

IP Addresses

What is an IP address ?

An IP (Internet Protocol) address is a unique numerical identifier assigned to every device connected to a network that uses the Internet Protocol for communication.

It consists of four numbers separated by periods that can be called dots, such as 192.168.0.1. Each number can range from 0 to 255, giving us over 4 billion possible combinations for IPV4 addresses. It uses a 32-bit addressing scheme used as TCP/IP host addressing mechanism.

Example like we have here - 192.168.1.152/24

In laymen terms, you can think An IP address is like a unique identifier for devices connected to a computer network. Just like how you have a mailing address nearby your house, not your actual house, i will tell you in the next module why we are not considering IP address as our home's address. As of now, we can consider IP address as our mail address in our city for receiving letters and packages. Like that only, devices on a network need an IP address to communicate with each other over the internet or a local network.

Understanding IP Address

So, here i have created a table that has bunch of 0s and 1s to understand how an IP address is formed. As we learned in the previous slide. Each IP address uses a 32 bit addressing scheme

What does that mean ?

that means, Each set is made of 8 bits.

Now, the numbers we see here has a range from 0 to 255. The minimum it can 0 and the maximum it can 255.

There are some number in the front row.

What is the similarity between them?

The similarity between them is that they all are related to number 2 - which is binary. Binary numbers consist of only two digits - 0 or 1. So the output can either be zero or one.

IPV4 vs IPV6

Next, we have IPV4 vs IPV6.

IPv4 has been the backbone of the internet for decades now, but.. with the rapid growth of connected devices, we're quickly running out of available IP addresses. Then Enters IPv6, the next-generation protocol which was designed to solve this particular problem and to provide a virtually limitless supply of IP addresses. So, we will look into differences between both of them. Starting off with

The Address Size - which is 32 bit for IPV4 and 128 bit for IPV6.

Next is Address format - where IPV4 addresses are separated in 4 numbers using dots where as in IPV6, it has 8 groups of 4 hexadecimal digits, separated by colons

Okay Now, the number of addresses - In IPV4 we can only have 4.3 billion IP addresses and in IPV6 it is virtually limitless as we are talking about 2 to the power 128 here.

Next is Address Configuration - In case of IPV4 it is either done manually or using a DHCP server however in IPV6 there is an automatic assignment.

At last, the Routing protocols in use - IPV4 uses RIP and IPsec whereas IPv6 uses RIPng and native Ipsec.

Types of IP addresses

So, in the previous slide while talking about the IPV4 addresses. We found out that the IPV4 addresses which is the most common IP address in use, in today also, can only have upto 4.3 billion addresses, however last i checked, the total population on our planet earth exceeds more than 7 billion and as we know, every device on the network have to have an IP address in order to communicate with other devices. Talking about my home only, i have more than 5 smart devices that are connected to the internet and i am sure you also might be having the same. Now, the question arises is that if we can only have 4 billion IP address and the total population on the planet is above 7 billion where 1 person is at least using more than one devices, then how we were dealing with this. To understand this, we have to look into the types of IP address.

So, every device on the network has two IP address. Let's say your phone. So your phone will have two IP addresses. One is the - Public IP address and the other one is the - Private IP address.

So, what is a public IP address

Public IP Addresses: A Public IP address is an internet address that is assigned to any device that directly faces the Internet. It is unique and identifies the device on the internet. It

<https://t.me/learningnets>

can be accessed from anywhere on the internet, making it useful for hosting websites or other services. Public IPs can be obtained from ISPs or purchased from companies that provide them.

Private IP Addresses: Private IPs on the other hand, also known as local IPs, are used within private networks and do not route over the Internet's backbone infrastructure like Public IPs do.

So, the public IP address of the device which is used to connect to the internet is different than the private IP address of the device that is used to communicate locally. But how both of them work in a sync. It is because of an awesome technology called NAT or Network Address Translation, which we will discuss in the next section.

- To check the local IP address on a system.

```
# Linux  
  
ip addr  
  
ifconfig  
  
# Windows  
  
ipconfig /all
```

- Check Public IP address online

<https://www.whatismyip.com/>

<https://www.ipaddress.my/>

Network Address Translation (NAT)

Network Address Translation (NAT) is a technique used to conserve IP addresses and provide security by mapping one or more private IP addresses to a public IP address.

Let's look into the picture we have here.

There are a bunch of devices which have their own Private IP addresses.

When they have to communicate to the outer world via Internet, they need to have a Public IP address. This is where the NAT comes into the picture. NAT is not a hardware technology rather it is embedded into your router only.

So, whenever a private IP address, let's say the first computer wants to connect to google.com on the internet. NAT will take its private IP address and forward the request to the google with the network Public IP address. Now, the thing to keep in mind here is that there is only 1 public IP address for all the private IP address here. So, when the google have to reply to the forwarded request, it will send the reply to our public IP address which NAT will then transfer to the respective private IP address that have made the request.

I hope, you have understood the basic concept of NAT and its working. Let's move forward to the section where will discuss the Classes of IP addresses.

Classes of IP addresses

So, here we have picture which shows some classes of IP addresses. Generally, there are 5 classes of IP addresses but the top 3 are the most in use. The picture here is showing the classes of private IP addresses, there is a public one also but the base skeleton of its working remains the same.

So, first we have Class A. The network numbers it starts off is of 10 range. Like this 10.0.0.0. The network mask it has is of 255.0.0.0, we will look into it later thoroughly and the number of network it can have is 126. Now, the number of hosts it can have - it is more than 16 million. So, whenever you are dealing with a Class A network it is generally related to big corporations and organizations.

Next, we have Class B. The network numbers in this starts off with 172 range. Like this 172.16.0.0. The network mask it has is 255.255.0.0. Number of network it can have is 16,383 and number of hosts it can have is 65,024. So, if you are dealing with such network then it might belong to a medium level organization.

At last, we have Class C. This is one of the most common types. We have already seen it while checking our private IP address. It starts off with 192 range have subnet mask of 255.255.255.0 and can hold upto 2,097,151 however the number of hosts it can have is 254 which is ideal for a small organization and home networks.

The thing to notice in all the three classes is the number of network and number of hosts. As the number of network decreases, the number of hosts increases and as the number of network increases, the number of hosts decreases. The reason behind this will be cleared more in the subnetting section. So, stay tuned! As of now, we are moving to the next section where we will learn about MAC addresses.
