

IP Addressing I

Course Title: Computer Networks



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Lecture Outline

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



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

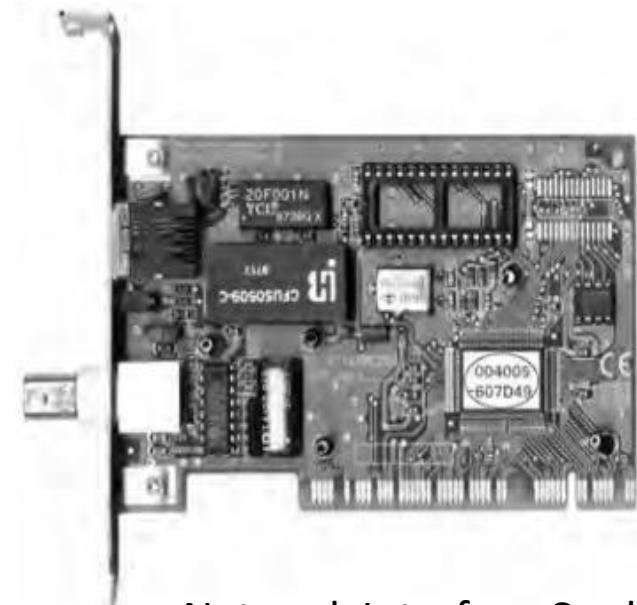
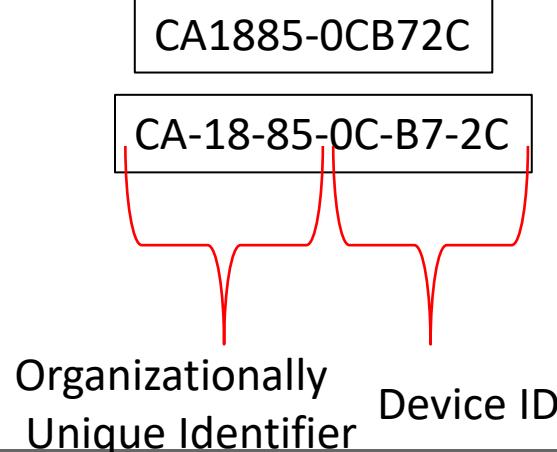
- 6 byte address is also called *Medium/Media Access Control (MAC)*.
- No two NICs ever share the same MAC address.
- Either imprinted on the surface or burnt into a ROM chip.

Both are used

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



Network Interface Card



Physical Address

What's Your MAC Address?

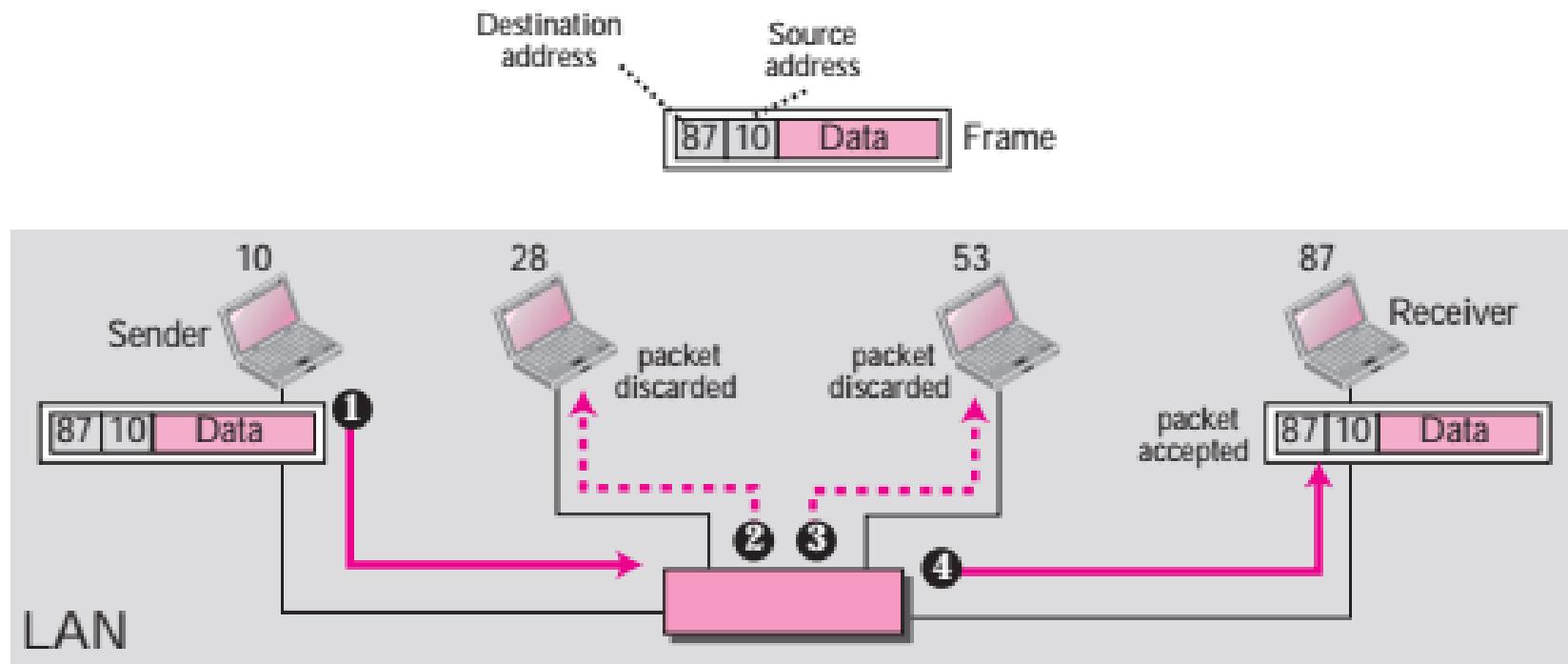
You can readily determine your MAC address on a modern computer from the command line.

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

- 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	Protocol
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 8-bit 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 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

❖ $(172)_{10} = (\quad)_2$

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

- Step 1.** Because 172 is NOT less than 128, place a 1 in the 128 position and subtract $1 * 128$.
- Step 2.** Because 44 is less than 64, place a 0 in the 64 position and subtract $0 * 64$.
- Step 3.** Because 44 is NOT less than 32, place a 1 in the 32 position and subtract $32 * 1$.
- Step 4.** Because 12 is less than 16, place a 0 in the 16 position and subtract $0 * 16$.
- Step 5.** Because 12 is NOT less than 8, place a 1 in the 8 position and subtract $1 * 8$.
- Step 6.** Because 4 is NOT less than 4, place a 1 in the 4 position and subtract $1 * 4$.
- Step 7.** Because 0 is less than 2, place a 0 in the 2 position and subtract $0 * 2$.
- Step 8.** Because 0 is less than 1, place a 0 in the 1 position and subtract $0 * 1$.



Decimal-to-Binary Conversion

❖ $(20)_{10} = (\quad)_2$

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

- 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 ($0 * 1$).

Conversion Exercise

- ↗ Convert the following:
- ↗ 210, 50, 65, 172, 169
- ↗ 11001010, 11100001, 10101111



IP Address

- IP=Internet Protocol
- Unique and universal
- 32-bit binary address
- Divided into four octet
- 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 a) 192.168.10.25

b) 16.32.25.31

c) 78.123.222.44

Example

a) 11110000.10101010.11100011.00011100

b) 10001000.10010011.11100000.00000110



IP Address

Example

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

- a. 111.56.045.78
- b. 221.34.7.8.20



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 Wiley & 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 Wiley & Sons, Second Edition, 2016, USA.**