

4.3 Experiment no.3

Aim:

Write a program to demonstrate subnetting and find the subnet masks.

Theory:**Subnetting**

Subnetting is a process of dividing large network into the smaller networks based on layer 3 IP address. Every computer on network has an IP address that represent its location on network. Two version of IP addresses are available IPv4 and IPv6. In this article we will perform subnetting on IPv4.

IPv4

IP addresses are displayed in dotted decimal notation, and appear as four numbers separated by dots. Each number of an IP address is made from eight individual bits known as octet. Each octet can create number value from 0 to 255. An IP address would be 32 bits long in binary divided into the two components, network component and host component. Network component is used to identify the network that the packet is intended for, and host component is used to identify the individual host on network.

IP addresses are broken into the two components:

Network component :- Defines network segment of device.

Host component :- Defines the specific device on a particular network segment

IP Classes in decimal notation

1. Class A addresses range from 1-126
 2. Class B addresses range from 128-191
 3. Class C addresses range from 192-223
 4. Class D addresses range from 224-239
 5. Class E addresses range from 240-254
- 0 [Zero] is reserved and represents all IP addresses.
 - 127 is a reserved address and is used for testing, like a loop back on an interface.
 - 255 is a reserved address and is used for broadcasting purposes

Subnet mask

Subnet mask is a 32 bits long address used to distinguish between network address and host address in IP address. Subnet mask is always used with IP address. Subnet mask has only one purpose, to identify which part of an IP address is network address and which part is host address.

For example how will we figure out network partition and host partition from IP address 192.168.1.10 ? Here we need subnet mask to get details about network address and host address.

- In decimal notation subnet mask value 1 to 255 represent network address and value 0 [Zero] represent host address.
- In binary notation subnet mask **ON** bit [1] represent network address while **OFF** bit[0] represent host address.

In decimal notation

IP address	192.168.1.10
Subnet mask	255.255.255.0

Network address is **192.168.1** and host address is **10**.

In binary notation

IP address	11000000.10101000.00000001.00001010
Subnet mask	11111111.11111111.11111111.00000000

Network address is 11000000.10101000.00000001 and host address is 00001010

IP Class	Default Subnet	Network bits	Host bits	Total hosts	Valid hosts
A	255.0.0.0	First 8 bits	Last 24 bits	16, 777, 216	16, 777, 214
B	255.255.0.0	First 16 bits	Last 16 bits	65,536	65,534
C	255.255.255.0	First 24 bits	Last 8 bits	256	254

Network ID

First address of subnet is called network ID. This address is used to identify one segment or broadcast domain from all the other segments in the network.

Block Size

Block size is the size of subnet including network address, hosts addresses and broadcast address.

Broadcast ID

There are two types of broadcast, direct broadcast and full broadcast.

Direct broadcast or local broadcast is the last address of subnet and can be heard by all hosts in subnet.

Full broadcast is the last address of IP classes and can be heard by all IP hosts in network. Full broadcast address is 255.255.255.255

The main difference between direct broadcast and full broadcast is that routers will not propagate local broadcasts between segments, but they will propagate directed broadcasts.

Host Addresses

All address between the network address and the directed broadcast address is called host address for the subnet. You can assign host addresses to any IP devices such as PCs, servers, routers, and switches.

Single class C IP range can fulfill this requirement, still you have to purchase 2 class C IP range, one for each network. Single class C range provides 256 total addresses and we need only 30 addresses, this will waste 226 addresses. These unused addresses would make additional route advertisements slowing down the network.

With subnetting you only need to purchase single range of class C. You can configure router to take first 26 bits instead of default 24 bits as network bits. In this case we would extend default boundary of subnet mask and borrow 2 host bits to create networks. By taking two bits from the host range and counting them as network bits, we can create two new subnets, and assign hosts them. As long as the two new network bits match in the address, they belong to the same network. You can change either of the two bits, and you would be in a new subnet.

Advantage of Subnetting

- Subnetting breaks large network in smaller networks and smaller networks are easier to manage.
- Subnetting reduces network traffic by removing collision and broadcast traffic, that overall improve performance.
- Subnetting allows you to apply network security policies at the interconnection between subnets.
- Subnetting allows you to save money by reducing requirement for IP range.

Default subnet mask

Class	Subnet Mask	Format
A	255.0.0.0	Network.Host.Host.Host
B	255.255.0.0	Network.Network.Host.Host
C	255.255.255.0	Network.Network.Network.Host

Key terms to remember

- A subnet is a smaller portion of large network treated as its own separate network. To create subnet we borrow bits from host portion and assign them as network bits. This means more networks, fewer hosts.
- If the network bits on two addresses do not match, then the two packets are intended for two separate networks.
- On a 32 bits IP address at least eight bits must belong to the network portion and at least 2 bits must belong to the host portion.
- Each IP address has a predefined IP class and that cannot be changed.
- Each class has a predefined default subnet mask that tells us the octets, which are already part of the network portion, as well as how many bits we have available to work with.
- Whatever network class it is, we cannot change those bits that are already assigned. We cannot assign the network ID and the broadcast address to a host.
- Regardless of how many bits are left in the host field, network ID and the broadcast address must be reserved.
- Subnet bits start at the left and go to the right, without skipping bits.

Conclusion:

Successfully implemented the subnetting and subnet mask program.