Comp416 Project 3 Report
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1)

```
burak@BURAK-MacBook-Pro ~ % ip route
default via 172.16.108.1 dev en0
127.0.0.0/8 via 127.0.0.1 dev lo0
127.0.0.1/32 via 127.0.0.1 dev lo0
169.254.0.0/16 dev en0  scope link
172.16.108.0/22 dev en0  scope link
172.16.108.1/32 dev en0  scope link
172.16.108.49/32 dev en0  scope link
224.0.0.0/4 dev en0  scope link
255.255.255.255/32 dev en0  scope link
```

Figure 1

```
[byildirim19@linux02 ~]$ ip route
default via 192.168.168.1 dev em2 proto static metric 101
172.20.17.0/24 dev em1 proto kernel scope link src 172.20.17.57 metric 100
172.20.19.32 via 172.20.17.1 dev em1
192.168.122.0/24 dev virbr0 proto kernel scope link src 192.168.122.1
192.168.168.0/24 dev em2 proto kernel scope link src 192.168.168.12 metric 101
```

Figure 2

```
[byildirim19@linux02 ~]$ netstat -nr
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
0.0.0.0         192.168.168.1   0.0.0.0         UG        0 0          0 em2
172.20.17.0     0.0.0.0         255.255.255.0   U         0 0          0 em1
172.20.19.32    172.20.17.1     255.255.255.255 UGH       0 0          0 em1
192.168.122.0   0.0.0.0         255.255.255.0   U         0 0          0 virbr0
192.168.168.0   0.0.0.0         255.255.255.0   U         0 0          0 em2
```

Figure 3

```
burak@BURAK-MacBook-Pro ~ % netstat -nr
Routing tables

Internet:
Destination        Gateway            Flags           Netif Expire
default            172.16.108.1       UGScg             en0
127                127.0.0.1          UCS               lo0
127.0.0.1          127.0.0.1          UH                lo0
169.254            link#6             UCS               en0      !
169.254.1.29       2e:c2:8f:84:d4:9f  UHLSW             en0      !
169.254.2.240      b4:8c:9d:6f:4c:13  UHLSW             en0      !
169.254.3.123      de:47:83:8f:98:b5  UHLSW             en0      !
169.254.3.230      aa:dc:37:63:50:41  UHLSW             en0      !
169.254.4.202      de:4d:db:8b:70:bc  UHLSW             en0      !
169.254.5.172      2:14:55:fd:8f:ed   UHLSW             en0      !
169.254.6.137      32:ac:20:bb:8b:39  UHLSW             en0    646
169.254.6.228      a2:11:85:a4:90:f6  UHLSW             en0    215
169.254.6.238      d6:1b:8e:f9:9f:22  UHLSW             en0    602
169.254.7.204      ee:9b:a5:6c:9:83   UHLSW             en0      !
169.254.8.44       96:dc:76:9e:74:78  UHLSW             en0   1019
169.254.8.181      da:6e:ad:6a:66:58  UHLSW             en0      !
169.254.9.123      a2:b2:6b:ce:7:4d   UHLSW             en0      !
169.254.9.186      e:fe:84:71:d8:fc   UHLSW             en0      !
169.254.9.216      5e:4a:f7:ab:32:c4  UHLSW             en0      !
169.254.9.245      76:f3:79:e3:7d:9   UHLSW             en0      !
169.254.10.187     42:d0:6:5c:6b:d2   UHLSW             en0    643
169.254.11.44      e:62:31:a5:ab:a    UHLSW             en0      !
169.254.11.238     1e:e9:12:fb:c1:c2  UHLSW             en0    911
169.254.12.54      b2:51:20:91:f6:8d  UHLSW             en0   1153
169.254.12.70      36:89:d5:b2:ce:c9  UHLSW             en0    510
169.254.12.181     f6:50:36:28:f9:1f  UHLSW             en0      !
169.254.12.221     2:8f:67:3f:a6:58   UHLSW             en0     49
169.254.13.115     7a:af:35:f:4c:fd   UHLSW             en0      !
169.254.13.172     d6:8d:c:cf:b8:63   UHLSW             en0      !
169.254.14.125     e2:3d:19:58:51:24  UHLSW             en0      !
169.254.15.206     68:3e:26:f8:e3:eb  UHLSW             en0      !
169.254.18.217     32:a2:23:83:37:51  UHLSW             en0      !
169.254.19.2       c6:8b:1d:82:44:24  UHLSW             en0      !
169.254.19.76      aa:bf:73:cc:2c:9f  UHLSW             en0      !
169.254.19.248     4a:33:4:63:9e:45   UHLSW             en0    525
169.254.20.58      d2:27:dd:76:f4:e7  UHLSW             en0    937
169.254.21.157     2c:20:b:46:80:92   UHLSW             en0      !
169.254.24.16      2a:15:4:8c:82:1f   UHLSW             en0    953
169.254.24.27      c6:ad:80:cc:f:e1   UHLSW             en0    639
169.254.24.34      6e:7b:7d:79:b8:ed  UHLSW             en0    182
169.254.24.51      aa:b9:34:4f:b5:6f  UHLSW             en0      !
169.254.25.113     4e:98:ac:23:2d:d5  UHLSW             en0      !
169.254.25.142     3e:ce:af:45:5b:3f  UHLSW             en0      !
169.254.25.232     ca:71:ee:9a:7e:d   UHLSW             en0      !
169.254.27.224     f8:34:41:92:f3:5b  UHLSW             en0    652
169.254.27.234     3a:e1:ec:d8:3e:dd  UHLSW             en0      !
169.254.28.32      ca:2a:64:c1:bf:fc  UHLSW             en0      !
169.254.29.204     26:7:7a:5e:3e:50   UHLSW             en0      !
```

Figure 4

Parameters of the routing tables are as follows:
Destination: The destination address
Gateway: Next hop
Flags: G: Gateway, U: Up, C: Cloning the host interface, H: Host is the destination, L: Local address of the host
Netif Expire: Network interface that is used by the host along with the expiration time of the interface in seconds

2)

```
[[byildirim19@linux02 ~]$ ip -br -c addr show
lo               UNKNOWN        127.0.0.1/8 ::1/128
em1              UP             172.20.17.57/24 fe80::6c31:a472:88eb:5c62/64
em2              UP             192.168.168.12/24 fe80::5e8:a49d:925b:7537/64
ib0              DOWN
ib1              DOWN
virbr0           DOWN           192.168.122.1/24
virbr0-nic       DOWN
```

Figure 5

Flags:
-br: Gives brief information of routing tables
-c: Gives coloring to the information
addr: Shows the ip addresses and property information
show: Shows the information
The results indicate that first column shows the interface of the network, second column shows the status of the network, third column show the interface addresses in IPv4 format and the last column shows the interface addresses in IPv6 format.

3)

Since my assigned url which is wisc.edu wasn't returning anything and stuck in * * * I choosed a different url which is www.lse.ac.uk

```
burak@BURAK-MacBook-Pro ~ % traceroute -I www.lse.ac.uk
traceroute to lb.outweb.lse.ac.uk (185.18.139.132), 64 hops max, 72 byte packets
 1  172.16.108.2 (172.16.108.2)  3.925 ms  1.320 ms  1.279 ms
 2  10.20.30.3 (10.20.30.3)  3.608 ms  2.038 ms  2.042 ms
 3  212.175.32.141.static.ttnet.com.tr (212.175.32.141)  2.309 ms  2.020 ms  2.406 ms
 4  212.174.167.209 (212.174.167.209)  4.912 ms  6.356 ms  4.438 ms
 5  00-gayrettepe-sr14s-t2-1---00-buyukdere-t3-1.statik.turktelekom.com.tr (212.156.121.72)  5.204 ms  4.403 ms  4.222 ms
 6  * * *
 7  * * *
 8  308-buk-col-2---00-ebgp-gayrettepe-k.statik.turktelekom.com.tr (212.156.139.62)  27.318 ms  21.592 ms  25.896 ms
 9  ae52.bar1.bucharest1.level3.net (212.162.26.177)  56.620 ms  70.249 ms  57.561 ms
10  ae1.3110.edge3.london1.level3.net (4.69.140.198)  71.522 ms  70.293 ms  70.591 ms
11  212.113.11.36 (212.113.11.36)  74.865 ms  74.308 ms  78.269 ms
12  185.18.139.132 (185.18.139.132)  81.700 ms  77.159 ms  77.438 ms
```

Figure 6

The minimum TTL is 12 because less values do not reach to the URL destination.

4)
The default number of probes used by the traceroute is 3. Using -q flag I used traceroute command with number of probes of 4 and 5 as well.

```
burak@BURAK-MacBook-Pro ~ % traceroute -I -q 4 www.lse.ac.uk
traceroute to lb.outweb.lse.ac.uk (185.18.139.132), 64 hops max, 72 byte packets
 1  172.16.108.2 (172.16.108.2)  3.579 ms  1.307 ms  1.635 ms  1.586 ms
 2  10.20.30.3 (10.20.30.3)  3.050 ms  1.644 ms  2.852 ms  1.751 ms
 3  212.175.32.141.static.ttnet.com.tr (212.175.32.141)  4.153 ms  2.017 ms  2.951 ms  9.330 ms
 4  212.174.167.209 (212.174.167.209)  4.686 ms  4.224 ms  3.375 ms  3.230 ms
 5  00-gayrettepe-sr14s-t2-1---00-buyukdere-t3-1.statik.turktelekom.com.tr (212.156.121.72)  4.733 ms  3.348 ms  3.886 ms  3.833 ms
 6  * * * *
 7  * * * *
 8  308-buk-col-2---00-ebgp-gayrettepe-k.statik.turktelekom.com.tr (212.156.139.62)  26.136 ms  19.247 ms  18.915 ms  19.509 ms
 9  ae52.bar1.bucharest1.level3.net (212.162.26.177)  55.229 ms  53.756 ms  53.473 ms  53.597 ms
10  ae1.3110.edge3.london1.level3.net (4.69.140.198)  71.095 ms  69.283 ms  73.044 ms  69.249 ms
11  212.113.11.36 (212.113.11.36)  72.602 ms  72.256 ms  72.367 ms  71.729 ms
12  185.18.139.132 (185.18.139.132)  76.545 ms  74.923 ms  75.088 ms  74.991 ms
```

Figure 7

```
burak@BURAK-MacBook-Pro ~ % traceroute -I -q 5 www.lse.ac.uk
traceroute to lb.outweb.lse.ac.uk (185.18.139.132), 64 hops max, 72 byte packets
 1  172.16.108.2 (172.16.108.2)  2.670 ms  1.477 ms  1.304 ms  1.268 ms  1.220 ms
 2  10.20.30.3 (10.20.30.3)  3.640 ms  1.790 ms  1.787 ms  1.908 ms  2.696 ms
 3  212.175.32.141.static.ttnet.com.tr (212.175.32.141)  2.305 ms  2.451 ms  2.059 ms  2.205 ms  2.091 ms
 4  * 212.174.167.209 (212.174.167.209)  1521.628 ms  9.843 ms  2.732 ms  2.397 ms
 5  00-gayrettepe-sr14s-t2-1---00-buyukdere-t3-1.statik.turktelekom.com.tr (212.156.121.72)  3.163 ms  2.924 ms  2.888 ms  2.968 ms  3
.070 ms
 6  00-ebgp-gayrettepe-k---00-gayrettepe-sr14s-t2-1.statik.turktelekom.com.tr (81.212.201.195)  3.771 ms  3.125 ms  2.937 ms  3.371 ms
  2.787 ms
 7  212.156.120.178.static.turktelekom.com.tr (212.156.120.178)  4.130 ms  3.256 ms  3.333 ms  2.997 ms  2.915 ms
 8  308-buk-col-2---00-ebgp-gayrettepe-k.statik.turktelekom.com.tr (212.156.139.62)  19.128 ms  19.075 ms  19.245 ms  18.988 ms  19.75
3 ms
 9  ae52.bar1.bucharest1.level3.net (212.162.26.177)  53.829 ms  54.675 ms  53.415 ms  56.093 ms  53.945 ms
10  ae1.3110.edge3.london1.level3.net (4.69.140.198)  73.891 ms  69.164 ms  70.916 ms  70.673 ms  81.568 ms
11  212.113.11.36 (212.113.11.36)  72.226 ms  71.124 ms  76.271 ms  71.099 ms  71.213 ms
12  185.18.139.132 (185.18.139.132)  75.202 ms  75.029 ms  75.070 ms  76.715 ms  76.380 ms
```

Figure 8

When we increase the number of probes, we can observe that it can obtain more information about the route so that it can resolve better. Moreover, since we sent more packets response times became longer and it is more likely to have a timeout. In this case, it took much more time to resolve when number of probes is increased. Also, it resolved the 6 and 7 ttl values as well so resolution is improved.

5)
A routing blackhole is that due to a lack of a routing information the communication of the source and destination is lost. It can be beneficial if we face with a unusual traffic we can direct it into a blackhole so that we can prevent ddos attacks.

6)

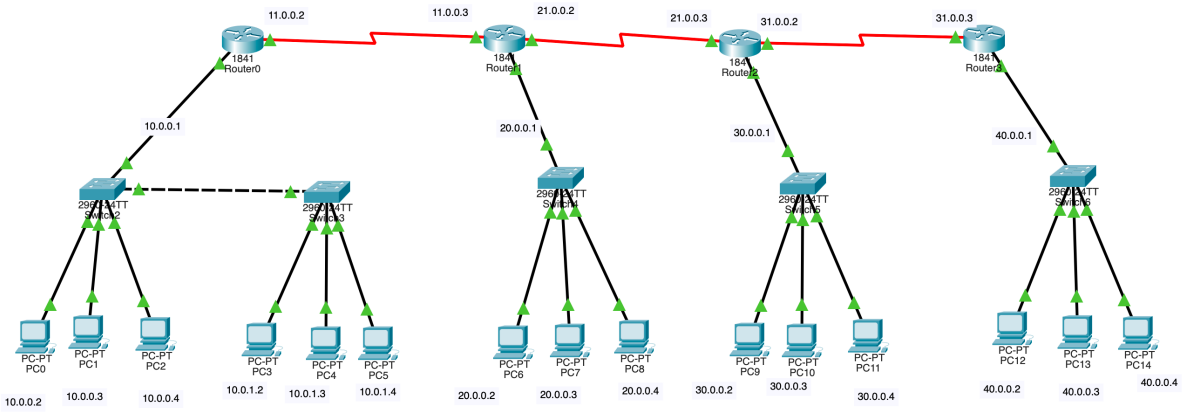

Figure 9

7)

Router No	Process	Command
Router 0	Location 1: Network 10.0.0.0	ip address 10.0.0.1 255.0.0.0
Router 1	Location 2: Network 20.0.0.0	ip address 20.0.0.1 255.0.0.0
Router 2	Location 3: Network 30.0.0.0	ip address 30.0.0.1 255.0.0.0
Router 3	Location 4: Network 40.0.0.0	ip address 40.0.0.1 255.0.0.0

8)
When connecting PCs to switches, copper straight-through cables are used. When connecting switches to a router, copper straight-through cables are used. When connecting switch to switch, copper cross-over cable is used. When connecting router to router, serial dte cable is used.
It is a must to connect two distant routers with a serial cable because we need to establish connection between two routers. The serial cable ensures that routers can transfer routing information via network addresses and communicate with each other.

9)

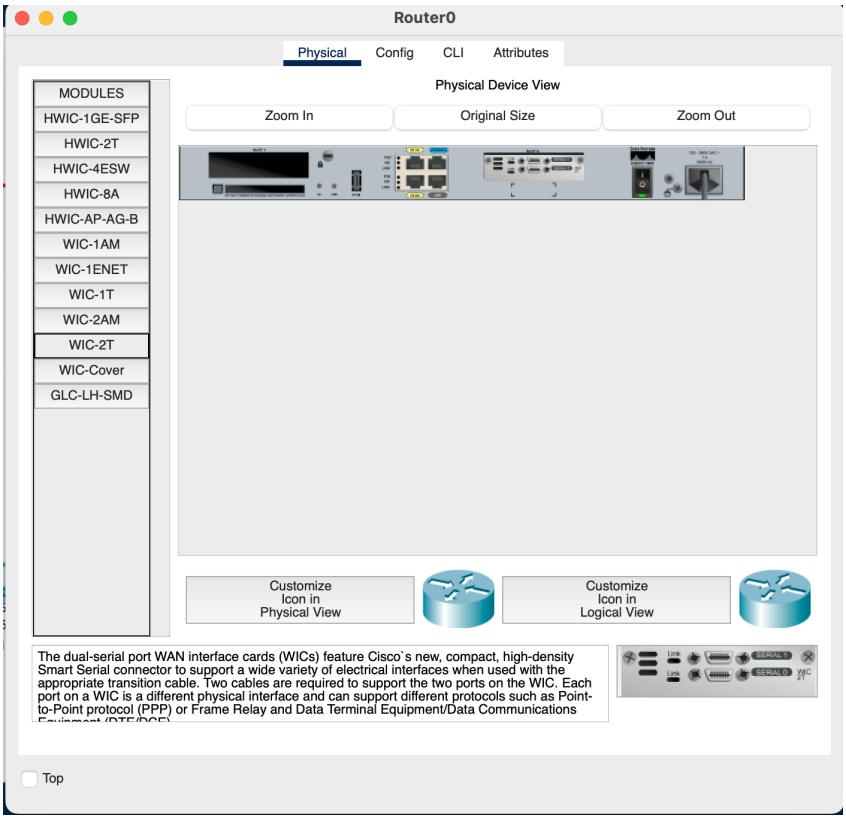

Figure 10

In Cisco Packet Tracer, first we need to click on a router. In the physical section, we need to find WIC-2T which is an interface card providing a dual-serial port. We need to turn off the router using power switch. After that, we need to drag and drop the interface card from bottom right corner to our router. Then, we need to turn on the router and select the config tab. It will show the router is booting. Once the booting is completed, we can use the dual-serial ports. In this project, we need dual-serial port because routers should be able to communicate with the previous and next routers.

10)

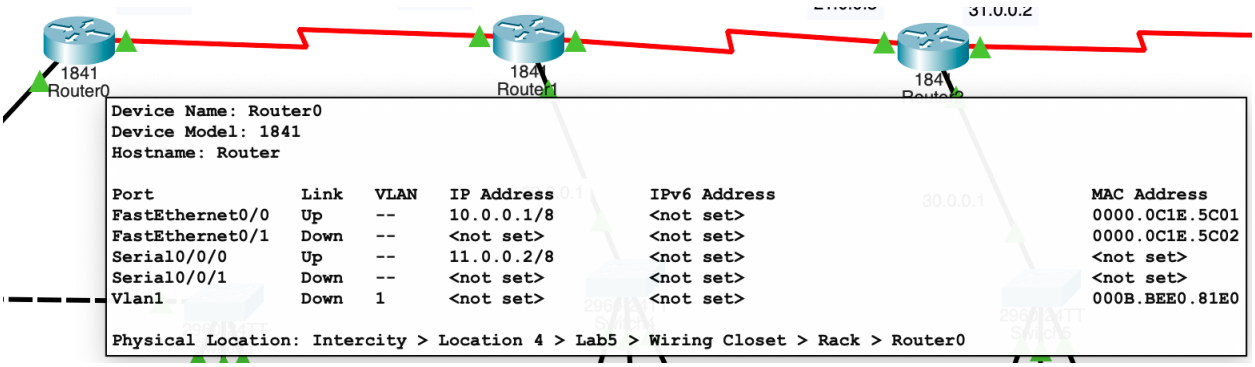

Figure 11

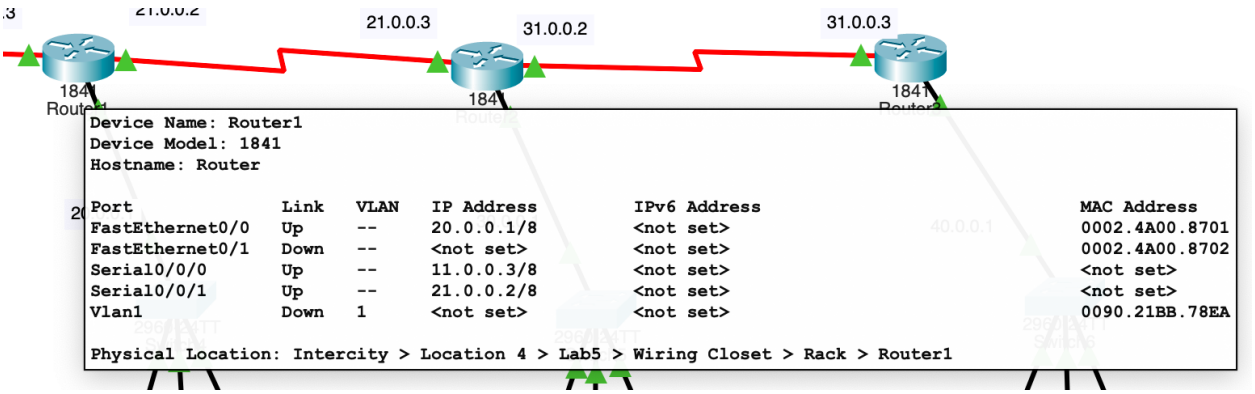

Figure 12

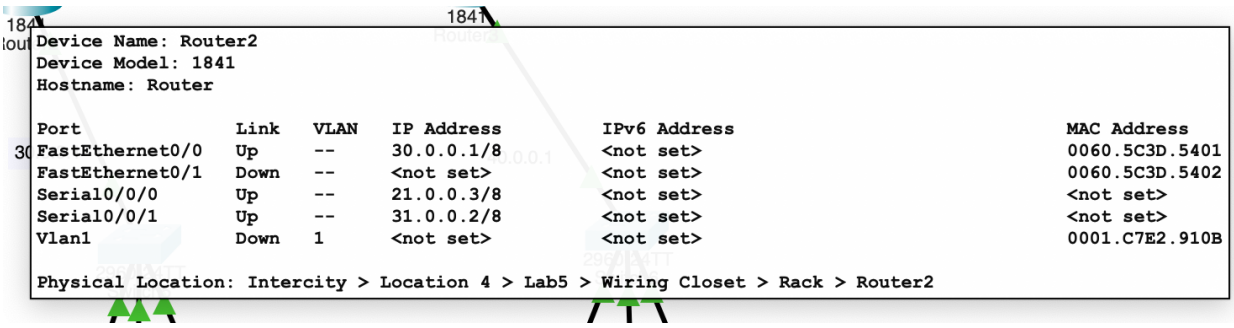

Figure 13

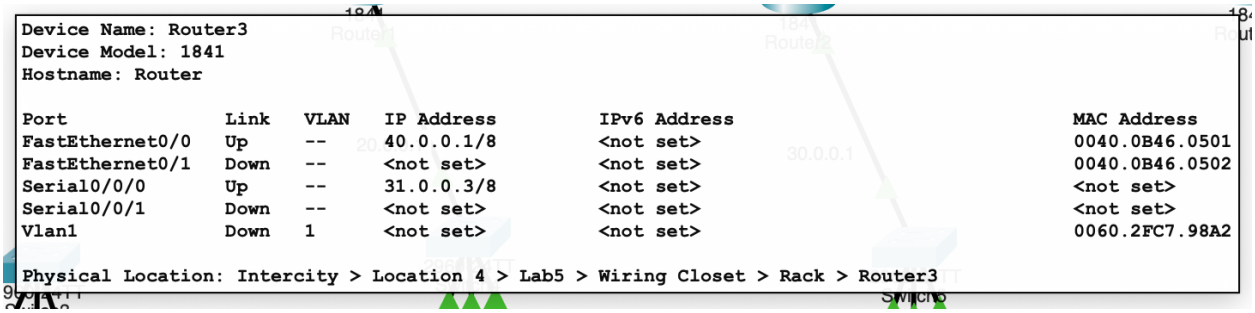

Figure 14

When we look into the fastethernet0/0 ports of each router their ip addresses ends with a subnet mask of /8. In order to find the number of subnetworks we can use the following formula which is 2^(32-CIDR). In this case, cidr = 8.

2^(32-8) = 2^24 = 16777216 is the number of subnetworks for each network it's the same since their subnet masks are same as /8.

Router No	No Of Subnets
Router 0	2^(32-8) = 2^24 = 16777216
Router 1	2^(32-8) = 2^24 = 16777216
Router 2	2^(32-8) = 2^24 = 16777216
Router 3	2^(32-8) = 2^24 = 16777216

11)

Lab No	Network ID	Max No. Devices	Gateway IP	Broadcast IP
Lab1	10.0.0.0	(2^24)-2=16777212	10.0.0.1	10.255.255.255
Lab2	10.0.0.0	(2^24)-2=16777212	10.0.0.1	10.255.255.255
Lab3	20.0.0.0	(2^24)-2=16777212	20.0.0.1	20.255.255.255
Lab4	30.0.0.0	(2^24)-2=16777212	30.0.0.1	30.255.255.255
Lab5	40.0.0.0	(2^24)-2=16777212	40.0.0.1	40.255.255.255

12)
You can see the routing tables of router0, router1, router2, and router3 respectively.

Router0

Physical Config CLI Attributes

IOS Command Line Interface

```
                 ^
% Invalid input detected at '^' marker.

Router(config)#show ip protocols
                 ^
% Invalid input detected at '^' marker.

Router(config)#show ip route
                 ^
% Invalid input detected at '^' marker.

Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#
Router#
Router#
Router#
Router#
Router#
Router#
Router#
Router#
Router#
Router#
Router#
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

C    10.0.0.0/8 is directly connected, FastEthernet0/0
C    11.0.0.0/8 is directly connected, Serial0/0/0
S    20.0.0.0/8 [1/0] via 11.0.0.3
S    21.0.0.0/8 [1/0] via 11.0.0.3
S    30.0.0.0/8 [1/0] via 11.0.0.3
S    31.0.0.0/8 [1/0] via 21.0.0.3
S    40.0.0.0/8 [1/0] via 11.0.0.3

Router#
```

Figure 15

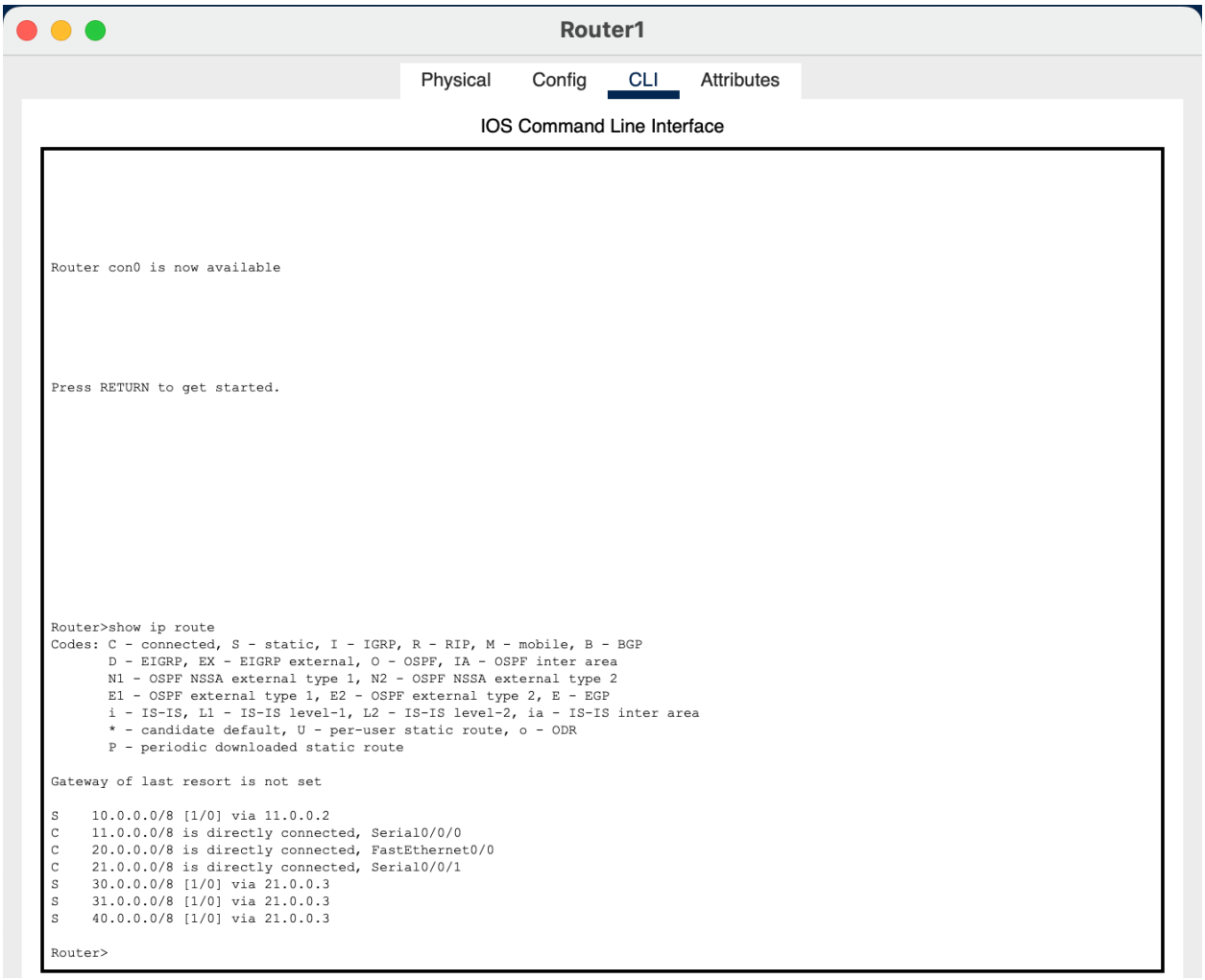
Router1
Physical
Config
CLI
Attributes
IOS Command Line Interface
Router con0 is now available
Press RETURN to get started.
Router>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external 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
S 10.0.0.0/8 [1/0] via 11.0.0.2
C 11.0.0.0/8 is directly connected, Serial0/0/0
C 20.0.0.0/8 is directly connected, FastEthernet0/0
C 21.0.0.0/8 is directly connected, Serial0/0/1
S 30.0.0.0/8 [1/0] via 21.0.0.3
S 31.0.0.0/8 [1/0] via 21.0.0.3
S 40.0.0.0/8 [1/0] via 21.0.0.3
Router>

Figure 16

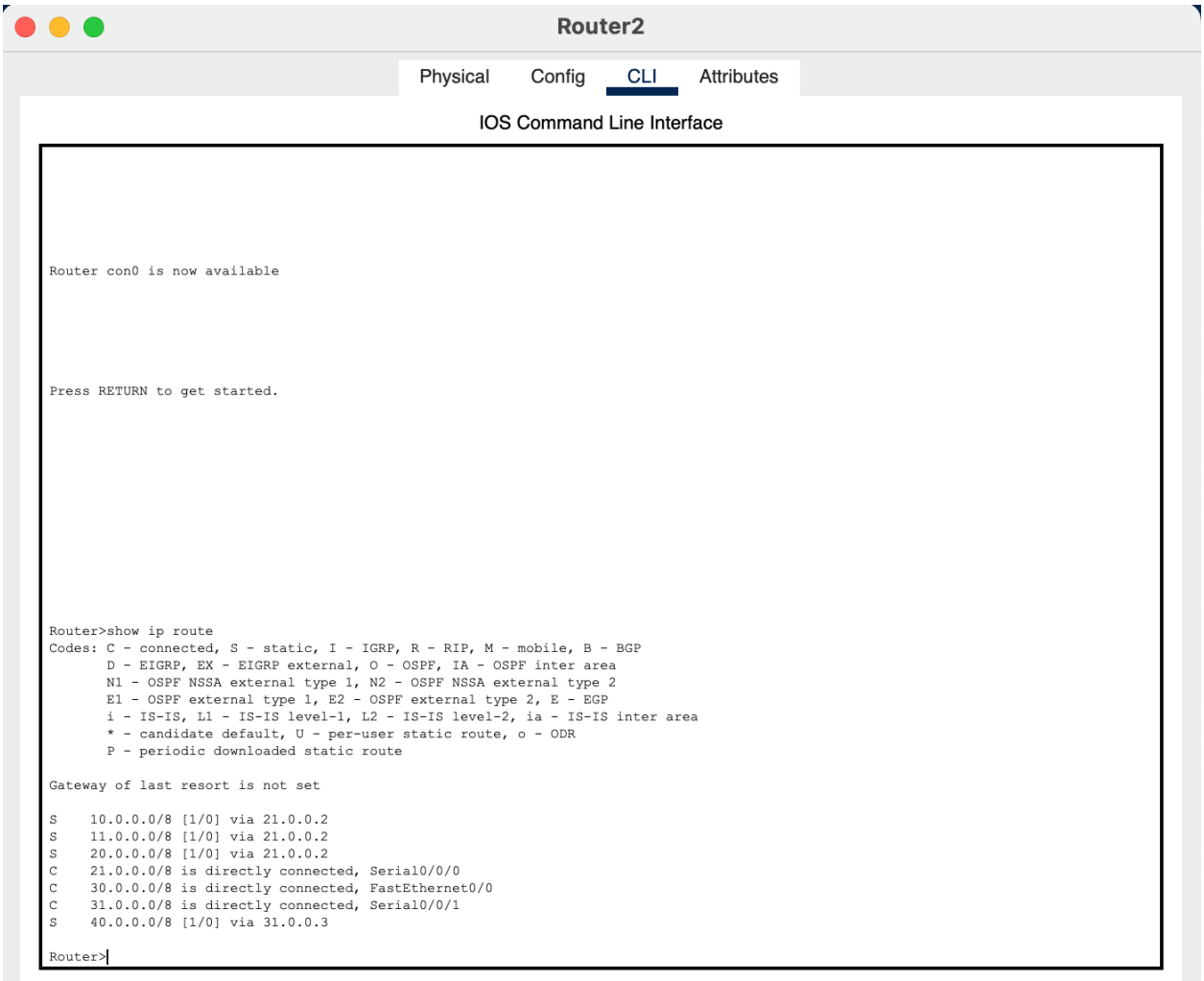
Router2
Physical
Config
CLI
Attributes
IOS Command Line Interface
Router con0 is now available
Press RETURN to get started.
Router>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external 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
S 10.0.0.0/8 [1/0] via 21.0.0.2
S 11.0.0.0/8 [1/0] via 21.0.0.2
S 20.0.0.0/8 [1/0] via 21.0.0.2
C 21.0.0.0/8 is directly connected, Serial0/0/0
C 30.0.0.0/8 is directly connected, FastEthernet0/0
C 31.0.0.0/8 is directly connected, Serial0/0/1
S 40.0.0.0/8 [1/0] via 31.0.0.3
Router>

Figure 17

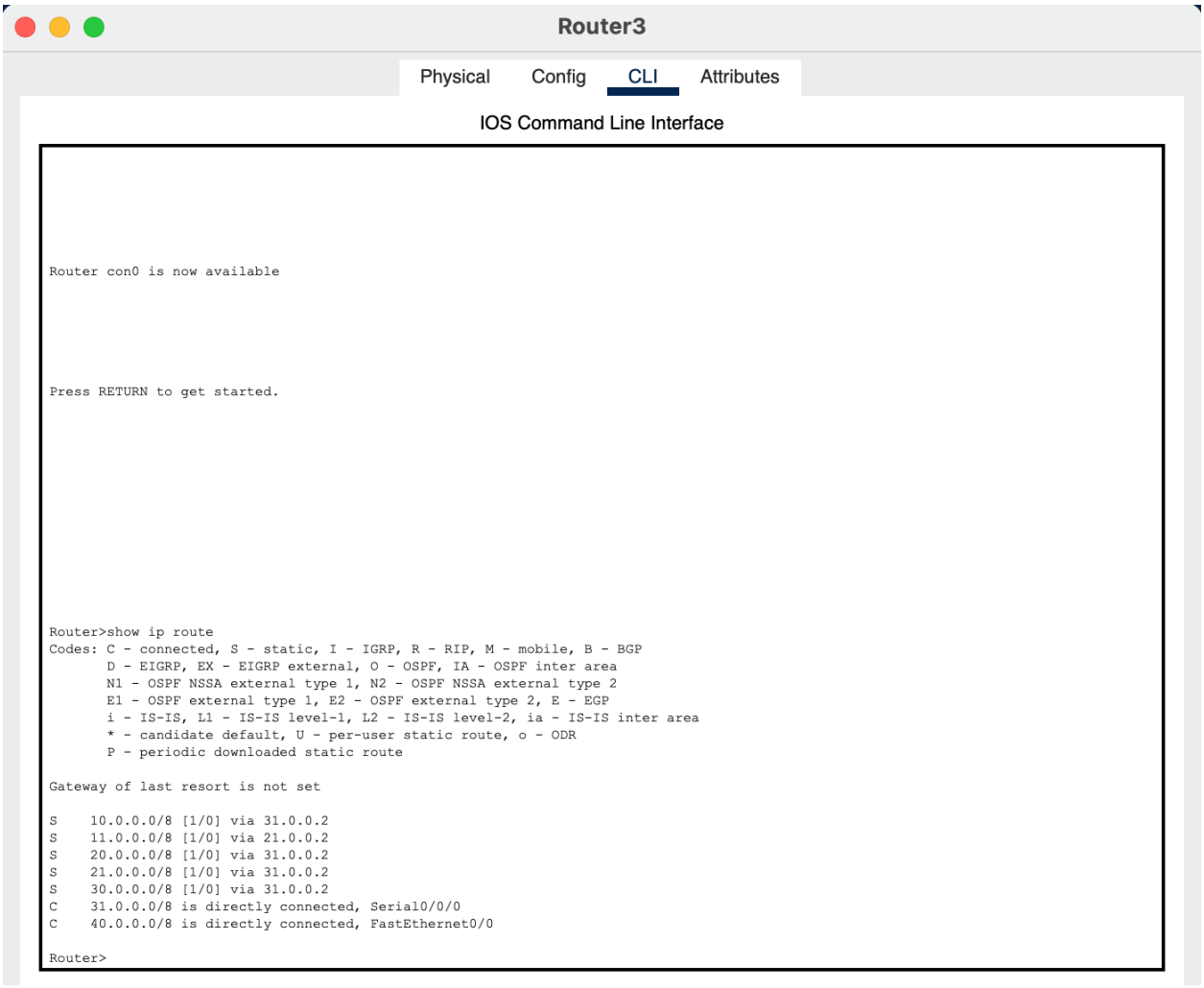
Router3
Physical
Config
CLI
Attributes
IOS Command Line Interface
Router con0 is now available
Press RETURN to get started.
Router>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external 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
S 10.0.0.0/8 [1/0] via 31.0.0.2
S 11.0.0.0/8 [1/0] via 21.0.0.2
S 20.0.0.0/8 [1/0] via 31.0.0.2
S 21.0.0.0/8 [1/0] via 31.0.0.2
S 30.0.0.0/8 [1/0] via 31.0.0.2
C 31.0.0.0/8 is directly connected, Serial0/0/0
C 40.0.0.0/8 is directly connected, FastEthernet0/0
Router>

Figure 18

13)

Figure 19

As you can see above, when I sent ping from PC1 to the ip addresses of PC2, PC3, PC7, PC11, and PC12 all of the packets received successfully without any loss.

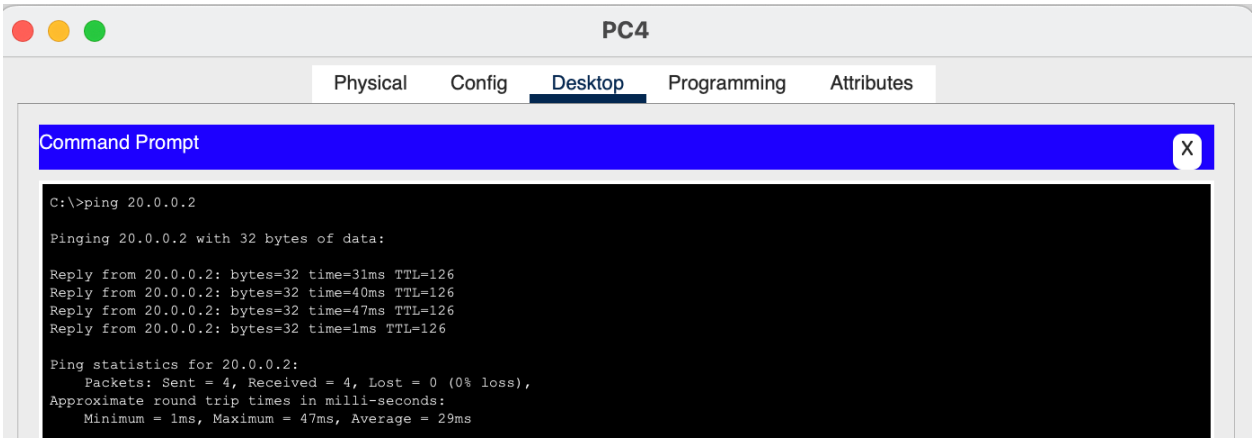

Figure 20

Ping from PC4 to PC6 is successful.

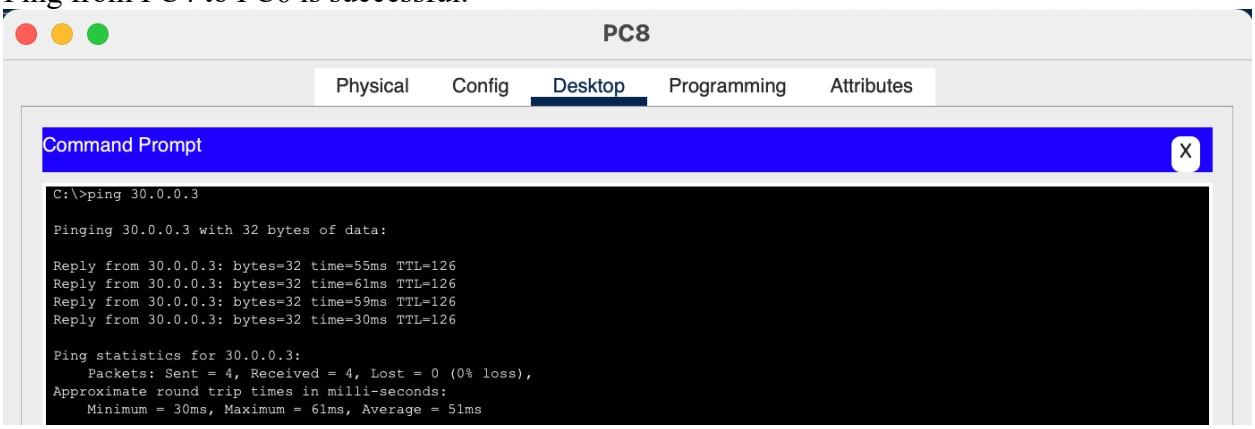

Figure 21

Ping from PC8 to PC10 is successful.

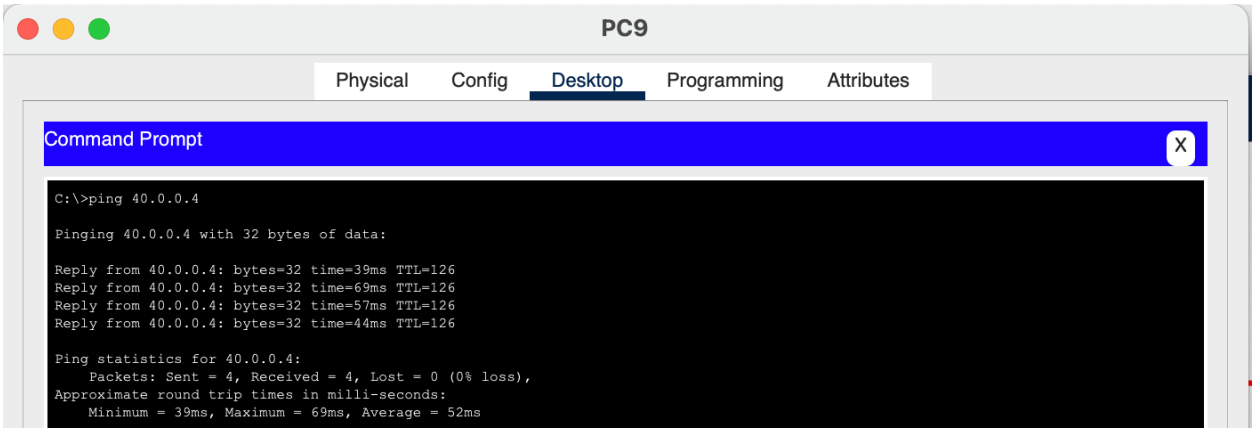

Figure 22

Ping from PC9 to PC14 is successful.

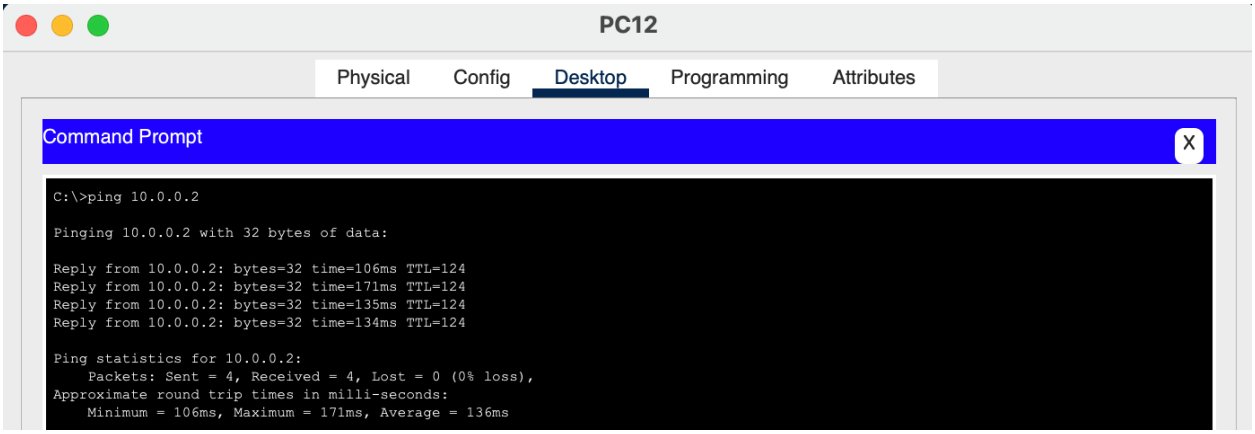

Figure 23

Ping from PC12 to PC0 is successful.

According to the results above, the network is working and any two device can communicate.