

IP Address - Internet Protocol Address

A numerical address assigned to each device in a computer network.

Internet Protocol Version 4 (IPv4)

- 32 bit number
- 4 octets
- commonly in use today

Internet Protocol Version 6 (IPv6)

- 128 bit number
- 8 octets
- Not yet widely used.

Classes of IP Addresses

IPv4 Classes:

Class	A	B	C	D	E
1st Octet Range	1-126*	128-191	192-223	224-239	240-254
IP Addresses Range	1.0.0.1 to 126.255.255.254	128.1.0.1 to 191.255.255.254	192.0.1.1 to 223.255.254.254	224.0.0.0 to 239.255.255.255	240.0.0.0 to 254.255.255.254
Default Subnet Mask	255.0.0.0	255.255.0.0	255.255.255.0	NA	NA
Network / Host ID	N.H.H.H	N.N.H.H	N.N.N.H	NA	NA
Number of Networks configurable	126 ($2^7 - 2$)	16,382 ($2^{14} - 2$)	2,097,150 ($2^{21} - 2$)	NA	NA
Number of devices configurable per network	16,777,214 ($2^{24} - 2$)	65,534 ($2^{16} - 2$)	254 ($2^8 - 2$)	NA	NA
Purpose	Large networks	Medium sized networks	Small networks	Reserved for multi casting	For research and development

- Class A - range 127.0.0.1 to 127.255.255.255 - reserved for loop back and diagnostic purposes.
- Any server / system localhost ip address is 127.0.0.1

Public vs Private IP Addresses

- Public IP address is assigned to a computer by the ISP when it is connected to the Internet.
- Private IP addresses are used to configure the devices in a private network (LAN / MAN / WAN).

Reserved IP Range for configuring devices LAN (Private IP Addresses):

Class	Private Networks	Subnet Mask	Address Range
A	10.0.0.0	255.0.0.0	10.0.0.0 - 10.255.255.255
B	172.16.0.0 - 172.31.0.0	255.240.0.0	172.16.0.0 - 172.31.255.255
C	192.168.0.0	255.255.0.0	192.168.0.0 - 192.168.255.255

Static vs Dynamic IP Addresses

Static

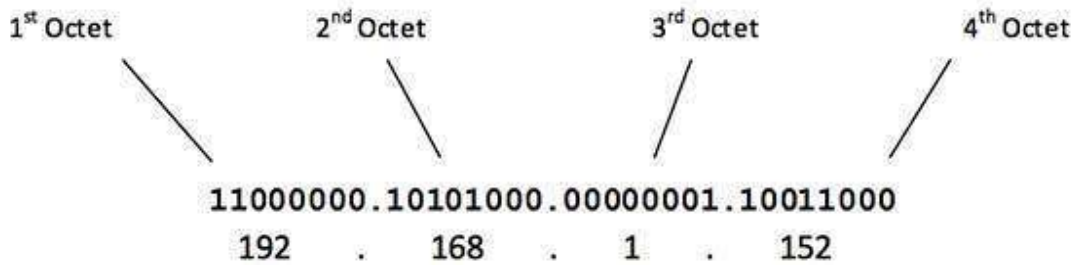
- Static IP address does not change once it is assigned to a device / computer in a network.
- Since, the IP is static and known there is more possibility for network attacks
- Used by Web Servers, E-mail Servers
- Number of allocatable IP addresses is limited in IPv4. Hence, nowadays it is not possible to connect all the devices that exists in world to **Internet** simultaneously by using IPv4.

Dynamic

- Dynamic IP addresses are assigned by ISP using DHCP
- Available IP address is assigned to a device when it is connected to the network, after the session expiry the IP address released for other device's use.
- Effective use of IP addresses is an advantage of Dynamic IP address assigning.
- Since, the IP address changes frequently, it become not traceable.

Explanation of various IP address Classes

The first octet referred here is the left most of all. The octets numbered as follows depicting dotted decimal notation of IP Address:



The number of networks and the number of hosts per class can be derived by this formula:

$$\text{Number of networks} = 2^{\text{network_bits}}$$

$$\text{Number of Hosts/Network} = 2^{\text{host_bits}} - 2$$

When calculating hosts' IP addresses, 2 IP addresses are decreased because they cannot be assigned to hosts, i.e. the first IP of a network is network number and the last IP is reserved for Broadcast IP.

Class A Address

The first bit of the first octet is always set to 0 (zero). Thus the first octet ranges from 1 – 127, i.e.

$$\begin{array}{l} 00000001 - 01111111 \\ 1 - 127 \end{array}$$

Class A addresses only include IP starting from 1.x.x.x to 126.x.x.x only. The IP range 127.x.x.x is reserved for loopback IP addresses.

The default subnet mask for Class A IP address is 255.0.0.0 which implies that Class A addressing can have 126 networks (2^7-2) and 16777214 hosts ($2^{24}-2$).

Class A IP address format is thus: 0NNNNNNN.HHHHHHHH.HHHHHHHH.HHHHHHHH

Class B Address

An IP address which belongs to class B has the first two bits in the first octet set to 10, i.e.

$$\begin{array}{l} 10000000 - 10111111 \\ 128 - 191 \end{array}$$

Class B IP Addresses range from 128.0.x.x to 191.255.x.x. The default subnet mask for Class B is 255.255.x.x.

Class B has 16384 (2^{14}) Network addresses and 65534 ($2^{16}-2$) Host addresses.

Class B IP address format is: **10**NNNNNNN.NNNNNNNN.HHHHHHHH.HHHHHHHH

Class C Address

The first octet of Class C IP address has its first 3 bits set to 110, that is:

11000000 - 11011111
192 - 223

Class C IP addresses range from 192.0.0.x to 223.255.255.x. The default subnet mask for Class C is 255.255.255.x.

Class C gives 2097152 (2^{21}) Network addresses and 254 (2^8-2) Host addresses.

Class C IP address format is: **110**NNNNNN.NNNNNNNN.NNNNNNNN.HHHHHHHH

Class D Address

Very first four bits of the first octet in Class D IP addresses are set to 1110, giving a range of:

11100000 - 11101111
224 - 239

Class D has IP address range from 224.0.0.0 to 239.255.255.255. Class D is reserved for Multicasting. In multicasting data is not destined for a particular host, that is why there is no need to extract host address from the IP address, and Class D does not have any subnet mask.

Class E Address

This IP Class is reserved for experimental purposes only for R&D or Study. IP addresses in this class ranges from 240.0.0.0 to 255.255.255.254. Like Class D, this class too is not equipped with any subnet mask.