Computer Techniques Engineering Department
College of Engineering and Technology
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Networks Simulation

IP addressing and Subnetting part 2

IP addressing, CAST, NAT & PAT and Subnet Zero

Topic 6

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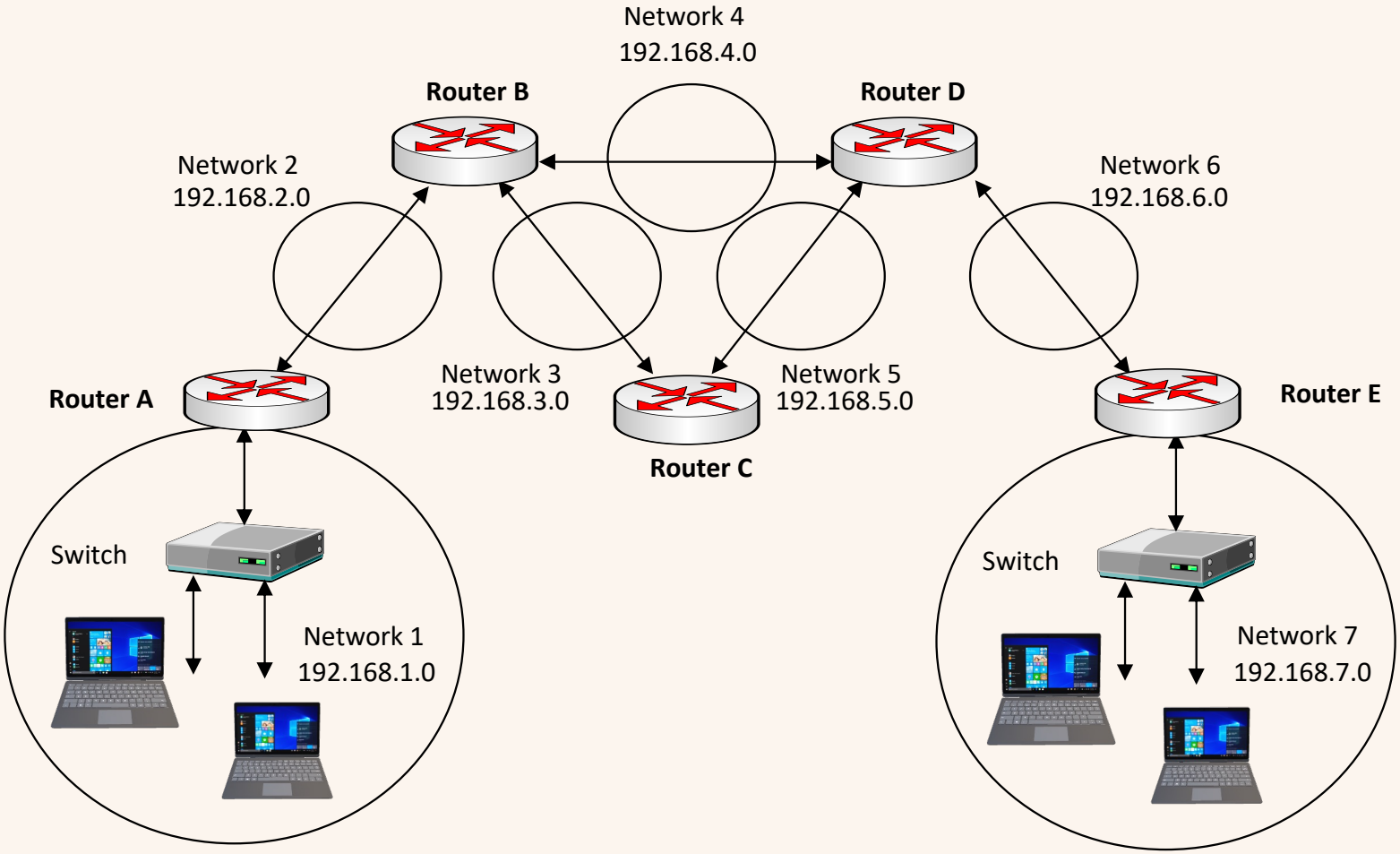
ICANN

The Internet Corporation for Assigned Names and Numbers (**ICANN**) is responsible for coordinating the allocation and assignment of the three sets of unique identifiers for the Internet: **domain names, Internet protocol (IP) addresses and autonomous system numbers, and protocol port**, as well as to facilitate the coordination of the operation and evolution of the **Domain Name System** (**DNS**) root name server system.

How Many Networks?



IPv4 Address Classes (Classful Addressing)

Address Class	First Octet Range	Number of Possible Networks	Number of Hosts per Network
Class A	0 to 127	128 (2 are reserved)	16,777,214
Class B	128 to 191	16,348	65,534
Class C	192 to 223	2,097,152	254

Class D Addresses

- A Class D address begins with **binary 1110 in the first octet**.
- First octet range from 224 to 239.
- Class D address can be used to represent a group of hosts called **a host group, or multicast group.**

Class E Addresses

- The first octet of an IP address begins with 1111
- First octet range from 240 to 255.
- Class E addresses are reserved for experimental purposes and should not be **used for addressing hosts or multicast groups**.

Private and Public addresses

Private addresses are connected to the internal networks hidden behind a firewall. Your private IP address ranges are reserved by the Internet Assigned Numbers Authority (IANA).

The public IP address range encompasses every number *not* reserved for the private IP range.

Class	Private IP ranges
Class A	10.0.0.0 — 10.255.255.255
Class B	172.16.0.0 — 172.31.255.255
Class C	192.168.0.0 — 192.168.255.255

Reserved IP addresses

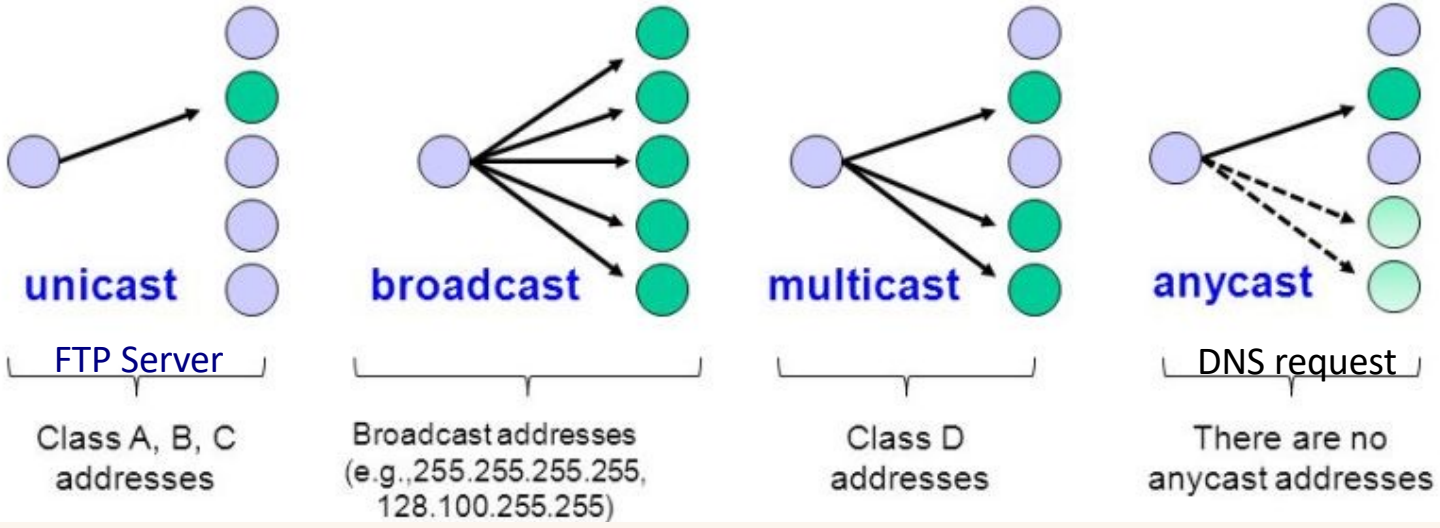
Reserved IP addresses are reserved for special use by TCP/IP and should not be assigned to a device on a network.

IP addresses	Function
255.255.255.255	Used for broadcast messages by TCP/IP background processes. A broadcast message is read by every node on the network.
0.0.0.0	Currently unassigned
127.0.0.1 through 127.255.255.254	Used for research or can indicate your computer, which is called the loopback address. The loopback address to verify that TCP/IP is configured correctly on a computer when it can talk to and hear itself on the loopback interface.
169.254.0.1 through 169.254.255.254	Used to create an APIPA (Automatic Private IP Addressing) address when a computer configured for DHCP first connects to the network and is unable to lease an IPv4 address from the DHCP server.

Concepts of “cast”

Cast Concepts: Broadcasting, Multicasting, Anycasting, and Unicasting

- Supported by IPv4
  - one-to-one (unicast)
  - one-to-all (broadcast)
  - one-to-many (multicast)
- Not supported by IPv4:
  - one-to-any (anycast)



Concepts of “cast”

Cast Concepts: Broadcasting, Multicasting, Anycasting, and Unicasting

1. **Broadcasting**:
   - **Definition**: Communication where data is sent from one sender to all devices on the network segment.
   - **Example**: ARP (Address Resolution Protocol) requests on a local network.
   - **Use Case**: Used in local networks where all devices must receive the same data (network discovery).
2. **Multicasting**:
   - **Definition**: Communication where data is sent from one sender to multiple receivers in a specific group.
   - **Example**: Streaming video to a group of subscribed users.
   - **Use Case**: Efficient for group communication, such as video conferencing or IPTV.

Concepts of “cast”

Cast Concepts: Broadcasting, Multicasting, Anycasting, and Unicasting

3. **Anycasting**:
   - **Definition**: Communication where data is sent from one sender to the nearest receiver among potential receivers.
   - **Example**: DNS requests are routed to the closest DNS server in an anycast group.
   - **Use Case**: Load balancing and improving response times by routing to the nearest server.

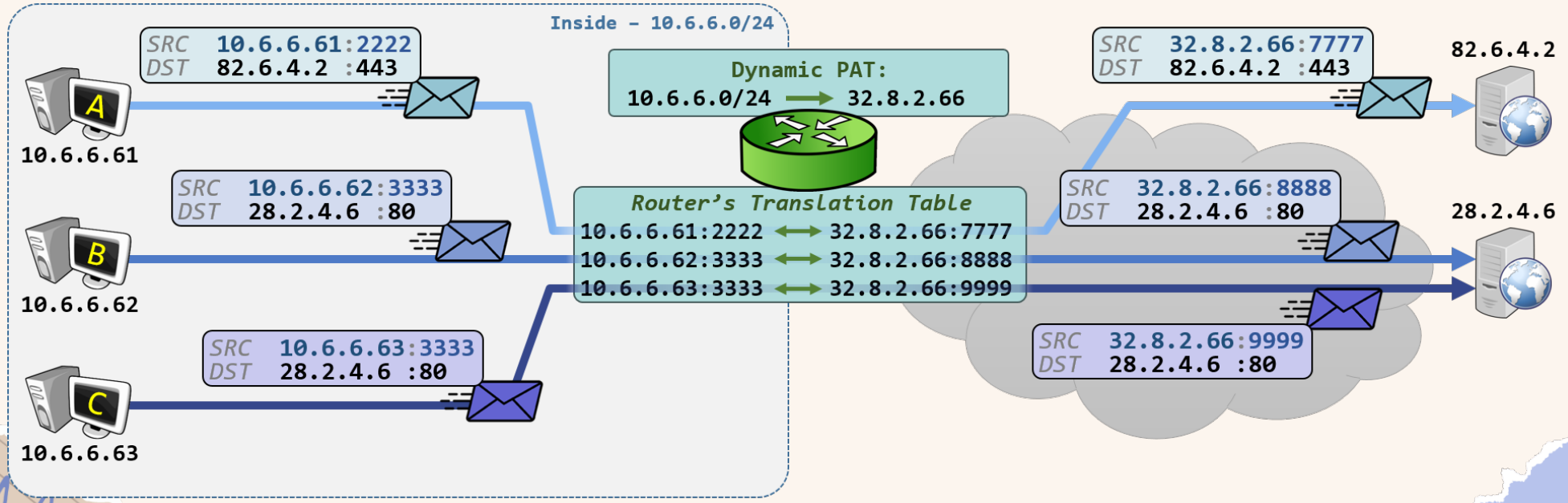
4. **Unicasting**:
   - **Definition**: Communication where data is sent from one sender to one specific receiver.
   - **Example**: Sending an email to a single recipient.
   - **Use Case**: Point-to-point communication in applications like web browsing or file transfer.

NAT & PAT

Network Address Translation (NAT) device translates the Private IP address to the Public IP address and vice versa.

How does the gateway know which local host will receive a response from a host on the Internet?

Port Address Translation (PAT) assigns a separate TCP port to each session between a local host (Private IP address) and an Internet host (Public IP address).



Role of PAT in Identifying Local Hosts

Role of PAT in Identifying Local Hosts:

1. Port Assignment:

- When a device on the local network initiates a connection to the Internet, the NAT device assigns a unique TCP or UDP port to the session.
- This port is combined with the public IP address of the NAT device to form a unique identifier (32.8.2.66:7777).

2. Translation Table:

- The NAT device maintains a translation table that maps the private IP address and port number of the local device (10.6.6.61:2222) to the public IP address and port number (32.8.2.66:7777).

3. Incoming Response:

- When the Internet host sends a response back to the public IP address (32.8.2.66) on the assigned port (7777), the NAT device looks up the translation table to find the corresponding private IP address and port (10.6.6.61:2222).

4. Routing the Response:

- The NAT device forwards the packet to the correct local host (10.6.6.61) based on the table entry.

Classful IP Addressing and Subnet Zero

- **Historical Restriction on Subnet Zero and All-Ones Subnet:**
  - In **classful IP addressing**, the **first subnet (subnet zero)** and the **last subnet (all-ones subnet)** were traditionally discouraged from use.
    - **Subnet Zero**:
      The first subnet (for a network 192.168.1.0/24, the subnet zero is 192.168.1.0).
    - **All-Ones Subnet**: The last subnet (the all-ones subnet is 192.168.1.255).

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    - **All-Ones Subnet**: The last subnet (the all-ones subnet is 192.168.1.255).

  - **Reason for Avoidance**:
    - **Subnet Zero**: It could be confused with the original network ID.
    - **All-Ones Subnet**: It was reserved for broadcasting.

Classful IP Addressing and Subnet Zero

✓ **Variable Length Subnet Masking (VLSM):**

- VLSM allows networks to be divided into subnets of varying sizes, making efficient use of available IP address space.
- When VLSM is used, both subnet zero and the all-ones subnet can be utilized without confusion, as routers are capable of distinguishing between subnets.

❖ **Enabling Subnet Zero Usage:**

- In Cisco routers, the **ip subnet-zero** command ensures the router can use subnet zero.

Benefits of Using Subnet Zero and All-Ones Subnet

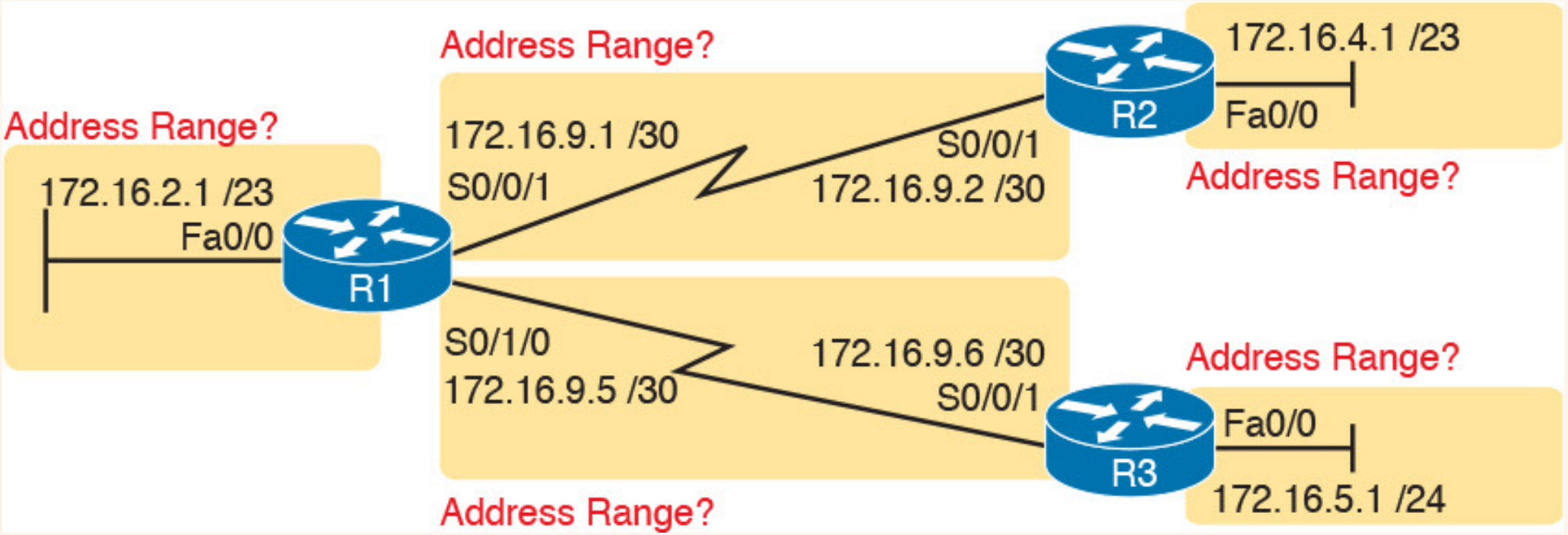
1. **Increased Address Space Efficiency:**
   By using these subnets, organizations gain access to additional subnets, which is particularly valuable in large networks.

2. **Compatibility with Modern Technologies:**
   Modern IP addressing and routing protocols are designed to handle these subnets without issues.

For a network 192.168.1.0/26 (with 64 addresses):

- **Subnet Zero**: 192.168.1.0 - 192.168.1.63
- **All-Ones Subnet**: 192.168.1.192 - 192.168.1.255

Address Range?



Address Range?

IP Address: **172.16.2.1/23**
Subnet Mask: **255.255.254.0**
Network Address: **172.16.2.0**
Broadcast Address: **172.16.3.255**
Usable Host Range: **172.16.2.1 to 172.16.3.254**
Total Usable Hosts: **510** (512 total addresses minus 2 for network and broadcast).

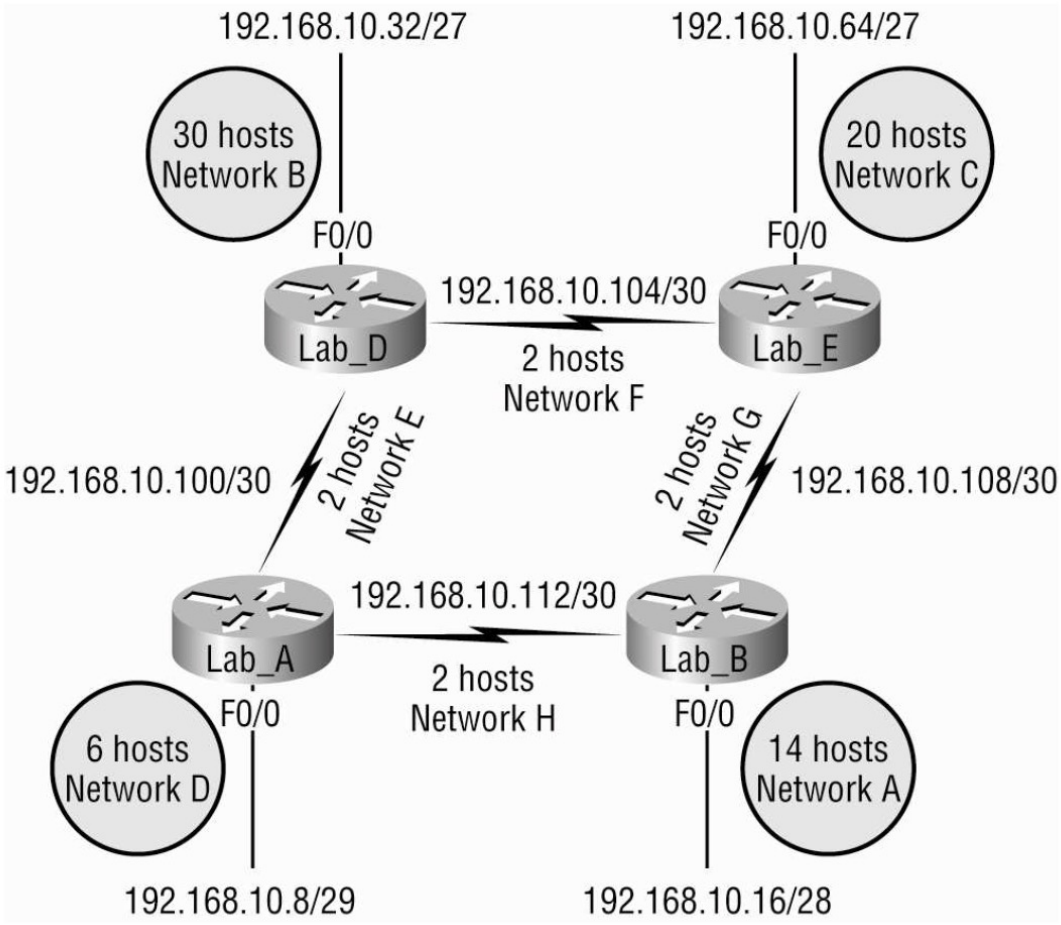
……..

IP Address: **172.16.9.0/30**
Subnet Mask: **255.255.255.252**
Network Address: **172.16.9.0**
Broadcast Address: **172.16.9.3**
Usable Host Range: **172.16.9.1 to 172.16.9.2**
Total Usable Hosts: **2** (suitable for point-to-point links).

Address Range?

IP Address: **172.16.4.1/23**
Subnet Mask: **255.255.254.0**
Network Address: **172.16.4.0**
Broadcast Address: **172.16.5.255**
Usable Host Range: **172.16.4.1 to 172.16.5.254**
Total Usable Hosts: **510** (512 total addresses minus 2 for network and broadcast).
……..
P Address: **172.16.5.1/23**
Subnet Mask: **255.255.254.0**
Network Address: **172.16.4.0**
Broadcast Address: **172.16.5.255**
Usable Host Range: **172.16.4.1 to 172.16.5.254**
Total Usable Hosts: **510** (512 total addresses minus 2 for network and broadcast).

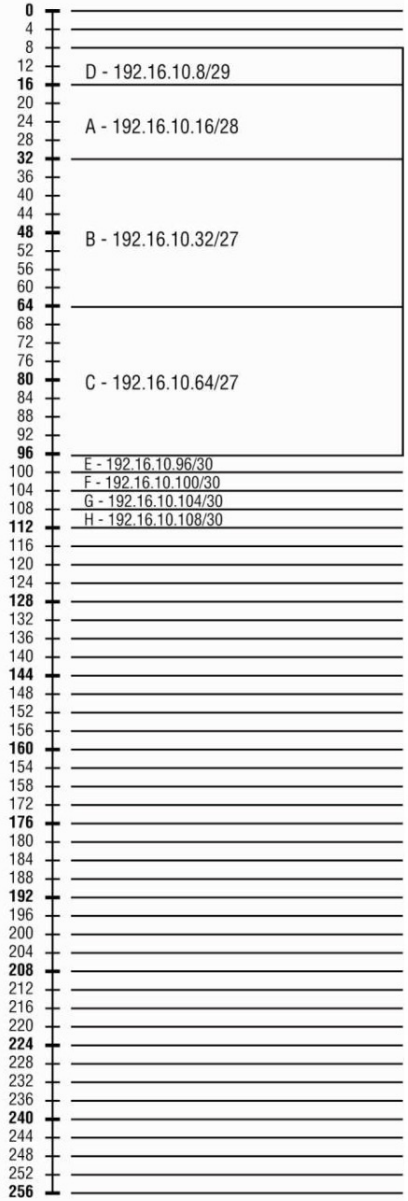
VLSM Example 1



Subnet	Mask	Subnets	Hosts	Block
/26	192	4	62	64
/27	224	8	30	32
/28	240	16	14	16
/29	248	32	6	8
/30	252	64	2	4

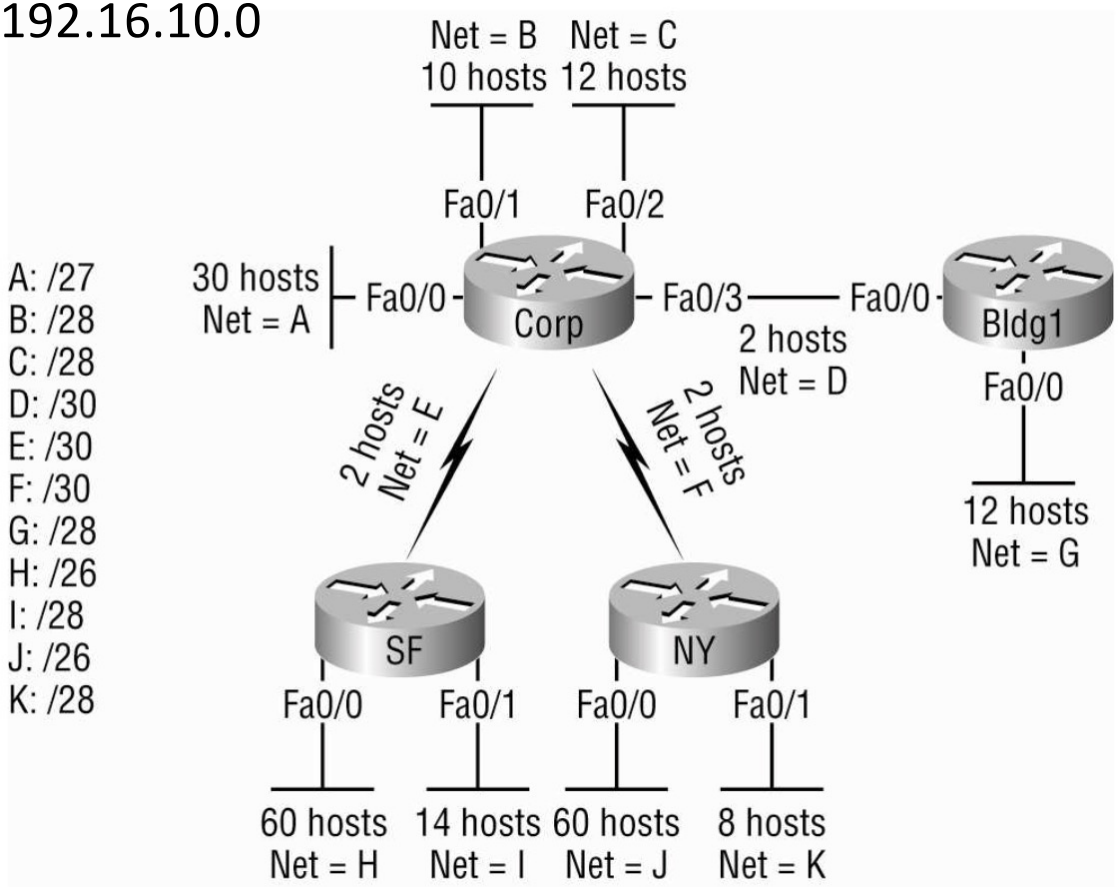
Class C Network 192.16.10.0

Network	Hosts	Block	Subnet	Mask
A	12	16	/28	240
B	20	32	/27	224
C	25	32	/27	224
D	4	8	/29	248
E	2	4	/30	252
F	2	4	/30	252
G	2	4	/30	252
H	2			



VLSM Example 2

192.16.10.0



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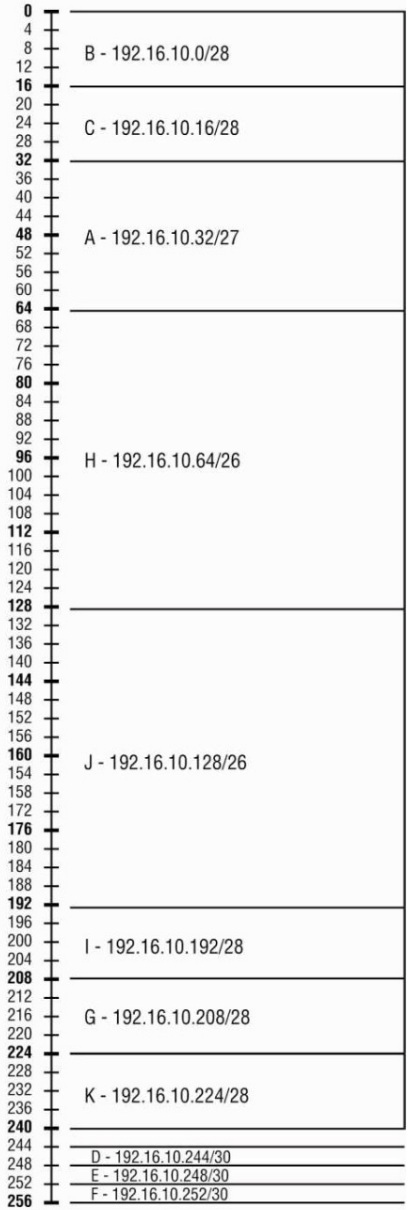
/29	248	32	6	8
/30	252	64	2	4

Class C Network 192.168.10.0

Network	Hosts	Block	Subnet	Mask
A	30	32	32	224
B	10	16	0	240
C	12	16	16	240
D	2	4	244	252
E	2	4	248	252
F	2	4	252	252
G	12	16	208	240
H	60	64	64	192
I	14	16	192	240
J	60	64	128	192
K	8	16	224	240
L				
M				



Thank you!

Do you have any questions?

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