Cisco Packet Tracer Project - Network Configuration

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Introduction

This document provides a detailed breakdown of the IP addressing scheme used in the enterprise network. Each floor and department has been allocated its own subnet, ensuring logical separation, efficient address management, and secure communication. For every subnet, the network address, subnet mask, usable host range, and broadcast address are specified.

In addition to departmental addressing, this document also includes the IP configuration of the routers and Layer-3 switch, which serve as the backbone for inter-VLAN routing and OSPF connectivity. Public IP addresses, provided in the project scenario, are also documented to demonstrate external communication with the ISP and internet services.

By establishing a clear and structured addressing plan, this document ensures:

- Proper **segmentation** of departments across all three floors.
- **Scalability**, with room for future growth.
- **Security**, by minimising broadcast domains and controlling traffic flow.
- **Clarity**, making troubleshooting and expansion more efficient.

This configuration serves as the foundation for the subsequent device configurations and validates that the overall addressing scheme aligns with best practices in enterprise network design.

⚙️ Configurations

Base Network: 172.16.1.0 (Provided in scenario)

1st Floor

Department	Network Address	Subnet Mask	Host Address Range	Broadcast Address
Sales & Marketing	172.16.1.0	255.255.255.128/25	172.16.1.1 to 172.16.1.126	172.16.1.127
HR & Logistics	172.16.1.128	255.255.255.128/25	172.16.1.129 to 172.16.1.254	172.16.1.255

🔹 **Why These Subnets and IPs Were Used**

The **base network** is 172.16.1.0/24, which provides **256 total IP addresses** (0–255). Since a single /24 does not fit the design needs of multiple departments while still keeping things organised and scalable, the network was **subnetted**.

1. **Subnetting into /25 networks**
    - A /25 mask (255.255.255.128) splits the 172.16.1.0/24 network into **two equal subnets**:
        - 172.16.1.0 – 172.16.1.127
        - 172.16.1.128 – 172.16.1.255
    - Each /25 gives **126 usable host addresses**, which is enough capacity for our 120 host departments while avoiding waste.
2. **Department Allocation**
    - **Sales & Marketing** was assigned the **first subnet**:
        - Network: 172.16.1.0
        - Range: 172.16.1.1 – 172.16.1.126
        - Broadcast: 172.16.1.127
        - Reason: Starting department gets the lower subnet block for simplicity.

- **HR & Logistics** was assigned the **second subnet**:
    - Network: 172.16.1.128
    - Range: 172.16.1.129 – 172.16.1.254
    - Broadcast: 172.16.1.255
    - Reason: They receive the next contiguous block, maintaining logical separation while staying within the same base network.

3. **Benefits of this Design**
    - **Logical separation:** Each department is isolated at Layer 3, improving security and reducing broadcast traffic.
    - **Efficient allocation:** /25 ensures no large address spaces are wasted (a /24 would give 254 hosts, more than one department might need).
    - **Scalability:** More /25 subnets can be carved out from other base networks (172.16.2.0/24, 172.16.3.0/24, etc.) as the organisation grows.

2nd Floor

Department	Network Address	Subnet Mask	Host Address Range	Broadcast Address
Finance & Accounting	172.16.2.0	255.255.255.128/25	172.16.2.1 to 172.16.2.126	172.16.2.127
Admin & Public Relations	172.16.2.128	255.255.255.128/25	172.16.2.129 to 172.16.2.254	172.16.2.255

🔹 **Why These Subnets and IPs Were Used**

The base network remains within the private range /24. To accommodate 120 devices per department, the /25 mask (255.255.255.128) is again applied.

1. Subnetting into /25 networks
    - A /25 gives 126 usable host addresses.
    - This is an optimal fit for departments with around 120 devices, close to full capacity without wasted space.
2. Department Allocation
    - Finance & Accounting
        - Network: 172.16.2.0
        - Range: 172.16.2.1 - 172.16.2.126
        - Broadcast: 172.16.2.127
        - Reason: Finance receives the first block for clear numbering continuity.
    - Admin & Public Relations
        - Network: 172.16.2.128
        - Range: 172.16.2.129 - 172.16.2.254
        - Broadcast: 172.16.2.255
        - Reason: Allocated the second half of the /24 to maintain logical separation and reduce broadcast domains.
3. Benefits of this Design
    - Each department has its own broadcast domain, improving performance and security.
    - The addressing scheme ensures easy scalability by reserving the next /24 block (172.16.3.0/24) for the third floor.

3rd Floor

Department	Network Address	Subnet Mask	Host Address Range	Broadcast Address
ICT	172.16.3.0	255.255.255.128/25	172.16.3.1 to 172.16.3.126	172.16.3.127
Server Room	172.16.3.128	255.255.255.240/28	172.16.3.129 to 172.16.3.142	172.16.3.143

🔹 **Why These Subnets and IPs Were Used**

Floor 3 has different requirements: one large department (ICT with 120 devices) and one small critical subnet (Server Room with only 12 devices).

1. ICT Department
    - Subnet mask: /25 (255.255.255.128)
    - Reasoning: Requires 120 devices, making a /25 ideal since it provides 126 usable IPs.
    - Allocation:
        - Network: 172.16.3.0
        - Range: 172.16.3.1 - 172.16.3.126
        - Broadcast: 172.16.3.127
2. Server Room
    - Subnet mask: /28 (255.255.255.240)
    - Reasoning: Requires only 12 IP addresses for its devices. A /28 provides 14 usable host addresses (more than enough without wasting space).
    - Allocation:
        - Network: 172.16.3.128
        - Range: 172.16.3.129 - 172.16.3.142
        - Broadcast: 172.16.3.143

3. Benefits of this Design

    - ICT's large allocation supports growth and ensures they have their own broadcast domain.
    - The Server Room's /28 is a tight, efficient allocation. It minimises unused IPs while isolating critical infrastructure devices for security.
    - This mix of /25 and /28 shows the network design is tailored to departmental needs, not a one-size-fits-all approach.

Between the Routers & Layer-3 Switches

No.	Network Address	Subnet Mask	Host Address Range	Broadcast Address
R1 - MLSW1	172.16.3.144	255.255.255.252	172.16.3.145 to 172.16.3.146	172.16.3.147
R1 - MLSW2	172.16.3.148	255.255.255.252	172.16.3.149 to 172.16.3.150	172.16.3.151
R2 - MLSW1	172.16.3.152	255.255.255.252	172.16.3.153 to 172.16.3.154	172.16.3.155
R2 - MLSW2	172.16.3.156	255.255.255.252	172.16.3.157 to 172.16.3.158	172.16.3.159

🔹 **Why These Subnets and IPs Were Used**

In addition to departmental subnets, dedicated **point-to-point links** were established between the routers (R1, R2) and the multilayer switches (MLSW1, MLSW2). Since these links only require **two usable IP addresses each**, a **/30 subnet mask** (255.255.255.252) was applied.

1. **Why /30 Subnets Were Chosen**

    - A /**30** provides exactly **2 usable host addresses**, which is ideal for router-to-switch or router-to-router connections.
    - This prevents waste of IP space, as allocating a larger subnet (such as /24 or /25) would leave most addresses unused.

- The small subnet size also reduces unnecessary broadcast traffic, keeping point-to-point links efficient.

2. **Link Allocations**

   - **R1 – MLSW1**

     - Network: 172.16.3.144/30
     - Usable Range: 172.16.3.145 - 172.16.3.146
     - Broadcast: 172.16.3.147

   - **R1 – MLSW2**

     - Network: 172.16.3.148/30
     - Usable Range: 172.16.3.149 - 172.16.3.150
     - Broadcast: 172.16.3.151

   - **R2 – MLSW1**

     - Network: 172.16.3.152/30
     - Usable Range: 172.16.3.153 - 172.16.3.154
     - Broadcast: 172.16.3.155

   - **R2 – MLSW2**

     - Network: 172.16.3.156/30
     - Usable Range: 172.16.3.157 - 172.16.3.158
     - Broadcast: 172.16.3.159

3. **Benefits of this Design**

   - **Efficiency:** Each link uses the minimum possible address space while still supporting connectivity.

   - **Clarity:** Allocating sequential /30 networks keeps the design easy to follow and reduces misconfiguration risk.

   - **Scalability:** Additional point-to-point links can be added using the next available /30 blocks without overlapping other subnets.

Between the Routers & ISPs

Public IP addresses:

- 195.136.17.0/30
- 195.136.17.4/30
- 195.136.17.8/30
- 195.136.17.12/30

🔹 **Public IP Allocation**

To support external communication with the Internet Service Provider (ISP) and provide access to internet-based services, **public IP addresses** were assigned as part of the project scenario.

Unlike private addresses used within the enterprise LAN, these public IPs are **globally routable** and ensure that the enterprise network can exchange traffic with external networks.

1. **Why Public IPs Are Required**
    - Public IPs allow the enterprise to host services (e.g., web, email, VPN) that must be accessible from outside the internal network.
    - They also enable routers to establish connectivity with the ISP for outbound internet access.
    - Where appropriate, Network Address Translation (NAT) or Port Address Translation (PAT) can be implemented so multiple internal private addresses can share a smaller pool of public addresses.
2. **Benefits of This Design**
    - **Separation of roles:** Internal traffic remains on private subnets, while only necessary traffic is exposed via public IPs.
    - **Security:** Minimises the enterprise's attack surface by limiting direct exposure.
    - **Scalability:** Additional public addresses can be allocated as new external-facing services are deployed.

Final Thoughts

The network addressing and configuration were designed to balance **scalability**, **efficiency**, and **security** across all departments and floors. Larger subnets (/25) were allocated to departments with approximately 120 devices, ensuring sufficient host capacity while minimising wasted address space. A smaller, more efficient subnet (/28) was reserved for the Server Room, reflecting its limited device count and critical infrastructure role.

By separating each department into its own subnet, the design reduces broadcast traffic, improves performance, and provides logical segmentation for better security and manageability. The structured approach also allows for future expansion, as additional /24 blocks within the 172.16.0.0 private range can easily be assigned to new departments or building floors.

Overall, this network design demonstrates how thoughtful subnetting and IP allocation create a scalable and resilient foundation that supports both current organizational needs and long-term growth.

Acknowledgements

This project was developed using guidance from the "GuruTech Networking Training" YouTube channel, which served as a learning resource for understanding IP addressing, subnetting, and Packet Tracer configuration. While the tutorial provided foundational guidance, all network designs, subnet allocations, explanations, and additional configurations presented in this document were independently created and implemented by the author.