IP ADDRESSING

INTRODUCTION

- An IP address, short for Internet Protocol address, is an identifying number for network hardware connected to a network.
- Having an IP address allows a device to communicate with other devices over an IP-based network like the internet.
- An IP address provides an identity to a networked device on the internet.
- Similar to a home or business address that supplies a specific physical location with an identifiable address, devices on a network are differentiated from one another through IP addresses.

Types of IP Addresses

- ***Private IP Address:*** These are used inside a network, for example, a home network that is used by tablets, Wi-Fi cameras, wireless printers, and desktop PCs.
- These types of IP addresses provide a way for devices to communicate with a router and the other devices on the private home network. Private IP addresses can be set manually or assigned automatically by the router.

Types of IP Addresses

- ***Public IP Address:*** These are used on the outside of a network and are assigned by an ISP(Internet Service Provider).
- It's the main address that a home or business network uses to communicate with the rest of the networked devices around the world (for example, the internet). E.g enables a device in a home network to access a website
- Both private IP addresses and public IP addresses are either dynamic or static, which means that, respectively, they either change or they don't.

Types of IP Addresses

- ***Dynamic IP Address:*** it is any IP Address assigned by a Dynamic Host Configuration (DHCP) Server.
- A DHCP server assigns an IP address to a device whenever the devise connects to the network with such as server.
- The IP address assigned to a device by a DHCP is not permanent and thus every time the device connects to the network it is assigned a new IP address and every time the device is disconnected the DHCP takes back the IP address

Types of IP Addressing

- ***Static IP Address:*** Any IP address that is assigned manually by the network designer or administrator. It is advisable to use static IP Addresses in Servers since the server IP address needs to be constant at all times for security purposes and also for ease of access by clients.

Categories of IP Addresses

- We have two addressing schemes namely;
  - IPv4- Comprised of 32 bits
  - IPv6-Comprised of 128 bits

IPv4 Addressing

- IPv6 is increasingly being adopted in corporate networks, however ,IPv4 is by far the most popular Layer 3 addressing scheme in today's networks.

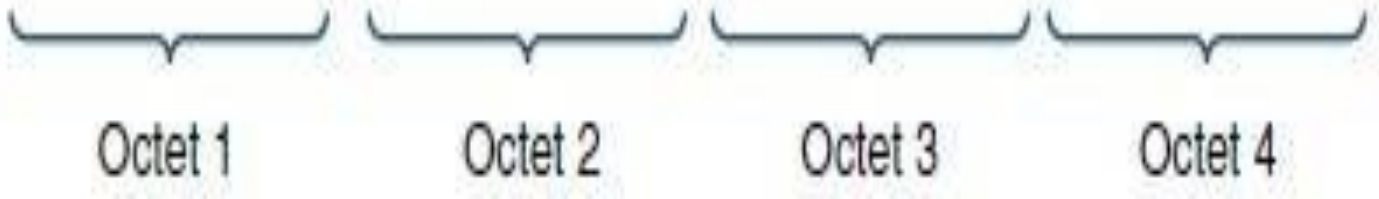
IPv4 Address Structure

An IPv4 address is a 32-bit address, however the address is typically written in *dotted-decimal* notation.

An IPV4 address is divided into four octets

Binary Representation of Dotted Decimal IP Address 10.1.2.3

Dotted Decimal Notation	10	1	2	3
Binary Bits	00001010	00000001	00000010	00000011



- IP address is composed of two types of addresses or two parts :
  - a network address.
  - a host address.

- The IP address component that determines which bits refer to the network and which bits refer to the host is called the ***subnet mask*** .
- A subnet mask contains 32 bits, which correspond to the 32 bits found in an IPv4 address.
- Note that once you assign an IP address to a device, the subnet mask is assigned automatically

Dividing an IP Address into a Network Portion and a Host Portion

Dotted Decimal Notation	10	1	2	3
IP Address (in Binary)	00001010	00000001	00000010	00000011
Subnet Mask	11111111	00000000	00000000	00000000

Network Bits

Host Bits

Classes of Addresses

- Although an IP address (or a network address) needs subnet mask information to determine which bits represent the network portion of the address, there are default subnet masks with which you should be familiar.
- The default subnet mask for a given IP address is solely determined by the value in the IP address' first octet.

IP Address Classes

Address Class	Value in First Octet	Classful Mask(Dotted Decimal)	Classful Mask(Prefix Notation)
Class A	1-126	255.0.0.0	/8
Class B	128-191	255.255.0.0	/16
Class C	192-223	255.255.255.0	/24
Class D	224-239	N/A	N/A
Class E	240-255	N/A	N/A

NB: The number **127** was skipped, reason being 127 is used as a loopback IP address, meaning a locally significant IP Address representing the device itself.

- Classes A, B, and C are those ranges of addresses assigned to network devices.
- Class D addresses are used as destination IP for multicast networks.
- Class E addresses are reserved for experimental use.
- The default subnet masks associated with address classes A, B, and C are called *classful masks .*

- When an organization is assigned one or more publicly routable IP addresses by its service provider, that organization often needs more IP addresses to accommodate all of its devices.
- One solution is to use *private IP addressing within an organization,* in combination with *Network Address Translation (NAT).*
- Specific Class A, B, and C networks have been designed for private use. Although these networks are routable (with the exception of the 169.254.0.0–169.254.255.255 address range), within the organization, ISPs do not route these private networks over the public Internet.

Private IP Networks

Address Class	Address Range
Class A	10.0.0.0 -10.255.255.255
Class B	172.16.0.0 -172.31.255.255
Class B	169.254.0.0 -169.254.255.255
Class C	192.168.0.0 -192.168.255.255

NB: The 169.254.0.0 – 169.254.255.255 address range is not routable. These addresses are used only on their local subnet and are dynamically assigned to network hosts using the Automatic IP Address Assignment(APIPA)

Assignable IP Addresses

Address Class	Assignable IP Addresses
Class A	16,777,214(2^{24} -2)
Class B	65,534(2^{16} -2)
Class C	254(2^{8} -2)

Suppose that you decide to use a private Class B IP address (for example, 172.16.0.0/16) for your internal IP addressing. For performance reasons, you probably would not want to support as many as 65,534 hosts in a single broadcast domain.
Therefore, a best practice is to take such a network address and subnet the network (thereby extending the number of network bits in the network's subnet mask) into additional subnetworks.

IP Version 6

- IPv6 provides enough IP addresses for many generations to come.

Features of IPv6

- Increased address space(IPv6 offers approximately 3.4028e+38 IP addresses for each person on the planet).
- Simplified header
  - IPv4 header uses 12 fields
  - IPv6 header uses five fields
- No broadcasts
- Can coexist with IPv4 during a transition
  - Dual stack (running IPv4 and IPv6 simultaneously)
  - IPv6 over IPv4 (tunneling IPv6 over an IPv4 tunnel)