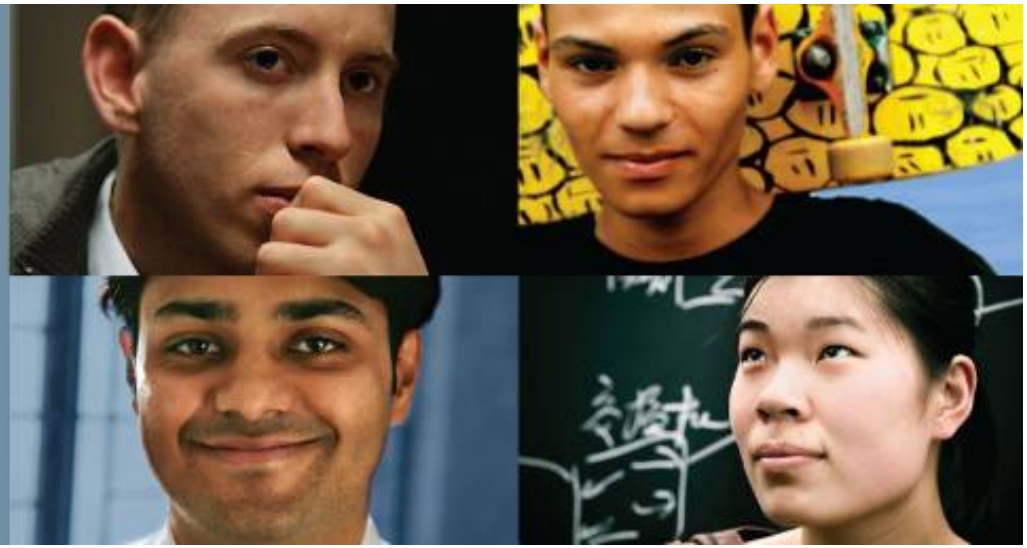
Instructor Materials
Chapter 4: Network Addressing



Networking Essentials

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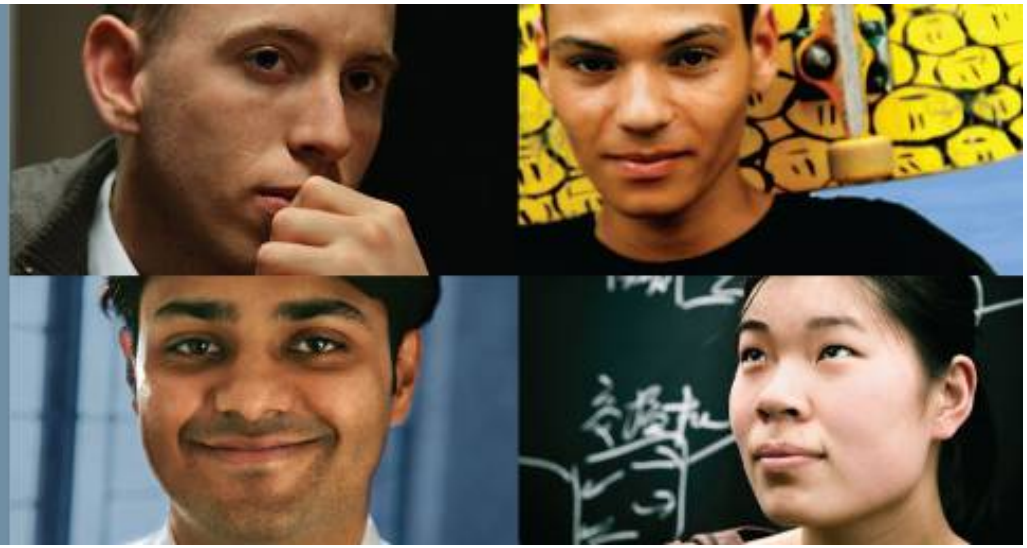
Chapter 4: Network Addressing



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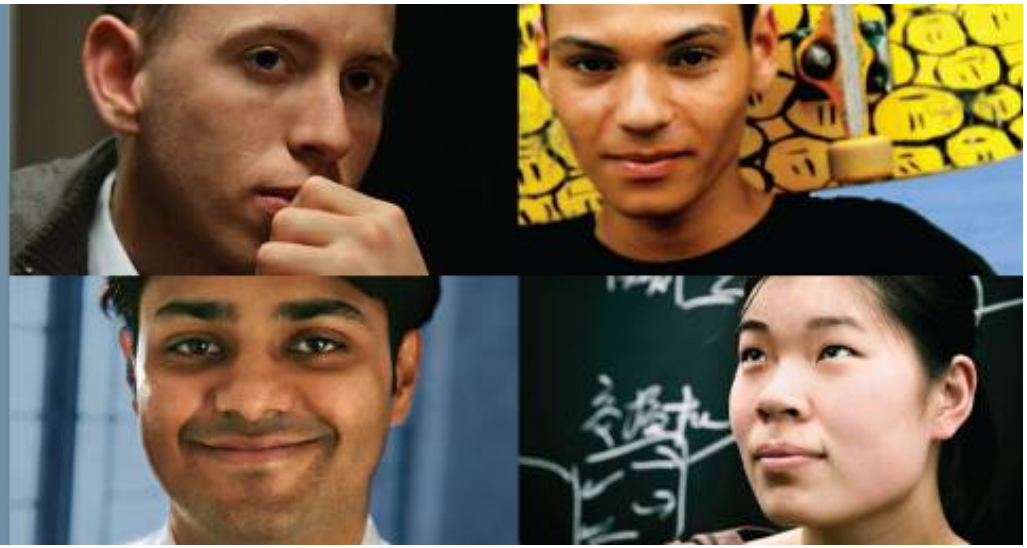
Chapter 4 - Sections & Objectives

- 4.1 IPv4 Addresses and Subnet Masks
  - Explain the features of an IPv4 address.
- 4.2 Types of IPv4 Addresses
  - Explain the features of the different types of IPv4 addresses.
- 4.3 How IPv4 Addresses are Obtained
  - Configure a DHCP server.
- 4.4 IPv4 Address Management
  - Explain the need for public and private addressing.
- 4.5 Addressing with IPv6
  - Explain the need for IPv6.

4.1 IPv4 Addresses and Subnet Masks



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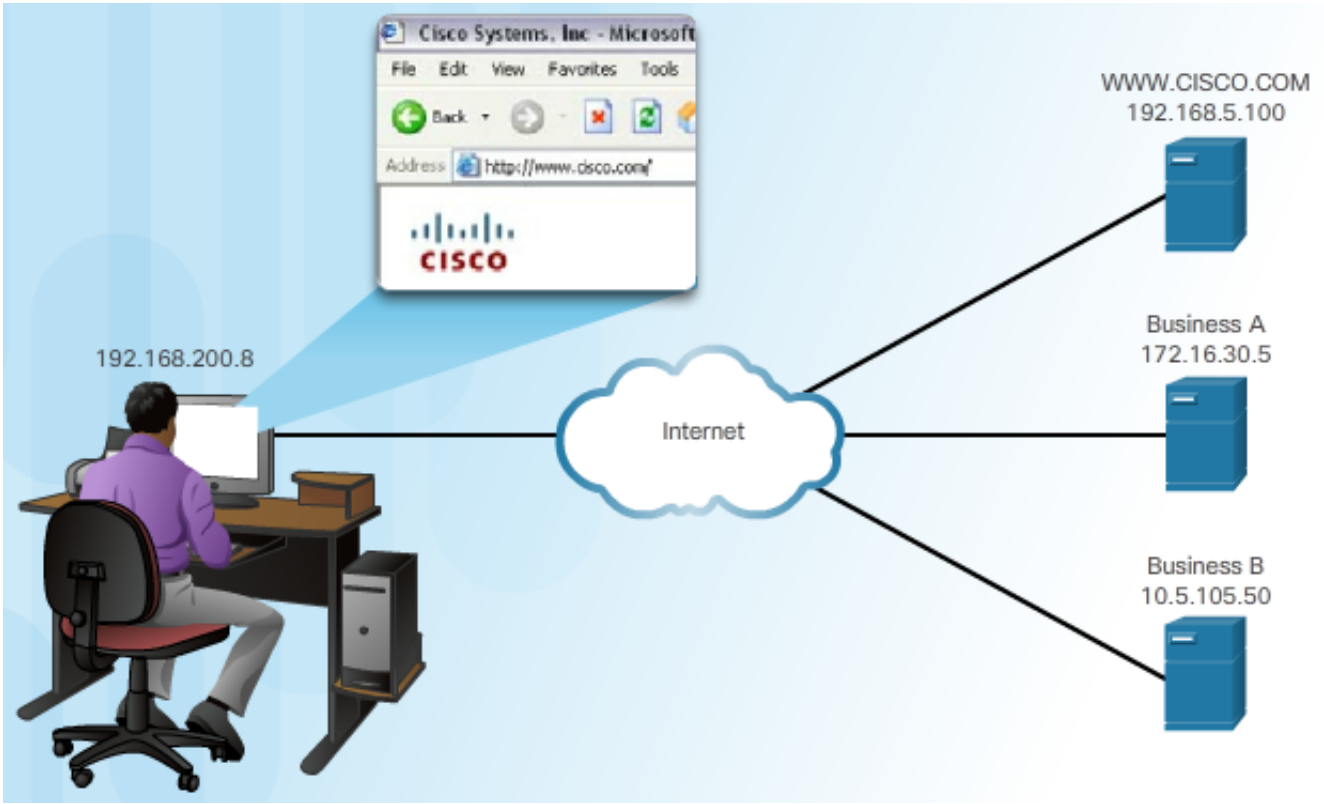
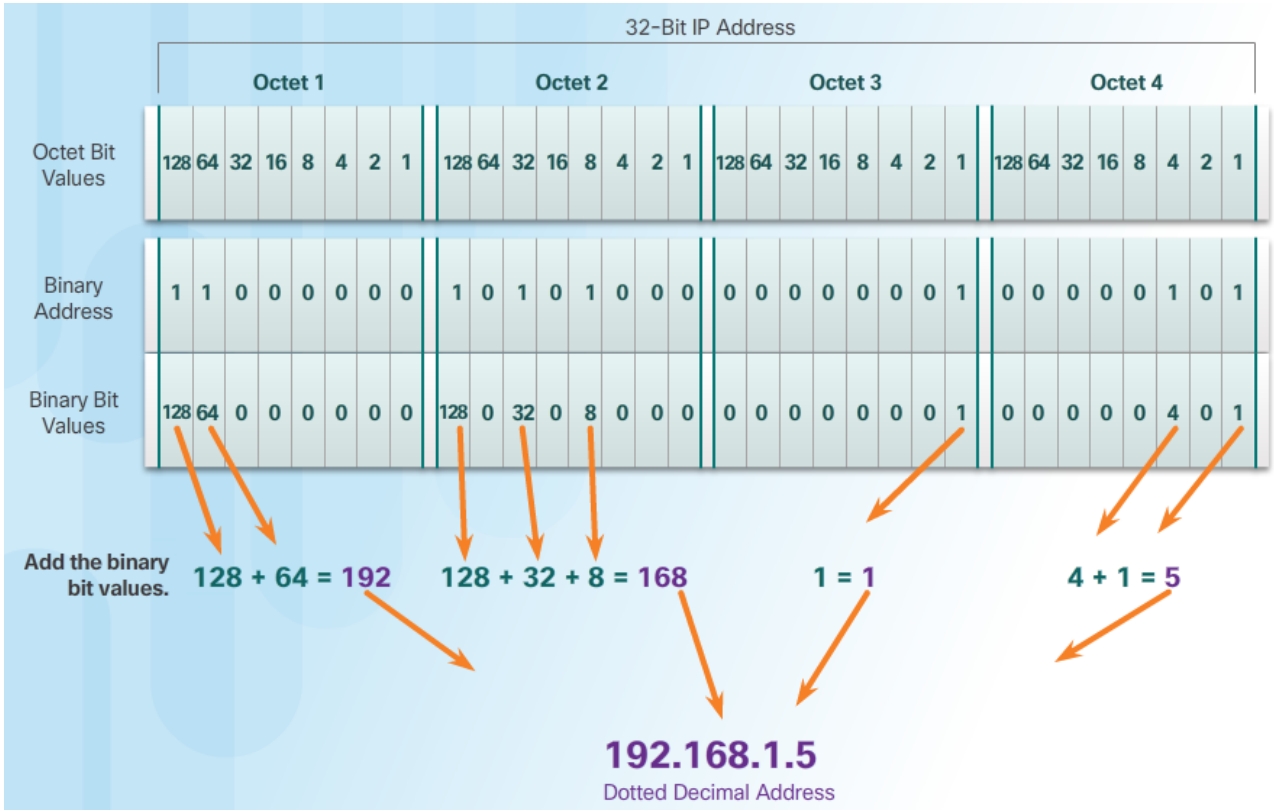
Purpose of the IPv4 Address

- What is an IPv4 Address?
  - Is a logical network address that identifies a particular host
  - Configured and is unique on the network for communications
  - Is associated with a network interface card



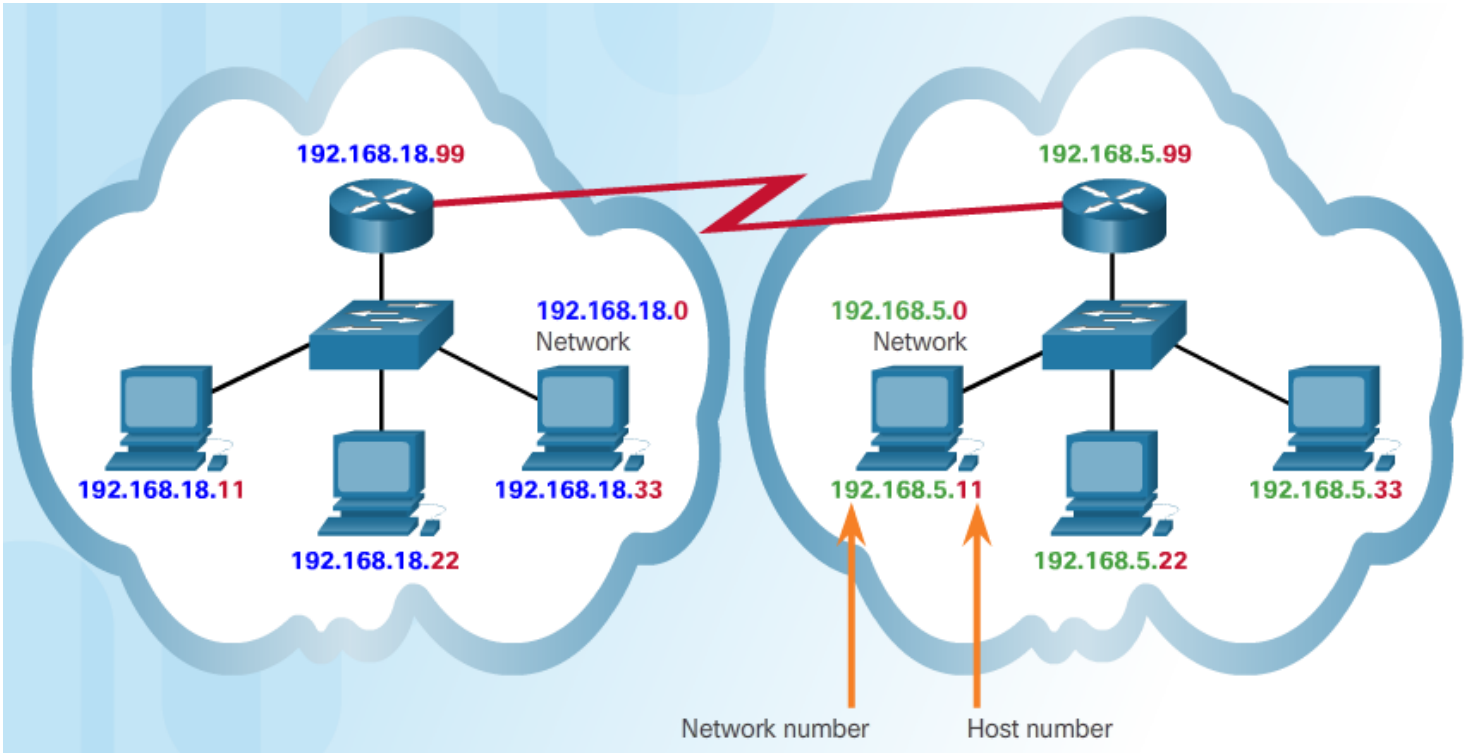
IP Address Structure

- IPv4 Addressing
  - 32 binary bits
  - For ease of use, the 32 bits are group into four 8-bit bytes called octets.
  - The octets are represented in dotted-decimal notation.
- Binary to Decimal



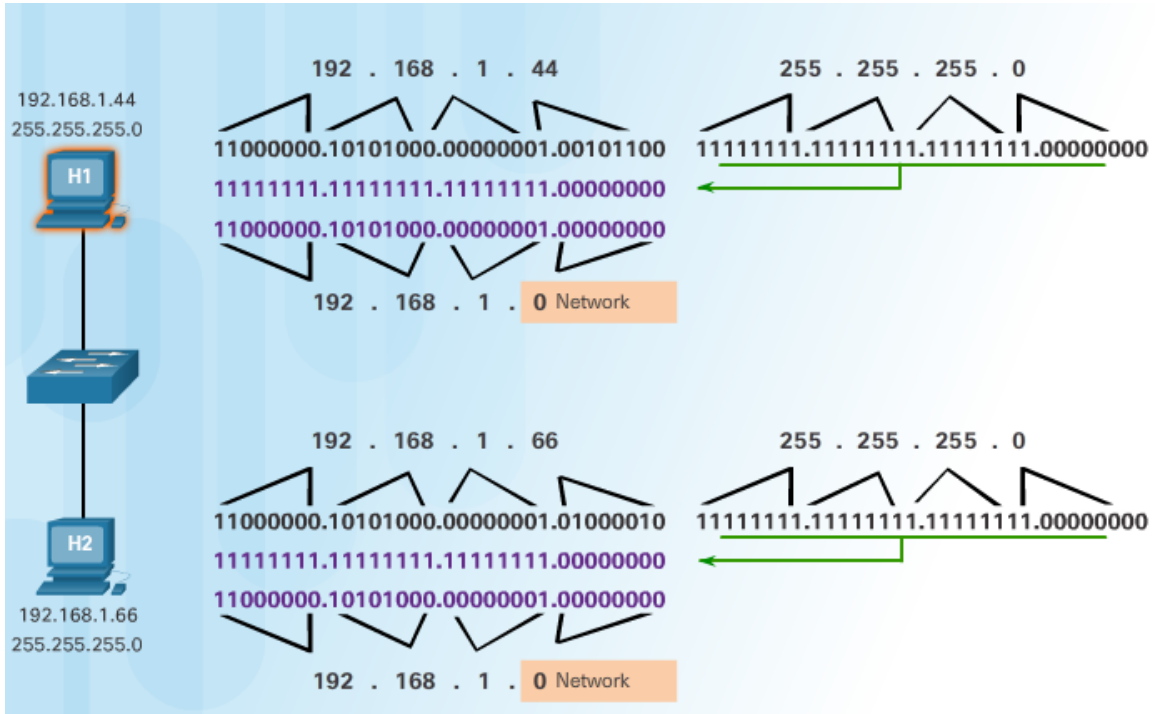
Parts of an IP Address

- Networks and Hosts
  - Logical 32-bit IPv4 address is hierarchical and is made up of two parts
    - Network
    - Host

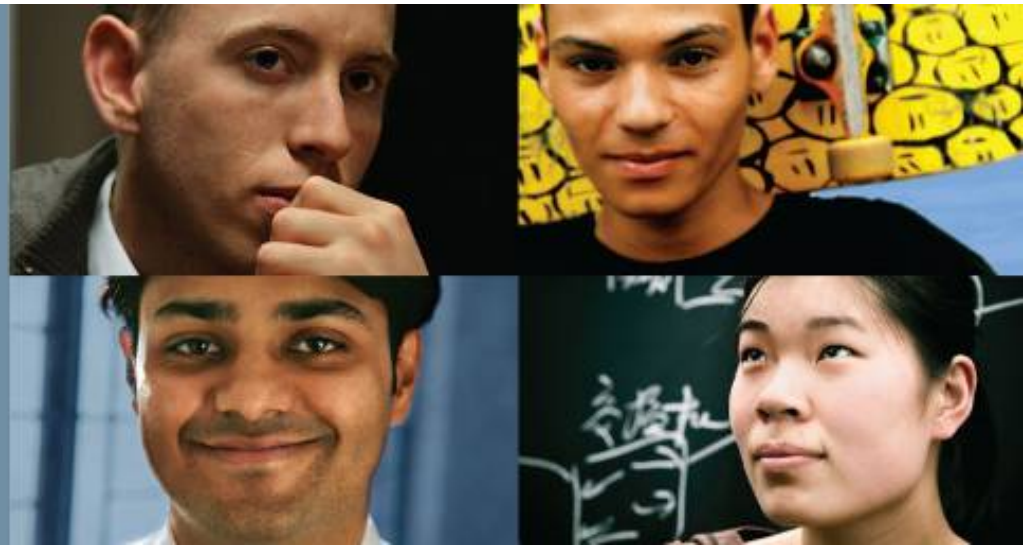


How IP Addresses and Subnet Masks Interact

- Are You on My Network?
  - When a host sends a packet, it compares its subnet mask to its own IPv4 address and the destination IPv4 address.
- Subnet Masks
  - Common subnet masks: 255.0.0.0 (8-bits), 255.255.0.0 (16 bits) and 255.255.255.0 (24 bits).
  - Number of hosts: $2^x - 2$



4.2 Types of IPv4 Addresses



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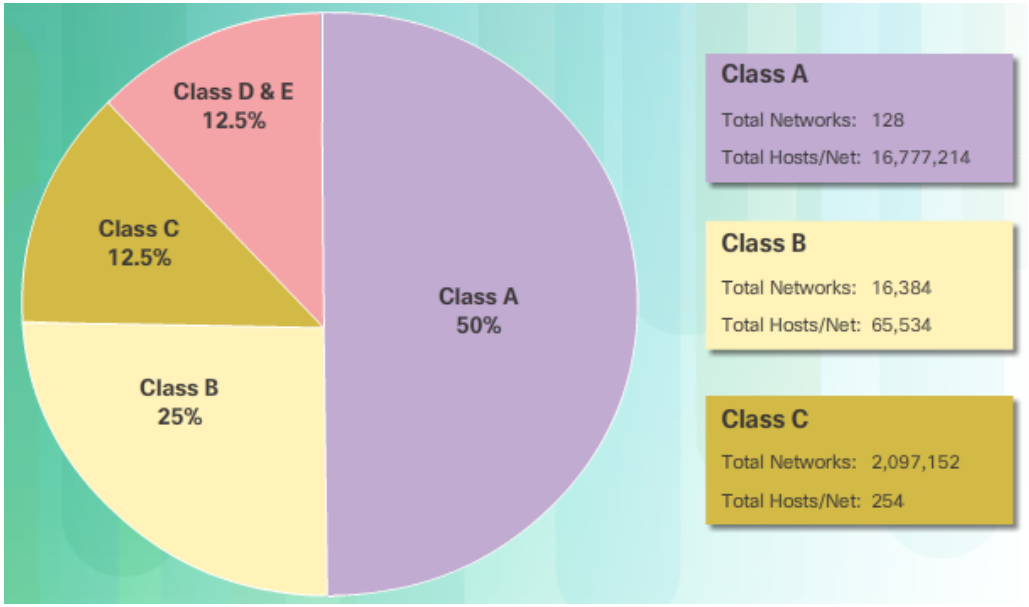
IPv4 Address Classes and Default Subnet Masks

- Classful Addressing
  - Class A (0.0.0.0/8 to 127.0.0.0/8) supports extremely large networks.
  - Class B (128.0.0.0 /16 – 191.255.0.0 /16) supports the needs of moderate to large size networks.
  - Class C (192.0.0.0 /24 – 223.255.255.0 /24) supports small networks with a maximum of 254 hosts.
- Classless Addressing
  - IPv4 addresses allocated on any address bit boundary
  - Delays the depletion and exhaustion of IPv4 addresses
  - Classless Inter-Domain Routing (CIDR)

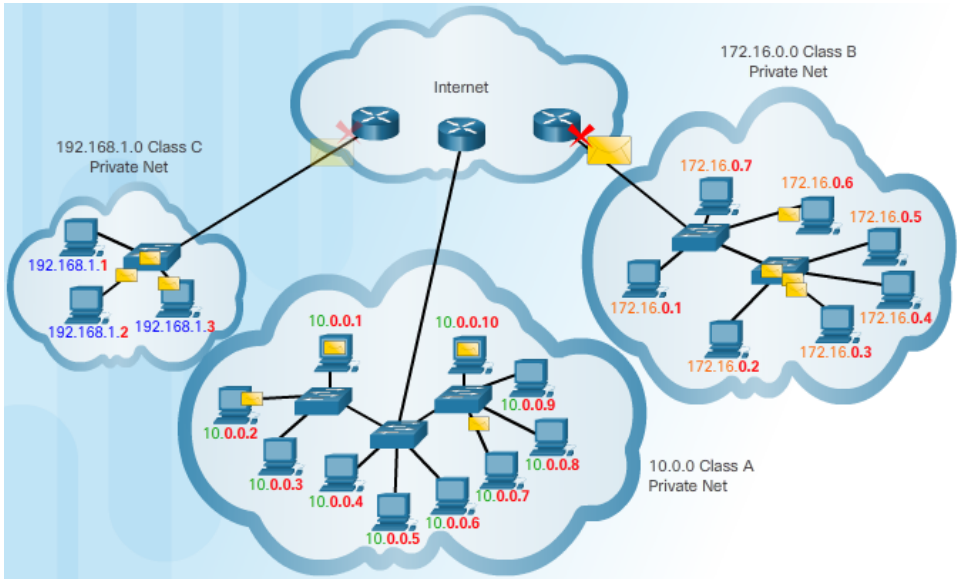


Public and Private IP Addresses

- Private IPv4 Addressing

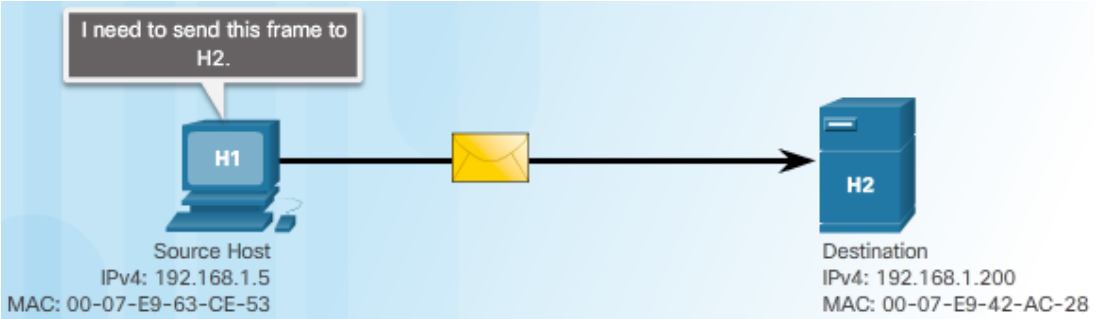
Address Class	Number of Network Numbers Reserved	Network Addresses
A	1	10.0.0.0
B	16	172.16.0.0 - 172.31.0.0
C	256	192.168.0.0 - 192.168.255.0

- Using Private IPv4 Addresses
  - Does not connect directly to the Internet
  - Visible on local network only
  - Loopback address: 127.0.0.0 network

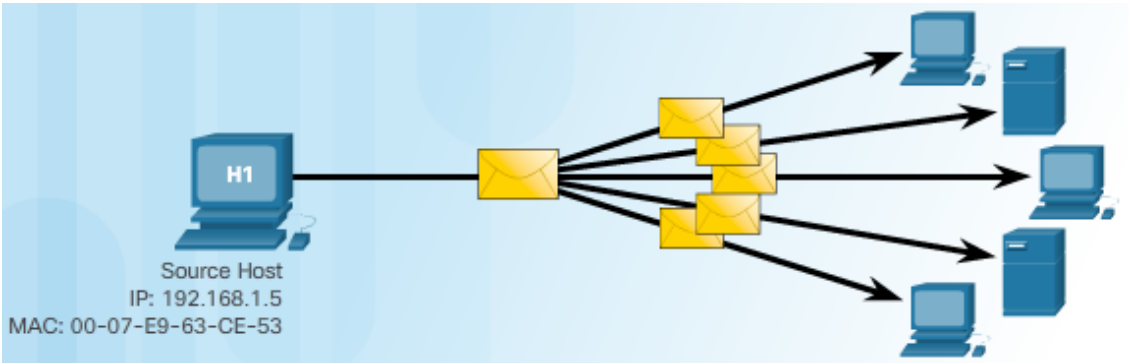


Unicast, Broadcast and Multicast Addresses

- A Message for Me
  - Unique destination MAC and IP addresses

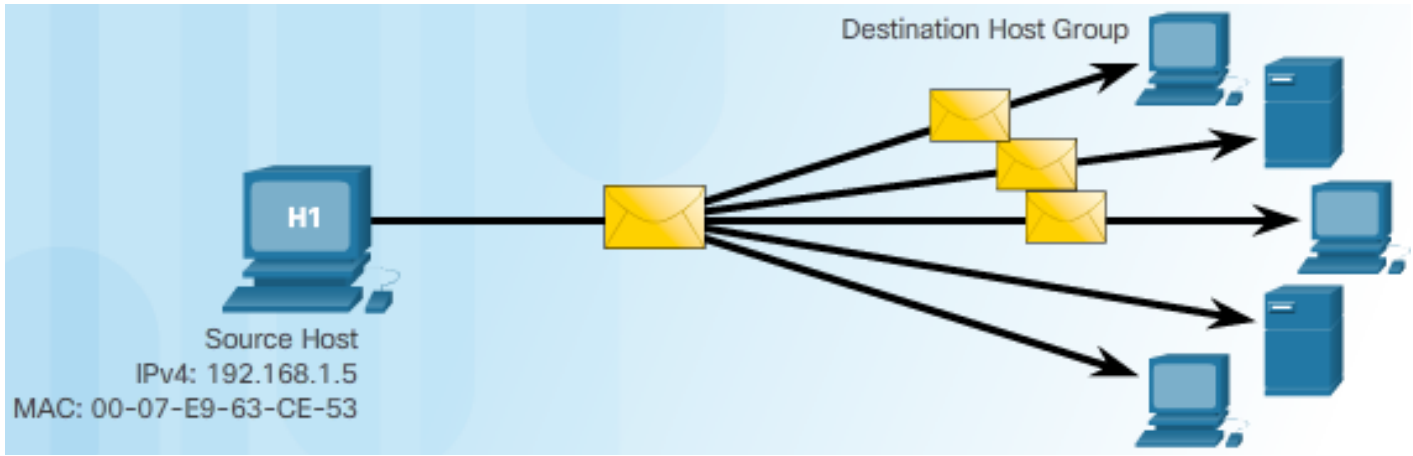


- Something for Everyone
  - Broadcast MAC and IP address:
    - MAC address: FFFF:FFFF:FFFF
    - Host portion of IP Address is all 1s

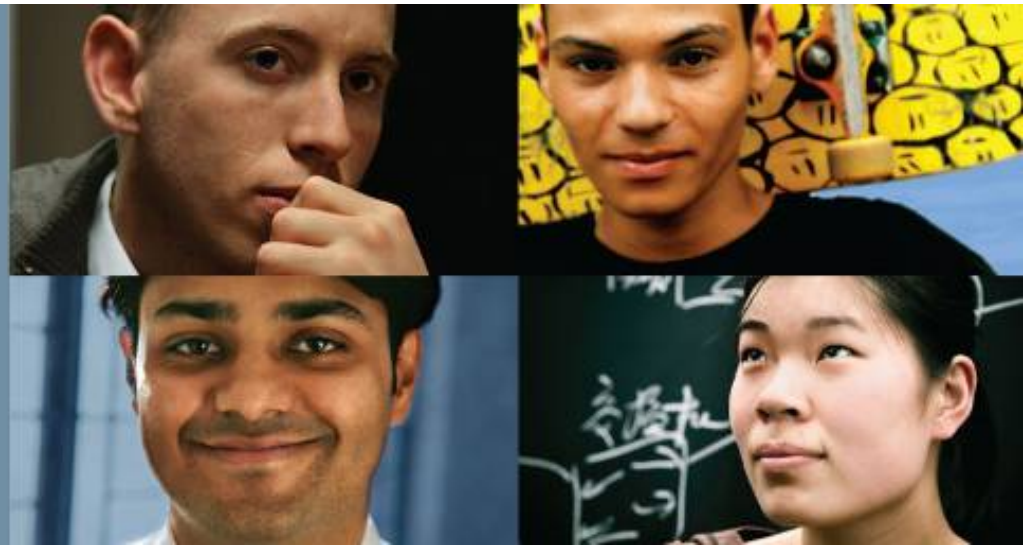


Unicast, Broadcast and Multicast Addresses (Cont.)

- Just for this Group
  - A single packet is sent to a selected set of hosts in the multicast group
  - Reserved IPv4 address
    - Reserved multicast range: 224.0.0.0 to 239.255.255.255
    - Reserved multicast range on local network: 224.0.0.0 to 224.0.0.255



4.3 How IPv4 Addresses are Obtained



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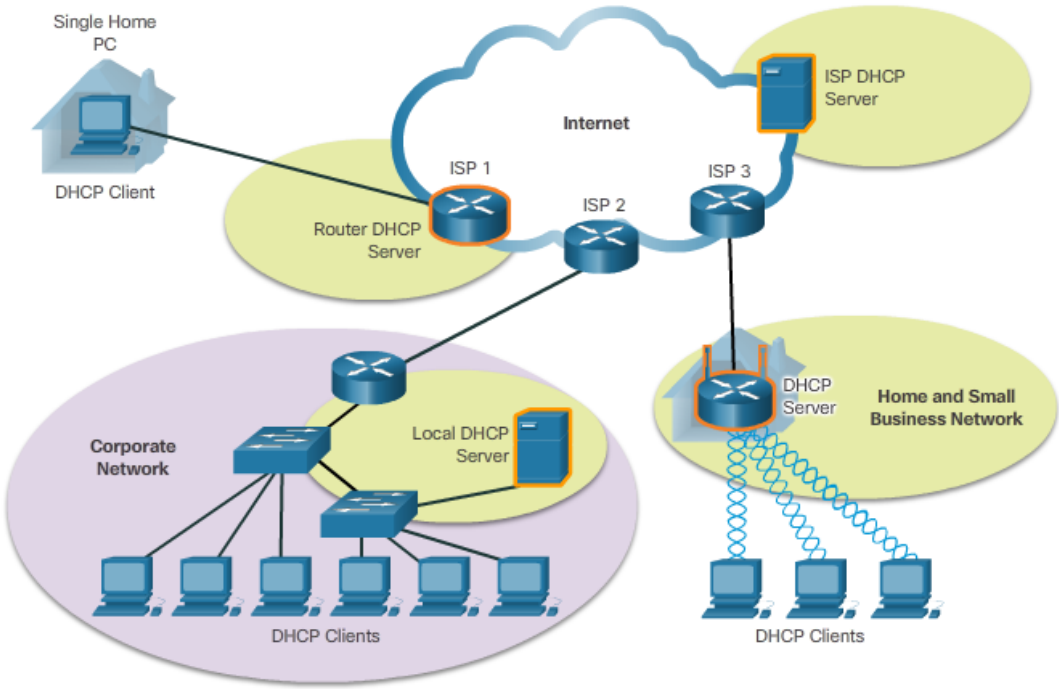
Static and Dynamic Address Assignment

- Assigning Addresses
  - Can be done statically or dynamically
  - Assign an IPv4 address, subnet mask, default gateway and other necessary info for network communications
  - Static IPv4 addresses:
    - Hosts, such as servers and printers, that need particular addresses
    - Can be time consuming and error prone
    - Need to maintain an accurate list of which IPv4 addresses
  - Dynamic IPv4 Address Assignment
    - Dynamic Host Configuration Protocol (DHCP) allows for automatic assignment of addressing information
    - Preferred method of assignment for a large network
    - IP addresses can be reallocated when they become available

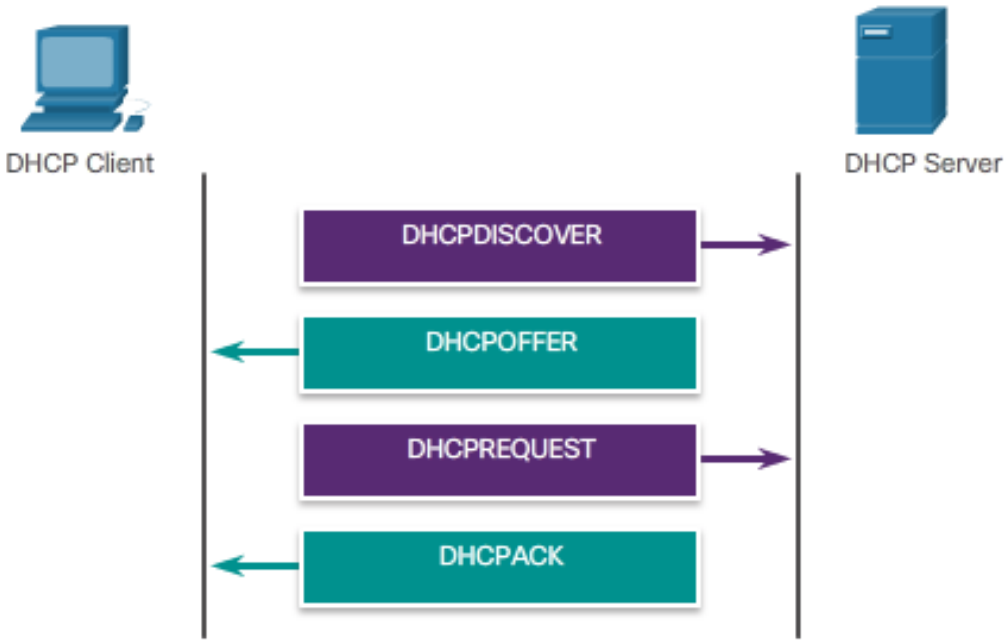
DHCP Servers

- Where Do DHCP Addresses Come From?
  - Medium to large network
    - Usually a local dedicated PC-based server
  - Home network
    - A wireless router can serve as a client to receive IP configuration information from the ISP
    - A wireless router can act as a DHCP server for the hosts in the local network

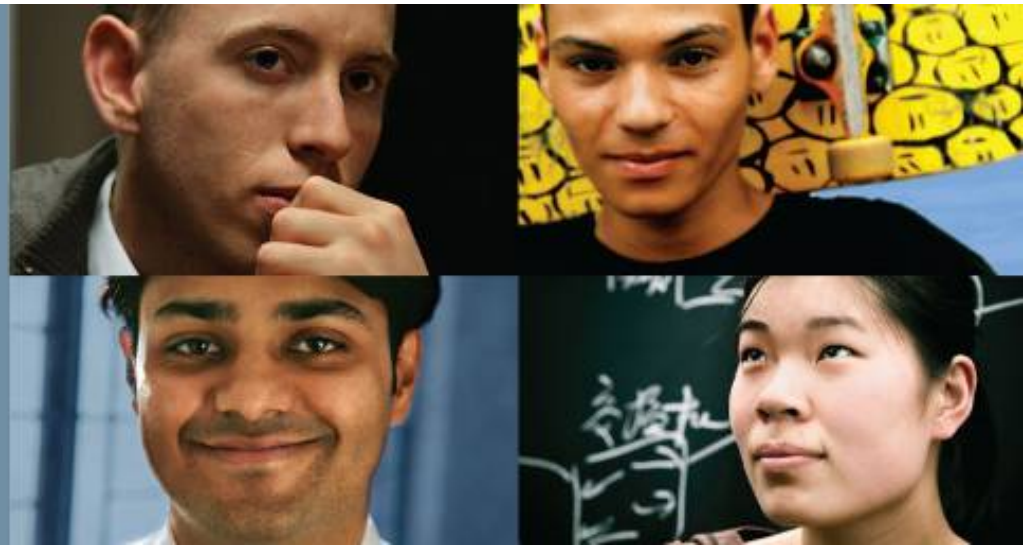


Configuring DHCP

- How Does IPv4 DHCP Work?
  - Client sends a DHCP Discover message.
    - A destination IPv4 address of 255.255.255.255 (32 ones)
    - A destination MAC address of FF-FF-FF-FF-FF-FF (48 ones).
  - DHCP server will respond with a DHCP Offer, suggesting an IPv4 address for the client.
  - The host sends a DHCP Request to that server asking to use the suggested IPv4 address.
  - The server responds with a DHCP Acknowledgment.



4.4 IPv4 Address Management



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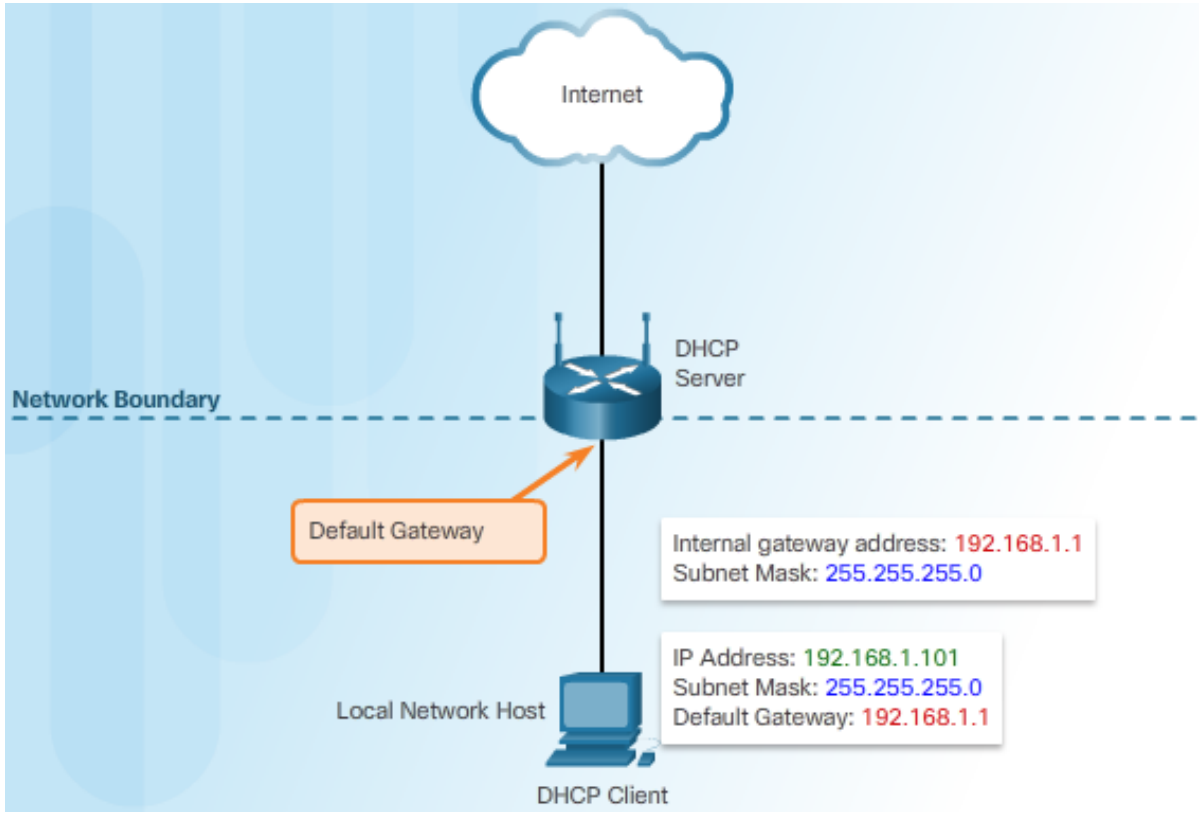
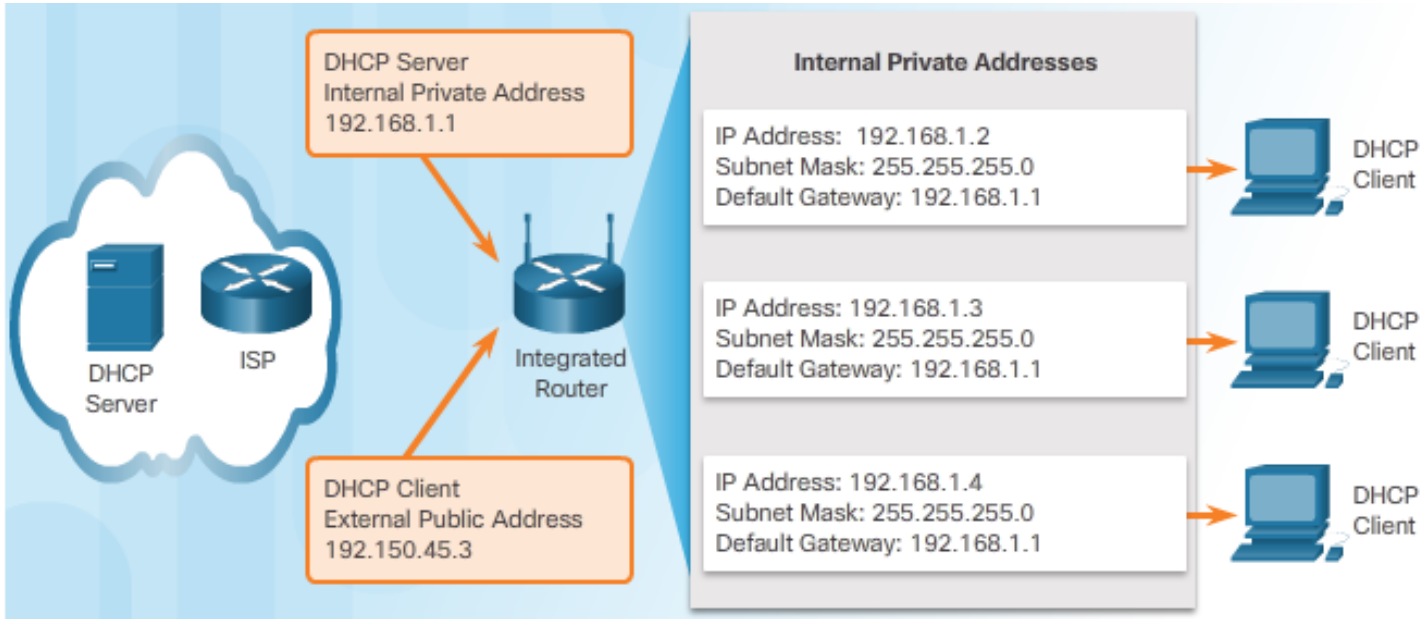
Network Boundaries and Address Space

- Gateways to Other Networks
  - Each host on a network uses a default gateway to reach other networks.
  - The default gateway is the IPv4 address of the router interface connected to the network where the host is attached



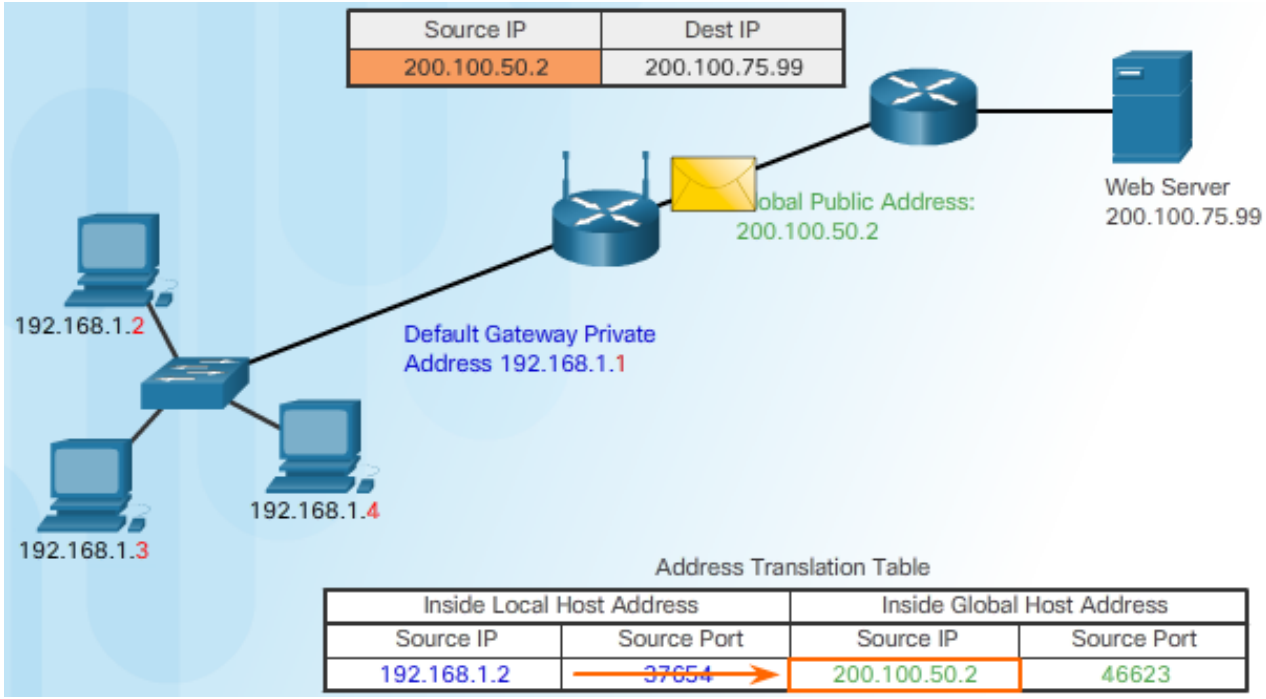
Address Assignment

- Who is on the Inside?
  - Internal hosts must be assigned addresses within the same network as the integrated router statically or through DHCP. It also provides IPv4 address, subnet mask, default gateway and other network information.
  - The network assigned to the Internet side of the integrated router is referred to as the external, or outside, network. ISPs usually provide an Internet-routable address, which enables hosts connected to the integrated router to have access to the Internet.
  - The integrated router serves as the boundary between the local internal network and the external Internet.

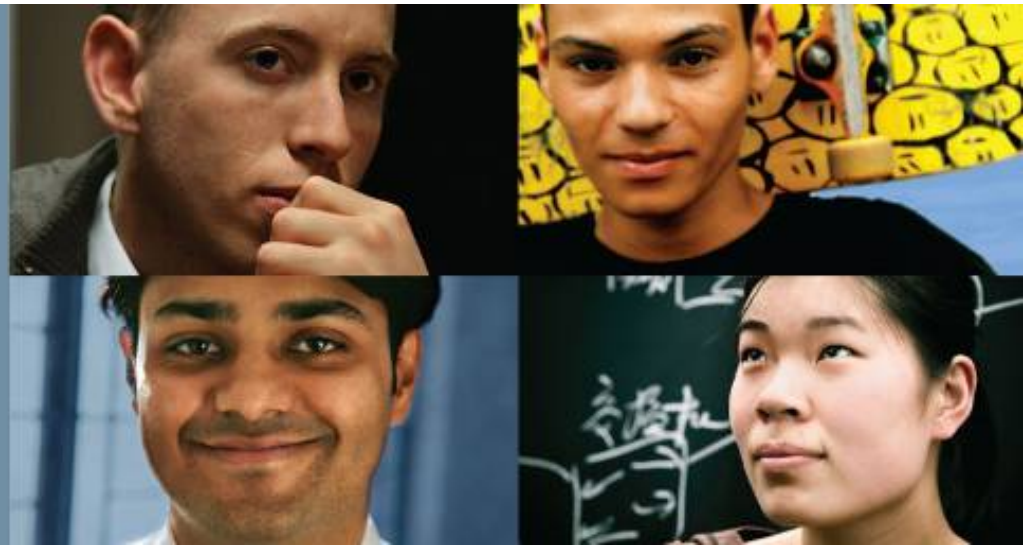


Network Address Translation

- From IPv4 Private to Public Addresses
  - Network Address Translation
    - Translate private addresses into unique Internet-routable public addresses for outgoing packets
    - The process is reversed for incoming packets
    - The router can translate many internal IPv4 addresses to the same public address



4.5 Addressing with IPv6



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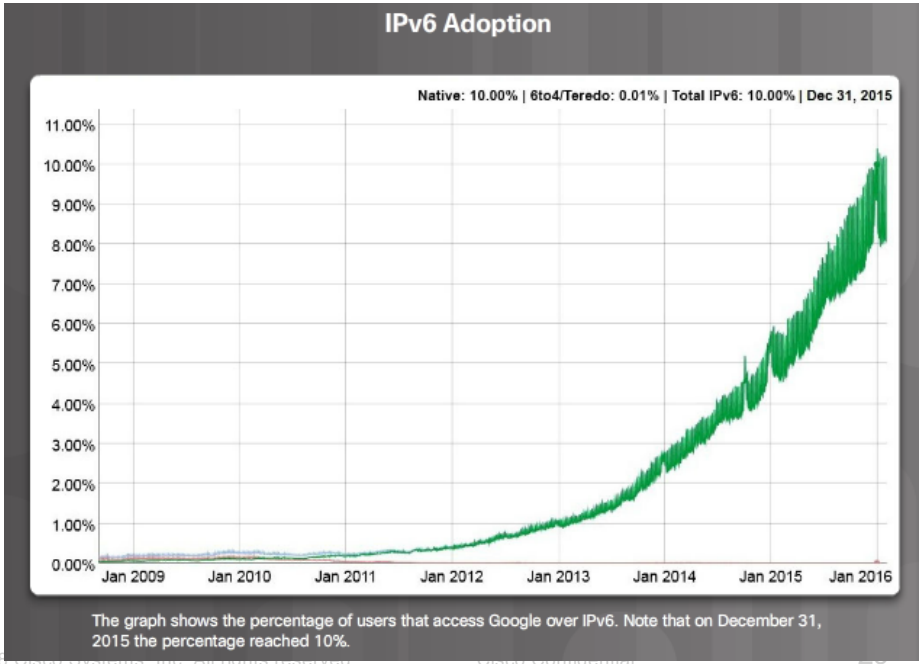
Are You Ready for Change?

- Need more IP addresses
  - An IPv4 address is 32 bits (4 bytes) long.
  - An IPv6 address is 128 bits (16 bytes) in length.
- IPv6 benefits
  - More IP addresses
  - No need for NAT
  - Autoconfiguration capabilities
- Change is Coming
  - NAT has prolonged the life of IPv4
  - IPv6 adoption rate is increasing



How is IPv6 Different?

- IPv6 Differences
  - Address autoconfiguration
  - Link-local address
    - Communications within the same network
- IPv6 Address Formatting
  - Compressing IPv6 Addresses Rules
    - Omit Leading Zeros
    - Omit One “all zero” Segment

Fully expanded	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