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INTRODUCTION

Subnetting refers to the process of dividing a large network into smaller logical sub-networks, known as sub-nets. It is a technique used in computer networking to optimize the utilization of IP addresses and improve network efficiency.

In a sub-netted network, a portion of the host bits in an IP address is allocated for network identification, and the remaining bits are used for host identification within that sub-net. By dividing a network into sub-nets, you can create smaller, more manageable network segments that can be independently managed and configured.

Sub-netting is primarily used in IPv4 networks, where IP addresses are 32 bits long and typically represented in dotted decimal notation (e.g 192.168.0.1). The process of sub-netting involves borrowing bits from the host portion of the IP address to create a sub-net mask, which defines the network and sub-net boundaries.

Schematic Diagram:

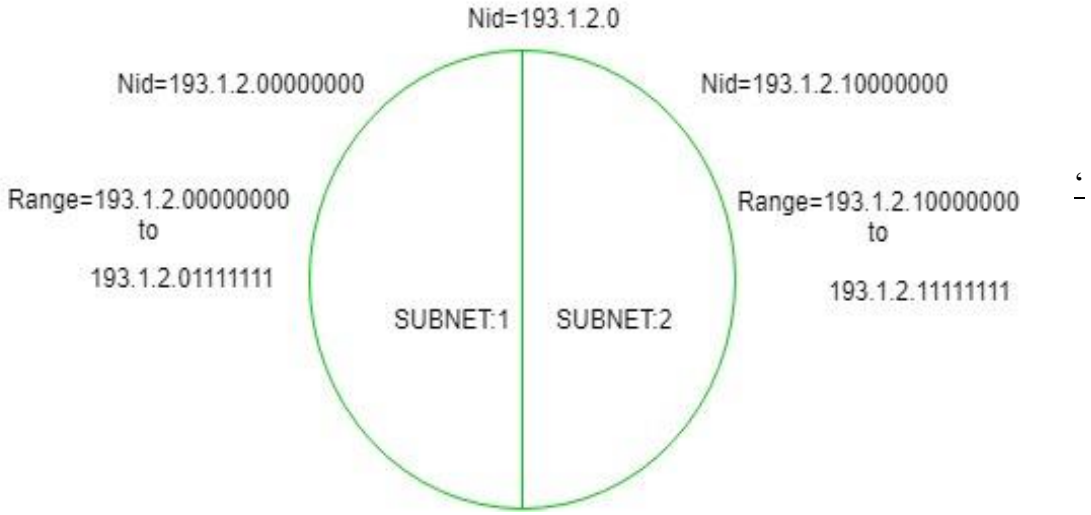


Figure-1

Schematic Diagram of subnetting

SOFTWARE USED

The software used for this activity is the Cisco Packet Tracer(C.P.T)

Cisco Packet Tracer as the name suggests, is a tool built by Cisco. This tool provides a network simulation to practice simple and complex networks.

"Cisco believes, the best way to learn about networking is to do it."

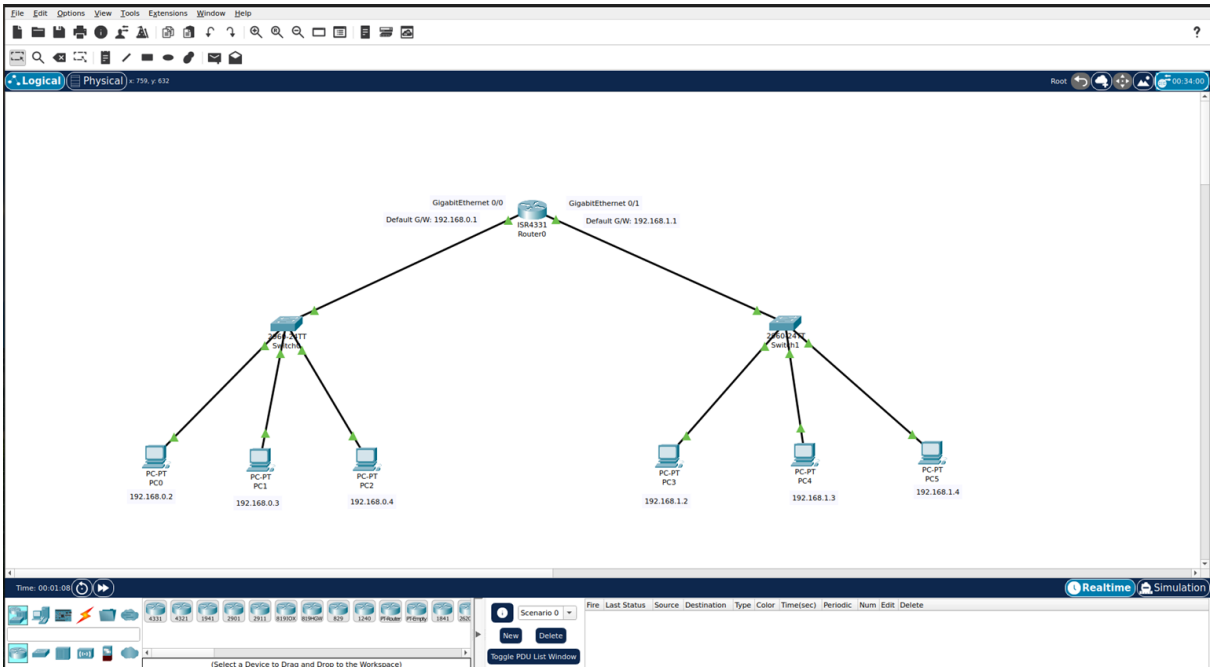


Figure-2
An overveiw of CPT interface

Even network engineers prefer to test any protocols on Cisco Packet Tracer before implementing them. Also, Engineers who would like to deploy any change in the production network prefer to use Cisco Packet Tracer to first test the required changes and proceed to deploy if and only if everything is working as expected.

CLASS FULL IP ADDRESSING

IP address is an address having information about how to reach a specific host, especially outside the LAN. An IP address is a 32 bit unique address having an address space of 232.

Generally, there are two notations in which IP address is written, dotted decimal notation and hexadecimal notation.

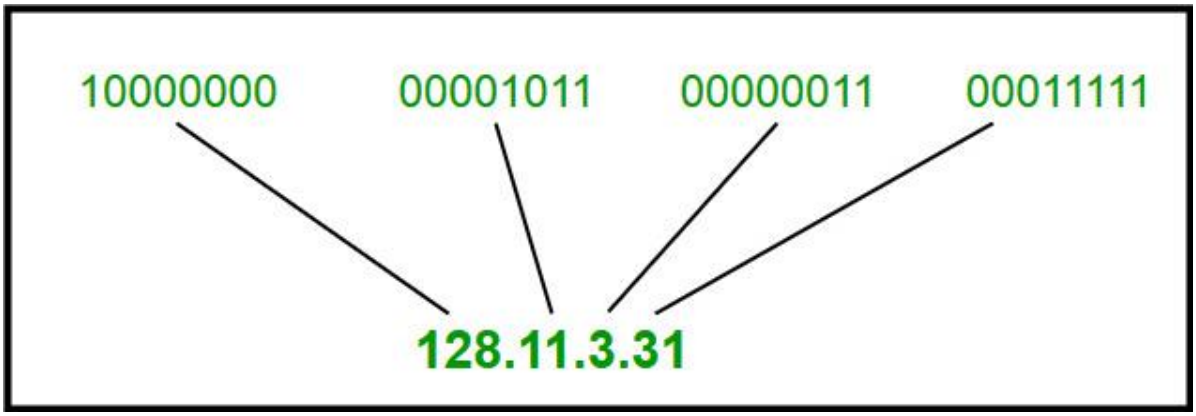


Figure 3
IP notation

In Class full Addressing
The 32 bit IP address is divided into five sub-classes. These are:

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

Schematic Diagram of Class A, B, C IP Addresses

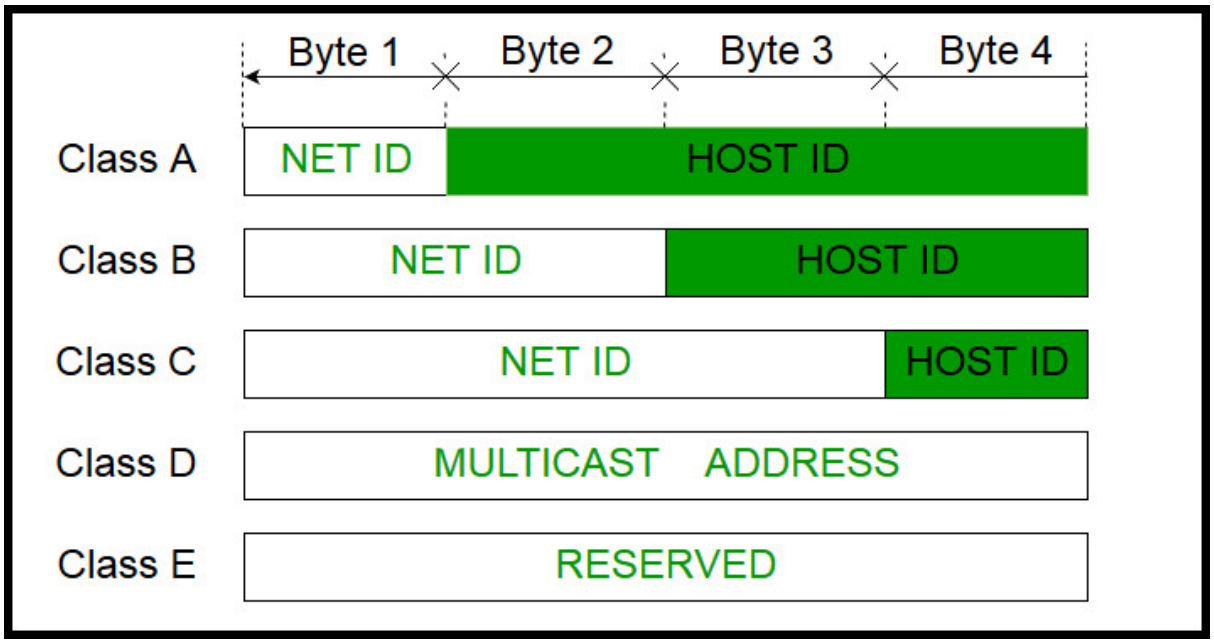


figure-4

Rules for assigning Host ID:

Host ID's are used to identify a host within a network. The host ID are assigned based on the following rules:

- Within any network, the host ID must be unique to that network.
- Host ID in which all bits are set to 0 cannot be assigned because this host ID is used to represent the network ID of the IP address.
- Host ID in which all bits are set to 1 cannot be assigned because this host ID is reserved as a broadcast address to send packets to all the hosts present on that particular network.

Rules for assigning Network ID:

Hosts that are located on the same physical network are identified by the network ID, as all host on the same physical network is assigned the same network ID. The network ID is assigned based on the following rules:

- The network ID cannot start with 127 because 127 belongs to class A address and is reserved for internal loop-back functions.
- All bits of network ID set to 1 are reserved for use as an IP broadcast address and therefore, cannot be used.
- All bits of network ID set to 0 are used to denote a specific host on the local network and are not routed and therefore, aren't used.

Disadvantages:

1. Class A with a mask of 255.0.0.0 can support 128 Network, 16,777,216 addresses per network and a total of 2,147,483,648 addresses.
2. Class B with a mask of 255.255.0.0 can support 16,384 Network, 65,536 addresses per network and a total of 1,073,741,824 addresses.
3. Class C with a mask of 255.255.255.0 can support 2,097,152 Network, 256 addresses per network and a total of 536,870,912 addresses.

But what if someone requires 2000 addresses ?

One way to address this situation would be to provide the person with class B network. But that would result in a waste of so many addresses. Another possible way is to provide multiple class C networks, but that too can cause a problem as there would be too many networks to handle.

To resolve problems like the one mentioned above CIDR was introduced.

Problems with Classful Addressing:

The problem with this classful addressing method is that millions of class A address are wasted, many of the class B address are wasted, whereas, number of addresses available in class C is so small that it cannot cater the needs of organizations. Class D addresses are used for multicast routing and are therefore available as a single block only. Class E addresses are reserved.

Since there are these problems, Classful networking was replaced by Classless Inter-Domain Routing (CIDR) in 1993.

CIDR NOTATION :

In CIDR sub-net masks are denoted by /X. For example a sub-net of 255.255.255.0 would be denoted by /24. To work a sub-net mask in CIDR, we have to first convert each octet into its respective binary value.

With CIDR, we can create Variable Length Subnet Masks, leading to less wastage of IP addresses. It is not necessary that the divider between the network and the host portions is at an octet boundary. For example, in CIDR a subnet mask like 255.224.0.0 or 11111111.11100000.00000000.00000000 can exist.

And hence classless addressing was invented

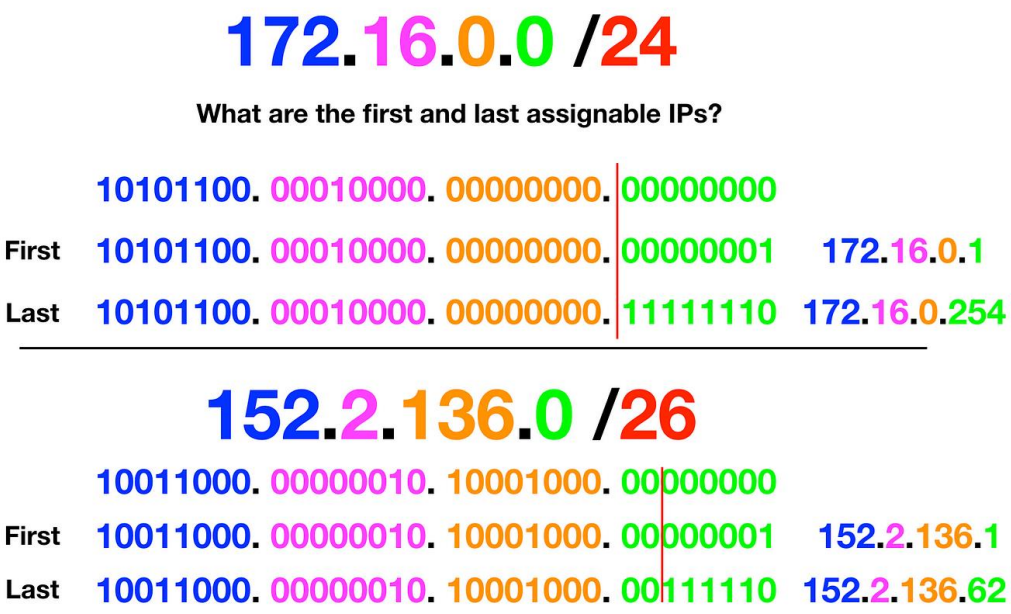


Figure-5

Classless-Subnetting

Qualities of Subnetting:

Here are a few qualities of subnetting:

1.Each subnet has its own extraordinary organization address and subnet veil.

2.Subnetting can further develop network execution, security, and association.

3.It isolates a solitary organization into more modest subnetworks or subnets.

4.It very well may be utilized to lessen network blockage and further develop network unwavering quality.

5.Subnetting permits you to make separate organizations for various divisions, areas, or sorts of gadgets.
It permits you to add more gadgets to an organization without requiring extra IP locations or organization foundation.

Hence sub-netting concept is most widely used in corporate offices.

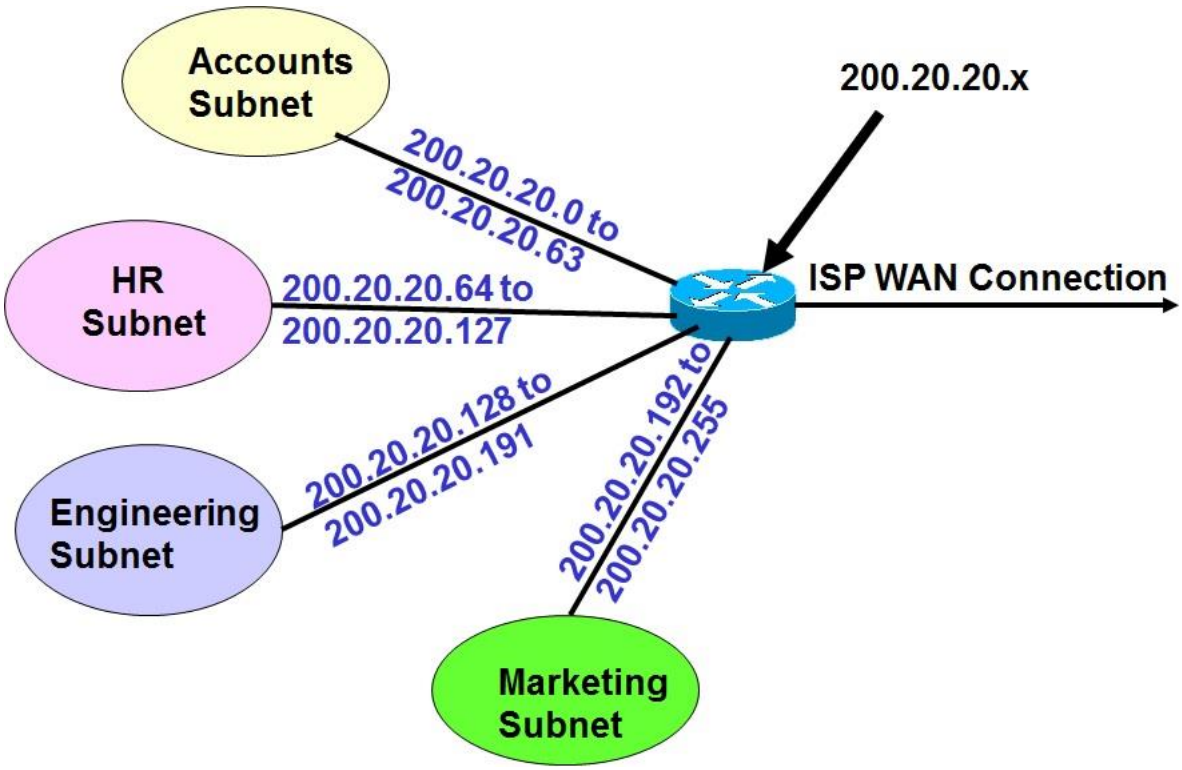


Figure-6

Subnetting scenario in an office

REAL LIFE PROBLEM STATEMENT

Problem Statement:

An office has 4 departments IT, marketing, services, finance. Given the IP address 196.10.20.0, sub-net it into 52 hosts per department.

Solution:

Given IP : 196.10.20.0 is a class A addresses

Default Sub-net Mask: 255,255.255.0 or

11111111.11111111.11111111.00000000 in binary

Required Hosts : 52

52 in binary= 110100 which is a 6 bit number

Therefore reserve 6 bits in the sub-net mask for host

new sub-net will be

11111111.11111111.11111111.11 000000 OR

255.255.255.192 in Dotted Decimal notation

Sub-net generator=2^6=64

Hence 256/64 = 4 logical sub-nets can be for 4 depts

Sub-net 1:

196.10.20.0 – 196.10.20.63 → 64 hosts

196.10.20.0 → Network ID

196.10.20.1 → Default Gateway for sub-net 1

196.10.20.2 → host-min in sub-net 1 up to

196.10.20.62 → host-max in sub-net 1

196.10.20.63 → broadcast ID of sub-net 1

Sub-net 2:

196.10.20.64 – 196.10.20.127 → 64 hosts

196.10.20.64 → Network ID

196.10.20.65 → Default Gateway for sub-net 1

196.10.20.66 → host-min in sub-net 1 up to

196.10.20.126 → host-max in sub-net 1

196.10.20.127 → broadcast ID of sub-net 1

Sub-net 3:

196.10.20.128 – 196.10.20.191→ 64 hosts

196.10.20.128 → Network ID

196.10.20.129 → Default Gateway for sub-net 1

196.10.20. 130→ host-min in sub-net 1 up to

196.10.20.190 → host-max in sub-net 1

196.10.20.191 → broadcast ID of sub-net 1

Sub-net 4:

196.10.20.192 – 196.10.20.255 → 64 hosts

196.10.20.192 → Network ID

196.10.20.193 → Default Gateway for sub-net 1

196.10.20.194 → host-min in sub-net 1 up to

196.10.20.254 → host-max in sub-net 1

196.10.20.255 → broadcast ID of sub-net 1

PRACTICAL IMPLEMENTATION ON CPT

Sub-net 1 (IT DEPARTMENT)

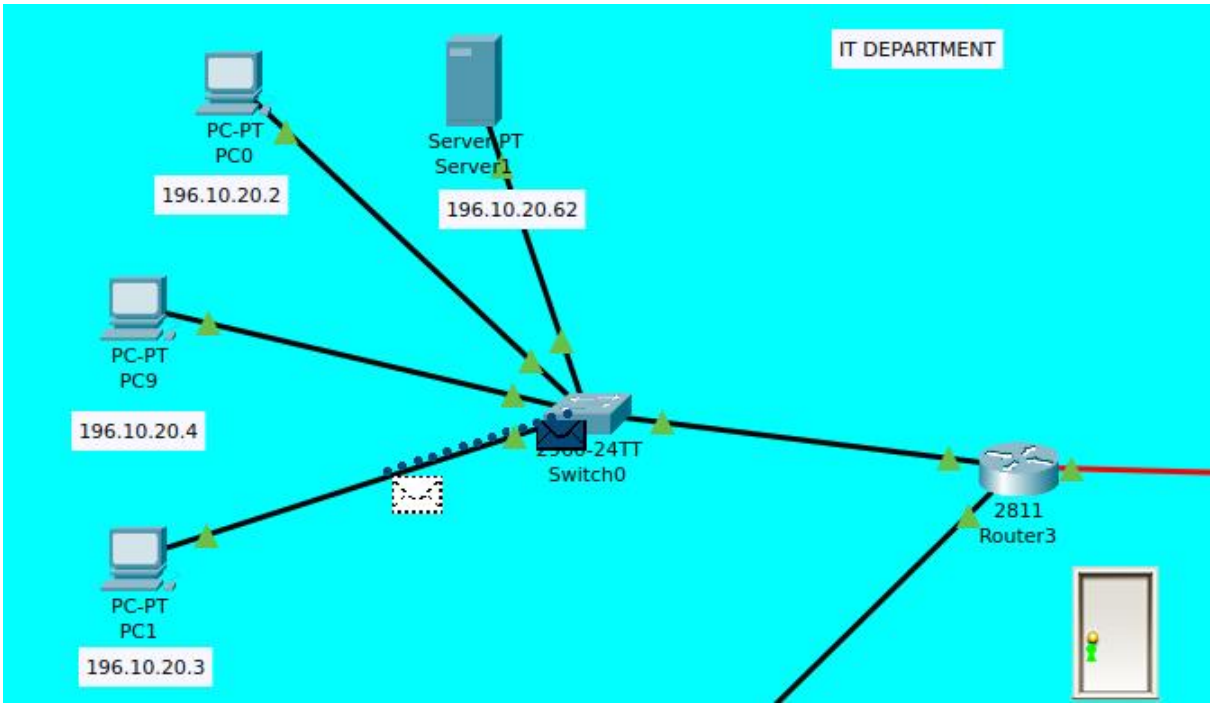
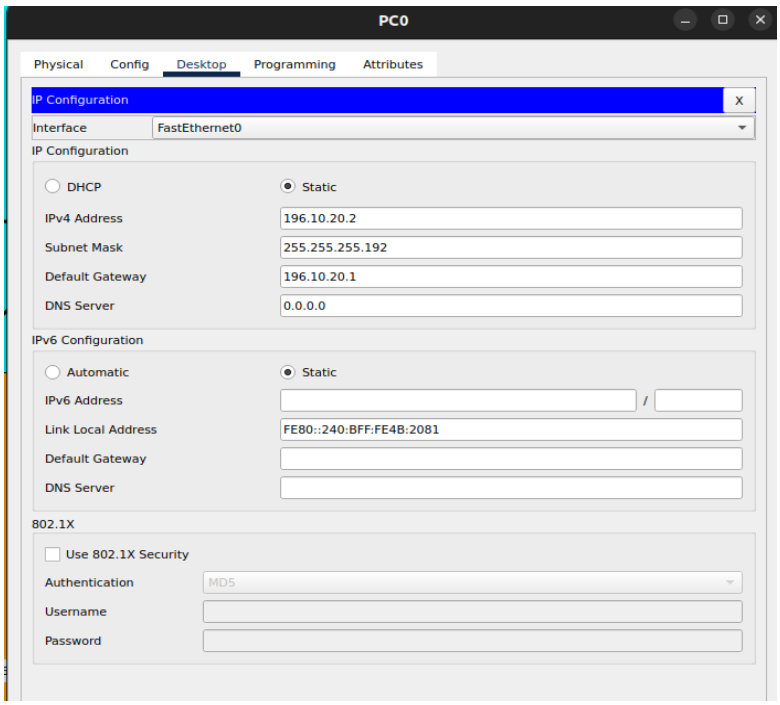


Figure-7

configuration



Sub-net 2 (Marketing DEPARTMENT)

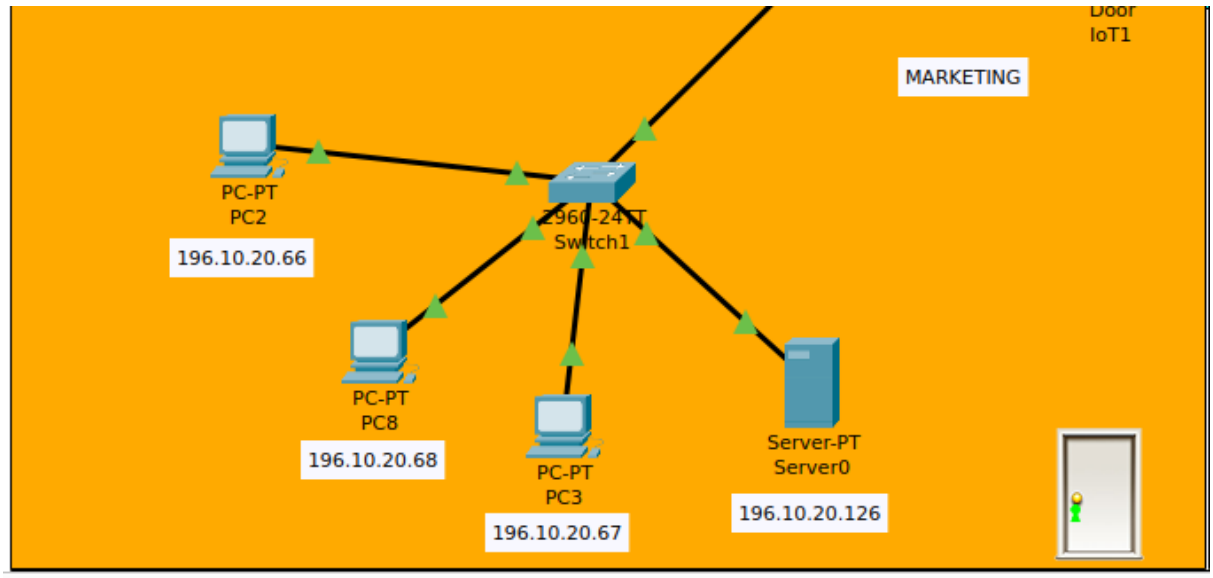
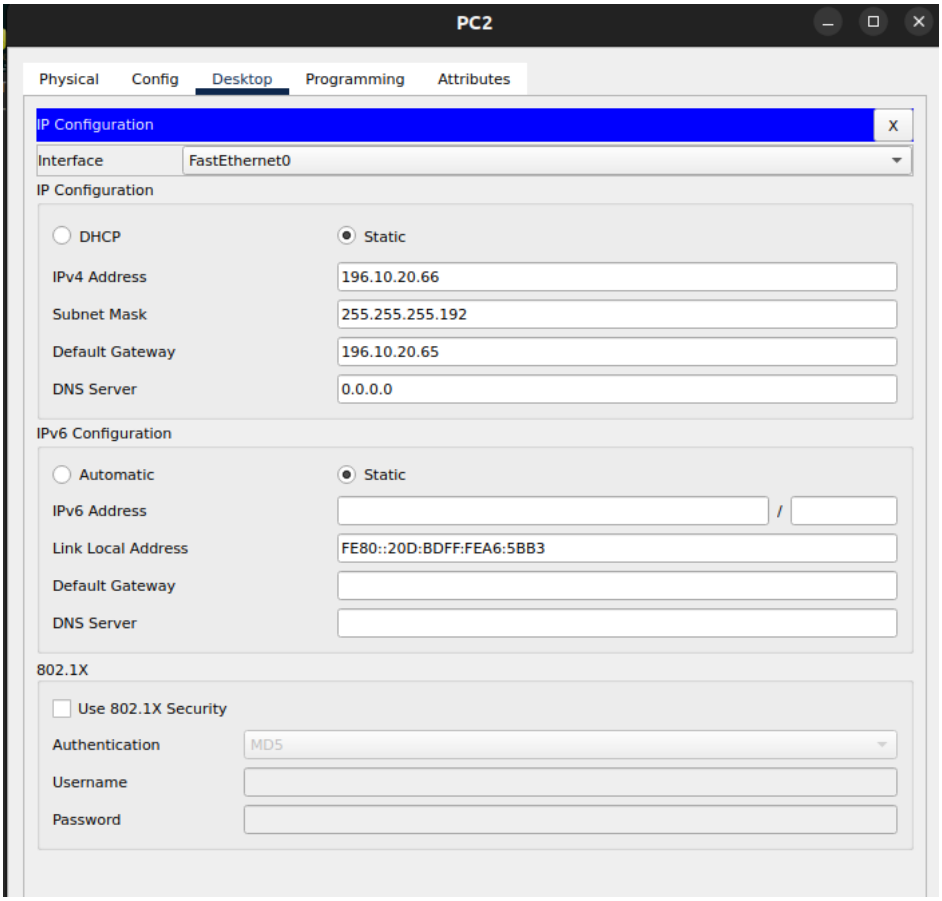


Figure-8

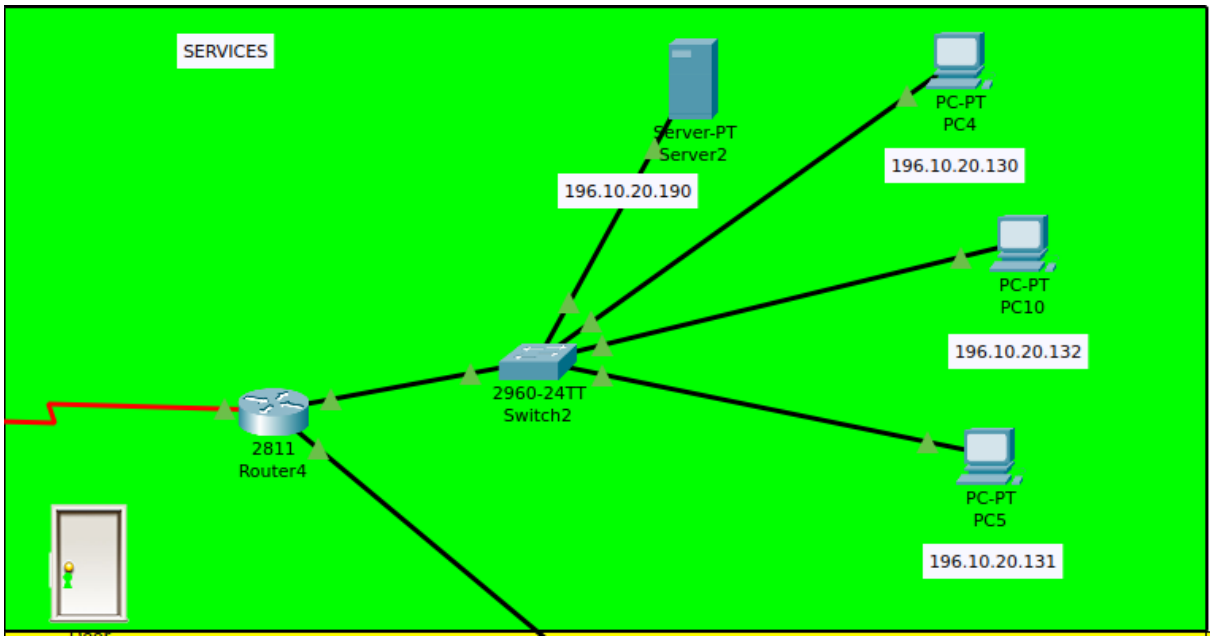
configuration

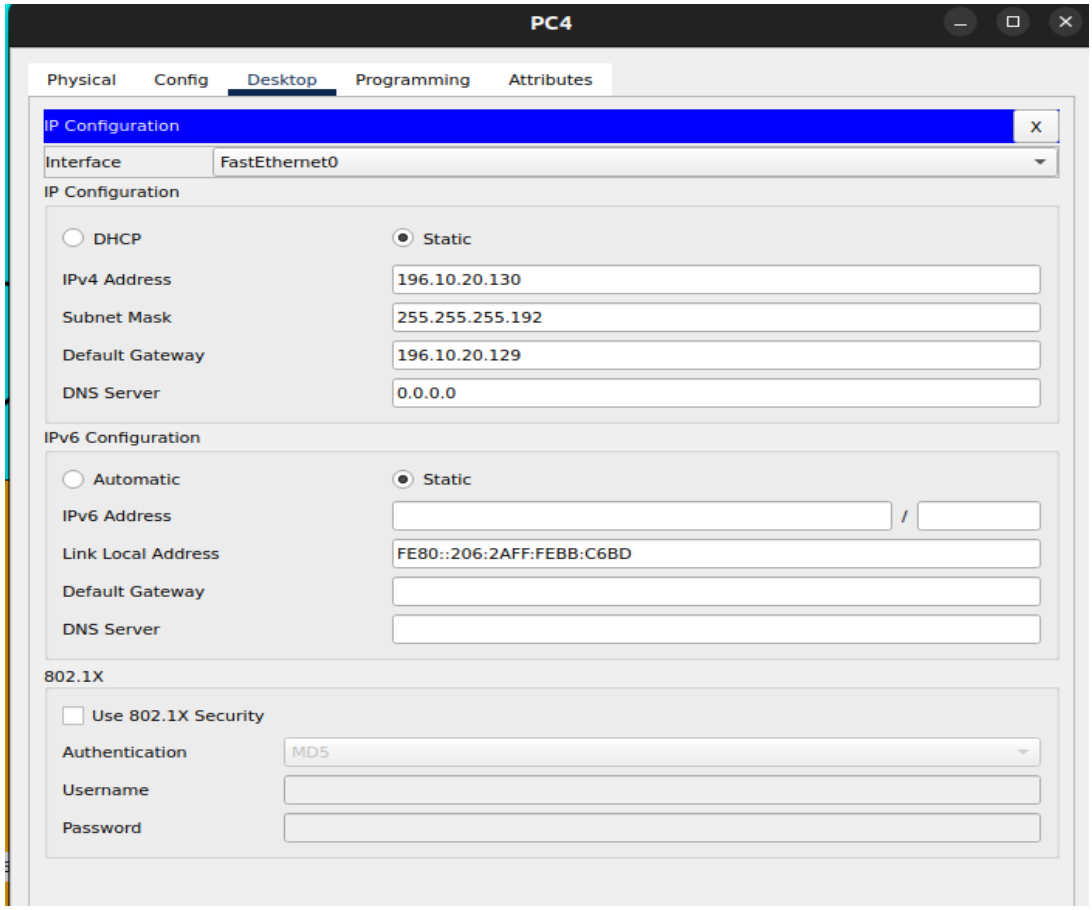


Sub-net3 (Services DEPARTMENT)

Figure-9

Configuration

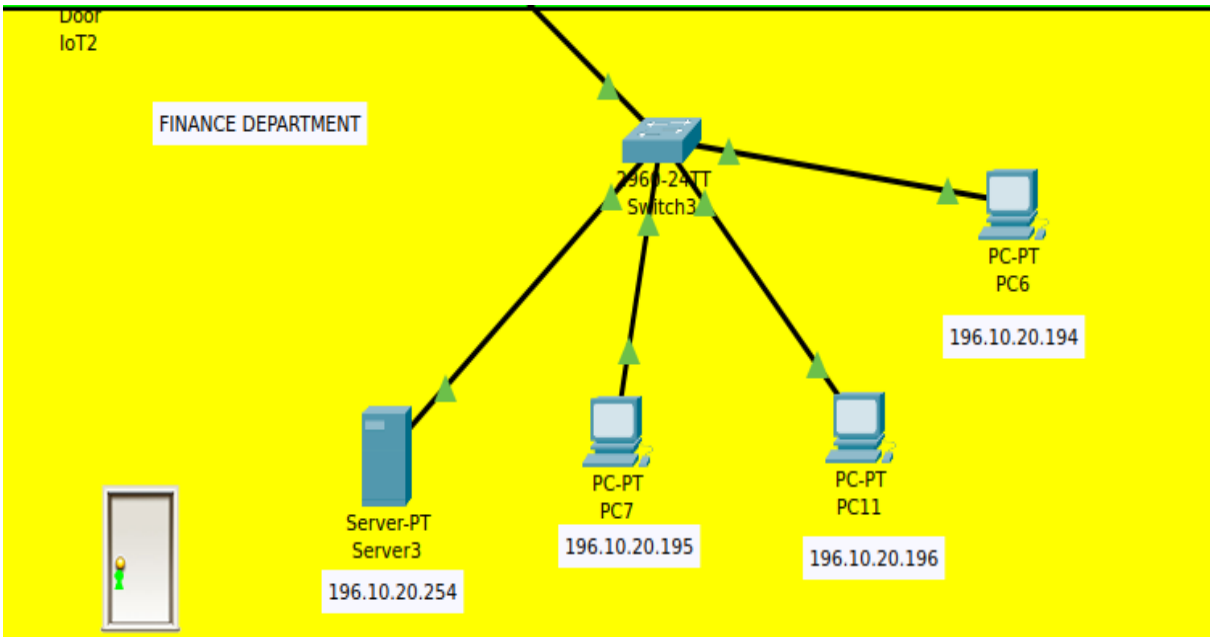


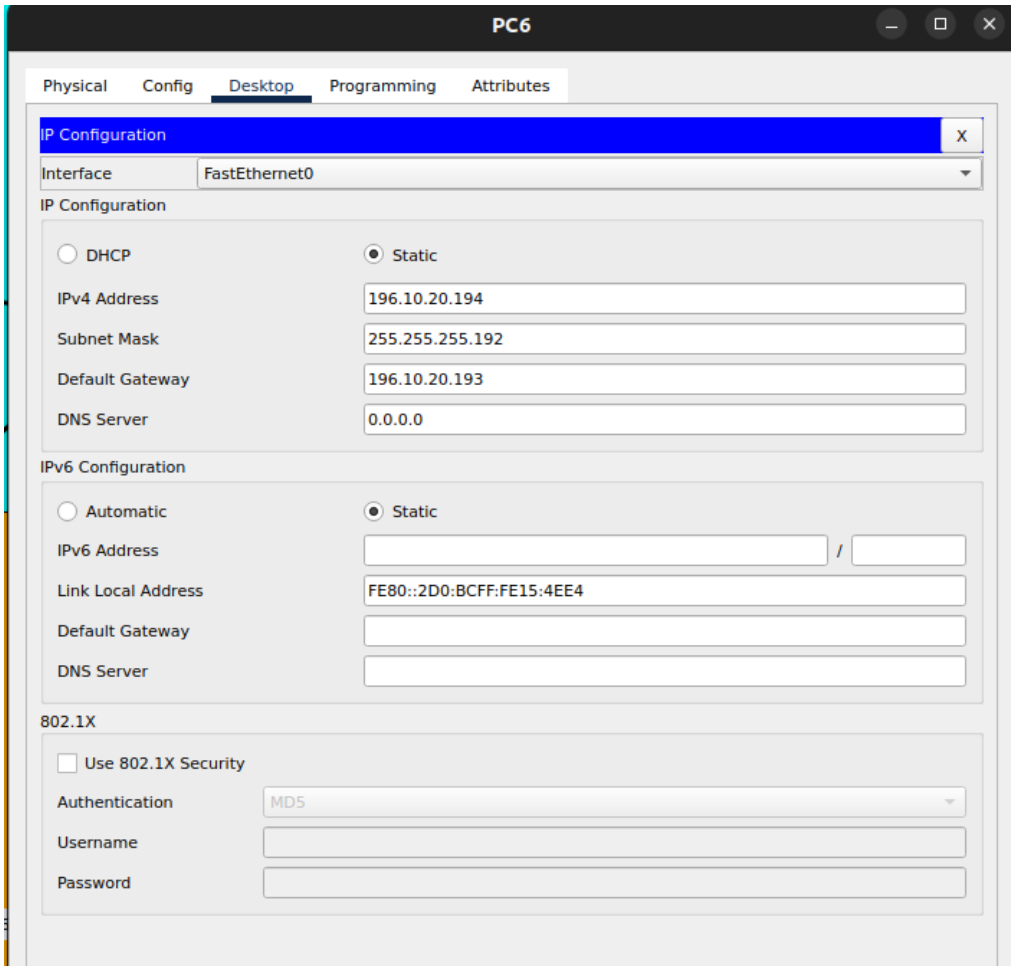


Sub-net 4(Finance Department)

Figure-10

Configuration

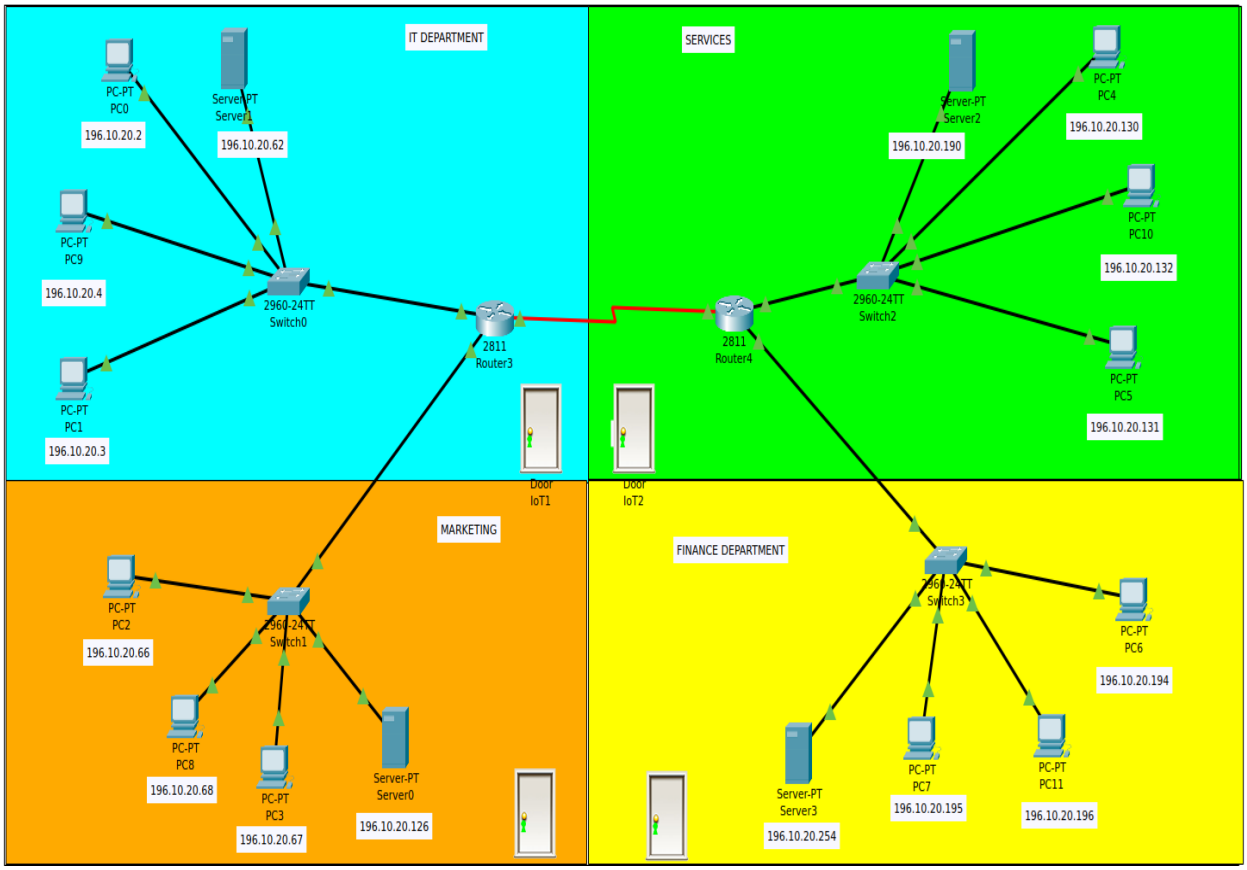




FULL NETWORK(SUB-NETTED)

Figure-11

Complete Network



CONCLUSION

"The sub-netting project successfully optimized IP address utilization and improved network efficiency by dividing the existing network into smaller, manageable sub-nets. By implementing sub-netting, we achieved more efficient allocation of IP addresses, reduced network congestion, and enhanced security through better network segmentation. This project not only improved overall network performance but also simplified network management by organizing devices into logical segments. Sub-netting has proven to be a valuable technique for optimizing network resources and improving network scalability, making it an essential practice for modern computer networks."

BIBLIOGRAPHY :

1) Book:Computer Network by Andrew S Tanenbaum
2) You Tube : Power Cert Animated Videos
3) Website – homenethowto.com