ASSIGNMENT 2

Title:

Subnet an IPv4 Network.

Aim:

To study IPv4 subnetting and calculate network address, broadcast address, total host addresses, create equal subnets, and determine usable host IP addresses for a given network.

Objectives:

1) To understand IPv4 address structure and subnet masks.
2) To calculate network and broadcast addresses for a given network.
3) To compute total and usable host addresses.
4) To divide a given network into equal subnets and list their IP ranges.
5) To find specific usable host addresses within a subnet.
6) To verify the calculated results using CLI tools or a simulator (Packet Tracer).

Theory:

1. Subnet

A subnet (short for subnetwork) is a logical subdivision of an IP network created by borrowing bits from the host portion of an address. Subnetting allows a large network to be broken into smaller, more manageable networks with their own address ranges. Each subnet behaves like an independent network for routing and addressing purposes, while still remaining part of the larger overall address space.

2. Network Address

The network address identifies the beginning of a subnet. It is the first address in the range and is used to represent the entire subnet rather than a single device. In binary, all host bits of a network address are zero. Routers and devices use the network address to determine whether a destination IP is within the same subnet or needs to be forwarded elsewhere. For example, in the subnet 100.100.18.0/24, the network address is 100.100.18.0.

3. Broadcast Address

The broadcast address is the last address in a subnet and is used to send messages to all hosts within that subnet at once. In binary form, all host bits are set to one. Devices use this address when they need to communicate with every device in the subnet simultaneously (e.g., ARP requests). For the subnet 100.100.18.0/24, the broadcast address is 100.100.18.255.

4. Host Address

Host addresses are the IP addresses between the network and broadcast addresses within a subnet. They are assigned to individual devices (computers, printers, routers) on that subnet so each device can communicate uniquely. Host addresses are “usable” addresses because they can be given to hosts, unlike the network or broadcast addresses which are reserved.

5. Subnet Mask

A subnet mask is a 32-bit number used alongside an IP address to define which portion of the address refers to the network and which portion refers to the host. It consists of a series of ones (network bits) followed by zeros (host bits). For example, the mask 255.255.255.0 corresponds to /24 in CIDR notation, meaning the first 24 bits are network bits.

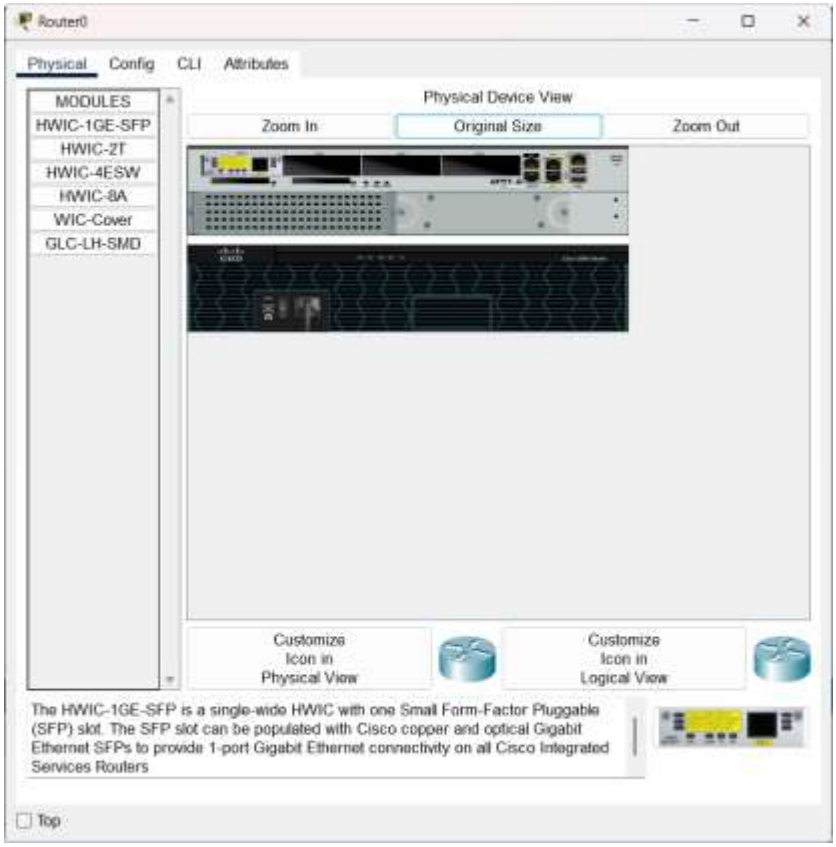
6. Usable Host Range

The usable host range is the span of IP addresses within a subnet that can actually be assigned to devices. It excludes the first (network) and last (broadcast) addresses. For a /24 subnet like 100.100.18.0/24, the usable host range is from 100.100.18.1 to 100.100.18.254.

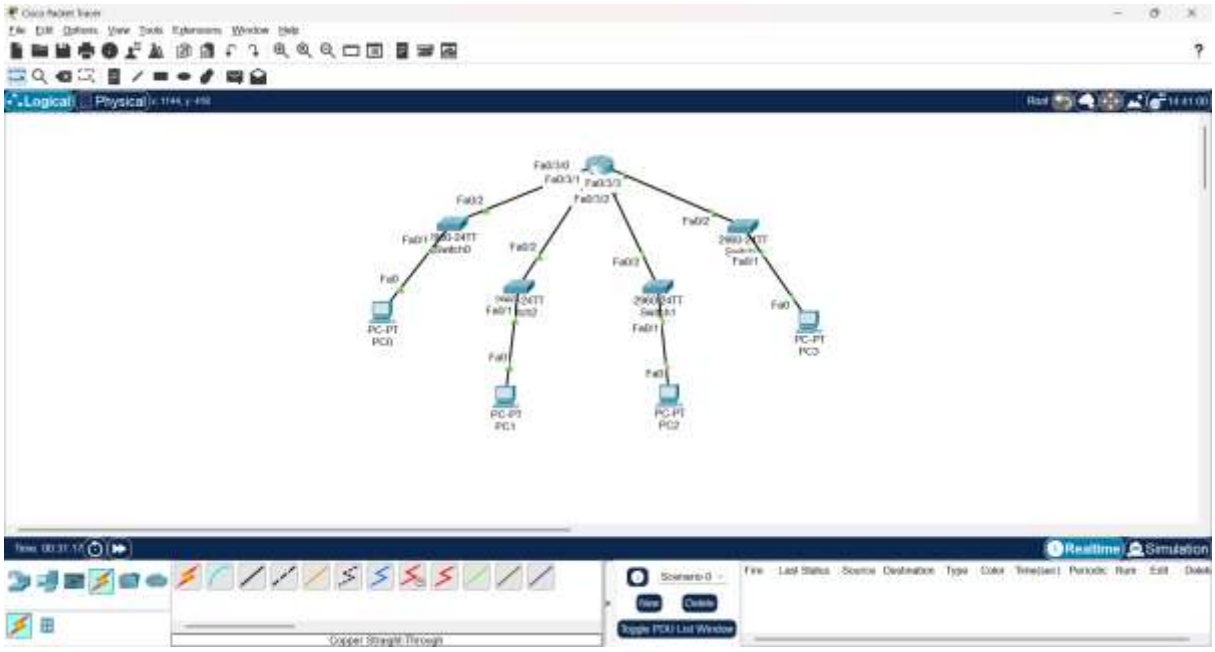
Implementation details and Screenshots:

1) Adding Extra Port.

Router 2911 has only 3 ports so we have to add the port physically.
*Click on router → physical → turn of router → drag & drop **HWIC-4ESW** in empty slot → turn on the router.*

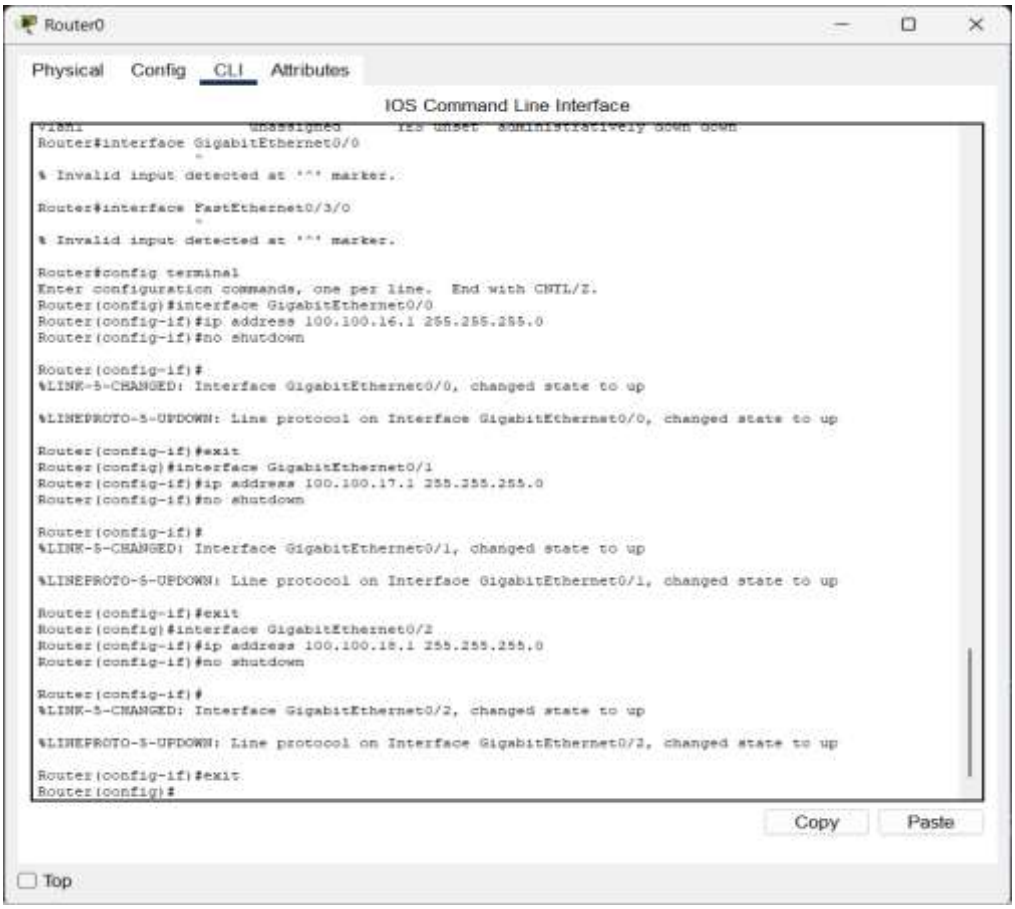


2) Create a basic Topology



3) Configuring the router interfaces.

Using CLI we will configure the router i.e we will create 4 subnets. One switch will contain one subnet.



4) Router Configure is Completed

```
Router#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     100.100.16.1    YES manual up                    up
GigabitEthernet0/1     100.100.17.1    YES manual up                    up
GigabitEthernet0/2     100.100.18.1    YES manual up                    up
```

5) Configure PC IP settings

For each PC: Click PC → Desktop → IP Configuration → enter IP, Subnet Mask, Default Gateway.

PC0 (Subnet 1)

- *IP Address: 100.100.16.2*
- *Subnet Mask: 255.255.255.0*
- *Default Gateway: 100.100.16.1*

PC1 (Subnet 2)

- *IP Address: 100.100.17.2*
- *Subnet Mask: 255.255.255.0*
- *Default Gateway: 100.100.17.1*

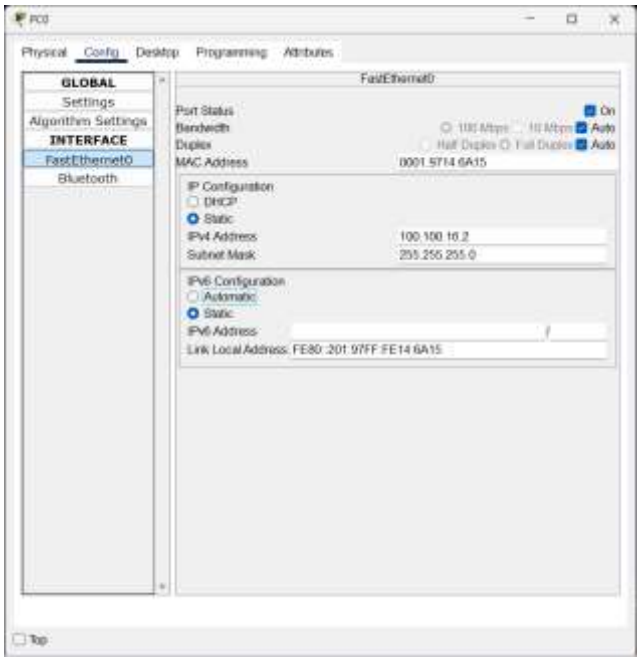
PC2 (Subnet 3) —

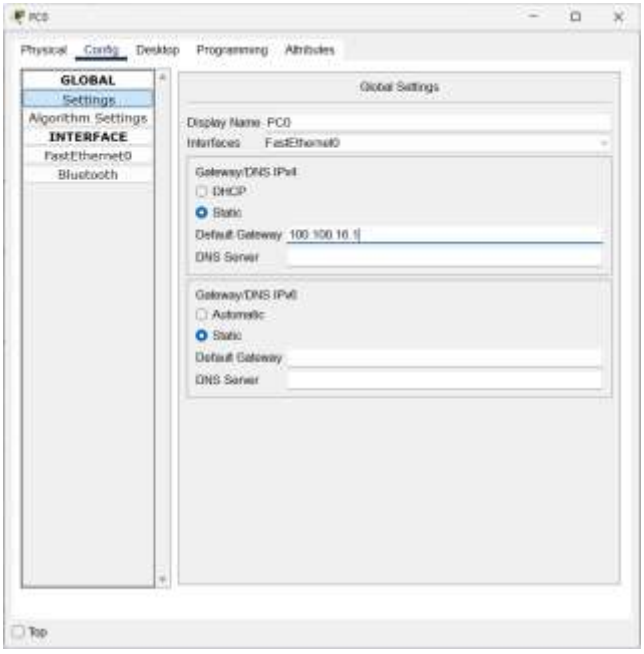
- *IP Address: 100.100.18.5 ← (5th usable)*
- *Subnet Mask: 255.255.255.0*
- *Default Gateway: 100.100.18.1*

PC3 (Subnet 4)

- *IP Address: 100.100.19.2*
- *Subnet Mask: 255.255.255.0*
- *Default Gateway: 100.100.19.1*

Follow same steps shown in fig for each PC and add the above information.

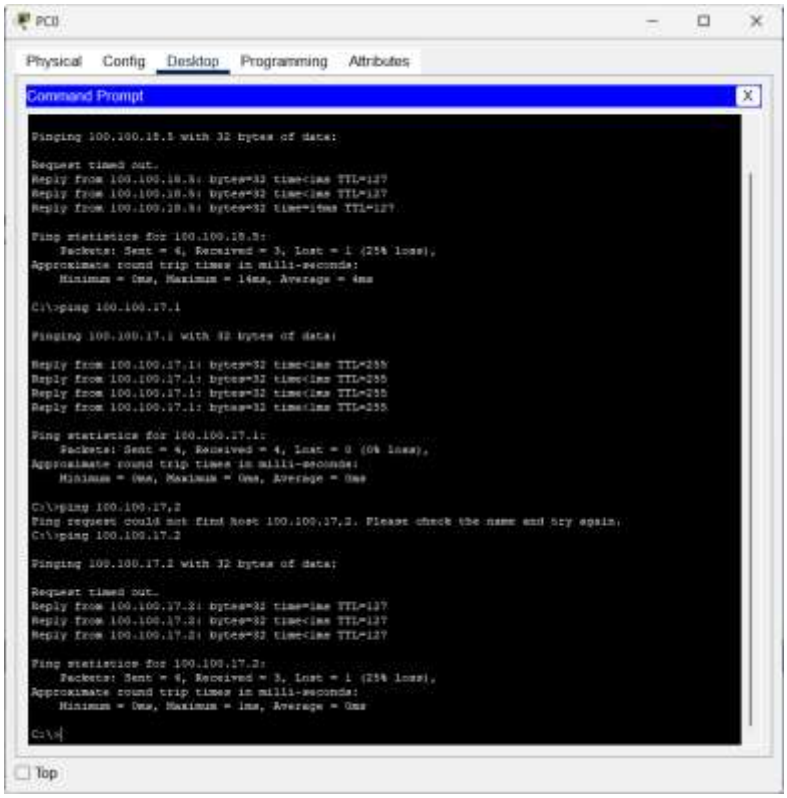




6) Subnets are Created

7) Verifying Subnet

Using Ping command we are verifying that the subnets are working properly.



8) Question & Answer

I. Network Address and Broadcast Address.

→ Network = **100.100.16.0**, Broadcast = **100.100.19.255**.

II. How many Total Host Addresses possible?

→ Total addresses = **1024**, Usable = **1022**.

III. If we make 4 sub-networks then what will be each sub-network's IP address ranges?

→ Four /24 subnets: 100.100.16.0/24, 100.100.17.0/24, 100.100.18.0/24, 100.100.19.0/24 (each usable .1–.254, broadcast .255).

IV. What will be 5th usable and last usable IP address in 3rd Subnet?

→ In 3rd subnet (100.100.18.0/24): 5th usable = 100.100.18.5, last usable = 100.100.18.254.

Conclusion

In this assignment I successfully learned and applied the concept of IPv4 subnetting. Starting from the given network 100.100.16.0/22, I calculated its network and broadcast addresses, determined the total and usable host addresses, divided it into four equal subnets, and identified specific usable IP addresses within one of the subnets. By then implementing the design in Cisco Packet Tracer and verifying connectivity through pings and router outputs, I was able to confirm that my theoretical calculations matched practical results. This exercise deepened my understanding of how subnetting improves address management, enhances routing efficiency, and forms the foundation for real-world IP network design.