COMP416: Computer Networks Project 3

Network Layer Analysis and Simulation with Cisco Tracer

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My URL: **https://www.u-tokyo.ac.jp/**

Question 1 - Network Layer Analysis

1.1.

```
PS C:\Users\AHMET> tracert www.u-tokyo.ac.jp

Tracing route to www.u-tokyo.ac.jp [210.152.243.234]
over a maximum of 30 hops:

  1     1 ms     1 ms     2 ms  192.168.1.1 [192.168.1.1]
  2    15 ms     8 ms     7 ms  host-212-57-0-125.reverse.superonline.net [212.57.0.125]
  3     8 ms     7 ms     7 ms  10.36.254.45 [10.36.254.45]
  4     6 ms     7 ms     6 ms  10.58.19.33 [10.58.19.33]
  5     8 ms     7 ms     7 ms  10.58.19.46 [10.58.19.46]
  6    12 ms     8 ms    11 ms  10.40.170.209 [10.40.170.209]
  7     *       11 ms     *     10.36.8.126 [10.36.8.126]
  8     *        9 ms     9 ms  10.38.210.61 [10.38.210.61]
  9    11 ms     9 ms     8 ms  10.40.168.61 [10.40.168.61]
 10     *        *        8 ms  lag-150.bear1.Istanbul2.Level3.net [213.249.104.1]
 11   268 ms   269 ms   268 ms  ae2.3601.edge1.Osaka1.level3.net [4.69.215.94]
 12   302 ms   294 ms   287 ms  8.245.32.246
 13   284 ms   277 ms   277 ms  163.139.136.69
 14   285 ms   284 ms   284 ms  222.230.187.142
 15     *        *        *     Request timed out.
 16     *        *        *     Request timed out.
 17     *        *        *     Request timed out.
 18   286 ms   285 ms   286 ms  158.205.121.38
 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.
PS C:\Users\AHMET>
```

1.1.1. Observing the tracert output the first timeout occurs at hop 15, looking at its predecessor hop 14 we see the TTL is 284 ms.

1.1.2. Windows by default uses 30 probes. We can use the -h flag to explicitly set the probe number. We can observe that timeouts occur at different nodes.

```
Tracing route to www.u-tokyo.ac.jp [210.152.243.234]
over a maximum of 13 hops:

  1    11 ms     3 ms    40 ms  192.168.1.1 [192.168.1.1]
  2    40 ms    29 ms    23 ms  host-212-57-0-125.reverse.superonline.net [212.57.0.125]
  3     8 ms     7 ms     7 ms  10.36.254.45 [10.36.254.45]
  4     7 ms     6 ms     9 ms  10.58.19.33 [10.58.19.33]
  5    21 ms     7 ms     7 ms  10.58.19.46 [10.58.19.46]
  6    11 ms    15 ms    10 ms  10.40.170.209 [10.40.170.209]
  7    14 ms     *        *     10.36.8.126 [10.36.8.126]
  8     *       10 ms     8 ms  10.38.210.61 [10.38.210.61]
  9    16 ms    28 ms    24 ms  10.40.168.61 [10.40.168.61]
 10     *        *        *     Request timed out.
 11   272 ms   287 ms   267 ms  ae2.3601.edge1.Osaka1.level3.net [4.69.215.94]
 12   286 ms   287 ms   287 ms  8.245.32.246
 13   278 ms   277 ms   280 ms  163.139.136.69

Trace complete.
PS C:\Users\AHMET> tracert -h 15 www.u-tokyo.ac.jp

Tracing route to www.u-tokyo.ac.jp [210.152.243.234]
over a maximum of 15 hops:

  1     1 ms     2 ms     1 ms  192.168.1.1 [192.168.1.1]
  2    15 ms     6 ms     7 ms  host-212-57-0-125.reverse.superonline.net [212.57.0.125]
  3     8 ms     8 ms     7 ms  10.36.254.45 [10.36.254.45]
  4     7 ms     6 ms     7 ms  10.58.19.33 [10.58.19.33]
  5     8 ms     7 ms     8 ms  10.58.19.46 [10.58.19.46]
  6     9 ms     9 ms     8 ms  10.40.170.209 [10.40.170.209]
  7     *        *        *     Request timed out.
  8     9 ms    10 ms     *     10.38.210.61 [10.38.210.61]
  9    12 ms     8 ms     8 ms  10.40.168.61 [10.40.168.61]
 10     *        *        *     Request timed out.
 11   278 ms   271 ms   268 ms  ae2.3601.edge1.Osaka1.level3.net [4.69.215.94]
 12   288 ms   287 ms   289 ms  8.245.32.246
 13   278 ms   277 ms   277 ms  163.139.136.69
 14   286 ms   285 ms   284 ms  222.230.187.142
 15     *        *        *     Request timed out.
```

1.1.3. I am using a windows machine. Checking the documentation `traceroute -I www.u-tokyo.ac.jp` adding -I flag solves the case.

1.1.4.

A Routing Blackhole occurs when network packets are intentionally ignored or dismissed, rendering the destination unreachable. This typically arises from network misconfigurations or failures. In certain security setups, intentionally creating a Routing Blackhole can serve a beneficial purpose. By selectively dropping packets from specific sources or with particular characteristics, this approach becomes a component of a network security plan aimed at blocking malicious traffic and safeguarding specific destinations. Essentially, it functions as a form of traffic filtering, playing a valuable role in countering various types of attacks.

1.2.

```
shanimtastan@192 ~ % sudo ifconfig en1 hw ether 00:11:22:33:44:55
```

Explanation: This command changes the MAC address of the specified network interface. The hw option is used to specify hardware (MAC) addresses.

```
shanimtastan@192 ~ % sudo ifconfig en1 up
```

Explanation: This command enables the specified network interface.

```
shanimtastan@192 ~ % sudo ifconfig en1 -d
```

Explanation: This command disables the specified network interface.

Question 2 - Understanding IP and Subnetting

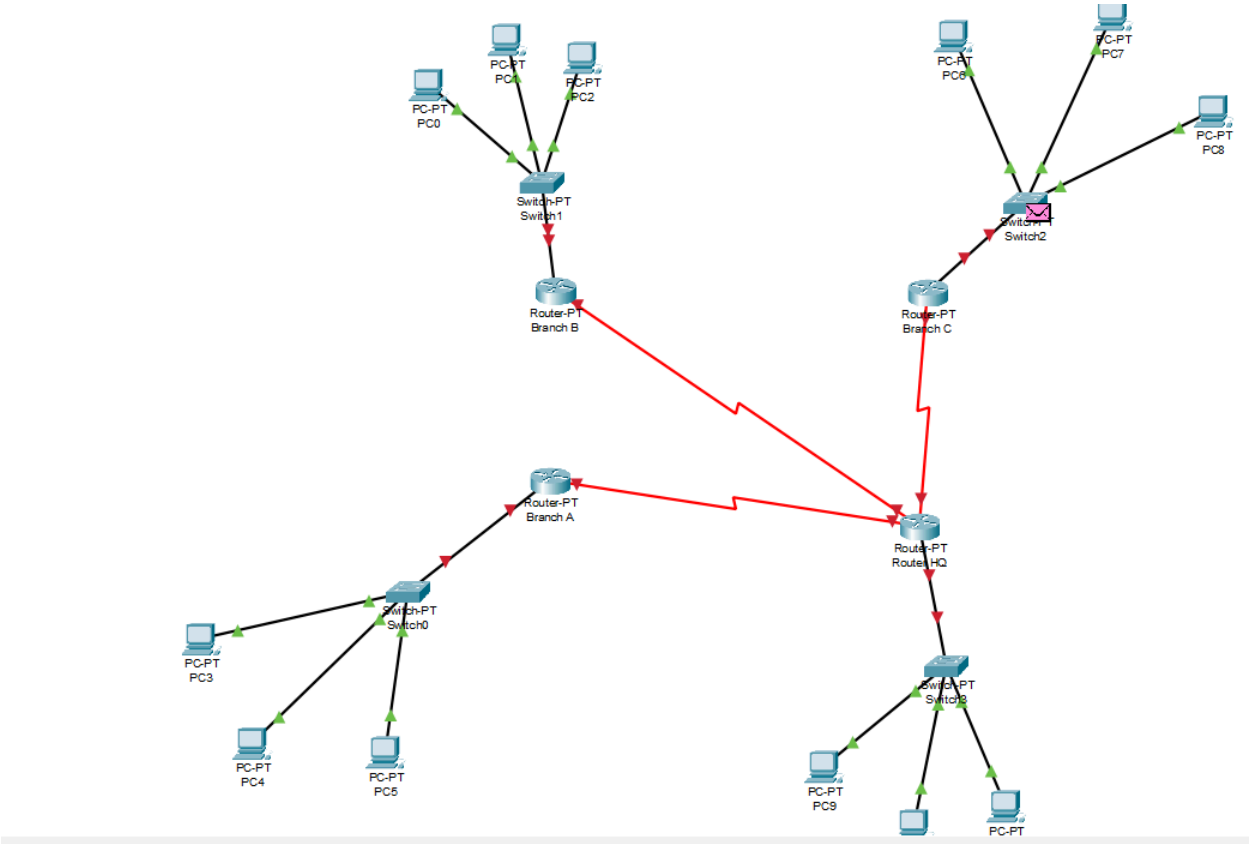
```
PS C:\Users\AHMET> ipconfig

Windows IP Configuration


Ethernet adapter Ethernet:

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

Wireless LAN adapter Yerel Ağ Bağlantısı* 1:

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

Wireless LAN adapter Yerel Ağ Bağlantısı* 10:

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

Wireless LAN adapter Wi-Fi:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::a374:256f:52f0:2899%10
   IPv4 Address. . . . . . . . . . . : 192.168.1.54
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : 192.168.1.1

Ethernet adapter Bluetooth Ağ Bağlantısı:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
PS C:\Users\AHMET>
```

1. We can see that the IP address I am connected to is **192.168.1.1**
2. Subnet mask of the network is **255.255.255.0**
3. We perform bitwise AND operation between IP address and subnet mask which returns us **192.168.1.0**
4. Broadcast address is the last node in the subnet which is **192.168.1.255.** (If needed the calculation for this consists of inverting all bits in the subnet mask and apply bitwise OR to network address)

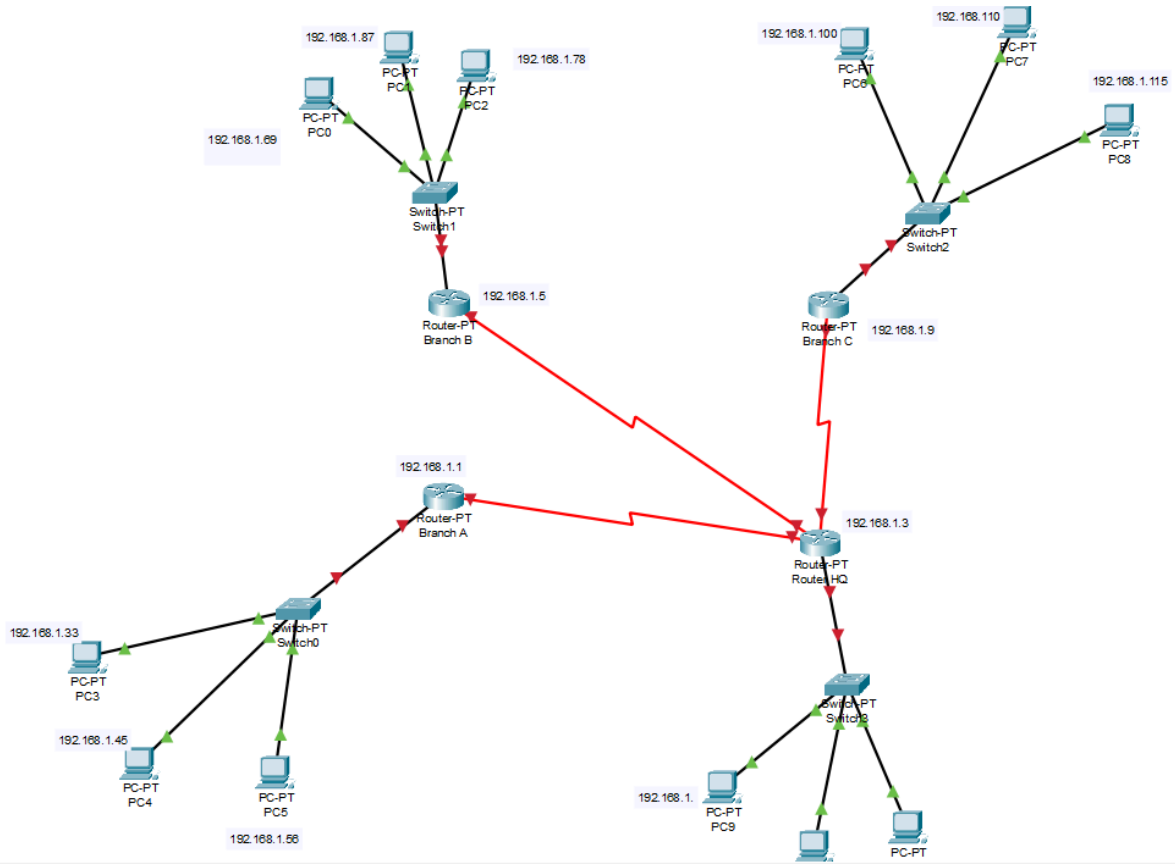
5. The subnet mask is **/24** which means there are 32 - 24 = 8, thus **2^8 = 256** devices. (We understood the subnet is /24 observing the broadcast address. The subnet mask is /24.)

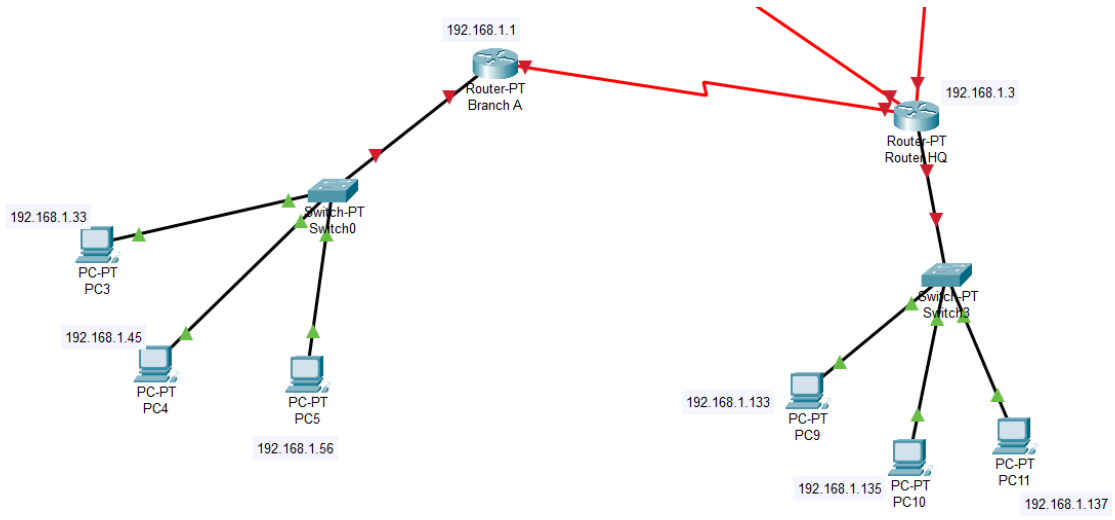
Question 3 - Simulations with Cisco Packet Tracer

My Network:

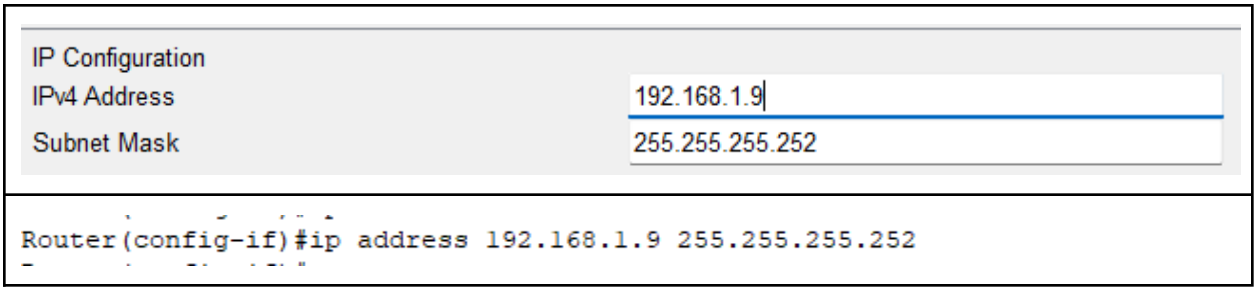


1)

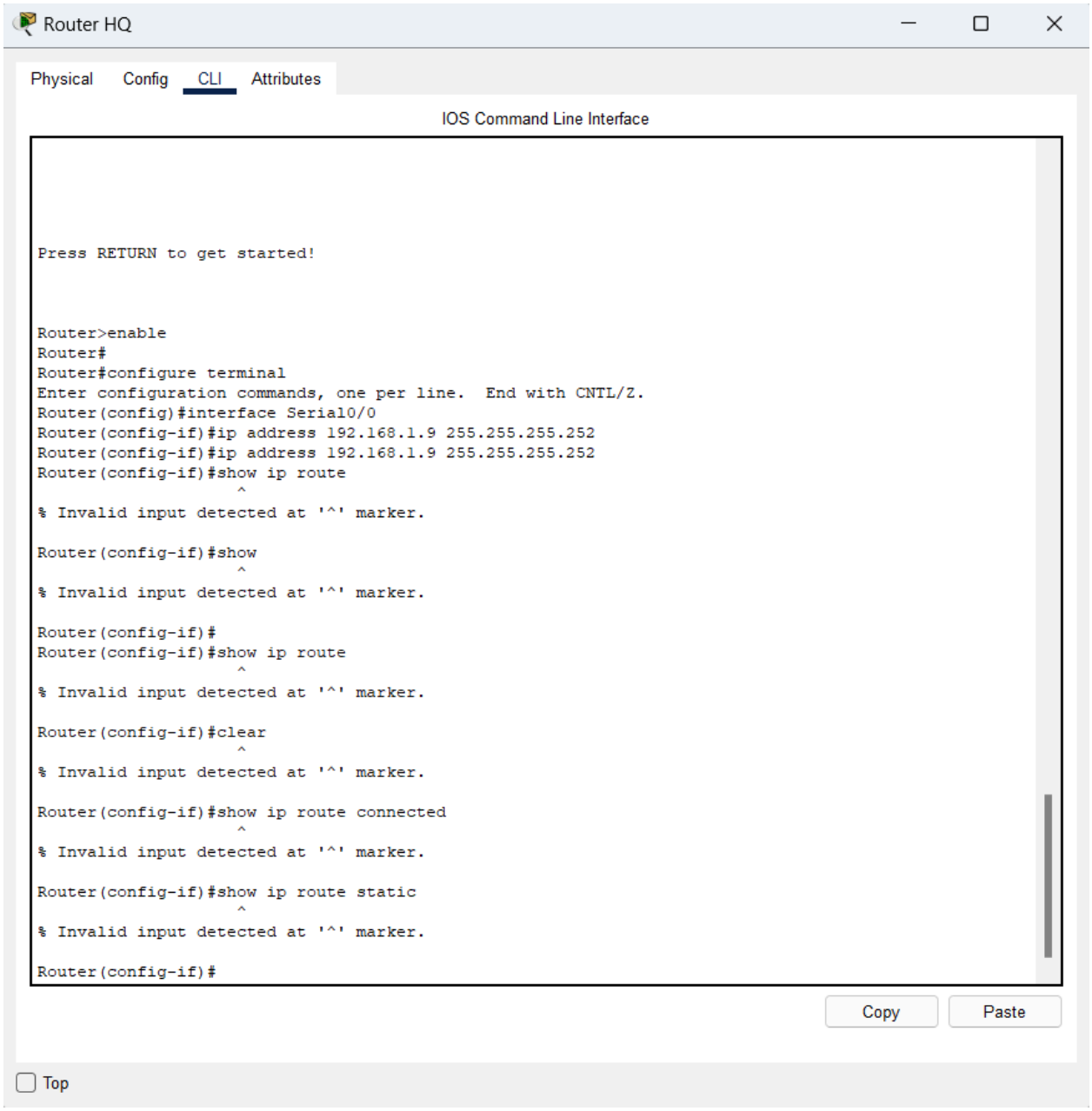

192.168.1.87
PC-PT PC1
PC-PT PC2
192.168.1.78
PC-PT PC0
192.168.1.69
Switch-PT Switch1
192.168.1.5
Router-PT Branch B
192.168.1.100
PC-PT PC6
192.168.110
PC-PT PC7
192.168.1.115
PC-PT PC8
Switch-PT Switch2
Router-PT Branch C
192.168.1.9
192.168.1.1
Router-PT Branch A
192.168.1.3
Router-PT Router-HQ
192.168.1.33
Switch-PT Switch0
PC-PT PC3
192.168.1.45
PC-PT PC4
PC-PT PC5
192.168.1.56
Switch-PT Switch3
192.168.1.
PC-PT PC9
PC-PT


192.168.1.1
Router-PT Branch A
192.168.1.3
Router-PT Router-HQ
192.168.1.33
Switch-PT Switch0
PC-PT PC3
192.168.1.45
PC-PT PC4
PC-PT PC5
192.168.1.56
Switch-PT Switch3
192.168.1.133
PC-PT PC9
192.168.1.135
PC-PT PC10
PC-PT PC11
192.168.1.137

2) I’ve selected option 1, namely 192.168.1.0/24 because 254 devices sufficed the requirements of 4 routers and 90 hosts. /16 and /22 subnets had an abundant number of IPs and we did not need to occupy that much space.
3) My implementation supports 29 branches since I have allocated 192.168.1.0/27, 32 devices but 30 of them are available for use because 2 of them are reserved and 1 of them is the headquarters itself.
4) Yes, the IOS language commands are executed when selecting buttons and entering fields in the GUI. Here is the table.



5)



The necessary code show ip route [static/connected] but for some reason it does not work.

6)

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.56

Pinging 192.168.1.56 with 32 bytes of data:

Reply from 192.168.1.56: bytes=32 time<1ms TTL=128
Reply from 192.168.1.56: bytes=32 time<1ms TTL=128
Reply from 192.168.1.56: bytes=32 time<1ms TTL=128
Reply from 192.168.1.56: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.1.56:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.87

Pinging 192.168.1.87 with 32 bytes of data:

Request timed out.
```

In my project the devices in the same network can communicate but I have failed to establish communication between two different branches in different subnets.

Appendix

More on my implementation of the network.

1. Configuration of Router Interfaces:

Router HQ:

- Interface connecting to Router A: 192.168.1.1/28
- Interface connecting to Router B: 192.168.1.5/28
- Interface connecting to Router C: 192.168.1.9/28

Router A:

- Interface connecting to Router HQ: 192.168.1.1/28
- PCs connected to Router A: 192.168.1.33/27 to 192.168.1.62/27

Router B:

- Interface connecting to Router HQ: 192.168.1.5/28
- PCs connected to Router B: 192.168.1.65/27 to 192.168.1.94/27

Router C:

- Interface connecting to Router HQ: 192.168.1.9/28
- PCs connected to Router C: 192.168.1.97/27 to 192.168.1.126/27

2. Configuration of PC IP Addresses:

PCs at Headquarters (Connected to Router HQ):

- PCs: 192.168.1.129/27 to 192.168.1.161/27

PCs at Branch A (Connected to Router A):

- PCs: 192.168.1.33/27 to 192.168.1.62/27

PCs at Branch B (Connected to Router B):

- PCs: 192.168.1.65/27 to 192.168.1.94/27

PCs at Branch C (Connected to Router C):

- PCs: 192.168.1.97/27 to 192.168.1.126/27