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| **Assignment No** | three |

# Assignment Number - 03

**Title :** Subnetting and Supernetting in Computer Network

**Problem Statement** Using a Network Simulator (e.g. packet tracer) Configure subnetting and supernetting.

**Theory :**

**Subnetting**

Subnetting is a technique used in computer networking to divide a larger IP network into smaller, more manageable sub-networks or subnets. It's a fundamental concept in IP addressing and is used to efficiently allocate IP addresses and manage network resources. Subnetting allows network administrators to create logical divisions within a larger network, helping to improve network performance, security, and organization.

**IP Address Classes:** IP addresses are categorized into classes: A, B, and C. Each class has a default subnet mask that determines the default network and host portions of the IP address.

**Subnet Mask**: A subnet mask is a 32-bit binary number that separates the IP address into network and host portions. It is usually represented in decimal-dotted format (e.g., 255.255.255.0).

**Subnetting:** To subnet a network, you borrow bits from the host portion of the IP address to create additional subnets. This increases the number of available subnets but reduces the number of available host addresses within each subnet.

**Subnet Size:** The size of a subnet is determined by the number of borrowed bits. The formula to calculate the number of usable host addresses in a subnet is 2^(number of host bits) - 2. The "-2" accounts for the network address (all host bits set to 0) and the broadcast address (all host bits set to 1).

**Benefits of Subnetting:**

Efficient IP Address Allocation: Subnetting prevents wastage of IP addresses, as you can allocate addresses more precisely based on your network's needs.

Improved Network Performance: Smaller subnets can reduce network congestion and improve the efficiency of communication.

Enhanced Security: Subnets can isolate different parts of a network, improving security by restricting the flow of traffic.

Simplified Management: Dividing a large network into smaller subnets makes it easier to manage and troubleshoot network issues.

**Important point about subnetting**

- 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 mean 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 tell 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 is it, we cannot change those bits that are already assigned.
- We cannot assign the network ID and the broadcast address to a host.
- Regardless 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.

**Case Study :**

**Vishwakarma University is granted an network address 221.56.64.0 by Internet Assigned Numbers Authority (IANA). University required five subnet for its Computer, AIDS, AIML, AI and Engineering science Department. The network administrator needs to design the subnets for the University. Help him to create subnetwork.**

**Problem :** Finding IP Address Range for each subnet.

**Solution :**

To find a IP address range for each subnet

1. The given IP address 221.56.64.0 refers to class C.

2. The number of 1s in the default mask is 24 in class C.

3. The requirement is five subnets. This number should be within the range of power of 2 which comes out to be $\mathbf{2^3 = 8.}$ There should be 3 more 1 in the subnet mask.

4. The total no of 1s in the subnet mask is 24 + 3 = 27

5. The total no of 0s in the address is 32 – 27 =5, where 32 are the total number of IP address bits and 27 is the total number of 1s in the address as given in step 4.

6. The subnet mask in binary notation is denoted as : 11111111.11111111.11111111.111000 or 255.255.255.224 in decimal form.

7. A number of subnets that can be actually implemented are 8.

8. The number of addresses in each subnet is $2^5$= 32. Out of which $2^5$-2=30 host addresses are available in each subnet. The address 221.56.64.0 is used as network address and 221.56.64.31 is used as broadcast address. So, the hosts range from 221.56.64.1 to 221.56.64.30

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| **Computer (Subnet I )** | **Range of Addresses** | 221.56.64.0 to 221.56.64.31 |
| | **Network Address** | 221.56.64.0 |
| | **Broadcast Address** | 221.56.64.31 |
| | **Host Address Range** | 221.56.64.1 to 221.56.64.30 |
| **AIDS (Subnet II )** | **Range of Addresses** | 221.56.64.32 to 221.56.64.63 |
| | **Network Address** | 221.56.64.32 |
| | **Broadcast Address** | 221.56.64.63 |
| | **Host Address Range** | 221.56.64.33 to 221.56.64.62 |
| **AIML (Subnet III )** | **Range of Addresses** | 221.56.64.64 to 221.56.64.95 |
| | **Network Address** | 221.56.64.64 |
| | **Broadcast Address** | 221.56.64.95 |
| | **Host Address Range** | 221.56.64.65 to 221.56.64.94 |
| **AI (Subnet IV )** | **Range of Addresses** | 221.56.64.96 to 221.56.64.127 |
| | **Network Address** | 221.56.64.96 |
| | **Broadcast Address** | 221.56.64.127 |
| | **Host Address Range** | 221.56.64.97 to 221.56.64.126 |
| **Engineering Science (Subnet V )** | **Range of Addresses** | 221.56.64.128 to 221.56.64.159 |
| | **Network Address** | 221.56.64.128 |
| | **Broadcast Address** | 221.56.64.1159 |
| | **Host Address Range** | 221.56.64.129 to 221.56.64.158 |

**Supernetting**

Supernetting is the opposite of Subnetting. In subnetting, a single big network is divided into multiple smaller subnetworks. In Supernetting, multiple networks are combined into a bigger network termed as a Supernetwork or Supernet.

Supernetting is mainly used in Route Summarization, where routes to multiple networks with similar network prefixes are combined into a single routing entry, with the routing entry pointing to a Super network, encompassing all the networks. This in turn significantly reduces the size of routing tables and also the size of routing updates exchanged by routing protocols. one reason we'd want to supernet is to reduce the size of your IP routing table to improve network routing efficiency. Another use case of supernetting is to merge a bunch of

smaller subnets to create a larger network capable of accommodating a more hosts (attached devices). For example, supernetting can allow you to grow your maximum number of hosts on a subnetwork from 254 to 1022 after the merge.

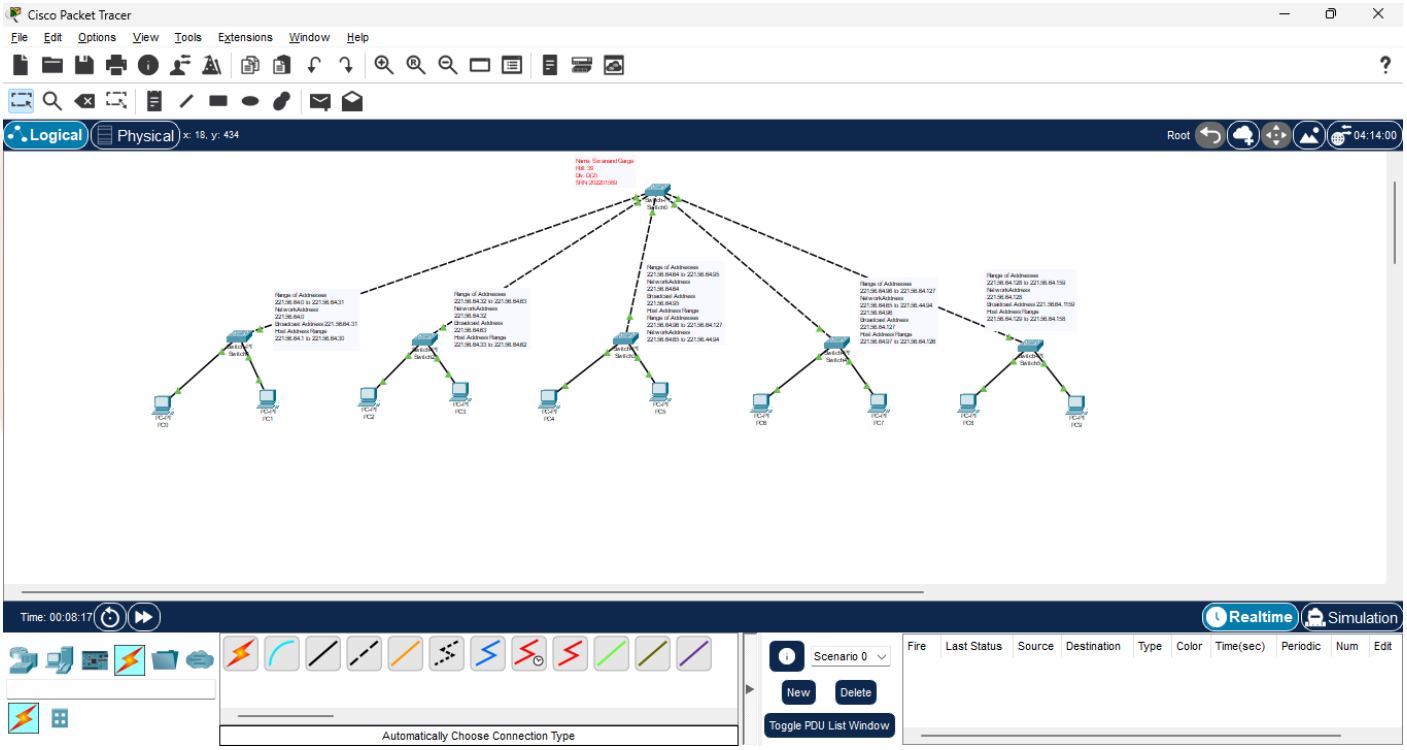
More specifically,

- When multiple networks are combined to form a bigger network, it is termed as super-netting
- Supernetting is used in route aggregation to reduce the size of routing tables and routing table updates

## Configuration of subnetting

Add screenshot from Packet tracer for Subnetting

Sample screenshot-




**Packet tracer**

**Conclusion:**

In conclusion, subnetting is a crucial technique in computer networking that allows us to efficiently manage IP addresses and network resources. In the case study for Vishwakarma University, we successfully divided the given Class C IP address, 221.56.64.0, into five distinct subnets for the Computer, AIDS, AIML, AI, and Engineering Science departments.

By carefully borrowing bits from the host portion and creating subnet masks, we ensured that each subnet had its own unique range of IP addresses. This not only optimizes IP address allocation but also enhances network performance, security, and overall management.

The subnetting process involved determining the required number of subnets, calculating the subnet mask, and identifying the network, broadcast, and host address ranges for each subnet. This meticulous approach guarantees that each department at Vishwakarma University has its dedicated portion of the network while efficiently utilizing the available IP addresses.

In practical networking scenarios, subnetting plays a critical role in optimizing resource utilization and ensuring the seamless functioning of complex networks. It empowers network administrators to tailor network structures to specific needs while maintaining efficient IP address allocation and management.