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The Network Layer

While discussing network layer , the important term to be discussed is IP - Internet Protocol.

IP Address : 32 bit long number made up of 4 octets, each octet is normally described in decimal numbers. Each octet value can range from 0 to 255. IP can be configured either by static or dynamically. Nowadays, a special protocol is used to configure the IP addresses known as Dynamic Host Configuration Protocol (DHCP). That IP is said to be dynamic IP.

In most cases, Static IP addresses are reserved for servers and network devices, while dynamic IP addresses are reserved for clients.

Note : IP addresses belong to networks, not to the devices attached to those networks.

IP Datagrams and Encapsulation

Packets under IP protocol are known to be IP datagram. There are two primary sections are in IP datagram,

- Header Section
- Payload Section

And, two versions of IP exist in this world : **IPv4** and **IPv6**. Mostly, we use IPv4 addresses.

IP Address Classes

Generally IP addresses can be split into two sections : **Network ID** and **Host ID**. IP addresses are classified into some classes by the **Address Class System** (A way of defining how the global IP address space is split up).

We already know that IP addresses of range 0 to 255 and IP addresses comprises 4 octets based upon first octet value, the IP addresses are categorized.

IP address classes

Class	Range	Max Hosts
A	0-126	16 Million
B	128-191	64,000
C	192-224	254
D	224-239	N/A
E	240-255	N/A

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Address Resolution Protocol

How , **MAC** and **IP** can relate to each other? This is where Address Resolution Protocol comes into play.

Generally ARP is a protocol used to discover the hardware address of the node with a certain IP address. ARP has a table, called ARP table in which the list of IP addresses and the MAC addresses associated with them. ARP table entries generally expire after a short amount of time to ensure changes in the network that are connected.

Subnetting :

The process of taking a large network and splitting it up into many individual and smaller subnetworks of subnets.

Subnetting Mask :

A way for a computer to use AND operators to determine if an ip address exists on the same network. It is a 32 bit number that is normally written out as four octets in decimal. Consider a simple example 9.100.100.100

IP address	9	100	100	100
IP address (in binary)	0000 1001	0110 0100	0110 0100	0110 0100
Subnet mask (in binary)	1111 1111	1111 1111	1111 1111	0000 0000

The most common Subnet Mask is **255.255.255.224** shortly described as /27 (No of ones)(i.e)CIDR notation will be discussed later.

255 . 255 . 255 . 224

11111111 11111111 11111111 11100000

Classless Inter- Domain Routing (CIDR)

Address classes were the first attempt at splitting up the global internet IP space. Subnetting is introduced when address classes themselves weren't an efficient way of keeping everything organized. But using traditional subnet masking and address classes is not efficient nowadays. That's where classless Inter-Domain Routing comes into play.

In older methods, we use subnet ID, network ID and host ID to deliver an IP datagram to the correct location. With CIDR, the network ID and subnet ID are combined into one.

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CIDR uses slash notation which is also known as CIDR notation. CIDR basically just abandons the concept of address classes entirely allowing an address to be defined by only two individual ID's

Eg : 9.100.100.100 (IP)

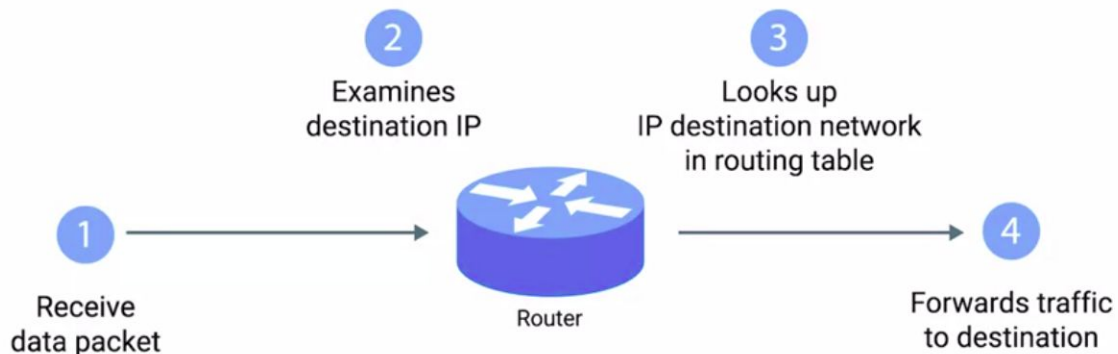
255.255.255.0 => Net mask

This can be written as **9.100.100.100/24**

Routing :

The way communications happen across all these networks, allowing you to access data from the other side of the planet is through **routing**.

Router : A network device that forwards traffic depending on the destination address of that traffic. Generally routing process carried out through Routing tables. Router looks at the routing table to determine which path is the quickest and forward the packet along the path.



Router uses two types of protocols to do the routing process, namely

- **Interior Gateway Protocol**
 - **Link state routing protocol**
 - **Distance vector routing protocol**
- **Exterior Gateway Protocol**

Interior Gateway Protocol

Used by routers to share information within a single autonomous system. Autonomous system means a collection of networks that all fall under the control of a single network operator. Interior Gateway Protocol can be further classified into link state routing and distance vector routing protocols.

Distance Vector Protocols :

A router using a distance vector protocol basically just takes its routing table. It contains the information of the immediate neighbour only, not the entire autonomous system.

Link state routing protocols :

Routers using link state routing protocol use sophisticated approaches to find out the shortest path for the network. But, It requires more space to hold all the data.

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Exterior Gateway Protocol

Used by routers to exchange of information between independent autonomous systems. It represents the edges of an autonomous system, when they need to share information across different organizations.

IANA (Internet Assigned Numbers Authority) : *A non profit organization that helps in managing things like IP address allocation.*

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