Review on:
IPv4 Addressing & Subnetting
IPv6 Addressing

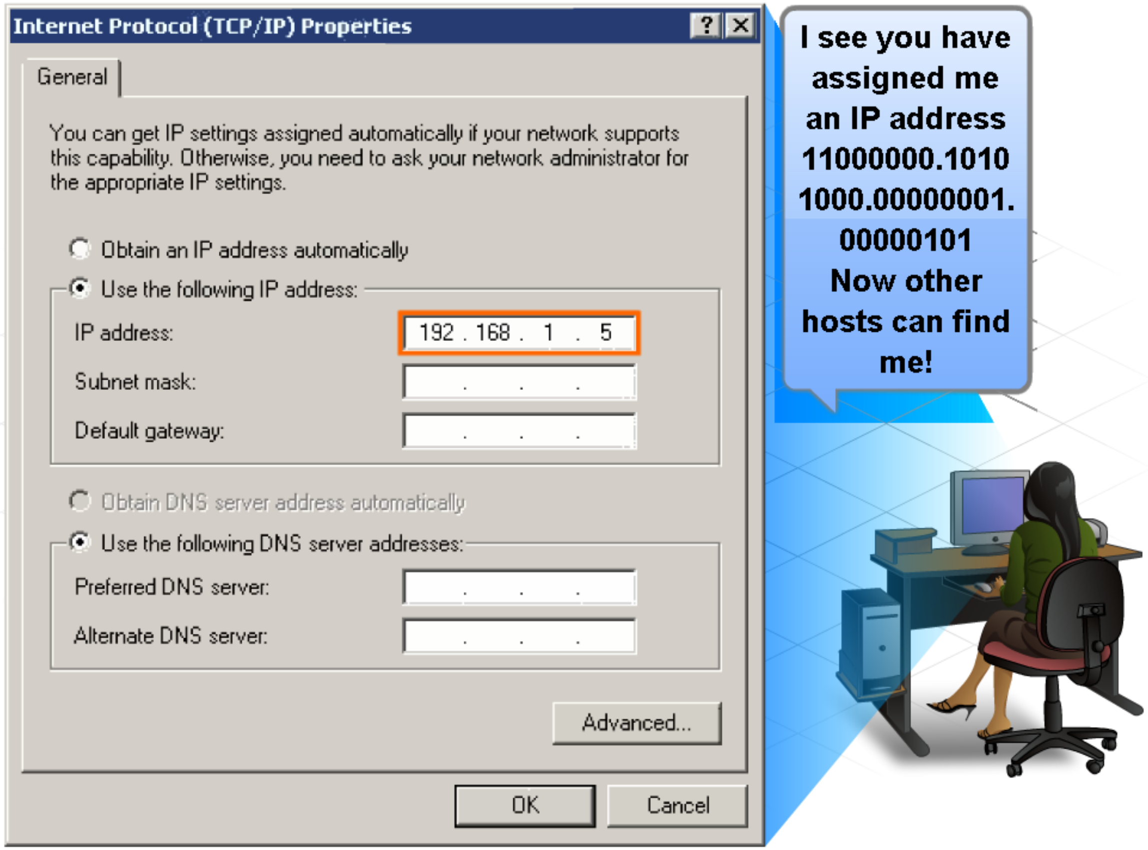
Dr. Md. Nadir Bin Ali

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



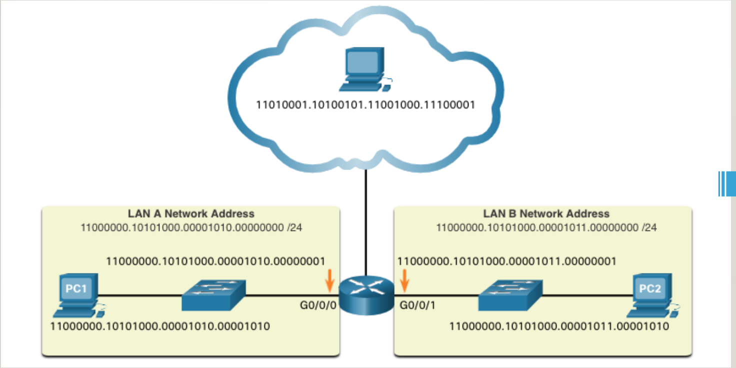
IP version 4 (IPv4) is the current form of addressing used on the Internet.

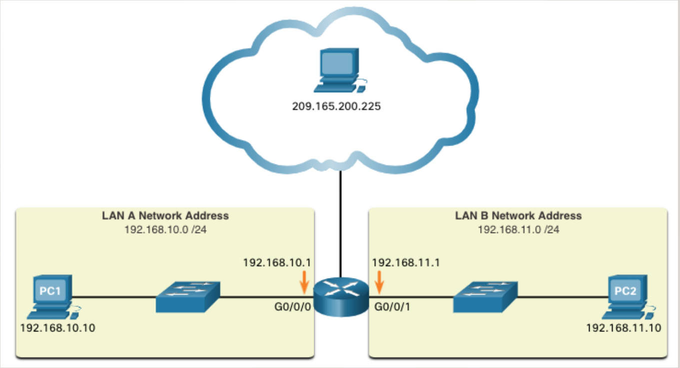
Numbering Systems

BINARY NUMBER SYSTEM

BINARY AND IPV4 ADDRESSES

- Binary numbering system consists of 1s and 0s, called bits
- Decimal numbering system consists of digits 0 through 9
- Hosts, servers, and network equipment using binary addressing to identify each other.
- Each address is made up of a string of 32 bits, divided into four sections called octets.
- Each octet contains 8 bits (or 1 byte) separated by a dot.
- For ease of use by people, this dotted notation is converted to dotted decimal.





BINARY NUMBER SYSTEM

BINARY POSITIONAL NOTATION (CONT.)

The binary positional notation system operates as shown in the tables below.

Radix	2	2	2	2	2	2	2	2
Position in Number	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)
Position Value	128	64	32	16	8	4	2	1

↓

Positional Value	128	64	32	16	8	4	2	1
Binary Number (11000000)	1	1	0	0	0	0	0	0
Calculate	1x128	1x64	0x32	0x16	0x8	0x4	0x2	0x1
Add Them Up…	128	+ 64	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0
Result	**192**							

BINARY NUMBER SYSTEM

CONVERT BINARY TO DECIMAL

Convert 11000000.10101000.00001011.00001010 to decimal.

Positional Value	128	64	32	16	8	4	2	1
Binary Number (11000000)	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
Calculate	1x128	1x64	0x32	0x16	0x8	0x4	0x2	0x1
Add Them Up…	128	+ 64	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0
Binary Number (10101000)	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**0**
Calculate	1x128	0x64	1x32	0x16	1x8	0x4	0x2	0x1
Add Them Up…	128	+ 0	+ 32	+ 0	+ 8	+ 0	+ 0	+ 0
Binary Number (00001011)	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**
Calculate	0x128	0x64	0x32	0x16	1x8	0x4	1x2	1x1
Add Them Up…	0	+ 0	+ 0	+ 0	+ 8	+ 0	+ 2	+ 1
Binary Number (00001010)	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**
Calculate	0x128	0x64	0x32	0x16	1x8	0x4	1x2	0x1
Add Them Up…	0	+ 0	+ 0	+ 0	+ 8	+ 0	+ 2	+ 0

→ 192

→ 168

→ 11

→ 10

192.168.11.10

HEXADECIMAL NUMBER SYSTEM

HEXADECIMAL NUMBER SYSTEM
HEXADECIMAL AND IPV6 ADDRESSES

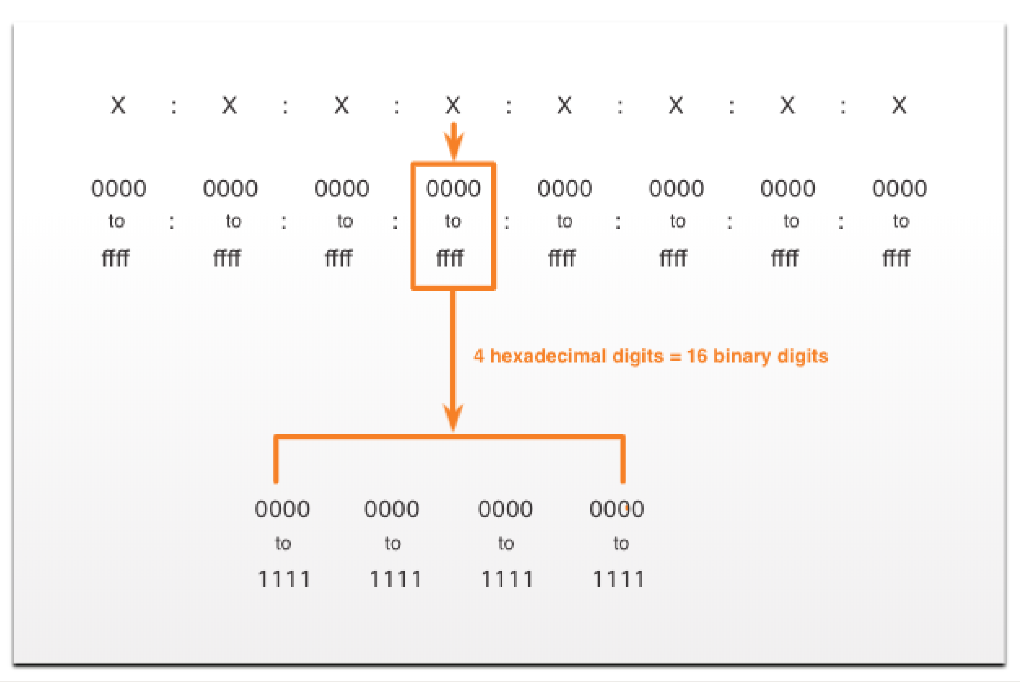
- To understand IPv6 addresses, you must be able to convert hexadecimal to decimal and vice versa.
- Hexadecimal is a base sixteen numbering system, using the digits 0 through 9 and letters A to F.
- It is easier to express a value as a single hexadecimal digit than as four binary bit.
- Hexadecimal is used to represent IPv6 addresses and MAC addresses.

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

HEXADECIMAL NUMBER SYSTEM

HEXADECIMAL AND IPV6 ADDRESSES (CONT.)

- IPv6 addresses are **128 bits** in length. Every 4 bits is represented by a single hexadecimal digit. That makes the IPv6 address a total of 32 hexadecimal values.
- The figure shows the preferred method of writing out an IPv6 address, with each X representing four hexadecimal values.
- Each four hexadecimal character group is referred to as a hextet.



HEXADECIMAL NUMBER SYSTEM

DECIMAL TO HEXADECIMAL CONVERSIONS

Follow the steps listed to convert decimal numbers to hexadecimal values:

- Convert the decimal number to 8-bit binary strings.
- Divide the binary strings in groups of four starting from the rightmost position.
- Convert each four binary numbers into their equivalent hexadecimal digit.

For example, 168 converted into hex using the three-step process.

- 168 in binary is 10101000.
- 1010 1000 in two groups of four binary digits is 1010 and 1000.
- 1010 is hex A and 1000 is hex 8, so 168 is A8 in hexadecimal.

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

- 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.

IPV4 PRIVATE ADDRESSES

The private address blocks are:

10.0.0.0 to 10.255.255.255 (10.0.0.0 /8)

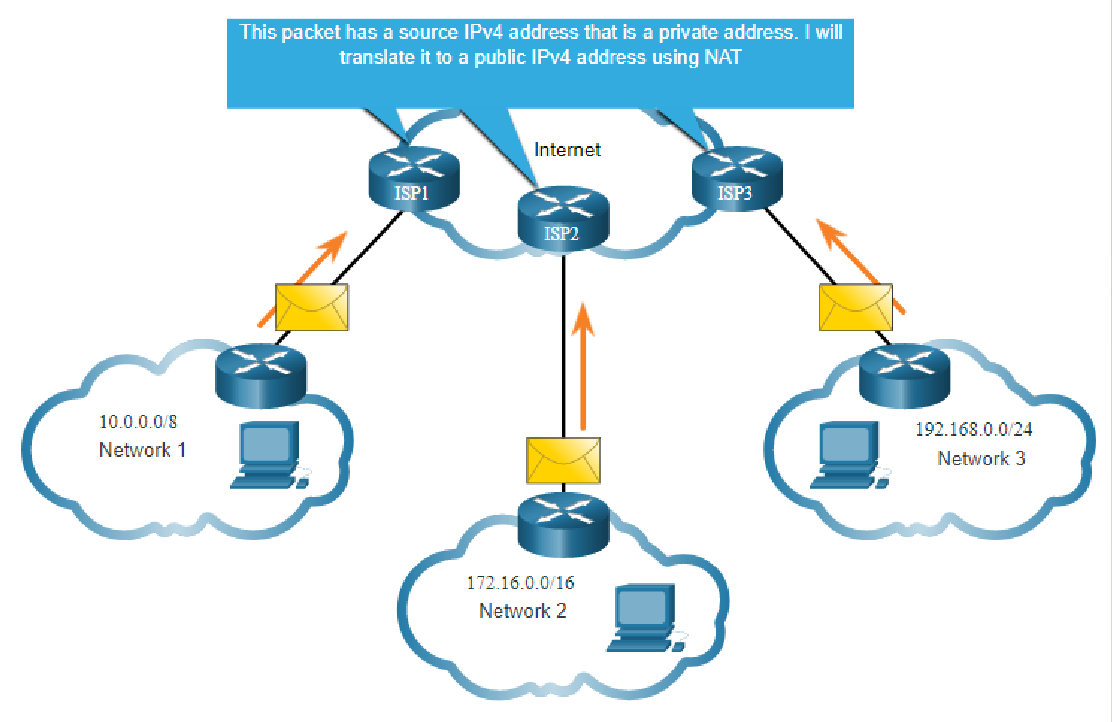
172.16.0.0 to 172.31.255.255 (172.16.0.0 /12)

192.168.0.0 to 192.168.255.255 (192.168.0.0 /16)

TYPES OF IPV4 ADDRESSES

ROUTING TO THE INTERNET

- Network Address Translation (NAT) translates private IPv4 addresses to public IPv4 addresses.
- NAT is typically enabled on the edge router connecting to the internet.
- It translates the internal private address to a public global IP address.



TYPES OF IPV4 ADDRESSES
SPECIAL USE IPV4 ADDRESSES

Loopback addresses

- 127.0.0.0 /8 (127.0.0.1 to 127.255.255.254)
- Commonly identified as only 127.0.0.1
- Used on a host to test if TCP/IP is operational.

```
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
```

Link-Local addresses

- 169.254.0.0 /16 (169.254.0.1 to 169.254.255.254)
- Commonly known as the Automatic Private IP Addressing (APIPA) addresses or self-assigned addresses.
- Used by Windows DHCP clients to self-configure when no DHCP servers are available.

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

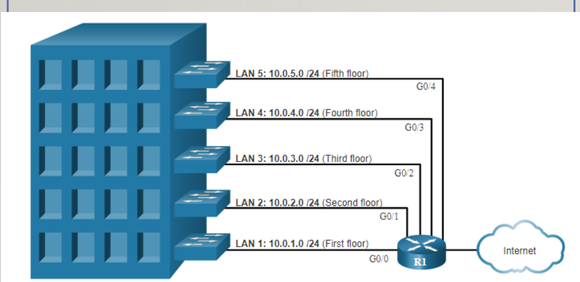
SUBNETTING

Subnetting allows for creating multiple logical networks from a single address block. Since we use a router to connect these networks together, each interface on a router must have a unique network ID.

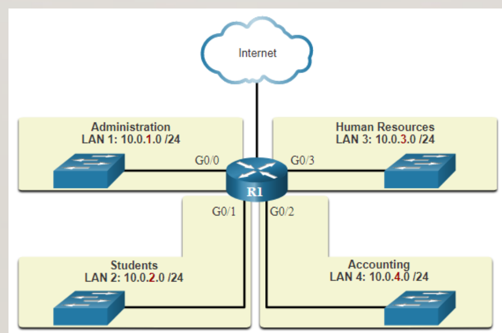
NETWORK SEGMENTATION
REASONS FOR SEGMENTING NETWORKS

- Subnetting reduces overall network traffic and improves network performance.
- It can be used to implement security policies between subnets.
- Subnetting reduces the number of devices affected by abnormal broadcast traffic.
- Subnets are used for a variety of reasons including by:

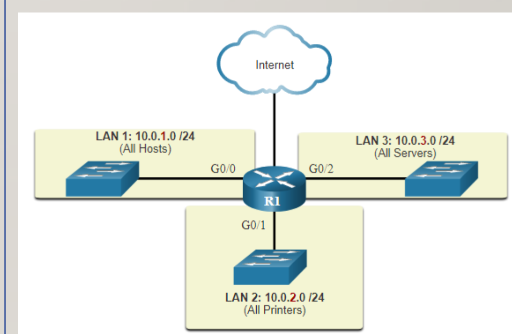
Location



Group or Function



Device Type



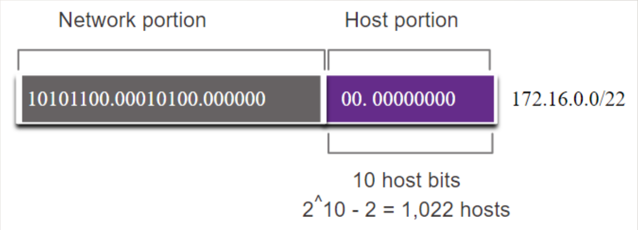
SUBNET TO MEET REQUIREMENTS

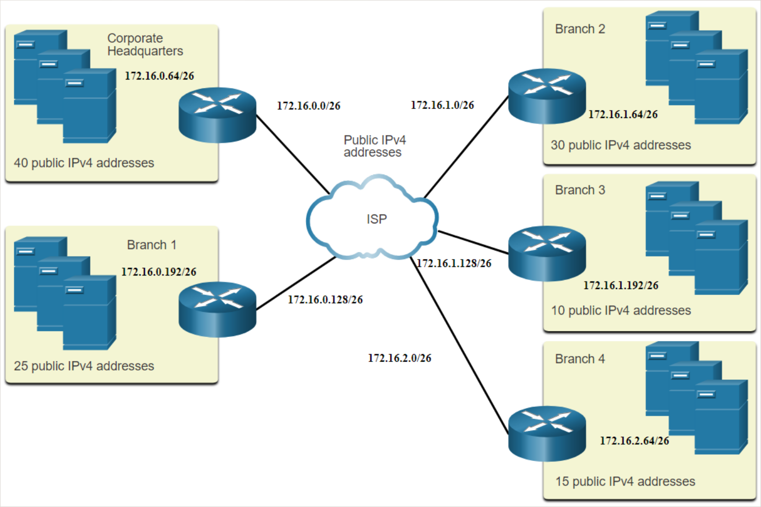
EXAMPLE: EFFICIENT IPV4 SUBNETTING

- In this example, corporate headquarters has been allocated a public network address of 172.16.0.0/22 (10 host bits) by its ISP providing 1,022 host addresses.

- There are five sites and therefore five internet connections which means the organization requires 10 subnets with the largest subnet requires 40 addresses.

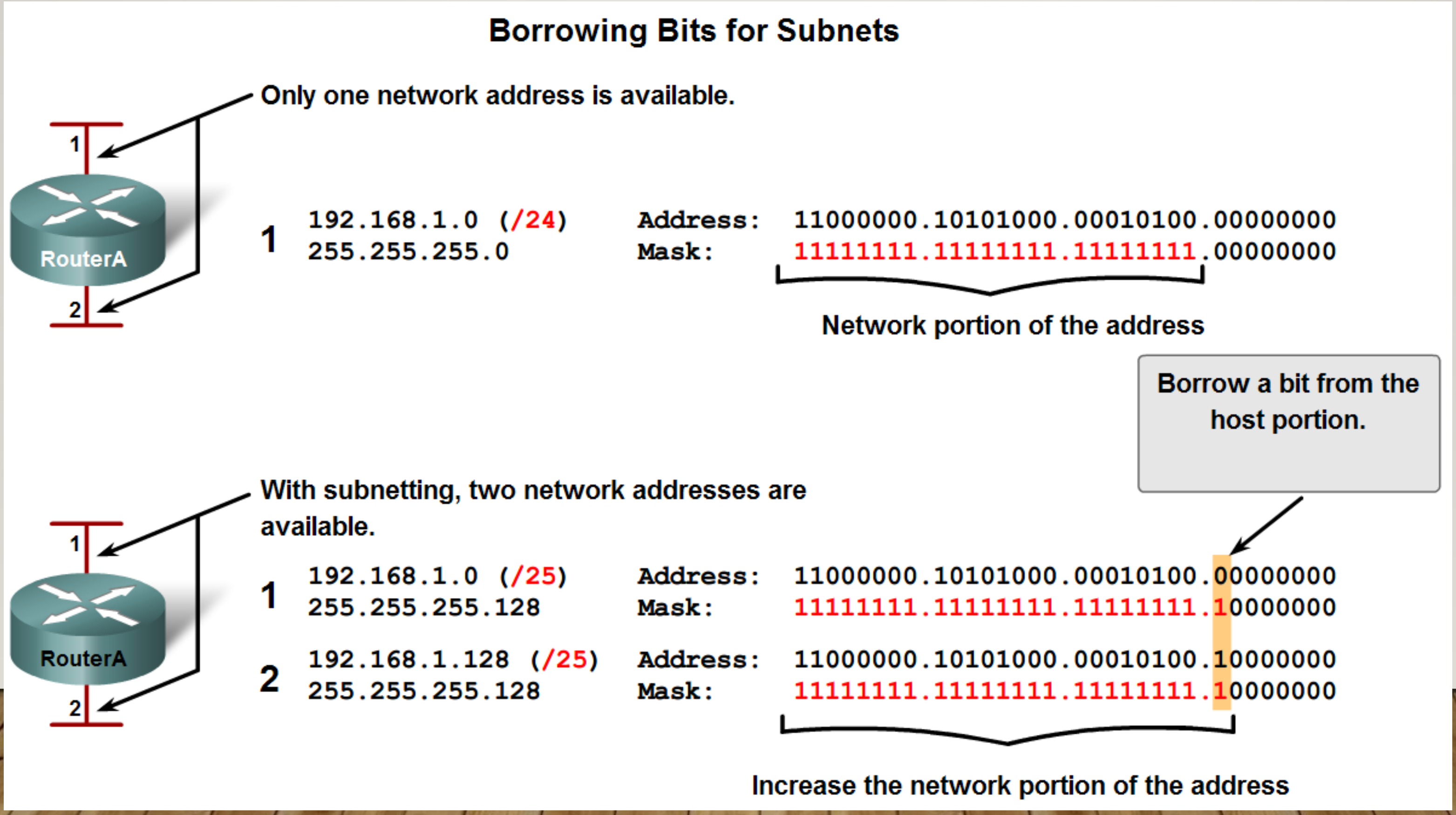
- It allocated 10 subnets with a /26 (i.e., 255.255.255.192) subnet mask.





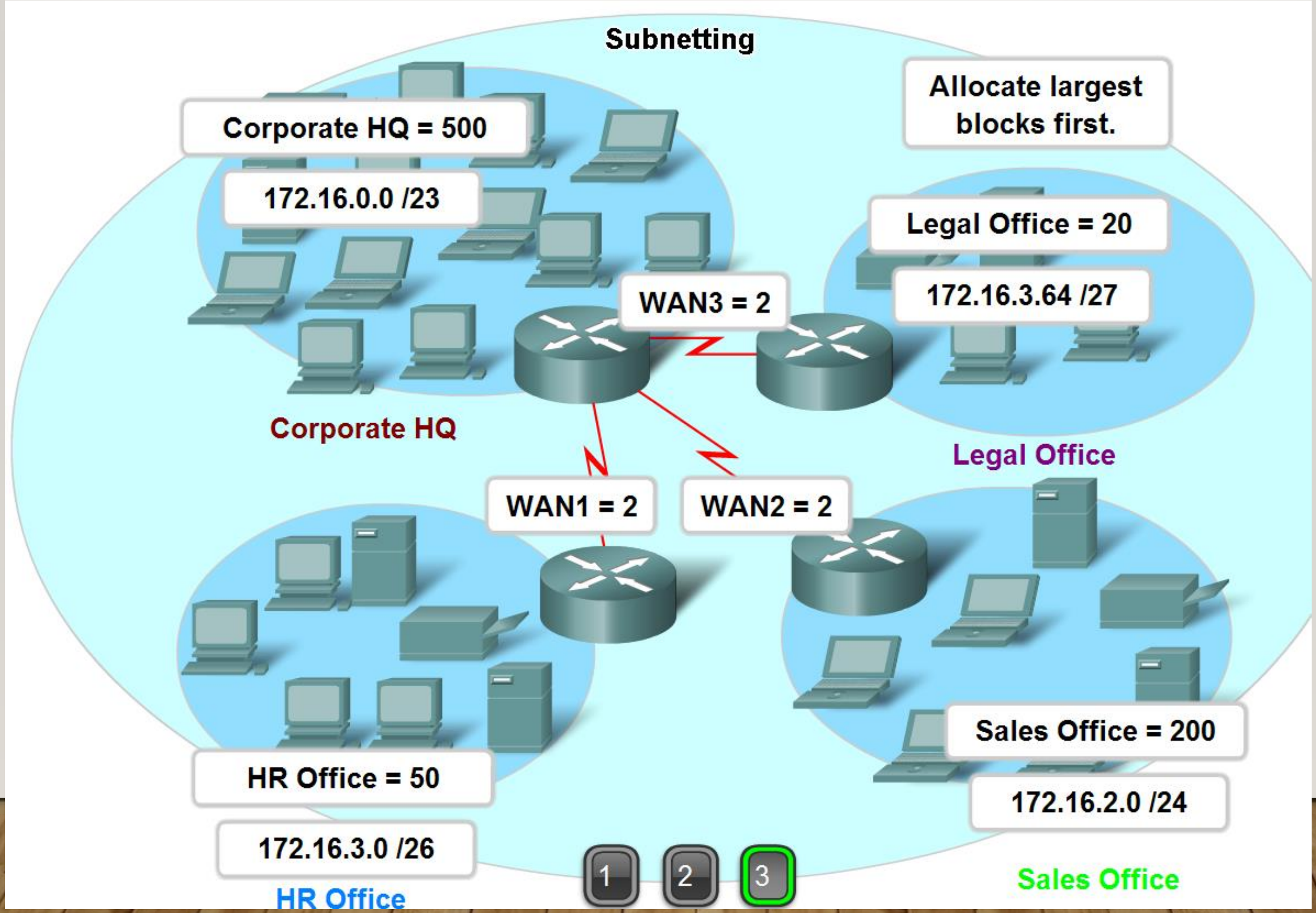
CALCULATING ADDRESSES

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



CALCULATING ADDRESSES

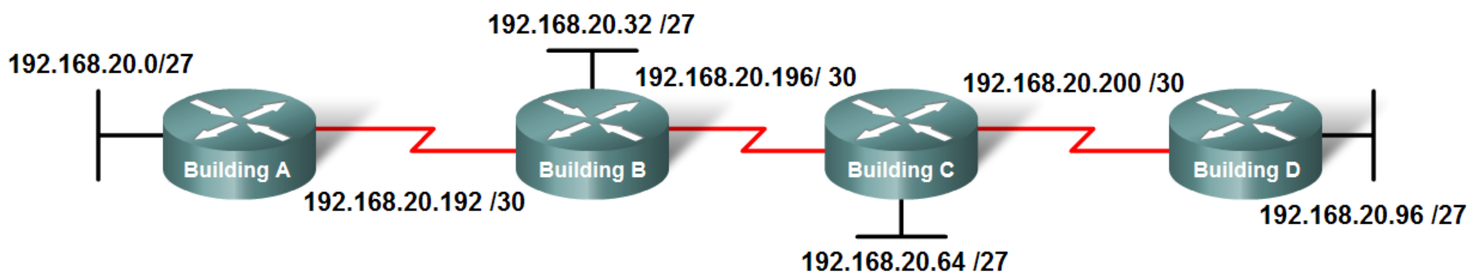
- Extract network addresses from host addresses using the subnet mask



CALCULATING ADDRESSES

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

Subnetting a Subnetwork Block



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

IPV6 ADDRESSING (REVIEW)

IPV4 ISSUES
NEED FOR IPV6

- IPv4 is running **out of addresses**. IPv6 is the successor to IPv4. IPv6 has a much larger 128-bit address space.
- The development of IPv6 also included fixes for IPv4 limitations and other enhancements.
- With an increasing Internet population, a limited IPv4 address space, issues with NAT and the IoT, the time has come to begin the transition to IPv6.

IPV4 ISSUES

IPV4 AND IPV6 COEXISTENCE

Both IPv4 and IPv6 will coexist in the near future and the transition will take several years.

The IETF has created various protocols and tools to help network administrators migrate their networks to IPv6. These migration techniques can be divided into three categories:

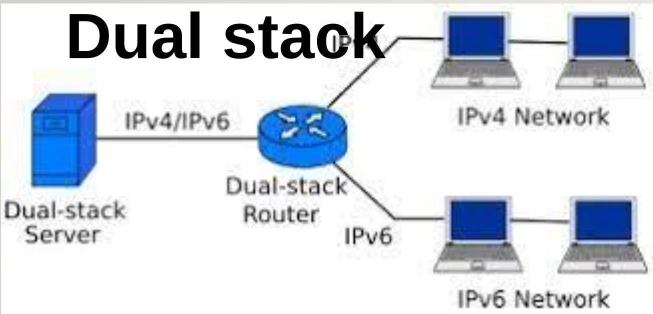
- **Dual stack -** The devices run both IPv4 and IPv6 protocol stacks simultaneously.
- **Tunneling** – A method of **transporting an IPv6 packet over an IPv4 network**. The IPv6 packet is encapsulated inside an IPv4 packet.
- **Translation -** Network Address Translation **64 (NAT64) allows IPv6-enabled devices** to communicate with **IPv4-enabled devices** using a translation technique similar to NAT for IPv4.

Note: Tunneling and translation are for transitioning to native IPv6 and should only be used where needed. The goal should be native IPv6 communications from source to destination.

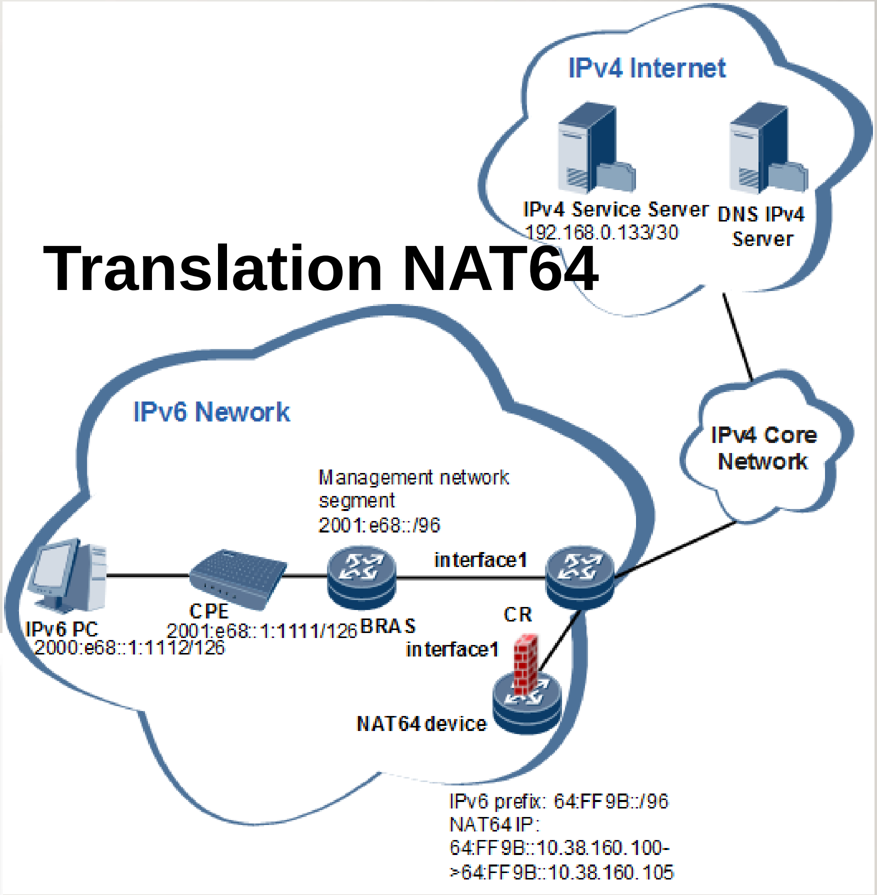
IPV4 ISSUES

IPV4 AND IPV6 COEXISTENCE EXAMPLE

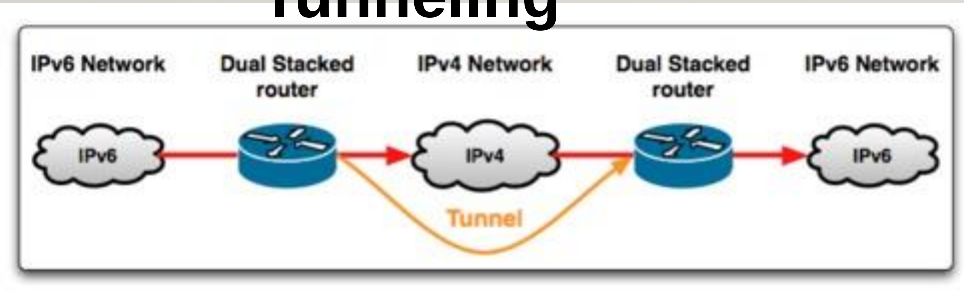
Dual stack



Translation NAT64



Tunneling



IPV6 ADDRESS REPRESENTATION

IPV6 ADDRESSING

- **128 bits (or 16 bytes) long:** four times as long as its predecessor.
- $\mathbf{2^{128}}$: about 340 billion billion billion billion different addresses
- **Colon hexadecimal notation**:
  - addresses are written using **32 hexadecimal digits**.
  - digits are arranged into **8 groups** of four to improve the readability.
  - Groups are **separated by colons**

2001:0718:1c01:0016:020d:56ff:fe77:52a3

- Note:
  - DNS plays an important role in the IPv6 world
    - (manual typing of IPv6 addresses is not an easy thing,
    - Some **zero suppression rules** are allowed to lighten this task at least a little.

IPV6 ADDRESS REPRESENTATION

IPV6 ADDRESSING FORMATS

- IPv6 addresses are **128 bits in length** and written in hexadecimal.
- IPv6 addresses are **not case-sensitive** and can be written in either lowercase or uppercase.
- The preferred format for writing an IPv6 address is x:x:x:x:x:x:x:x, with each "x" consisting of four hexadecimal values.
- In IPv6, a hextet is the unofficial term used to refer to a **segment of 16 bits**, or **four hexadecimal** values (per group, have 8 Group).
- Examples of IPv6 addresses in the preferred format:

```
2001:0db8:0000:1111:0000:0000:0000:0200

(8 part every part have 16 bits)

2001:0db8:0000:00a3:abcd:0000:0000:1234
```

IPV6 ADDRESS REPRESENTATION
RULE 1 – OMIT LEADING ZERO

The first rule to help reduce the notation of IPv6 addresses is to omit any leading 0s (zeros).

Examples:

- 01ab can be represented as 1ab
- 09f0 can be represented as 9f0
- 0a00 can be represented as a00
- 00ab can be represented as ab

Note: This rule only applies to leading 0s, NOT to trailing 0s, otherwise the address would be ambiguous.

Type	Format
Preferred	2001 : **0**db8 : **000**0 : 1111 : **000**0 : **000**0 : **000**0 : **0**200
No leading zeros	2001 : db8 : 0 : 1111 : 0 : 0 : 0 : 200

IPV6 ADDRESS REPRESENTATION
RULE 2 – DOUBLE COLON

A double colon (::) can replace any single, contiguous string of one or more 16-bit hextets consisting of all zeros.

Example:

- 2001:db8:cafe:1:0:0:0:1 (leading 0s omitted) could be represented as 2001:db8:cafe:1::1

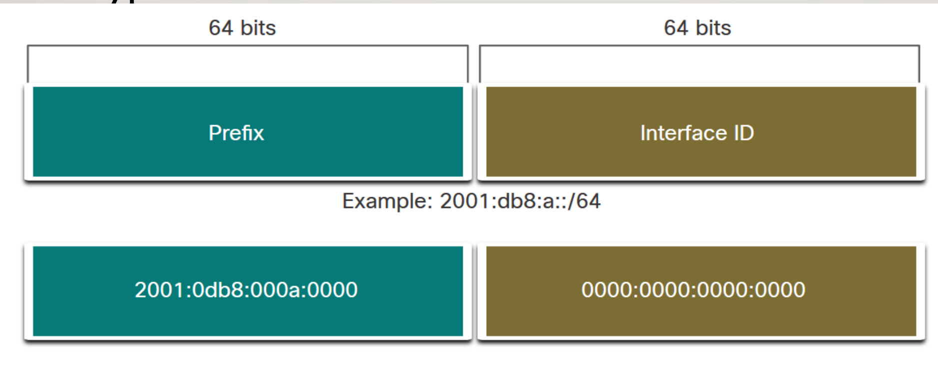
Note: The double colon (::) can only be used once within an address, otherwise there would be more than one possible resulting address.

Type	Format
Preferred	2001 : **0**db8 : **000**0 : 1111 : **0000** : **0000** : **0000** : **0**200
Compressed	2001:db8:0:1111::200

IPV6 PREFIX LENGTH

Prefix length is represented in slash notation and is used to **indicate the network portion** of an IPv6 address.

The ***IPv6 prefix length can range from 0 to 128***. The recommended IPv6 prefix length for LANs and most other types of networks is /64.



Note: It is strongly recommended to use a 64-bit Interface ID for most networks. This is because stateless address autoconfiguration (SLAAC) uses 64 bits for the Interface ID. It also makes subnetting easier to create and manage.

IPV6 ADDRESS TYPES

IPV6 ADDRESS TYPES
UNICAST, MULTICAST, ANYCAST

There are three broad categories of IPv6 addresses:

•**Unicast** – Unicast uniquely identifies an interface on an IPv6-enabled device.

•**Multicast** – Multicast is used to send a single IPv6 packet to multiple destinations.

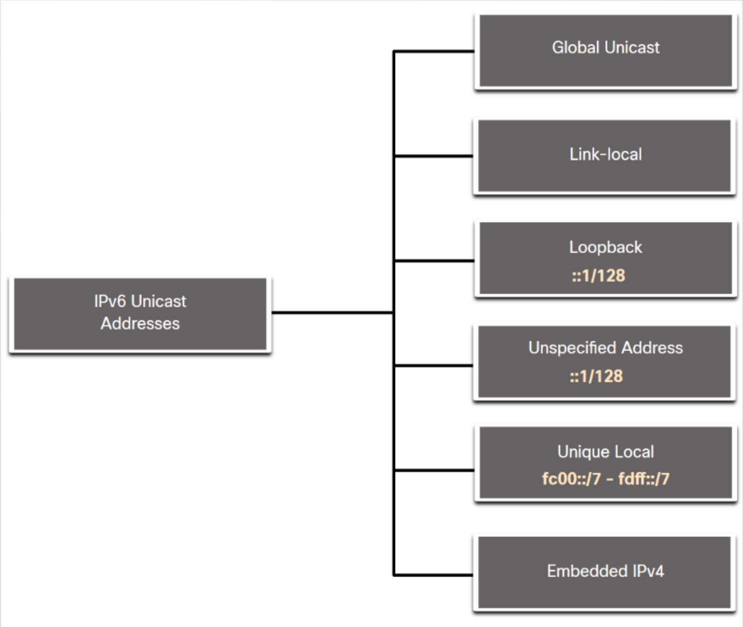
•**Anycast** – This is any IPv6 unicast address that can be assigned to multiple devices. A packet sent to an anycast address is routed to the nearest device having that address.

Note: Unlike IPv4, IPv6 does not have a broadcast address. However, there is an IPv6 all-nodes multicast address that essentially gives the same result.

TYPES OF IPV6 **UNICAST** ADDRESSES

Unlike IPv4 devices that have only a single address, IPv6 addresses typically have two unicast addresses:

- **Global Unicast Address (GUA)** – This is similar to a public IPv4 address. These are globally unique, internet-routable addresses.
- **Link-local Address (LLA)** - Required for every IPv6-enabled device and used to communicate with other devices on the same local link. LLAs are not routable and are confined to a single link.



IPV6 ADDRESS TYPES
A NOTE ABOUT THE UNIQUE LOCAL ADDRESS

The IPv6 unique local addresses (**range fc00::/7 to fdff::/7**) have some similarity to RFC 1918 **private addresses for IPv4**, but there are significant differences:

•Unique local addresses are used for local addressing within a site or between a limited number of sites.

•Unique local addresses can be used for devices that will never need to access another network.

•Unique local addresses are not globally routed or translated to a global IPv6 address.

Note: Many sites use the private nature of RFC 1918 addresses to attempt to secure or hide their network from potential security risks. This was never the intended use of ULAs.

GLOBAL UNICAST

Public IP Like IPv4

2000::1/64

1st 3 bit constant

0010= 2000

0011=3000

Example : 2001::1/64

UNIQUE LOCAL

Private IP Like IPv4

FC::1/64

1st 7 bit constant

1111 1100= FC

1111 1101=FD

Example :FC::1/64

LINK LOCAL

FE80::1/64

1st 10 bit constant

1111 1110 1000= FE80

1111 1110 1011 =FE8B

Example :FE80::1/64

GUA AND LLA STATIC CONFIGURATION

GUA AND LLA STATIC CONFIGURATION
STATIC GUA CONFIGURATION ON A ROUTER

Most IPv6 configuration and verification commands in the Cisco IOS are similar to their IPv4 counterparts. In many cases, the only difference is the use of **ipv6** in place of **ip** within the commands.

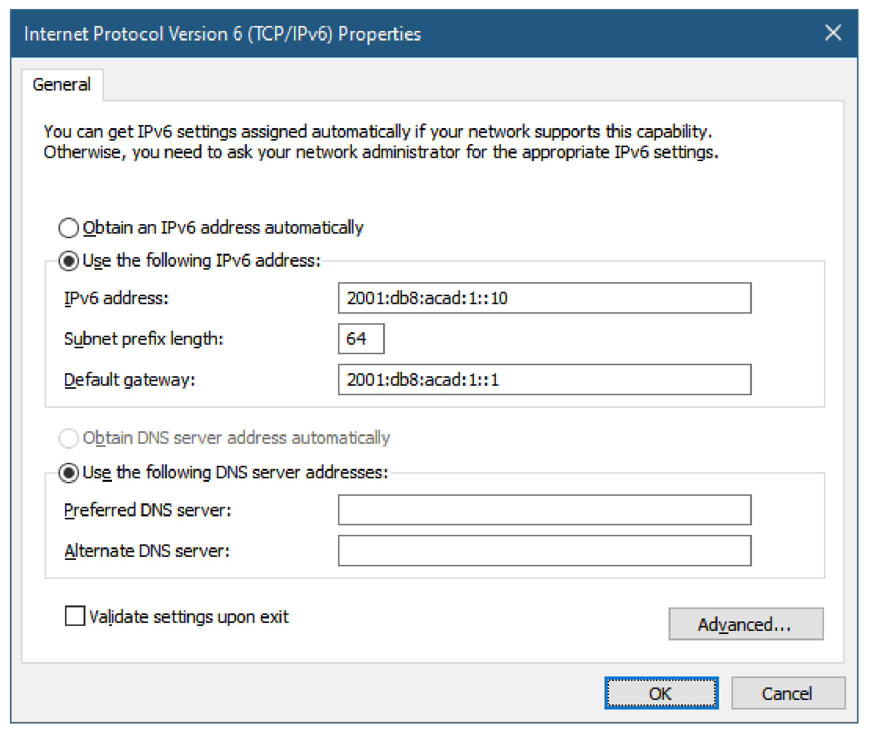
- The command to configure an IPv6 GUA on an interface is: **ipv6 address** *ipv6-address/prefix-length.*
- The example shows commands to configure a GUA on the G0/0/0 interface on R1:

```
R1(config)# interface gigabitethernet 0/0/0
R1(config-if)# ipv6 address 2001:db8:acad:1::1/64
R1(config-if)# no shutdown
R1(config-if)# exit
```

STATIC GUA CONFIGURATION ON A WINDOWS HOST

- Manually configuring the IPv6 address on a host is similar to configuring an IPv4 address.
- The GUA or LLA of the router interface can be used as the default gateway. Best practice is to use the LLA.

Note: When DHCPv6 or SLAAC is used, the LLA of the router will automatically be specified as the default gateway address.



GUA AND LLA STATIC CONFIGURATION

STATIC GUA CONFIGURATION OF A LINK-LOCAL UNICAST ADDRESS

Configuring the LLA manually lets you create an address that is recognizable and easier to remember.

- LLAs can be configured manually using the **ipv6 address** *ipv6-link-local-address* **link-local** command.
- The example shows commands to configure a LLA on the G0/0/0 interface on R1

```
R1(config)# interface gigabitethernet 0/0/0
R1(config-if)# ipv6 address fe80::1:1 link-local
R1(config-if)# no shutdown
R1(config-if)# exit
```

Note: The same LLA can be configured on each link as long as it is unique on that link. Common practice is to create a different LLA on each interface of the router to make it easy to identify the router and the specific interface.

DYNAMIC ADDRESSING FOR IPV6 GUAS

DYNAMIC ADDRESSING FOR IPV6 GUAS

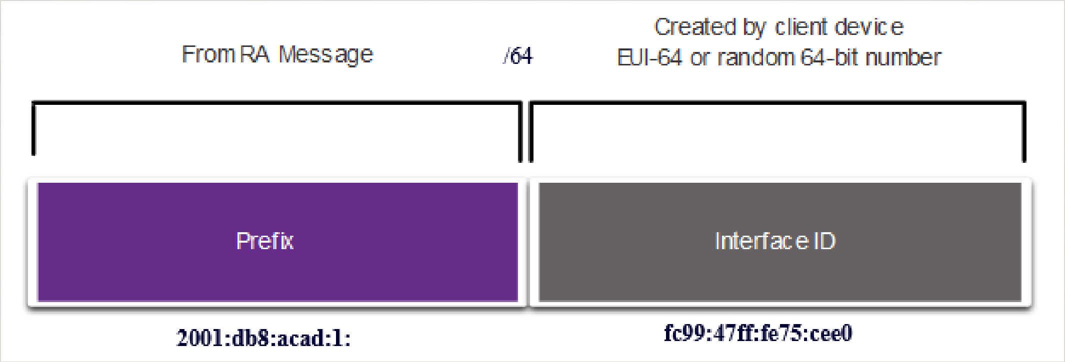
RS AND RA MESSAGES

Devices obtain GUA addresses dynamically through Internet Control Message Protocol version 6 (ICMPv6) messages.

- Router Solicitation (RS) messages are sent by host devices to discover IPv6 routers
- Router Advertisement (RA) messages are sent by routers to inform hosts on how to obtain an IPv6 GUA and provide useful network information such as:
  - Network prefix and prefix length
  - Default gateway address
  - DNS addresses and domain name
- The RA can provide three methods for configuring an IPv6 GUA :
  - SLAAC
  - SLAAC with stateless DHCPv6 server
  - Stateful DHCPv6 (no SLAAC)

DYNAMIC ADDRESSING FOR IPV6 GUAS
METHOD 1: SLAAC

- SLAAC allows a device to configure a GUA without the services of DHCPv6.
- Devices obtain the necessary information to configure a GUA from the ICMPv6 RA messages of the local router.
- The prefix is provided by the RA and the device uses either the EUI-64 or random generation method to create an interface ID.

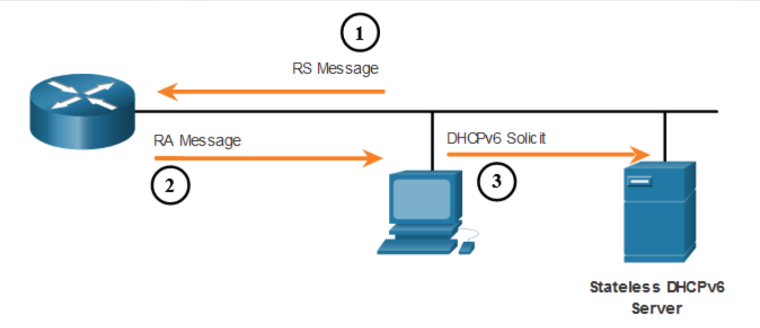


METHOD 2: SLAAC AND STATELESS DHCP

An RA can instruct a device to use both SLAAC and stateless DHCPv6.

The RA message suggests devices use the following:

- SLAAC to create its own IPv6 GUA
- The router LLA, which is the RA source IPv6 address, as the default gateway address
- A stateless DHCPv6 server to obtain other information such as a DNS server address and a domain name



DYNAMIC ADDRESSING FOR IPV6 GUAS

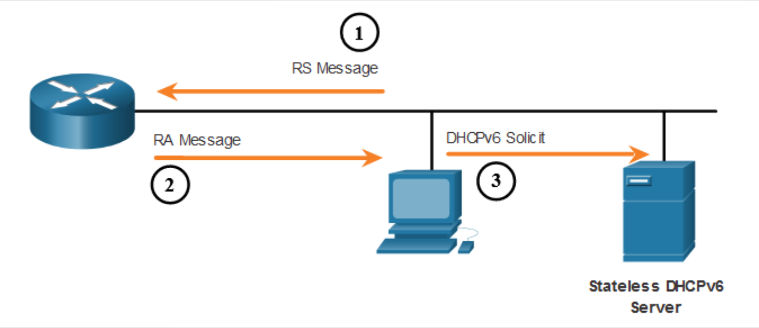
METHOD 3: STATEFUL DHCPV6

An RA can instruct a device to use stateful DHCPv6 only.

Stateful DHCPv6 is similar to DHCP for IPv4. A device can automatically receive a GUA, prefix length, and the addresses of DNS servers from a stateful DHCPv6 server.

The RA message suggests devices use the following:

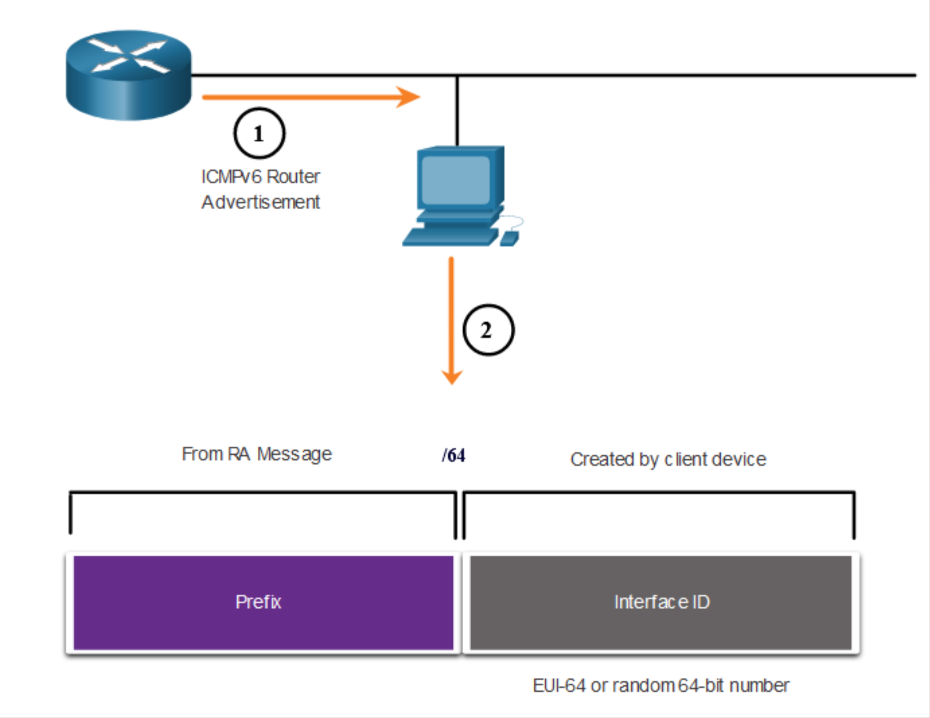
- The router LLA, which is the RA source IPv6 address, for the default gateway address.
- A stateful DHCPv6 server to obtain a GUA, DNS server address, domain name and other necessary information.



DYNAMIC ADDRESSING FOR IPV6 GUAS

EUI-64 PROCESS VS. RANDOMLY GENERATED

- When the RA message is either SLAAC or SLAAC with stateless DHCPv6, the client must generate its own interface ID.
- The interface ID can be created using the EUI-64 process or a randomly generated 64-bit number.



DYNAMIC ADDRESSING FOR IPV6 GUAS

EUI-64 PROCESS

The IEEE defined the Extended Unique Identifier (EUI) or modified EUI-64 process which performs the following:

- A 16 bit value of **fffe** (in hexadecimal) is inserted into the middle of the 48-bit Ethernet MAC address of the client.
- The **7th bit** of the client MAC address is reversed from binary **0 to 1**.
- Example:

48-bit MAC	fc:99:47:75:ce:e0
EUI-64 Interface ID	fe:99:47:ff:fe:75:ce:e0

DYNAMIC ADDRESSING FOR IPV6 GUAS
RANDOMLY GENERATED INTERFACE IDS

Depending upon the operating system, a device may use a randomly generated interface ID instead of using the MAC address and the EUI-64 process.

Beginning with Windows Vista, Windows uses a randomly generated interface ID instead of one created with EUI-64.

```
C:\> 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
C:\>
```

Note: To ensure the uniqueness of any IPv6 unicast address, the client may use a process known as Duplicate Address Detection (DAD). This is similar to an ARP request for its own address. If there is no reply, then the address is unique.

IPV6 MULTICAST ADDRESSES

IPV6 MULTICAST ADDRESSES

ASSIGNED IPV6 MULTICAST ADDRESSES

IPv6 multicast addresses have the prefix ff00::/8. There are two types of IPv6 multicast addresses:

- Well-Known multicast addresses
- Solicited node multicast addresses

Note: Multicast addresses can only be destination addresses and not source addresses.

IPV6 MULTICAST ADDRESSES
WELL-KNOWN IPV6 MULTICAST ADDRESSES

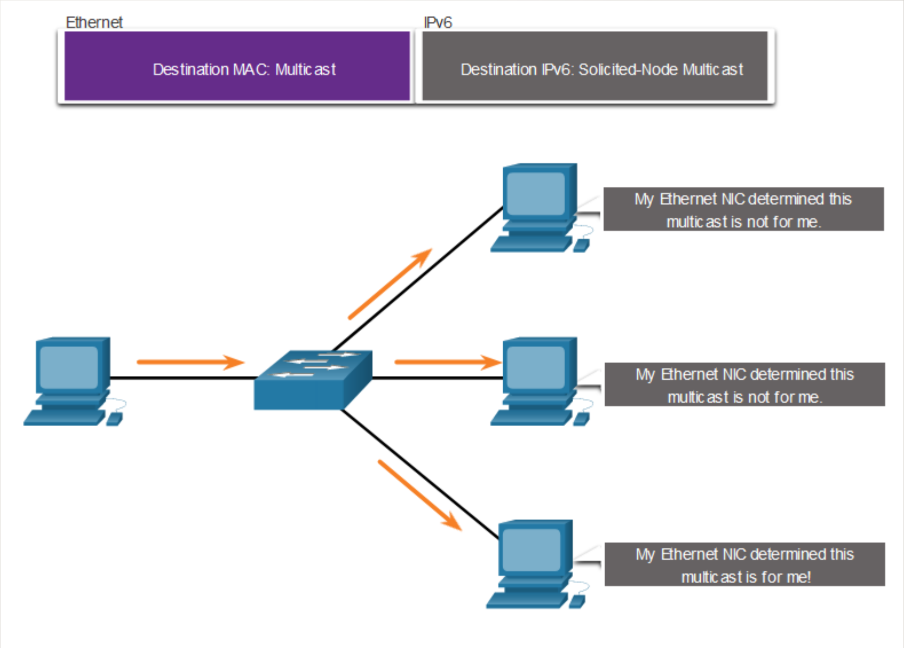
Well-known IPv6 multicast addresses are assigned and are reserved for predefined groups of devices.

There are two common IPv6 Assigned multicast groups:

- **ff02::1 All-nodes multicast group -** This is a multicast group that all IPv6-enabled devices join. A packet sent to this group is received and processed by all IPv6 interfaces on the link or network.
- **ff02::2 All-routers multicast group -** This is a multicast group that all IPv6 routers join. A router becomes a member of this group when it is enabled as an IPv6 router with the **ipv6 unicast-routing** global configuration command.

IPV6 MULTICAST ADDRESSES
SOLICITED-NODE IPV6 MULTICAST

- A solicited-node multicast address is similar to the all-nodes multicast address.
- A solicited-node multicast address is mapped to a special Ethernet multicast address.
- The Ethernet NIC can filter the frame by examining the destination MAC address without sending it to the IPv6 process to see if the device is the intended target of the IPv6 packet.

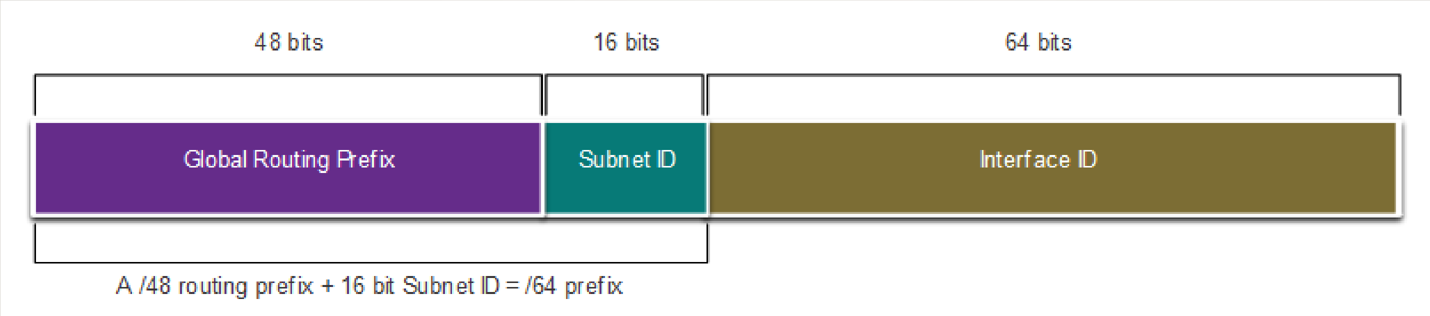


SUBNET AN IPV6 NETWORK

SUBNET AN IPV6 NETWORK
SUBNET USING THE SUBNET ID

IPv6 was designed with subnetting in mind.

- A separate subnet ID field in the IPv6 GUA is used to create subnets.
- The subnet ID field is the area between the Global Routing Prefix and the interface ID.

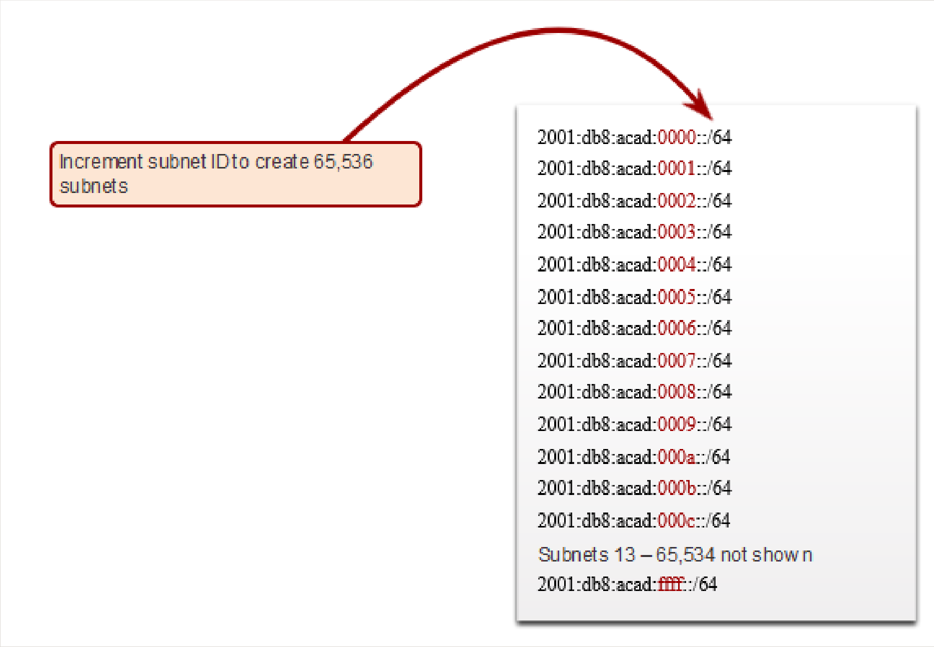


SUBNET AN IPV6 NETWORK

IPV6 SUBNETTING EXAMPLE

Given the 2001:db8:acad::/48 global routing prefix with a 16 bit subnet ID.

- Allows 65,536 /64 subnets
- The global routing prefix is the same for all subnets.
- Only the subnet ID hextet is incremented hexadecimal for each subnet.

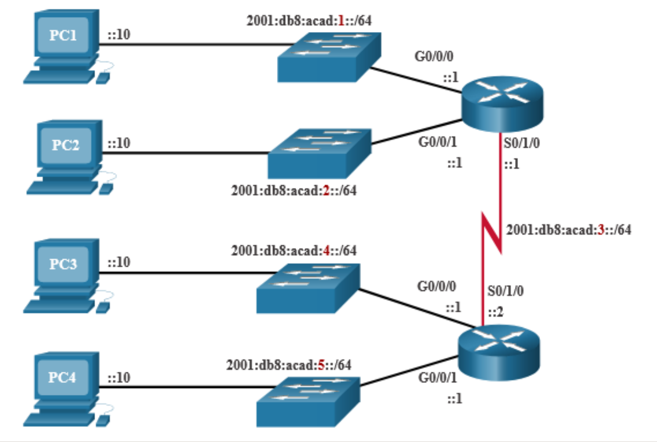


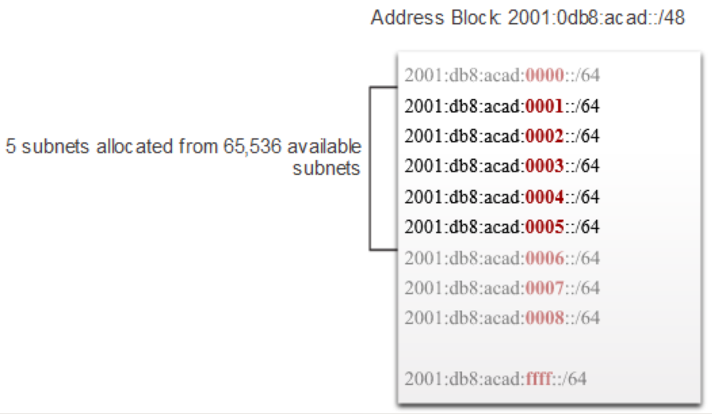
SUBNET AN IPV6 NETWORK

IPV6 SUBNET ALLOCATION

The example topology requires five subnets, one for each LAN as well as for the serial link between R1 and R2.

The five IPv6 subnets were allocated, with the subnet ID field 0001 through 0005. Each /64 subnet will provide more addresses than will ever be needed.





SUBNET AN IPV6 NETWORK

ROUTER CONFIGURED WITH IPV6 SUBNETS

The example shows that each of the router interfaces on R1 has been configured to be on a different IPv6 subnet.

```
R1(config)# interface gigabitethernet 0/0/0
R1(config-if)# ipv6 address 2001:db8:acad:1::1/64
R1(config-if)# no shutdown
R1(config-if)# exit
R1(config)# interface gigabitethernet 0/0/1
R1(config-if)# ipv6 address 2001:db8:acad:2::1/64
R1(config-if)# no shutdown
R1(config-if)# exit
R1(config)# interface serial 0/1/0
R1(config-if)# ipv6 address 2001:db8:acad:3::1/64
R1(config-if)# no shutdown
```

Thank You