

Network



LAB 2

Introduction to IP addressing:



- Each Network Interface Card (NIC or Network card) present in a PC is assigned one Network address called as IP address [or Network address]. This IP address is assigned by the administrator of the network. No two PCs can have the same IP address.
- A MAC (Media Access Control) address is a number that identifies the network adapter(s) installed on your computer. The address is composed of up to 6 pairs of characters, separated by colons. You may need to provide your MAC address to a router in order to successfully connect to a network.

Introduction to IP addressing:

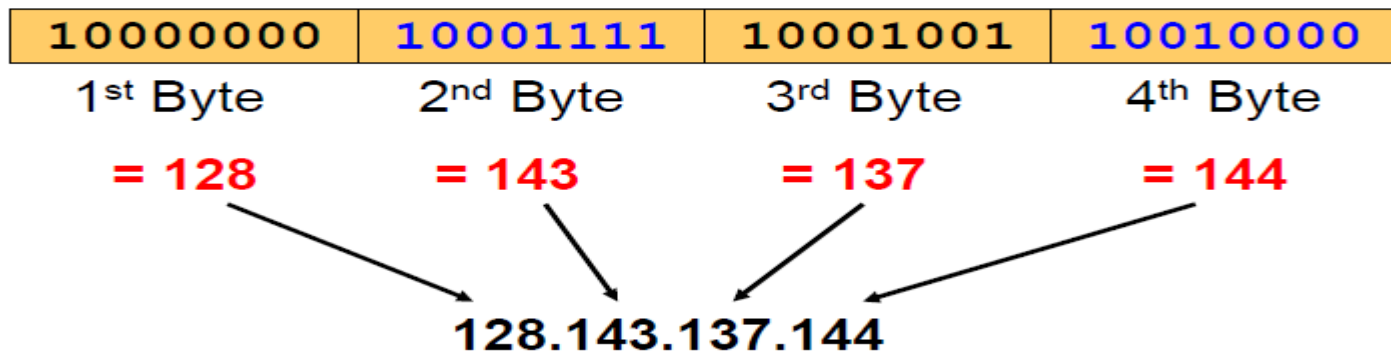


- The network prefix identifies a network and the host number identifies a specific host (actually, interface on the network).

network prefix

host number

- **Example:**



Rules of IPv4 addressing



1. Format of IP address

- IPv4 is made up of four parts, in the pattern as w.x.y.z. Each part has 8 binary bits and the values in decimal can range from 0 to 255.

2. IP address classes

- IP addresses are divided into different classes. These classes determine the maximum number of hosts per network ID. Only three classes are actually used for network connectivity. The following table lists all of the address class.

Rules of IPv4 addressing



IP address class	Value of the leftmost byte
Class A	1-126 [0 and 127 are not allowed]
Class B	128-191
Class C	192-223

Rules of IPv4 addressing



3. Grouping of IP addresses into different classes.

a. Class A, B, C, D, E

b. Class A: first bit in w is 0 and others can be anything

-i. 0.0.0.0 to 126.255.255.255

○ ii. First bits are used for network part and the remaining for host part.

c. Class B: First bit in w is 1 and second bit is 0.

128.0.0.0 to 191.255.255.255

ii. First 16 bits for network part and remaining host part

Rules of IPv4 addressing



- d. Class C: first bit in w is 1, second bit in w is 1 and third bit is 0
- i. 192.0.0.0 to 223.255.255.255
 - ii. First 24 bits for network part and last 8 bits for host part.

Rules of IPv4 addressing



e. Class D: first, second, third bits in w are 1 and fourth bit is 0; used for multicast.

i. 224.0.0.0 to 247.255.255.255

f. Class E: future use or experimental purposes.

Rules of IPv4 addressing



4. Default Subnet mask

- it is used to identify the network part from the host part. Put binary one for the parts that represent network part and zero for the part that represent host part.
 - a. Class A: 255.0.0.0
 - b. Class B: 255.255.0.0
 - c. Class C: 255.255.255.0

Invalid IP address.



- a. If the network part is all 0s, the address belongs to class A. But this is an invalid ip address because for an ip address all the network or host part should not be all 1s or all 0s.
 - i. 0.0.0.0 is not valid. Routers use it internally.
- b. If the network part is all 1s, this address belongs to class E. But due to presence of all 1s, it is not valid. This represent broadcast to all networks.
 - i. 255.255.255.255 is not valid.

Invalid IP address.



c. If the host part is all 0s, this represents network address. This is not a valid ip address.

d. 127.0.0.0 network address is used for loop-back testing. This will help you to check the network card of your own PC [localhost].

Number of hosts/networks per classes



IP Address Class	Total # Of Bits For Network ID / Host ID	First Octet of IP Address	# Of Network ID Bits Used To Identify Class	# Of Host IDs Per Network ID
Class A	8 / 24	0xxx xxxx	1	$2^{24}-2 = 16,277,214$
Class B	16 / 16	10xx xxxx	2	$2^{16}-2 = 65,534$
Class C	24 / 8	110x xxxx	3	$2^8-2 = 254$

Examples



1. Find the class of the address:

- **11000001 10000011 00011011 11111111**
- The first 2 bits are 1; the third bit is 0.
- This is a class C address.

Examples



2. Find the class of the address:

- **227.12.14.87**
- The first byte is 227 (between 224 and 239); the class is D. or $227 = \mathbf{11100011}$, the first 4 bit 1110 is class |D

Examples



- Given the address 23.56.7.91 and the default class A mask, find the beginning address (network address).
- The default mask is 255.0.0.0, which means that only the first byte is preserved and the other 3 bytes are set to 0s.
- The network address is 23.0.0.0.

Examples



- Given the address 132.6.17.85 and the default class B mask, find the beginning address (network address).
- **Solution**
- The default mask is 255.255.0.0, which means that the first 2 bytes are preserved and the other 2 bytes are set to 0s.
- The network address is 132.6.0.0.

Addresses at Layers



- **Data Link Layer** - address must be able to select any host on the network (MAC).
- **Network Layer** - address must be able to provide information to enable routing (IP).
- **Transport Layer** - address must identify the destination process (PORT).

Types of Message



- 1- **Unicast:** in a single destination between switch or router to one device (host) this mean one-to-one.
- 2- **Multicast:** the packet sends from single source to many hosts in the network this mean one-to-many.
- 3- **Broadcast:** the packet sends from single source to all hosts this mean one –to-all.

Custom Mask



- this method allow us to use number of hosts that responds our need.

How we calculate custom Mask?



- Suppose we have 500 hosts in network, what is suitable subnet mask used?
- We use $(2^h - 2) = \text{number of hosts}$
- So, $2^9 - 2 = 510$
- Then $h = 9$
- Number of zeros in custom mask from right are 9, so custom mask that suitable to this network is

11111111.11111111.11111110.00000000

255.255.254.0

How we calculate custom Mask? (Cont.)



- Suppose we have 2000 hosts in network.

Step 1:

- We use the equation $(2^h - 2)$ to execute the number of zeros in the subnet mask.
- The nearest number of 2000 is 2048
- $2^{11} - 2 = 2046$.
- Then $h = 11$ (the number of zeros).

How we calculate custom Mask? (Cont.)



- **Step 2:**

- The subnet is in binary

11111111.11111111.11111000.00000000

- In decimal

255.255.242.0

How we calculate custom Mask? (Cont.)



Step 3:

- We take a random IP 10.80.80.80
- convert it to binary

00001010.01010000. 01010000. 01010000

How we calculate custom Mask? (Cont.)



Step 4:

- We make And operation between the random IP and subnet mask to extract the subnet in our network.

11111111.11111111.11110000.00000000

00001010.01010000.01010000.01010000

- The result is:

00001010. 01010000. 01010000.00000000

10.80.80.0

AND Operation:

1 + 1 = 1 , others equal 0 (0+0 =0, 0 +1 = 0)

How we calculate custom Mask? (Cont.)



- How to calculate Broadcast IP?

subnet= 11111111.11111111.11111000.00000000

random IP=

00001010.01010000.01010000.01010000

Broadcast IP is

00001010.01010000.01010111.11111111

10.80.87.255

How we calculate custom Mask? (Cont.)



Subnet	First ip	Last ip	Broadcast
10.80.80.0	10.80.80.1	10.80.87.254	10.80.87.255

- This Custom Mask 255.255.248.0 Include $2^5=32$ Subnet each subnet include 2048 Hosts.
- Number of subnets = $2^{\text{numOf}(1\text{s})}$ in Octet with mix of (0 and 1) in subnet mask



END