

Addressing Overview

- There are four addressing methods:
 - Data link layer MAC (Media Access Control) address is 48 bits, written as six hex numbers separated by colons
 - It is also called a physical address
 - MAC addresses are embedded on every NIC in the world
 - Network layer IP (Internet Address) address can be used to find any computer in the world
 - IPv4 addresses have 32 bits and are written as four decimal numbers called octets
 - IPv6 addresses have 128 bits and are written as eight blocks of hexadecimal number
 - Transport layer port numbers are used to find applications
 - Application layer FQDNs, computer names, and host names
 - Fully qualified domain name (FQDN) – a unique character-based name

MAC Addresses (1 of 2)

- Traditional MAC addresses contain two parts
 - The first 24 bits are known as the **OUI (Organizationally Unique Identifier)** or manufacturer-ID
 - This part is assigned by the IEEE
 - The last 24 bits make up the **extension identifier** or **device ID**
 - Manufacturer's assign each NIC a unique device ID
- Switches use MAC addresses to identify devices on the local area network

MAC Addresses (2 of 2)

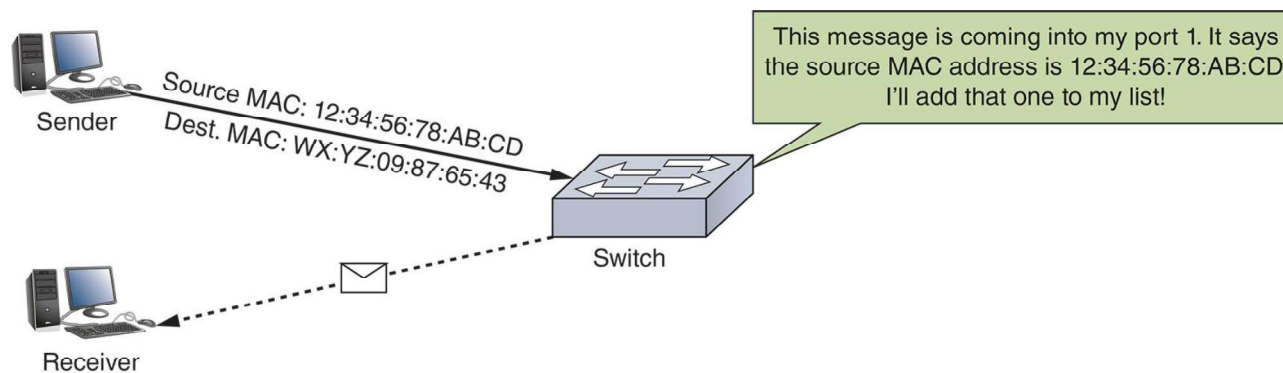


Figure 3-3 The switch learns the sending device's MAC address

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IP Addresses

- Static IP addresses are assigned manually by the network administrator
- Dynamic IP addresses are automatically assigned by a DHCP server
 - You'll learn more about DHCP later in the chapter
- There are two types of IP addresses:
 - IPv4 is a 32-bit address
 - IPv6 is a 128-bit address

IPv4 Addresses (1 of 4)

- A 32-bit IPv4 address is organized into four groups of 8 bits each (known as octets)
 - Each of the four octets can be any number from 0 to 255
 - Some IP addresses are reserved
- Example of an IPv4 address: 72.56.105.12
- Classful addressing
 - The dividing line between the network and host portions is determined by the numerical range the IP address falls in
- Classful IPv4 addresses are divided into five classes:
 - Class A, Class B, Class C, Class D, and Class E

IPv4 Addresses (2 of 4)

- Class A, B, and C licensed IP addresses are available for use on the Internet
 - These are called **public IP addresses**
- A company can use **private IP addresses** on its private networks
- The IANA recommends the following IP addresses be used for private networks:
 - 10.0.0.0 through 10.255.255.255
 - 172.16.0.0 through 172.31.255.255
 - 192.168.0.0 through 192.168.255.255
- **Classless addressing** allows the dividing line between network and host portions to fall anywhere along the string of binary bits in an IP address
- **CIDR (Classless Interdomain Routing) notation** takes the network ID or a host's IP address and follows it with a forward slash (/) followed by the number of bits that are used for the network ID

IPv4 Addresses (3 of 4)

- **Network Address Translation (NAT)** is a technique designed to conserve public IP addresses needed by a network
- Address translation is a process where a gateway device substitutes the private IP addresses with its own public address
 - When these computers need access to other networks or Internet
- Port Address Translation (PAT) is the process of assigning a TCP port number to each ongoing session between a local host and Internet host
- Two variations of NAT to be aware of:
 - **SNAT (Source Network Address Translation)** - the gateway assigns the same public IP address to a host each time it makes a request to access the Internet
 - **DNAT (Dynamic Network Address Translation)** - the gateway has a pool of public address that it is free to assign to a local host when it makes a request to access the Internet

IPv4 Addresses (4 of 4)

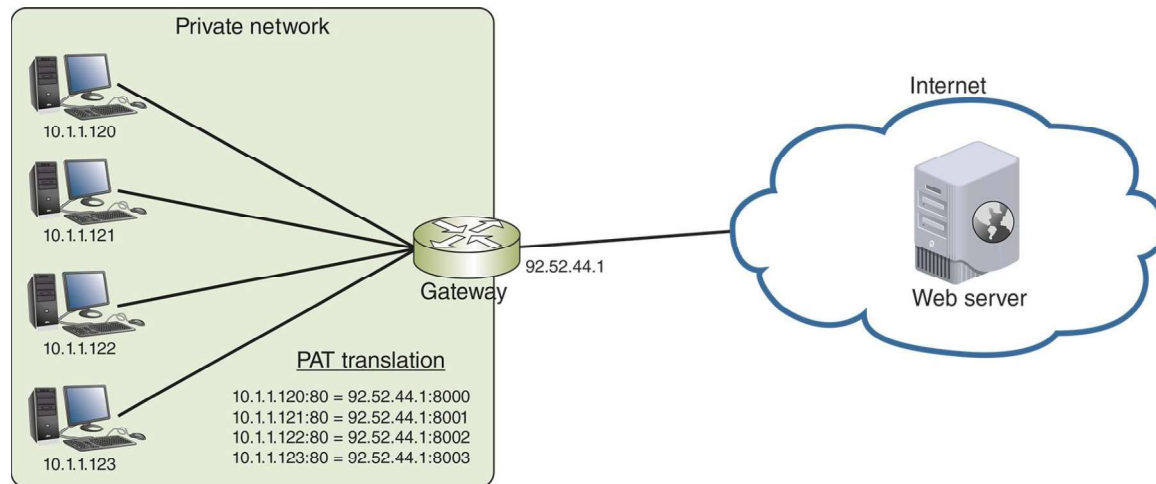


Figure 3-12 PAT (Port Address Translation)

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IPv6 Addresses (1 of 2)

- An IPv6 address has 128 bits written as eight blocks of hexadecimal numbers separated by colons
 - Ex: 2001:0000:0B80:0000:0000:00D3:9C5A:00CC
 - Each block is 16 bits
 - Leading zeros in a four-character hex block can be eliminated
 - If blocks contain all zeroes, they can be written as double colons (::), only one set of double colons is used in an IP address
 - Therefore, above example can be written two ways:
 - 2001::B80:0000:0000:D3:9C5A:CC
 - 2001:0000:B80::D3:9C5A:CC (this is the preferred method because it contains the fewest zeroes)

IPv6 Addresses (2 of 2)

- IPv6 terminology:
 - A **link** (sometimes called local link) is any LAN bounded by routers
 - **Neighbors** are two or more nodes on the same link
 - **Dual stacked** is when a network is configured to use both IPv4 and IPv6
 - **Tunneling** is a method used by IPv6 to transport IPv6 packets through or over an IPv4 network
 - **Interface ID** is the last 64 bits or four blocks of an IPv6 address that identify the interface

Types of IPv6 Addresses (1 of 4)

- **Unicast address** - specifies a single node on a network
 - **Global address** can be routed on the Internet
 - **Link local address** can be used for communicating with nodes in the same link
 - **Loopback address** can be used to test that an interface and supporting protocol stack are functioning properly
- **Multicast address** – delivers packets to all nodes on a network
- **Anycast address** - can identify multiple destinations, with packets delivered to the closest destination

Types of IPv6 Addresses (2 of 4)

Global address

3 bits	45 bits	16 bits	64 bits
001	Global routing prefix	Subnet ID	Interface ID

Link local address

64 bits	64 bits
1111 1110 1000 0000 0000 0000 0000 0000 FE80::/64	Interface ID

Loopback address

127 bits	1 bit
0000 0000 0000 0000 000	1

Figure 3-16 Three types of IPv6 addresses

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Types of IPv6 Addresses (3 of 4)

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Windows PowerShell
PS C:\Users\jillw> ipconfig

Windows IP Configuration

Ethernet adapter Ethernet:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Ethernet adapter VirtualBox Host-Only Network:

    Connection-specific DNS Suffix  . :
    Link-local IPv6 Address . . . . . : fe80::2985:d1d8:60d2:4b2a%11
    IPv4 Address. . . . . : 192.168.56.1
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . :

Wireless LAN adapter Local Area Connection* 3:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Wireless LAN adapter Local Area Connection* 4:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Wireless LAN adapter Wi-Fi:

    Connection-specific DNS Suffix  . :
    Link-local IPv6 Address . . . . . : fe80::1c33:fed2:faf0:ece%14
    IPv4 Address. . . . . : 192.168.2.137
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.2.1

PS C:\Users\jillw>
```

IPv6 address assigned to virtual interface

IPv4 address assigned to virtual interface

IPv6 address assigned to physical Wi-Fi interface

IPv4 address assigned to physical Wi-Fi interface

Figure 3-18 The `ipconfig` command shows IPv4 and IPv6 addresses assigned to this computer

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Types of IPv6 Addresses (4 of 4)

- IPv6 autoconfiguration
 - IPv6 addressing is designed so that a computer can autoconfigure its own link local IP address
 - This process is called **SLAAC (stateless address autoconfiguration)**
- Step 1 - The computer creates its IPv6 address
 - It uses FE80::/64 as the first 64 bits (called prefix)
 - The last 64 bits are generated from the network adapter's MAC address
- Step 2 - The computer checks to make sure its IP address is unique on the network
- Step 3 - The computer asks if a router on the network can provide configuration information
 - This message is called an **RS (router solicitation)** message

Knowledge Check Activity 3-1

Which of the following IPv4 addresses is a public IP address?

- a. 10.0.2.14
- b. 172.16.156.254
- c. 192.168.72.73
- d. 64.233.177.189

Knowledge Check Activity 3-1: Answer

Which of the following IPv4 addresses is a public IP address?

Answer: d. 64.233.177.189

IP addresses within the ranges of 10.0.0.0 through 10.255.255.255, 172.16.0.0 through 172.31.255.255, and 192.168.0.0 through 192.168.255.255 are RFC1918, or private, IP addresses. The address 64.233.177.189 is a public IP address.

Ports and Sockets (1 of 2)

- A port is a number assigned to a process that can receive data
 - Port numbers ensure data is transmitted to the correct process among multiple processes running on a single device
- A socket consists of host's IP address and the port number of an application running on the host
 - A colon separates the two values
 - Example - 10.43.3.87:23
- Port numbers are divided into three types:
 - Well-known ports - 0 to 1023
 - Registered ports - 1024 to 49151
 - Dynamic and private ports - 49152 to 65535

Ports and Sockets (2 of 2)

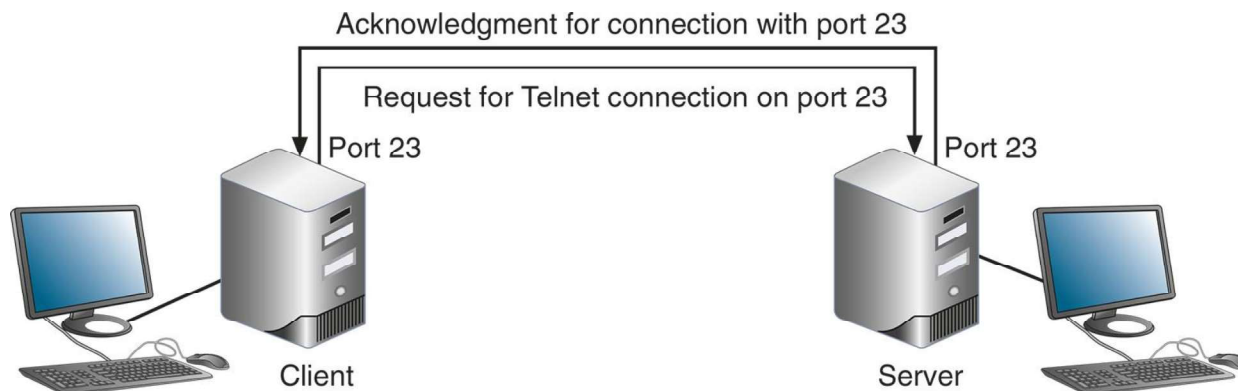


Figure 3-19 A virtual connection for the Telnet service

Figure 3-19 A virtual connection for the Telnet service