

# IP Address

**Course Code:** CSE-311

**Course Name:** Computer Network and Security

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# Key Takeaways

## Computer Networking & Security – IP Module

### IP Address

Unique identifier for every networked device

### IP Types

Static, Dynamic, Public, Private, Shared, Dedicated

### Special IPs

Loopback (127.0.0.1), Broadcast, Network Address

### CIDR

Flexible prefix notation (/n) replacing classful system

### IPv4 / IPv6

32-bit vs 128-bit; IPv6 solves address exhaustion

### IP Classes

Class A–E; classful addressing; different network sizes

### Subnetting

Divides networks; uses subnet mask for boundary

### Net ID / Host ID

Subnet mask separates network from host portion

# What is an IP Address?

- All the computers of the world on the **Internet Network** communicate with each other with underground or underwater cables or wirelessly.
- If I want to download a file from the internet or load a web page or literally do anything related to the internet, my computer must have an address so that other computers can find and locate mine in order to deliver that particular file or webpage that I am requesting.
- In technical terms, that address is called **IP**

# What is an IP Address?

- An **Internet Protocol address (IP address)** is a numerical label such as 192.0.2.1 that is connected to a computer network that uses the Internet Protocol for communication.
- An IP address serves **two** main functions:
  - **Network interface identification:** Between a device and the network.
  - **Location addressing:** Geolocation is mapping

# IP Address in Networking

So we can say, In networking,

- IP Address is short for Internet Protocol Address.
- It is a unique address assigned to each computing device in an IP network.
- ISP assigns IP Address to all the devices present on its network.
- Computing devices use IP Address to identify and communicate with other devices in the IP network

# Why Do We Need IP?

- Unique device identification on networks
- Enables routing of data packets across internet
- Facilitates communication between different networks
- Supports network segmentation & security
- Foundation for all internet communication protocols
- Allows geolocation-based services

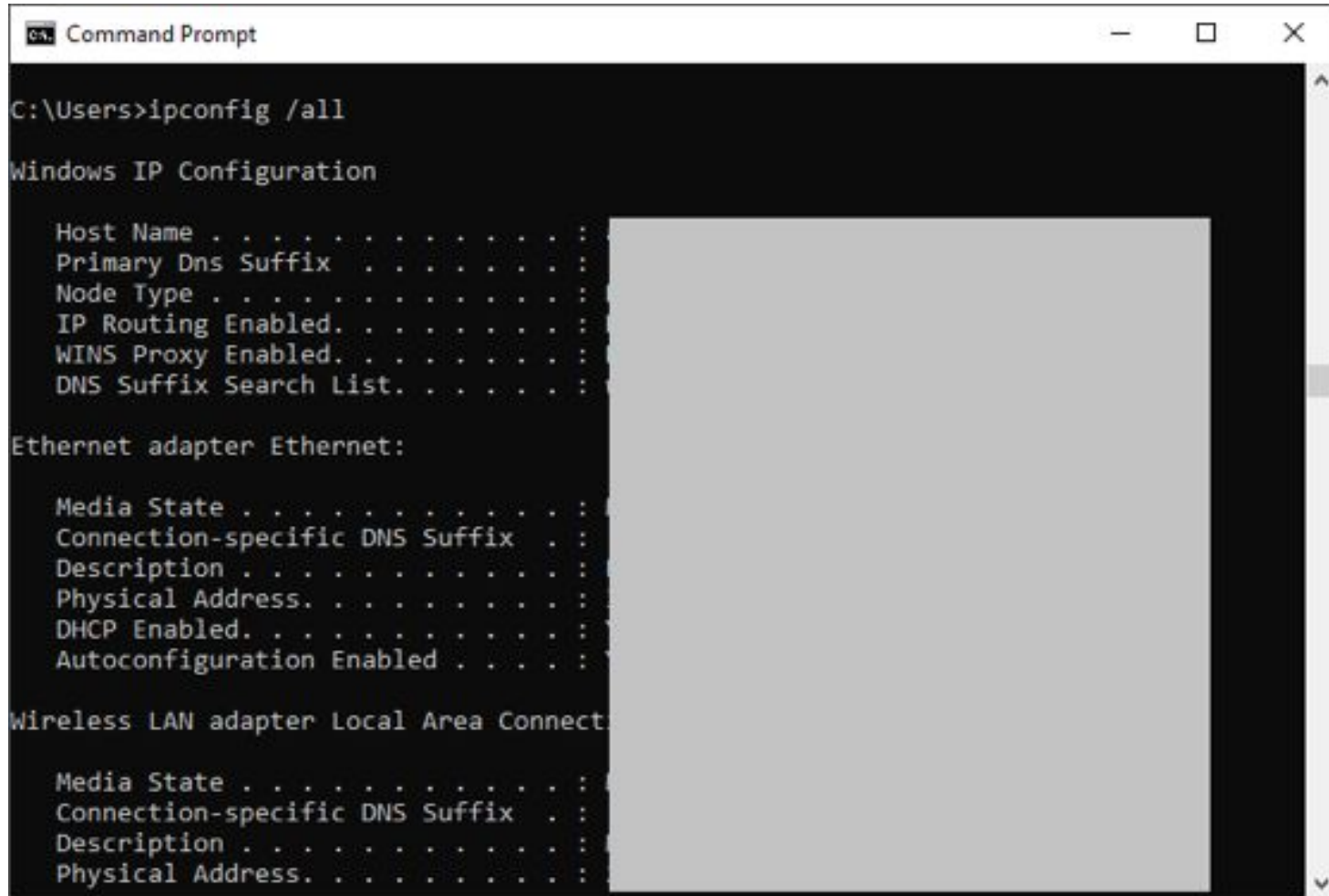
# How to Find Your IP Address?

There are many tools available on the Internet that interprets your computer's IP address and find your location. You can also try to find the IP address on your Windows 10, Mac, iPhone and Android phone.

**For example, on Windows 10 follow the below instructions:**

- Right click on the Start menu and open Command Prompt.
- Type **ipconfig** and hit enter.
- You will see IP address of your computer as below.

# How to Find Your IP Address?



```
Command Prompt

C:\Users>ipconfig /all

Windows IP Configuration

    Host Name . . . . . : 
    Primary Dns Suffix . . . . . : 
    Node Type . . . . . : 
    IP Routing Enabled. . . . . : 
    WINS Proxy Enabled. . . . . : 
    DNS Suffix Search List. . . . . : 

Ethernet adapter Ethernet:

    Media State . . . . . : 
    Connection-specific DNS Suffix . : 
    Description . . . . . : 
    Physical Address. . . . . : 
    DHCP Enabled. . . . . : 
    Autoconfiguration Enabled . . . . : 

Wireless LAN adapter Local Area Connect

    Media State . . . . . : 
    Connection-specific DNS Suffix . : 
    Description . . . . . : 
    Physical Address. . . . . :
```

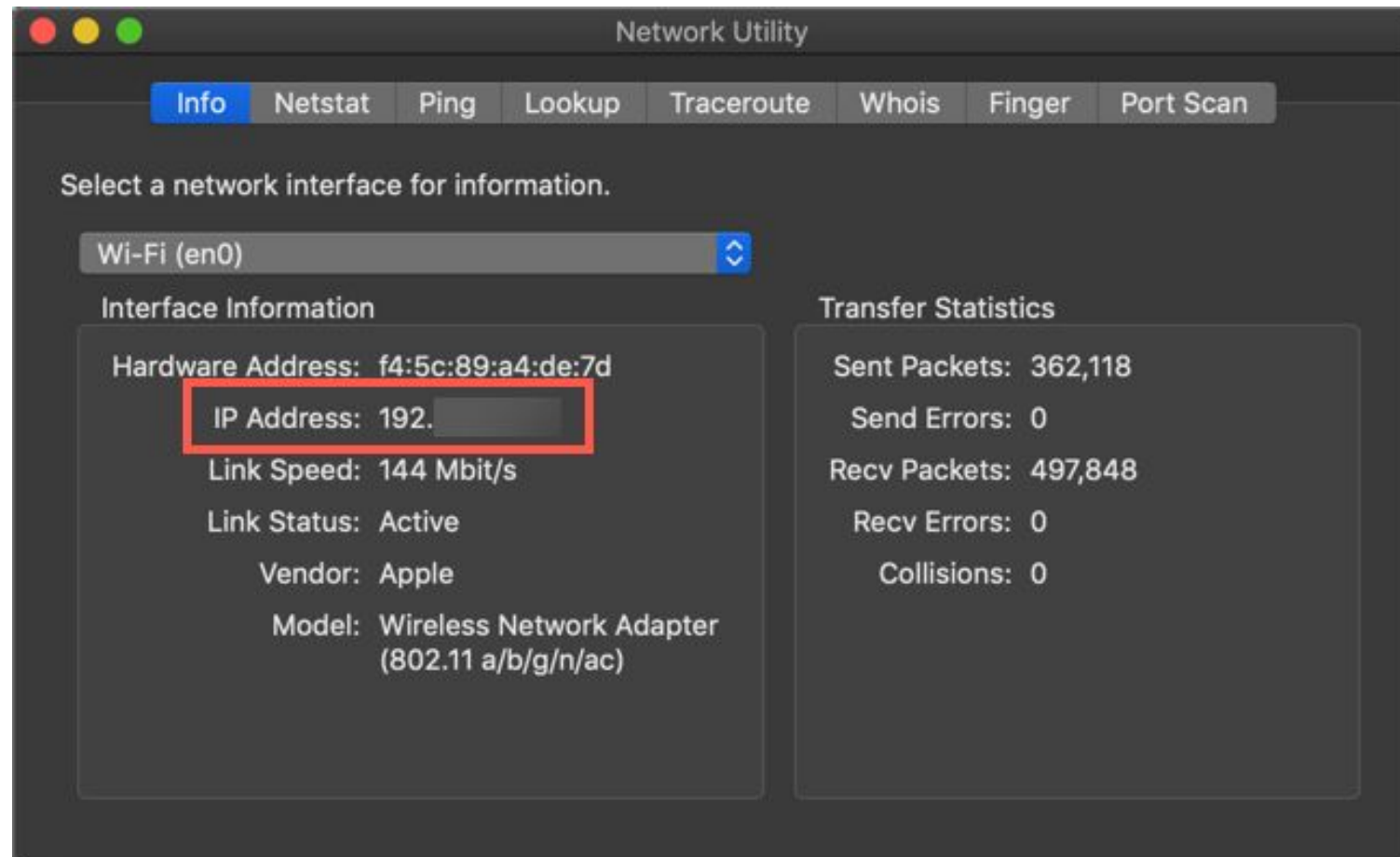


# How to Find Your IP Address?

## **Follow the below instructions on Mac:**

- Press “Command + Spacebar” to open Spotlight Search.
- Type “network utility” and open Network Utility app.
- Select your network name under “Info” tab.
- You can find the IP address of your Mac here.

# How to Find Your IP Address?



# Classification of IP Address

- **An IP address is classified into the following types:**
- **Public IP Address or Real IP Address :** This address is available publicly and it is assigned by your network provider to your router, which further divides it to your devices. Public IP Addresses are of two types,
- **Dynamic IP Address:** When you connect a smartphone or computer to the internet, your Internet Service Provider provides you an IP Address from the range of available IP Addresses. Now, your device has an IP Address and you can simply connect your device to the Internet and send and receive data to and from your device. The very next time when you try to connect to the internet with the same device, your provider provides you with different IP Addresses to the same device and also from the same available range. Since IP Address keeps on changing every time when you connect to the internet, it is called a Dynamic IP Address.
- **Static :** Static address never changes. They serve as a permanent internet address. These are used by DNS servers. What are DNS servers? Actually, these are computers that help you to open a website on your computer. Static IP Address provides information such as device is located on which continent, which country, which city, and which Internet Service Provider provides internet connection to that particular device. Once, we know who is the ISP, we can trace the location of the device connected to the internet. Static IP Addresses provide less security than Dynamic IP Addresses because they are easier to track.

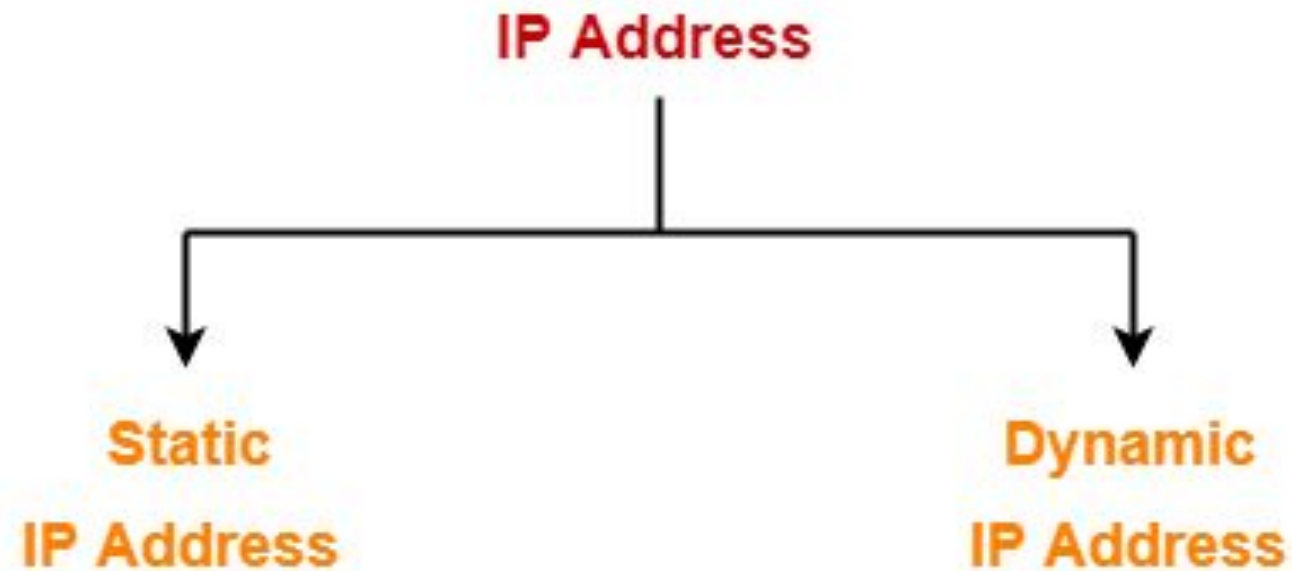
# Classification of IP Address

- **Private IP Address:** This is an internal address of your device which are not routed to the internet and no exchange of data can take place between a private address and the internet.
- **Shared IP addresses:** Many websites use shared IP addresses where the traffic is not huge and very much controllable, they decide to rent it to other similar websites so to make it cost-friendly. Several companies and email sending servers use the same IP address (within a single mail server) to cut down the cost so that they could save for the time the server is idle.
- **Dedicated IP addresses:** A dedicated IP Address is an address used by a single company or an individual which gives them certain benefits using a private Secure Sockets Layer (SSL) certificate which is not in the case of a shared IP address. It allows to access the website or log in via File Transfer Protocol (FTP) by IP address instead of its domain name. It increases the performance of the website when the traffic is high. It also protects from a shared IP address that is black-listed due to spam.

# Types of IP Address

IP Addresses may be of the following two types-

- Static IP Address
- Dynamic IP Address



# Types of IP Address

## 1. Static IP Address:

- Static IP Address is an IP Address that once assigned to a network element always remains the same.
- They are configured manually.

### NOTE

- Some ISPs do not provide static IP addresses.
- Static IP Addresses are more costly than dynamic IP Addresses.

# Types of IP Address

## 2. Dynamic IP

- Dynamic IP Address is a temporarily assigned IP Address to a network element.
- It can be assigned to a different device if it is not in use.
- DHCP or PPPoE assigns dynamic IP addresses.

## Static IP

Manually assigned. Never changes. Used for servers, printers, network devices. Expensive & requires manual management.

## Dynamic IP

Automatically assigned by DHCP. Changes each session. Common for home/office users. Cost-effective & easier to manage.

## Shared IP

Multiple websites share one IP address. Common in shared web hosting. Cost-efficient but less flexible for SSL & reputation.

## Public IP

Globally routable on the internet. Assigned by ISP. Visible to outside world. Required to host public-facing services.

## Private IP

Used inside local networks (LAN). Not routable on internet. Ranges: 10.x.x.x, 172.16–31.x.x, 192.168.x.x.

## Dedicated IP

Single IP exclusive to one website/device. Required for SSL certificates (legacy), email reputation, FTP access.



# How to confirm a IP whether it is Public or Not?

- At first you need to install MicroTorrent (u torrent) in your PC.
- Then press Ctrl + G
- You will get the port number here.
- Copy it and go to [canyouseeme.org](http://canyouseeme.org).
- Then pest the port number.
- It will tell you whether your IP, assigned by your ISP, is a real IP or not.

Speed - Download Torrents Faster!

Trending Videos

Upgrade to Pro

Torrents (0)

Labels

Feeds (0)

Devices (0)

Go to T

Files Info

Downloaded:

Availability:

### Transfer

Time Elapsed:

Downloaded:

Download Speed

Down Limit:

Status:

### General

Save As:

Total Size:

Created On:

Pieces:

Created By:

DHT: 486 nodes

D: 0.0 kB/s T: 60.2 kB

U: 0.0 kB/s T: 17.9 kB



µTorrent Setup Guide

µTorrent will test your network and configure itself for best performance.

☒ Bandwidth
 

New Delhi, IN

This test will use [Measurement Lab](#) tools to check and set your bandwidth limits.

If no location is near, you can test at [dsireports](#) and input your upload speed.

Your Upload Speed: 

Current Settings (Unlimited)

µTorrent Bandwidth Configuration

|                            |          |                       |     |
|----------------------------|----------|-----------------------|-----|
| Upload Limit:              | 0.0 kB/s | Upload Slots:         | 4   |
| Connections (per-torrent): | 50       | Connections (global): | 200 |
| Max active torrents:       | 8        | Max active downloads: | 5   |

☒ Network
 

This test will verify your router settings and highlight any configuration issues.

Current Port: (0:random) 

57502

☒ Automatic Port Mapping (Recommended)

Cancel

Run tests

Save & Close

# CanYouSeeMe.org

## Open Port Check Tool

This is a free utility for remotely verifying if a port is open or closed. It is useful to users who wish to verify port forwarding and check to see if a server is running or a firewall or ISP is blocking certain ports.

**Error:** I could not see your service on 43.250.81.67 on port (57502)

Reason: Connection refused

Your IP: 43.250.81.67

Port to Check: 57502

Check Port

### Common Ports

|        |     |
|--------|-----|
| FTP    | 21  |
| SSH    | 22  |
| Telnet | 23  |
| SMTP   | 25  |
| DNS    | 53  |
| HTTP   | 80  |
| POP3   | 110 |
| IMAP   | 143 |

### Other Applications

|                |       |
|----------------|-------|
| Minecraft      | 25565 |
| Remote Desktop | 3389  |
| PC Anywhere    | 5631  |

# Version of IP address

Two types of IP addresses are

- 1) IPV4 and
- 2) IPV6.

IPv4

VS

IPv6

Example: 127.255.255.255

Example:

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

# Version of IP address

## What is IPv4?

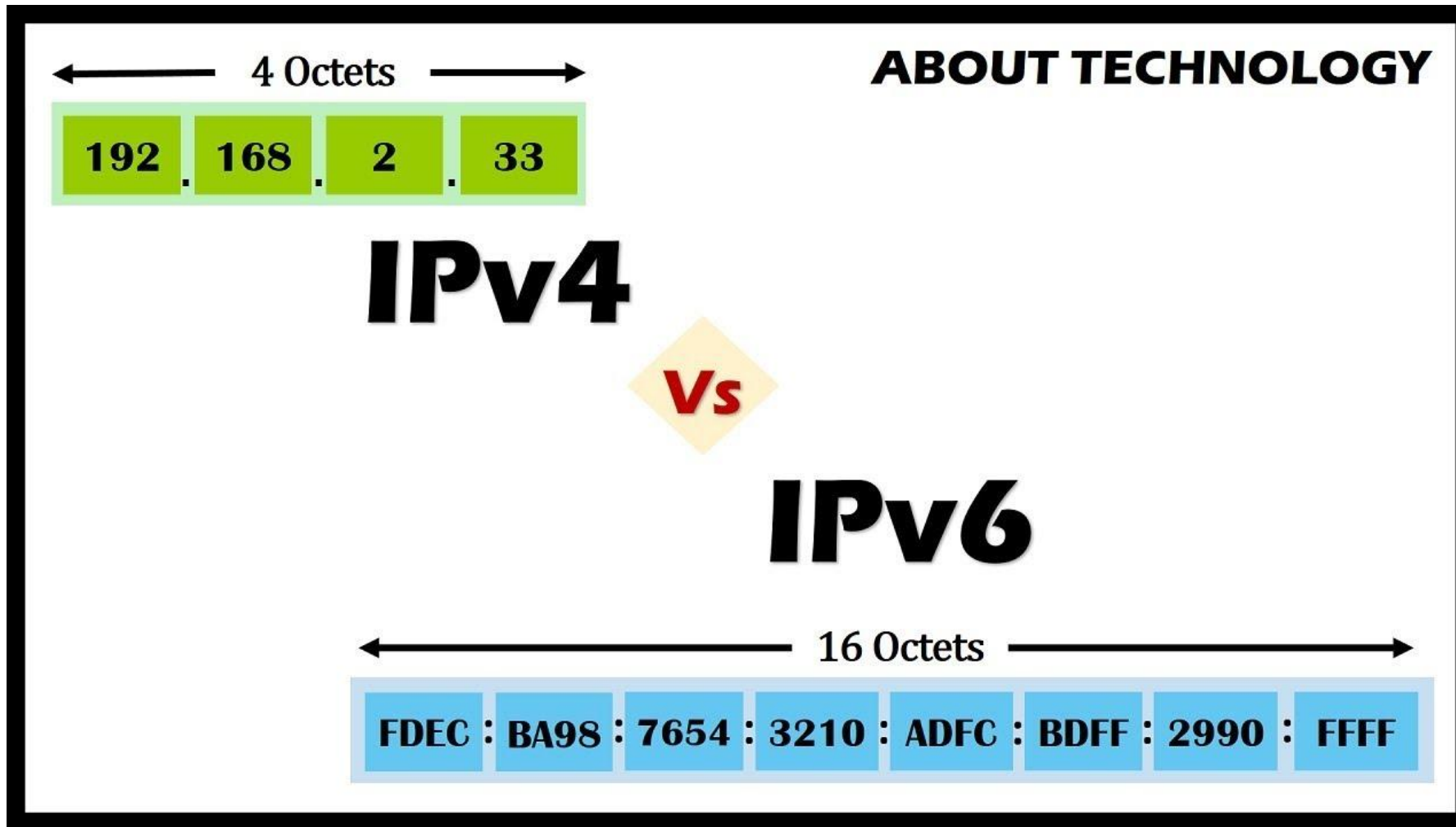
- IPv4 is an IP version widely used to identify devices on a network using an addressing system.
- It uses a **32-bit** address scheme to store  **$2^{32}$**  addresses which is more than **4 billion** addresses.
- It is considered the primary Internet Protocol and carries **94%** of Internet traffic.

# Version of IP address

## What is IPv6?

- IPv6 is the most recent version of the Internet Protocol.
- This new IP address version is being deployed to fulfill the need for more Internet addresses.
- It was aimed to resolve issues that are associated with IPv4.
- With **128-bit** address space, it allows 340 undecillion unique address space. IPv6 is also called IPng (Internet Protocol next generation).

# Version of IP address



# IPv4 VS. IPv6

## IPv4

vs.

## IPv6

Deployed 1981

32-bit IP address

**4.3 billion addresses**

Addresses must be reused and masked

Numeric dot-decimal notation

**192.168.5.18**

DHCP or manual configuration

Deployed 1998

128-bit IP address

**$7.9 \times 10^{28}$  addresses**

Every device can have a unique address

Alphanumeric hexadecimal notation

**50b2:6400:0000:0000:6c3a:b17d:0000:10a9**

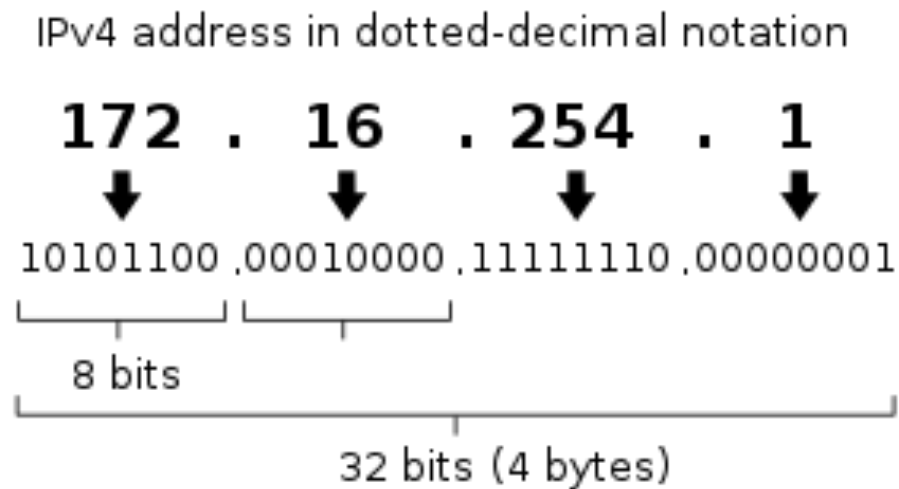
(Simplified - 50b2:6400::6c3a:b17d:0:10a9)

Supports autoconfiguration



# IP Address Format

- IP Address is a 32 bit binary address written as 4 numbers separated by dots.
- The 4 numbers are called as **octets** where each octet has 8 bits.
- The octets are divided into 2 components- Net ID and Host ID.



IPv4 Format: 32-bit → 4 Octets → Dotted Decimal Notation

Octet 1

192

11000000

Octet 2

168

10101000

Octet 3

1

00000001

Octet 4

10

00001010

**32 bits**

Total bit length of IPv4

**4 octets**

Groups of 8 bits each

**0 – 255**

Range per octet

**~4.3 billion**

Total unique addresses

# IP Address Format



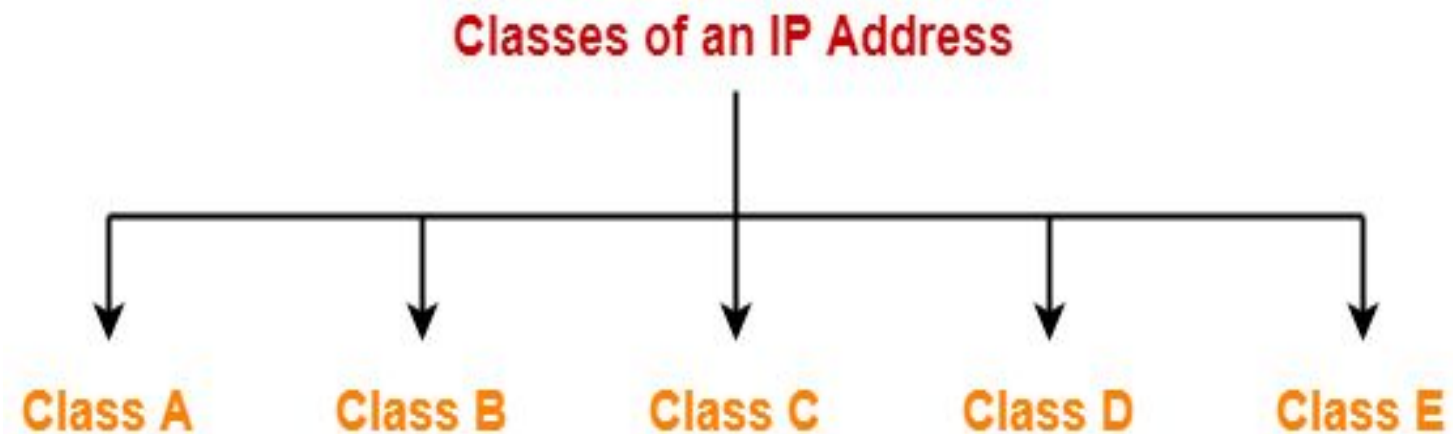
Format of an IP Address

- **Network ID** represents the IP Address of the network and is used to identify the network.
- **Host ID** represents the IP Address of the host and is used to identify the host within the network.

# Classful Addressing

In Classful Addressing System, IP Addresses are organized into following 5 classes-

- Class A
- Class B
- Class C
- Class D
- Class E



# IP address classes

- With an IPv4 IP address, there are five classes of available IP ranges: Class A, Class B, Class C, Class D and Class E, while only A, B, and C are commonly used. Each class allows for a range of valid IP addresses, shown in the following table.

| Class   | Address range                | Supports                                                       |
|---------|------------------------------|----------------------------------------------------------------|
| Class A | 1.0.0.1 to 126.255.255.254   | Supports 16 million hosts on each of 127 networks.             |
| Class B | 128.1.0.1 to 191.255.255.254 | Supports 65,000 hosts on each of 16,000 networks.              |
| Class C | 192.0.1.1 to 223.255.254.254 | Supports 254 hosts on each of 2 million networks.              |
| Class D | 224.0.0.0 to 239.255.255.255 | Reserved for <a href="#">multicast</a> groups.                 |
| Class E | 240.0.0.0 to 254.255.255.254 | Reserved for future use, or research and development purposes. |

# What is an IP Address?

| Class      | Address Range | Subnet masking | Example IP | Leading bits | Max number of networks | Application                                                   |
|------------|---------------|----------------|------------|--------------|------------------------|---------------------------------------------------------------|
| IP Class A | 1 to 126      | 255.0.0.0      | 1.1.1.1    | 8            | 128                    | Used for large number of hosts.                               |
| IP Class B | 128 to 191    | 255.255.0.0    | 128.1.1.1  | 16           | 16384                  | Used for medium size network.                                 |
| IP Class C | 192 to 223    | 255.255.255.0  | 192.1.11.  | 24           | 2097157                | Used for local area network.                                  |
| IP Class D | 224 to 239    | NA             | NA         | NA           | NA                     | Reserve for multi-tasking.                                    |
| IP Class E | 240 to 254    | NA             | NA         | NA           | NA                     | This class is reserved for research and Development Purposes. |

# Fact's

- The IP address space is managed globally by the [Internet Assigned Numbers Authority](#) (IANA), and by five [regional Internet registries](#) (RIRs) responsible in their designated territories for assignment to [local Internet registries](#), such as [Internet service providers](#) (ISPs), and other [end users](#). IPv4 addresses were distributed by IANA to the RIRs in blocks of approximately 16.8 million addresses each, but have been exhausted at the IANA level since 2011. Only one of the RIRs still has a supply for local assignments in Africa. Some IPv4 addresses are reserved for [private networks](#) and are not globally unique.

# Different Classes Of IP's In Hosting

- **Network ID**–

It is the part of the left-hand IP address that identifies the specific network where the device is located. In the normal home network, where the device has an IP address 192.168.1.32, the 192.168.1 part of the address will be the network ID. It is customary to fill in the last part that is not zero, so we can say that the device's network ID is 192.168.1.0.

- **Hosting ID**–

The host ID is part of the IP address that was not taken by the network ID. Identifies a specific device (in the TCP / IP world, we call devices “host”) in that network. Continuing with our example of the IP address 192.168.1.32, the host ID will be 32- the unique host ID on the 192.168.1.0 network.



# Different Classes Of IP's In Hosting

## Network ID and Host ID

**Class A** 0xxx xxxx.xxxx xxxx.xxxx xxxx.xxxx xxxx  
Network ID Host ID

**Class B** 10xx xxxx.xxxx xxxx.xxxx xxxx.xxxx xxxx  
Network ID Host ID

**Class C** 110x xxxx.xxxx xxxx.xxxx xxxx.xxxx xxxx  
Network ID Host ID

**Class D** 1110 xxxx.xxxx xxxx.xxxx xxxx  
Network ID

**Class E** 1111 0xxx.xxxx xxxx.xxxx xxxx  
Network ID

# Different Classes Of IP's In Hosting

The different classes of IP's are:

## Class A

- Class A IP's are majorly used for **large networks**. Also, this kind of IPs are generally used by **large organizations** such as Google, Bing, Yahoo, etc., The huge benefit in this type of IP is you can host many numbers of devices to the IP address. The main thing is that class IP's are generally used by Internet Service Providers (ISP). Additionally, the A-class IP's are not used by many of the bloggers.

## Class B

- Class B IP's are not mostly used by **bloggers** or **business websites**. These kinds of IP's are used by **medium-sized organizations** and **networks**. The advantage of this kind of IP is, you can also host devices, but little less than the class A IP's. Class B IP's are not recommended for hosting the sites and also most of the users are not using these IP's

# Different Classes Of IP's In Hosting

## Class C

- When coming to class C IP's, most of the PBN and SEO hosting sites are using it more. Because of the various benefits. This range of IP's are used by the bloggers, business sites and personal sites. This C class IP's are used for PBN and SEO hosting. The advantages of using c class IP's are
- Helps to boost the SEO of your sites
- Improves ranking in search results
- Increases traffic to the sites
- Generally used for blogging and business sites

# Different Classes Of IP's In Hosting

## Class D & Class E

- The Class D & E IP's are used very less by the users. The D-class IPs are not used widely by the users and they are used only on special occasions. Whereas the class E IP's are the reserved ones, which are used for research, scientific studies, etc., These two class IPs are not used in the public sector. Only used in private sectors. Also, the class E IP's are not provided by the hosting providers for hosting the sites.

# loopback or localhost Address

- Ranges 127.x.x.x are reserved for the [loopback or localhost](#), for example, **127.0.0.1** is the loopback address.
- The loopback addresses are built into the IP domain system, **enabling devices** to transmit and receive the data packets.
- The loopback address 127.0.0.1 is generally known as **localhost**.
- The loopback interface refers to the overall system by which network engineers can self-reference a device, or “ping” a device by sending its data packets back to itself.
- How to test a network card using the loopback address? **CMD>Ping> 127.0.0.1**

Microsoft Windows [Version 10.0.22621.755]  
(c) Microsoft Corporation. All rights reserved.

C:\Users\tariq>ping 127.0.0.1

Pinging 127.0.0.1 with 32 bytes of data:

Reply from 127.0.0.1: bytes=32 time<1ms TTL=128

Reply from 127.0.0.1: bytes=32 time<1ms TTL=128

Reply from 127.0.0.1: bytes=32 time<1ms TTL=128

Reply from 127.0.0.1: bytes=32 time<1ms TTL=128

Ping statistics for 127.0.0.1:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Users\tariq>

# Broadcasts Address

- **Broadcasts Address:** A **multipoint** connection in **IP networks** that automatically **reaches** all nodes in the **network without** knowing the recipient addresses. For this purpose, a fixed **reserved broadcast** address exists in each network or subnet.

# IP Address Classification Based on Operational Characteristics:

According to operational characteristics, IP address is classified as follows:

- Broadcast addressing–  
The term 'Broadcast' means to transmit audio or video **over a network**. A broadcast packet is **sent to all users** of a **local network at once**. They do not have to be explicitly named as recipients. The users of a network can open the data packets and then interpret the information, carry out the instructions or discard it. This service is available in IPv4. The IP address commonly used for broadcasting is 255.255.255.255
- Unicast addressing–  
This address identifies a unique node on the network. Unicast is nothing but **one-to-one** data transmission from one point in the network to another. It is the most common form of IP addressing. This method can be used for both sending and receiving data. It is available in IPv4 and IPv6.



# IP Address Classification Based on Operational Characteristics:

- **Multicast IP addresses**–

These IP addresses mainly help to establish **one-to-many** communication. Multicast IP routing protocols are used to distribute data to multiple recipients. The class D addresses (224.0.0.0 to 239.255.255.255) define the multicast group.

- **Anycast addressing**–

In anycast addressing the data, a packet is **not transmitted to all the receivers on the network**. When a data packet is allocated to an anycast address, it is delivered to the closest interface that has this anycast address.

# IP Address Classification Based on Operational Characteristics:

| Method    | Message Addressing Methods |                                  |                                            |
|-----------|----------------------------|----------------------------------|--------------------------------------------|
|           | Source-to-Destination      | How many potential destinations? | How many destinations receive the message? |
| Unicast   | One-to-One                 | One                              | One                                        |
| Broadcast | One-to-All                 | Multiple                         | Multiple                                   |
| Multicast | One-to-Many                | Multiple                         | Multiple                                   |
| Anycast   | One-to-Any                 | Multiple                         | One                                        |

<https://www.baeldung.com/cs/multicast-vs-broadcast-anycast-unicast>

# Net ID, Host ID & Special IP Addresses

Chapter 7 – Address Anatomy

Network ID (Net ID)

192 . 168 . 1

Host ID

. 10

## Loopback (Localhost)

127.0.0.1 / ::1

Used to test network stack on local machine. Packets never leave the device. Also called 'lookback' address.

## Broadcast IP

x.x.x.255 (e.g. 192.168.1.255)

Sends packets to ALL hosts on the network segment. Used by DHCP, ARP. Cannot be assigned to a host.

## Network Address

x.x.x.0 (e.g. 192.168.1.0)

Identifies the network itself. First address in a subnet. Cannot be assigned to any host device.

## Default Gateway

e.g. 192.168.1.1

Router IP that forwards packets to outside networks. First usable address by convention (not mandatory).

# Subnetting: What is Subnet Mask?

- **Subnetting** is the practice of dividing a network into two or smaller networks. It increases routing efficiency, which helps to enhance the security of the network and reduces the size of the broadcast domain.
- IP Subnetting designates high-order bits from the host as part of the network prefix. This method divides a network into smaller subnets.
- It also helps you to reduce the size of the routing tables, which is stored in routers. This method also helps you to extend the existing IP address base & restructures the IP address.

# What is CIDR notation?

- CIDR format, or "Classless Inter-Domain Routing", released in 1993, is the industry standard for displaying IP addresses and their related subnets. It consists of a network prefix and the significant bits which determines the size of the IP block. Significant bits are in 8-bit groups that form Class A, B, and C blocks of IP addresses. An example of CIDR format is "255.254.0.0/16", which indicates there are 65,000 hosts in this range from "255.254.0.1" to "255.254.255.255".

# Problem:01

- What do you mean by Subnet Mask? Let's consider an IP address provided to you like this: 192.168.10.0. Subnet Mask 255.255.255.224. Now find out the following terms:
  - a. Find the block address?
  - c. Find the number of subnets?
  - d. Find the number of hosts?
  - e. Determine the subnets address?
  - f. Determine the First valid hosts and Last valid hosts.
  - g. Determine Broadcast addresses.

# Problem:02

- Let's consider an IP address provided to you like this:  
**192.231.232.116/27**. Now find out the following terms:
  - a. Find the subnet mask?
  - b. Find the block address?
  - c. Find the number of subnets?
  - d. Find the number of hosts?
  - e. Determine the subnets address?
  - f. Determine the First valid hosts and Last valid hosts.
  - g. Determine Broadcast addresses.

# Problem:03

- Suppose you are given an IP address of 192.168.10.0, and subnet mask 255.255.255.248. Find out the flowing term:
  - a. Find the block address?
  - c. Find the number of subnets?
  - d. Find the number of hosts?
  - e. Determine the subnets address?
  - f. Determine the First valid hosts and Last valid hosts.
  - g. Determine Broadcast addresses.



# Problem:04

- Let consider an IP address provided to you like this: 192.119.204.116/26.  
Now find out the flowing terms:
  - a. Find the subnet mask?
  - b. Find the block address?
  - c. Find the number of subnets?
  - d. Find the number of hosts?
  - e. Determine the subnets address?
  - f. Determine the First valid hosts and Last valid hosts.
  - g. Determine Broadcast addresses.

# Problem:05

- Let consider an IP address provided to you like this: 192.119.204.114/28.  
Now find out the flowing terms:
  - a. Find the subnet mask?
  - b. Find the block address?
  - c. Find the number of subnets?
  - d. Find the number of hosts?
  - e. Determine the subnets address?
  - f. Determine the First valid hosts and Last valid hosts.
  - g. Determine Broadcast addresses.

# IP Address Solutions:

- [https://www.youtube.com/watch?v=dH5mOkzUN\\_U&list=PLgH5QX0i9K3p5OI88r3ob-otmKqIm\\_DbS](https://www.youtube.com/watch?v=dH5mOkzUN_U&list=PLgH5QX0i9K3p5OI88r3ob-otmKqIm_DbS)

**THANK YOU**