# IP Addressing- I

Course Code: CSC 3116 Course Title: Computer Networks


**Dept. of Computer Science**
**Faculty of Science and Technology**

| **Lecturer No:** | Lab 1 | **Week No:** | 1 | **Semester:** | Spring 2022-23 |
|---|---|---|---|---|---|
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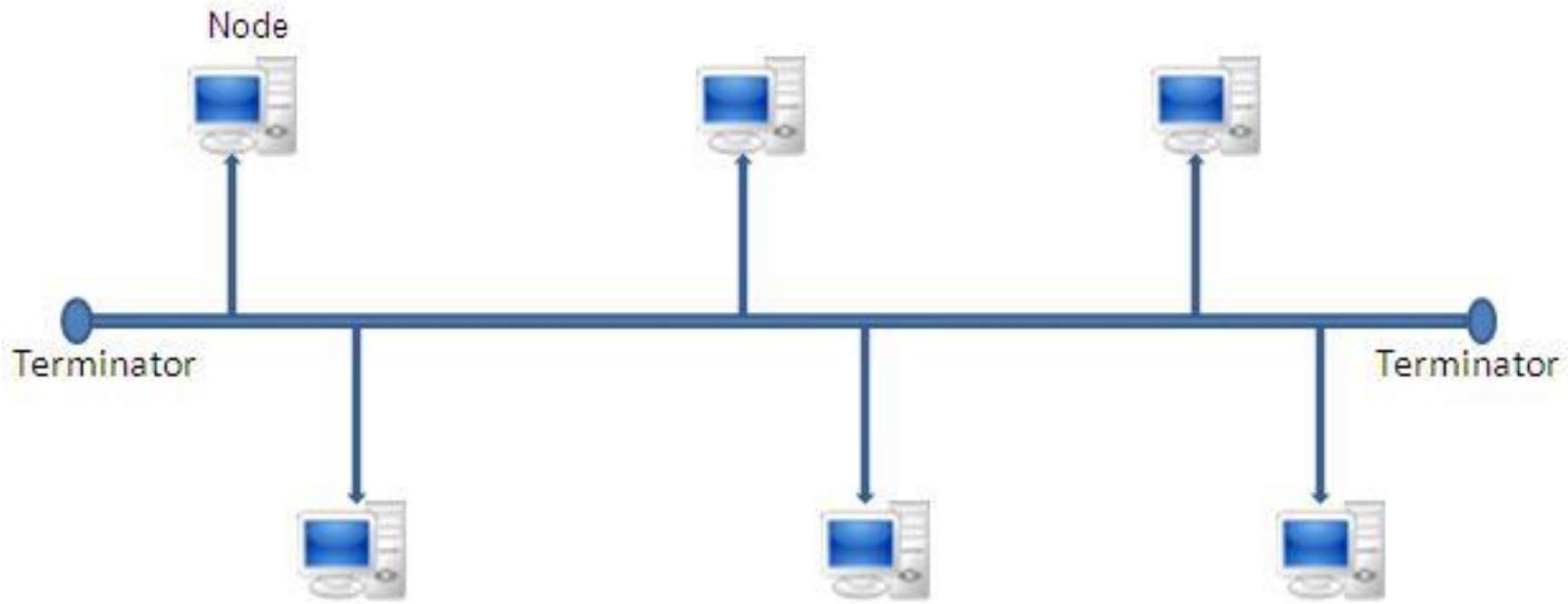
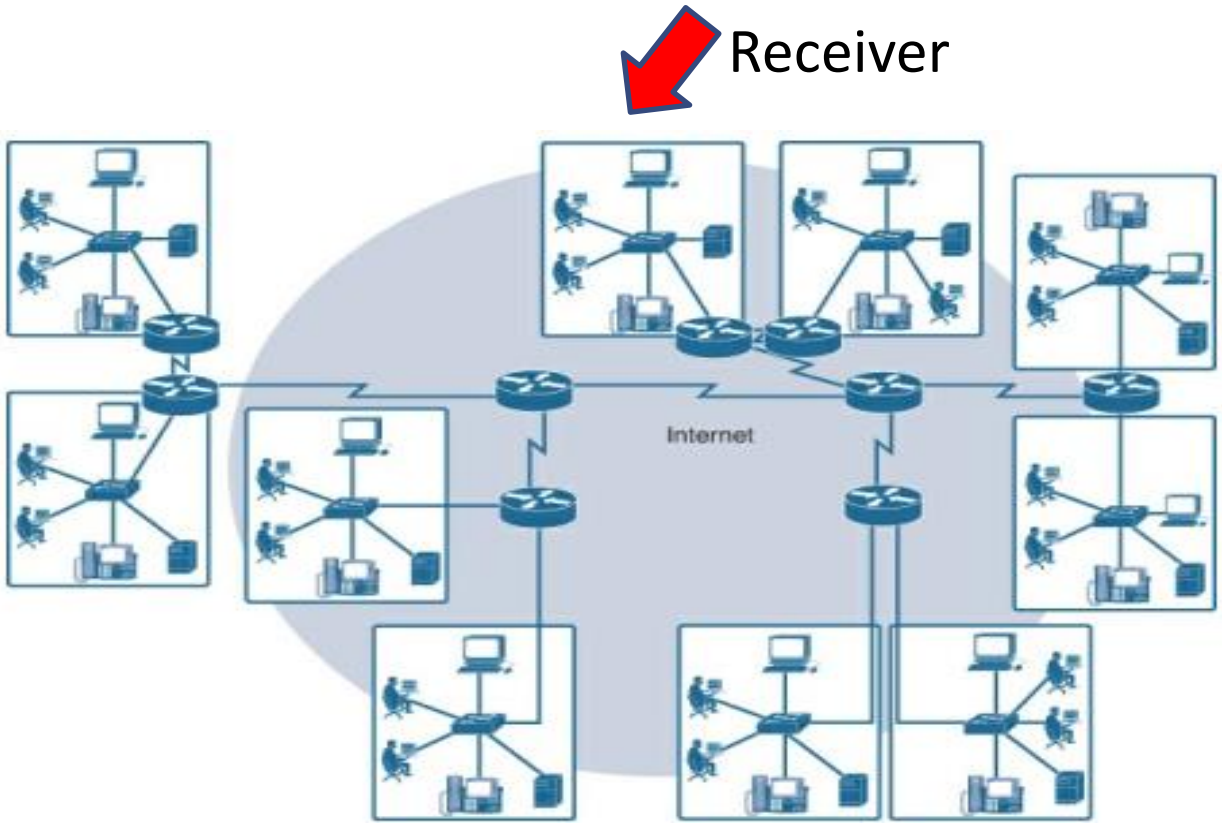
# Lecture Outline

- Classification of Address
- Conversion from binary to decimal and vice-versa
- Range of Address

# How to identify the recipient?



# How to identify the recipient? (contd...)




Is single address is enough for both LAN and collection of networks?

# Classification of Address


- Address
  - Physical Address
  - Logical Address
  - Port Address

# Physical Address

- the address of a node as defined by its LAN
- The lowest-level address
- The size and format of these addresses vary depending on the network
  - Ethernet uses 6 bytes address (imprinted on Network Interface Card (NIC))

# Physical Address (contd…)

- 6 byte address is also called *Medium Access Control (MAC)* address
- No two NICs ever share the same MAC address
- Either imprinted on the surface or burnt into a ROM chip

d: Hexadecimal digit

$$d_1d_2 : d_3d_4 : d_5d_6 : d_7d_8 : d_9d_{10} : d_{11}d_{12}$$

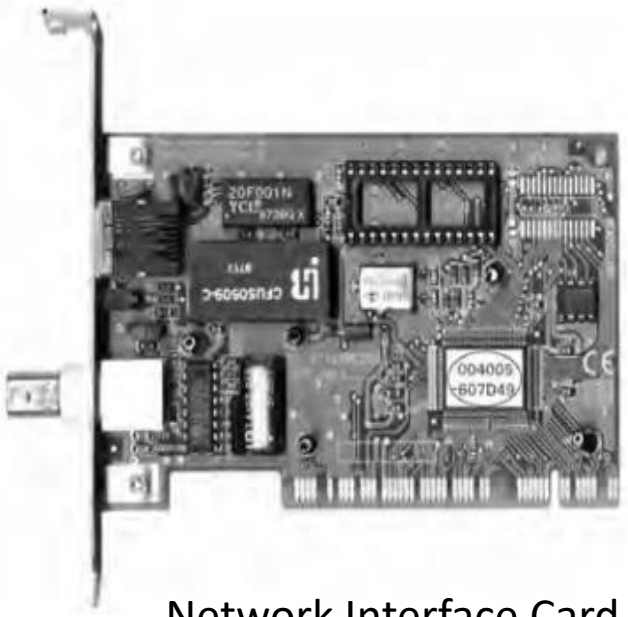
6 bytes = 12 hexadecimal digits = 48 bits

CA1885-0CB72C

CA-18-85-0C-B7-2C

Organizationally Unique Identifier

Device ID



Network Interface Card

# Physical Address (contd…)

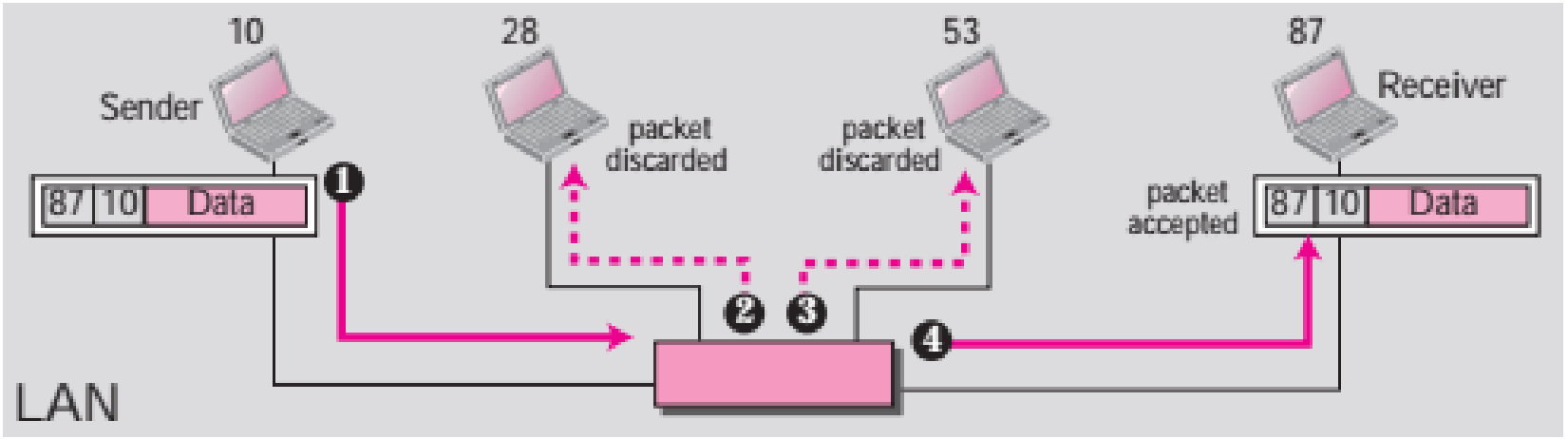

## What's Your MAC Address?

You can readily determine your MAC address on a modern computer from the command line.

1. In Windows Vista/7, click Start, enter **`cmd`** in the Start Search text box, and press the ENTER key to get to a command prompt.
2. In Windows 8, simply type **`cmd`** at the Start screen and press ENTER when the Command Prompt option appears on the right.
3. At the command prompt, type the command **`ipconfig /all`** and press the ENTER key.

# Physical Address (contd…)

- Use of Physical Address

# Logical Address

- Physical address is not suitable for internetwork as different networks can have different address formats
- A universal addressing system is needed in which each host can be identified uniquely, regardless of the underlying physical network
- Can be changed depending on the network
- No two publicly addressed and visible hosts on the Internet can have the same logical address (widely known as Internet Protocol (IP) address.
- 32-bits length

# Port Address

- Used to identify a process (Email, FTP)
- 16-bits length
- Internet Assigned Number Authority (IANA) assigns Port address

# Port Address

| Well-Known Port | Application | Protoc |
|---|---|---|
| 20 | File Transfer Protocol (FTP) Data | TCP |
| 21 | File Transfer Protocol (FTP) Control | TCP |
| 23 | Telnet | TCP |
| 25 | Simple Mail Transfer Protocol (SMTP) | TCP |
| 69 | Trivial File Transport Protocol (TFTP) | UDP |
| 80 | Hypertext Transfer Protocol (HTTP) | TCP |
| 110 | Post Office Protocol 3 (POP3) | TCP |
| 194 | Instant Relay Chat (IRC) | TCP |
| 443 | Secure HTTP (HTTPS) | TCP |
| 520 | Routing Information Protocol | UDP |

# Binary-to-Decimal Conversion


For addressing, we require
to convert a 8-bits binary to decimal
To convert a decimal number of up to 255 to binary number

| Digit | $x_8$ | $x_7$ | $x_6$ | $x_5$ | $x_4$ | $x_3$ | $x_2$ | $x_1$ |
|---|---|---|---|---|---|---|---|---|
| Position of digit, *i* | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Contribution of the digit, $2^{i-1}$ | $2^{8-1}$ | $2^{7-1}$ | $2^{6-1}$ | $2^{5-1}$ | $2^{4-1}$ | $2^{3-1}$ | $2^{2-1}$ | $2^{1-1}$ |
| Decimal contribution | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |

# Binary-to-Decimal Conversion

$if\ \ x_i = 1, add\ 2^{i-1}\ to\ the\ sum \qquad for\ \forall i$

| **Digits** | **1** | **0** | **0** | **1** | **1** | **0** | **0** | **1** |
|---|---|---|---|---|---|---|---|---|
| Position | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Contribution | 128 | | | 16 | 8 | | | 1 |

128+16+8+1=153

$(10011001)_2=(153)_{10}$

# Binary-to-Decimal Conversion

| 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
|---|---|---|---|---|---|---|---|

| **Digits** | **0** | **1** | **0** | **0** | **1** | **1** | **0** | **1** |
|---|---|---|---|---|---|---|---|---|
| Position | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Contribution | | 64 | | | 8 | 4 | | 1 |

$$64+8+4+1=77$$

$$(01001101)_2=(77)_{10}$$

# Decimal-to-Binary Conversion


❖$(172)_{10}$ =(  )$_2$

$(172)_{10}$ =( 10101100)$_2$

**Step 1.** Because 172 is NOT less than 128, place a 1 in the 128 position and subtract 128 (1 * 128).

**Step 2.** Because 44 is less than 64, place a 0 in the 64 position and subtract 0 (0 * 64).

**Step 3.** Because 44 is NOT less than 32, place a 1 in the 32 position and subtract 32 (1 * 32).

**Step 4.** Because 12 is less than 16, place a 0 in the 16 position and subtract 0 (0 * 16).

**Step 5.** Because 12 is NOT less than 8, place a 1 in the 8 position and subtract 8 (1 * 8).

**Step 6.** Because 4 is NOT less than 4, place a 1 in the 4 position and subtract 4 (1 * 4).

**Step 7.** Because 0 is less than 2, place a 0 in the 2 position and subtract 0 (0 * 2).

**Step 8.** Because 0 is less than 1, place a 0 in the 1 position and subtract 0 (0 * 1).

# Decimal-to-Binary Conversion


❖$(20)_{10}$ =( )$_2$

$(20)_{10}$ =( 00010100)$_2$

**Step 1.** Because 20 is less than 128, place a 0 in the 128 position and subtract 0 (0 * 128).

**Step 2.** Because 20 is less than 64, place a 0 in the 64 position and subtract 0 (0 * 64).

**Step 3.** Because 20 is less than 32, place a 0 in the 32 position and subtract 0 (0 * 32).

**Step 4.** Because 20 is NOT less than 16, place a 1 in the 16 position and subtract 16 (1 * 16).

**Step 5.** Because 4 is less than 8, place a 0 in the 8 position and subtract 0 (0 * 8).

**Step 6.** Because 4 is NOT less than 4, place a 1 in the 4 position and subtract 1 (1 * 4).

**Step 7.** Because 0 is less than 2, place a 0 in the 2 position and subtract 0 (0 * 2).

**Step 8.** Because 0 is less than 1, place a 0 in the 1 position and subtract 0 (0 * 1).

# IP Address

- IP=Internet Protocol
- Unique and universal
- 32-bit binary address
- Divided into four octate
- Octets are separated by dot (.) sign

**Address space**
Total number of address used by a protocol
For b bits, the address space is $2^b$

**The address space of IPv4 is $2^{32}$ or 4,294,967,296.**

10000000000010110000001100011111

10000000 00001011 00000011 00011111

**Octet**

**IP Address** 10000000.00001011.00000011.00011111

**Doted Decimal of IP address** 128.11.3.31

# IP Address

## Example

Change the following IPv4 addresses from binary notation to dotted-decimal notation.

a. 10000001 00001011 00001011 11101111

b. 11000001 10000011 00011011 11111111

## Example

Change the following IPv4 addresses from dotted-decimal notation to binary notation.

a. 111.56.45.78

b. 221.34.7.82

# IP Address

## Example

Find the error, if any, in the following IPv4 addresses:

a. 111.56.045.78

b. 221.34.7.8.20

# Ranges of Address

## Example

Find the number of addresses in a range if the first address is 146.102.29.0 and the last address is 146.102.32.255.

## Solution

$$\text{Number of addresses} = (0 \times 256^3 + 0 \times 256^2 + 3 \times 256^1 + 255 \times 256^0) + 1 = 1024$$

## Example

The first address in a range of addresses is 14.11.45.96. If the number of addresses in the range is 32, what is the last address?

## Solution

$$\text{Last address} = (14.11.45.96 + 0.0.0.31)_{256} = 14.11.45.127$$

# References


**1. Official Cert Guide CCNA 200-301 , vol. 1**, *W. Odom*, Cisco Press, First Edition, 2019, USA.

**2. CCNA Routing and Switching**, *T. Lammle*, John Wily & Sons, Second Edition, 2016, USA.

**3**. Cisco IOS Configuration Fundamentals Command Reference. http://www.cisco.com

# Books

**1. Official Cert Guide CCNA 200-301 , vol. 1**, *W. Odom*, Cisco Press, First Edition, 2019, USA.

**2. CCNA Routing and Switching**, *T. Lammle*, John Wily & Sons, Second Edition, 2016, USA.