Addressing the Network – IPv4

Network Fundamentals – Chapter 6

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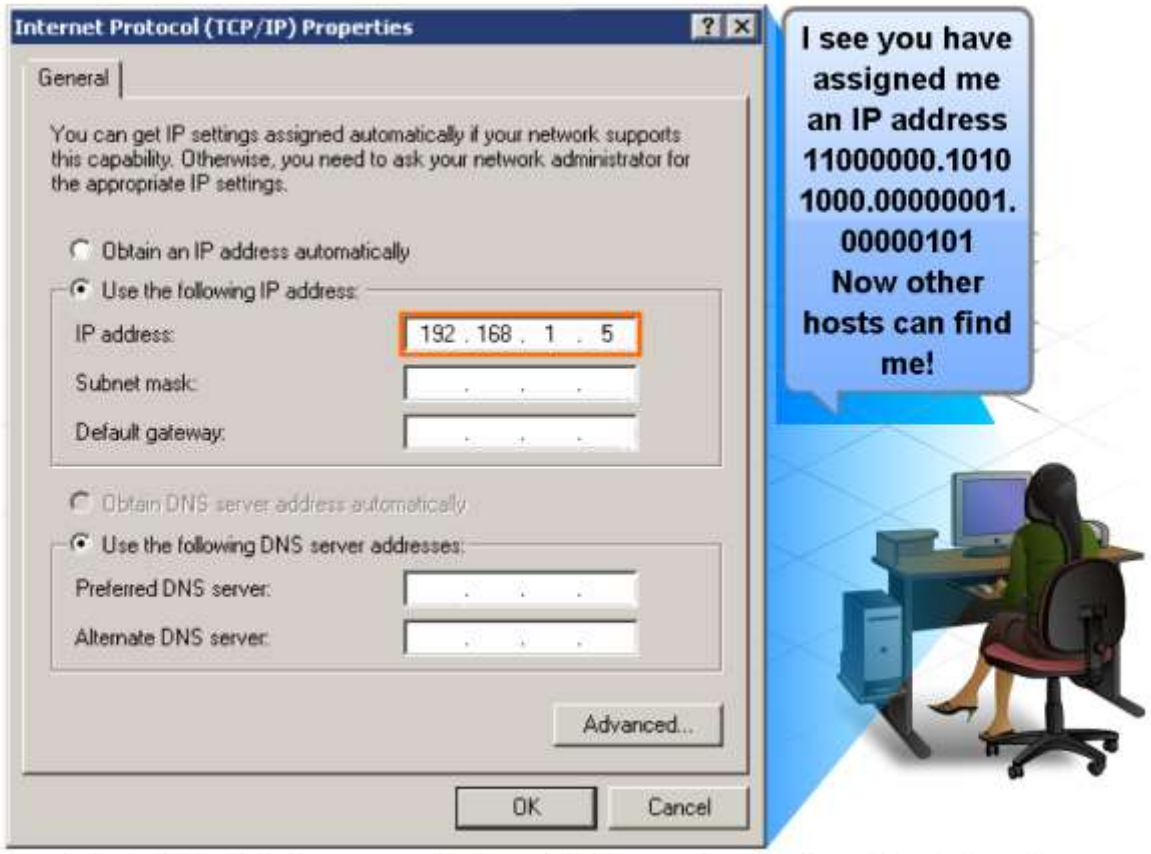
Objectives

- Explain the structure IP addressing and demonstrate the ability to convert between 8-bit binary and decimal numbers.
- Given an IPv4 address, classify by type and describe how it is used in the network
- Explain how addresses are assigned to networks by ISPs and within networks by administrators
- Determine the network portion of the host address and explain the role of the subnet mask in dividing networks.
- Given IPv4 addressing information and design criteria, calculate the appropriate addressing components.
- Use common testing utilities to verify and test network connectivity and operational status of the IP protocol stack on a host.

IP Addressing Structure

- Describe the dotted decimal structure of a binary IP address and label its parts

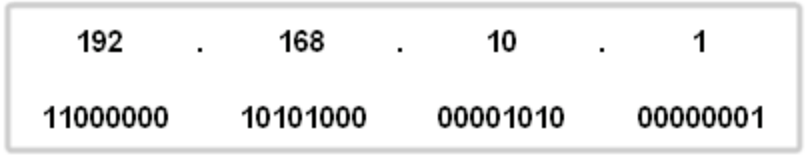


IP version 4 (IPv4) is the current form of addressing used on the Internet.

IP Addressing Structure

- Describe the general role of 8-bit binary in network addressing and convert 8-bit binary to decimal

IPv4 Addresses



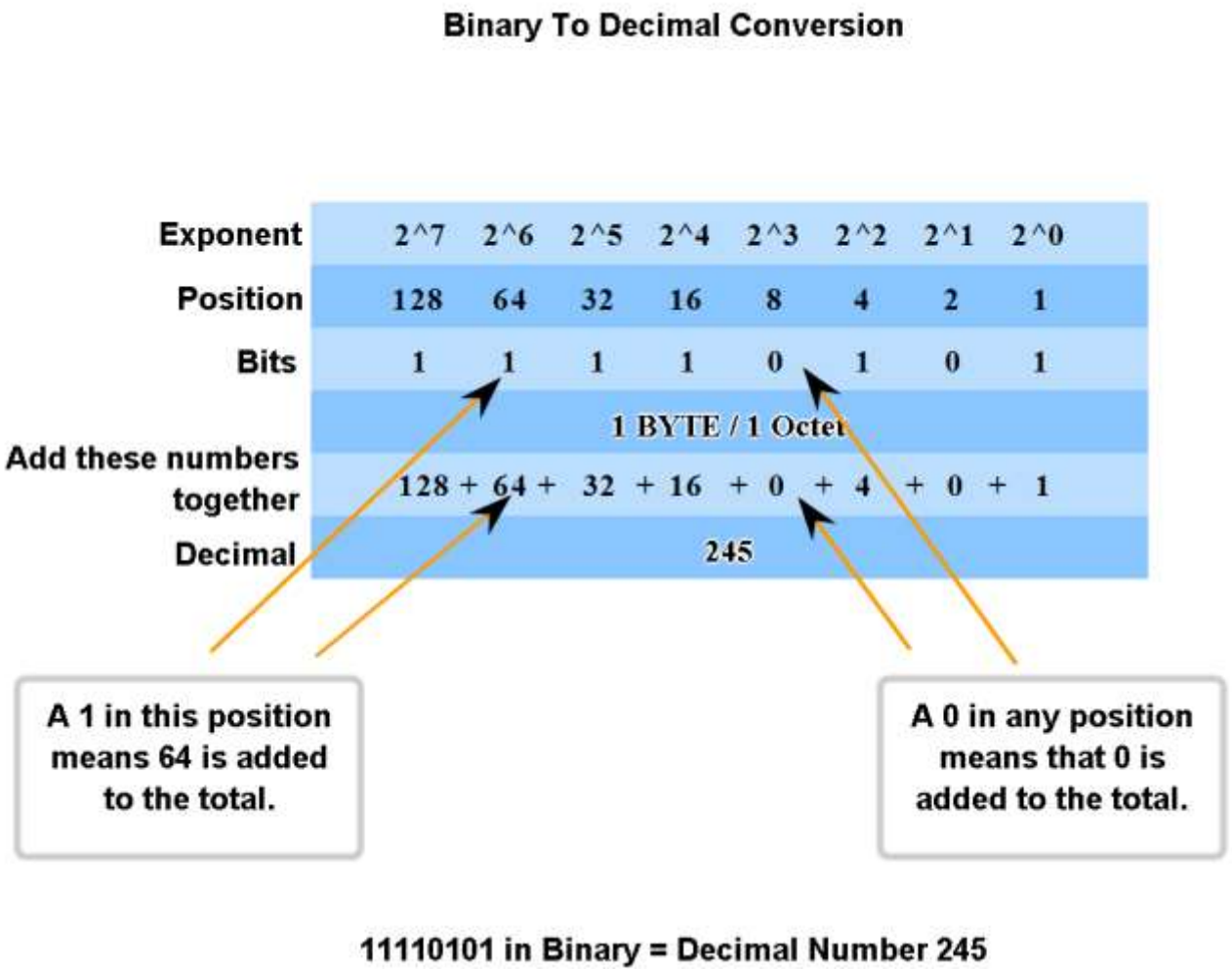
The computer using this IP address is on network 192.168.10.0.

Dotted Decimal Address | Network | Host | Octet | 32-Bit Address

Roll over a label to see the parts of an IP address.

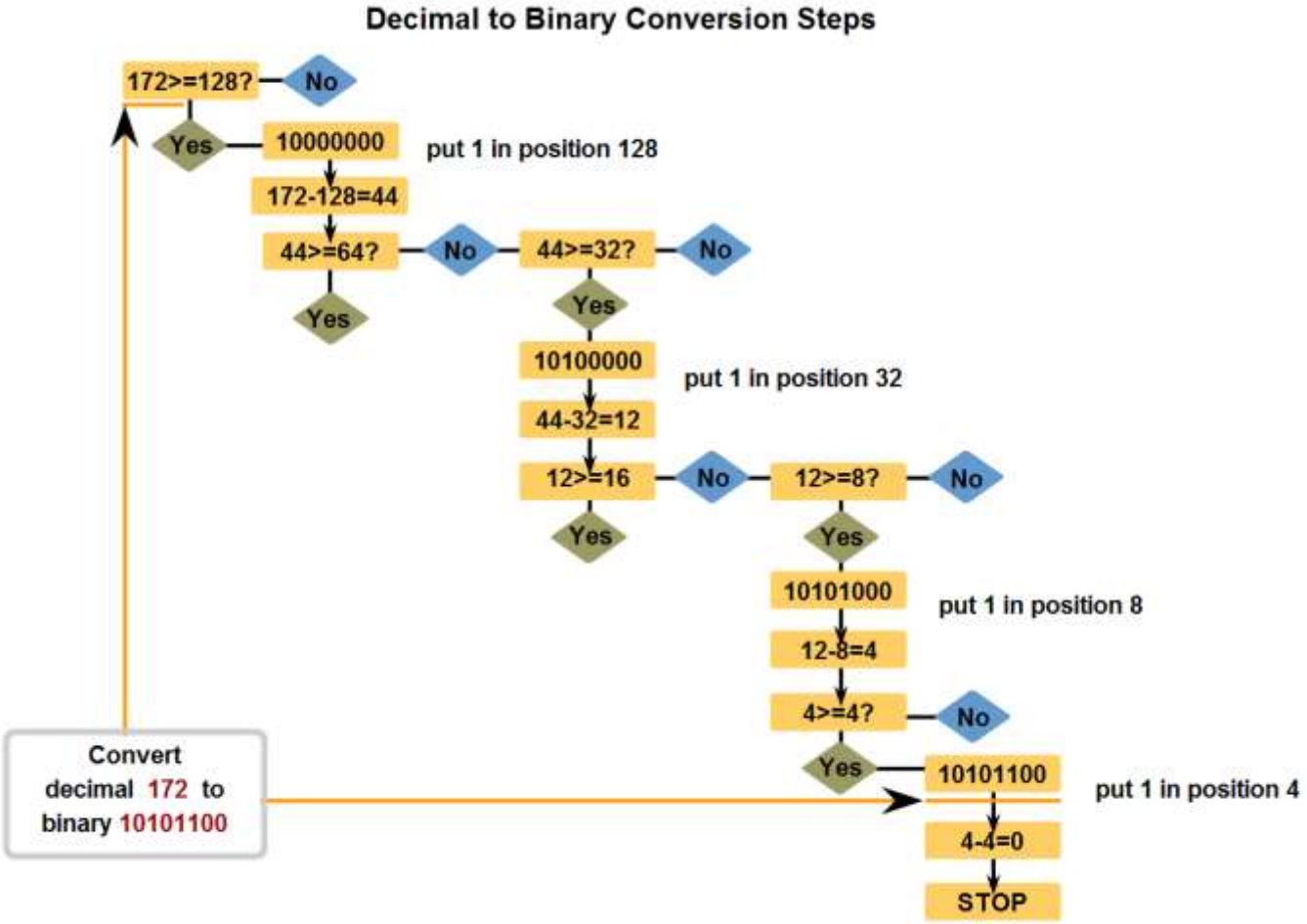
IP Addressing Structure

- Practice converting 8-bit binary to decimal



IP Addressing Structure

- Convert decimal to 8-bit binary



IP Addressing Structure

- Practice converting decimal to 8-bit binary

Decimal to Binary Conversion Activity

Given a decimal value, enter the correct binary values for each positon.

Decimal Value	209							
Exponent	2^7th	2^6th	2^5th	2^4th	2^3rd	2^2nd	2^1st	2^0
Position	128	64	32	16	8	4	2	1
Bit								

Enter numbers for these 8 positions.

Classify and Define IPv4 Addresses

- Name the three types of addresses in the network and describe the purpose of each type

Address Types

	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

Classify and Define IPv4 Addresses

- Determine the network, broadcast and host addresses for a given address and prefix combination

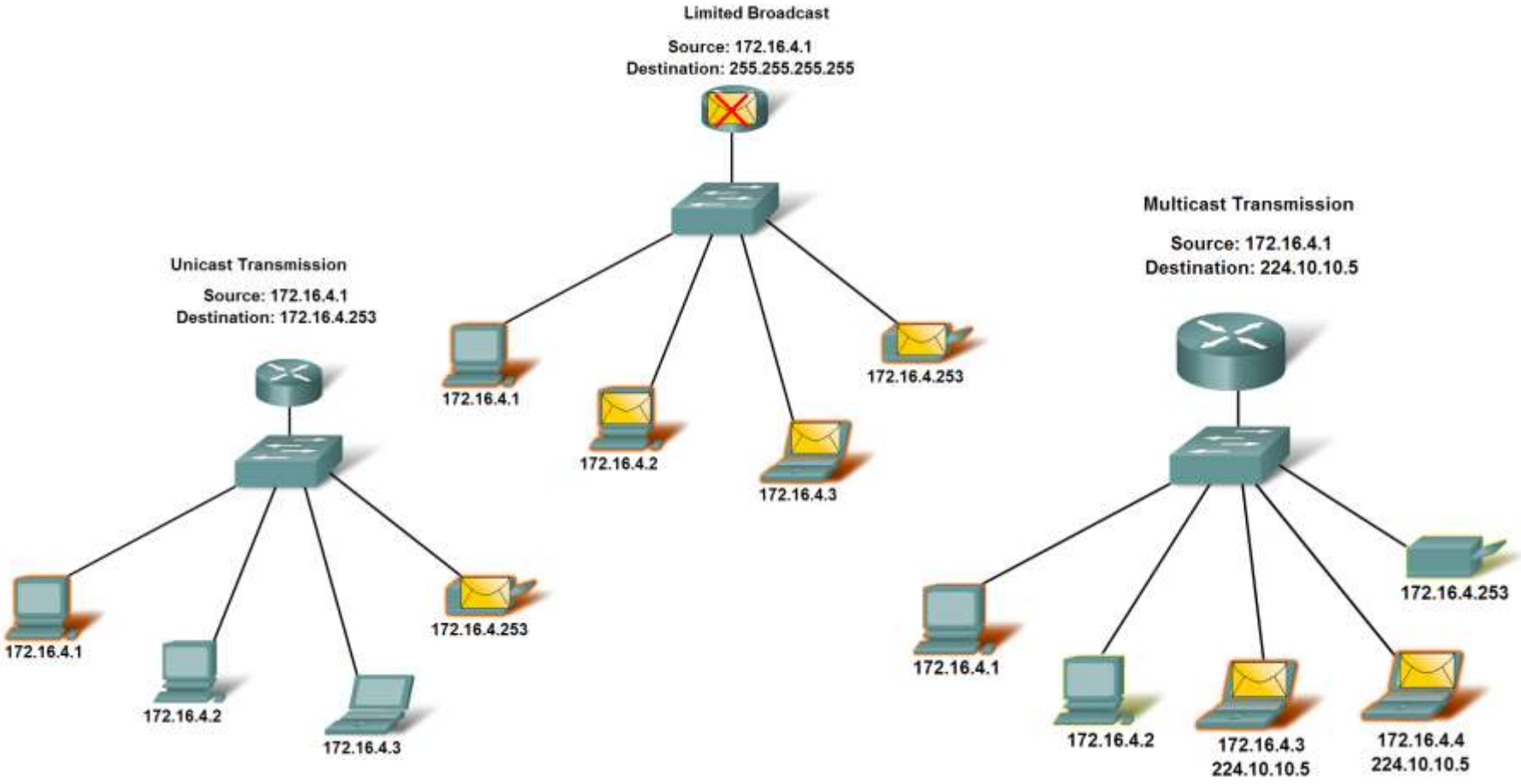
Given address/prefix of **183.26.103.215 /30**

For each row, enter the values ...

Type of Address	Enter LAST octet in binary	Enter LAST octet in decimal	Enter full address in decimal
Network			
Broadcast			
First Usable Host Address			
Last Usable Host Address			

Classify and Define IPv4 Addresses

- Name the three types of communication in the Network Layer and describe the characteristics of each type



Classify and Define IPv4 Addresses

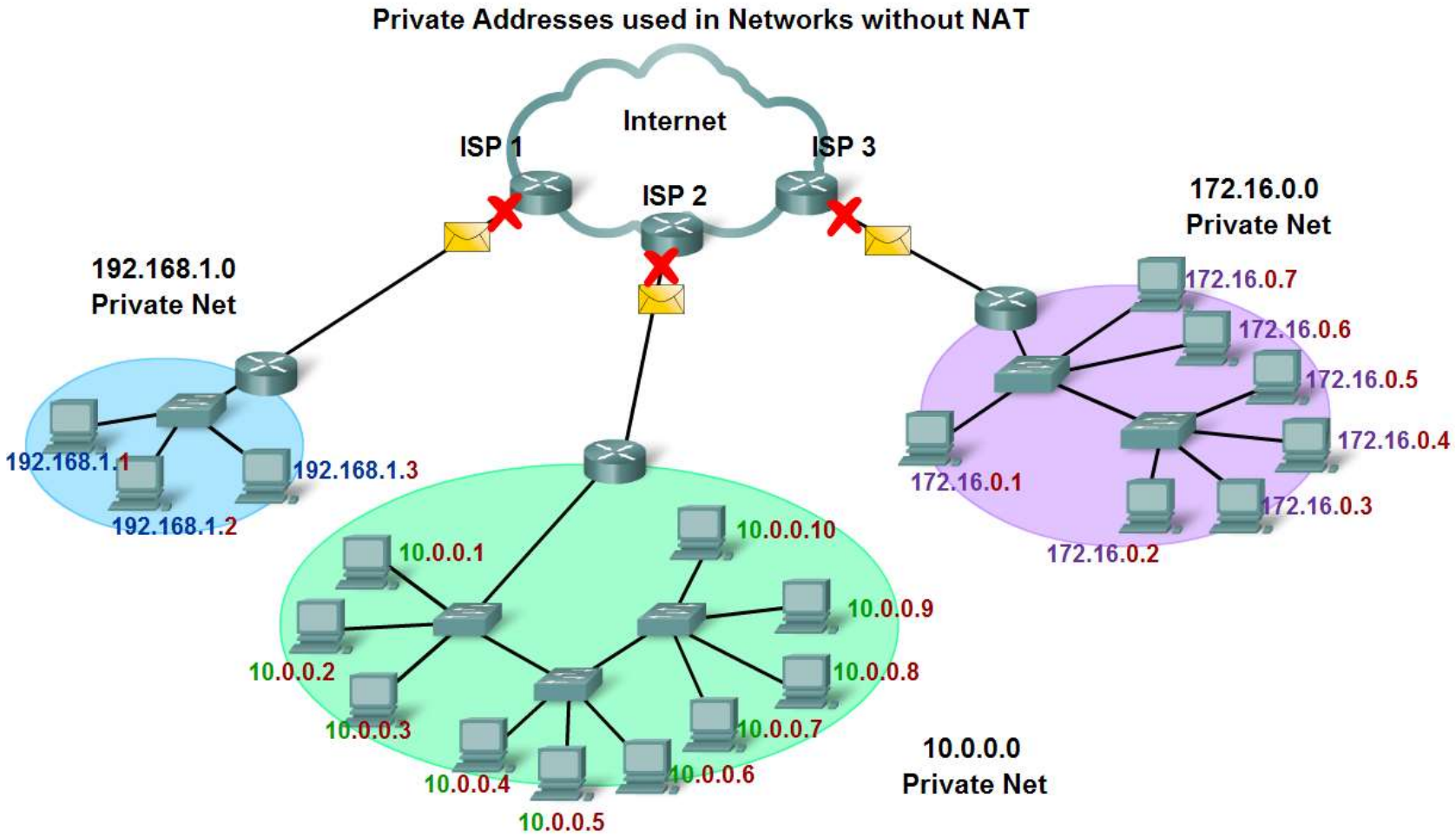
- Identify the address ranges reserved for these special purposes in the IPv4 protocol

Reserved IPv4 Address Ranges

Type of Address	Usage	Reserved IPv4 Address Range	RFC
Host Address	used for IPv4 hosts	0.0.0.0 to 223.255.255.255	790
Multicast Addresses	used for multicast groups on a local network	224.0.0.0 to 239.255.255.255	1700
Experimental Addresses	• used for research or experimentation • cannot currently be used for hosts in IPv4 networks	240.0.0.0 to 255.255.255.254	1700 3330

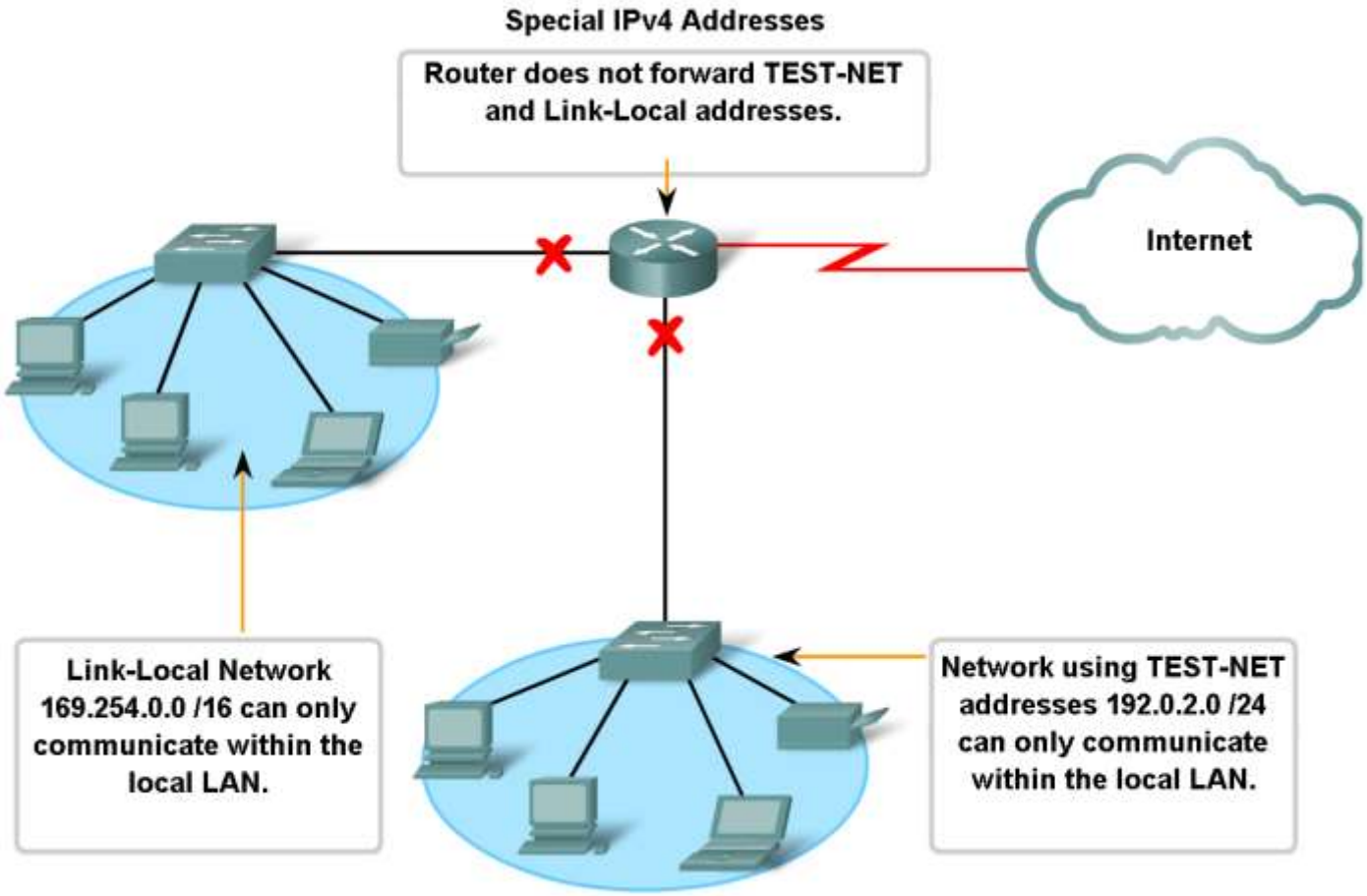
Classify and Define IPv4 Addresses

- Define public address and private address



Classify and Define IPv4 Addresses

- Describe the purpose of several special addresses



Classify and Define IPv4 Addresses

- Identify the historic method for assigning addresses and the issues associated with the method

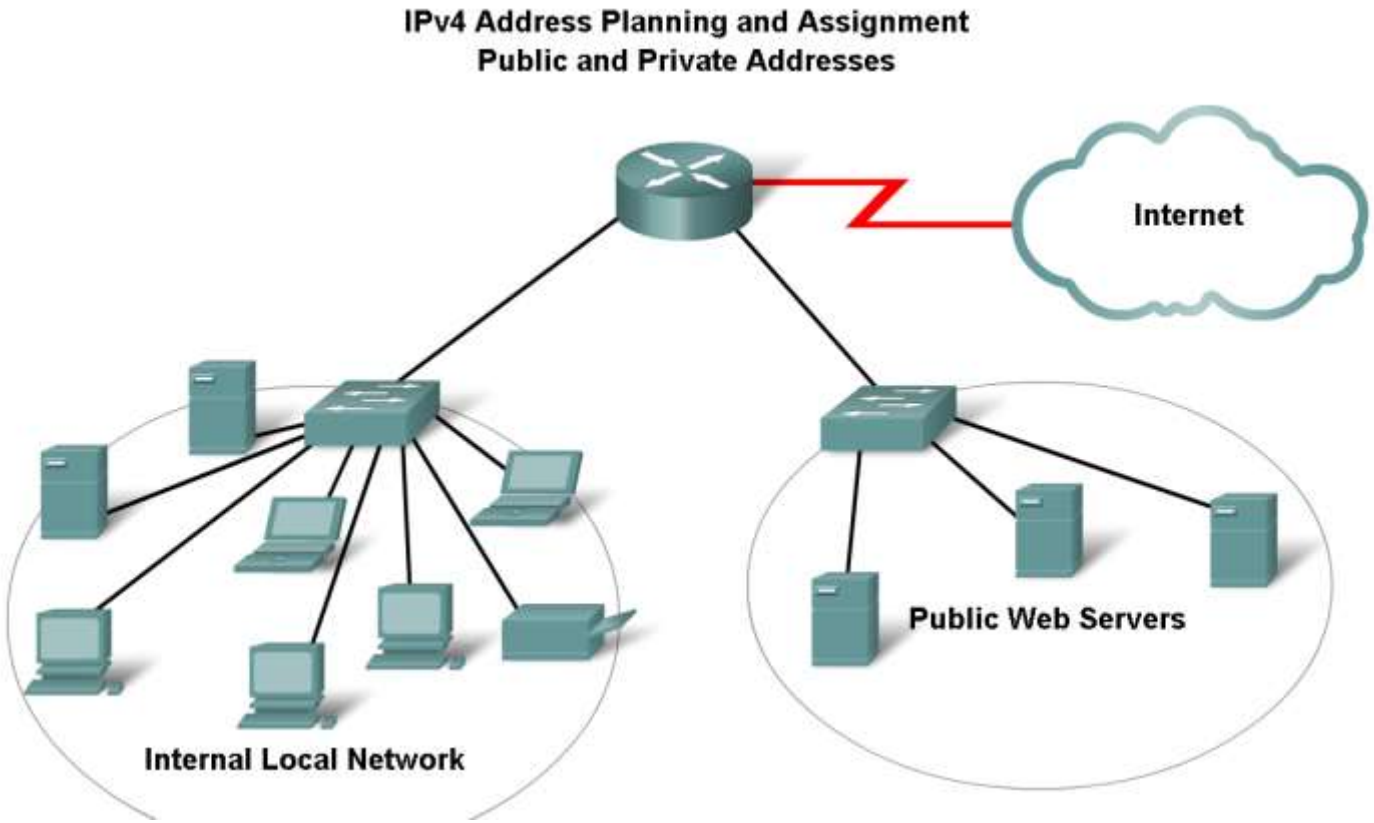
IP Address Classes

Address Class	1st octet range (decimal)	1st octet bits (green bits do not change)	Network(N) and Host(H) parts of address	Default subnet mask (decimal and binary)	Number of possible networks and hosts per network
A	1-127**	00000000-01111111	N.H.H.H	255.0.0.0	128 nets (2^7) 16,777,214 hosts per net (2^24-2)
B	128-191	10000000-10111111	N.N.H.H	255.255.0.0	16,384 nets (2^14) 65,534 hosts per net (2^16-2)
C	192-223	11000000-11011111	N.N.N.H	255.255.255.0	2,097,150 nets (2^21) 254 hosts per net (2^8-2)
D	224-239	11100000-11101111	NA (multicast)		
E	240-255	11110000-11111111	NA (experimental)		

** All zeros (0) and all ones (1) are invalid hosts addresses.

Assigning Addresses

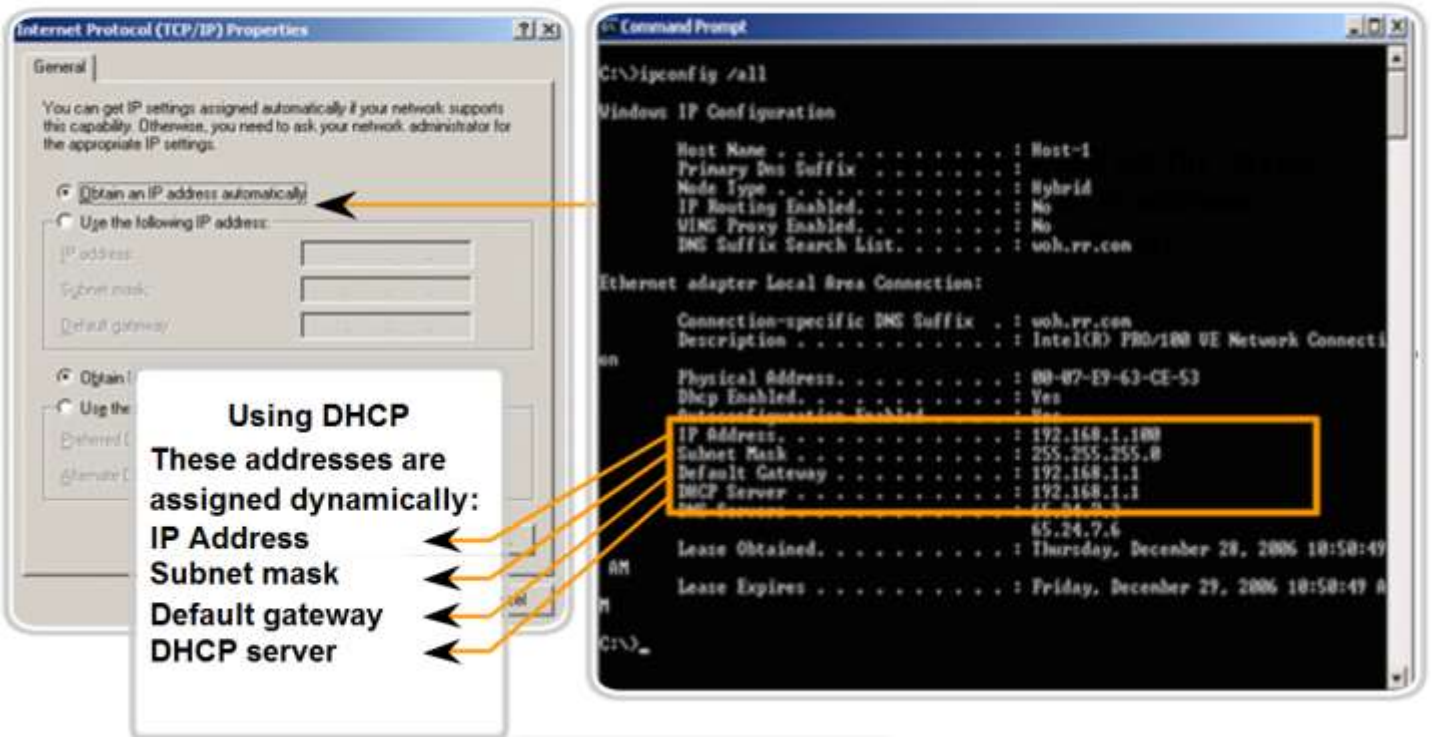
- Explain the importance of using a structured process to assign IP addresses to hosts and the implications for choosing private vs. public addresses



Assigning Addresses

- Explain how end user devices can obtain addresses either statically through an administrator or dynamically through DHCP

Assigning Dynamic Addresses

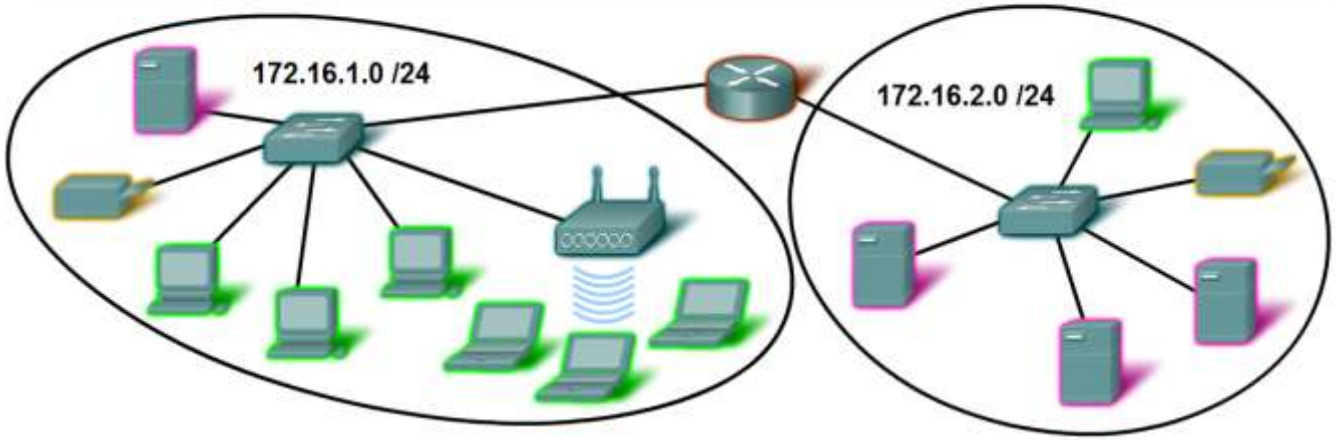


Assigning Addresses

- Explain which types of addresses should be assigned to devices other than end user devices

Devices IP Address Ranges

Use	First Address	Last Address	Summary Address
Network Address	172.16.x.0	.....	172.16.x.0 /25
User hosts (DHCP pool)	172.16.x.1	172.16.x.127	
Servers	172.16.x.128	172.16.x.191	172.16.x.128 /26
Peripherals	172.16.x.192	172.16.x.223	172.16.x.192 /27
Networking devices	172.16.x.224	172.16.x.253	172.16.x.224 /27
Router (gateway)	172.16.x.254	.....	
Broadcast	172.16.x.255	.....	



Assigning Addresses

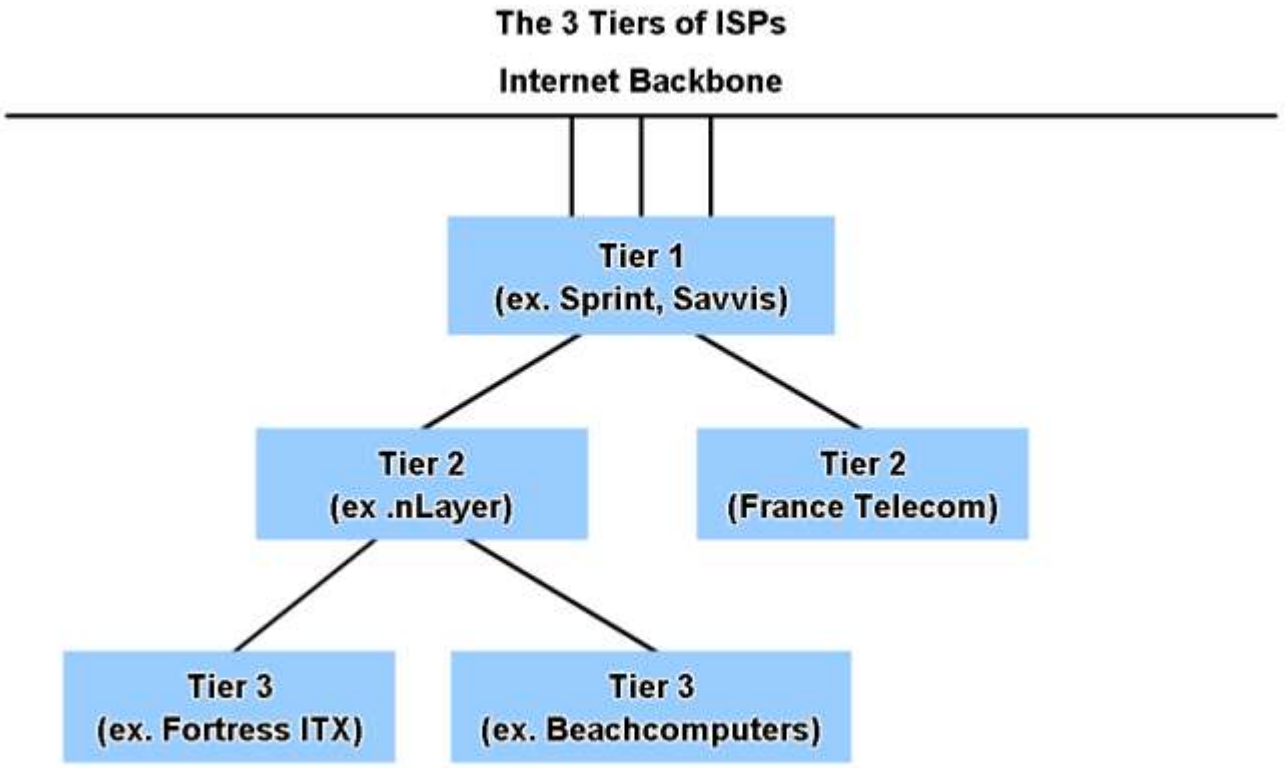
- Describe the process for requesting IPv4 public addresses, the role ISPs play in the process, and the role of the regional agencies that manage IP address registries

Entities that Oversee IP Address Allocation

Global	**IANA**				
Regional Internet Registries	**AfriNIC** Africa Region	**APNIC** Asia/ Pacific Region	**LACNIC** Latin America And Caribbean Region	**ARIN** North America Region	**RIPE NCC** Europe, Middle East, Central Asia Region

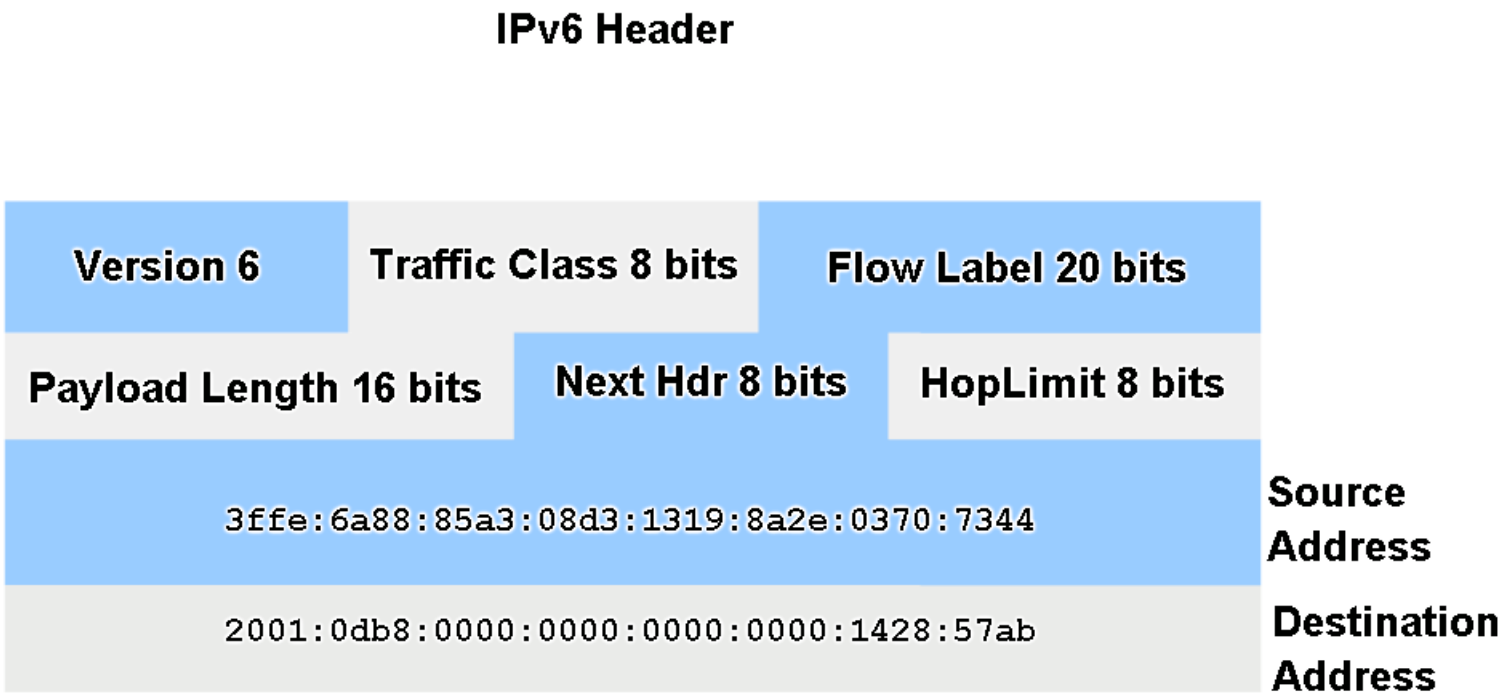
Assigning Addresses

- Identify different types of ISPs and their roles in providing Internet connectivity



Assigning Addresses

- Identify several changes made to the IP protocol in IPv6 and describe the motivation for migrating from IPv4 to IPv6.



Determine the network portion of the host address and the role of the subnet mask

- Describe how the subnet mask is used to create and specify the network and host portions of an IP address

Network and Host Portions of an IP Address

IP Address	172 .	16 .	4 .	1
	10101100	00010000	00000100	00000001
Subnet Mask	255 .	255 .	255 .	0
	11111111	11111111	11111111	00000000

Prefix /24 (24 high order bits)

Determine the network portion of the host address and the role of the subnet mask

- Use the subnet mask and ANDing process to extract the network address from the IP address.

Applying the Subnet Mask

A device with address 192.0.0.1 belongs to network 192.0.0.0

	High order bits Prefix /16		Low order bits	
	192 .	0 .	0 .	1
Host	11000000	00000000	00000000	00000001
Subnet	255 11111111	255 11111111	0 00000000	0 00000000
Network	11000000	00000000	00000000	00000000
Network	192 .	0 .	0 .	1

Determine the network portion of the host address and the role of the subnet mask

- Use ANDing logic to determine an outcome.

Applying the Subnet Mask

A device with address 192.0.0.1 belongs to network 192.0.0.0

	High order bits Prefix /16		Low order bits	
	192 . 0 .		0 .	1
Host	11000000	00000000	00000000	00000001
Subnet	255 11111111	255 11111111	0 00000000	0 00000000
Network	11000000	00000000	00000000	00000000
Network	192 .	0 .	0 .	1

Determine the network portion of the host address and the role of the subnet mask

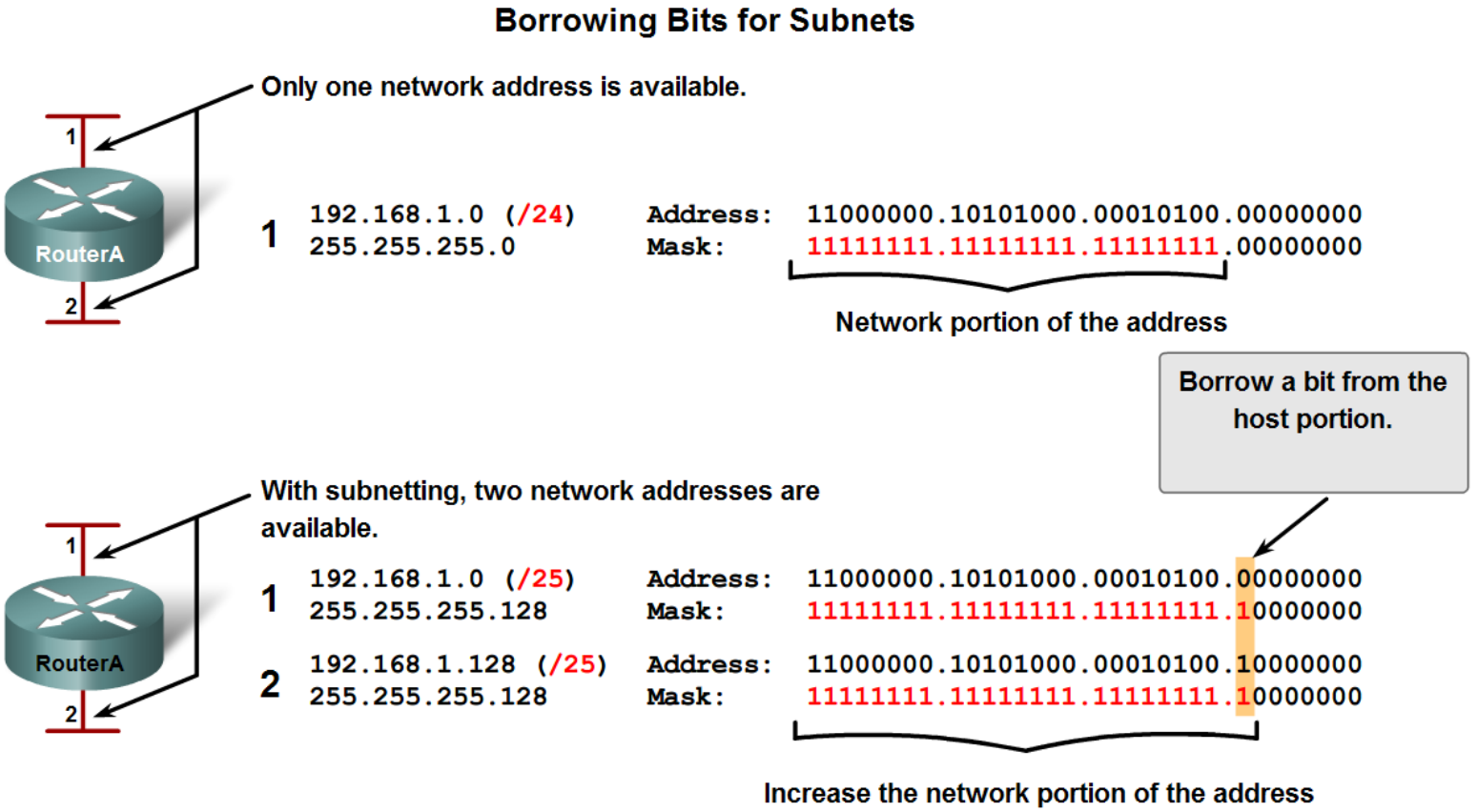
- Observe the steps in the ANDing of an IPv4 host address and subnet mask

Use the subnet mask to determine the network address for the host 173.16.132.70/20.

	Convert binary network address to decimal			
Host Address	172	16	132	70
Binary Host Address	10101100	00010000	10000100	01000110
Binary Subnet Mask	11111111	11111111	11110000	00000000
Binary Network Address	10101100	00010000	10000000	00000000
Network Address	172	16	128	0

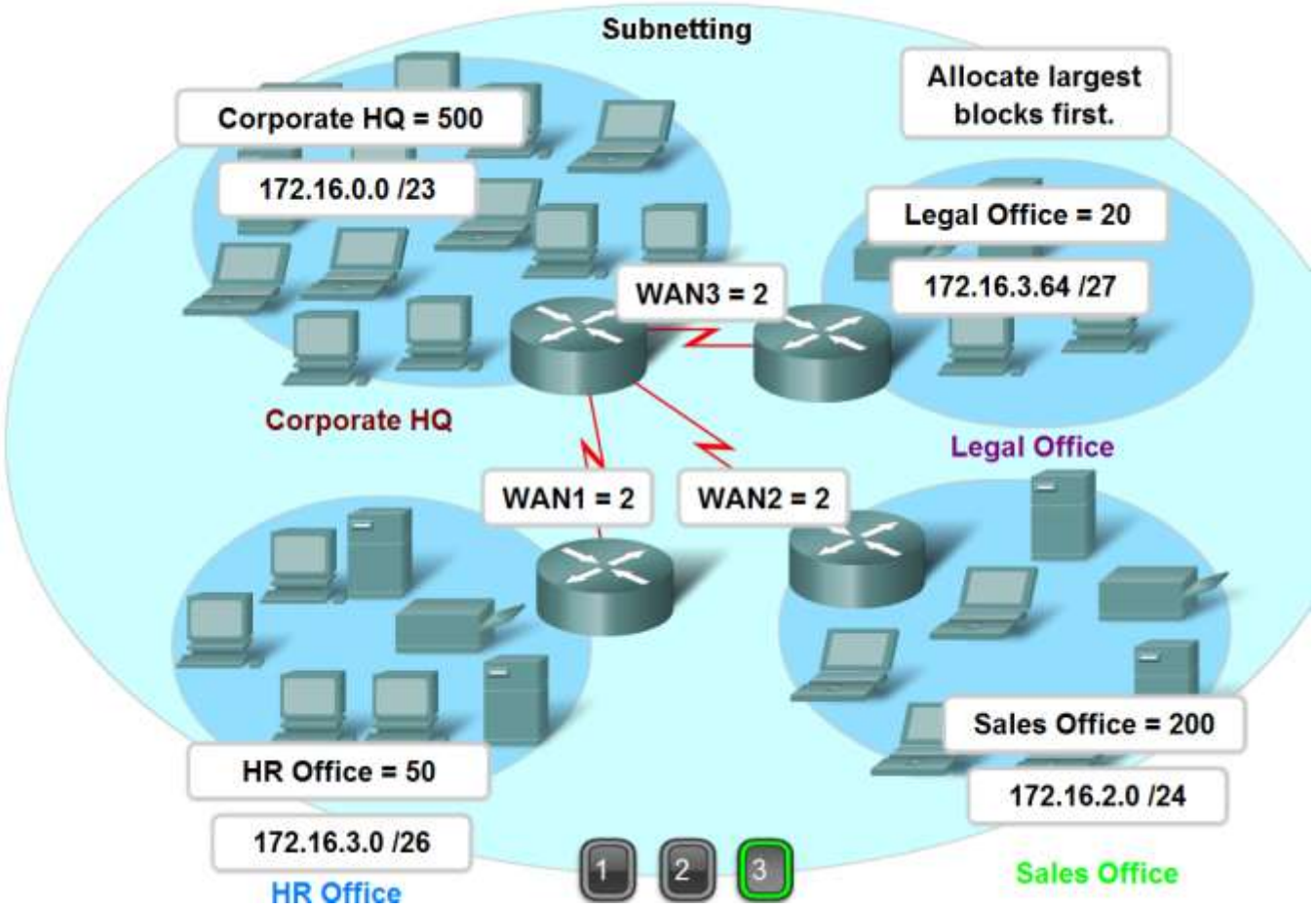
Calculating Addresses

- Use the subnet mask to divide a network into smaller networks and describe the implications of dividing networks for network planners



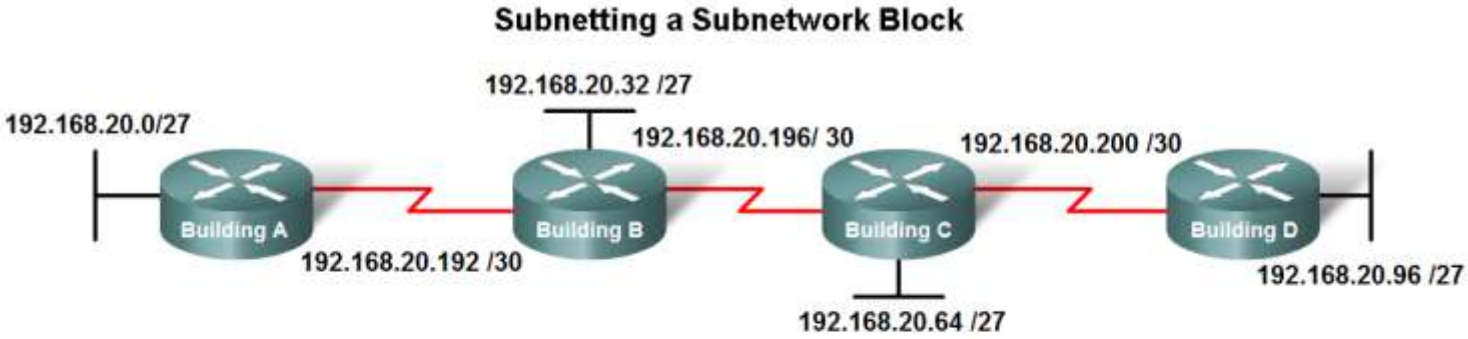
Calculating Addresses

- Extract network addresses from host addresses using the subnet mask



Calculating Addresses

- Calculate the number of hosts in a network range given an address and subnet mask



Subnet Number	Subnet Address
Subnet 0	192.168.20.0/27
Subnet 1	192.168.20.32/27
Subnet 2	192.168.20.64/27
Subnet 3	192.168.20.96/27
Subnet 4	192.168.20.128/27
Subnet 5	192.168.20.160/27
Subnet 6	192.168.20.192/27
Subnet 7	192.168.20.224/27

Subnet Number	Subnet Address
Subnet 0	192.168.20.192/30
Subnet 1	192.168.20.196/30
Subnet 2	192.168.20.200/30
Subnet 3	192.168.20.204/30
Subnet 4	192.168.20.208/30
Subnet 5	192.168.20.212/30
Subnet 6	192.168.20.216/30
Subnet 7	192.168.20.20/30

Calculating Addresses

- Given a subnet address and subnet mask, calculate the network address, host addresses and broadcast address

Activity

Given the host IP address and the subnet mask, enter the network address in binary and decimal.

Host Address	10	148	100	54
Subnet Mask	255	255	255	240
Host Address in binary	00001010	10010100	01100100	00110110
Subnet Mask in binary	11111111	11111111	11111111	11110000
Network Address in binary				
Network Address in decimal				

Calculating Addresses

- Given a pool of addresses and masks, assign a host parameter with address, mask and gateway

Given the network address and the subnet mask, enter the number of possible hosts. Click next to Number of Hosts to enter your response.

Network Address	10	0	0	0
Subnet Mask	255	255	255	192
Network address in binary	00001010	00000000	00000000	00000000
Subnet Mask in binary	11111111	11111111	11111111	11000000
Number of hosts				

Calculating Addresses

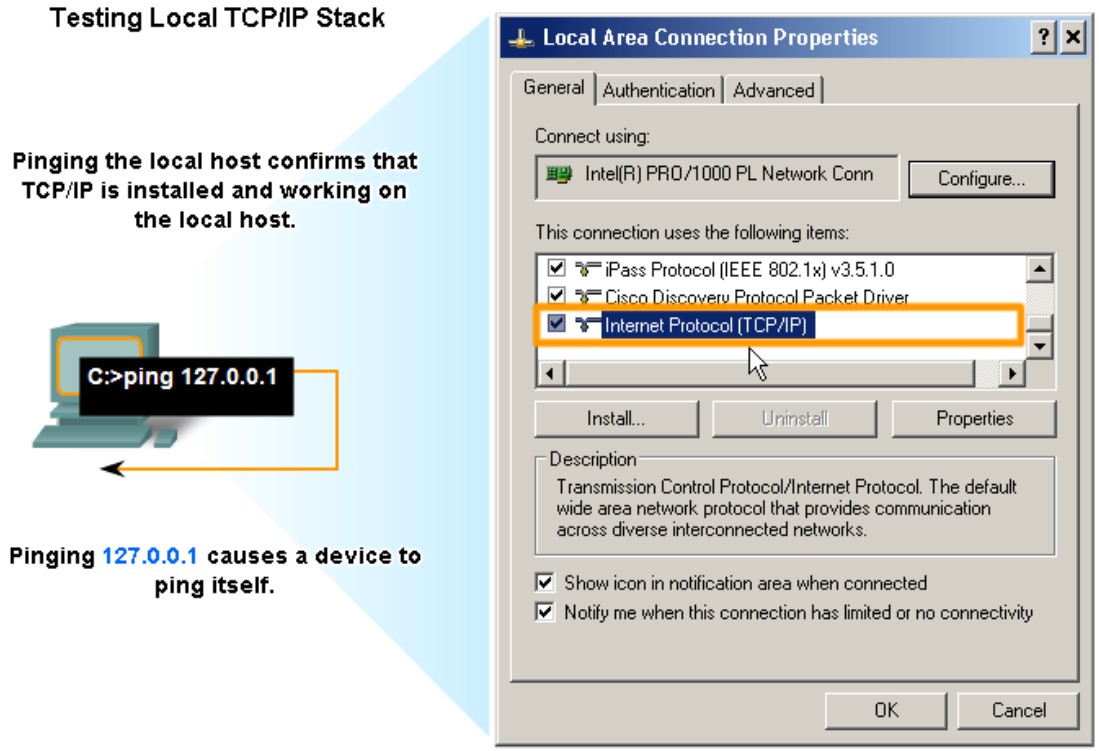
- Given a diagram of a multi-layered network, address range, number of hosts in each network and the ranges for each network, create a network scheme that assigns addressing ranges to each network

Given the network address and the subnet mask, define the range of hosts, the broadcast address, and the next network address.

Network Address in decimal	10	187	0	0
Subnet Mask in decimal	255	255	224	0
Network address in binary	00001010	10111011	00000000	00000000
Subnet Mask in binary	11111111	11111111	11100000	00000000
First Usable Host IP Address in decimal	1st octet	2nd octet	3rd octet	4th octet
Last Usable Host IP Address in decimal	1st octet	2nd octet	3rd octet	4th octet
Broadcast Address in decimal	1st octet	2nd octet	3rd octet	4th octet
Next Network Address in decimal	1st octet	2nd octet	3rd octet	4th octet

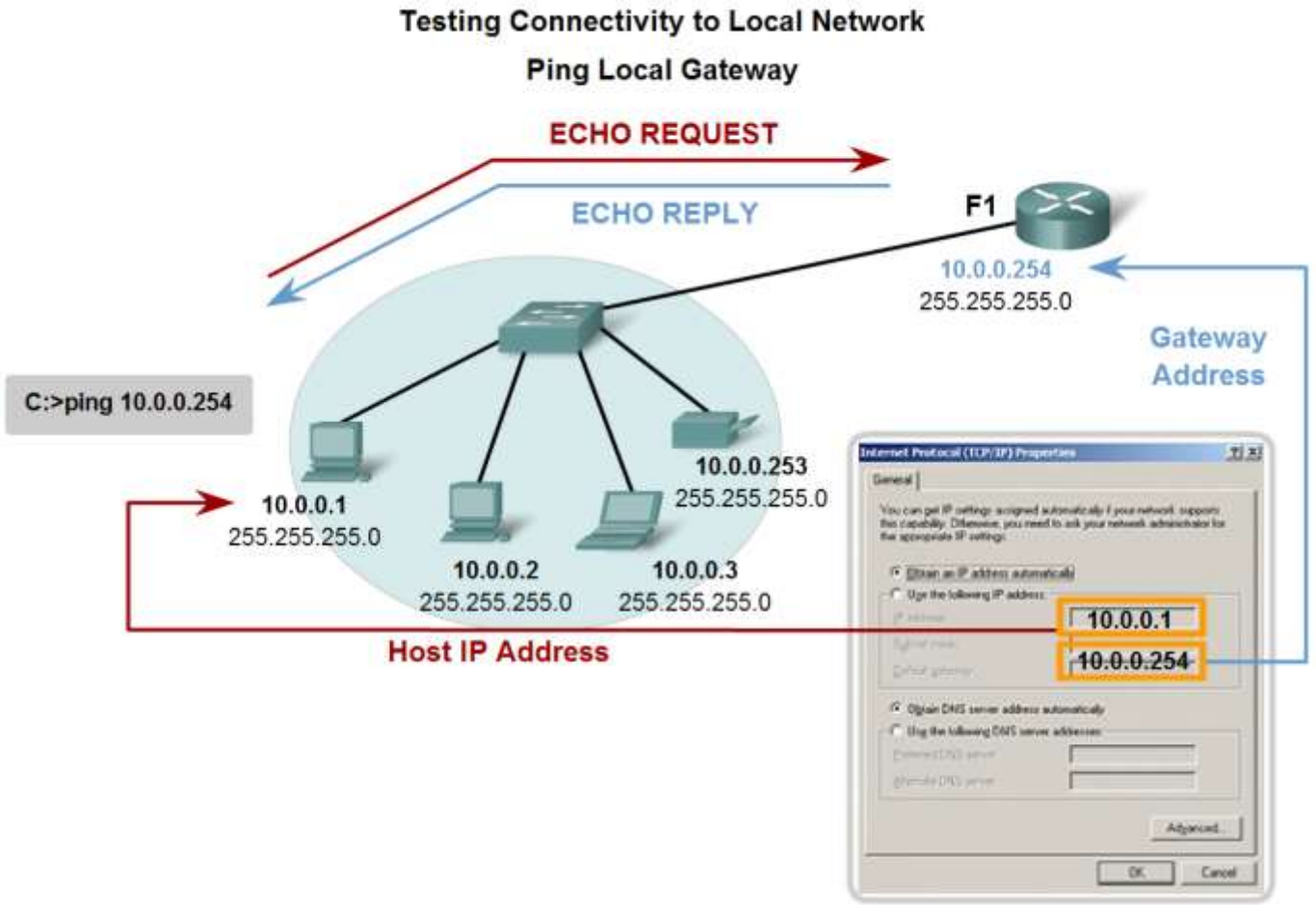
Testing the Network Layer

- Describe the general purpose of the ping command, trace the steps of its operation in a network, and use the ping command to determine if the IP protocol is operational on a local host



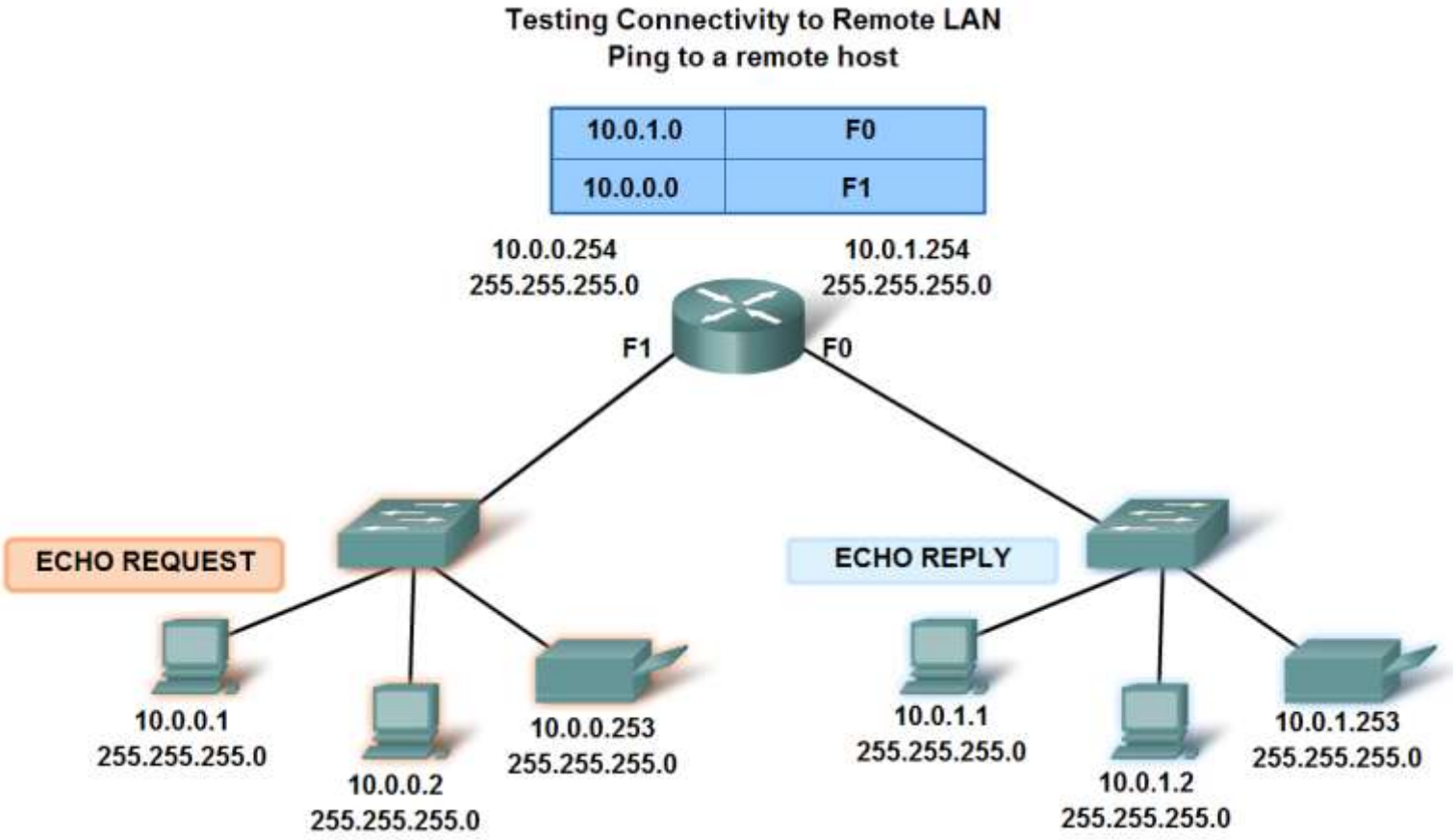
Testing the Network Layer

- Use ping to verify that a local host can communicate with a gateway across a local area network



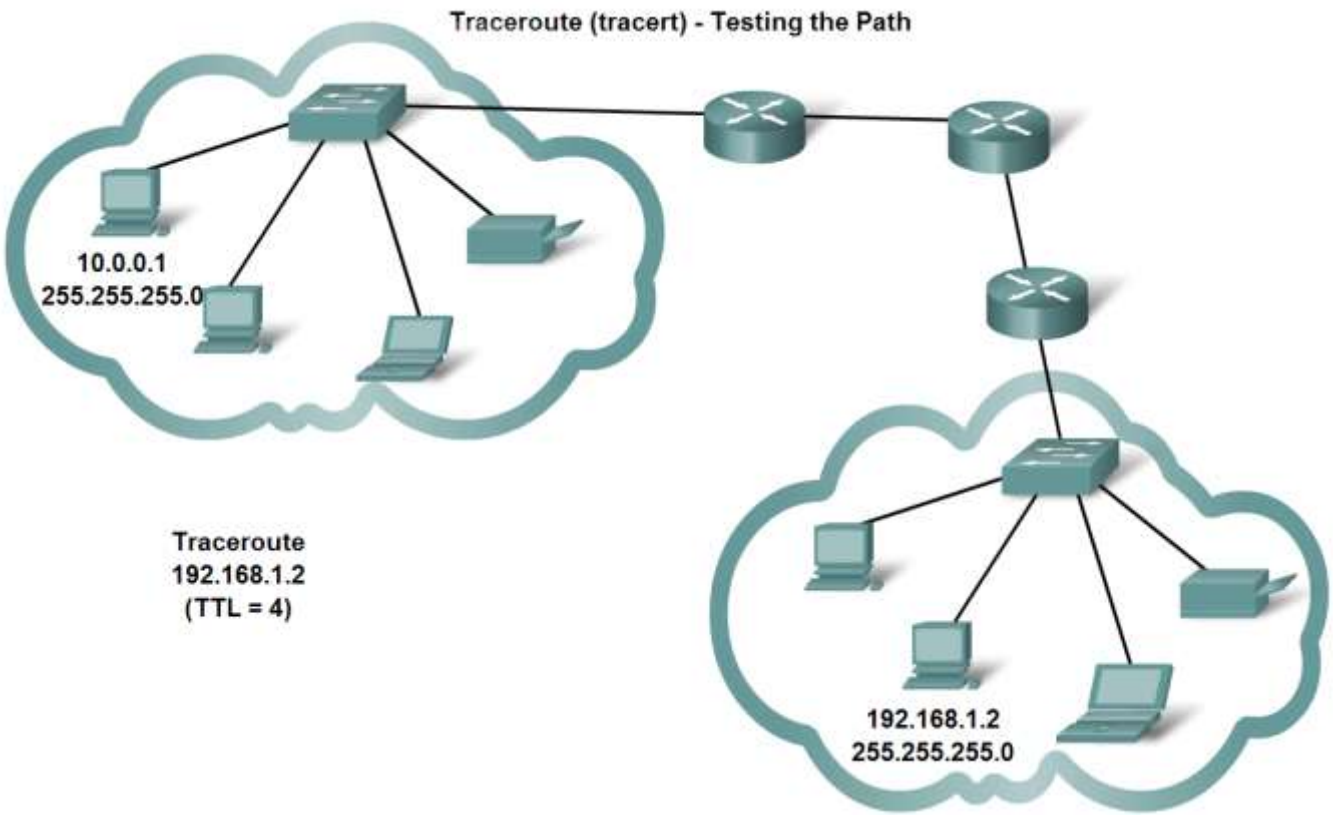
Testing the Network Layer

- Use ping to verify that a local host can communicate via a gateway to a device in remote network



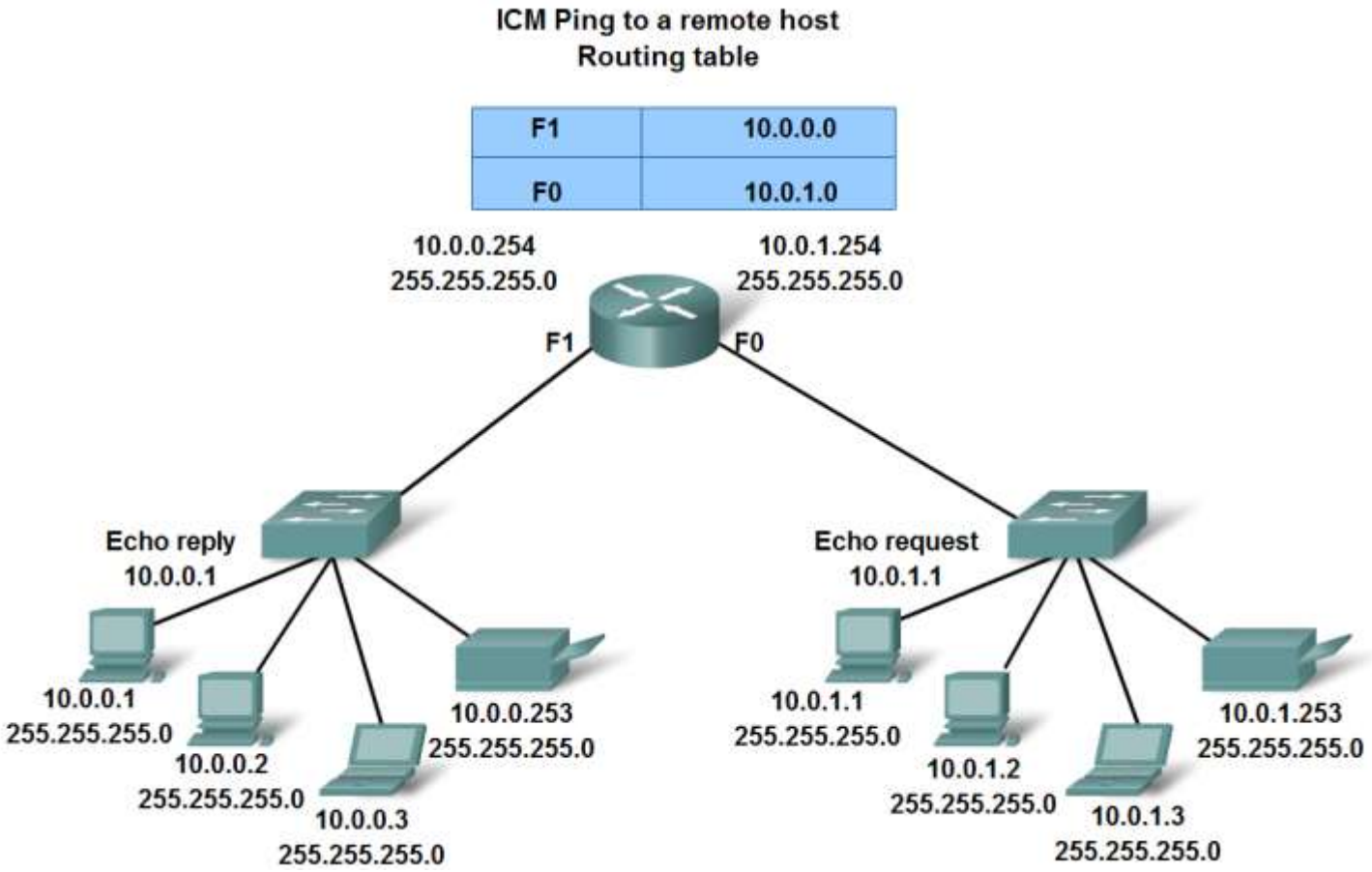
Testing the Network Layer

- Use tracert/traceroute to observe the path between two devices as they communicate and trace the steps of tracert/traceroute's operation



Testing the Network Layer

- Describe the role of ICMP in the TCP/IP suite and its impact on the IP protocol



Summary

In this chapter, you learned to:

- Explain the structure IP addressing and demonstrate the ability to convert between 8-bit binary and decimal numbers.
- Given an IPv4 address, classify by type and describe how it is used in the network.
- Explain how addresses are assigned to networks by ISPs and within networks by administrators.
- Determine the network portion of the host address and explain the role of the subnet mask in dividing networks.
- Given IPv4 addressing information and design criteria, calculate the appropriate addressing components.
- Use common testing utilities to verify and test network connectivity and operational status of the IP protocol stack on a host.