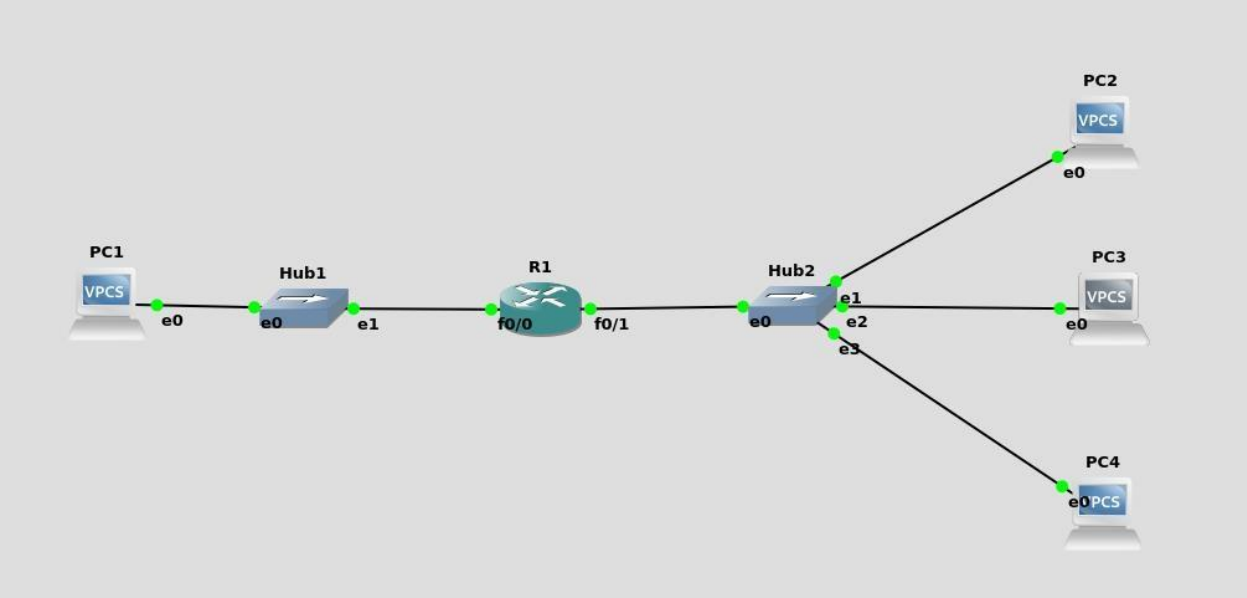
Q1. In this exercise you study how the network prefixes (netmasks) play a role when hosts determine if a datagram can be directly delivered or if it must be sent to a router. This part uses the network setup shown in Figure 5.1.

The network includes one router, four hosts and two hubs. The IP addresses of all devices are given in Figure 5.2. Here, each host has only a default route. In other words, the routing table at a host only knows about the directly connected networks and the default gateway.

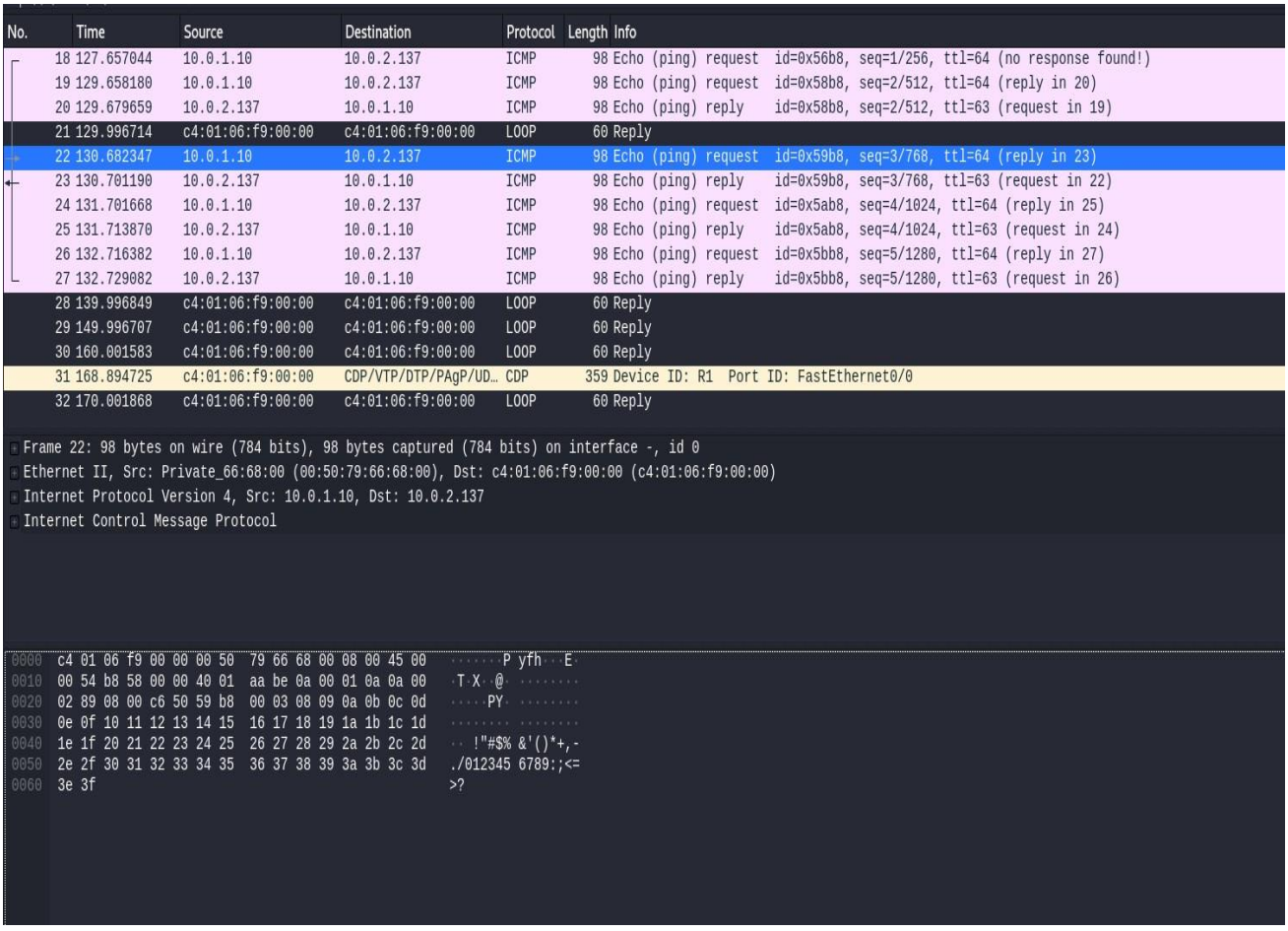


Pinging PC1 to PC3

```
PC1> ping 10.0.2.137 -c2

10.0.2.137 icmp_seq=1 timeout
84 bytes from 10.0.2.137 icmp_seq=2 ttl=63 time=21.692 ms
84 bytes from 10.0.2.137 icmp_seq=3 ttl=63 time=19.082 ms
84 bytes from 10.0.2.137 icmp_seq=4 ttl=63 time=12.414 ms
84 bytes from 10.0.2.137 icmp_seq=5 ttl=63 time=12.949 ms

PC1> save arp
Saving startup configuration to arp.vpc
.  done

PC1> clear arp

PC1> show arp

arp table is empty

PC1>
```

```
PC3> ip 10.0.2.137 255.255.255.248 10.0.2.138
Checking for duplicate address...
PC3 : 10.0.2.137 255.255.255.248 gateway 10.0.2.138

PC3> show arp

c4:01:06:f9:00:01  10.0.2.138 expires in 116 seconds

PC3> save arp
Saving startup configuration to arp.vpc
.  done

PC3> clear arp

PC3> show arp

arp table is empty

PC3>
```

```
R1#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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

     10.0.0.0/24 is subnetted, 2 subnets
C       10.0.2.0 is directly connected, FastEthernet0/1
C       10.0.1.0 is directly connected, FastEthernet0/0
R1#
```

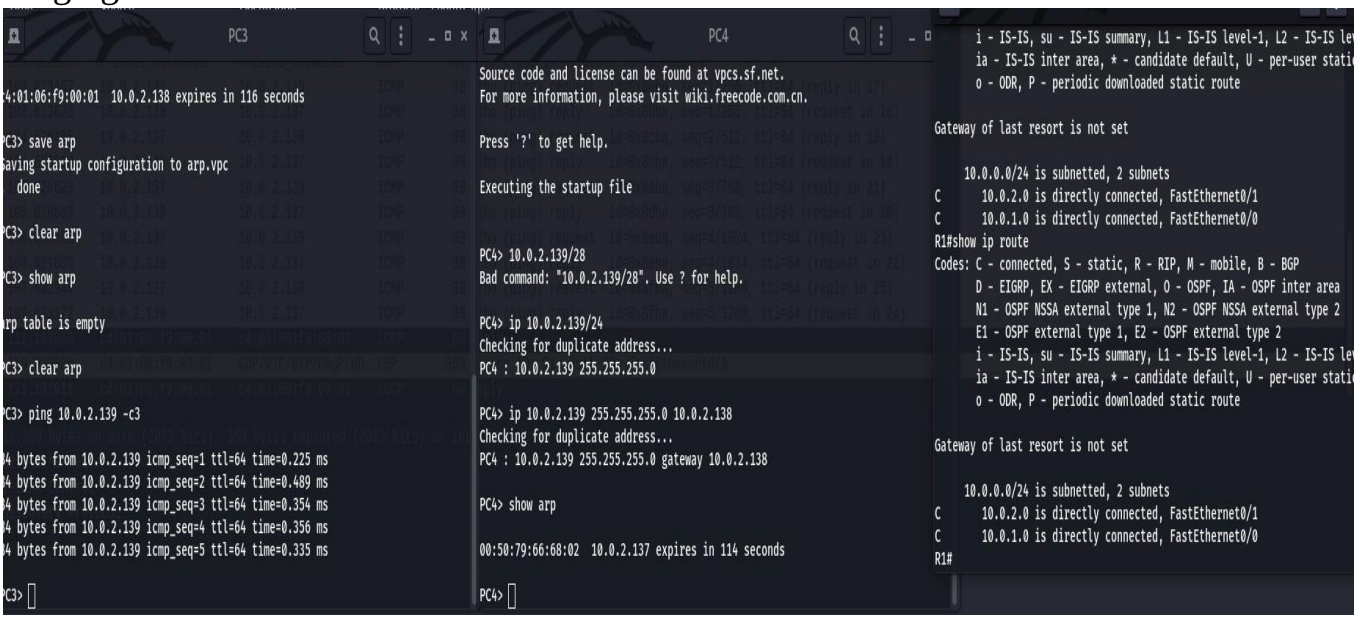


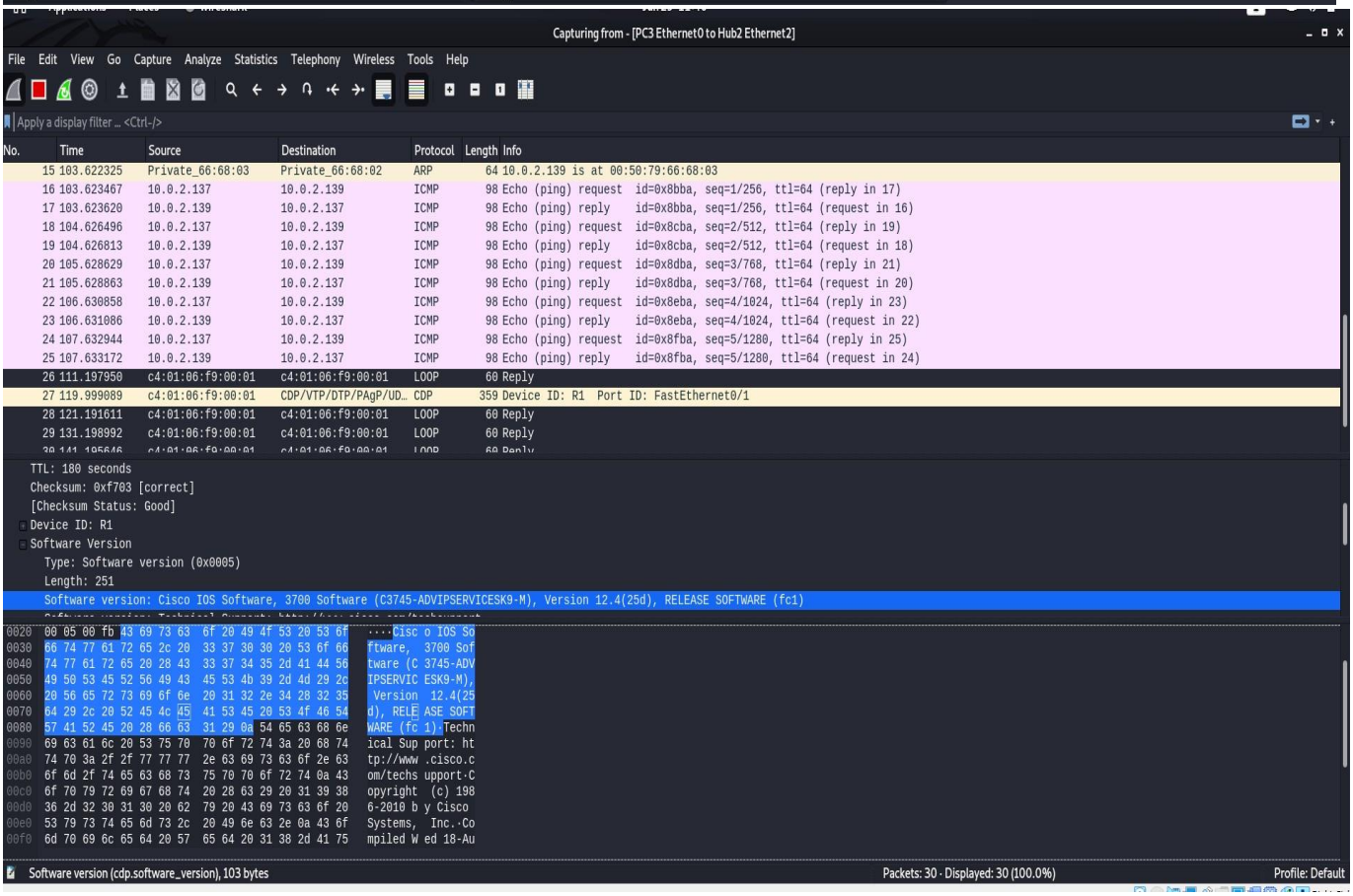
No.	Time	Source	Destination	Protocol	Length	Info
18	127.657044	10.0.1.10	10.0.2.137	ICMP	98	Echo (ping) request id=0x56b8, seq=1/256, ttl=64 (no response found!)
19	129.658180	10.0.1.10	10.0.2.137	ICMP	98	Echo (ping) request id=0x58b8, seq=2/512, ttl=64 (reply in 20)
20	129.679659	10.0.2.137	10.0.1.10	ICMP	98	Echo (ping) reply id=0x58b8, seq=2/512, ttl=63 (request in 19)
21	129.996714	c4:01:06:f9:00:00	c4:01:06:f9:00:00	LOOP	60	Reply
22	130.682347	10.0.1.10	10.0.2.137	ICMP	98	Echo (ping) request id=0x59b8, seq=3/768, ttl=64 (reply in 23)
23	130.701190	10.0.2.137	10.0.1.10	ICMP	98	Echo (ping) reply id=0x59b8, seq=3/768, ttl=63 (request in 22)
24	131.701668	10.0.1.10	10.0.2.137	ICMP	98	Echo (ping) request id=0x5ab8, seq=4/1024, ttl=64 (reply in 25)
25	131.713870	10.0.2.137	10.0.1.10	ICMP	98	Echo (ping) reply id=0x5ab8, seq=4/1024, ttl=63 (request in 24)
26	132.716382	10.0.1.10	10.0.2.137	ICMP	98	Echo (ping) request id=0x5bb8, seq=5/1280, ttl=64 (reply in 27)
27	132.729082	10.0.2.137	10.0.1.10	ICMP	98	Echo (ping) reply id=0x5bb8, seq=5/1280, ttl=63 (request in 26)
28	139.996849	c4:01:06:f9:00:00	c4:01:06:f9:00:00	LOOP	60	Reply
29	149.996707	c4:01:06:f9:00:00	c4:01:06:f9:00:00	LOOP	60	Reply
30	160.001583	c4:01:06:f9:00:00	c4:01:06:f9:00:00	LOOP	60	Reply
31	168.894725	c4:01:06:f9:00:00	CDP/VTP/DTP/PAgP/UD…	CDP	359	Device ID: R1 Port ID: FastEthernet0/0
32	170.001868	c4:01:06:f9:00:00	c4:01:06:f9:00:00	LOOP	60	Reply

```
Frame 22: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface -, id 0
Ethernet II, Src: Private_66:68:00 (00:50:79:66:68:00), Dst: c4:01:06:f9:00:00 (c4:01:06:f9:00:00)
Internet Protocol Version 4, Src: 10.0.1.10, Dst: 10.0.2.137
Internet Control Message Protocol
```

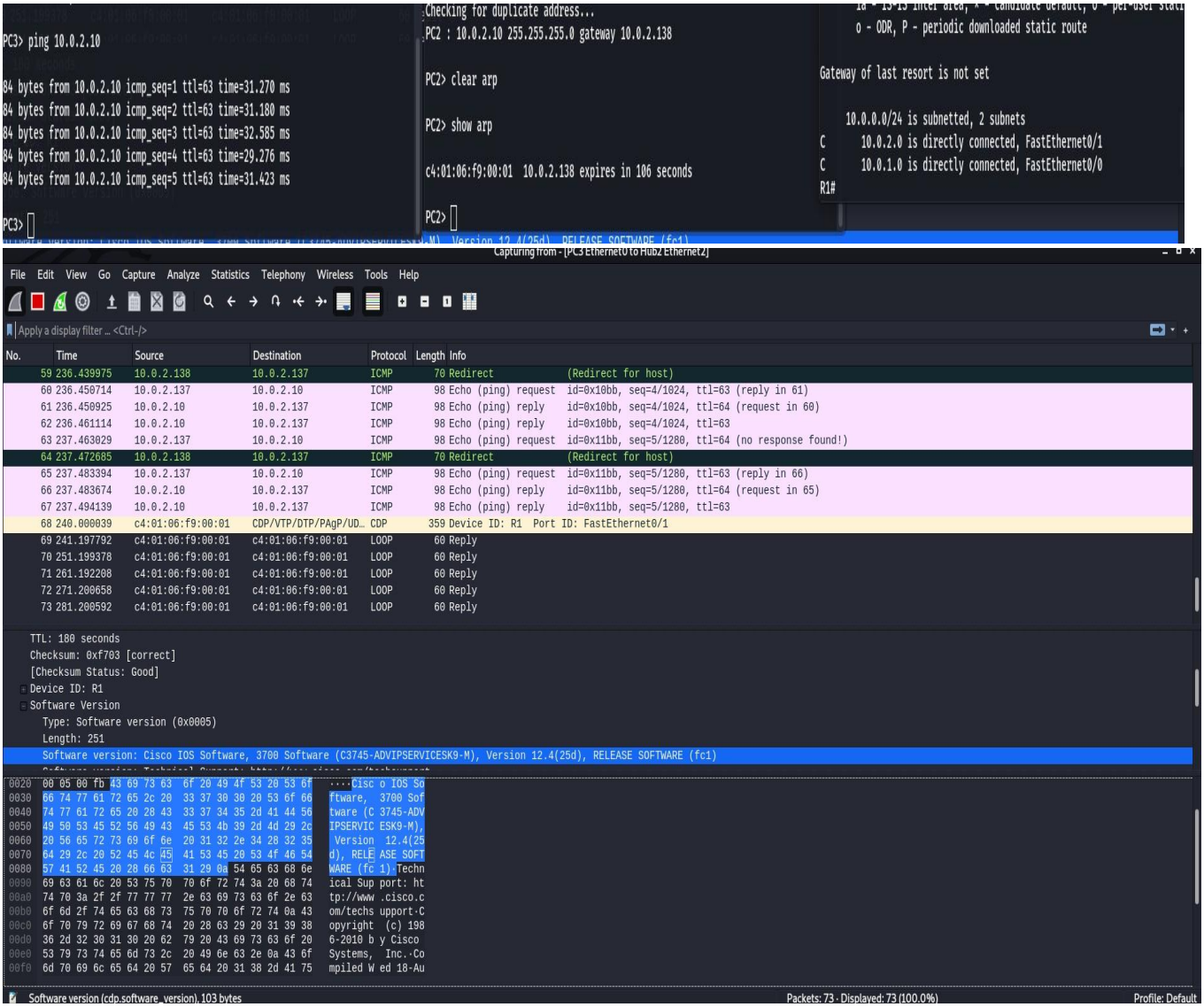
```
0000  c4 01 06 f9 00 00 00 50  79 66 68 00 08 00 45 00   .......P yfh...E.
0010  00 54 b8 58 00 00 40 01  aa be 0a 00 01 0a 0a 00   .T.X..@. ........
0020  02 89 08 00 c6 50 59 b8  00 03 08 09 0a 0b 0c 0d   .....PY. ........
0030  0e 0f 10 11 12 13 14 15  16 17 18 19 1a 1b 1c 1d   ........ ........
0040  1e 1f 20 21 22 23 24 25  26 27 28 29 2a 2b 2c 2d   .. !"#$% &'()*+,-
0050  2e 2f 30 31 32 33 34 35  36 37 38 39 3a 3b 3c 3d   ./012345 6789:;<=
0060  3e 3f                                             >?
```

Pinging PC3 to PC4

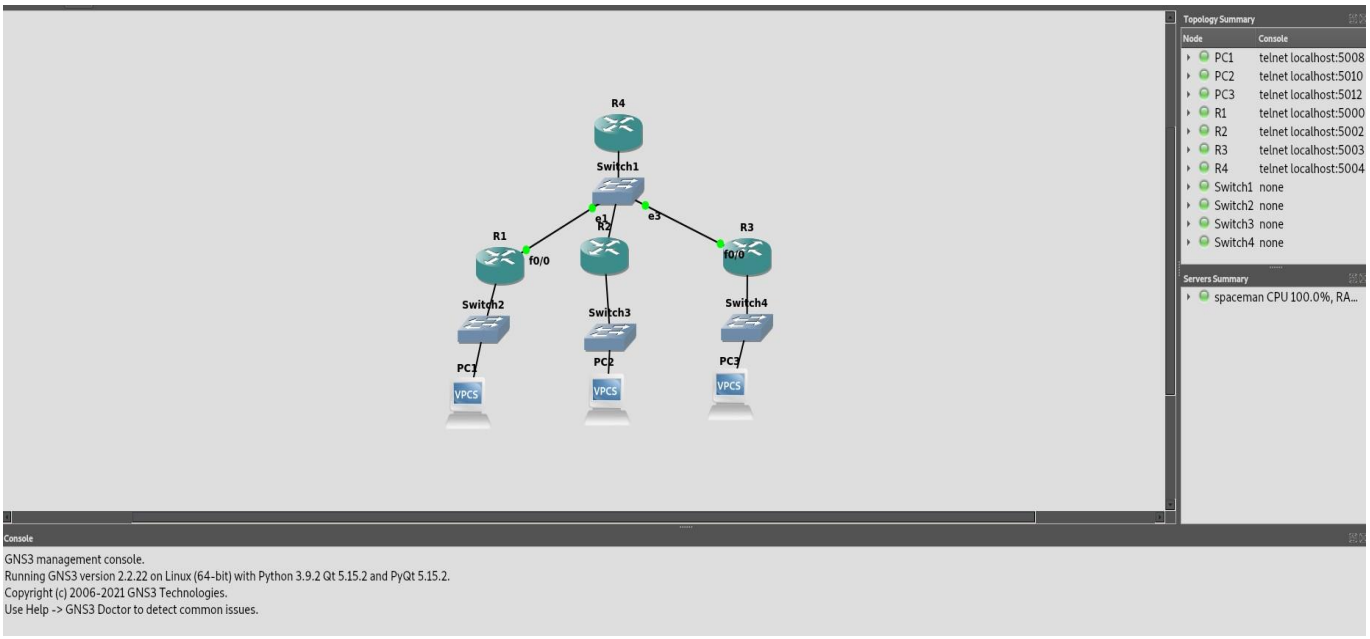




Pinging PC3 to PC2



Q2. An organization is granted a block of addresses with the beginning address 14.24.74.0/24. The organization needs to have 3 subblocks of addresses to use in its three subnets: one subblock of 10 addresses, one subblock of 60 addresses, and one subblock of 120 addresses. Design the subblocks. Use the topology shown below.



Router configurations

R1:

```
R1#enable
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface f0/0
R1(config-if)#ip add 14.24.74.193 255.255.255.240
R1(config-if)#no shutdown
R1(config-if)#
*Mar  1 00:04:50.903: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar  1 00:04:51.903: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R1(config-if)#exit
R1(config)#interface f0/1
R1(config-if)#ip add 10.0.1.1 255.255.255.0
R1(config-if)#no shutdown
R1(config-if)#
*Mar  1 00:05:24.723: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
*Mar  1 00:05:25.723: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
R1(config-if)#exit
R1(config)#end
R1#
*Mar  1 00:05:36.415: %SYS-5-CONFIG_I: Configured from console by console
R1#write
Building configuration...
[OK]
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#ip route 14.24.74.128 255.255.255.192 10.0.1.2
R1(config)#ip route 14.24.74.0 255.255.255.128 10.0.1.3
R1(config)#write
          ^
% Invalid input detected at '^' marker.

R1(config)#write
          ^
% Invalid input detected at '^' marker.

R1(config)#exit
R1#
*Mar  1 00:07:08.995: %SYS-5-CONFIG_I: Configured from console by console
R1#write
Building configuration...
[OK]
R1#show ip route
Codes: C - connected, S - static, 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
```

```
R1#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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

     10.0.0.0/24 is subnetted, 1 subnets
C       10.0.1.0 is directly connected, FastEthernet0/1
     14.0.0.0/8 is variably subnetted, 3 subnets, 3 masks
S       14.24.74.0/25 [1/0] via 10.0.1.3
C       14.24.74.192/28 is directly connected, FastEthernet0/0
S       14.24.74.128/26 [1/0] via 10.0.1.2
R1#
```

R2:

```
R2#enable
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#interface f0/1
R2(config-if)#ip add 10.0.1.2 255.255.255.0
R2(config-if)#no shutdown
R2(config-if)#
*Mar  1 00:12:04.823: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
*Mar  1 00:12:05.823: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
R2(config-if)#exit
R2(config)#interface f0/0
R2(config-if)#ip add 14.24.74.129 255.255.255.192
R2(config-if)#no shutdown
R2(config-if)#
*Mar  1 00:12:43.019: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar  1 00:12:44.019: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R2(config-if)#end
R2#
*Mar  1 00:12:46.319: %SYS-5-CONFIG_I: Configured from console by console
R2#end
Translating "end"

Translating "end"
% Unknown command or computer name, or unable to find computer address
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#ip route 14.24.74.192 255.255.255.240 10.0.1.1
R2(config)#exit
R2#
*Mar  1 00:13:21.067: %SYS-5-CONFIG_I: Configured from console by console
R2#write
Building configuration...
[OK]
R2#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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

     10.0.0.0/24 is subnetted, 1 subnets
C       10.0.1.0 is directly connected, FastEthernet0/1
     14.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
S       14.24.74.192/28 [1/0] via 10.0.1.1
C       14.24.74.128/26 is directly connected, FastEthernet0/0
```

R3:

```
R3#enable
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#interface f0/0
R3(config-if)#ip add 14.24.74.1 255.255.255.128
R3(config-if)#no shutdown
R3(config-if)#
*Mar  1 00:17:01.447: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar  1 00:17:02.447: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R3(config-if)#exit
R3(config)#interface f0/1
R3(config-if)#ip add 10.0.1.3 255.255.255.0
R3(config-if)#no shutdown
R3(config-if)#
*Mar  1 00:17:30.599: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
*Mar  1 00:17:31.599: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
R3(config-if)#end
R3#
*Mar  1 00:17:35.219: %SYS-5-CONFIG_I: Configured from console by console
R3#write
Building configuration...
[OK]
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#ip route 14.24.74.192 255.255.255.240 10.0.1.1
R3(config)#exit
R3#w
*Mar  1 00:18:43.411: %SYS-5-CONFIG_I: Configured from console by console
R3#write
Building configuration...
[OK]
R3#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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

     10.0.0.0/24 is subnetted, 1 subnets
C       10.0.1.0 is directly connected, FastEthernet0/1
     14.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       14.24.74.0/25 is directly connected, FastEthernet0/0
S       14.24.74.192/28 [1/0] via 10.0.1.1
R3#
```

```
PC1> ip 14.24.74.194/28 14.24.74.193
Checking for duplicate address...
PC1 : 14.24.74.194 255.255.255.240 gateway 14.24.74.193
```

```
PC2> ip 14.24.74.130/26 14.24.74.129
Checking for duplicate address...
PC2 : 14.24.74.130 255.255.255.192 gateway 14.24.74.129
```

```
PC3> ip 14.24.74.2/25 14.24.74.1
Checking for duplicate address...
PC3 : 14.24.74.2 255.255.255.128 gateway 14.24.74.1

PC3>
```