff:ff:ff:ff:ff:ff UHLWbI   en0      !
224.0.0/4       link#12       UmCS    en0      !
mdns.mcast.net  1:0:5e:0:0:fb   UHmLWI   en0
239.255.255.250 1:0:5e:7f:ff:fa   UHmLWI   en0
255.255.255.255/32 link#12       UCS      en0      !

Internet6:
Destination      Gateway        Flags     Netif  Expire
default          fe80::%utun0   UGcIg    utun0
default          fe80::%utun1   UGcIg    utun1
default          fe80::%utun2   UGcIg    utun2
default          fe80::%utun3   UGcIg    utun3
default          fe80::%utun4   UGcIg    utun4
localhost        localhost      UHL      lo0
fe80::%lo0       batuhan-macbook-pr UCI      lo0
batuhan-macbook-pr link#1    UHLI     lo0
fe80::%anpi0     link#4    UCI      anpi0
batuhan-macbook-pr 1a:3e:8c:6c:9d:91  UHLI     lo0
fe80::%anpi1     link#5    UCI      anpi1
batuhan-macbook-pr 1a:3e:8c:6c:9d:92  UHLI     lo0
fe80::%en0       link#12   UCI      en0
batuhan-macbook-pr a4:cf:99:64:ff:bc  UHLI     lo0
fe80::9072:2dff:fe 92:72:2d:19:5e:7a  UHLI     lo0
fe80::9072:2dff:fe 92:72:2d:19:5e:7a  UHLI     lo0
fe80::%utun0     batuhan-macbook-pr UCI      utun0
batuhan-macbook-pr link#15   UHLI     lo0
fe80::%utun1     batuhan-macbook-pr UCI      utun1
batuhan-macbook-pr link#16   UHLI     lo0
fe80::%utun2     batuhan-macbook-pr UCI      utun2
batuhan-macbook-pr link#17   UHLI     lo0
fe80::%utun3     batuhan-macbook-pr UCI      utun3
batuhan-macbook-pr link#18   UHLI     lo0
```

## netstat -i

**Usage:** It displays statistics for each network interface. (Such as number of packets and bytes sent and received)

Name	Mtu	Network	Address	Ipkts	Ierrs	Opkts	Oerrs	Coll
lo0	16384	<Link#1>		43028	0	43028	0	0
lo0	16384	127	localhost	43028	-	43028	-	-
lo0	16384	localhost	::1	43028	-	43028	-	-
lo0	16384	batuhan-mac	fe80:1::1	43028	-	43028	-	-
gif0*	1280	<Link#2>		0	0	0	0	0
stf0*	1280	<Link#3>		0	0	0	0	0
anpi0	1500	<Link#4>	1a:3e:8c:6c:9d:91	0	0	0	0	0
anpi0	1500	batuhan-mac	fe80:4::183e:8cff	0	-	0	-	-
anpi1	1500	<Link#5>	1a:3e:8c:6c:9d:92	0	0	0	0	0
anpi1	1500	batuhan-mac	fe80:5::183e:8cff	0	-	0	-	-
en3	1500	<Link#6>	1a:3e:8c:6c:9d:71	0	0	0	0	0
en4	1500	<Link#7>	1a:3e:8c:6c:9d:72	0	0	0	0	0
en1	1500	<Link#8>	36:67:a7:6c:a4:00	0	0	0	0	0
en2	1500	<Link#9>	36:67:a7:6c:a4:04	0	0	0	0	0
bridge0	1500	<Link#10>	36:67:a7:6c:a4:00	0	0	0	0	0
ap1*	1500	<Link#11>	a6:cf:99:64:ff:bc	0	0	0	0	0
en0	1500	<Link#12>	a4:cf:99:64:ff:bc	6324287	0	1475888	0	0
en0	1500	172.20.144/21	172.20.149.104	6324287	-	1475888	-	-
en0	1500	batuhan-mac	fe80:c::85c:3c82:	6324287	-	1475888	-	-
en0	1500	172.16.108/22	172.16.111.72	6324287	-	1475888	-	-
awdl0	1500	<Link#13>	92:72:2d:19:5e:7a	3991	0	2094	0	0
awdl0	1500	fe80::9072:	fe80:d::9072:2dff	3991	-	2094	-	-
llw0	1500	<Link#14>	92:72:2d:19:5e:7a	0	0	0	0	0
llw0	1500	fe80::9072:	fe80:e::9072:2dff	0	-	0	-	-
utun0	2000	<Link#15>		0	0	2	0	0
utun0	2000	batuhan-mac	fe80:f::cb81:6893	0	-	2	-	-
utun1	1000	<Link#16>		0	0	2	0	0
utun1	1000	batuhan-mac	fe80:10::ce81:b1c	0	-	2	-	-
utun2	1380	<Link#17>		0	0	2	0	0
utun2	1380	batuhan-mac	fe80:11::3783:615	0	-	2	-	-
utun3	1380	<Link#18>		120	0	118	0	0
utun3	1380	batuhan-mac	fe80:12::558a:c35	120	-	118	-	-
utun4	1380	<Link#19>		0	0	4	0	0
utun4	1380	batuhan-mac	fe80:13::29a5:62c	0	-	4	-	-

## netstat -an

**Usage:** It shows all active network connections and listening ports.

```
(base) batuhanar@Batuhan-MacBook-Pro ~ % netstat -an
Active Internet connections (including servers)
Proto Recv-Q Send-Q Local Address          Foreign Address        (state)
tcp6    0      0 fe80::558a:c35e:.1027  fe80::a8ee:4450:.1025 ESTABLISHED
tcp6    0      0 fe80::558a:c35e:.1024  fe80::a8ee:4450:.1024 ESTABLISHED
tcp6    0      0 *.50655                 *.*                  LISTEN
tcp4    0      0 *.50655                 *.*                  LISTEN
tcp4    0      0 127.0.0.1.63342       *.*                  LISTEN
tcp4    0      0 127.0.0.1.52607       *.*                  LISTEN
tcp4    0      0 127.0.0.1.45623       *.*                  LISTEN
tcp4    0      0 127.0.0.1.49237       *.*                  LISTEN
tcp4    0      0 127.0.0.1.49236       *.*                  LISTEN
tcp4    0      0 127.0.0.1.16494       *.*                  LISTEN
tcp4    0      0 127.0.0.1.15393       *.*                  LISTEN
tcp4    0      0 127.0.0.1.15292       *.*                  LISTEN
tcp6    0      0 *.5000                *.*                  LISTEN
tcp4    0      0 *.5000                *.*                  LISTEN
tcp6    0      0 *.7000                *.*                  LISTEN
tcp4    0      0 *.7000                *.*                  LISTEN
tcp4    0      0 127.0.0.1.3212       *.*                  LISTEN
tcp4    0      0 127.0.0.1.3213       *.*                  LISTEN
tcp4    0      0 *.88                 *.*                  LISTEN
tcp6    0      0 *.88                 *.*                  LISTEN
tcp4    0      0 *.445                *.*                  LISTEN
tcp6    0      0 *.445                *.*                  LISTEN
tcp4    0      0 172.16.111.72.50852   172.16.122.89.7000 TIME_WAIT
tcp4    0      0 172.16.111.72.50853   172.16.114.114.7000 TIME_WAIT
tcp4    0      0 172.16.111.72.62707   104.18.39.102.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62706   104.18.39.102.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62705   35.157.46.85.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62704   142.250.27.84.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62698   2.17.232.23.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62696   17.253.73.202.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62694   17.248.213.67.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62691   142.250.187.110.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62663   104.244.42.130.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62657   104.244.42.65.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62645   3.217.166.173.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62639   104.18.39.102.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62632   142.250.187.163.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62629   176.34.53.12.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62610   104.18.39.102.443 ESTABLISHED
tcp4    0      0 172.16.111.72.62607   17.57.146.135.5223 ESTABLISHED
udp4    0      0 *.53332               *.*                  *
udp4    0      0 *.58025               *.*                  *
udp4    0      0 *.64892               *.*                  *
udp4    0      0 *.55321               *.*                  *
udp4    0      0 *.56103               *.*                  *
udp4    0      0 *.52192               *.*                  *
udp4    0      0 *.54944               *.*                  *
udp4    0      0 *.*                  *.*                  *
```

## Part 2. Understanding IP and Subnetting

```
(base) batuhanararat@Batuhan-MacBook-Pro ~ % ifconfig en0
en0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    options=6463<RXCSUM,TXCSUM,TSO4,TSO6,CHANNEL_IO,PARTIAL_CSUM,ZEROINVERT_CSUM>
    ether a4:cf:99:64:ff:bc
    inet 172.20.149.104 netmask 0xfffff800 broadcast 172.20.151.255
        inet6 fe80::85c:3c82:4a74:9d99%en0 prefixlen 64 secured scopeid 0xc
    inet 172.16.111.72 netmask 0xfffffc00 broadcast 172.16.111.255
        nd6 options=201<PERFORMNUD,DAD>
    media: autoselect
    status: active
(base) batuhanararat@Batuhan-MacBook-Pro ~ %
```

## 1)

**IP Address:** It is a unique address assigned to my device on the network

When i write ifconfig en0, i can see the interface that is currently active. When we look at the output we can see the ip address at the row which starts with inet address.

Which is **172.20.149.104**

## 2)

**Subnet Mask:** That defines the network portion and the host portion of the IP address.

Subnet mask can be listed after netmask which is **0xfffff800**.

## 3)

**Network Address:** Which defines the subnet within the larger network.

**0xfffff800 → subnet mask in hexadecimal format.**

We have to convert it to the binary

- **f** (in hex) = **1111** (in binary)
- **8** (in hex) = **1000** (in binary)
- **0** (in hex) = **0000** (in binary)

So, **0xfffff800** in binary is **11111111.11111111.1111000.00000000**.

and in decimal format **255.255.248.0**

In order to find network address, we need to perform a bitwise AND operation between IP address and subnet mask

IP Address: 10101100.00010100.10010101.01101000 (172.20.149.104)

Subnet Mask: 11111111.11111111.1111000.00000000 (255.255.248.0)

Network Addr: 10101100.00010100.10010000.00000000

which is in decimal form: 172.20.144.0

4)

**Broadcast Address:** Used for sending packets to all devices on the subnet

Broadcast address is comes after broadcast keyword and it is 172.20.151.255

5)

Number of devices in a network is determined by the number of host bits in the subnet mask. Subnet mask has 11 0's at the end. Which means there are 11 bits used for the host addresses.

Maximum devices can be calculated from

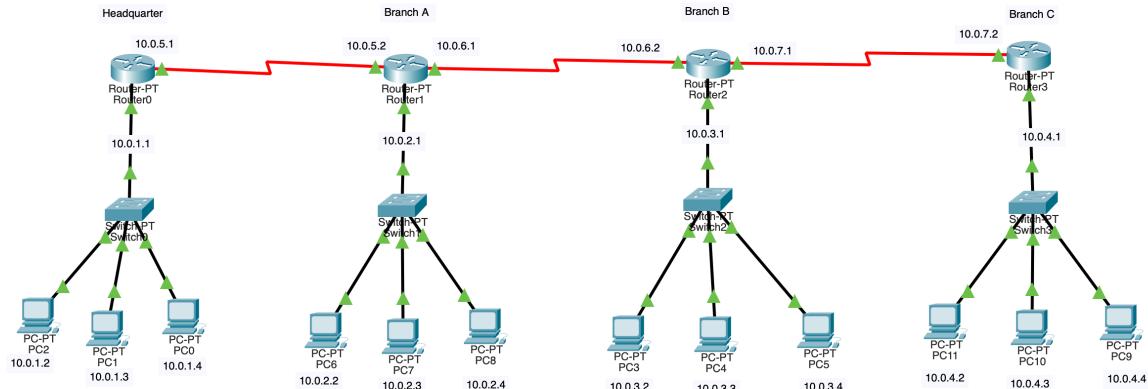
$$\text{Number of devices in a network} = 2^{\text{bits for host addresses}} - 2$$

$$2^{11} - 2 = 2048 - 2 = 2046$$

(Subtracting by 2 accounts for network address and broadcast address)

## Part 3. Simulations with Cisco Packet Tracer

1)



## 2)

I choose Option II.

Which is 10.0.0.0/16

because it has larger address space.  $32-16 = 16$

$2^{16} - 2 = 65534$  address space according to others.

we can create multiple /24 subnets for each branch.

As network grows, we might need to add more devices or branches. With **10.0.0.0/16**, we are less likely to run out of addresses and won't need to reconfigure your network to accommodate growth.

## 3)

We have calculated total addressable spaces on previous question.

Now focusing on possible subnets.

Our parent network has /16 and /24 subnets for each branch we can have total of

$$2^{24-16} = 2^8 = 256 \text{ subnets}$$

but we reserved 10.0.0.0/24 for network infrastructure, so we have 256 branches for subnet

Each /24 subnet can support up to 254 devices.

$$256 - 2 = 254 \text{ (1 address for network and 1 address for broadcast)}$$

## 4)

Configuration Task	CLI Command
Enter Global Configuration Mode	configure terminal or conf t
Configure an Interface	interface [interface_type] [interface_num]
Assign IP Address to an Interface	ip address [ip_address] [subnet_mask]
Activate an Interface	no shutdown
Configure Routing (Static Routing)	ip route [destination_network] [subnet_mask] [next_hop_ip]
Save Configuration	write memory or copy running-config startup-config

## 5)

CLI command for that is `show ip route`

### Headquarter Router

```
Router>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - candidate default, U - per-user static route, o - ODR
      P - periodic downloaded static route

Gateway of last resort is not set

  10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
C        10.0.1.0/24 is directly connected, FastEthernet0/0
S        10.0.2.0/24 [1/0] via 10.0.5.2
S        10.0.3.0/24 [1/0] via 10.0.5.2
S        10.0.4.0/24 [1/0] via 10.0.5.2
C        10.0.5.0/30 is directly connected, Serial2/0
```

## Branch A Router

```
Router>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - candidate default, U - per-user static route, o - ODR
      P - periodic downloaded static route

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 7 subnets, 2 masks
S        10.0.1.0/24 [1/0] via 10.0.5.1
C        10.0.2.0/24 is directly connected, FastEthernet0/0
S        10.0.3.0/24 [1/0] via 10.0.6.2
S        10.0.4.0/24 [1/0] via 10.0.6.2
C        10.0.5.0/30 is directly connected, Serial2/0
C        10.0.6.0/30 is directly connected, Serial3/0
S        10.0.7.0/24 [1/0] via 10.0.6.2
```

## Branch B Router

```
Router>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - candidate default, U - per-user static route, o - ODR
      P - periodic downloaded static route

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 7 subnets, 2 masks
S        10.0.1.0/24 [1/0] via 10.0.6.1
S        10.0.2.0/24 [1/0] via 10.0.6.1
C        10.0.3.0/24 is directly connected, FastEthernet0/0
S        10.0.4.0/24 [1/0] via 10.0.7.2
S        10.0.5.0/24 [1/0] via 10.0.6.1
C        10.0.6.0/30 is directly connected, Serial2/0
C        10.0.7.0/30 is directly connected, Serial3/0
```

## Branch C Router

```
Router>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - candidate default, U - per-user static route, o - ODR
      P - periodic downloaded static route

Gateway of last resort is not set

  10.0.0.0/8 is variably subnetted, 7 subnets, 2 masks
S   10.0.1.0/24 [1/0] via 10.0.7.1
S   10.0.2.0/24 [1/0] via 10.0.7.1
S   10.0.3.0/24 [1/0] via 10.0.7.1
C   10.0.4.0/24 is directly connected, FastEthernet0/0
S   10.0.5.0/24 [1/0] via 10.0.6.1
S   10.0.6.0/24 [1/0] via 10.0.7.1
C   10.0.7.0/30 is directly connected, Serial2/0

Router>
```

6)

Device from Headquarters to each branch

I choose PC0 from headquarter branch

To Branch A : PC6 (10.0.2.2)

```
CISCO Packet Tracer PC Command Line 1.0
C:\>ping 10.0.2.2

Pinging 10.0.2.2 with 32 bytes of data:

Reply from 10.0.2.2: bytes=32 time=3ms TTL=126
Reply from 10.0.2.2: bytes=32 time=1ms TTL=126
Reply from 10.0.2.2: bytes=32 time=1ms TTL=126
Reply from 10.0.2.2: bytes=32 time=23ms TTL=126

Ping statistics for 10.0.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 23ms, Average = 7ms
```

To Branch B: PC5 (10.0.3.4)

```
C:\>ping 10.0.3.4

Pinging 10.0.3.4 with 32 bytes of data:

Reply from 10.0.3.4: bytes=32 time=19ms TTL=125
Reply from 10.0.3.4: bytes=32 time=30ms TTL=125
Reply from 10.0.3.4: bytes=32 time=25ms TTL=125
Reply from 10.0.3.4: bytes=32 time=25ms TTL=125

Ping statistics for 10.0.3.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 19ms, Maximum = 30ms, Average = 24ms
```

To Branch C : PC11 (10.0.4.2)

```
C:\>ping 10.0.4.2

Pinging 10.0.4.2 with 32 bytes of data:

Request timed out.
Reply from 10.0.4.2: bytes=32 time=37ms TTL=124
Reply from 10.0.4.2: bytes=32 time=52ms TTL=124
Reply from 10.0.4.2: bytes=32 time=57ms TTL=124

Ping statistics for 10.0.4.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 37ms, Maximum = 57ms, Average = 48ms

C:\>ping 10.0.4.2

Pinging 10.0.4.2 with 32 bytes of data:

Reply from 10.0.4.2: bytes=32 time=24ms TTL=124
Reply from 10.0.4.2: bytes=32 time=34ms TTL=124
Reply from 10.0.4.2: bytes=32 time=40ms TTL=124
Reply from 10.0.4.2: bytes=32 time=30ms TTL=124

Ping statistics for 10.0.4.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 24ms, Maximum = 40ms, Average = 32ms
```

## Device from Branch A to each branch

I choose PC7 from branch A

To Headquarters : PC1 (10.0.1.3)

```
CISCO PACKET TRACER PC COMMAND LINE 1.0
C:\>ping 10.0.1.3

Pinging 10.0.1.3 with 32 bytes of data:

Reply from 10.0.1.3: bytes=32 time=2ms TTL=126
Reply from 10.0.1.3: bytes=32 time=1ms TTL=126
Reply from 10.0.1.3: bytes=32 time=16ms TTL=126
Reply from 10.0.1.3: bytes=32 time=1ms TTL=126

Ping statistics for 10.0.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 16ms, Average = 5ms
```

### To Branch B: PC4 (10.0.3.3)

```
C:\>ping 10.0.3.3

Pinging 10.0.3.3 with 32 bytes of data:

Reply from 10.0.3.3: bytes=32 time=11ms TTL=126
Reply from 10.0.3.3: bytes=32 time=24ms TTL=126
Reply from 10.0.3.3: bytes=32 time=1ms TTL=126
Reply from 10.0.3.3: bytes=32 time=1ms TTL=126

Ping statistics for 10.0.3.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 24ms, Average = 9ms
```

### To Branch C : PC10 (10.0.4.3)

```
C:\>ping 10.0.4.3

Pinging 10.0.4.3 with 32 bytes of data:

Reply from 10.0.4.3: bytes=32 time=29ms TTL=125
Reply from 10.0.4.3: bytes=32 time=2ms TTL=125
Reply from 10.0.4.3: bytes=32 time=29ms TTL=125
Reply from 10.0.4.3: bytes=32 time=2ms TTL=125

Ping statistics for 10.0.4.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 29ms, Average = 15ms
```

### Device from Branch B to each branch

I choose PC3 from branch B

To Headquarters: PC2 (10.0.1.2)

```
CISCO PACKET TRACER TO COMMAND LINE 1.0
C:\>ping 10.0.1.2

Pinging 10.0.1.2 with 32 bytes of data:

Reply from 10.0.1.2: bytes=32 time=46ms TTL=125
Reply from 10.0.1.2: bytes=32 time=36ms TTL=125
Reply from 10.0.1.2: bytes=32 time=3ms TTL=125
Reply from 10.0.1.2: bytes=32 time=20ms TTL=125

Ping statistics for 10.0.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 3ms, Maximum = 46ms, Average = 26ms
```

To Branch A: PC8 (10.0.2.4)

```
C:\>ping 10.0.2.4

Pinging 10.0.2.4 with 32 bytes of data:

Reply from 10.0.2.4: bytes=32 time=14ms TTL=126
Reply from 10.0.2.4: bytes=32 time=20ms TTL=126
Reply from 10.0.2.4: bytes=32 time=22ms TTL=126
Reply from 10.0.2.4: bytes=32 time=1ms TTL=126

Ping statistics for 10.0.2.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 22ms, Average = 14ms
```

To Branch C : PC11 (10.0.4.2)

```
C:\>ping 10.0.4.2

Pinging 10.0.4.2 with 32 bytes of data:

Reply from 10.0.4.2: bytes=32 time=11ms TTL=126
Reply from 10.0.4.2: bytes=32 time=31ms TTL=126
Reply from 10.0.4.2: bytes=32 time=1ms TTL=126
Reply from 10.0.4.2: bytes=32 time=5ms TTL=126

Ping statistics for 10.0.4.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 31ms, Average = 12ms
```

### Device from Branch C to each branch

I choose PC9 from branch C

To Headquarters : PC1 (10.0.1.3)

```
C:\>ping 10.0.1.3

Pinging 10.0.1.3 with 32 bytes of data:

Reply from 10.0.1.3: bytes=32 time=28ms TTL=124
Reply from 10.0.1.3: bytes=32 time=45ms TTL=124
Reply from 10.0.1.3: bytes=32 time=45ms TTL=124
Reply from 10.0.1.3: bytes=32 time=44ms TTL=124

Ping statistics for 10.0.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 28ms, Maximum = 45ms, Average = 40ms
```

To Branch A: PC 7 (10.0.2.3)

```
C:\>ping 10.0.2.3

Pinging 10.0.2.3 with 32 bytes of data:

Reply from 10.0.2.3: bytes=32 time=14ms TTL=125
Reply from 10.0.2.3: bytes=32 time=13ms TTL=125
Reply from 10.0.2.3: bytes=32 time=3ms TTL=125
Reply from 10.0.2.3: bytes=32 time=10ms TTL=125

Ping statistics for 10.0.2.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 3ms, Maximum = 14ms, Average = 10ms
```

To Branch B : PC 5 (10.0.3.4)

```
C:\>ping 10.0.3.4

Pinging 10.0.3.4 with 32 bytes of data:

Reply from 10.0.3.4: bytes=32 time=20ms TTL=126
Reply from 10.0.3.4: bytes=32 time=1ms TTL=126
Reply from 10.0.3.4: bytes=32 time=1ms TTL=126
Reply from 10.0.3.4: bytes=32 time=13ms TTL=126

Ping statistics for 10.0.3.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 20ms, Average = 8ms
```

## References

I get helped from this video on Part 3

[https://www.youtube.com/watch?v=rZw\\_b0wpQ00&list=PLB57s6OrG8LjS4rXfvYZd95H5oHPabDcF&index=3](https://www.youtube.com/watch?v=rZw_b0wpQ00&list=PLB57s6OrG8LjS4rXfvYZd95H5oHPabDcF&index=3)