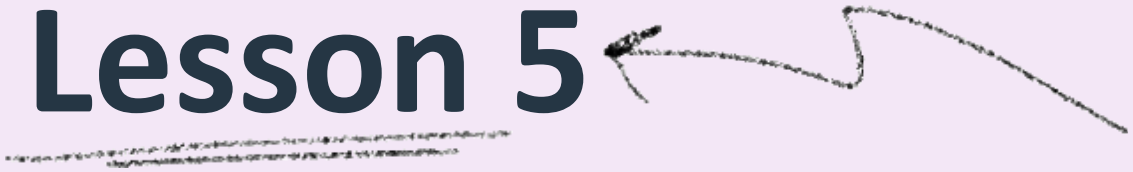
CompTIA Network+ Exam N10-008

Lesson 5



Explaining IPv4 Addressing

Objectives

- Explain IPv4 addressing schemes
- Explain IPv4 forwarding
- Configure IP networks and subnets

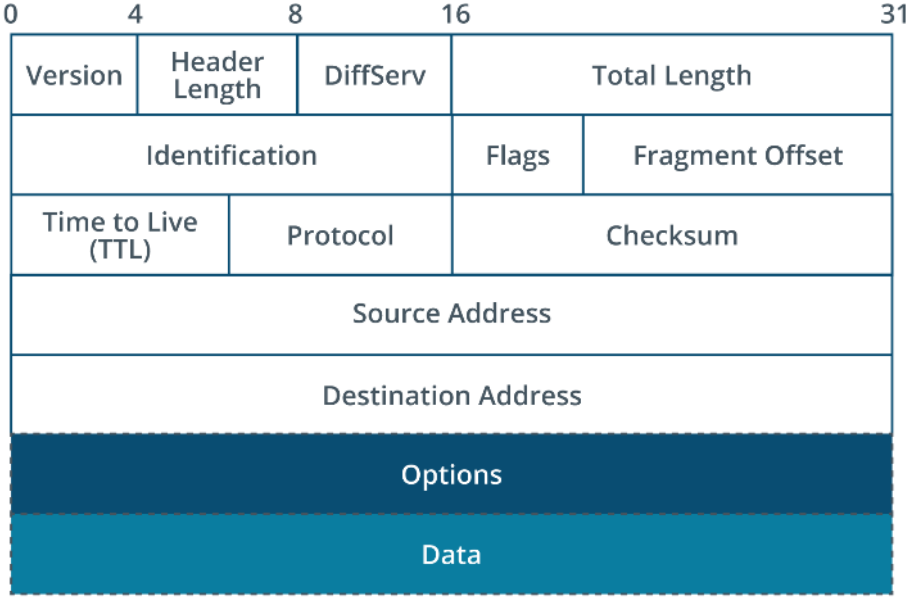
Lesson 5

Topic 5A

Explain IPv4 Addressing Schemes

IPv4 Datagram Header

- Version
- Length
- Protocol
  - Protocol type in datagram payload
  - Transmission Control Protocol (TCP)
  - User Datagram Protocol (UDP)
  - Internet Control Message Protocol (ICMP)
  - …



IPv4 Address Format (Slide 1 of 2)

- IP address encodes a network ID and a host ID
- 32-bit IPv4

  11000110001010010001000000001001

  - Divide into octets (8 bits)

  11000110 00101001 00010000 00001001

  - Convert each octet to dotted decimal notation

  198.51.100.1

IPv4 Address Format (Slide 2 of 2)

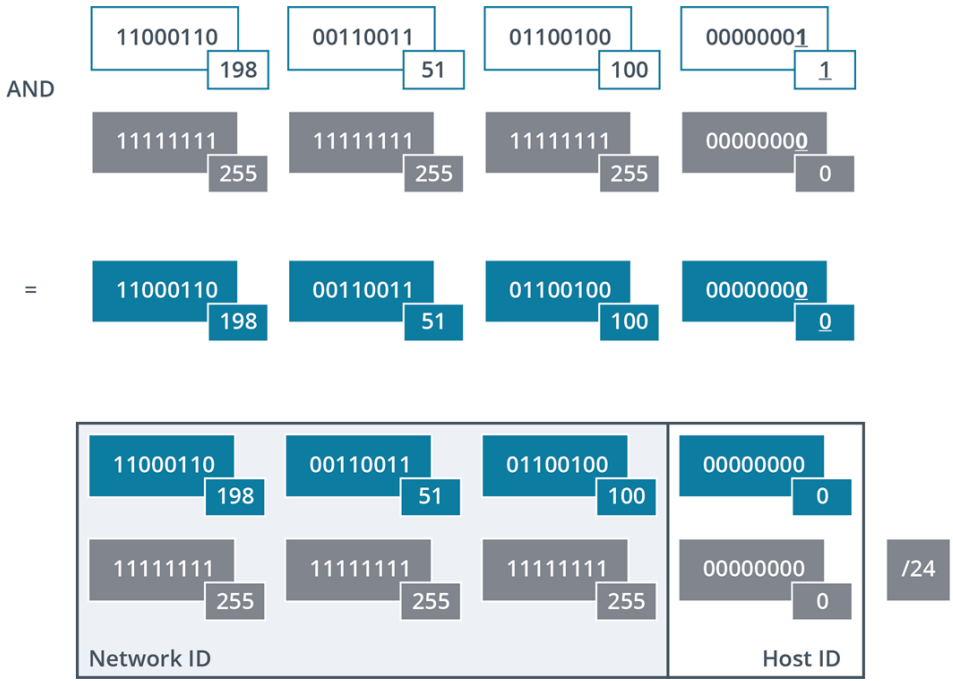
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
128	64	32	16	8	4	2	1	
1	1	0	0	0	1	1	0	
128*1	64*1	32*0	16*0	8*0	4*1	2*1	1*0	
128	+64	+0	+0	+0	+4	+2	+0	= 198

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
	128	64	32	16	8	4	2	1
51 =	0	+0	+32	+16	+0	+0	+2	+1
	0	0	1	1	0	0	1	1

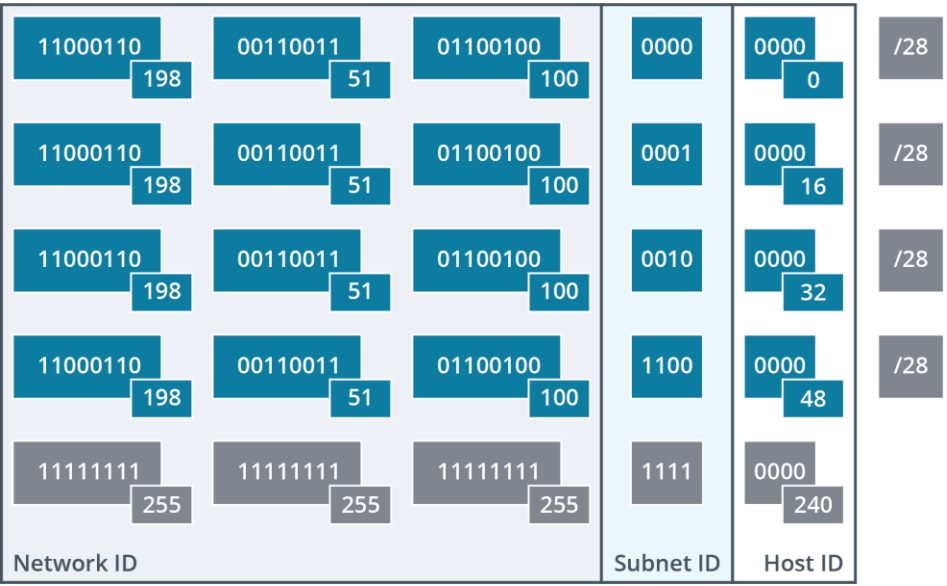
- Binary/decimal conversion
- Range of values from 0.0.0.0 to 255.255.255.255

Network Masks

- Accompanies IP address to reveal network ID part
- Binary 1 in the mask indicates corresponding bit is part of network ID
- Dotted decimal mask or network prefix (slash notation)
- “Default” masks align to octet boundaries



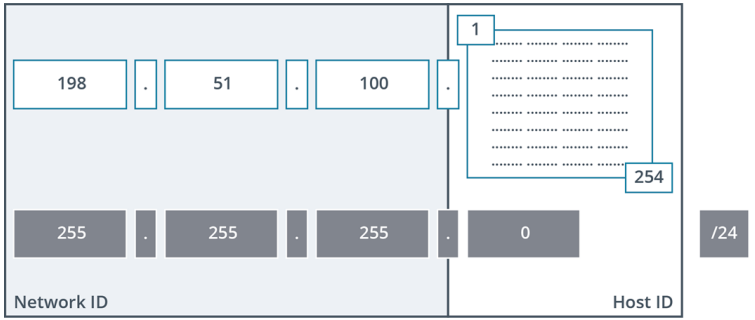
Subnet Masks

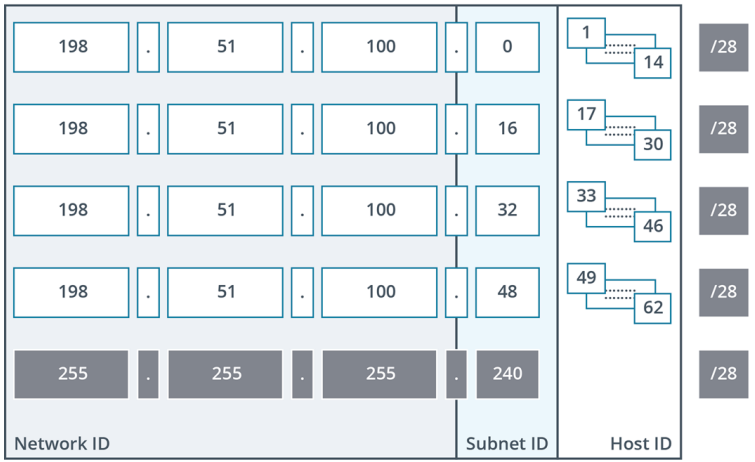


- Divide an IP network into multiple IP subnets
- Designate some host bits as subnet ID bits
- Subnet masks only used within the IP network

Host Address Ranges

- Number of host bits determines available addresses
  - First address is reserved for the network
  - Last address is reserved for broadcast
- Subnet design fits requirements for number of subnets and hosts per subnet





Review Activity: IPv4 Addressing Schemes

- IPv4 Datagram Header
- IPv4 Address Format
- Network Masks
- Subnet Masks
- Host Address Ranges

Lab Activity

Assisted Lab: Configure IPv4 Static Addressing

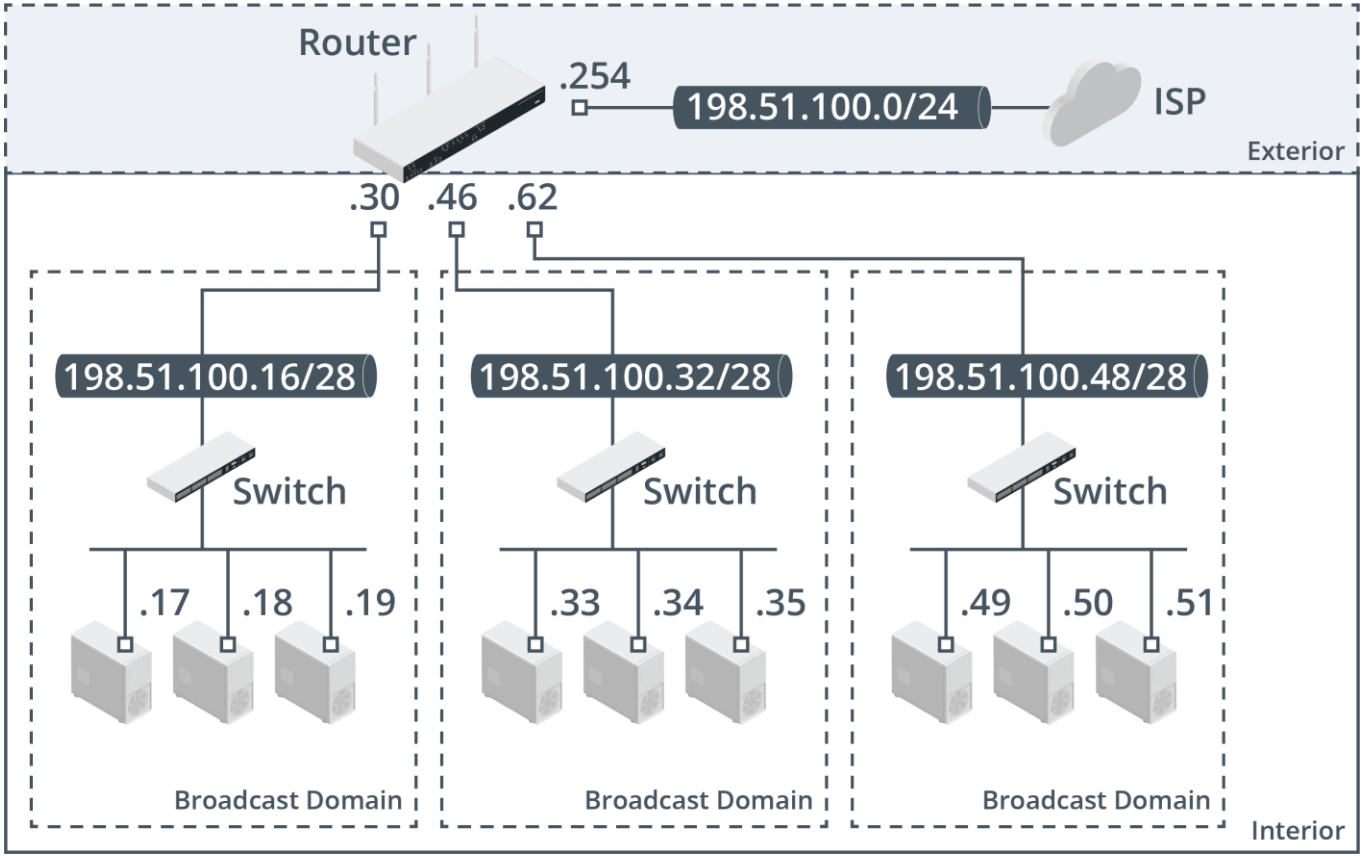
- Lab types
  - Assisted labs guide you step-by-step through tasks
  - Applied labs set goals with limited guidance
- Complete lab
  - Submit all items for grading and check each progress box
  - Select “Grade Lab” from final page
- Save lab
  - Select the hamburger menu and select “Save”
  - Save up to two labs in progress for up to 7 days
- Cancel lab without grading
  - Select the hamburger menu and select “End”

Lesson 5

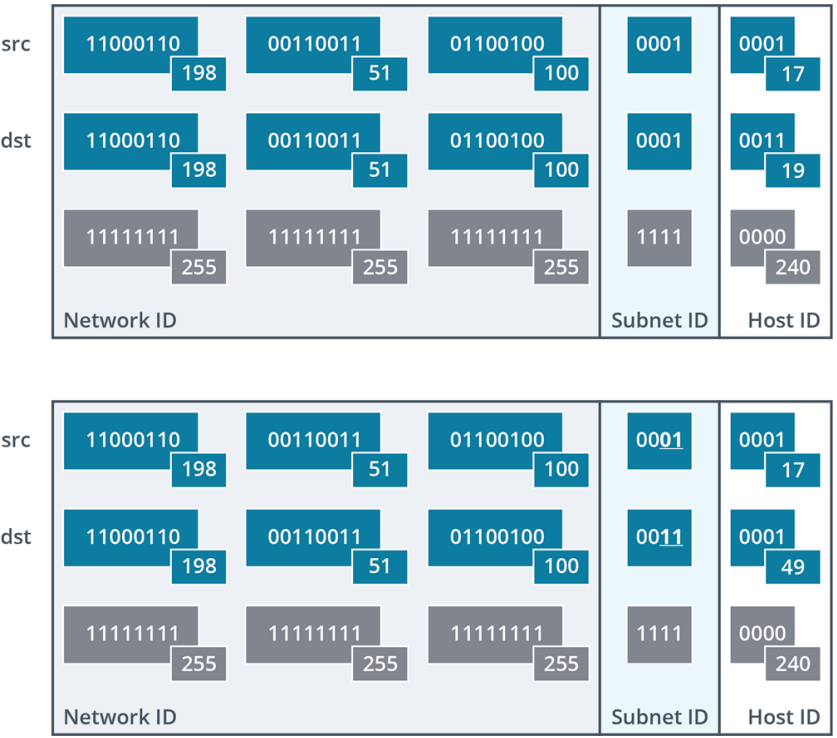
Topic 5B

Explain IPv4 Forwarding

Layer 2 versus Layer 3 Addressing and Forwarding

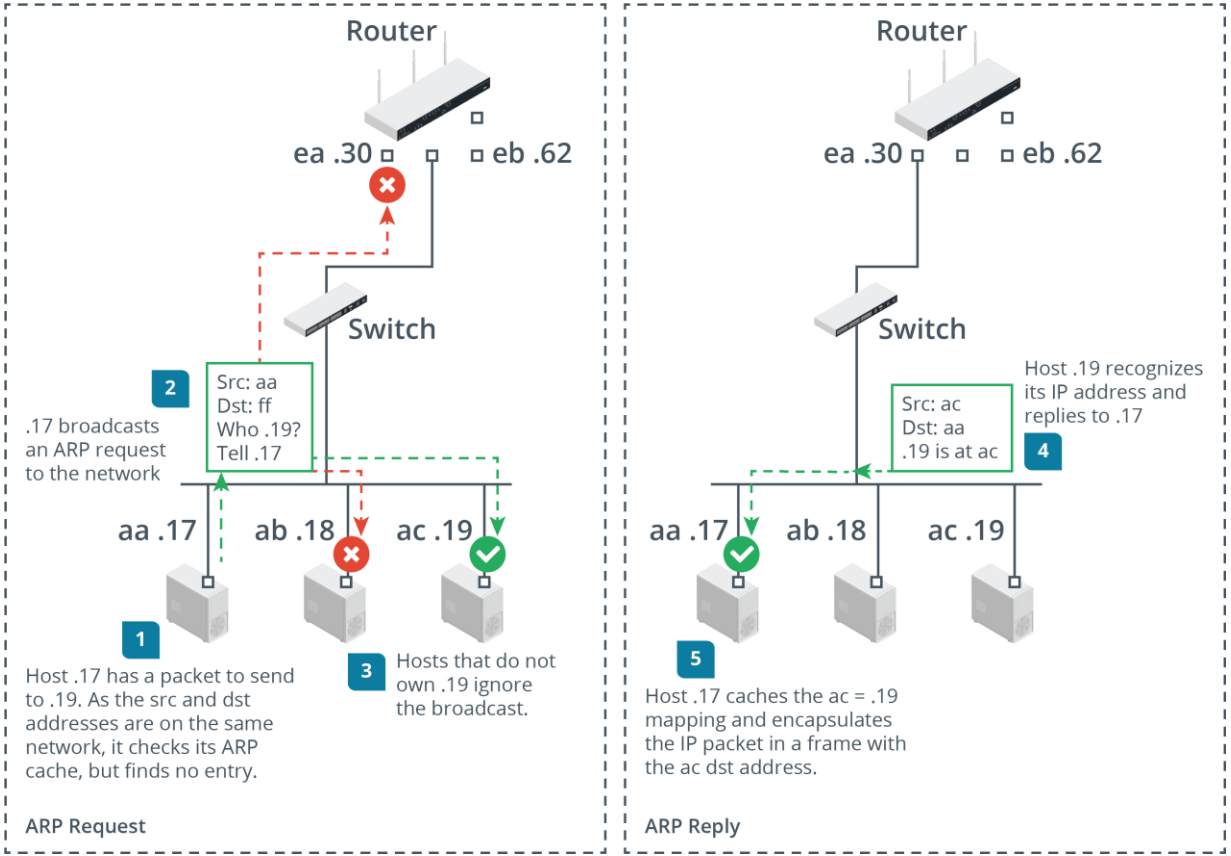


IPv4 Default Gateways



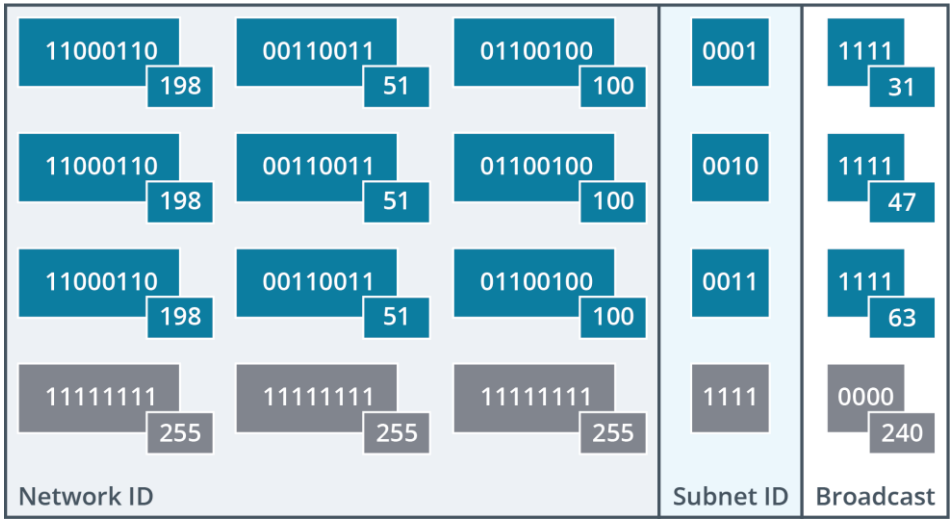
- Compare destination and source addresses against mask
- Local delivery over Ethernet uses Address Resolution Protocol (ARP)
- Remote delivery sent to the default gateway for forwarding
  - Configured as entry in host's local routing table
  - Host uses ARP to locate gateway host on local network
- Default gateway is a router
  - Routers hold paths to multiple networks
  - Paths configured statically or learned using a dynamic routing protocol

Address Resolution Protocol

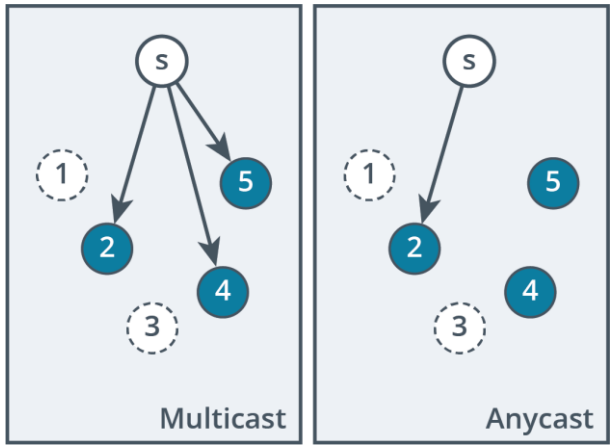


Unicast and Broadcast Addressing

- Unicast packet directed to a single destination IP address
- Broadcast packet directed to all interfaces in the local IP network
  - Layer 3 broadcast domain
  - IP network broadcast address
  - Delivered at layer 2 by broadcast MAC
  - Map layer 3 broadcast domains to layer 2 broadcast domains
  - Routers do not typically forward broadcasts



Multicast and Anycast Addressing



- Multicast
  - Hosts join a multicast group
  - Internet Group Management Protocol (IGMP)
  - IPv4 multicast delivery uses special address ranges
  - Delivery at layer 2
- Anycast
  - Group of hosts configured with same IP address
  - Router forwards to one node only based on prioritization algorithm
  - Used for load balancing and service failover

Review Activity: IPv4 Forwarding

- Layer 2 versus Layer 3 Addressing and Forwarding
- IPv4 Default Gateways
- Address Resolution Protocol
- Unicast and Broadcast Addressing
- Multicast and Anycast Addressing

Lab Activity

Assisted Lab: Analyze ARP Traffic

- Lab types
  - Assisted labs guide you step-by-step through tasks
  - Applied labs set goals with limited guidance
- Complete lab
  - Submit all items for grading and check each progress box
  - Select “Grade Lab” from final page
- Save lab
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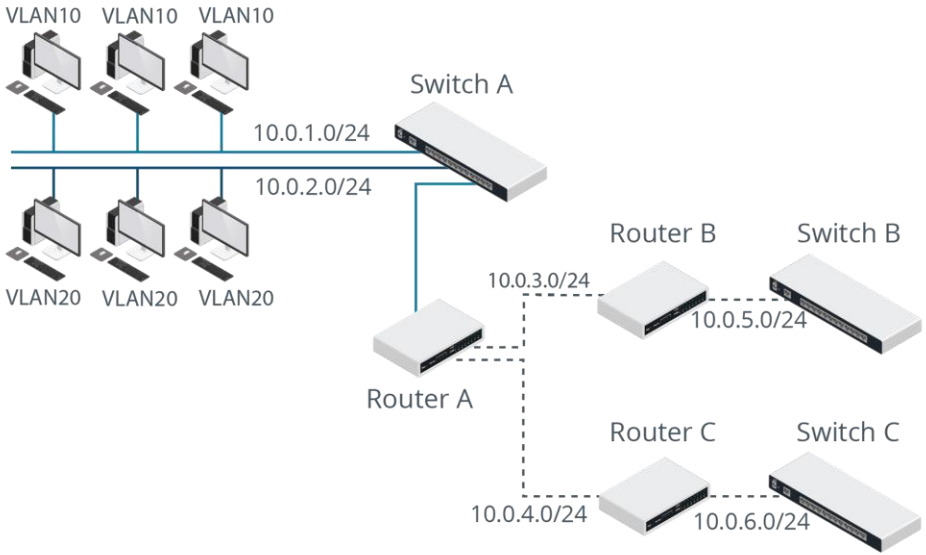
Lesson 5

Topic 5C

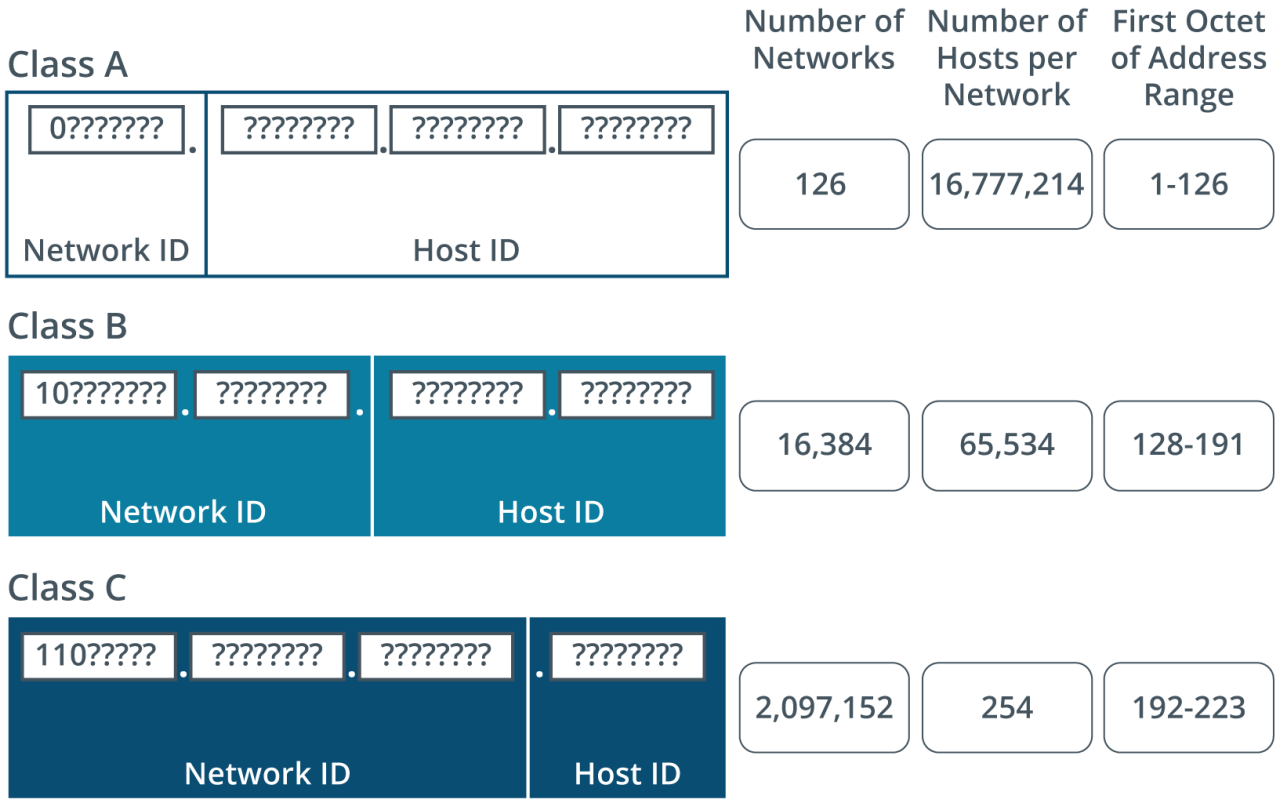
Configure IP Networks and Subnets

Virtual LANs and Subnets



- Limit number of hosts within broadcast domain to improve performance
  - Segments identified at layer 3 as subnets
  - Configure virtual LANs (VLANs) on switches to map layer 3 broadcast to layer 2
- Other uses for segmentation
  - Represent WAN links
  - Enforce security zones and boundaries
  - Isolate physical and data link layer segments that use different technologies

Classful Addressing



	Number of Networks	Number of Hosts per Network	First Octet of Address Range
Class A	126	16,777,214	1-126
Class B	16,384	65,534	128-191
Class C	2,097,152	254	192-223

Public versus Private Addressing

- Public addresses routable over the Internet
  - Governed by IANA and assigned by regional registries and ISPs
- Private address ranges not routable over the Internet
  - 10.0.0.0 to 10.255.255.255
  - 172.16.0.0 to 172.31.255.255
  - 192.168.0.0 to 192.168.255.255
- Hosts on the private network must use some mechanism to access the Internet
  - Network address translation (NAT) or proxy servers
- Automatic Private IP Addressing (APIPA)
  - 169.254.0.0 through 169.254.255.255

Other Reserved Address Ranges

- Class D multicast range
  - 224.0.0.0 through 239.255.255.255
- Class E experimental range
  - 240.0.0.0 through 255.255.255.255
- Loopback range
  - 127.0.0.0 to 127.255.255.255
- Other
  - 0.0.0.0/8 (address unknown)
  - 100.64.0.0/10, 192.0.0.0/24, 192.88.99.0/24, 198.18.0.0/15 (special usage)
  - 192.0.2.0/24, 198.51.100.0/24, 203.0.113.0/24 (documentation and examples)

IPv4 Address Scheme Design (Slide 1 of 2)

- Consider
  - Whether you need a public or private addressing scheme
  - How many networks and subnetworks you need
  - How many hosts per subnet
- Addressing rules
  - Network ID must be from valid range
  - Network and/or host IDs cannot be all 1s or 0s
  - Host ID must be unique in the subnet
- Network ID must be unique
  - On the Internet (in a public addressing scheme)
  - On your internal system of networks (in a private addressing scheme)

IPv4 Address Scheme Design (Slide 2 of 2)

- Calculate how many subnets are needed
  - Round up to nearest power of 2
  - Exponent (the value of n in 2^n) is how many bits to add to the default network prefix
- Check subnets allow sufficient hosts (2^n-2 where n is host bits)
- Calculate the subnets
  - For the first subnet ID, deduct the least significant octet in the mask from 256
  - For the next subnet ID, find the lowest subnet value higher than the previous one
- Calculate the host ranges for each subnet
  - For the first host, add a binary 1 to the subnet address
  - For the last host, deduct two binary digits from the next subnet's ID

Review Activity: Design an IP Subnet

- Virtual LANs and Subnets
- Classful Addressing
- Public versus Private Addressing
- Other Reserved Address Ranges
- IPv4 Address Scheme Design

Review Activity: Design an IP Subnet

- At the support branch office, you have been asked to implement an IP network. Your network ID is currently 198.51.100.0/24. You need to divide this in half (two subnets) to accommodate hosts on two separate floors of the building, each of which is served by managed switches. The whole network is served by a single router.

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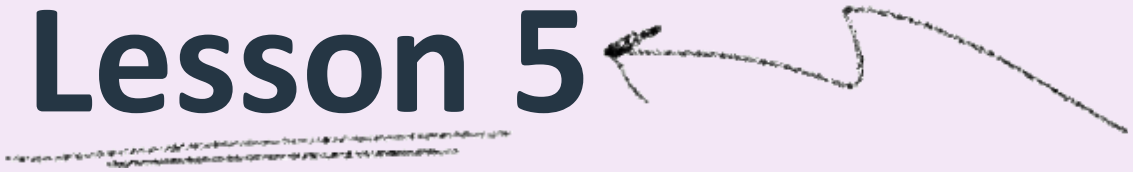

Summary