**Lecture 1**

Internet : It is used for communication

Suppose we have two computers. We want to send the message from one computer to another. This can be done using internet.

So internet is used to do communication between the two or more devices.

All the devices have IP addresses. IP stands for Internet Protocol.

IP address is not your permanent address. Whenever your device is connected with the internet, then the device is given the IP address. And as the computer disconnects from the internet, the IP address is removed from that computer/device.

The IP address is given by the Internet Service Provider (ISP).

Now when you search any website, let suppose google.com, then this request will be sent to the DNS. DNS stands for Domain Name System. This DNS will return the IP address of google.com. And then after, the request will be sent to google. Once it accepts the request, then the website is loaded on your screen/server.

Now as a human beings, we cannot remember all the numbers of IP address so we have given the names to the domains. And then we will retrieve the IP addresses when we are needed.

Now if we want to learn how the websites and servers works behind the scenes, then we need to understand some properties.

So first when we search google.com, then it will first search in your local computer. If it founds the IP address, then it will return the IP address otherwise it will go to Recursive server.

Now the recursive server will search this into Root server. Inside the root server, all the servers and domains are stored in group format. Means it is in the structured format. Like all the .com domains are together, then all the .in domains, then .edu , etc. all are stored in structured format.

So here in our example, we are looking for the google.com. so this will search the google.com and will send the address of TLD server of .com.

TLD stands for Top Level Domain. It contains the servers like .com, .in and all in groups. Then this will return one another address of Authoritative server. And in the authoritative server, we will get the IP address. This IP address is sent to the server. And later on the website is also get loaded.

So the IP address is not permanent address, but the mac address is permanent address. Mac stands for Medium Access Control.

So whenever we are sending some information, then we also mac address. So the message format be like this

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sender IP | Sender MAC | Message | Receiver IP | Receiver MAC |

So that we can say that by using MAC address, we can uniquely identify the device.

Now the question is. What if the user has opened too many tabs? Then in which tab the information will be sent?

To solve this we will also need another parameter known as port number. Port number is used to uniquely identify the site or tab on which we want to send the message.

So the message format will again change like this:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sender IP | Sender MAC | Sender Port | Message | Receiver IP | Receiver MAC | Receiver Port |

Now we have two types of ports http and https. http is not secure protocol means while transferring the message, the outsider can read the message. But https is known as secured port. In https, we first encrypt the code before sending and after receiving the code, we will decrypt the code.

IP Address

An IPv4 (Internet Protocol version 4) address is the classic IP address format everyone is used to seeing.

* Structure: It's a 32-bit number. To make it readable for humans, we divide it into four 8-bit sections, and write each section as a decimal number from 0 to 255.
  + Example: 172.217.16.142 (one of Google's addresses)
* The Big Problem (The Why): A 32-bit number means there's a hard limit on the total number of possible addresses: 2^32, which is about 4.3 billion.

When the internet was designed, 4.3 billion seemed like an infinite number. But with the explosion of laptops, phones, servers, smart watches, and even smart refrigerators, we quickly realized we would run out.

**IPv6 (Internet Protocol version 6)** is the next generation of the Internet Protocol. Its primary purpose was to solve the address exhaustion problem of IPv4.

The fundamental difference is the size of the address:

* **IPv4:** Uses a **32-bit** address, giving us ~4.3 billion unique addresses.
* **IPv6:** Uses a **128-bit** address.

The difference between 32-bit and 128-bit is not 4x. It's an exponential leap that is difficult to comprehend.

The number of possible IPv6 addresses is 2^128, which is roughly:

**340,000,000,000,000,000,000,000,000,000,000,000,000**

(340 undecillion)

An example of a full IPv6 address:

2001:0db8:85a3:0000:0000:8a2e:0370:7334