Subnetting Basics

Lec 7

LAN

Objectives

- Be able to perform basic subnetting in the shortest possible time

- Identify Network addresses, Host Address Ranges, Broadcast Addresses

- Subnetting a Subnet (VLSM) : Basics

- Troubleshoot Addressing Problems in a network

Classify and Define IPv4 Addresses

- 3 types of addresses determined by HOST value

	Network			Host

Network Address

10	0	0	0
00001010	00000000	00000000	00000000

Broadcast Address

10	0	0	255
00001010	00000000	00000000	11111111

Host Address

10	0	0	1
00001010	00000000	00000000	00000001

Range of addresses between Network & Broadcast address
e.g. 10.0.0.1 – 10.0.0.254

Determining the NW & Host portions

- **Subnet mask** :- all network bits =1, all host bits =0.

- **Network address** :- all host bits =0.

- **Broadcast address** :- all host bits =1.

- **First address** :- network address +1.

- **Last address** :- broadcast address -1.

Determining the NW & Host portions

- Indicated by the prefix or subnet mask (more later)

- E.g. network with prefix of /24 means
  - 24 bits used for NW portion
  - 8 bits used for Host portion (32 – 24)

- For a network with a prefix of /25
  - How many bits are used for the NW portion?
  - How many bits are used for the Host portion?

Using all this now to work out the addresses for a given network

- **For the address 172.16.20.0 with prefix /26**
  - What is the NW address?
  - What is the Broadcast address?
  - What is the range of Host addresses?

- Let's work through this example …

Using all this now to work out the addresses for a given network

- Now your turn…

- For the address 172.16.4.32 with prefix /28
    - What is the NW address?   172.16.4.32
    - What is the Broadcast address?   172.16.4.47
    - What is the range of Host addresses?   172.16.4.33-46

Challenge with IPv4 address

■ I have 2 departments in my organization

- Each has about 125 hosts

- I would like to keep them in separate NWs

- I have been assigned an IP network address space of 192.168.1.0 /24

- This is one NW, and I need 2

- I cannot change the IP address NW portion

  - But I can change the host portion

■ Solution = Subnetting (dividing network into separate networks)

- Borrowing bits from the Host portion

Subnetting

- ## 192.168.1.0 /24
  - 24 bit is NW portion
  - 8 bits is Host portion
  - I can borrow from the Host portion

- ## How many bits?
  - $2^n \geq$ # of subnets required
  - n = # of bits to borrow

- ## So for our example we need to borrow:
  - $2^n \geq 2$
  - Therefore n=1 (we need to borrow 1 bit)

Subnetting

- The borrowed bits become part of my subnet mask/prefix (we borrowed 1 bit)

- Before subnetting /24 (255.255.255.0)

- After subnetting /25 (255.255.255.128)
  - 25 bit is NW portion & 7 bits is Host portion

- How many hosts can I have per subnet?
  - $2^n - 2$
  - n = # of bits in the Host portion

- So for our example:
  - $2^n - 2$
  - n=7
  - Therefore we can have 126 hosts (128 – 2)
  - (We needed 125)

Subnetting

- Our previous network was 192.168.1.0 /24

- How does our new networks look like?
  - 192.168.1.**00**000000 /25 **or** 192.168.1.0 /25
  - 192.168.1.**10**000000 /25 **or** 192.168.1.128 /25

- And there special addresses?
  - Network/subnet 192.168.1.0 /25
  - Broadcast 192.168.1.0**1111111** or 192.168.1.127
  - Host range 192.168.1.0**0000001** – 0**1111110** or .1 - .126

- So how about the other subnet – you calculate:
  - Network/subnet 192.168.1.128 /25
  - Broadcast 192.168.1.1**1111111** or 192.168.1.255
  - Host range 192.168.1.1**0000001** – 1**1111110** or .129 - .254

Another Subnetting exercise

- You have 192.168.1.0 /24 and want 6 subnets

- Calculate
  - 6 subnets with prefix
  - Broadcast address for each subnet
  - Host range for each subnet

Subnet	Network address	Host range	Broadcast address
0	192.168.1.0/27	192.168.1.1 – 192.168.1.30	192.168.1.31
1	192.168.1.32/27	192.168.1.33 – 192.168.1.62	192.168.1.63
2	192.168.1.64/27	192.168.1.65 – 192.168.1.94	192.168.1.95
3	192.168.1.96/27	192.168.1.97 – 192.168.1.126	192.168.1.127
4	192.168.1.128/27	192.168.1.129 – 192.168.1.158	192.168.1.159
5	192.168.1.160/27	192.168.1.161 – 192.168.1.190	192.168.1.191
6	192.168.1.192/27	192.168.1.193 – 192.168.1.222	192.168.1.223
7	192.168.1.224/27	192.168.1.225 – 192.168.1.254	192.168.1.255

More Examples

Which Network Prefix will work with the IP addressing Scheme shown ..

Router A — 172.22.0.94

Router B — 172.22.0.126

A — 172.22.0.67

B — 172.22.0.107
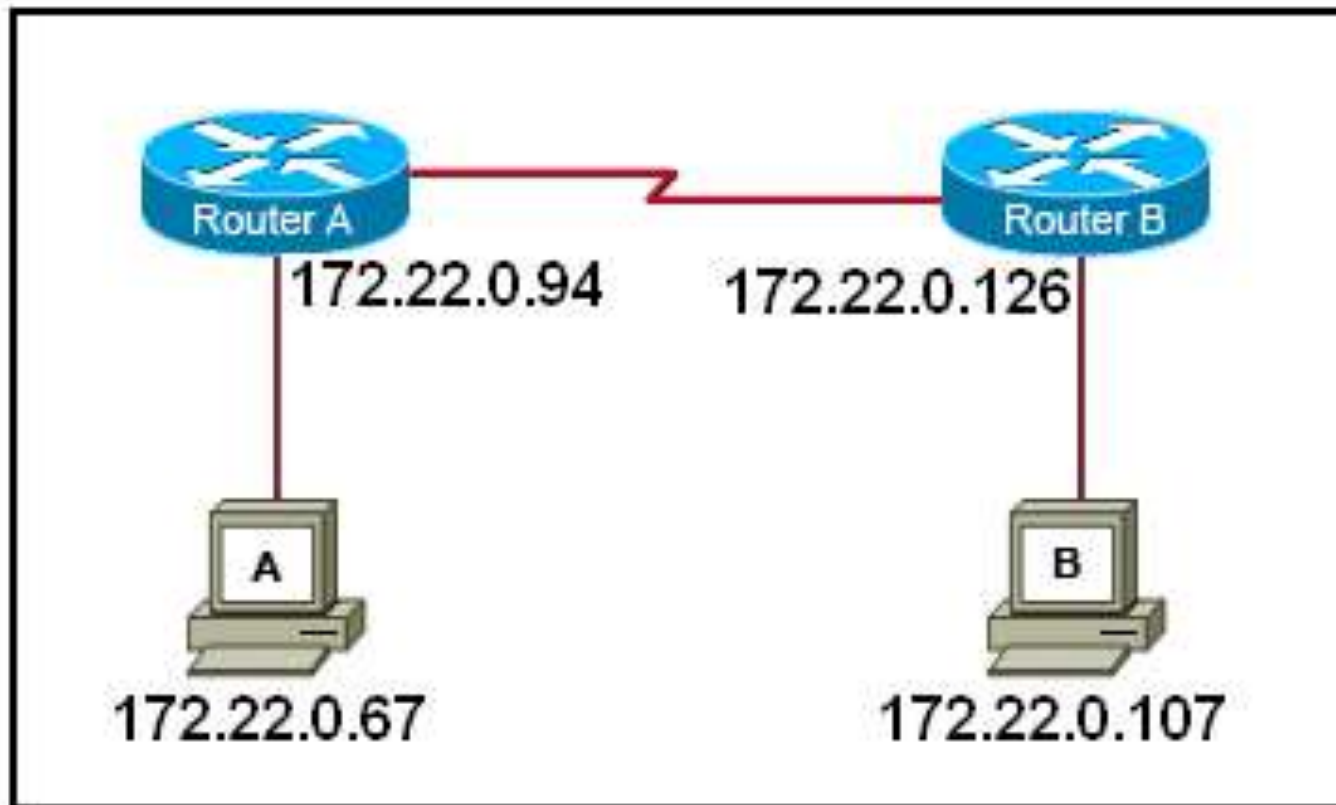
Which IPv4 Subnetted addresses represent host addresses

- 192.168.4.127/26

- 192.168.4.155/26

- 192.168.4.193/26

- 192.168.4.95/27

- 192.168.4.159/27

- 192.168.4.207/27

The Big Five Questions

- How many Subnets ?

  2^n = number of subnets , n = no. of bits borrow

- How many Hosts per Subnets?

  2^x -2 , x = no. of bits in the host portion

- What are the valid subnets ?

  256 – subnet mask = Block size or increment number

- What is the broadcast address of each subnet ?

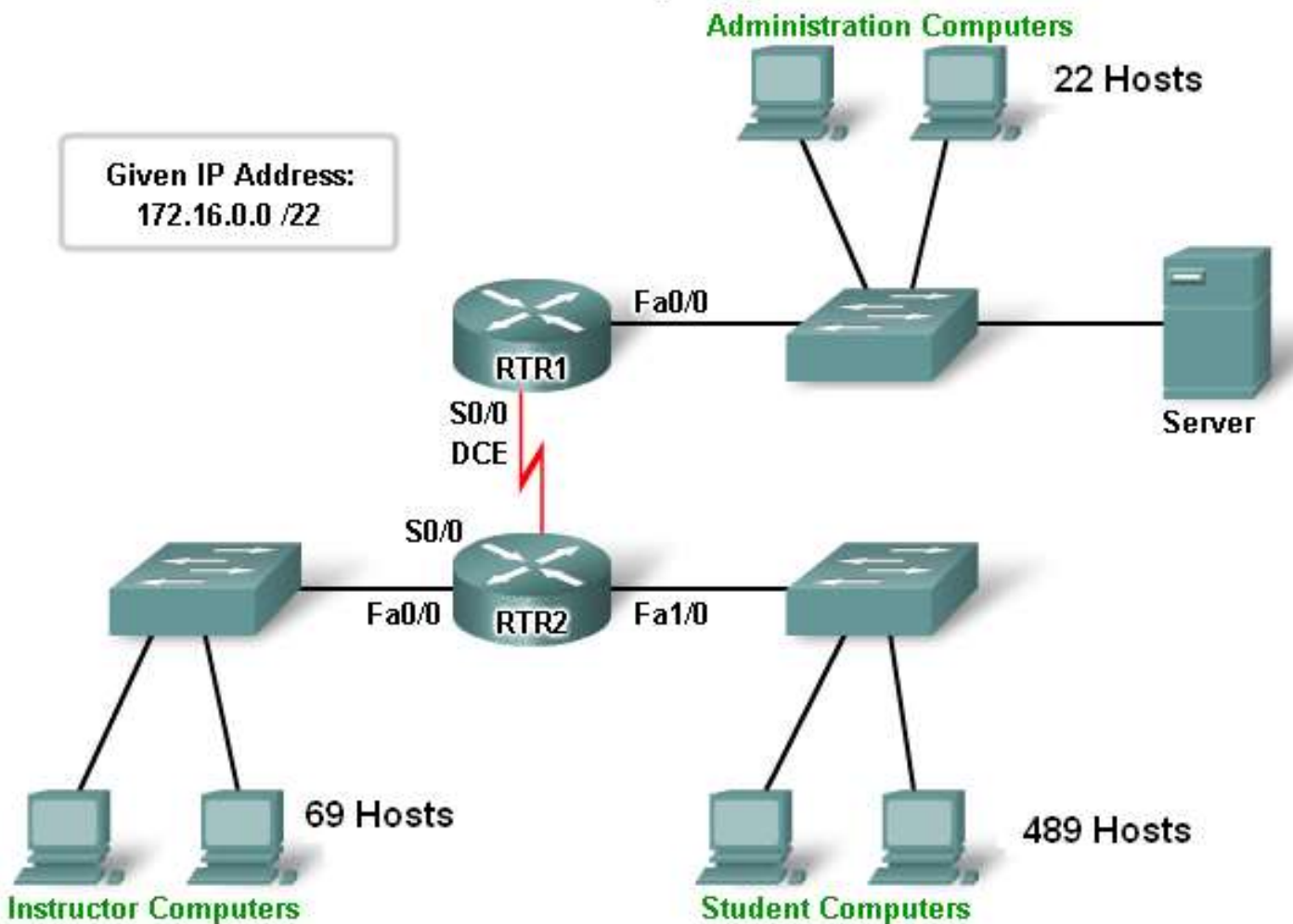 The number right before the next subnet

- What are the valid hosts ?

  Valid hosts are the numbers between the subnets , ommiting all

  0's and all 1's

Networking
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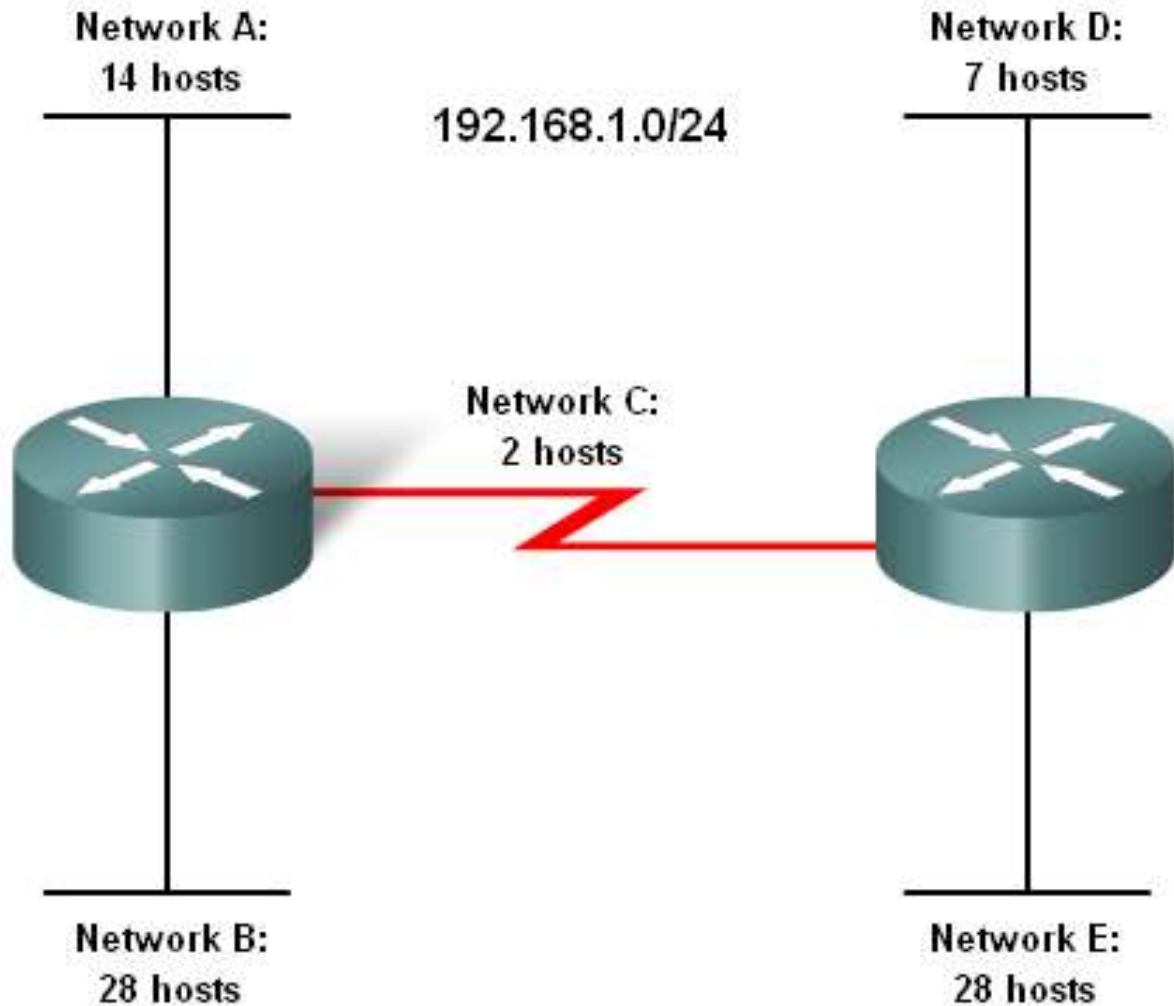# Calculate & Assign Addresses…

Network Topology

Administration Computers

22 Hosts

Given IP Address:
172.16.0.0 /22

Fa0/0

RTR1

Server

S0/0
DCE

S0/0

Fa0/0   RTR2   Fa1/0

69 Hosts

489 Hosts

Instructor Computers

Student Computers

Calculate Addresses for Host Requirements…

Network A:
14 hosts

Network D:
7 hosts

192.168.1.0/24

Network C:
2 hosts

Network B:
28 hosts

Network E:
28 hosts

Using the following options, select the necessary IP addresses that would accurately complete the network depicted in the exhibit. (Choose three.)
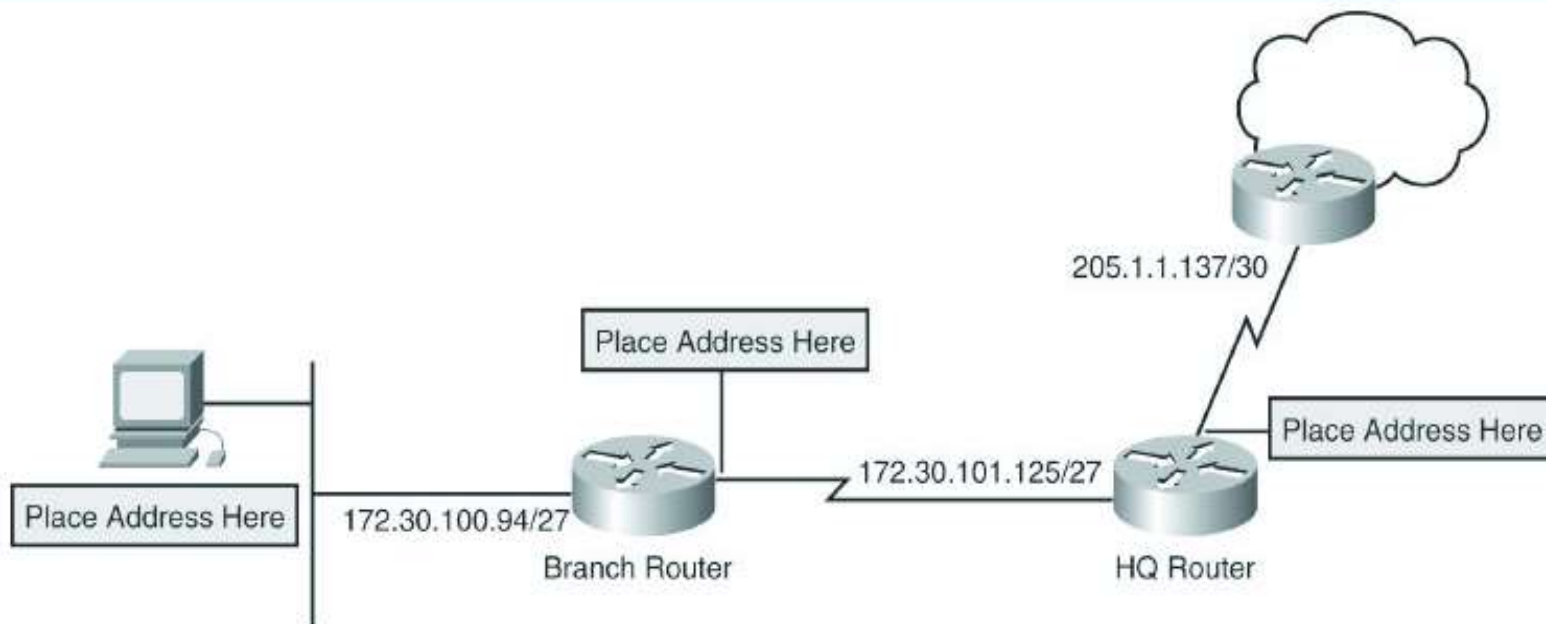
- [ ] 172.30.101.129/27
- [ ] 172.30.101.163/27
- [ ] 205.1.1.138/30
- [ ] 172.30.101.98/27
- [ ] 172.30.100.65/27
- [ ] 172.30.100.95/27
- [ ] 172.30.100.58/27
- [ ] 205.1.1.139/30
- [ ] 172.30.100.97/27
- [ ] 205.1.1.136/30

You are designing an IP address scheme for your brand-new remote office. The vice president of IT calls to tell you that you will be in charge of the 192.168.1.64/26 subnetwork. This supplies you with a single subnetwork with 62 hosts. You need to have at least two subnets with 14 hosts in each subnet.

What custom subnet mask should you use?

- ○ 255.255.255.128
- ○ 255.255.255.192
- ○ 255.255.255.224
- ○ 255.255.255.240
- ○ 255.255.255.248

Given the subnet 10.5.12.0/22, which of the following IP addresses are valid host addresses residing within the network? (Choose three.)

- ☐ 10.5.13.0
- ☐ 10.5.16.2
- ☐ 10.5.16.1
- ☐ 10.5.14.253
- ☐ 10.5.14.255

What two statements describe the IP address 172.16.3.68/23? (Choose two.)

- [ ] It is from the subnet 172.16.3.0 255.255.254.0.
- [ ] The first valid IP address of the subnet is 172.16.2.1.
- [ ] The last valid IP address of the subnet is 172.16.4.254.
- [ ] The broadcast address of the subnet is 172.16.3.255.
- [ ] The broadcast address of the subnet is 172.16.4.255.

What two statements describe the IP address 12.51.5.65/23? (Choose two.)

☐   The subnet address is 12.51.5.0 255.255.254.0.

☐   The last usable host address is 12.51.5.254.

☐   The range of usable addresses is from 12.51.5.1 to 12.51.5.254.

☐   The lowest usable host address is 12.51.4.1.

☐   It is a private IP address.

An Ethernet port on a router in your organization is assigned the IP address 10.65.64.1/21.

What is the maximum number of hosts allowed on this subnet?

- 510
- 1022
- 4096
- 2046
- 254
- 4094

Identify three valid host addresses in any subnet of the 201.168.27.0 network, assuming a fixed subnet mask of 255.255.255.240. (Choose three.)

- [ ] 201.168.27.119
- [ ] 201.168.27.112
- [ ] 201.168.27.126
- [ ] 201.168.27.208
- [ ] 201.168.27.33
- [ ] 201.168.27.175

TooCow University has acquired the 150.60.130.0/24 public address from the local ISP to use in its campus network. Each building has a specific number of devices that are required to be publicly accessible, as shown in the exhibit.

Which of the following subnets would accommodate the network shown? (Choose four.)



| Server Farm | Administration | College of Business | College of Education |
| 100 Hosts | 10 Hosts | 20 Hosts | 25 Hosts |

- ☐ 150.60.130.192/28
- ☐ 150.60.130.128/27
- ☐ 150.60.130.0/25
- ☐ 150.60.130.32/27
- ☐ 150.60.130.128/26
- ☐ 150.60.130.96/27
- ☐ 150.60.130.16/28
- ☐ 150.60.130.160/27

You have been allocated the address space 174.82.10.0/24 for the network shown in the exhibit. All devices in this network are required to use the same subnet mask, and all subnets are considered usable.

What is the most appropriate subnet mask for the network that is shown?

25 Users

20 Users

10 Users
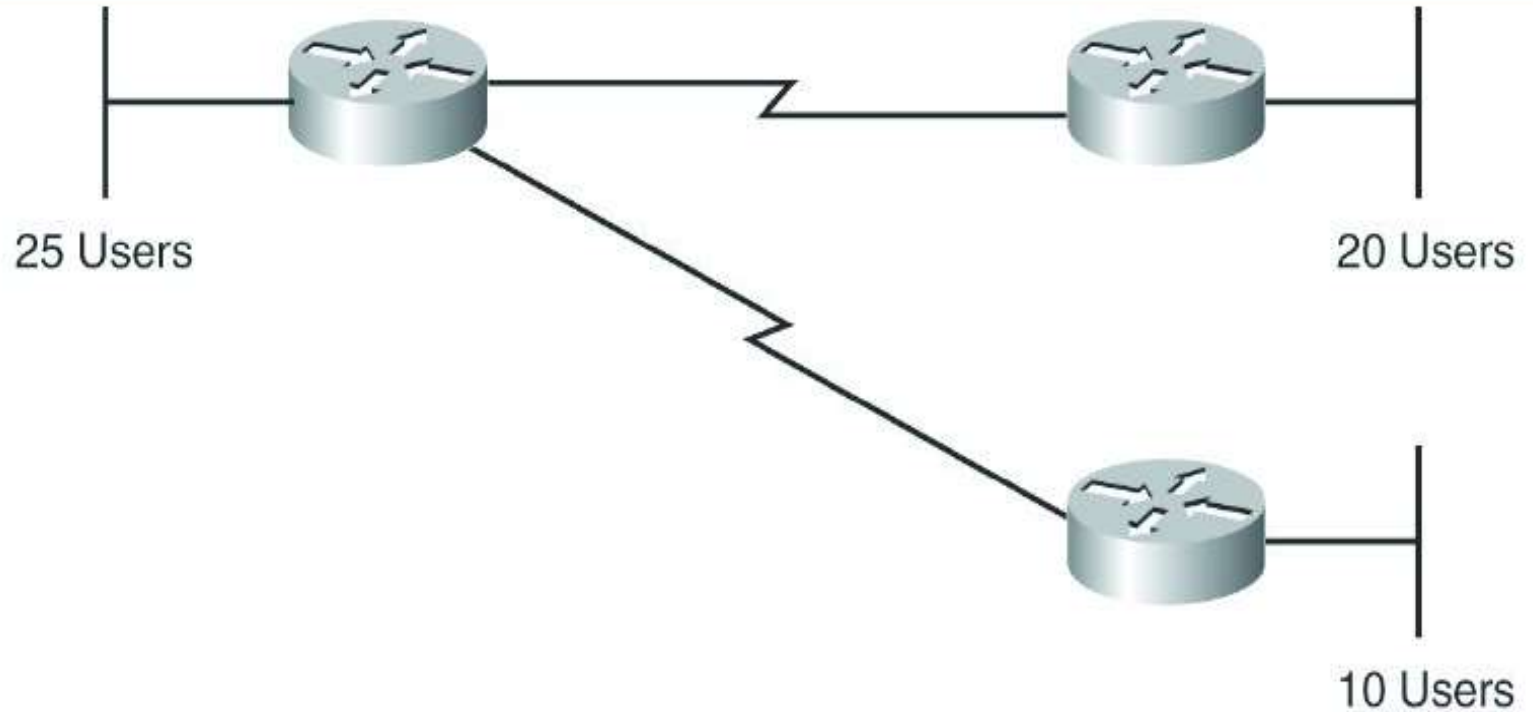
- ○ 255.255.255.0
- ○ 255.255.252.0
- ○ 255.255.255.240
- ○ 255.255.255.128
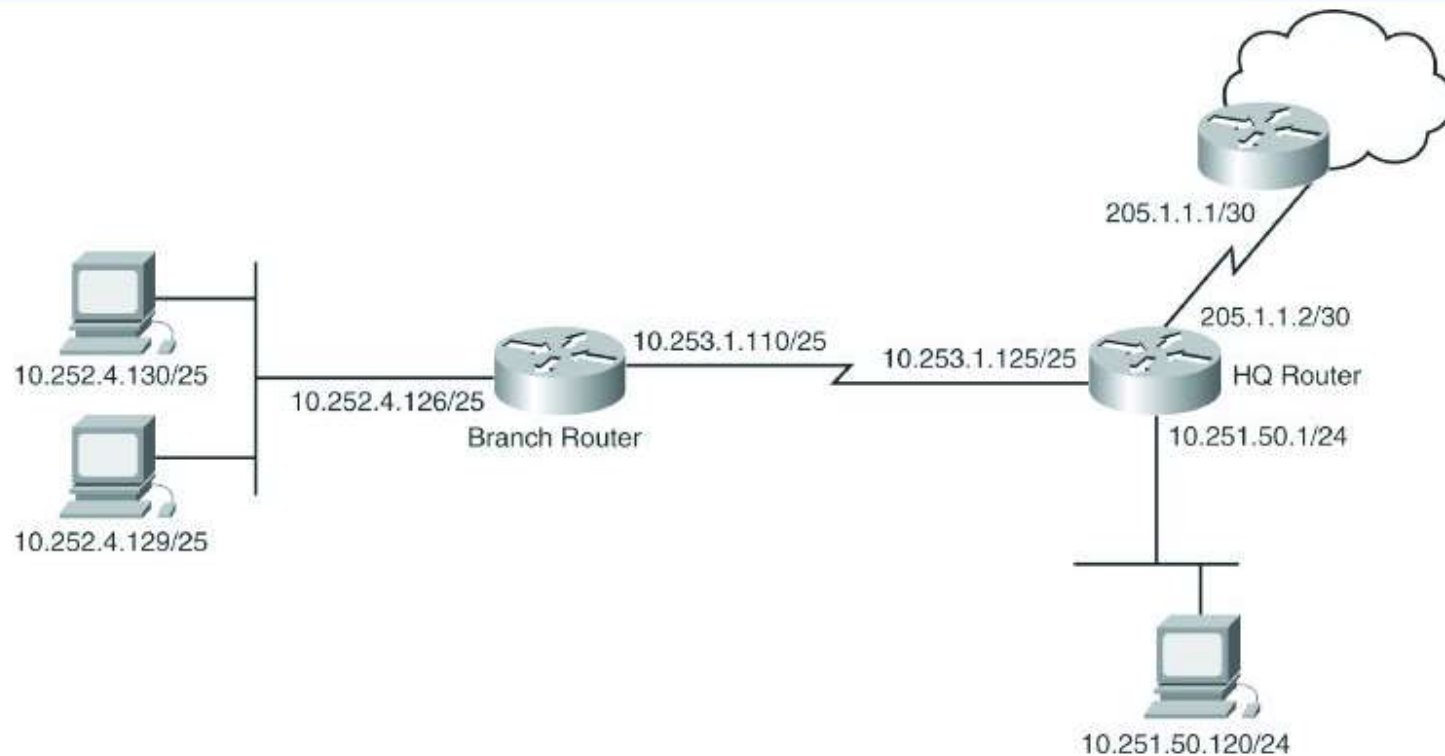- ○ 255.255.255.192
- ○ 255.255.255.224

You are a network technician at Acme, Inc. You have subnetted the 192.168.72.0 network with a /30 mask for connections between your routers. Your boss asks you how many usable subnetworks and usable host addresses per subnet this will provide.

What should you tell her, assuming your router can use all possible subnets?

○ 16 networks and 14 hosts

○ 64 networks and 2 hosts

○ 16 networks and 16 hosts

○ 8 networks and 32 hosts

○ 8 networks and 30 hosts

After the routers shown in the exhibit have been configured, it is discovered that the hosts in the branch office network cannot access the Internet. Further testing reveals additional connectivity issues.

What is the most likely solution to this problem?

- 205.1.1.1/30
- 205.1.1.2/30
- HQ Router
- 10.253.1.110/25
- 10.253.1.125/25
- 10.251.50.1/24
- Branch Router
- 10.252.4.130/25
- 10.252.4.126/25
- 10.252.4.129/25
- 10.251.50.120/24

- ○ Change the address of the HQ router WAN interface.
- ○ Change the address of the HQ router Internet interface.
- ○ Change the address of the Branch router LAN interface.
- ○ Change the address of the Branch router WAN interface.
- ○ Change the subnet mask of the HQ router LAN interface.
- ○ Change the subnet mask of the HQ router Internet interface.

Questions?