Computer Network

Day -2

1) What is an IP Address? What is its use?

IP address stands for Internet Protocol Address. It is a unique string of numbers used to specify the location of a computer or other device in a network usingTCP/IP. You have an address of your address where letters used to come, IP address is such an address which allow data to reach its destination in a network.

2) What is a IPID?

The IPID is the Identification field of the IP protocol packet header which along with the source address uniquely identifies the packet. The IPID is used to reassemble the packet should it be fragmented. Every fragments of the packet will then have the same IPID for the destination device identify them all to be a single packet.

3) What is the difference between Public and Private IP Address?

A public IP Address is allows access to the internet to a system.

A Private IP Address is used in private network such as in an office, college, school to connect many more PCs in a private network.

4) Tell the range of Public and Private IP Addresses?

Public Address range:

Class	Address Range
Class A	**1.0.0.1 to 126.255.255.254**
Class B	**128.1.0.1 to 191.255.255.254**
Class C	**192.0.1.1 to 223.255.254.254**
Class D	**224.0.0.0 to 239.255.255.255**
Class E	**240.0.0.0 to 254.255.255.254**

Private Address range:

10.0.0.0 – 10.255.255.255 (Total Addresses: 16,777,216)

172.16.0.0- 172.31.255.255 (Total Addresses: 1,048,576**)**

(Total Addresses: 65,536)

5) Why 127.0.0.1 address is not included in the public address range?

It is named as Loopback Address. It is used to test the communication medium on a local network card

A loopback address is the one, which normally used internally by the system to point to itself. This is different from another Public or Private IP Address. This is mostly used to call *the local system and for troubleshooting purposes*. The default Loopback IP Address is 127.0.0.1

6) What is the difference between static and dynamic IP Address?

Static address is a permanent address which can never be changed.

It is dynamically assigned by ISP. When the computer or router will reboot, ISP will dynamically assign an IP address to your computer using DHCP protocol.

7) What is the advantage and disadvantages of using static and dynamic address?

Advantages of static IP address

It is good to use for web servers, email servers and other internet servers as the address does not change.

Disadvantages of static IP address

ISPs charge additional fee to assign static address so it is expensive.

It needs more security to save from hacking.

Dynamic IP address Advantages

Cheaper than static IP address.

Changing IP address gives more privacy.

Dynamic IP address Disadvantages

Requires DHCP server to obtain an IP address.

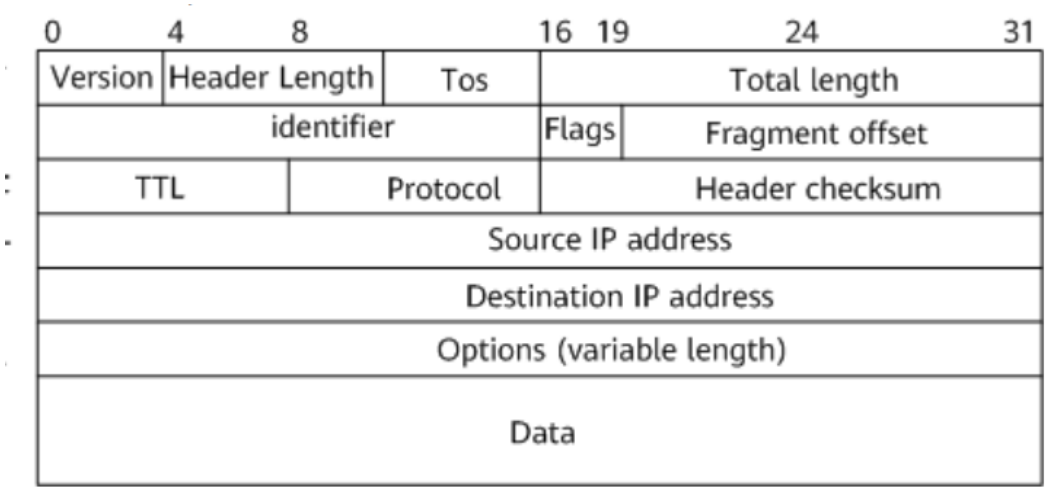
Non-static. Each time IP address changes, you may have to find you IP address again.

8)What Is Ipv4?

Answer :

IPv4 stands for Internet Protocol version 4. It is the fundamental technology that makes it possible for us to connect our devices to the Internet. Whenever a device accesses the Internet it is assigned a unique, numerical IP address such as 128.255.244.221. To send data from one computer to another through the Internet, a data packet must be transferred across the network containing the IP addresses of both the sender and the receiver. Without IP addresses it is not possible for devices to communicate with each other. It is fundamental to the existence of the Internet.

Address Size Of Ipv4:-32-bit number.



Version	4 bits	Specifies the IP protocol version, IPv4 or IPv6.
Header Length	4 bits	Specifies the length of the IPv4 header.
Type of Service (ToS)	8 bits	Specifies the type of service. This field takes effect only in the differentiated service model.
Total Length	16 bits	Specifies the length of the header and data.

Identification	16 bits	IPv4 software maintains a counter in the storage device to record the number of IP datagrams. The counter value increases by 1 every time a datagram is sent, and is filled in the identification field.
Flags	3 bits	Only the rightmost two bits are valid. The rightmost bit indicates whether the datagram is not the last data fragment. The value 1 indicates the last fragment, and the value 0 indicates non-last fragment. The middle bit is the fragmentation flag. The value 1 indicates that the datagram cannot be fragmented, and the value 0 indicates that the datagram can be fragmented.
Fragment Offset	13 bits	Specifies the location of a fragment in a packet.
Time to Live (TTL)	8 bits	Specifies the life span of a datagram on a network. TTL is measured by the number of hops.
Protocol	8 bits	Specifies the type of the protocol carried in the datagram.
Header Checksum	16 bits	A device calculates the header checksum for each datagram received. If the checksum is 0, the device knows that the header remains unchanged and retains the datagram. This field checks only the header but not the data.
Source IP Address	32 bits	Specifies the IPv4 address of a sender.
Destination IP Address	32 bits	Specifies the IPv4 address of a receiver.

Options	0-40 bytes (variable length)	Allows IPv4 to support various options such as fault handling, measurement, and security. Pad bytes with a value of 0 are added if necessary.
Data	Variable	Pads an IP datagram.

8) What Is Ipv6?

Answer :

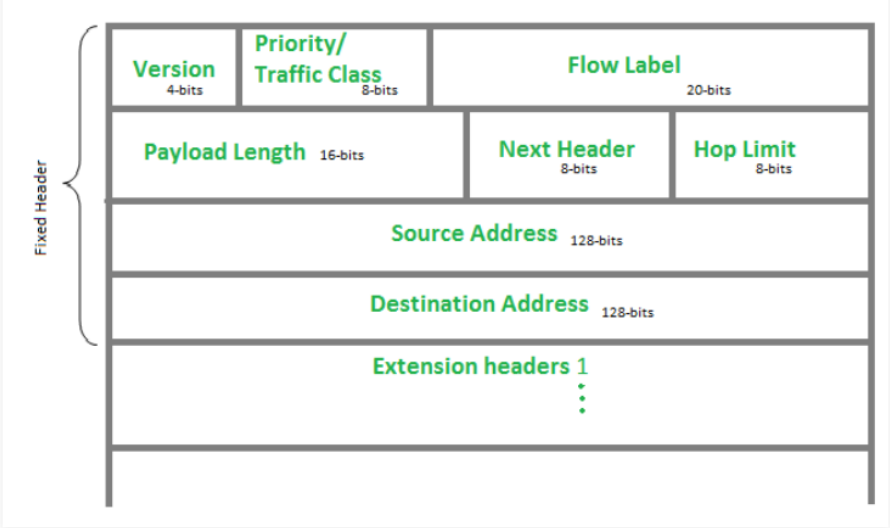
IPv6 is the new version of the Internet address protocol that has been developed to supplement (and eventually replace) IPv4, the version that underpins the Internet today.

The key difference between the versions of the protocol is that IPv6 has significantly more address space. The addresses do look different however. A typical IPv6 address has 8 groups of four letters and numbers separated by colons so it looks like this: 2001:db8:1f70:999:de8:7648:6e8|

The expanded addressing capacity of IPv6 will enable the trillions of new Internet addresses needed to support connectivity for a huge range of smart devices such as phones, household appliances and vehicles.

IPv6 also brings enhanced quality of service that is required for several new applications such as IP telephony, video/audio, interactive games or ecommerce.

Length Of Ipv6 Ip Address:-The lenth of IPV6 ip address is 128 bits.



9) How Do I Connect Ipv4 And Ipv6?

Answer :

Click Network and Sharing Center on your computer. Click Local Area Connections and then click Properties to configure network addresses and other information. Click the Networking tab and then, click either Internet Protocol Version 4 (TCP/IPv4) or Internet Protocol Version 6 (TCP/IPv6) and then click Properties

10) What Is The Length Of Header Of Ipv4 And Ipv6?

Answer :

IPV6 is of fixed 40byte header.

IPV4 it is variable(normally 20 bytes).

11) What is Default Gateway?

A Default Gateway is an address to which all the packets to which there is no known Route is available is been sent. In other words, if the system doesn't know where to send a set of packets, it will forward it to this address which then takes care of routing to appropriate destinations.

Note:-IP Address in Networking-

Before you go through this article, make sure that you have gone through the previous article on IP Address

We have discussed-

IP Address 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.

Casting refers to transmitting data (stream of packets) over the network.

Important Points-

Point-01:

For any given IP Address,

If the range of first octet is [1, 126], then IP Address belongs to class A.

If the range of first octet is [128, 191], then IP Address belongs to class B.

If the range of first octet is [192, 223], then IP Address belongs to class C.

If the range of first octet is [224, 239], then IP Address belongs to class D.

If the range of first octet is [240, 254], then IP Address belongs to class E.

Point-02:

For any given IP Address,

IP Address of its network is obtained by setting all its Host ID part bits to 0.

Point-03:

For any given IP Address,

Direct Broadcast Address is obtained by setting all its Host ID part bits to 1.

Point-04:

For any given IP Address, limited Broadcast Address is obtained by setting all its bits to 1.

For any network, its limited broadcast address is always 255.255.255.255

Point-05:

Class D IP Addresses are not divided into Net ID and Host ID parts.

Class E IP Addresses are not divided into Net ID and Host ID parts.

12) Problem-

For the following IP Addresses-

1.2.3.4

10.15.20.60

130.1.2.3

150.0.150.150

200.1.10.100

220.15.1.10

250.0.1.2

300.1.2.3

13) Identify the Class, Network IP Address, Direct broadcast address and Limited broadcast address of each IP Address.

Solution-

Part-A:

Given IP Address is-

1.2.3.4

IP Address belongs to class A

Network IP Address = 1.0.0.0

Direct Broadcast Address = 1.255.255.255

Limited Broadcast Address = 255.255.255.255

Part-B:

Given IP Address is-

10.15.20.60

IP Address belongs to class A

Network IP Address = 10.0.0.0

Direct Broadcast Address = 10.255.255.255

Limited Broadcast Address = 255.255.255.255

Part-C:

Given IP Address is-

130.1.2.3

IP Address belongs to class B

Network IP Address = 130.1.0.0

Direct Broadcast Address = 130.1.255.255

Limited Broadcast Address = 255.255.255.255

Part-D:

Given IP Address is-

150.0.150.150

IP Address belongs to class B

Network IP Address = 150.0.0.0

Direct Broadcast Address = 150.0.255.255

Limited Broadcast Address = 255.255.255.255

Part-E:

Given IP Address is-

200.1.10.100

IP Address belongs to class C

Network IP Address = 200.1.10.0

Direct Broadcast Address = 200.1.10.255

Limited Broadcast Address = 255.255.255.255

Part-F:

Given IP Address is-

220.15.1.10

IP Address belongs to class C

Network IP Address = 220.15.1.0

Direct Broadcast Address = 220.15.1.255

Limited Broadcast Address = 255.255.255.255

Part-G:

Given IP Address is-

250.0.1.2

IP Address belongs to class E

Network IP Address = Not available

Direct Broadcast Address = Not available

Limited Broadcast Address = Not available

Part-H:

Given IP Address is-

300.1.2.3

This is not a valid IP Address.

This is because for any given IP Address, the range of its first octet is always [1, 254].

First and Last IP Addresses are reserved

14) Problem-

A device has two or more IP Addresses, the device is called-

Workstation

Router

Gateway

All of these

Solution-

All the given devices have a network layer.

So, they will have at least one IP Address.

In TCP/IP suite-

Workstation and gateway have all the 5 layers.

Router has only 3 layers last layer being network layer.

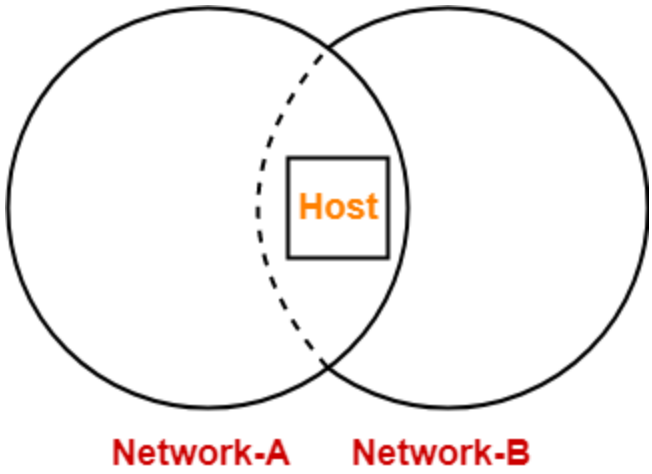
Workstation-

A user may configure more than one IP Addresses in his workstation / computer.

With more than one IP Address, it remains present in more than one networks.

So, if one network goes down, it is always reachable from other networks.

The following figure shows a host present in more than one networks-



It is important to note that IP Addresses are assigned to interfaces.

When we buy a new laptop, we usually get 2-3 interfaces.

Thus, a workstation can have more than one IP Addresses.

Router-

A router may be connected to various interfaces.

Each interface has a unique IP Address.

Thus, a router may also have more than IP Addresses.

Similar is the case with gateways because gateways are extension of routers.

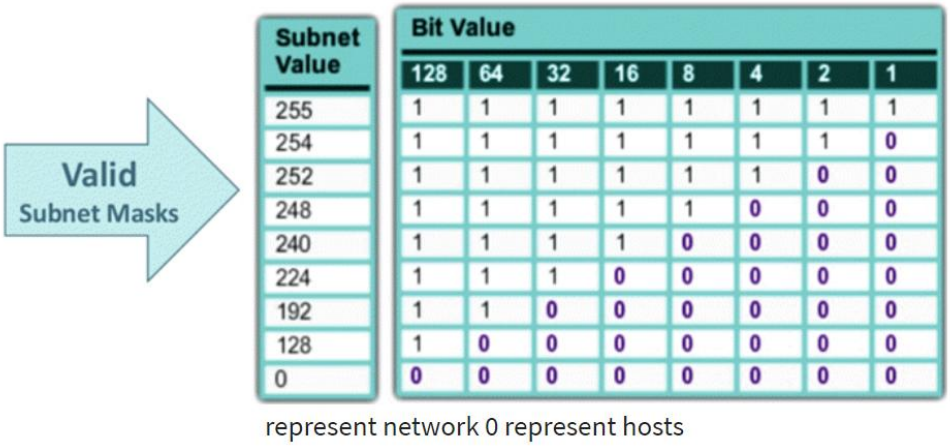
Thus, Option (D) is correct.

What is **Network Address ?**

Network address – It identifies a network on internet. Using this, we can find range of addresses in the network and total possible number of hosts in the network

15) What is Subnet Mask?

A subnet mask is a 32 bits address used to distinguish between a network address and a host address in IP address. A subnet mask identifies which part of an IP address is the network address and the host address. They are not shown inside the data packets traversing the Internet. They carry the destination IP address, which a router will match with a subnet.



Two types of subnet masks are:

The default Subnet Mask is the number of bits which is reserved by the address class. Using this default mask will accommodate a single network subnet in the relative class.

A Custom Subnet Mask can be defined by an administrator to accommodate many Network

16) What is Subnetting?

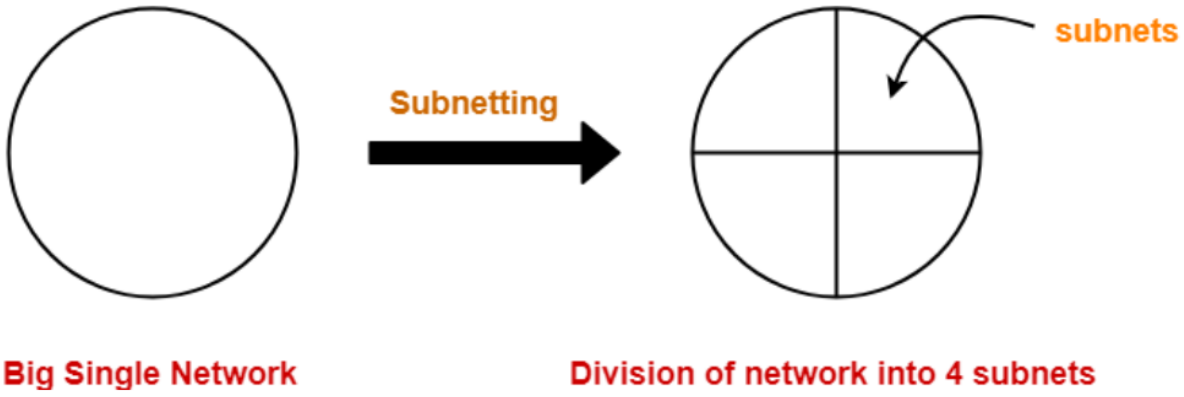
Subnetting is the practice of dividing a network into two or smaller networks. It increases routing efficiency, which helps to enhance the security of the network and reduces the size of the broadcast domain.

In networking,

- The process of dividing a single network into multiple sub networks is called as **subnetting**.
- The sub networks so created are called as **subnets**.

Example-

Following diagram shows the subnetting of a big single network into 4 smaller subnets-



the default mask in different classes are :

Class A – 255.0.0.0

Class B – 255.255.0.0

Class C – 255.255.255.0

17)

Example : Given IP address 132.6.17.85 and default class B mask, find the beginning address (network address).

Solution : The default mask is 255.255.0.0, which means that the only the first 2 bytes are preserved and the other 2 bytes are set to 0. Therefore, the network address is 132.6.0.0.

18) What is Classless Addressing

To reduce the wastage of IP addresses in a block, we use sub-netting. What we do is that we use host id bits as net id bits of a classful IP address. We give the IP address and define the number of bits for mask along with it (usually followed by a '/' symbol), like, 192.168.1.1/28. Here, subnet mask is found by putting the given number of bits out of 32 as 1, like, in the given address, we need to put 28 out of 32 bits as 1 and the rest as 0, and so, the subnet mask would be 255.255.255.240.

Classless Addressing-

Classless Addressing is an improved IP Addressing system.

It makes the allocation of IP Addresses more efficient.

It replaces the older classful addressing system based on classes.

It is also known as **Classless Inter Domain Routing (CIDR)**.

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CIDR Block-

When a user asks for specific number of IP Addresses,

CIDR dynamically assigns a block of IP Addresses based on certain rules.

This block contains the required number of IP Addresses as demanded by the user.

This block of IP Addresses is called as a **CIDR block**.

Rules For Creating CIDR Block-

A CIDR block is created based on the following 3 rules-

Rule-01:

All the IP Addresses in the CIDR block must be contiguous.

Rule-02:

The size of the block must be presentable as power of 2.

Size of the block is the total number of IP Addresses contained in the block.

Size of any CIDR block will always be in the form 2^1, 2^2, 2^3, 2^4, 2^5 and so on.

Rule-03:

First IP Address of the block must be divisible by the size of the block.

Some values calculated in subnetting :

Number of subnets : Given bits for mask – No. of bits in default mask

Subnet address : AND result of subnet mask and the given IP address

Broadcast address : By putting the host bits as 1 and retaining the network bits as in the IP address

Number of hosts per subnet : $2^{(32 - \text{Given bits for mask})} - 2$

First Host ID : Subnet address + 1 (adding one to the binary representation of the subnet address)

6. Last Host ID : Subnet address + Number of Hosts

19) Given IP Address – 172.16.0.0/25, find the number of subnets and the number of hosts per subnet. Also, for the first subnet block, find the subnet address, first host ID, last host ID and broadcast address

Solution : This is a class B address. So, no. of subnets = $2^{(25-16)} = 2^9 = 512$.

No. of hosts per subnet = $2^{(32-25)} - 2 = 2^7 - 2 = 128 - 2 = 126$

For the first subnet block, we have subnet address = 0.0,

first host id = 0.1, last host id = 0.126

and broadcast address = 0.127

20) Given the CIDR representation 20.10.30.35 / 27. Find the range of IP Addresses in the CIDR block.

Solution-

Given CIDR representation is 20.10.30.35 / 27.

It suggests-

27 bits are used for the identification of network.

Remaining 5 bits are used for the identification of hosts in the network.

Given CIDR IP Address may be represented as-

00010100.00001010.00011110.00100011 / 27

So,

First IP Address = 00010100.00001010.00011110.001**00000** = 20.10.30.32

Last IP Address = 00010100.00001010.00011110.001**11111** = 20.10.30.63

Thus, Range of IP Addresses = [20.10.30.32 , 20.10.30.63]

21) Given the CIDR representation 100.1.2.35 / 20. Find the range of IP Addresses in the CIDR block.

Solution-

Given CIDR representation is 100.1.2.35 / 20.

It suggests-

20 bits are used for the identification of network.

Remaining 12 bits are used for the identification of hosts in the network.

Given CIDR IP Address may be represented as-

01100100.00000001.00000010.00100011 / 20

So,

First IP Address = 01100100.00000001.0000**0000.00000000** = 100.1.0.0

Last IP Address = 01100100.00000001.0000**1111.11111111** = 100.1.15.255

Thus, Range of IP Addresses = [100.1.0.0 , 100.1.15.255]

22) Consider a block of IP Addresses ranging from 100.1.2.32 to 100.1.2.47.

Is it a CIDR block?

If yes, give the CIDR representation.

Solution-

For any given block to be a CIDR block, 3 rules must be satisfied-

Rule-01:

According to Rule-01, all the IP Addresses must be contiguous.

Clearly, all the given IP Addresses are contiguous.

So, Rule-01 is satisfied.

Rule-02:

According to Rule-02, size of the block must be presentable as 2^n.

Number of IP Addresses in the given block = 47 – 32 + 1 = 16.

Size of the block = 16 which can be represented as 2^4.

So, Rule-02 is satisfied.

Rule-03:

According to Rule-03, first IP Address must be divisible by size of the block.

So, 100.1.2.32 must be divisible by 2^4.

100.1.2.32 = 100.1.2.0010**0000** is divisible by 2^4 since its 4 least significant bits are zero.

So, Rule-03 is satisfied.

Since all the rules are satisfied, therefore given block is a CIDR block.

CIDR Representation-

We have-

Size of the block = Total number of IP Addresses = 2^4.

To have 2^4 total number of IP Addresses, total 4 bits are required in the Host ID part.

So, Number of bits present in the Network ID part = 32 – 4 = 28.

Thus,

CIDR Representation = 100.1.2.32 / 28

NOTE-

For writing the CIDR representation,

We can choose to mention any IP Address from the CIDR block.

The chosen IP Address is followed by a slash and IP network prefix.

We generally choose to mention the first IP Address.

23) Consider a block of IP Addresses ranging from 150.10.20.64 to 150.10.20.127.

Is it a CIDR block?

If yes, give the CIDR representation.

Solution-

For any given block to be a CIDR block, 3 rules must be satisfied-

Rule-01:

According to Rule-01, all the IP Addresses must be contiguous.

Clearly, all the given IP Addresses are contiguous.

So, Rule-01 is satisfied.

Rule-02:

According to Rule-02, size of the block must be presentable as 2^n.

Number of IP Addresses in given block = 127 – 64 + 1 = 64.

Size of the block = 64 which can be represented as 2^6.

So, Rule-02 is satisfied.

Rule-03:

According to Rule-03, first IP Address must be divisible by size of the block.

So, 150.10.20.64 must be divisible by 2^6.

150.10.20.64 = 150.10.20.01**000000** is divisible by 2^6 since its 6 least significant bits are zero.

So, Rule-03 is satisfied.

Since all the rules are satisfied, therefore given block is a CIDR block.

CIDR Representation-

We have-

Size of the block = Total number of IP Addresses = 2^6.

To have 2^6 total number of IP Addresses, 6 bits are required in the Host ID part.

So, Number of bits in the Network ID part = 32 – 6 = 26.

Thus,

CIDR Representation = 150.10.20.64 / 26

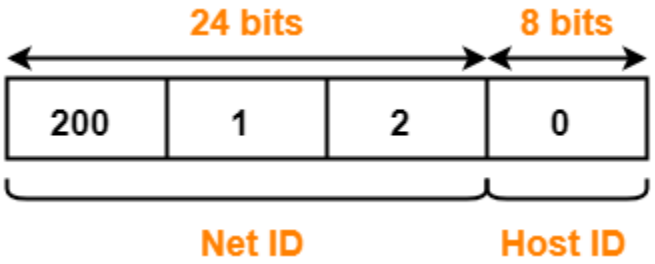
24)

Consider-

We have a big single network having IP Address 200.1.2.0.

We want to do subnetting and divide this network into 4 subnets.

Clearly, the given network belongs to class C.

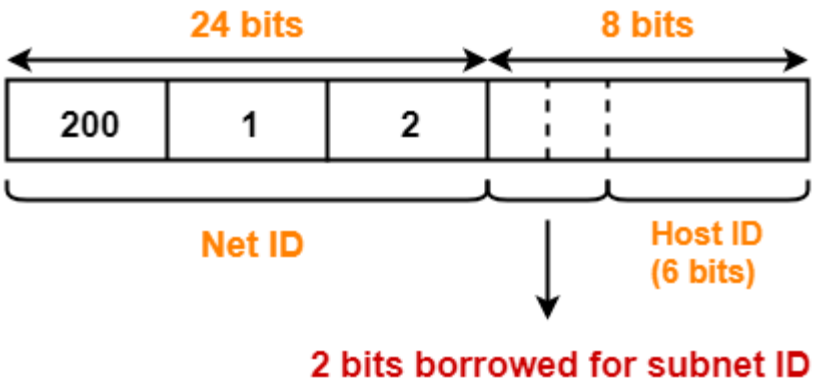


For creating four subnets and to represent their subnet IDs, we require 2 bits.

So,

We borrow two bits from the Host ID part.

After borrowing two bits, Host ID part remains with only 6 bits.



If borrowed bits = 00, then it represents the 1st subnet.

If borrowed bits = 01, then it represents the 2nd subnet.

If borrowed bits = 10, then it represents the 3rd subnet.

If borrowed bits = 11, then it represents the 4th subnet.

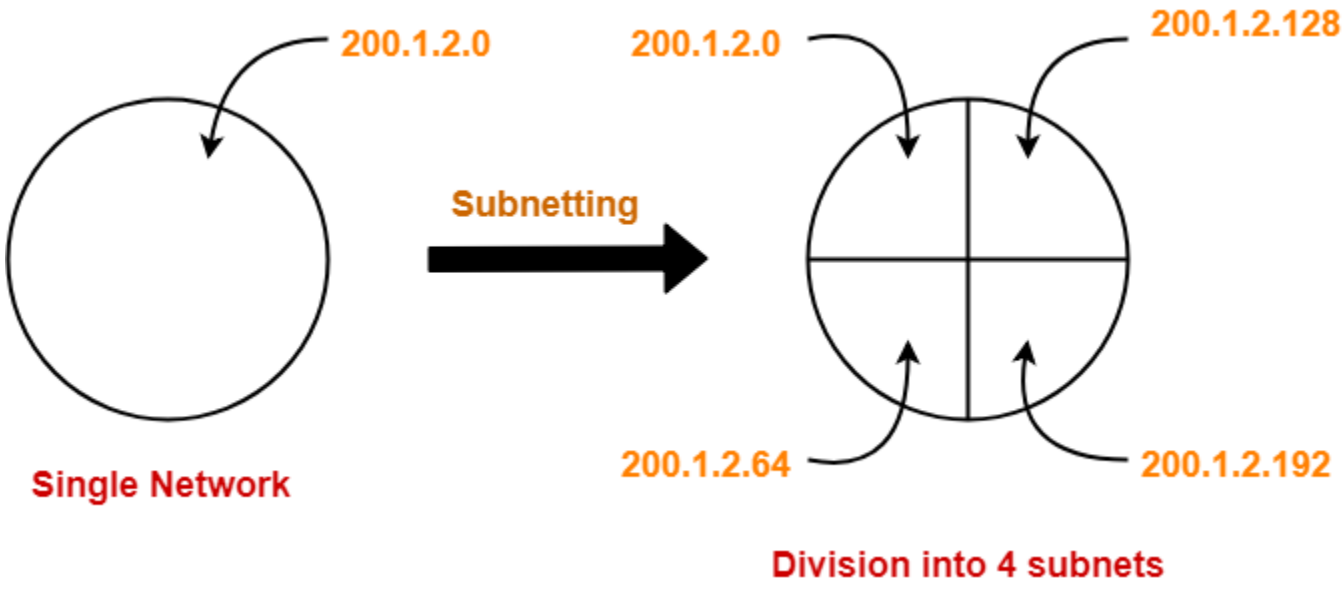
IP Address of the four subnets are-

200.1.2.**00**000000 = 200.1.2.0

200.1.2.**01**000000 = 200.1.2.64

200.1.2.**10**000000 = 200.1.2.128

200.1.2.**11**000000 = 200.1.2.192



<u>For 1st Subnet-</u>

IP Address of the subnet = 200.1.2.0

Total number of IP Addresses = 2^6 = 64

Total number of hosts that can be configured = 64 – 2 = 62

Range of IP Addresses = [200.1.2.**00**000000, 200.1.2.**00**111111] = [200.1.2.0, 200.1.2.63]

Direct Broadcast Address = 200.1.2.**00**111111 = 200.1.2.63

Limited Broadcast Address = 255.255.255.255

For 2nd Subnet-

IP Address of the subnet = 200.1.2.64

Total number of IP Addresses = 2^6 = 64

Total number of hosts that can be configured = 64 – 2 = 62

Range of IP Addresses = [200.1.2.**01**000000, 200.1.2.**01**111111] = [200.1.2.64, 200.1.2.127]

Direct Broadcast Address = 200.1.2.**01**111111 = 200.1.2.127

Limited Broadcast Address = 255.255.255.255

For 3rd Subnet-

IP Address of the subnet = 200.1.2.128

Total number of IP Addresses = 2^6 = 64

Total number of hosts that can be configured = 64 – 2 = 62

Range of IP Addresses = [200.1.2.**10**000000, 200.1.2.**10**111111] = [200.1.2.128, 200.1.2.191]

Direct Broadcast Address = 200.1.2.**10**111111 = 200.1.2.191

Limited Broadcast Address = 255.255.255.255

For 4th Subnet-

IP Address of the subnet = 200.1.2.192

Total number of IP Addresses = 2^6 = 64

Total number of hosts that can be configured = 64 – 2 = 62

Range of IP Addresses = [200.1.2.**11**000000, 200.1.2.**11**111111] = [200.1.2.192, 200.1.2.255]

Direct Broadcast Address = 200.1.2.**11**111111 = 200.1.2.255

Limited Broadcast Address = 255.255.255.255