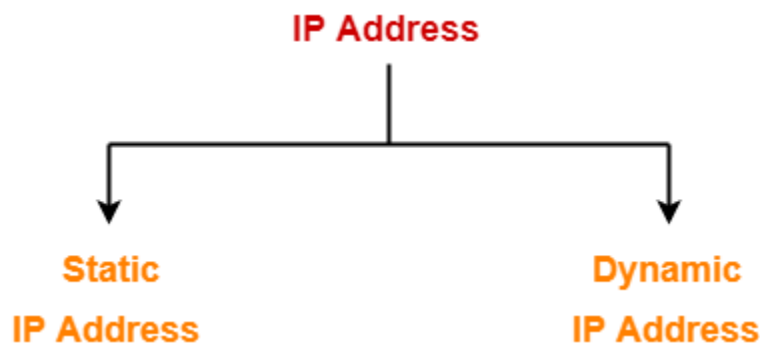# IP Address in Networking-

- 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.

Types Of IP Address-

IP Addresses may be of the following two types-

1. Static IP Address
2. Dynamic 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.

---

2. Dynamic IP Address-

- 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.

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.
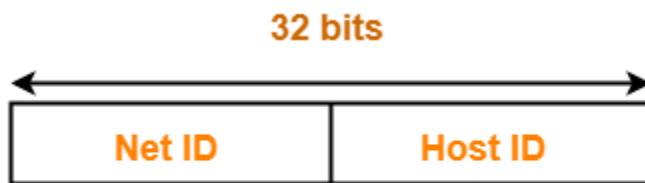
Format of an IP Address

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

IP Address Example-

Example of an IP Address is-

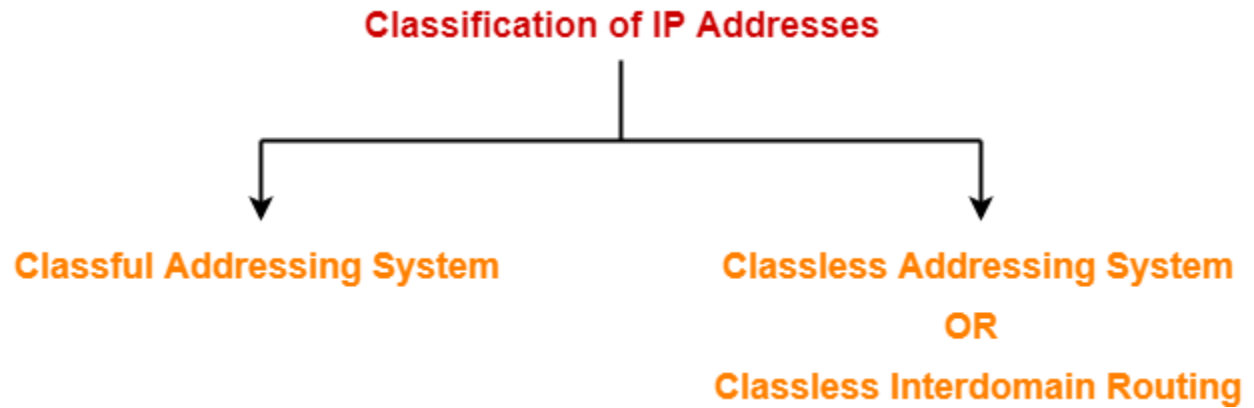00000001.10100000.00001010.11110000

(Binary Representation)

OR

1.160.10.240

(Decimal Representation)

IP Addressing-

There are two systems in which IP Addresses are classified-

Classification of IP Addresses

Classful Addressing System

Classless Addressing System
OR
Classless Interdomain Routing

1. Classful Addressing System
2. Classless Addressing System

Classful Addressing-

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

Classes of an IP Address

Class A   **Class B**   **Class C**   **Class D**   **Class E**
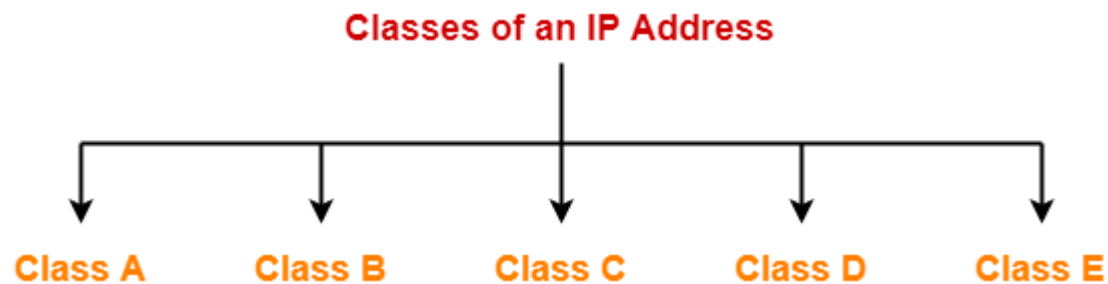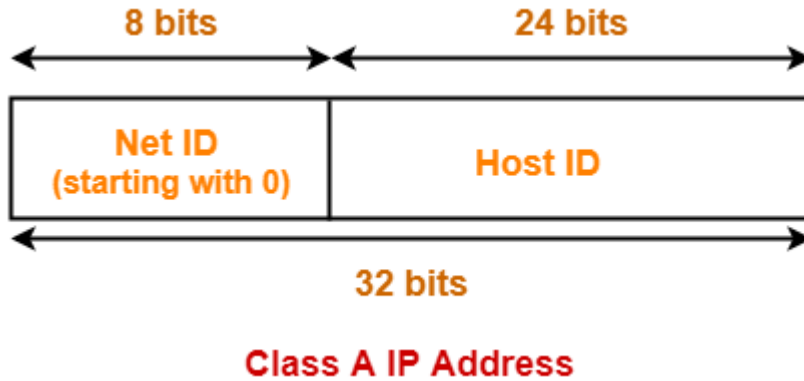
1. Class A
2. Class B
3. Class C
4. Class D
5. Class E

1. Class A-

If the 32 bit binary address starts with a bit 0, then IP Address belongs to class A.

In class A IP Address,

- The first 8 bits are used for the Network ID.
- The remaining 24 bits are used for the Host ID.

Class A IP Address

Total Number Of IP Addresses-

Total number of IP Addresses available in class A

= Numbers possible due to remaining available 31 bits

$= 2^{31}$

Total Number Of Networks-

Total number of networks available in class A

= Numbers possible due to remaining available 7 bits in the Net ID – 2

$= 2^7 - 2$

$= 126$

Total Number Of Hosts-

Total number of hosts that can be configured in class A

= Numbers possible due to available 24 bits in the Host ID – 2

$= 2^{24} - 2$

Range Of 1st Octet-

We have-

- Minimum value of 1st octet = **0**0000000 = 0
- Maximum value of 1st octet = **0**1111111 = 127

From here,

- Range of 1st octet = [0, 127]
- But 2 networks are reserved and unused.
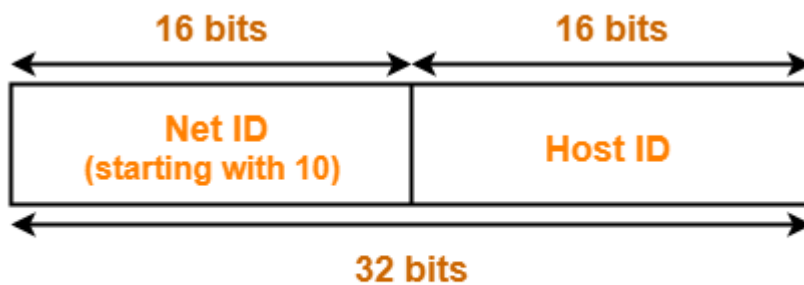- So, Range of 1st octet = [1, 126]

Use-

- Class A is used by organizations requiring very large size networks like NASA, Pentagon etc.

2. Class B-

> If the 32 bit binary address starts with bits 10, then IP Address belongs to class B.

In class B IP Address,

- The first 16 bits are used for the Network ID.
- The remaining 16 bits are used for the Host ID.

Class B IP Address

Total Number Of IP Addresses-

Total number of IP Addresses available in class B

= Numbers possible due to remaining available 30 bits

$= 2^{30}$

Total Number Of Networks-

Total number of networks available in class B

= Numbers possible due to remaining available 14 bits in the Net ID

$= 2^{14}$

Total Number Of Hosts-

Total number of hosts that can be configured in class B

= Numbers possible due to available 16 bits in the Host ID – 2

$= 2^{16} - 2$

Range Of 1st Octet-

We have-

- Minimum value of 1st octet = **10**000000 = 128
- Maximum value of 1st octet = **10**111111 = 191

So, Range of 1st octet = [128, 191]
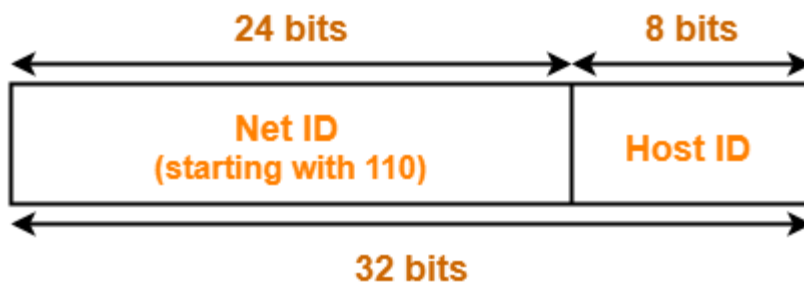

Use-

- Class B is used by organizations requiring medium size networks like IRCTC, banks etc.

3. Class C-

If the 32 bit binary address starts with bits 110, then IP Address belongs to class C.

In class C IP Address,

- The first 24 bits are used for the Network ID.
- The remaining 8 bits are used for the Host ID.

Class C IP Address

Total Number Of IP Addresses-

Total number of IP Addresses available in class C

= Numbers possible due to remaining available 29 bits

= 2^{29}

Total Number Of Networks-

Total number of networks available in class C

= Numbers possible due to remaining available 21 bits in the Net ID

= 2^{21}

Total Number Of Hosts-

Total number of hosts that can be configured in class C

= Numbers possible due to available 8 bits in the Host ID – 2

= $2^8 - 2$

Range Of 1st Octet-

We have-

- Minimum value of 1st octet = **110**00000 = 192

- Maximum value of 1st octet = **110**111111 = 223

So, Range of 1st octet = [192, 223]

Use-

- Class C is used by organizations requiring small to medium size networks.
- For example- engineering colleges, small universities, small offices etc.

4. Class D-

> If the 32 bit binary address starts with bits 1110, then IP Address belongs to class D.

- Class D is not divided into Network ID and Host ID.

IP Address
(starting with 1110)

←————————————————→

32 bits

Class D IP Address

Total Number Of IP Addresses-

Total number of IP Addresses available in class D
= Numbers possible due to remaining available 28 bits
= 2^{28}

Range Of 1st Octet-

We have-
- Minimum value of 1st octet = **1110**0000 = 224
- Maximum value of 1st octet = **1110**1111 = 239

So, Range of 1st octet = [224, 239]

Use-

- Class D is reserved for multicasting.
- In multicasting, there is no need to extract host address from the IP Address.
- This is because data is not destined for a particular host.

5. Class E-

> If the 32 bit binary address starts with bits 1111, then IP
> Address belongs to class E.

- Class E is not divided into Network ID and Host ID.

IP Address
(starting with 1111)

32 bits

Class E IP Address

Total Number Of IP Addresses-

Total number of IP Addresses available in class E
= Numbers possible due to remaining available 28 bits
= 2^{28}

Range Of 1st Octet-

We have-

- Minimum value of 1st octet = **1111**0000 = 240
- Maximum value of 1st octet = **1111**1111 = 255

So, Range of 1st octet = [240, 255]

Use-

- Class E is reserved for future or experimental purposes.

Classes of IP Address-

All the classes of IP Address are summarized in the following table-

Class of IP Address	Total Number of IP Addresses	1st Octet Decimal Range	Number of Networks available	Hosts per network	Default Subnet Mask
Class A	2^{31}	1 – 126	$2^7 - 2$	$2^{24} - 2$	255.0.0.0
Class B	2^{30}	128 – 191	2^{14}	$2^{16} - 2$	255.255.0.0
Class C	2^{29}	192 – 223	2^{21}	$2^8 - 2$	255.255.255.0
Class D	2^{28}	224 – 239	Not defined	Not defined	Not defined
Class E	2^{28}	240 – 254	Not defined	Not defined	Not defined