

Chapter 7: Explore the Network

Introduction to Networks v5.1



Chapter Outline

7.0 Introduction

7.1 IPv4 Network Addresses

7.2 IPv6 Network Addresses

7.3 Connectivity Verification

7.4 Summary

Section 7.1:

IPv4 Network Addresses

Upon completion of this section, you should be able to:

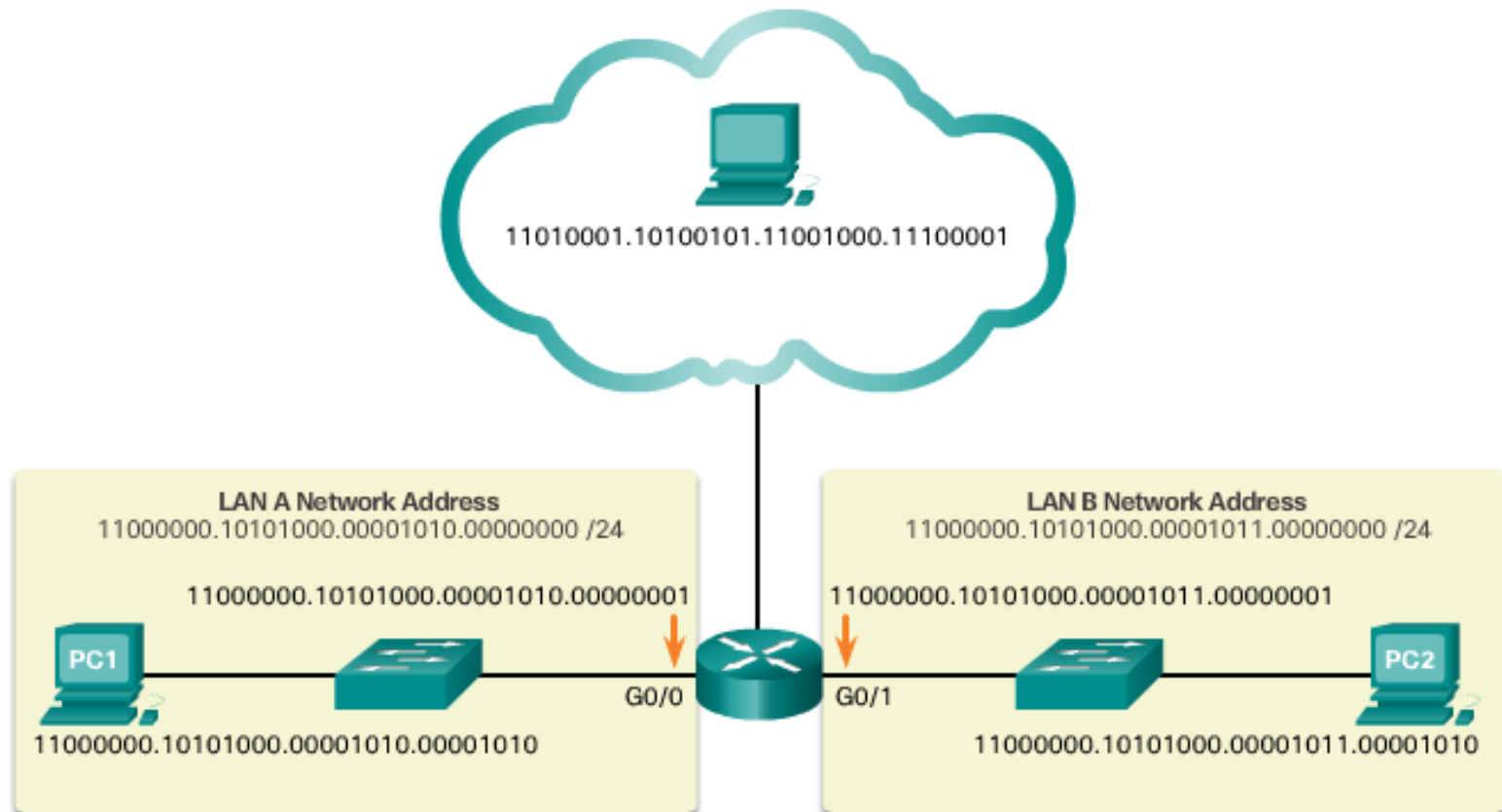
- Convert between binary and decimal numbering systems.
- Describe the structure of an IPv4 address including the network portion, the host portion, and the subnet mask.
- Compare the characteristics and uses of the unicast, broadcast, and multicast IPv4 addresses.
- Explain public, private, and reserved IPv4 addresses.

Topic 7.1.1: Binary and Decimal Conversion



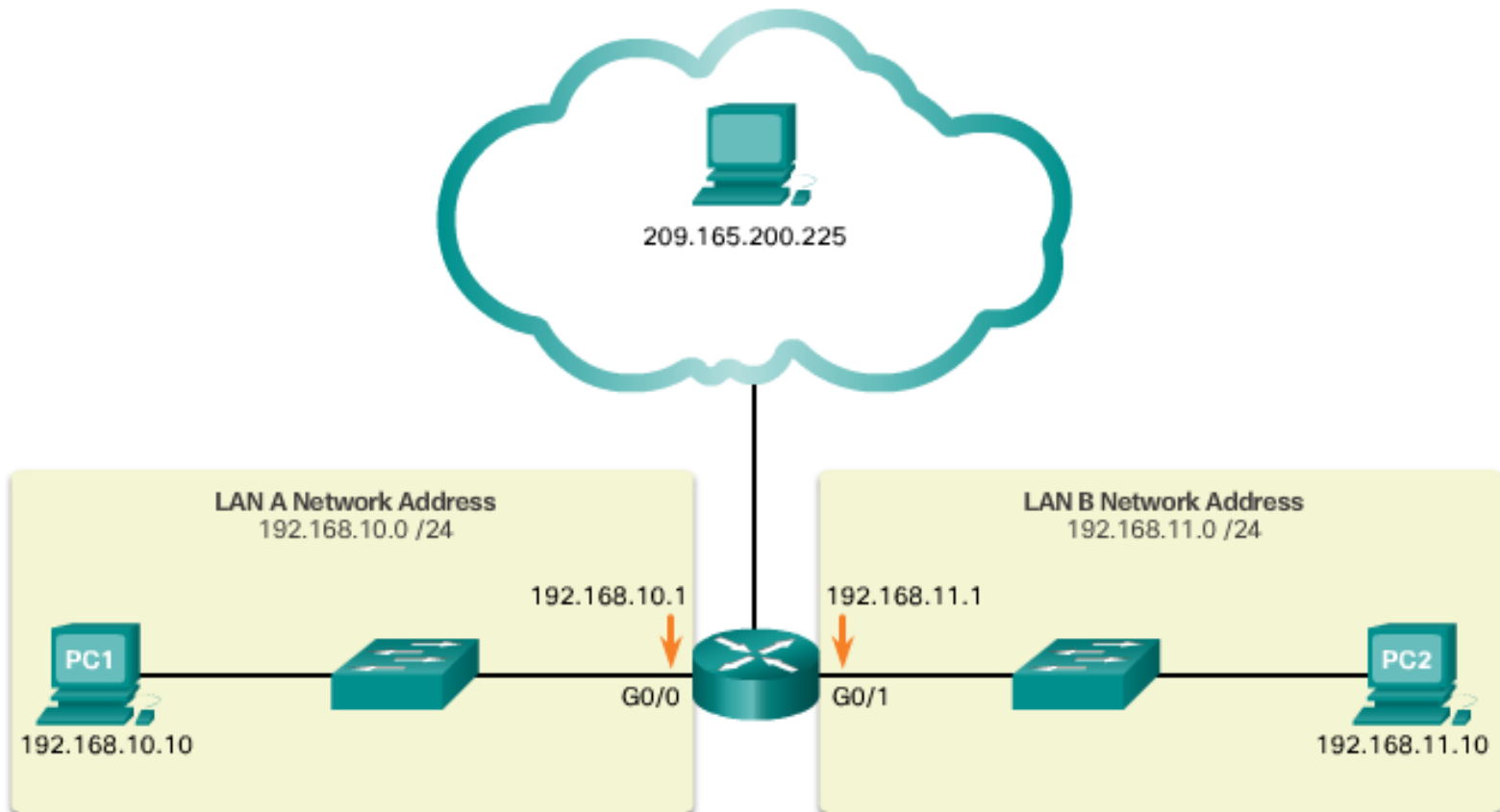
IPv4 Addresses

IPv4 Addresses Expressed in Binary



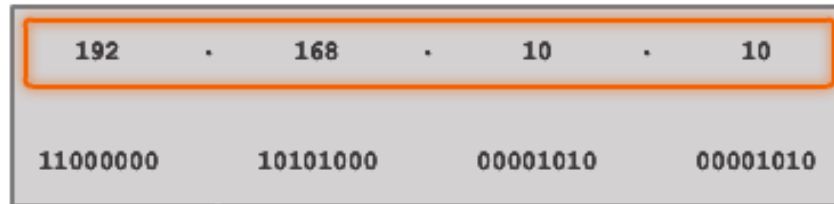
IPv4 Addresses (cont.)

IPv4 Addresses Expressed in Dotted Decimal



IPv4 Addresses (cont.)

Dotted Decimal Address



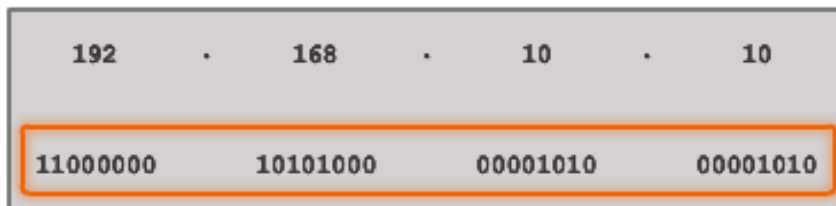
192.168.10.10 is an IP address that is assigned to a computer.

Octets



This address is made up of four different octets.

32-Bit Address



The computer stores the address as the entire 32-bit data stream.

Positional Notation

Decimal Positional Notation

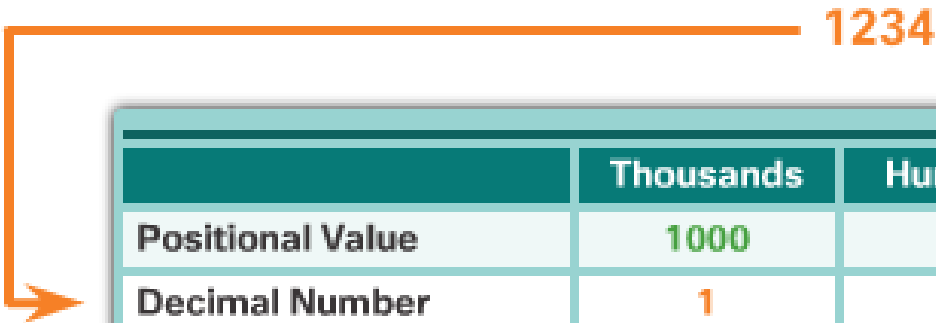
| | | | | |
|-------------------------|----------|----------|----------|----------|
| Radix | 10 | 10 | 10 | 10 |
| Position in # | 3 | 2 | 1 | 0 |
| Calculate | (10^3) | (10^2) | (10^1) | (10^0) |
| Positional Value | 1000 | 100 | 10 | 1 |

Positional Value

The first row identifies the number base or radix. Therefore the value listed, from left to right, represents units of thousands, hundreds, tens, and ones.

Positional Notation (cont.)

Applying Decimal Positional Notation



| | Thousands | Hundreds | Tens | Ones |
|------------------|-----------|----------|--------|-------|
| Positional Value | 1000 | 100 | 10 | 1 |
| Decimal Number | 1 | 2 | 3 | 4 |
| Calculate | 1 x 1000 | 2 x 100 | 3 x 10 | 4 x 1 |
| Add them up ... | 1000 | + 200 | + 30 | + 4 |
| Result | 1,234 | | | |

Positional Notation (cont.)

Binary Positional Notation

| | | | | | | | | |
|------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| Radix | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Position in # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Calculate | (2^7) | (2^6) | (2^5) | (2^4) | (2^3) | (2^2) | (2^1) | (2^0) |
| Positional Value | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |


Radix

The binary notation system is based on 2, therefore the radix is 2.

Positional Notation (cont.)

Applying Binary Positional Notation

11000000

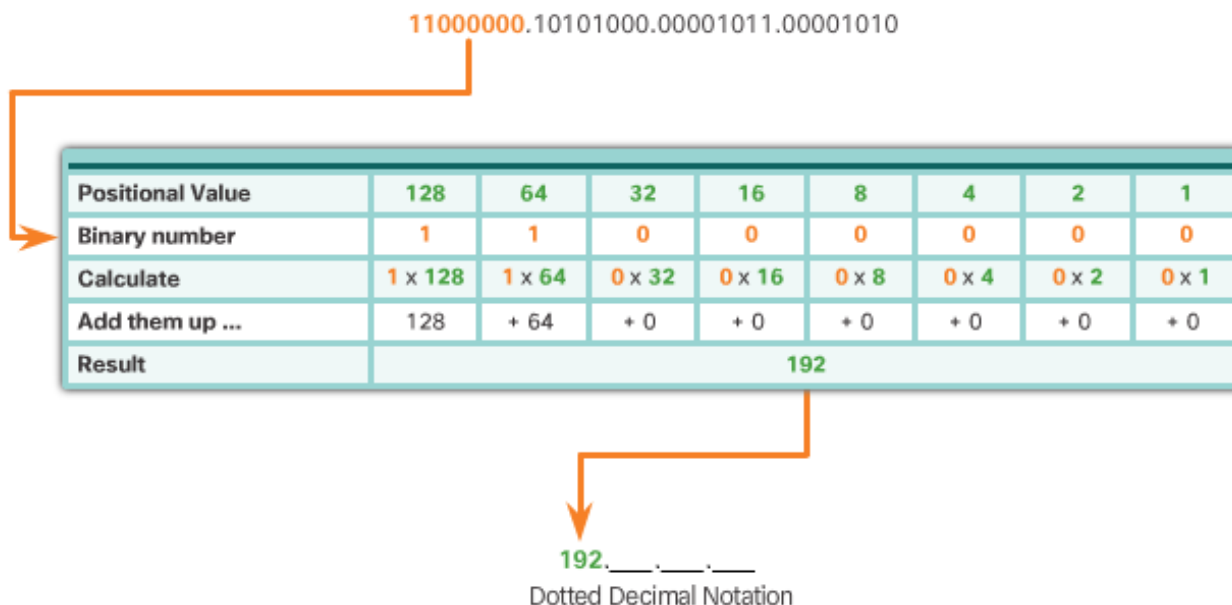


| Positional Value | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
|------------------|---------|--------|--------|--------|-------|-------|-------|-------|
| Binary number | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Calculate | 1 x 128 | 1 x 64 | 0 x 32 | 0 x 16 | 0 x 8 | 0 x 4 | 0 x 2 | 0 x 1 |
| Add them up ... | 128 | + 64 | + 0 | + 0 | + 0 | + 0 | + 0 | + 0 |
| Result | 192 | | | | | | | |

Binary to Decimal Conversion

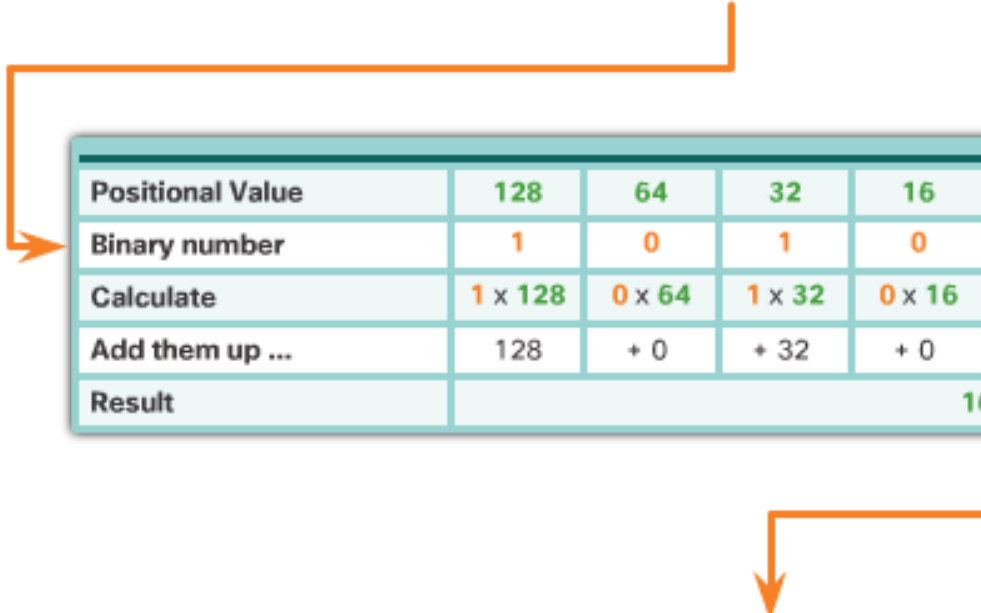
To convert a binary IPv4 address to its dotted decimal equivalent:

- Divide the IPv4 address into four 8-bit octets. Apply the binary positional value to the first octet binary number and calculate accordingly.
- Repeat for each octet.



Binary to Decimal Conversion (cont.)

11000000.10101000.00001011.00001010

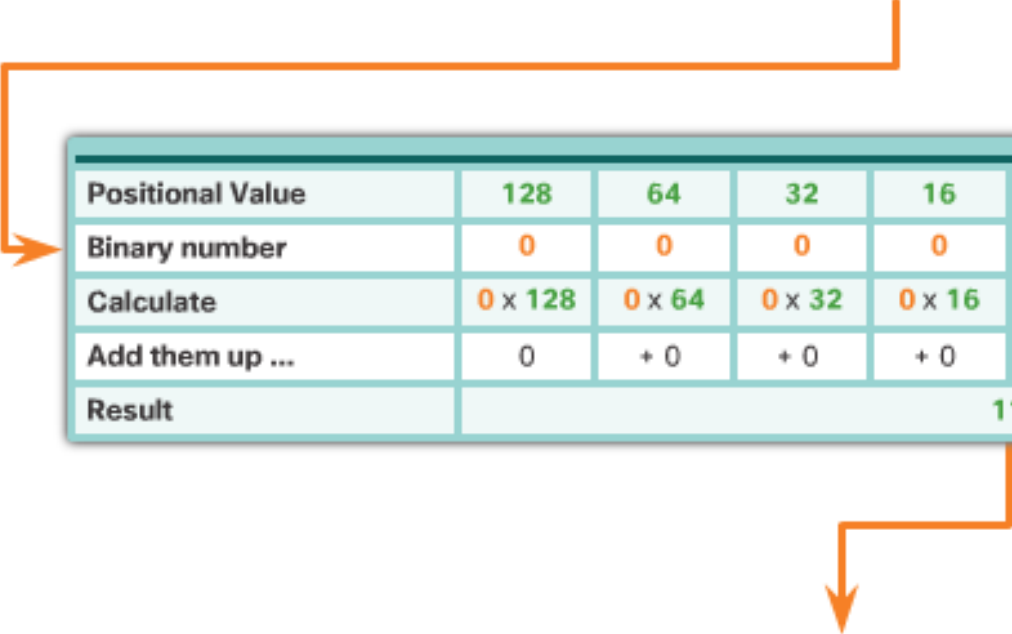


| | | | | | | | | |
|------------------|---------|--------|--------|--------|-------|-------|-------|-------|
| Positional Value | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| Binary number | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| Calculate | 1 x 128 | 0 x 64 | 1 x 32 | 0 x 16 | 1 x 8 | 0 x 4 | 0 x 2 | 0 x 1 |
| Add them up ... | 128 | + 0 | + 32 | + 0 | + 8 | + 0 | + 0 | + 0 |
| Result | 168 | | | | | | | |

192.168.____.____
Dotted Decimal Notation

Binary to Decimal Conversion (cont.)

11000000.10101000.00001011.00001010

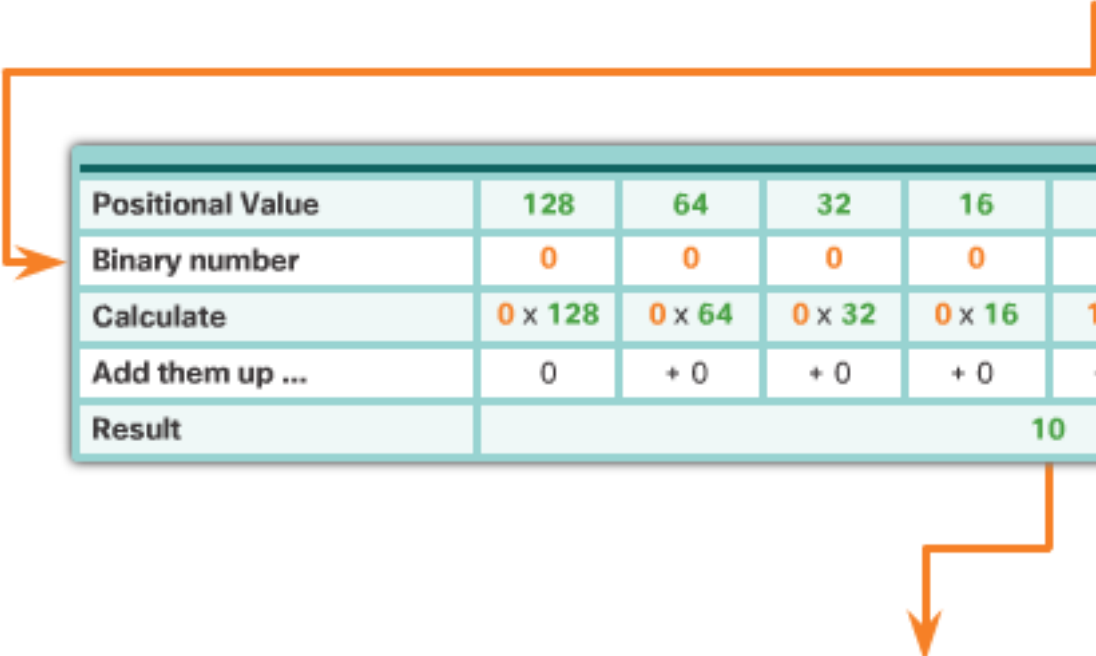


| Positional Value | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
|------------------|---------|--------|--------|--------|-------|-------|-------|-------|
| Binary number | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| Calculate | 0 x 128 | 0 x 64 | 0 x 32 | 0 x 16 | 1 x 8 | 0 x 4 | 1 x 2 | 1 x 1 |
| Add them up ... | 0 | + 0 | + 0 | + 0 | + 8 | + 0 | + 2 | + 1 |
| Result | 11 | | | | | | | |

192.168.11.___
Dotted Decimal Notation

Binary to Decimal Conversion (cont.)

11000000.10101000.00001011.00001010

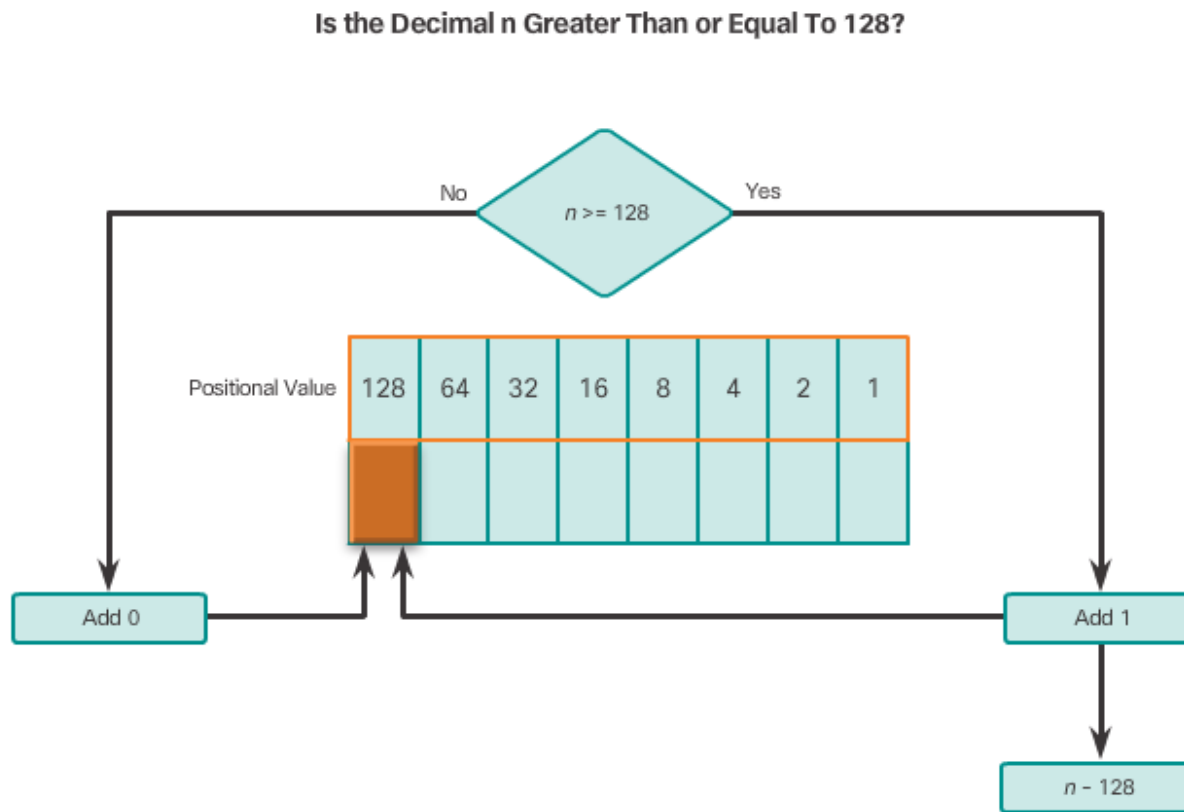


| | | | | | | | | |
|------------------|---------|--------|--------|--------|-------|-------|-------|-------|
| Positional Value | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| Binary number | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| Calculate | 0 x 128 | 0 x 64 | 0 x 32 | 0 x 16 | 1 x 8 | 0 x 4 | 1 x 2 | 0 x 1 |
| Add them up ... | 0 | + 0 | + 0 | + 0 | + 8 | + 0 | + 2 | + 0 |
| Result | 10 | | | | | | | |

192.168.11.10
Dotted Decimal Notation

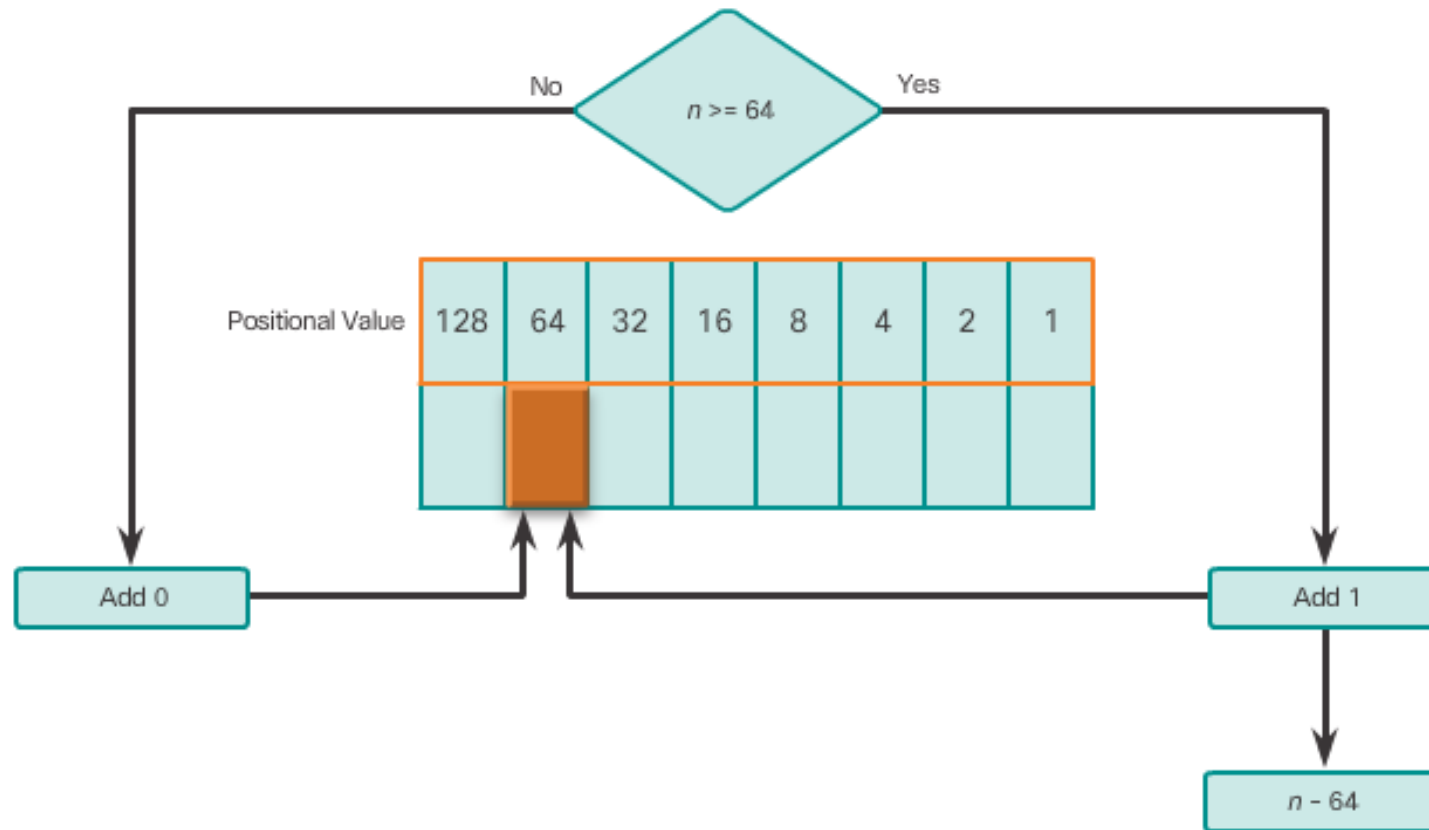
Decimal to Binary Conversion

The following illustrates how to use the binary positional value table to convert decimal to binary.



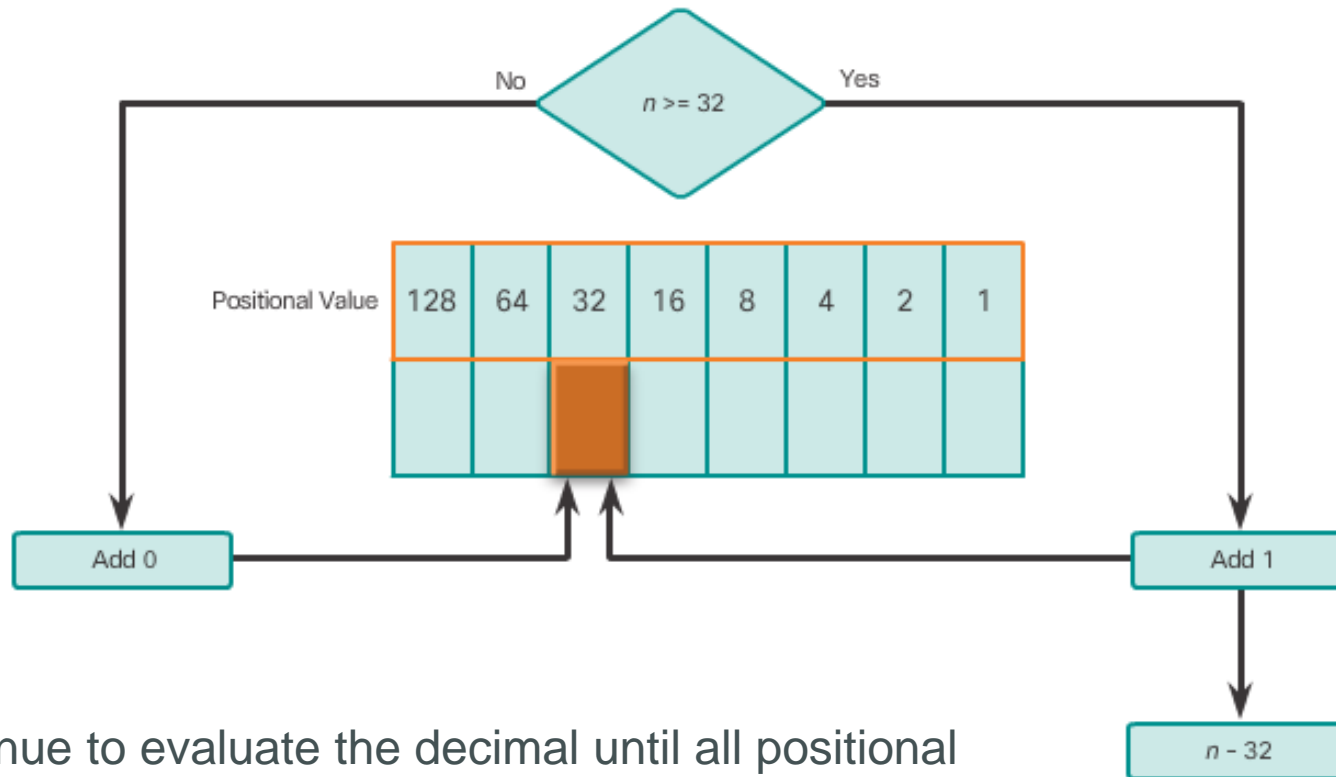
Decimal to Binary Conversion (cont.)

Is the Decimal n Greater Than or Equal To 64?



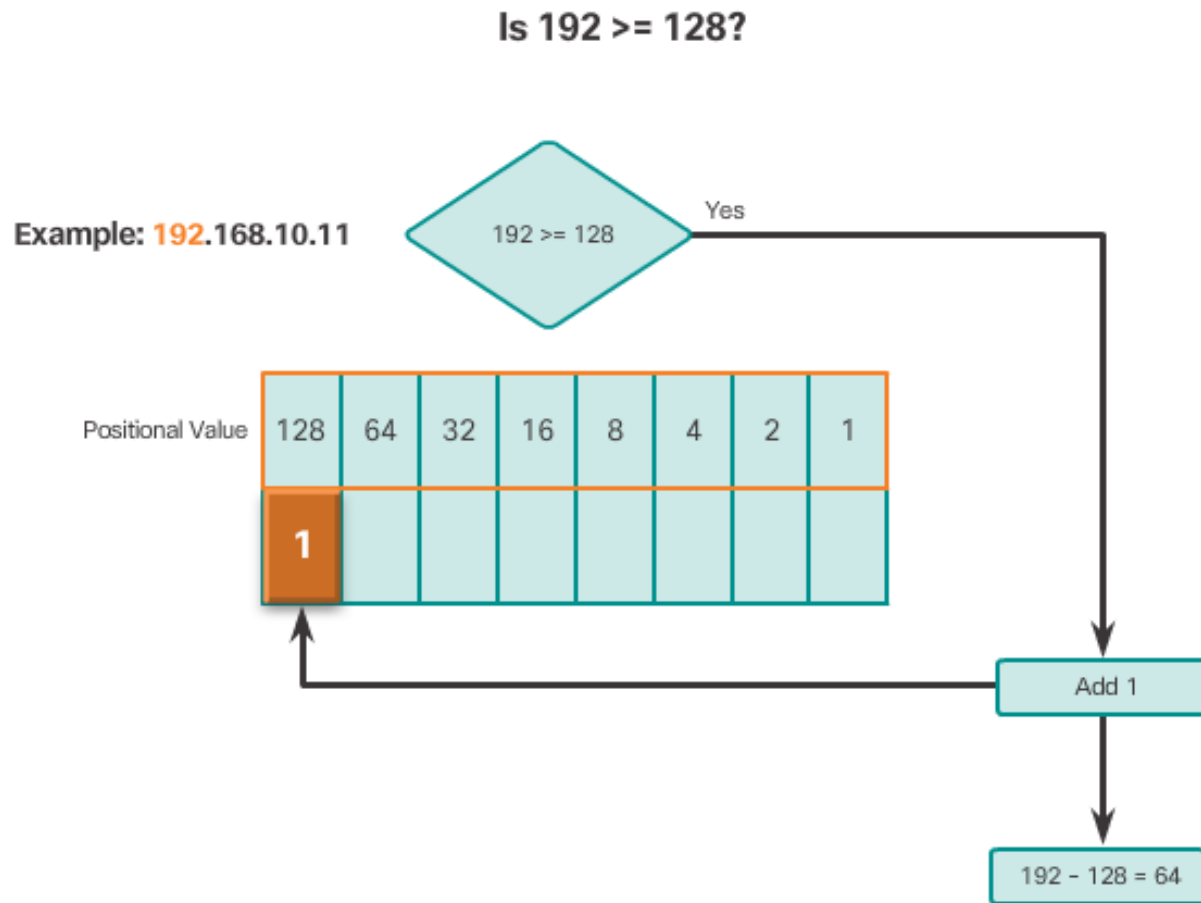
Decimal to Binary Conversion (cont.)

Is the Decimal n Greater Than or Equal To 32?



Continue to evaluate the decimal until all positional values have been entered, which results in the equivalent binary value.

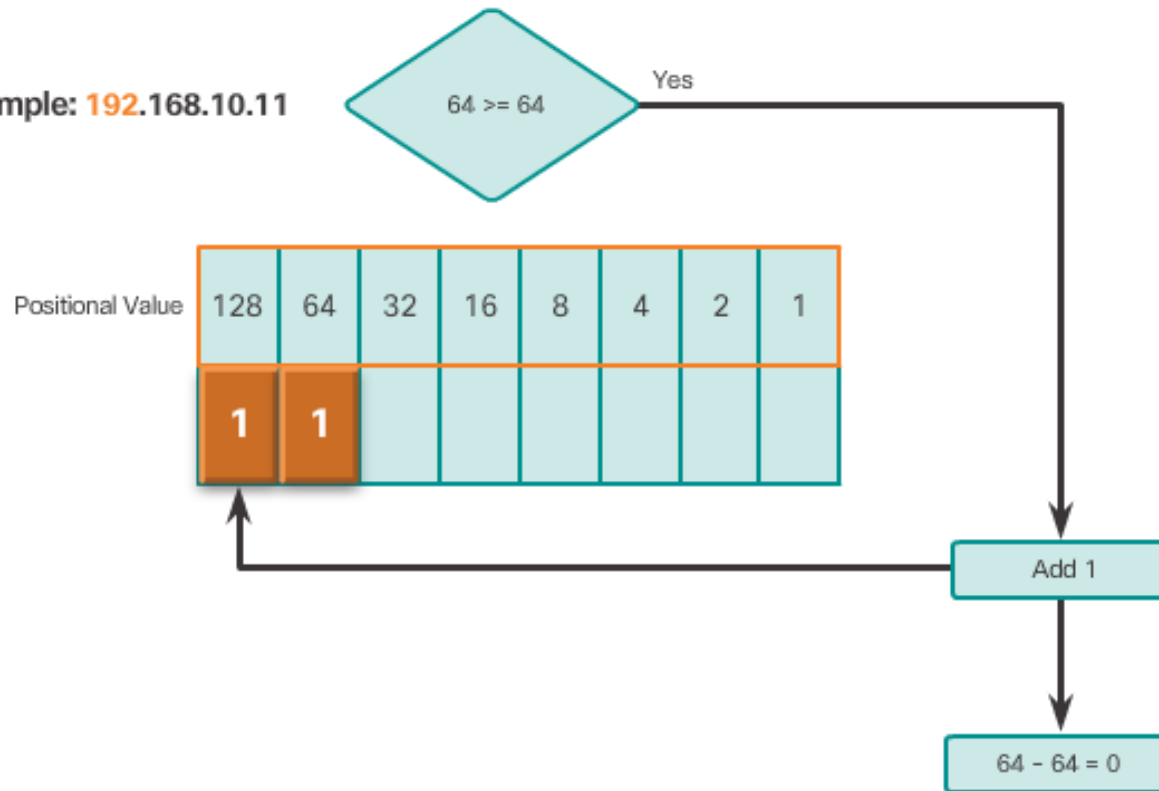
Decimal to Binary Conversion Example



Decimal to Binary Conversion Example (cont.)

Is 64 >= 64?

Example: 192.168.10.11



Decimal to Binary Conversion Example (cont.)

$$192 = 11000000$$

Example: 192.168.10.11

| | | | | | | | |
|-----|----|----|----|---|---|---|---|
| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |

11000000 . _____ . _____ . _____

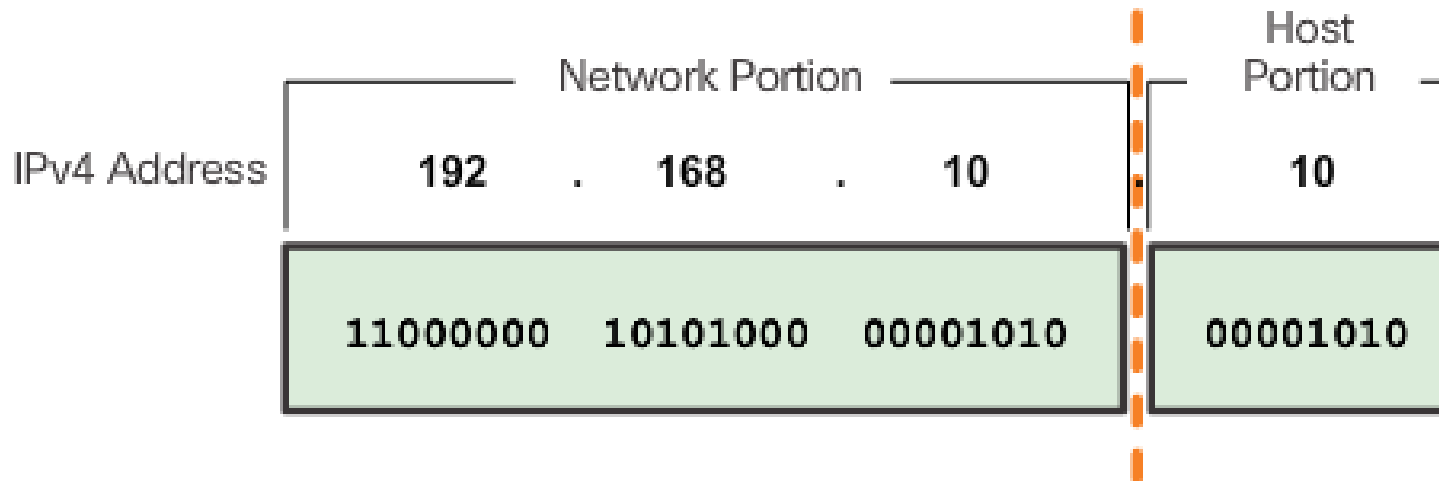
See VIDEO DEMONSTRATION

Topic 7.1.2: IPv4 Address Structure



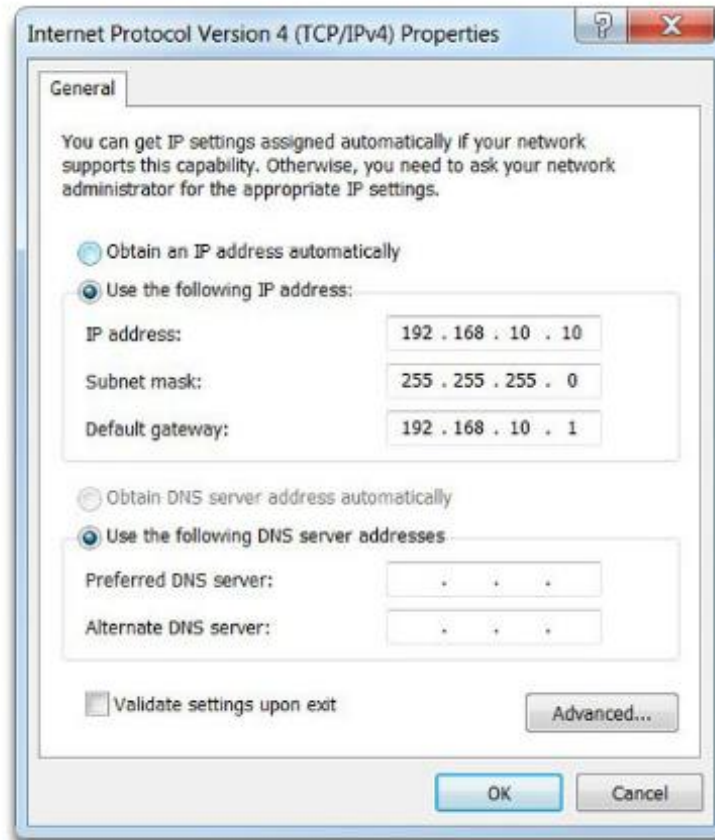
Network and Host Portions

One portion of the 32 bit IPv4 address identifies the network, and another portion identifies the host.



The Subnet Mask

IP Configuration on a Host



The Subnet Mask (cont.)

- Comparing the IP Address and the Subnet Mask
- The 1s in the subnet mask identify the network portion while the 0s identify the host portion.

| | Network Portion | | | Host Portion | |
|--------------|----------------------------|---|-----|--------------|----|
| IPv4 Address | 192 | . | 168 | . | 10 |
| | 11000000 10101000 00001010 | | | 00001010 | |
| Subnet Mask | 255 | . | 255 | . | 0 |
| | 11111111 11111111 11111111 | | | 00000000 | |

ANDing

- Logical AND is the comparison of two bits.
- ANDing between the IP address and the subnet mask yields the network address.

1 AND 1 = 1
0 AND 1 = 0
0 AND 0 = 0
1 AND 0 = 0

| | | | | | | | |
|-----------------|----------|---|----------|---|----------|---|----------|
| IP address | 192 | . | 168 | . | 10 | . | 10 |
| Binary | 11000000 | | 10101000 | | 00001010 | | 00001010 |
| Subnet mask | 255 | . | 255 | . | 255 | . | 0 |
| | 11111111 | | 11111111 | | 11111111 | | 00000000 |
| AND Results | 11000000 | | 10101000 | | 00001010 | | 00000000 |
| Network Address | 192 | . | 168 | . | 10 | . | 0 |

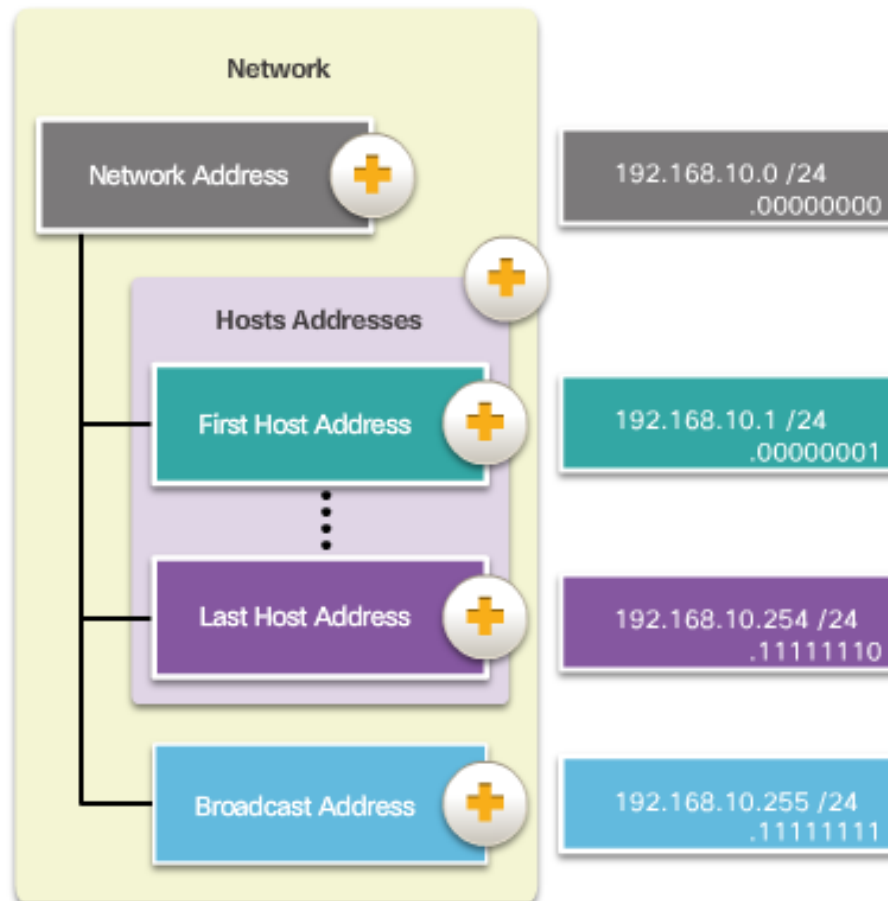
The Prefix Length

- Shorthand method of identifying a subnet mask.
- It is the number of bits set to 1 in the subnet mask.
- Written in “slash notation”, a “/” followed by the number of bits set to 1.

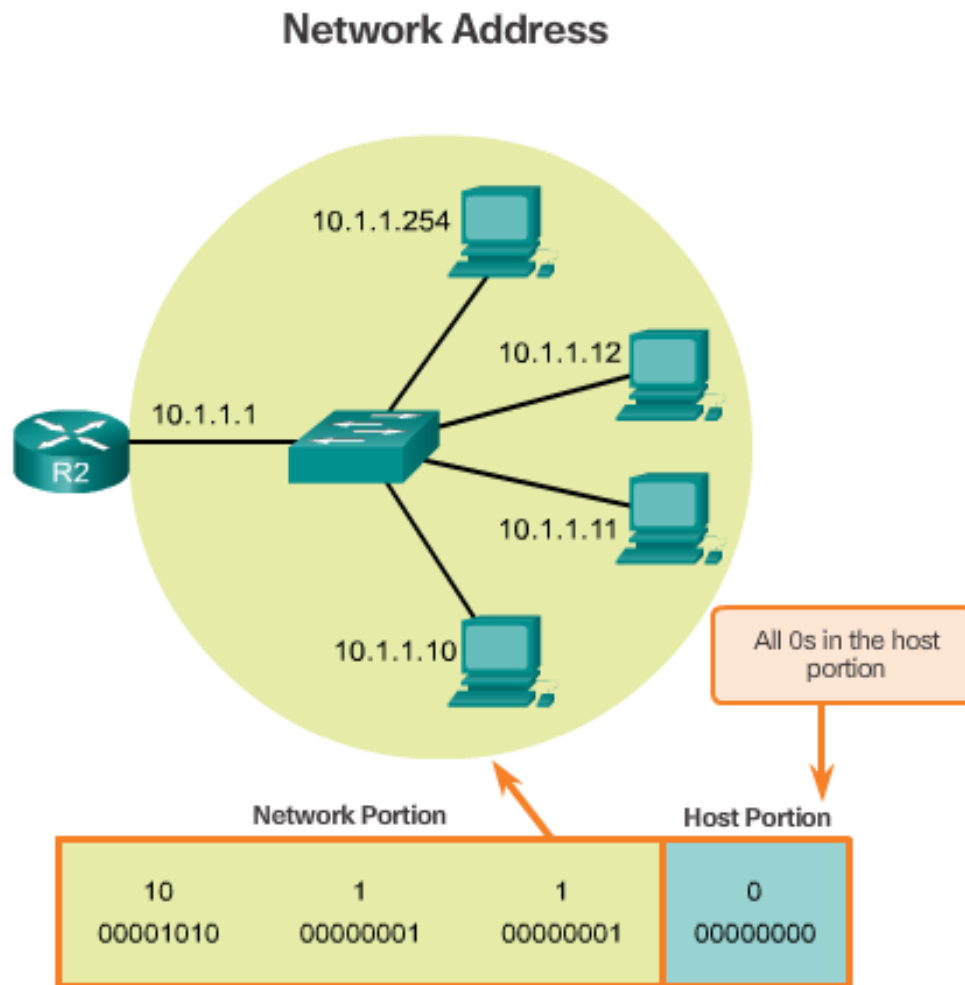
| Subnet Mask | 32-bit Address | Prefix Length |
|-----------------|-------------------------------------|---------------|
| 255.0.0.0 | 11111111.00000000.00000000.00000000 | /8 |
| 255.255.0.0 | 11111111.11111111.00000000.00000000 | /16 |
| 255.255.255.0 | 11111111.11111111.11111111.00000000 | /24 |
| 255.255.255.128 | 11111111.11111111.11111111.10000000 | /25 |
| 255.255.255.192 | 11111111.11111111.11111111.11000000 | /26 |
| 255.255.255.224 | 11111111.11111111.11111111.11100000 | /27 |
| 255.255.255.240 | 11111111.11111111.11111111.11110000 | /28 |
| 255.255.255.248 | 11111111.11111111.11111111.11111000 | /29 |
| 255.255.255.252 | 11111111.11111111.11111111.11111100 | /30 |

Network, Host, and Broadcast Addresses

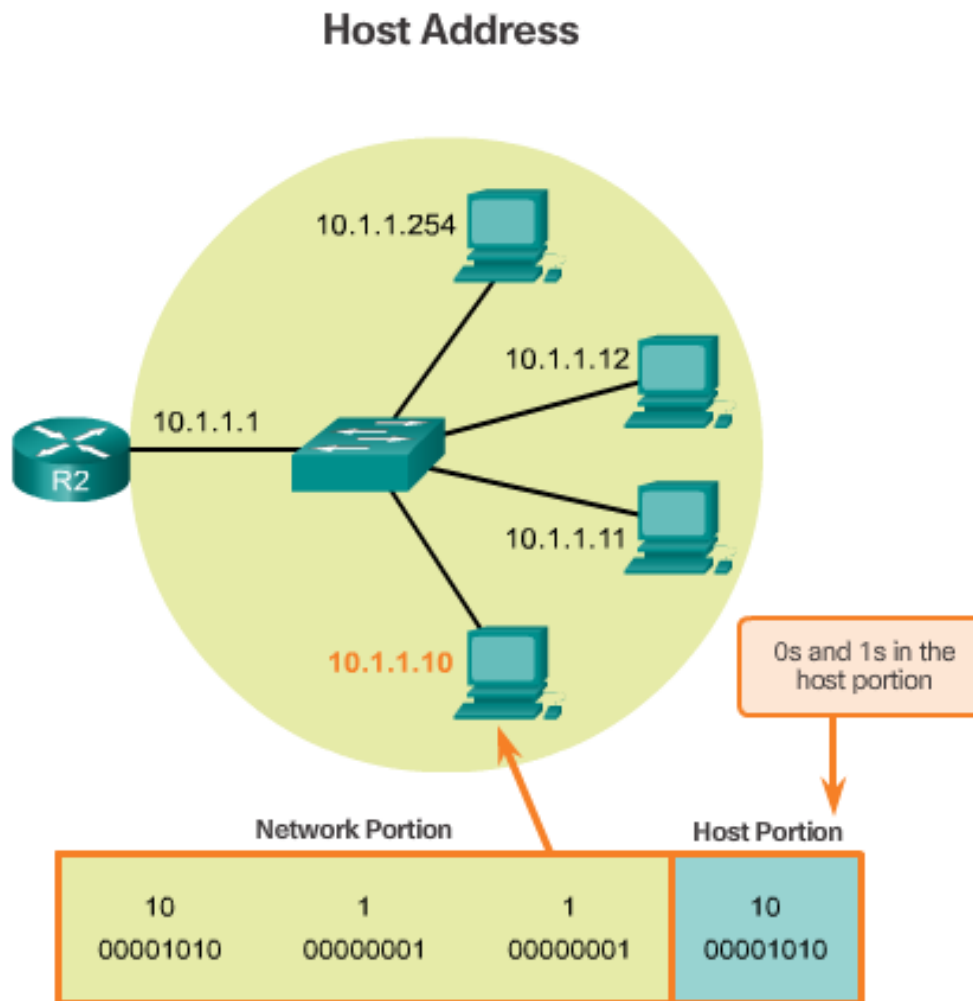
Types of Addresses in Network 192.168.10.0 /24



Network, Host, and Broadcast Addresses (cont.)

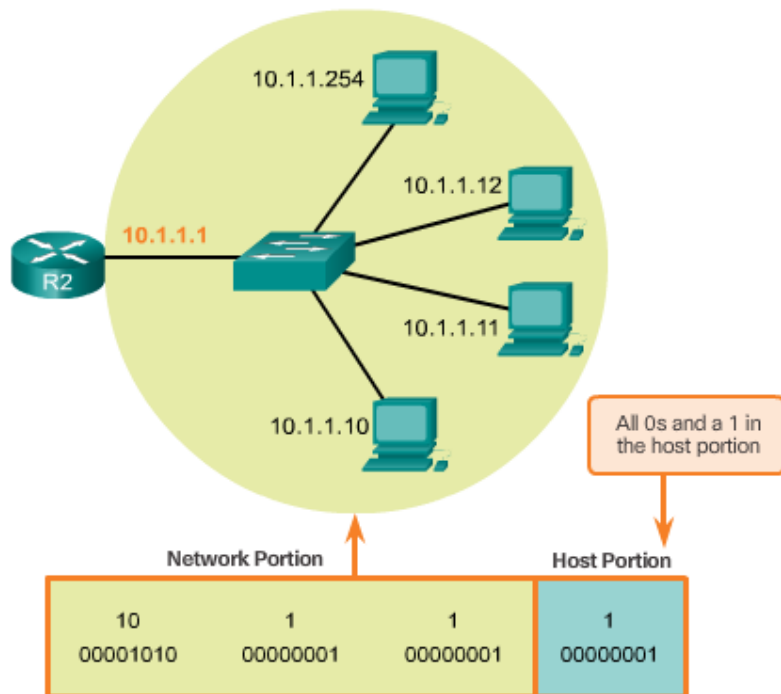


Network, Host, and Broadcast Addresses (cont.)

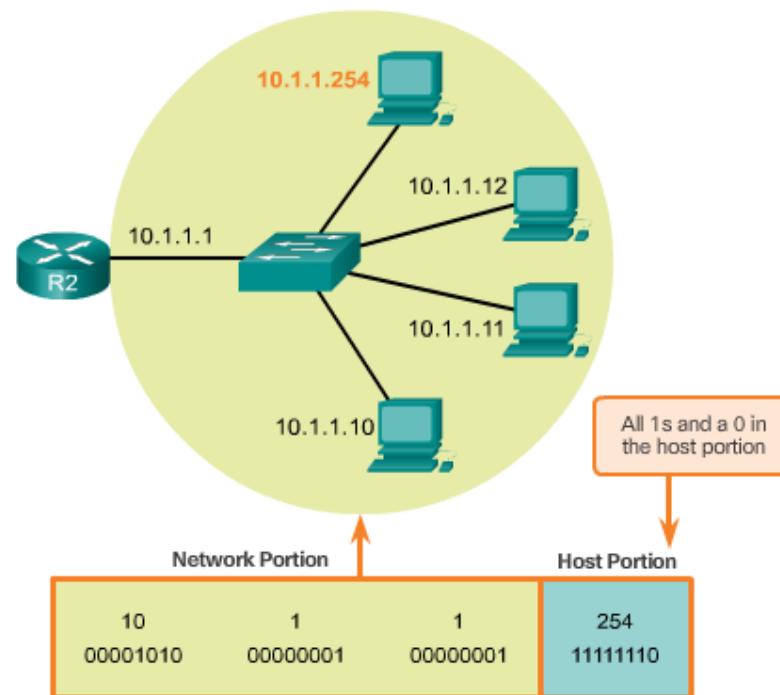


Network, Host, and Broadcast Addresses (cont.)

First Host Address

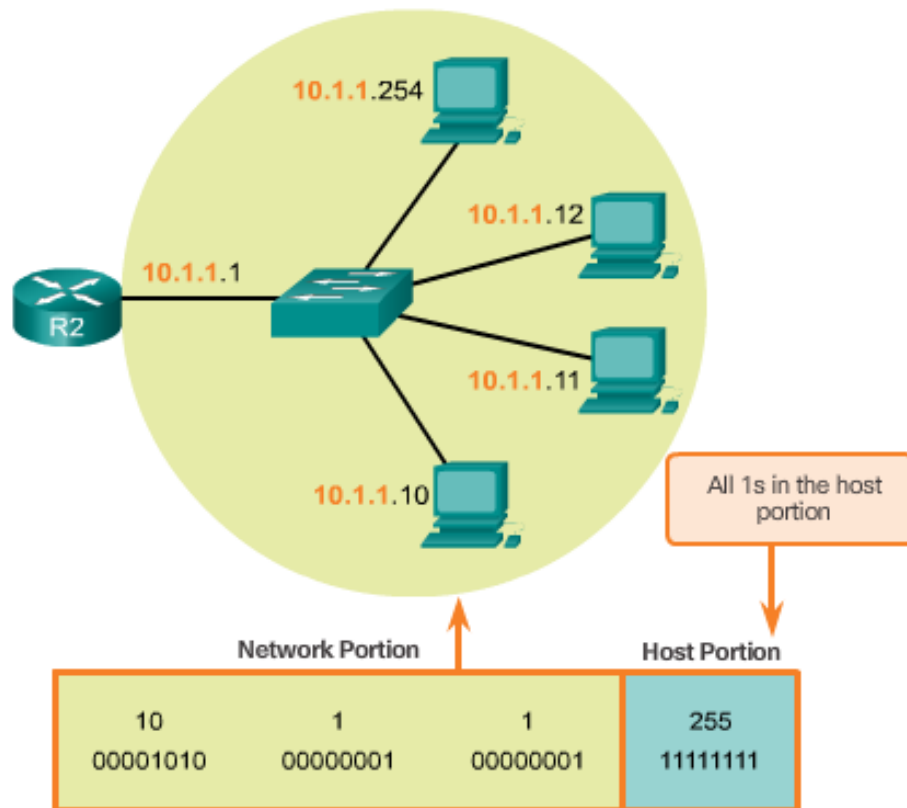


Last Host Address



Network, Host, and Broadcast Addresses (cont.)

Broadcast Address



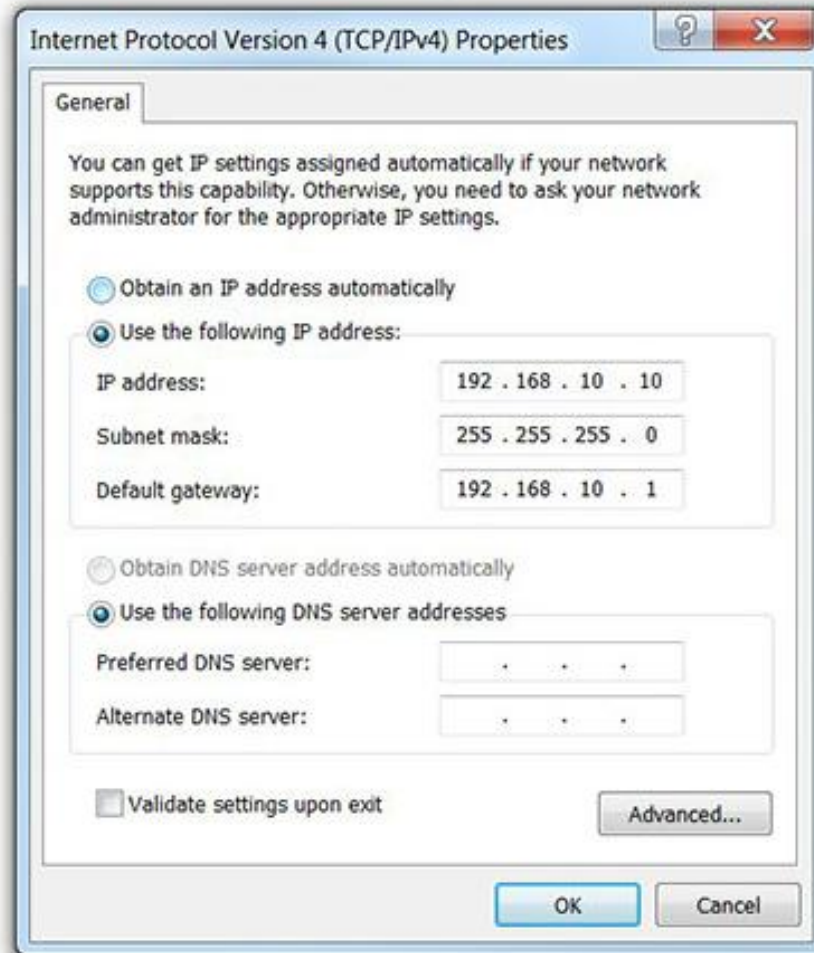
See VIDEO DEMONSTRATION

Topic 7.1.3: IPv4 Unicast, Broadcast, and Multicast



Static IPv4 Address Assignment to a Host

Static Assignment



The screenshot shows the 'Internet Protocol Version 4 (TCP/IPv4) Properties' dialog box. The 'General' tab is selected. The text inside the dialog reads: 'You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.'

There are two radio button options for IP address assignment:

- ☐ Obtain an IP address automatically
- ☒ Use the following IP address:

Below the 'Use the following IP address' option, there are three text input fields:

- IP address: 192 . 168 . 10 . 10
- Subnet mask: 255 . 255 . 255 . 0
- Default gateway: 192 . 168 . 10 . 1

There are two radio button options for DNS server address assignment:

- ☐ Obtain DNS server address automatically
- ☒ Use the following DNS server addresses

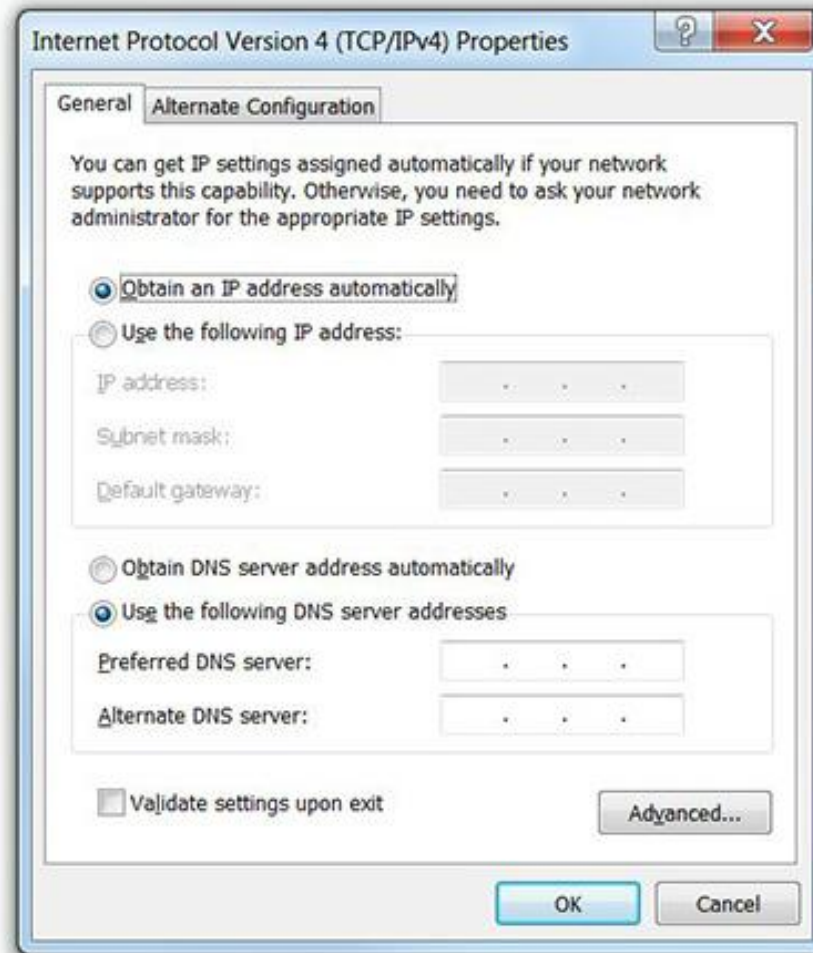
Below the 'Use the following DNS server addresses' option, there are two text input fields:

- Preferred DNS server: . . .
- Alternate DNS server: . . .

At the bottom left, there is a checkbox labeled 'Validate settings upon exit' which is currently unchecked. At the bottom right, there is an 'Advanced...' button. At the very bottom, there are 'OK' and 'Cancel' buttons.

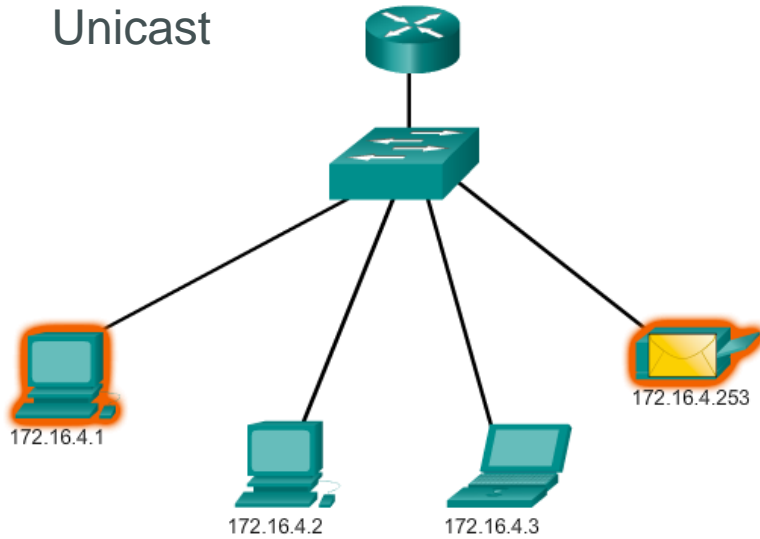
Dynamic IPv4 Address Assignment to a Host

Dynamic Assignment

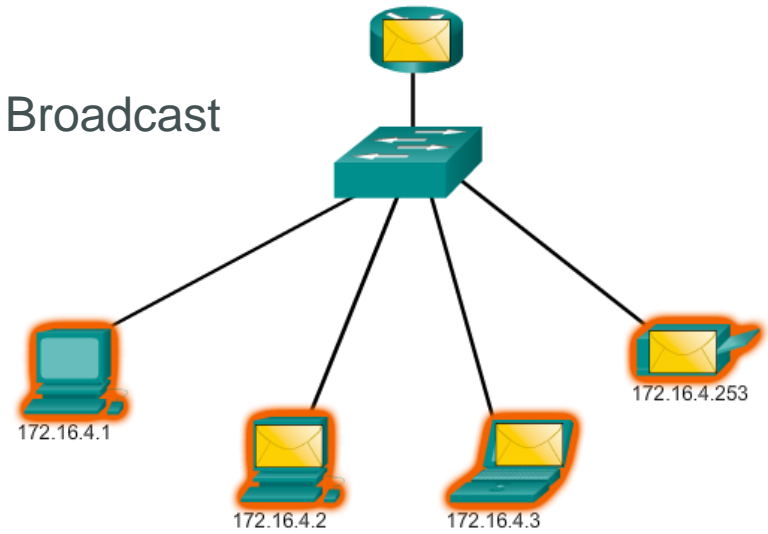


IPv4 Communication

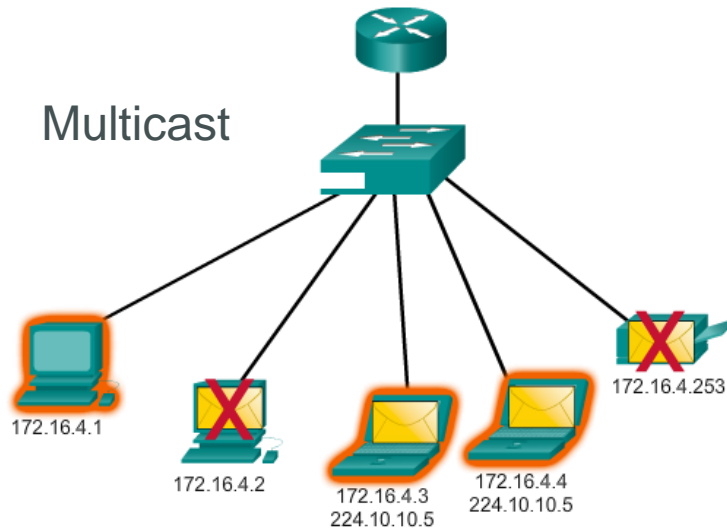
Unicast



Broadcast

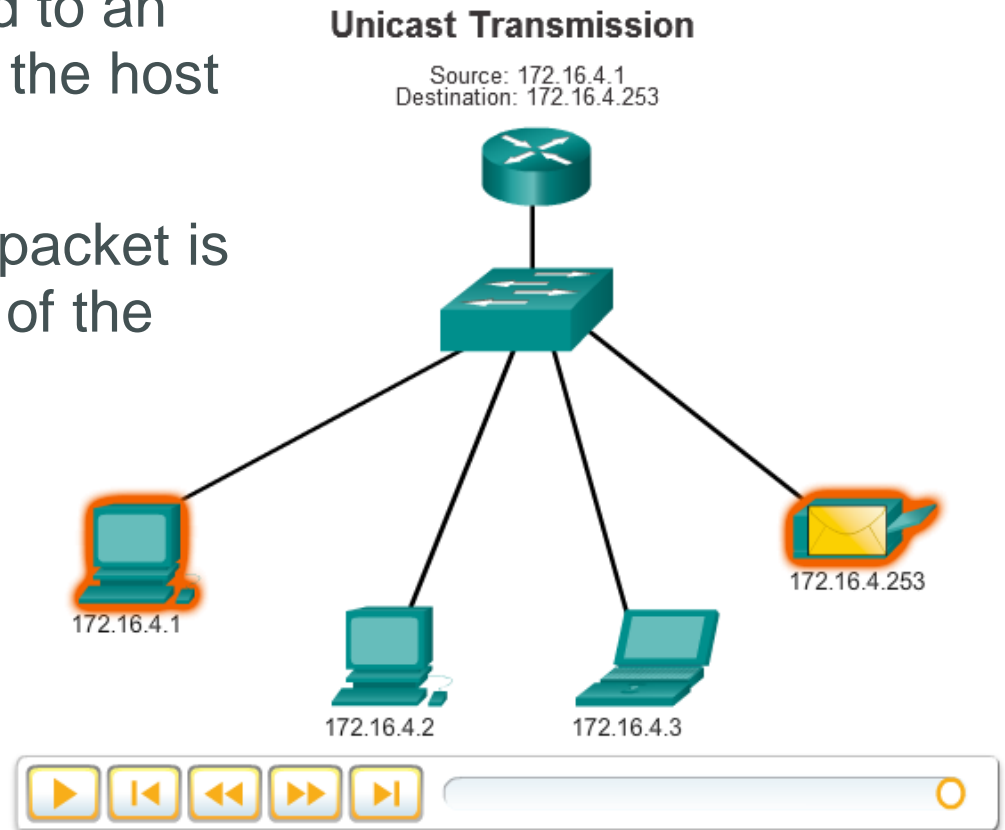


Multicast



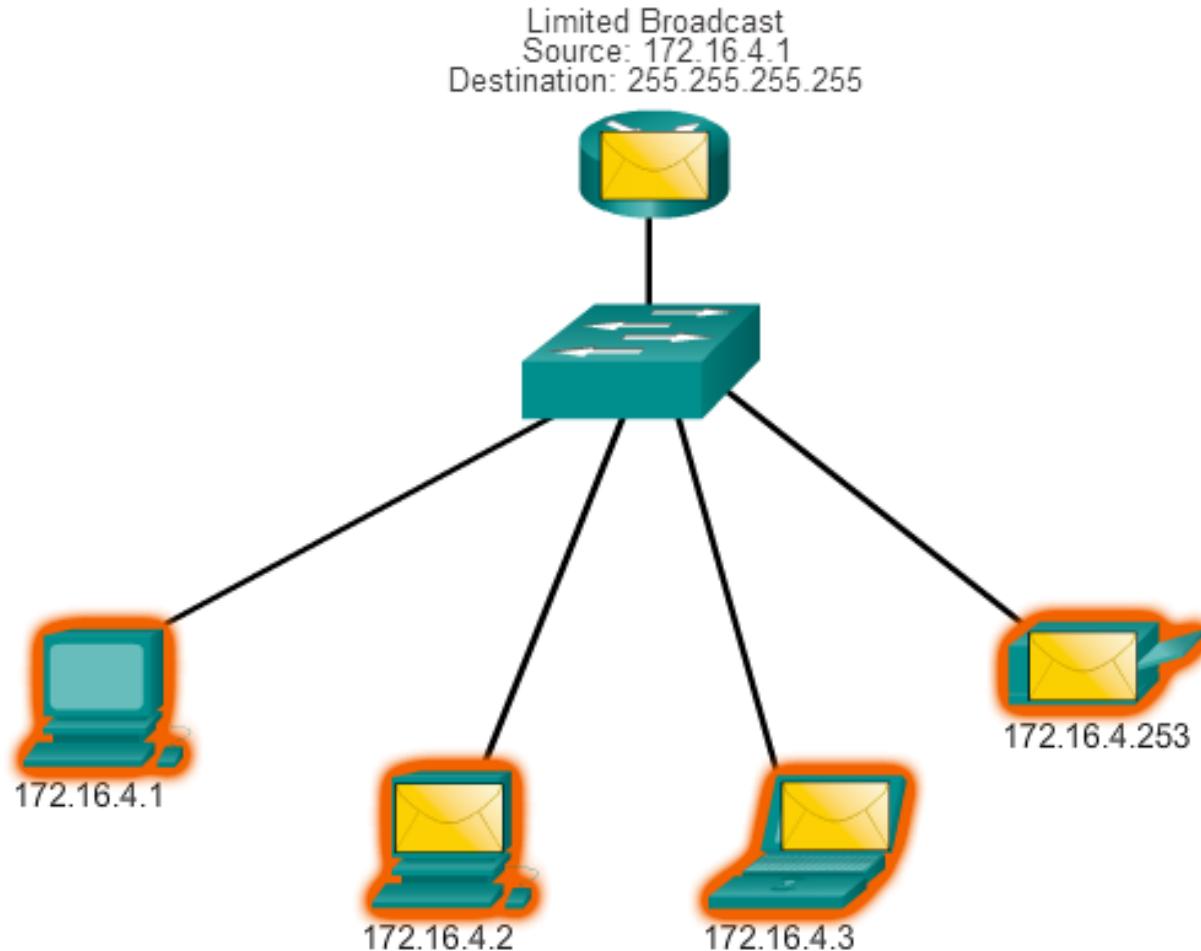
Unicast Transmission

- Unicast communication is used for normal host-to-host communication.
- The unicast address applied to an end device is referred to as the host address.
- The source address of any packet is always the unicast address of the originating host.



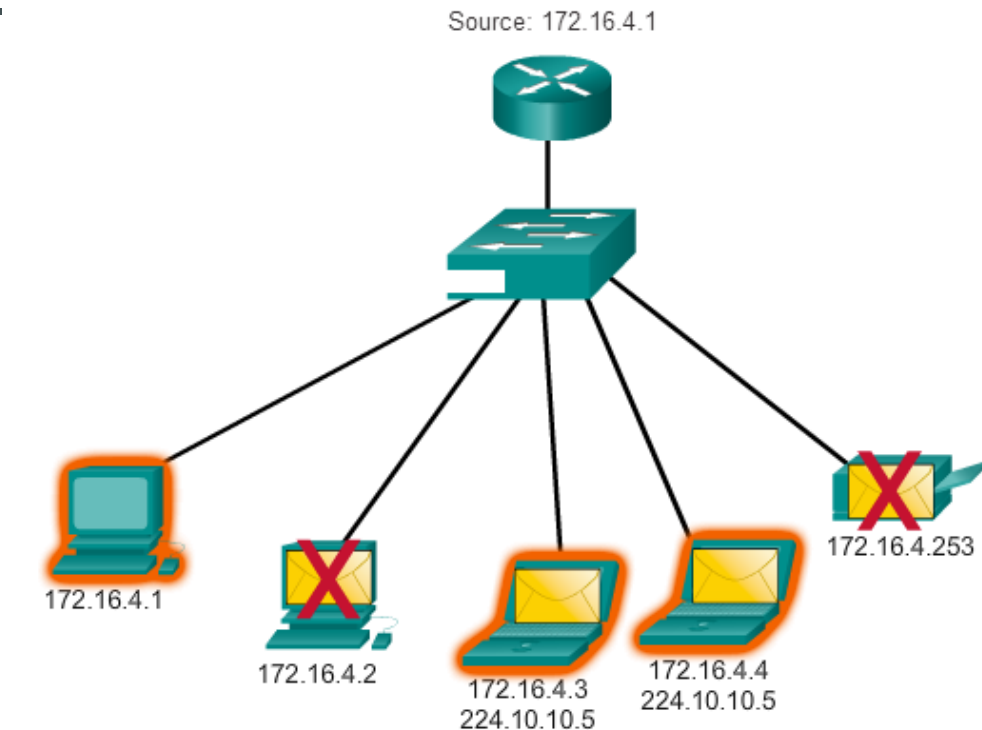
Broadcast Transmission

Limited Broadcast Transmission



Multicast Transmission

- A host sends a single packet to a selected set of hosts that subscribe to a multicast group.
- The 224.0.0.0 to 239.255.255.255 range of addresses are reserved for multicast.



Topic 7.1.4: Types of IPv4 Addresses

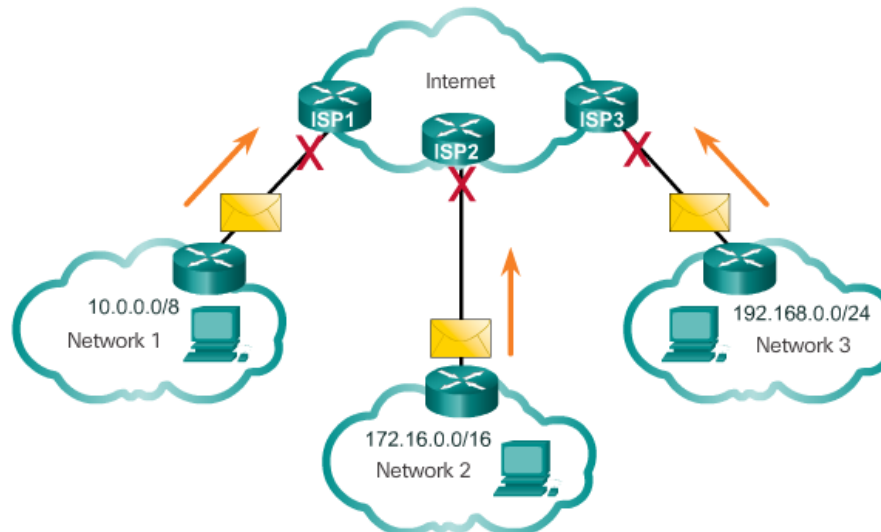


Public and Private IPv4 Addresses

Private Addresses:

- 10.0.0.0/8 or 10.0.0.0 to 10.255.255.255
- 172.16.0.0 /12 or 172.16.0.0 to 172.31.255.255
- 192.168.0.0 /16 or 192.168.0.0 to 192.168.255.255

Private addresses cannot be routed over the Internet



Special Use IPv4 Addresses

- Loopback addresses
127.0.0.0 /8 or 127.0.0.1 to 127.255.255.254
- Link-Local addresses or Automatic Private IP Addressing (APIPA) addresses
169.254.0.0 /16 or
169.254.0.1 to 169.254.255.254
- TEST-NET addresses
192.0.2.0/24 or 192.0.2.0
to 192.0.2.255

Pinging the Loopback Interface

```
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\NetAcad> ping 127.0.0.1

Pinging 127.0.0.1 with 32 bytes of data:
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128

Ping statistics for 127.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Users\NetAcad> ping 127.1.1.1

Pinging 127.1.1.1 with 32 bytes of data:
Reply from 127.1.1.1: bytes=32 time<1ms TTL=128
Reply from 127.1.1.1: bytes=32 time<1ms TTL=128
Reply from 127.1.1.1: bytes=32 time<1ms TTL=128
Reply from 127.1.1.1: bytes=32 time<1ms TTL=128

Ping statistics for 127.1.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Users\NetAcad>
```

Legacy Classful Addressing

| Class A Specifics | |
|----------------------------|-------------------------|
| Address block | 0.0.0.0 - 127.0.0.0* |
| Default Subnet Mask | /8 (255.0.0.0) |
| Maximum Number of Networks | 128 |
| Number of Host per Network | 16,777,214 |
| High order bit | 0xxxxxxx.____.____.____ |

* 0.0.0.0 and 127.0.0.0 are reserved and cannot be assigned

| Class B Specifics | |
|----------------------------|-------------------------|
| Address block | 128.0.0.0 - 191.255.0.0 |
| Default Subnet Mask | /16 (255.255.0.0) |
| Maximum Number of Networks | 16,384 |
| Number of Host per Network | 65,534 |
| High order bit | 10xxxxxx.____.____.____ |

| Class C Specifics | |
|----------------------------|---------------------------|
| Address block | 192.0.0.0 - 223.255.255.0 |
| Default Subnet Mask | /24 (255.255.255.0) |
| Maximum Number of Networks | 2,097,152 |
| Number of Host per Network | 254 |
| High order bit | 110xxxxx.____.____.____ |

Classless Addressing

- Formal name is Classless Inter-Domain Routing (CIDR, pronounced “cider”).
- Created a new set of standards that allowed service providers to allocate IPv4 addresses on any address bit boundary (prefix length) instead of only by a class A, B, or C address.

Assignment of IP Addresses



Section 7.2:

IPv6 Addresses

Upon completion of this section, you should be able to:

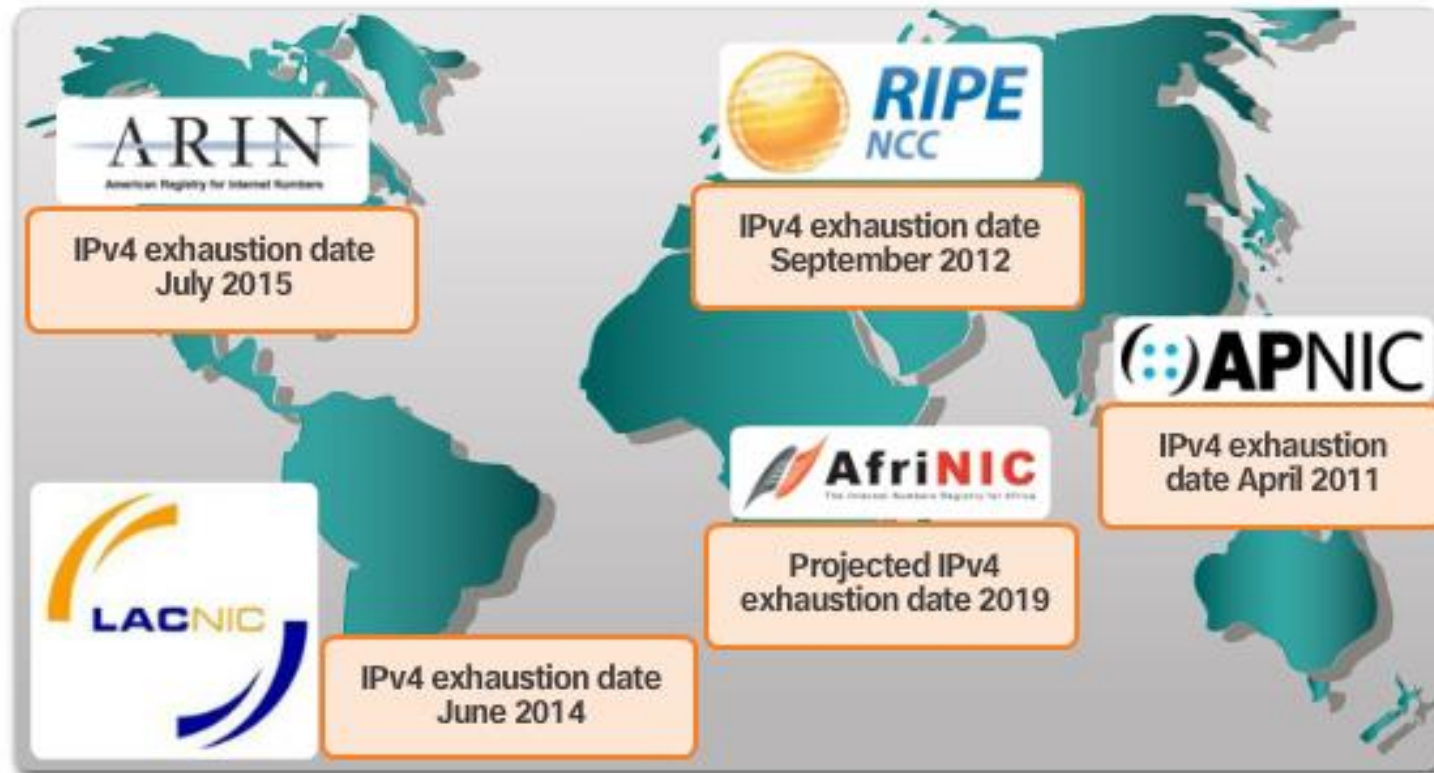
- Explain the need for IPv6 addressing.
- Describe the representation of an IPv6 address.
- Describe types of IPv6 network addresses.
- Configure global unicast addresses.
- Describe multicast addresses.

Topic 7.2.1: IPv4 issues



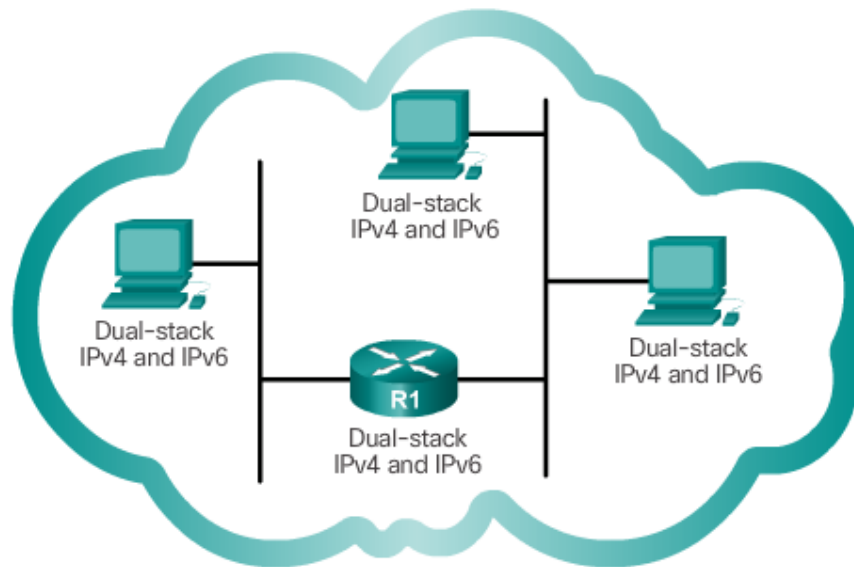
The Need for IPv6

RIR IPv4 Exhaustion Dates



IPv4 and IPv6 Coexistence

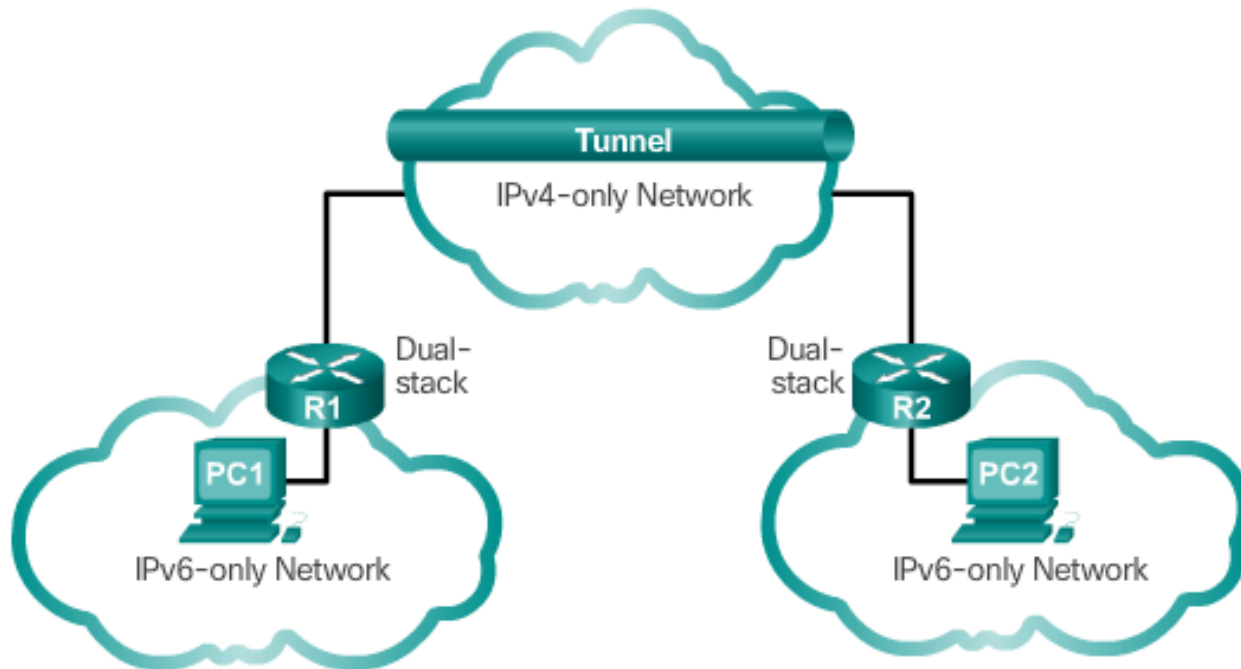
- The migration techniques can be divided into three categories: Dual Stack, Tunneling, and Translation.
- **Dual-stack** allows IPv4 and IPv6 to coexist on the same network. Devices run both IPv4 and IPv6 protocol stacks simultaneously.



IPv4 and IPv6 Coexistence (cont.)

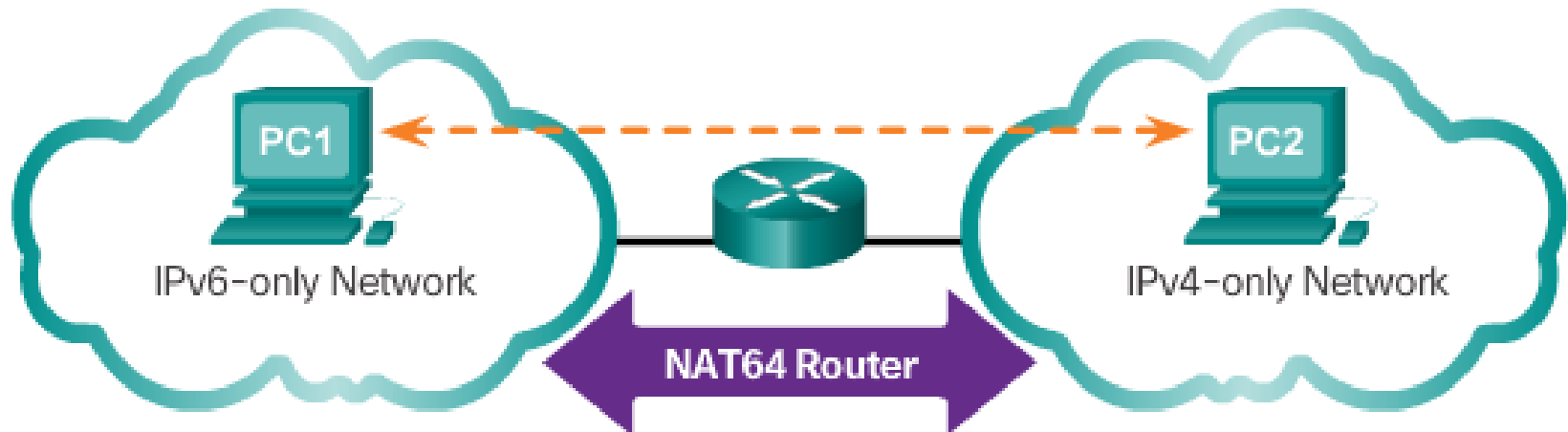
- **Tunneling** is a method of transporting an IPv6 packet over an IPv4 network. The IPv6 packet is encapsulated inside an IPv4 packet.

Tunnelling



IPv4 and IPv6 Coexistence (cont.)

- **Translation:** Network Address Translation 64 (NAT64) allows IPv6-enabled devices to communicate with IPv4-enabled devices using a translation technique similar to NAT for IPv4. An IPv6 packet is translated to an IPv4 packet, and vice versa.

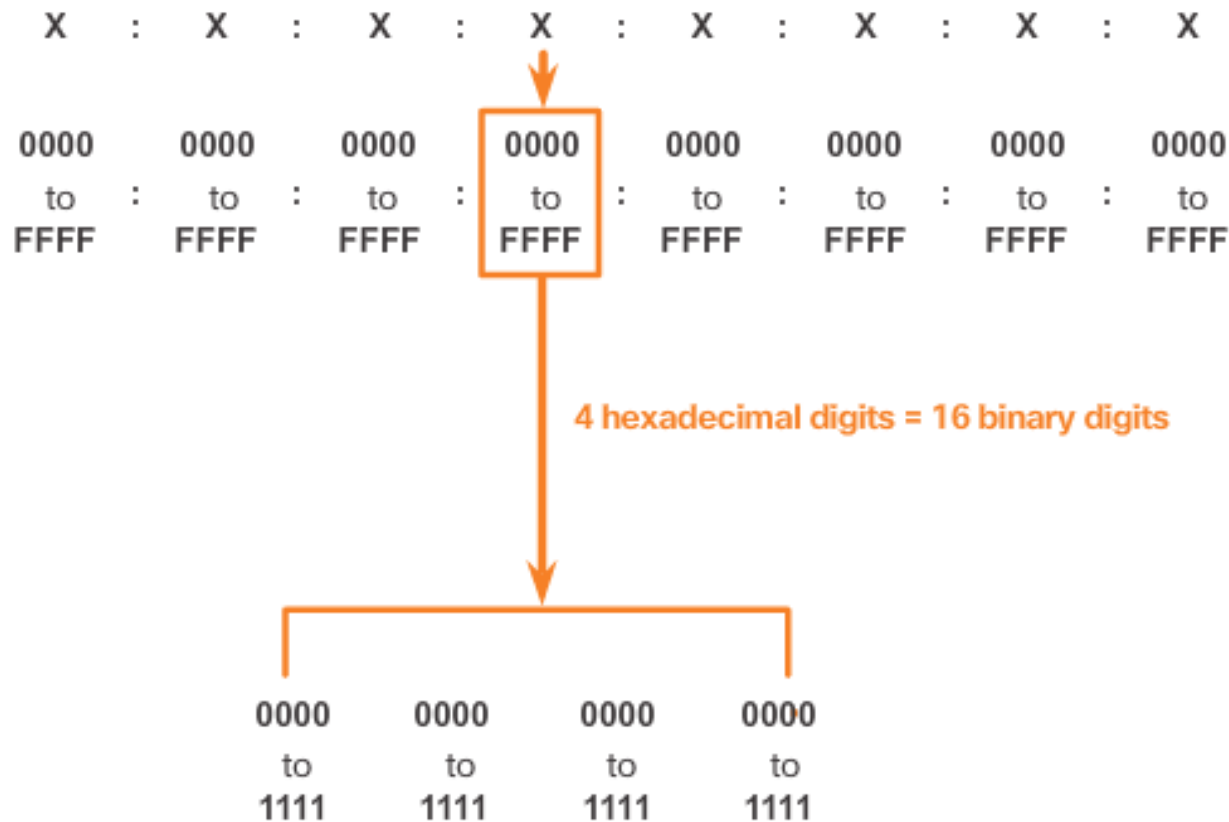


Topic 7.2.2: IPv6 Address Structure



IPv6 Address Representation

Hextets – 4 Hexadecimal digits = 16 binary digits



IPv6 Address Representation (cont.)

Hexadecimal Numbering

Decimal and Binary equivalents of 0 to F Hexadecimal

| Decimal | Binary | Hexadecimal |
|---------|--------|-------------|
| 0 | 0000 | 0 |
| 1 | 0001 | 1 |
| 2 | 0010 | 2 |
| 3 | 0011 | 3 |
| 4 | 0100 | 4 |
| 5 | 0101 | 5 |
| 6 | 0110 | 6 |
| 7 | 0111 | 7 |
| 8 | 1000 | 8 |
| 9 | 1001 | 9 |
| 10 | 1010 | A |
| 11 | 1011 | B |
| 12 | 1100 | C |
| 13 | 1101 | D |
| 14 | 1110 | E |
| 15 | 1111 | F |

IPv6 Address Representation (cont.)

Preferred Format Examples

2001 : 0DB8 : 0000 : 1111 : 0000 : 0000 : 0000 : 0200

2001 : 0DB8 : 0000 : 00A3 : ABCD : 0000 : 0000 : 1234

2001 : 0DB8 : 000A : 0001 : 0000 : 0000 : 0000 : 0100

2001 : 0DB8 : AAAA : 0001 : 0000 : 0000 : 0000 : 0200

FE80 : 0000 : 0000 : 0000 : 0123 : 4567 : 89AB : CDEF

FE80 : 0000 : 0000 : 0000 : 0000 : 0000 : 0000 : 0001

FF02 : 0000 : 0000 : 0000 : 0000 : 0000 : 0000 : 0001

FF02 : 0000 : 0000 : 0000 : 0000 : 0001 : FF00 : 0200

0000 : 0000 : 0000 : 0000 : 0000 : 0000 : 0000 : 0001

0000 : 0000 : 0000 : 0000 : 0000 : 0000 : 0000 : 0000

Rule 1 – Omit Leading 0's

Example 1

| | |
|---------------|--|
| Preferred | 2001:DB8:0000:1111:0000:0000:0000:0200 |
| No leading 0s | 2001: DB8: 0:1111: 0: 0: 0: 200 |

Example 2

| | |
|---------------|--|
| Preferred | 2001:DB8:0000:A300:ABCD:0000:0000:1234 |
| No leading 0s | 2001: DB8: 0:A300:ABCD: 0: 0:1234 |

Example 3

| | |
|---------------|---|
| Preferred | FF02:0000:0000:0000:0000:0001:FF00:0200 |
| No leading 0s | FF02: 0: 0: 0: 0: 1:FF00: 200 |

Rule 2 – Omit All 0 Segments

Example 1

| | |
|---------------|---|
| Preferred | 2001:0DB8:0000:1111:0000:0000:0000:0200 |
| No leading 0s | 2001: DB8: 0:1111: 0: 0: 0: 200 |
| Compressed | 2001:DB8:0:1111::200 |

Example 2

| | |
|---------------|---|
| Preferred | 2001:0DB8:0000:0000:ABCD:0000:0000:0100 |
| No leading 0s | 2001: DB8: 0: 0:ABCD: 0: 0: 100 |
| Compressed | 2001:DB8::ABCD:0:0:100 |
| or | |
| Compressed | 2001:DB8:0:0:ABCD::100 |

Only one :: may be used.

Rule 2 – Omit All 0 Segments (cont.)

Example 3

| | |
|---------------|---|
| Preferred | FF02:0000:0000:0000:0000:0000:0000:0001 |
| No leading 0s | FF02: 0: 0: 0: 0: 0: 0: 1 |
| Compressed | FF02::1 |

Example 4

| | |
|---------------|---|
| Preferred | 0000:0000:0000:0000:0000:0000:0000:0000 |
| No leading 0s | 0: 0: 0: 0: 0: 0: 0: 0 |
| Compressed | :: |

Topic 7.2.3: Types of IPv6 Addresses



IPv6 Address Types

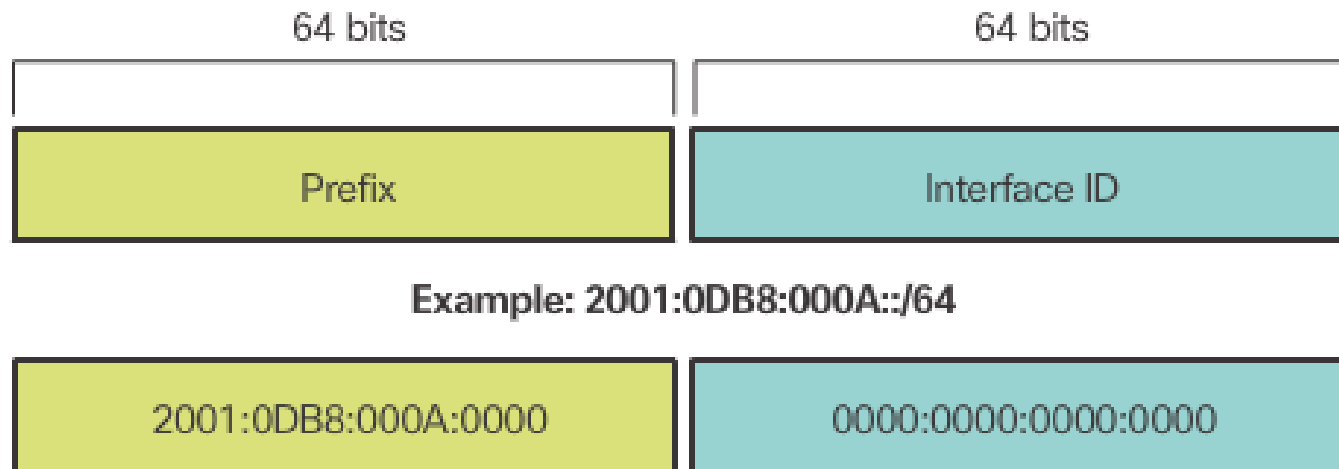
There are three types of IPv6 addresses:

- Unicast
- Multicast
- Anycast

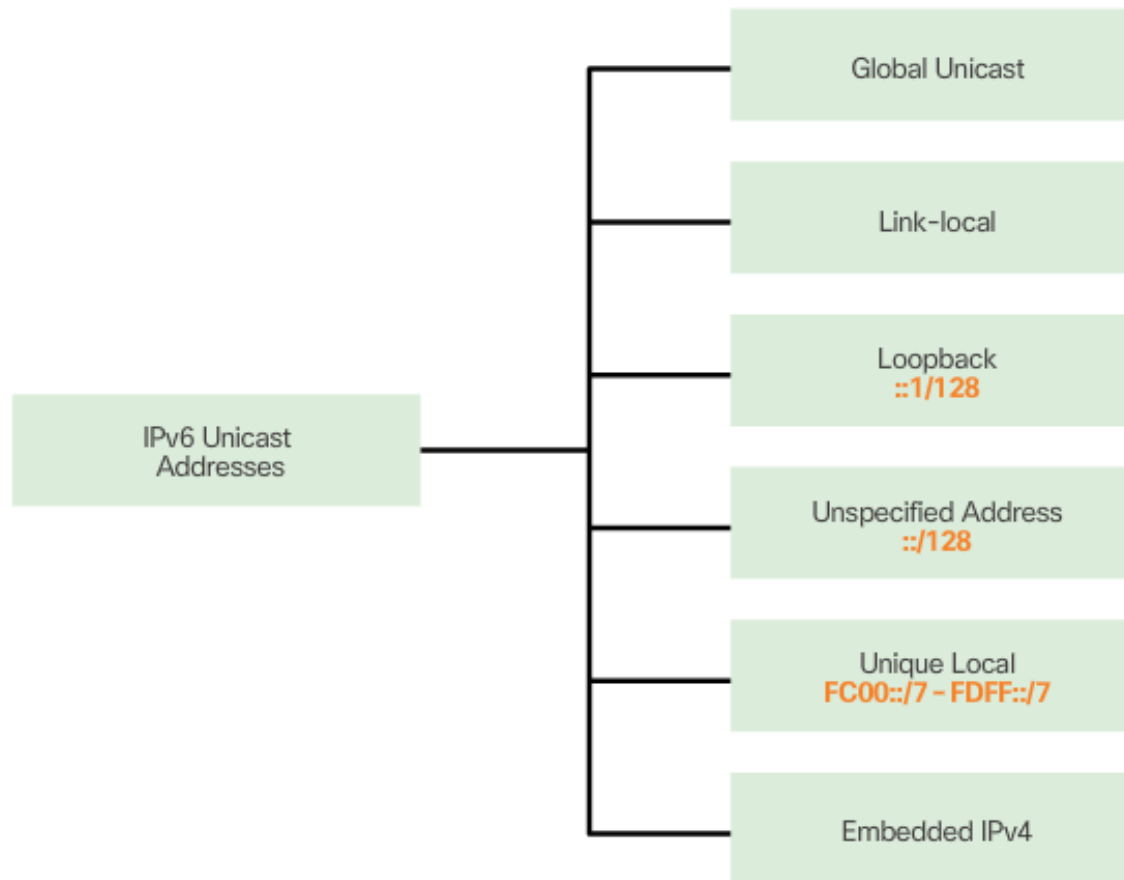
Note: IPv6 does not have broadcast addresses.

IPv6 Prefix Length

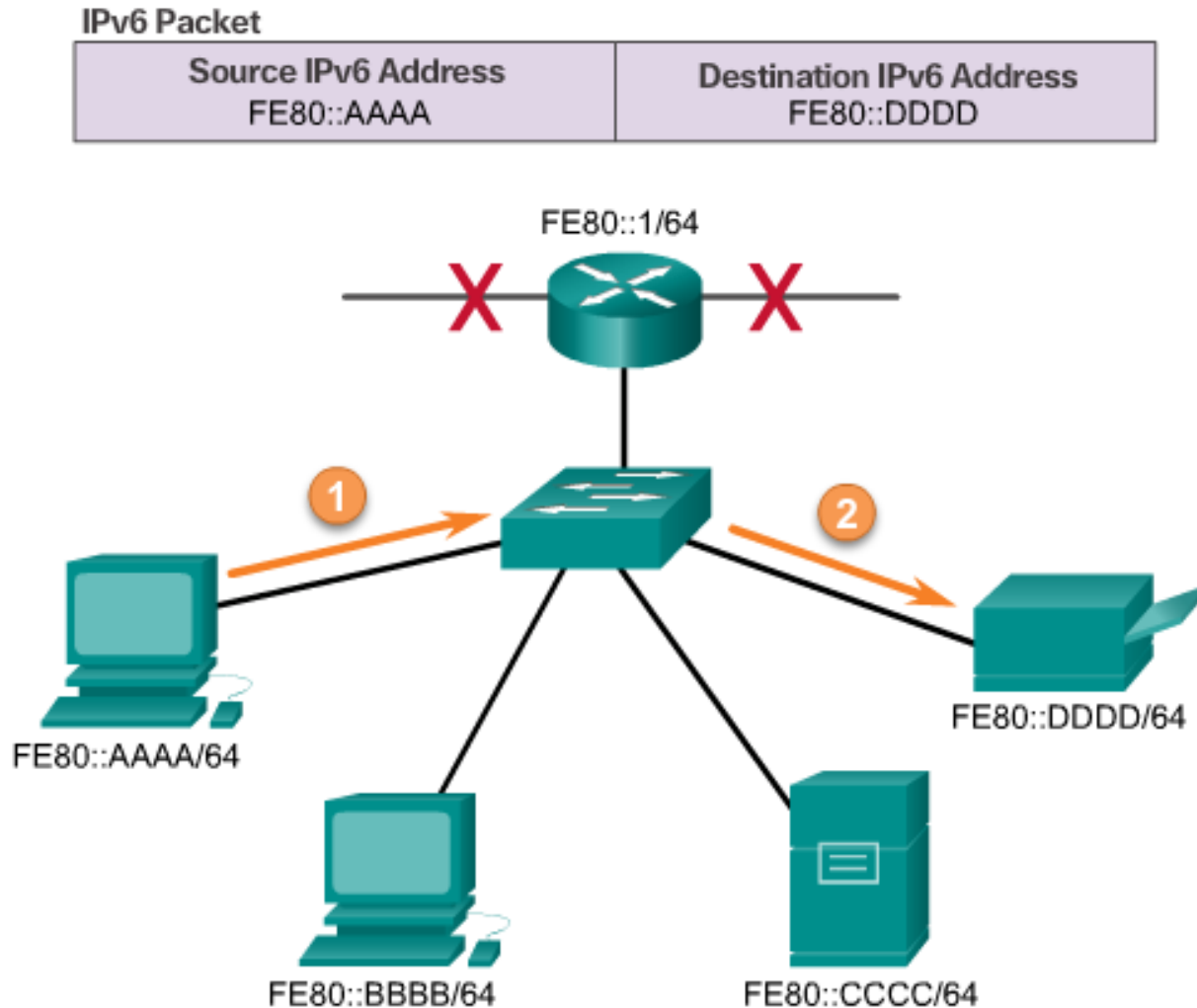
- IPv6 does not use the dotted-decimal subnet mask notation.
- Prefix length indicates the network portion of an IPv6 address using the following format:
 - IPv6 address /prefix length
 - Prefix length can range from 0 to 128
 - Typical prefix length is /64



IPv6 Unicast Addresses

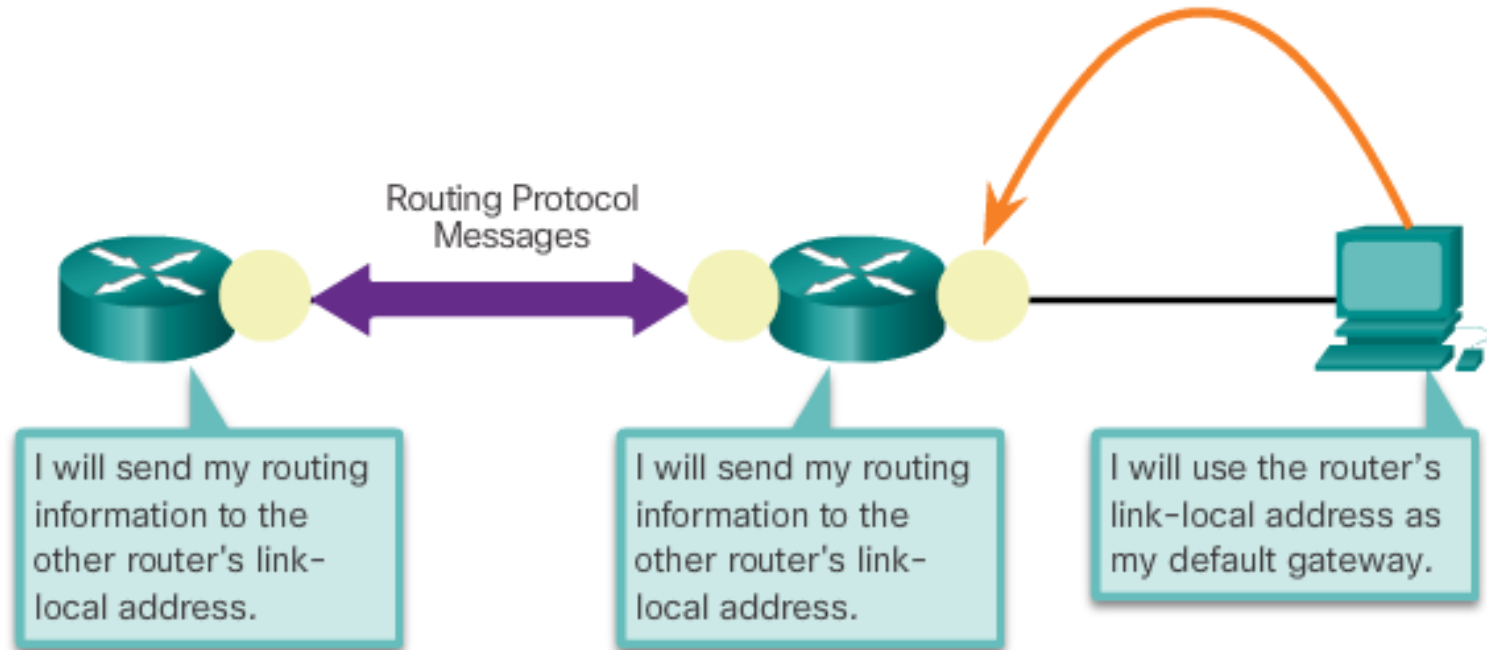


IPv6 Link-Local Unicast Addresses



IPv6 Link-Local Unicast Addresses (cont.)

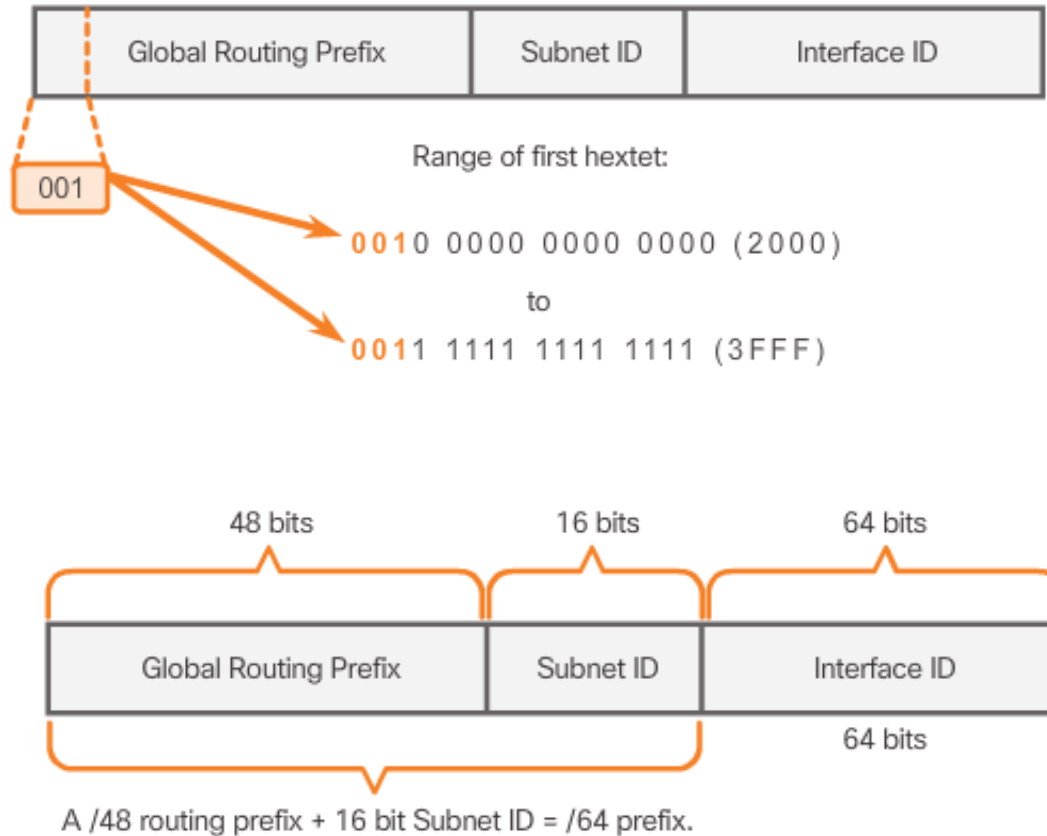
Uses of an IPv6 Link-local address



Topic 7.2.4: IPv6 Unicast Addresses

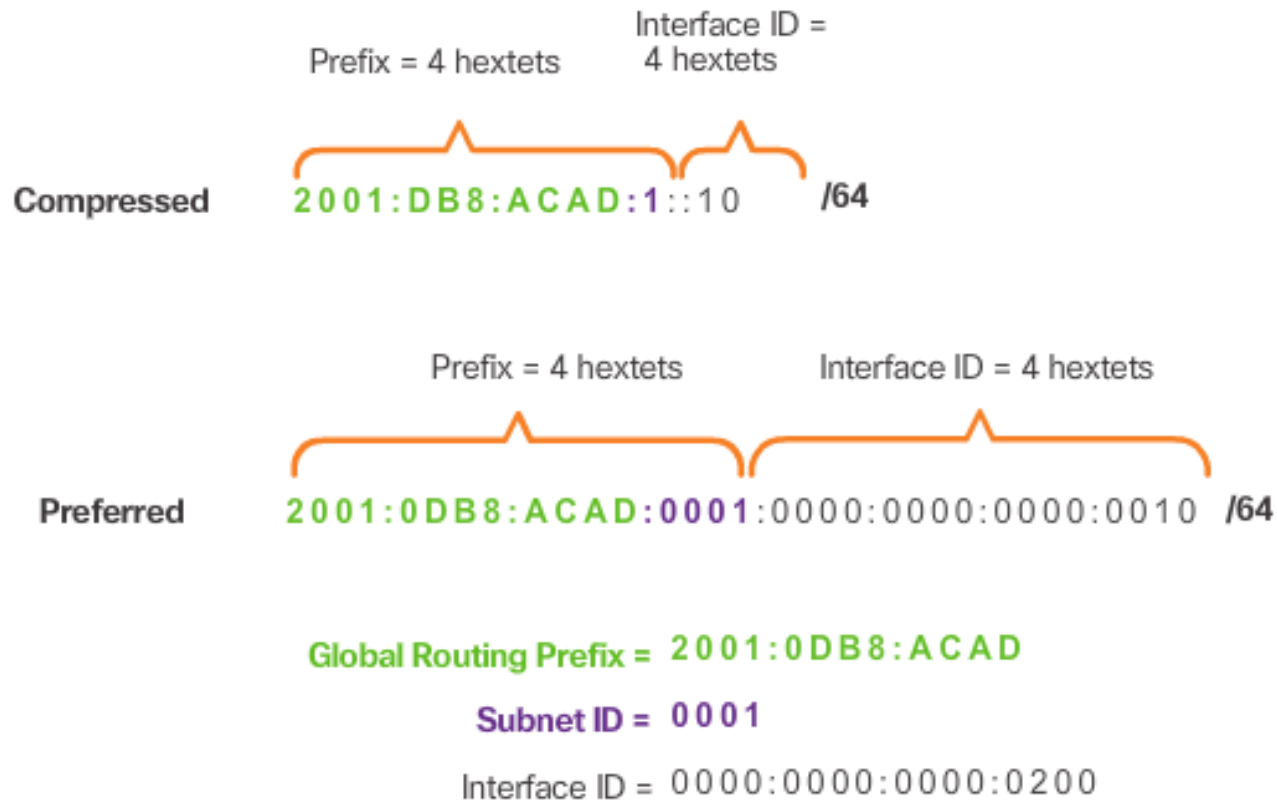


Structure of an IPv6 Global Unicast Address



Structure of an IPv6 Global Unicast Address (cont.)

Reading a Global Unicast Address



Static Configuration of a Global Unicast Address (cont.)

The screenshot shows the 'Internet Protocol Version 6 (TCP/IPv6) Properties' dialog box. The 'General' tab is selected. The text inside the dialog reads: 'You can get IPv6 settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IPv6 settings.'

Under the 'Use the following IPv6 address:' section, the following values are entered:

- IPv6 address: 2001:db8:acad:1::10
- Subnet prefix length: 64
- Default gateway: 2001:db8:acad:1::1

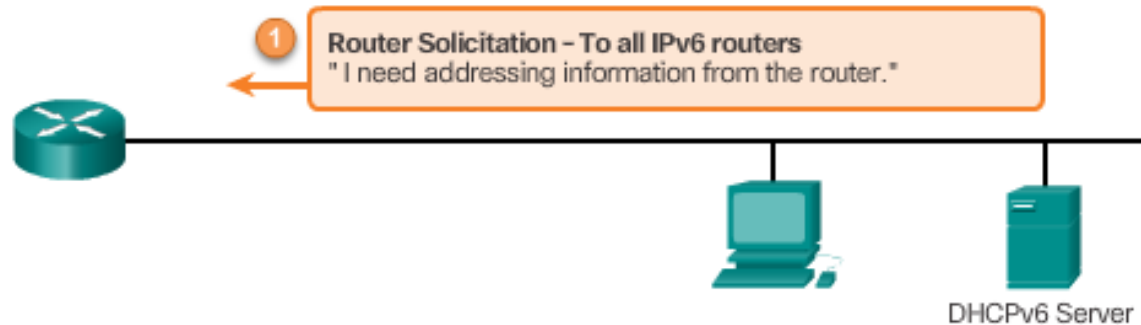
Under the 'Use the following DNS server addresses:' section, the 'Preferred DNS server' and 'Alternate DNS server' fields are empty.

At the bottom, there is a checkbox for 'Validate settings upon exit' which is unchecked, and an 'Advanced...' button.

At the very bottom of the dialog are 'OK' and 'Cancel' buttons.

Dynamic Configuration - SLAAC

Router Solicitation and Router Advertisement Messages



Router Advertisement Options

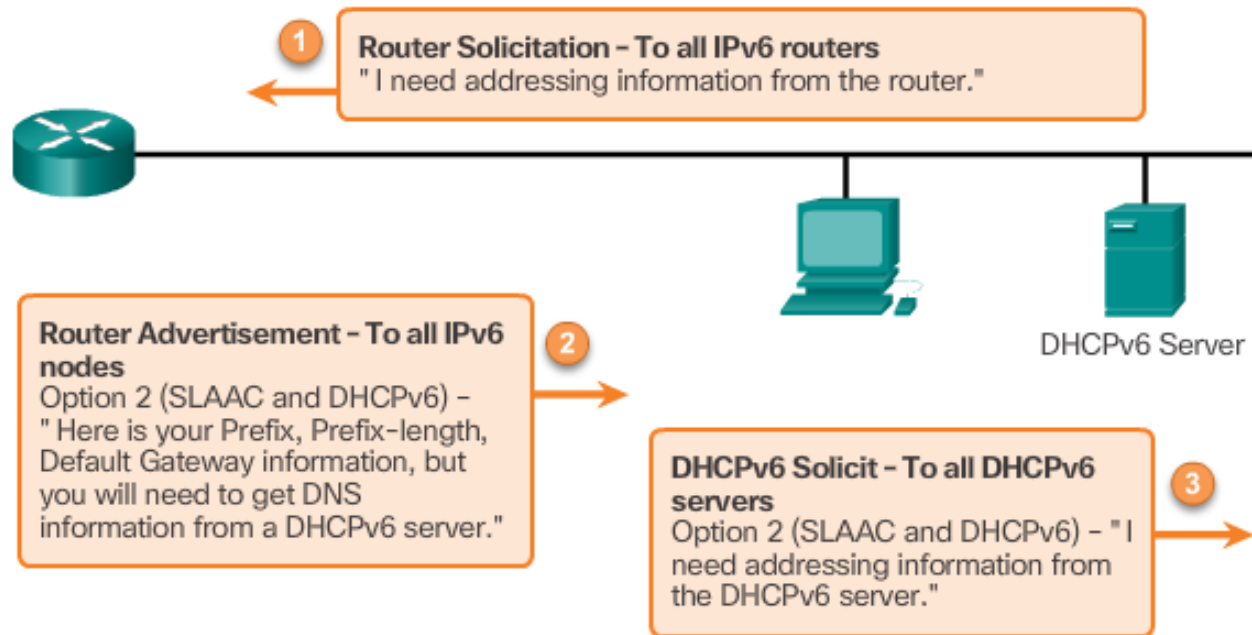
Option 1 (SLAAC Only) - "I'm everything you need (Prefix, Prefix-length, Default Gateway)"

Option 2 (SLAAC and DHCPv6) - "Here is my information but you need to get other information such as DNS addresses from a DHCPv6 server."

Option 3 (DHCPv6 Only) - "I can't help you. Ask a DHCPv6 server for all your

Dynamic Configuration – DHCPv6

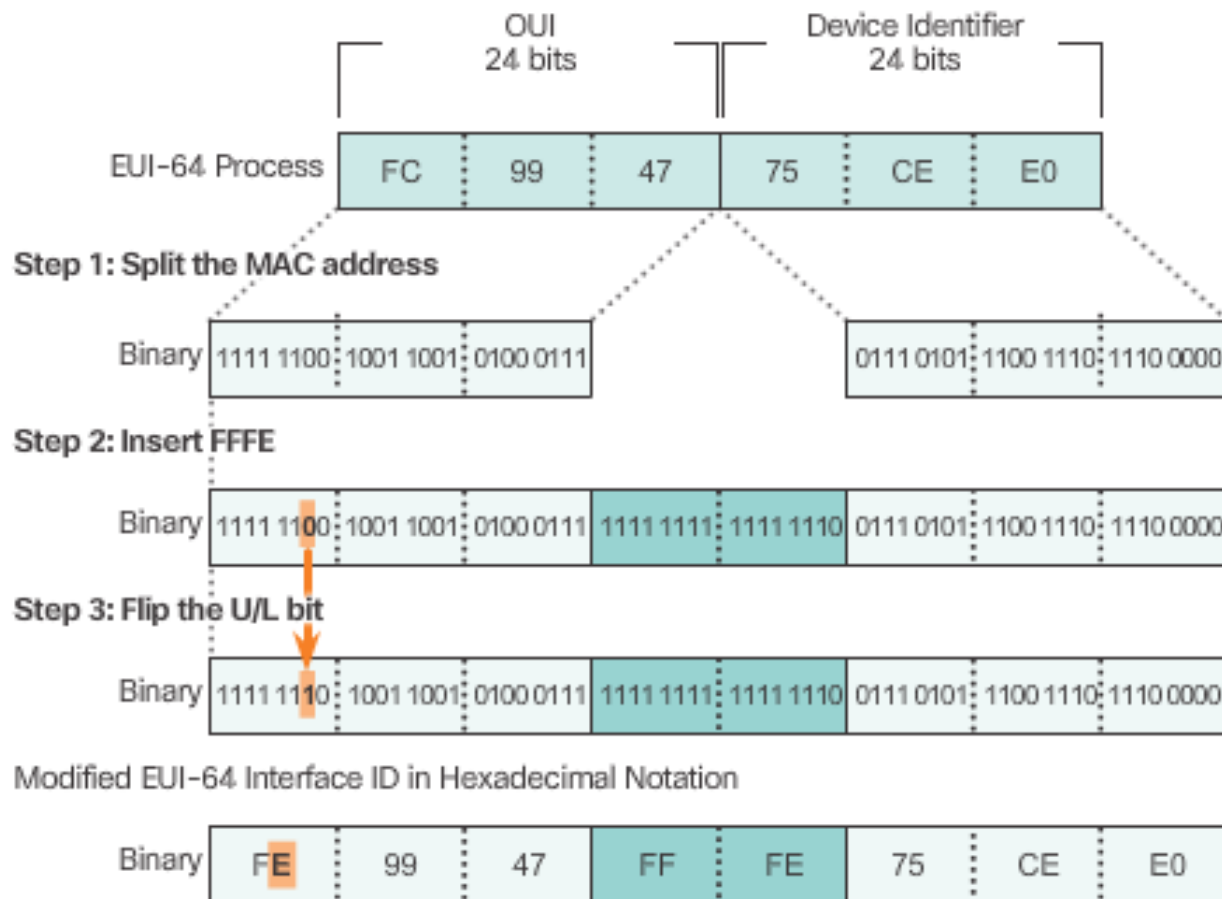
Router Solicitation and Router Advertisement Messages



Note: An RA with option 3 (DHCPv6 Only) enabled will require the client to obtain all information from the DHCPv6 server except the default gateway address. The default gateway address is the RA's source IPv6 address.

EUI-64 Process and Randomly Generated

EUI-64 Process



EUI-64 Process and Randomly Generated

EUI-64 Process

```
PCA> ipconfig
Windows IP Configuration

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix  : 
    IPv6 Address. . . . . : 2001:db8:acad:1:fc99:47ff:FE75:cee0
    Link-local IPv6 Address . . . . : fe80::fc99:47FF:FE75:CEE0
    Default Gateway . . . . . : fe80::1
```

Randomly Generated Interface ID

```
PCEB> ipconfig
Windows IP Configuration

Ethernet adapter Local Area Connection:

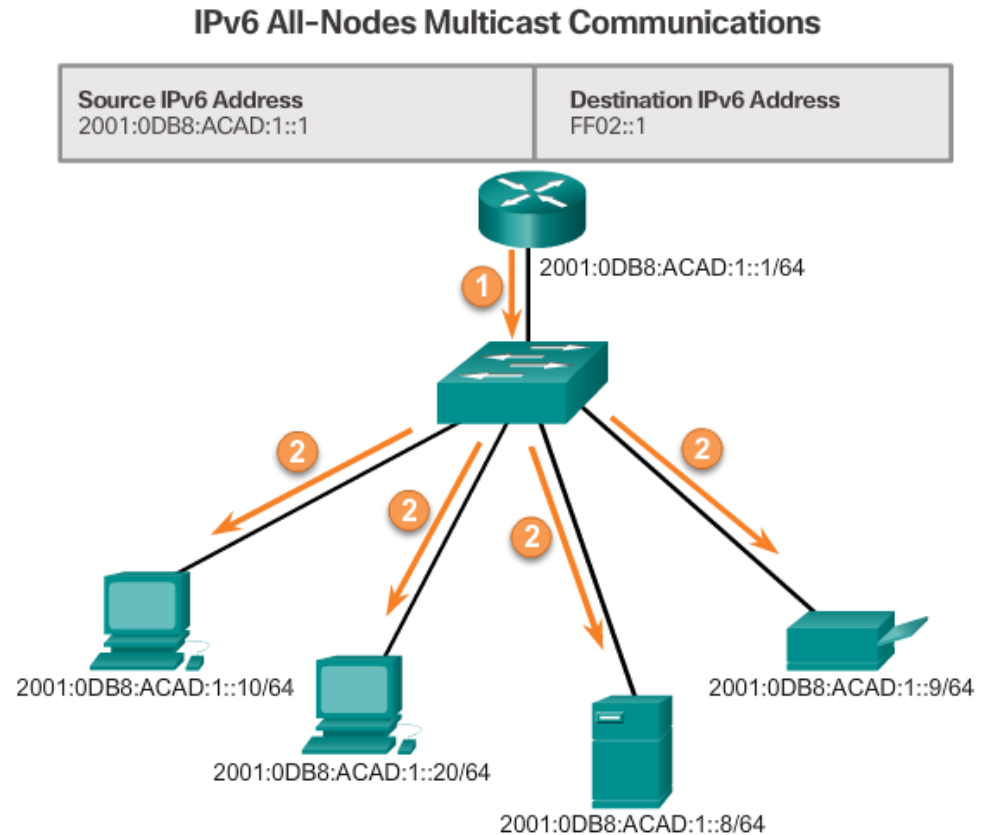
    Connection-specific DNS Suffix  : 
    IPv6 Address. . . . . : 2001:db8:acad:1:50a5:8a35:a5bb:66e1
    Link-local IPv6 Address . . . . : fe80::50a5:8a35:a5bb:66e1
    Default Gateway . . . . . : fe80::1
```


Topic 7.2.5: IPv6 Multicast Addresses

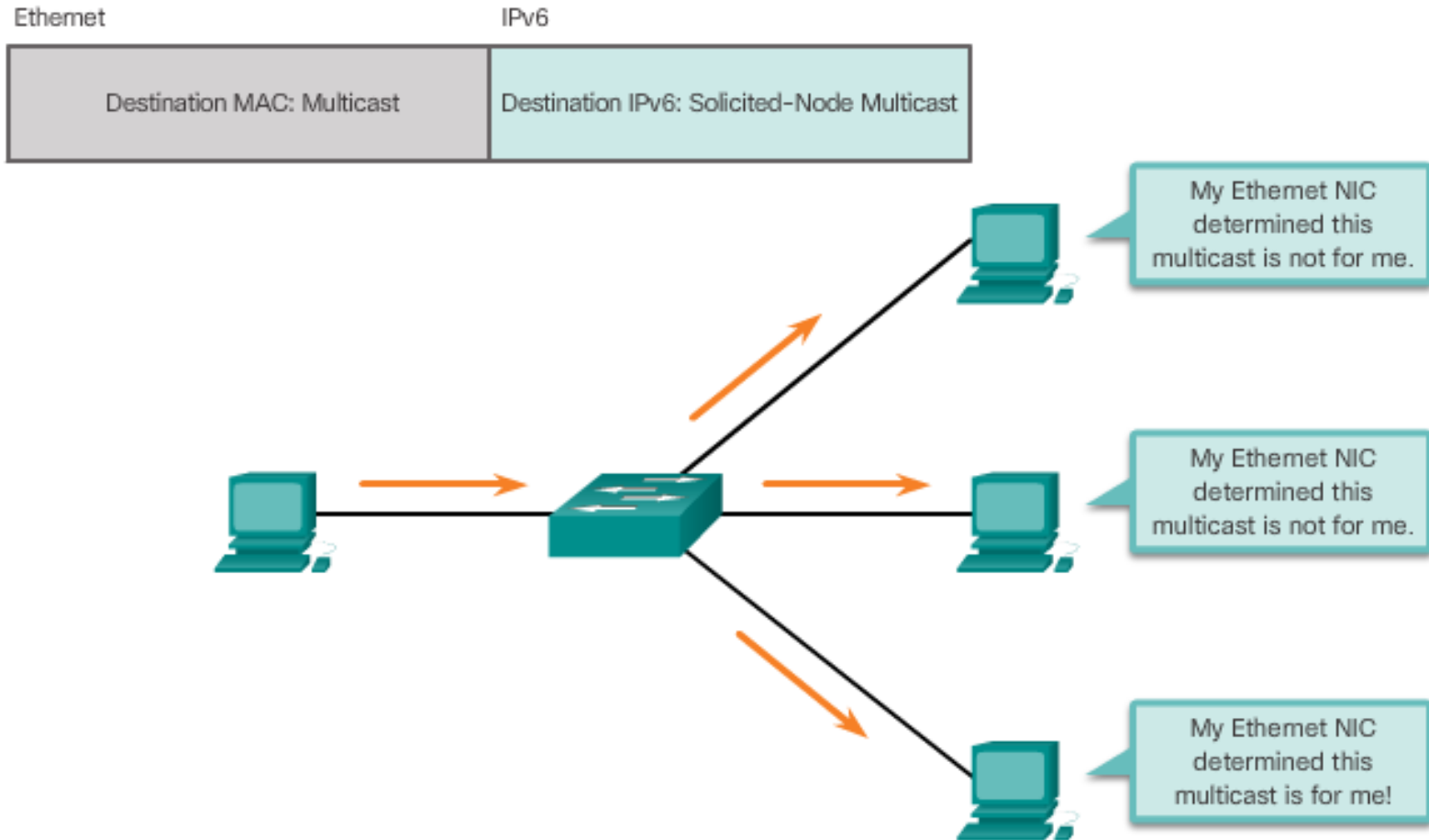


Assigned IPv6 Multicast Addresses

- IPv6 multicast addresses have the prefix FF00::/8.
- There are two types of IPv6 multicast addresses:
 - Assigned multicast
 - Solicited node multicast



Solicited-Node IPv6 Multicast Addresses



Section 7.3:

Connectivity Verification

Upon completion of this section, you should be able to:

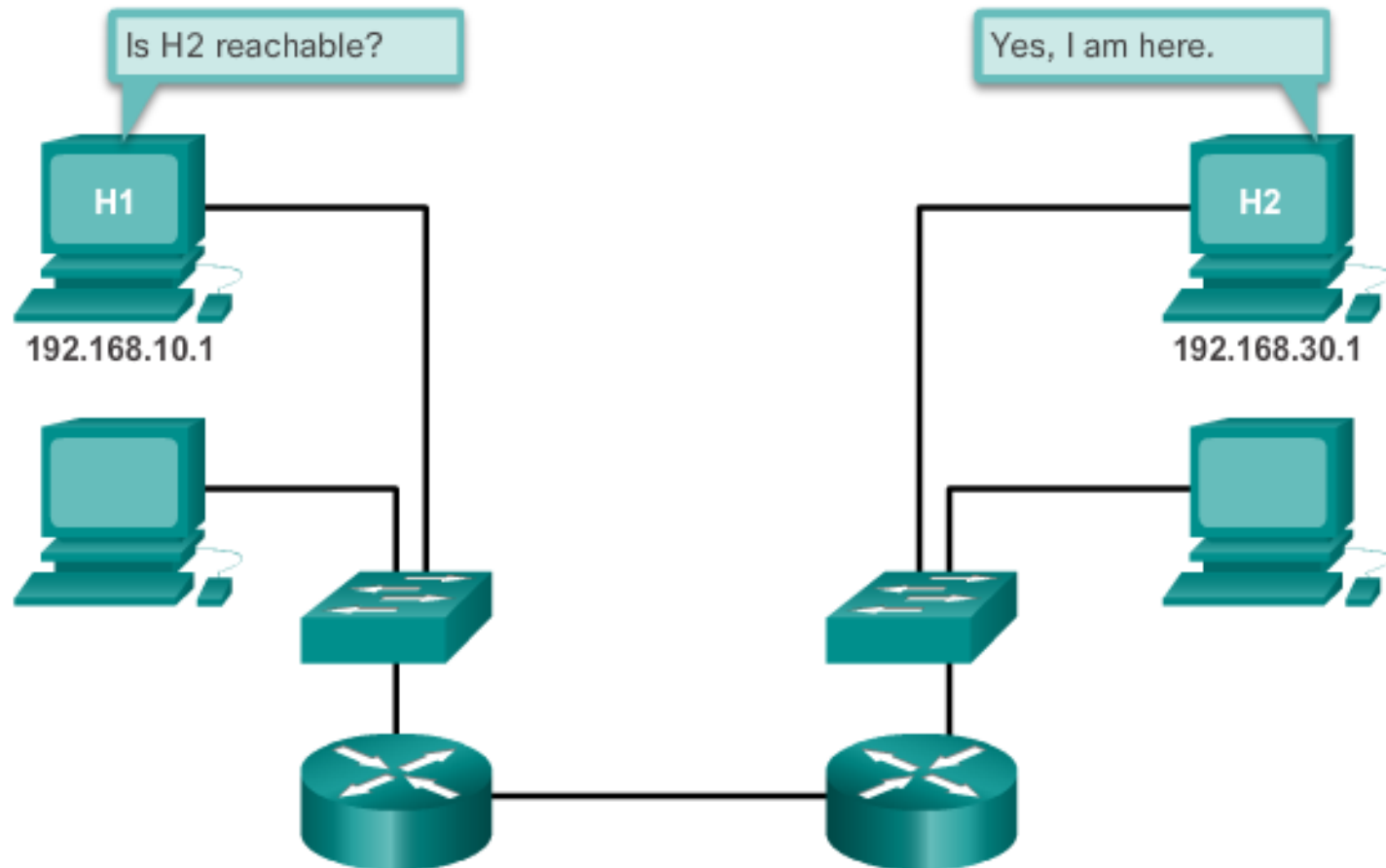
- Explain how ICMP is used to test network connectivity.
- Use ping and traceroute utilities to test network connectivity.

Topic 7.3.1: ICMP



ICMPv4 and ICMPv6

ICMPv4 Ping to a Remote Host

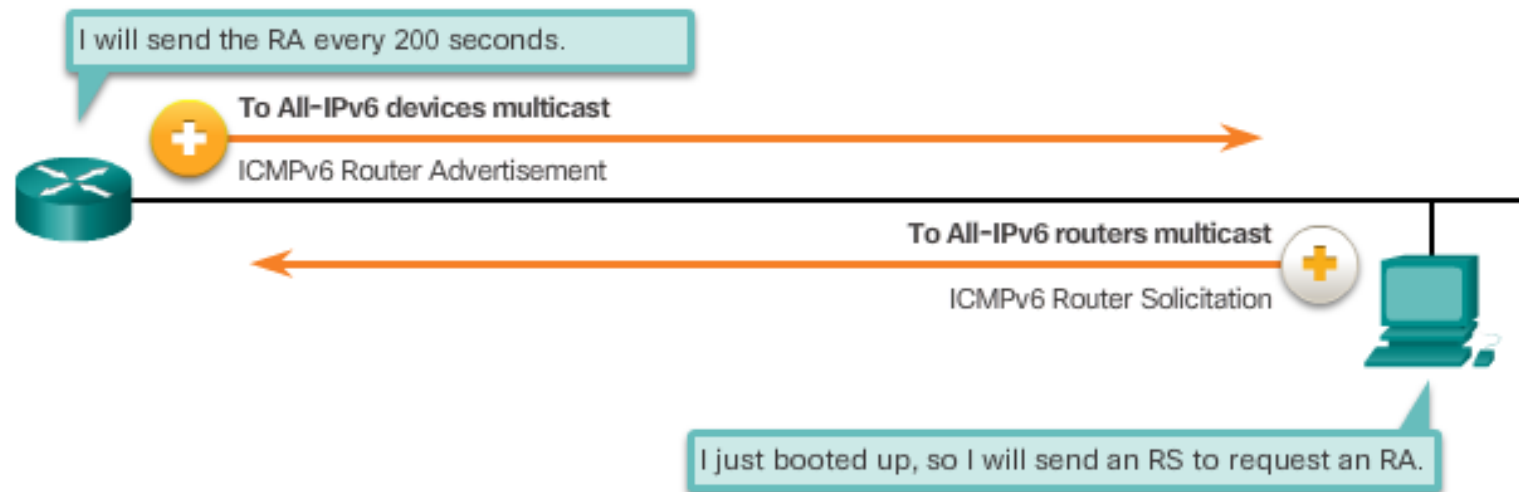


ICMPv4 and ICMPv6 (cont.)

- ICMP messages common to both ICMPv4 and ICMPv6 include:
 - Host confirmation
 - Destination or service unreachable
 - Time exceeded
 - Route redirection
- Although IP is not a reliable protocol, the TCP/IP suite provides for messages to be sent in the event of certain errors. They are sent using the services of ICMP.

ICMPv6 Router Solicitation and Router Advertisement Messages

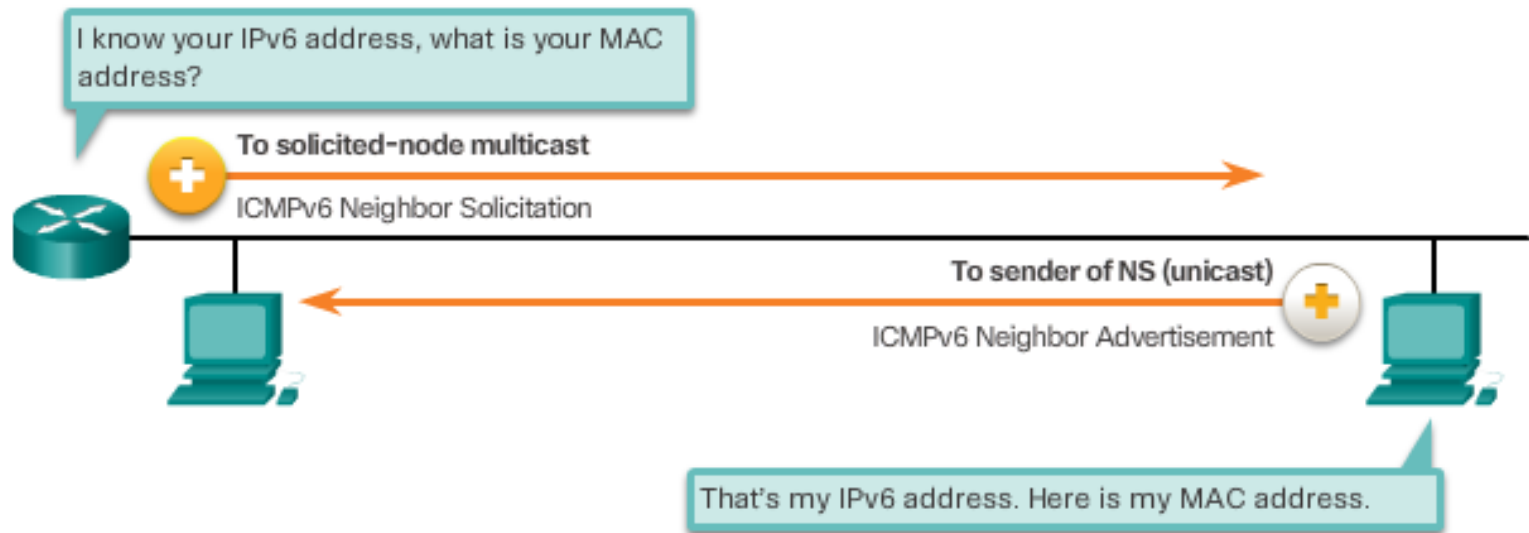
Messaging Between an IPv6 Router and an IPv6 Device



RA messages are sent by routers to provide addressing information to hosts using SLAAC. The RA message can include addressing information for the host such as the prefix, prefix length, DNS address and domain name. A router will send an RA message periodically or in response to an RS message. A host using SLAAC will set its default gateway to the link-local address of the router that sent the RA.

ICMPv6 Router Solicitation and Router Advertisement Messages (cont.)

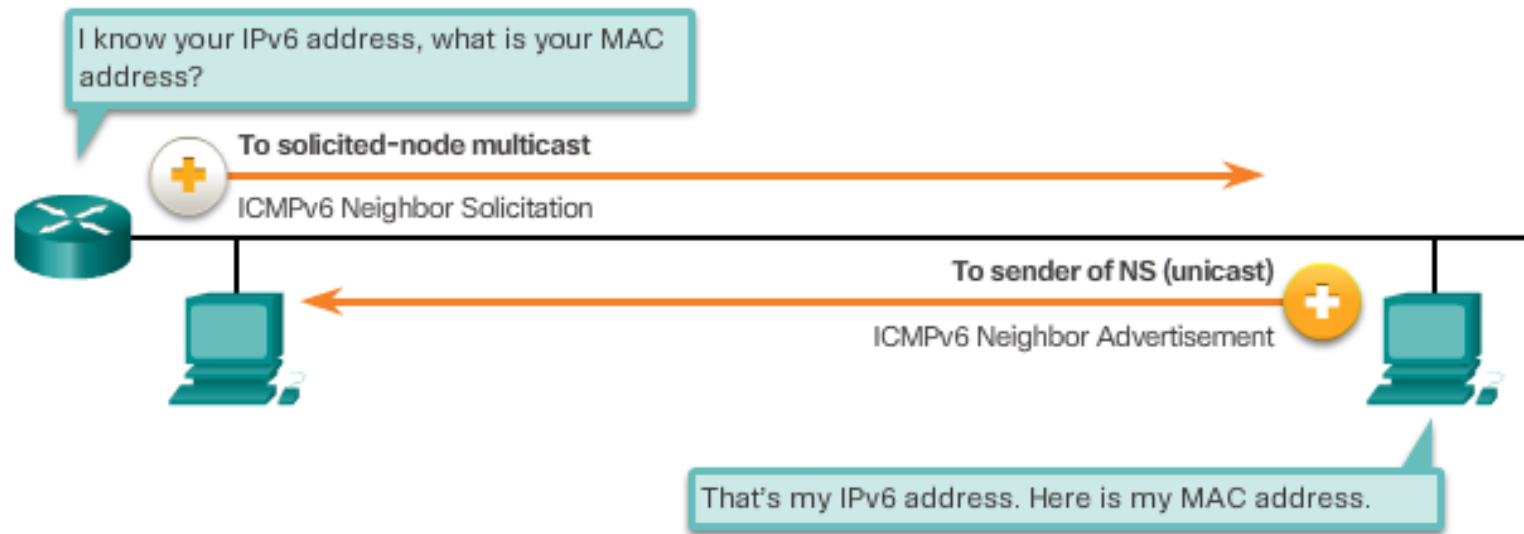
Messaging Between IPv6 Devices



NS messages are sent when a device knows the IPv6 address of a device but does not its MAC address. This is equivalent to an ARP Request for IPv4.

ICMPv6 Router Solicitation and Router Advertisement Messages (cont.)

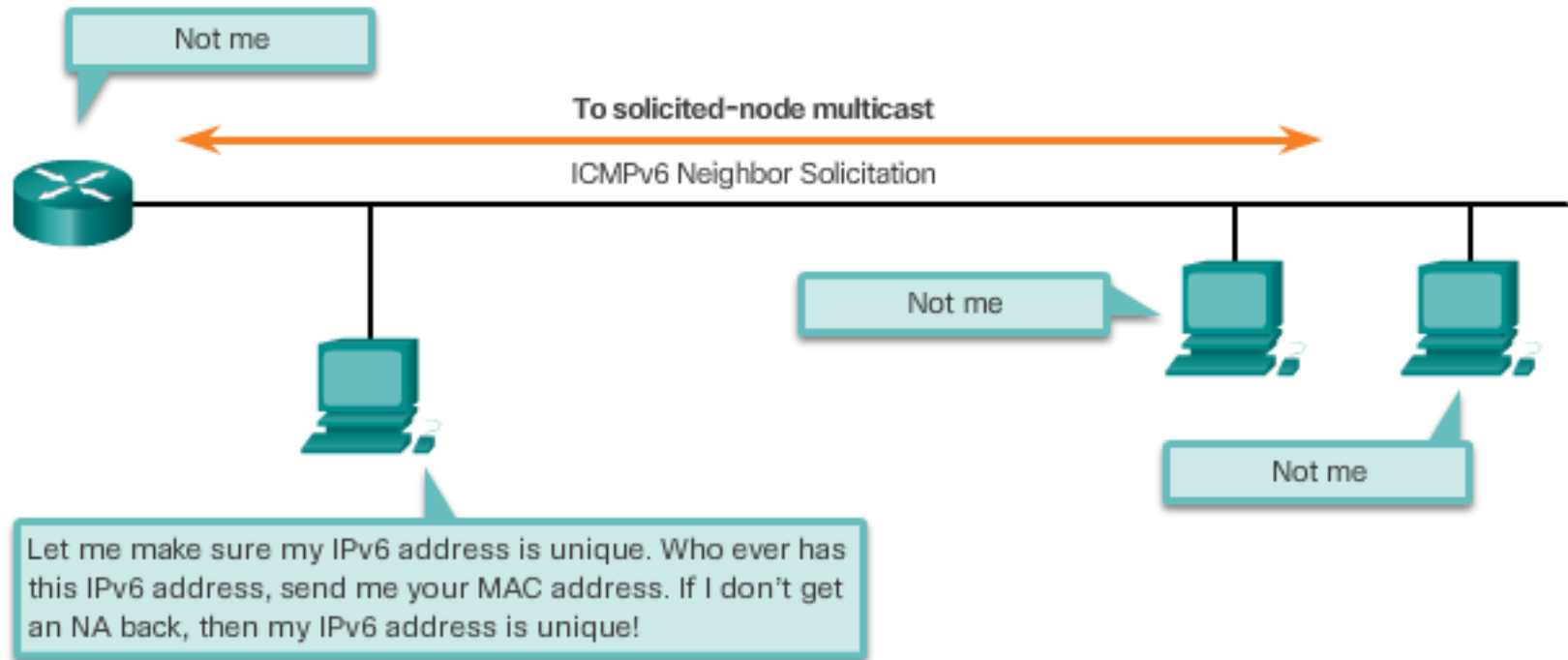
Messaging Between IPv6 Devices



NA messages are sent in response to an NS message and matches the target IPv6 address in the NS. The NA message includes the device's Ethernet MAC address. This is equivalent to an ARP Reply for IPv4.

ICMPv6 Router Solicitation and Router Advertisement Messages (cont.)

Duplicate Address Detection (DAD)

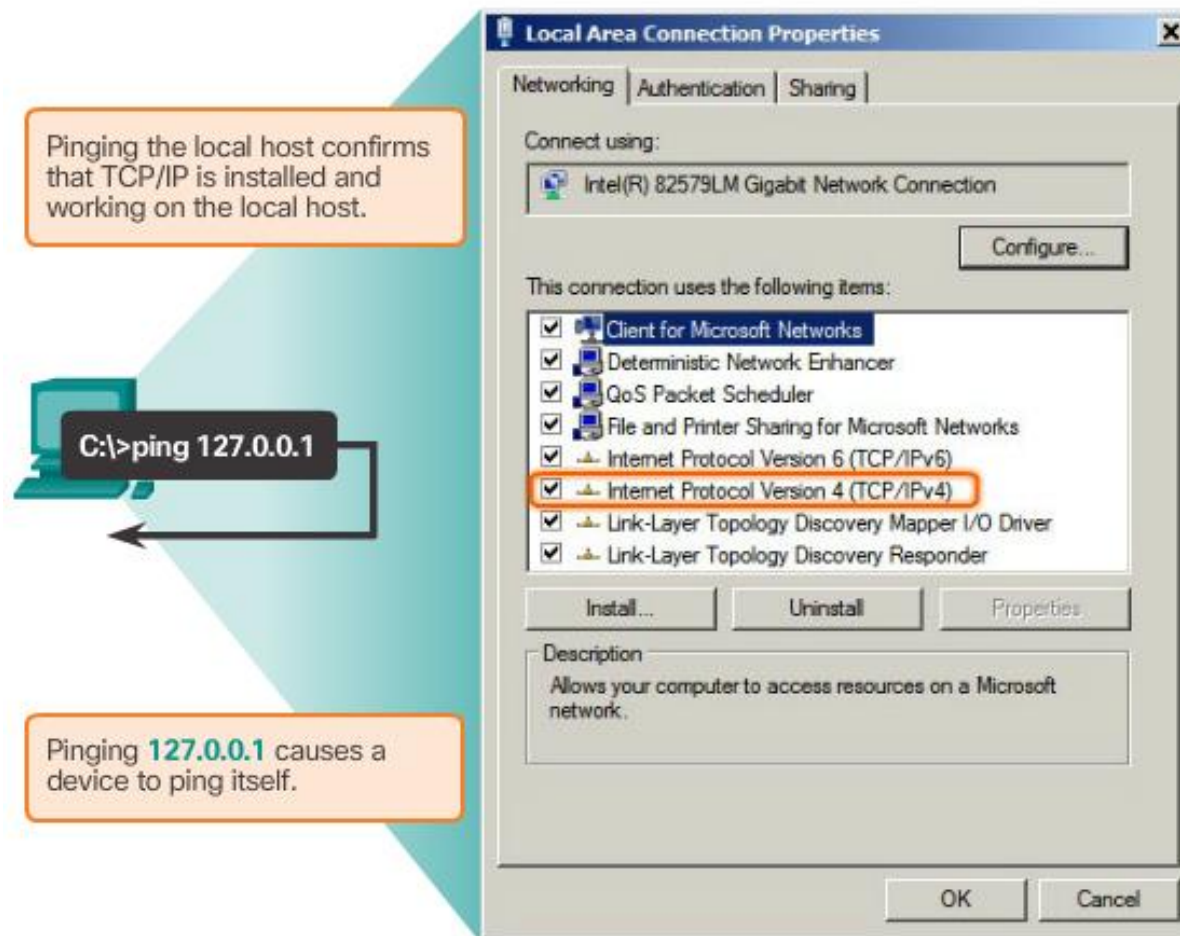


Topic 7.3.2: Testing and Verification

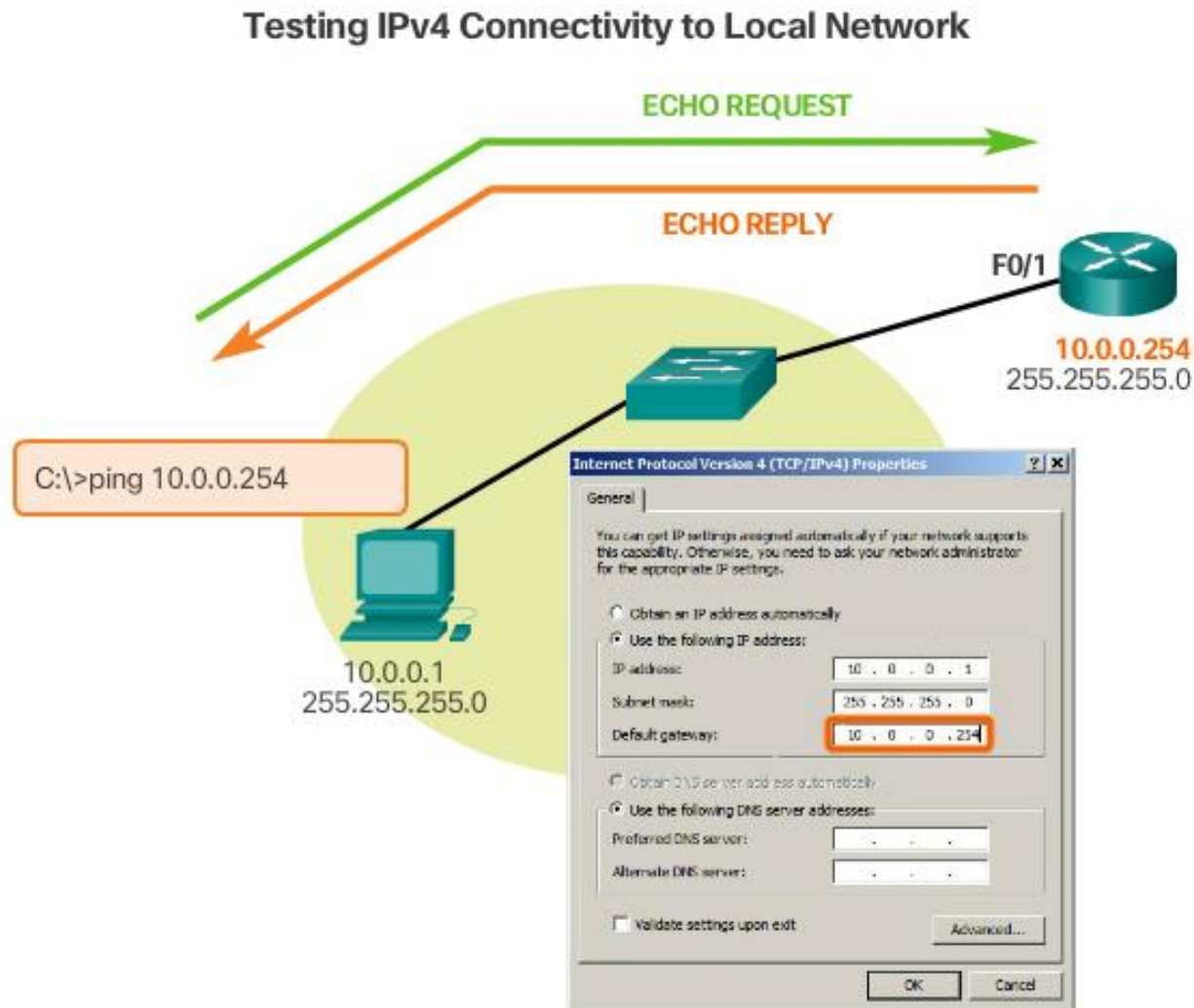


Ping - Testing the Local Stack

Testing Local TCP/IP Stack

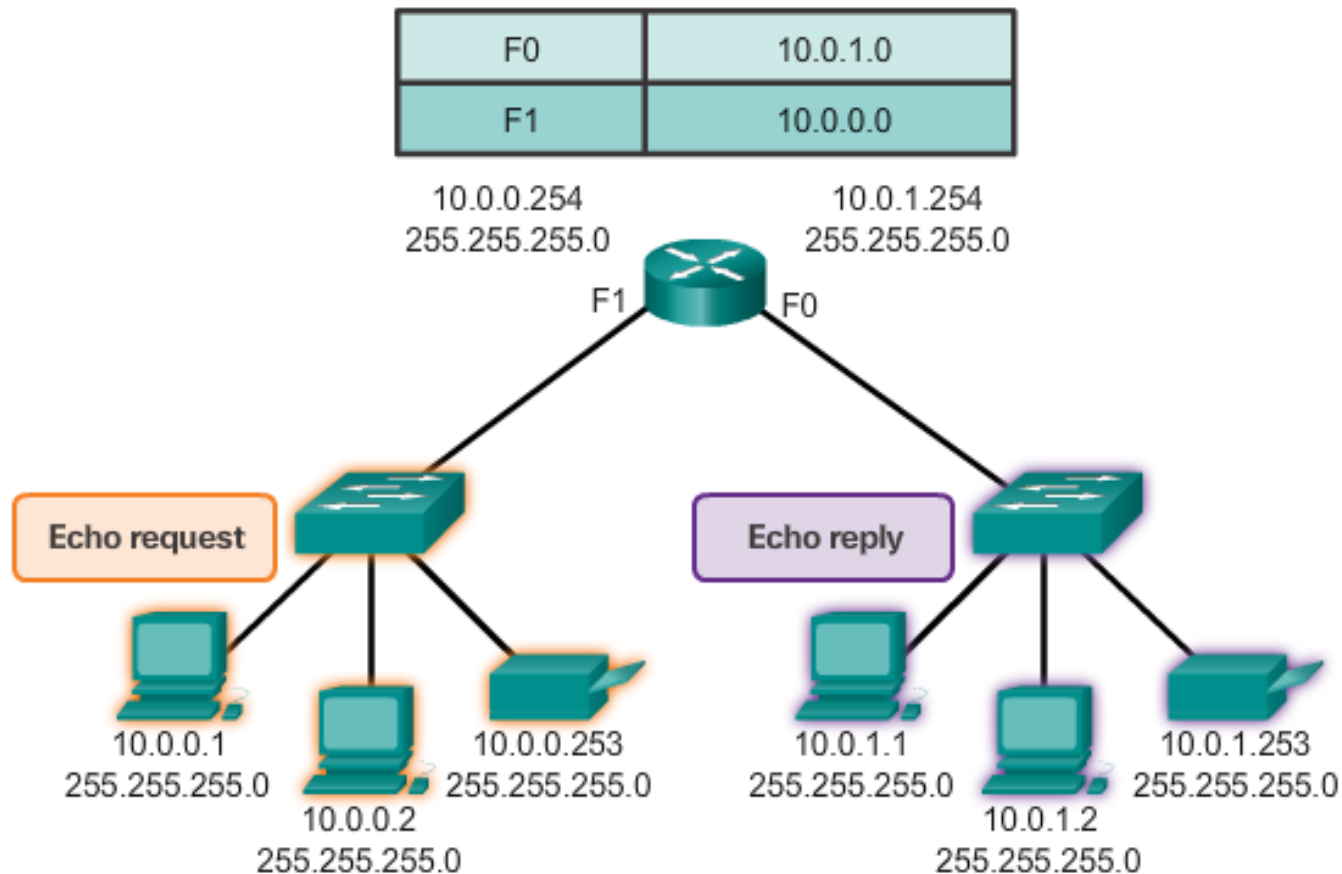


Ping – Testing Connectivity to the Local LAN



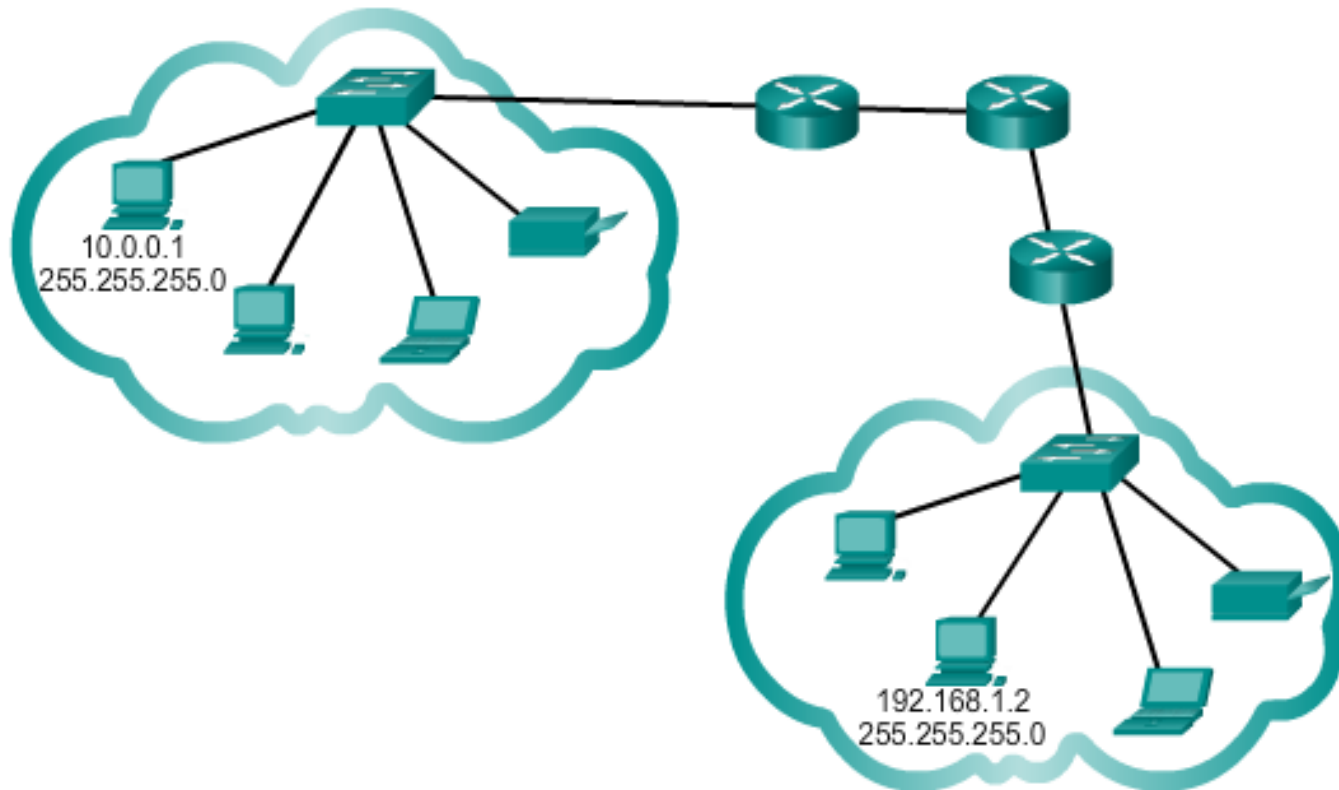
Ping – Testing Connectivity to Remote

Testing Connectivity to Remote LAN
Ping to a Remote Host



Traceroute – Testing the Path

Traceroute (tracert) - Testing the Path



Section 7.4: Summary

Chapter Objectives:

- Explain the use of IPv4 addresses to provide connectivity in a small to medium-sized business network.
- Configure IPv6 addresses to provide connectivity in small to medium-sized business networks.
- Use common testing utilities to verify network connectivity.

Thank you.



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