PROJECT REPORT

Data Center Simulation:

Design and Implementation VLANs for web, database, and mail servers.

Submitted by:

Name: Zafar Iqbal and Meryam Batool

Roll Number: 47 and 31

Subject: Computer Networks

Department: Artificial Intelligence

Supervised by:

Mr. Bilal Ahmed

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Finally, I am grateful to my peers and family for their encouragement throughout the duration of this project.

Abstract:

In the modern digital era, the backbone of any organization is its network infrastructure. This project, titled **"Data Center Simulation,"** demonstrates the design and simulation of a robust Enterprise Network connected to a centralized Data Center using Cisco Packet Tracer.

The project goes beyond simple connectivity; it implements a **Collapsed Core Architecture** using a Multilayer Switch to route traffic between various functional including departments **web, database, and mail servers.**.

Key technologies implemented include **Virtual LANs (VLANs)** for segmentation, **Inter-VLAN Routing** for communication, and **EtherChannel** for high-bandwidth redundant connectivity between the Core and the Data Center. This report details the design topology, configuration of Layer 2 and Layer 3 devices, and verification of network connectivity showing successful communication between end-users and the servers.

Contents

1. Introduction

1.1 Project Overview

This project involves the comprehensive simulation of a corporate Data Center network. As organizations grow, the need for centralized data storage and distinct departmental networks becomes critical. This project simulates a real-world environment where multiple functions (web, database, and mail servers.) access a centralized **Storage Server Farm** (Data Center).

The network is designed to be scalable, secure, and redundant. It moves away from a simple "flat" network to a hierarchical, segmented network using VLANs.

1.2 Problem Statement

In unmanaged networks, all devices reside in a single broadcast domain. This leads to:

- **Security Risks:** Sensitive Server data is accessible to unauthorized vlans.
- **Network Congestion:** Broadcast storms can bring down the entire network.
- **Single Point of Failure:** Connecting a Data Center with a single cable creates a bottleneck and a risk of disconnection.

1.3 Project Objectives

The specific objectives of this simulation are:

- To design a **Data Center Simulation** where servers are isolated in a secure VLAN.
- To implement **VLANs** for distinct departments (web, database, and mail servers.) and the Data Center.
- To configure a **Multilayer Switch** to act as the core router (Gateway).
- To implement **EtherChannel** (Link Aggregation) between the Core and the Data Center switches to increase bandwidth and provide redundancy.
- To verify successful communication between the web Department and the Storage Servers.

1.4 Tools Used

- **Software:** Cisco Packet Tracer.
- **Hardware Simulated:**

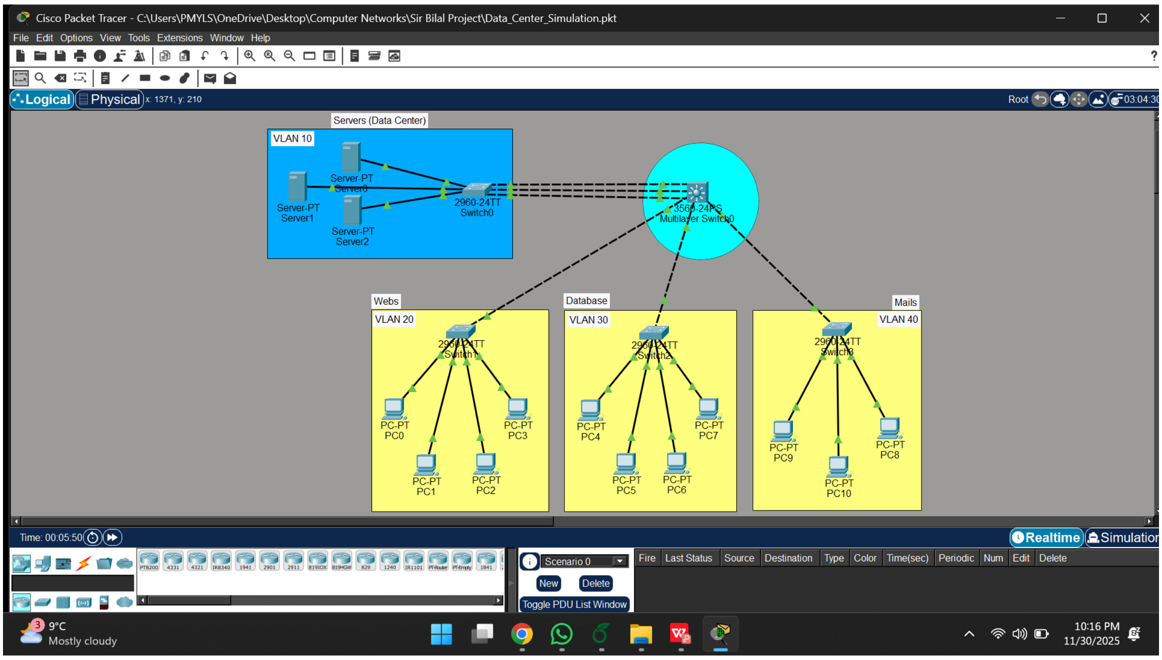
- 3560 Multilayer Switch (Core).
- 2960 Switches (Access Layer).
- Servers (Data Center).
- End Devices (PCs).
- Cabling: Copper Straight-Through and Crossover cables.

2. Network Architecture & Design

2.1 Topology Description

The network topology follows a **Collapsed Core Design**. In this model, the Distribution Layer and Core Layer are combined into a single high-performance device—the **Multilayer Switch (MLS)**. This is a cost-effective industry standard for medium-sized enterprises.

- **The Core:** A Central Multilayer Switch connects all departmental switches.
- **The Access Layer:** Separate switches for web, database, and mail, and Servers connect end-user devices to the network.



Complete Network Topology of Data Center Simulation.

2.2 The Data Center (VLAN 10)

Located at the top of the topology (Blue Zone), the **Storage Server Farm** is the heart of this simulation.

- **Isolation:** By placing servers in VLAN 10, we ensure that only authorized traffic routed through the Core can access these servers.
- **Redundancy:** The switch connecting the servers is linked to the Core via **4 Physical Cables (EtherChannel)** to prevent bottlenecks.

2.3 Departmental Segmentation

The network is divided into physical and logical blocks (Yellow Zones):

- **Webs (VLAN 20):** For technical staff requiring management access.
- **Database (VLAN 30):** For administrative staff.
- **Mails (VLAN 40):** For the creative team.

3. Theoretical Background

3.1 Virtual LANs (VLANs)

A VLAN allows a network administrator to create groups of logically networked devices that act as if they are on their own independent network. In this project, VLANs prevent broadcast traffic from the Marketing department from interrupting the Server Farm operations.

3.2 Inter-VLAN Routing

By default, devices in different VLANs cannot communicate. To allow the webs Department to access the Data Center, routing is required. We utilize **Switch Virtual Interfaces (SVIs)** on the Multilayer Switch. An SVI is a virtual interface that acts as a gateway for a specific VLAN.

3.3 EtherChannel (Link Aggregation)

Data Centers require massive bandwidth. A single link is often insufficient.

- **Technology:** EtherChannel groups multiple physical Ethernet links into one single logical link.
- **Implementation:** In this project, **4 physical cables** connect the Server Switch to the Core Switch. This provides **4x the speed** and ensures that if one cable fails, the link stays up.

4. IP Addressing Scheme

A structured IP addressing plan was designed to ensure no conflicts occur. We used the private Class C address space `192.168.x.x`.

4.1 VLAN Allocation Table

VLAN ID	Department Name	Network Address	Gateway (SVI)
10	**Servers (Data Center)**	192.168.10.0/24	192.168.10.1
20	Webs	192.168.20.0/24	192.168.20.1
30	Database	192.168.30.0/24	192.168.30.1
40	Mails	192.168.40.0/24	192.168.40.1

VLAN and IP Allocation Table

4.2 Device IP Assignments

Specific devices were configured manually to test connectivity:

- **Server 0 (Data Center):**
  - IP: 192.168.10.2
  - Subnet: 255.255.255.0
  - Gateway: 192.168.10.1
- **Webs PC 0 (VLAN 20):**
  - IP: 192.168.20.2
  - Subnet: 255.255.255.0
  - Gateway: 192.168.20.1

5. Implementation & Configuration

This chapter documents the configuration commands used on the Cisco devices.

5.1 Core Multilayer Switch Configuration

The Core switch handles all routing, gateways, and the EtherChannel connection.

```
Switch> enable
Switch# configure terminal
Switch(config)# hostname Core-MLS
Switch(config)# ip routing        ! Enables Layer 3 Routing

! Creating VLANs
Switch(config)# vlan 10
Switch(config-vlan)# name SERVERS
Switch(config-vlan)# vlan 20
Switch(config-vlan)# name Webs
Switch(config-vlan)# vlan 30
Switch(config-vlan)# name Database
Switch(config-vlan)# vlan 40
Switch(config-vlan)# name Mails
Switch(config-vlan)# exit

! Configuring Gateways (SVIs)
Switch(config)# interface vlan 10
Switch(config-if)# ip address 192.168.10.1 255.255.255.0
Switch(config-if)# no shutdown

Switch(config)# interface vlan 20
Switch(config-if)# ip address 192.168.20.1 255.255.255.0
Switch(config-if)# no shutdown
! (Repeated for VLAN 30 and 40)
```

5.2 EtherChannel Implementation

To create the high-speed link for the Data Center:

```
! On Core Switch and Server Switch (Switch0)
Switch(config)# interface range fa 0/1 - 4
Switch(config-if-range)# switchport mode trunk
Switch(config-if-range)# channel-group 1 mode on
Switch(config-if-range)# exit
```

5.3 Access Switch Configuration (Example:Web Switch)

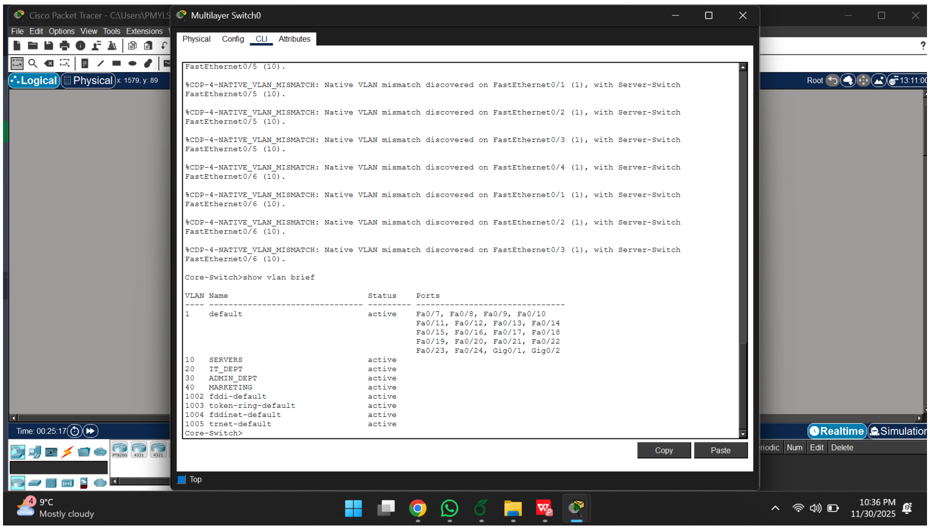
```
Switch(config)# interface range fa0/2 - 24
Switch(config-if-range)# switchport mode access
Switch(config-if-range)# switchport access vlan 20
Switch(config-if-range)# exit
```

6. Testing and Verification

To validate the simulation, we performed connectivity tests to ensure that different departments could access the Storage Server Farm.

6.1 VLAN Verification

We verified that the Core Switch has all the necessary VLANs created. The `show vlan brief` command displays the Servers, Webs, Database, Mails VLANs.



Output of 'show vlan brief' confirming VLAN creation.

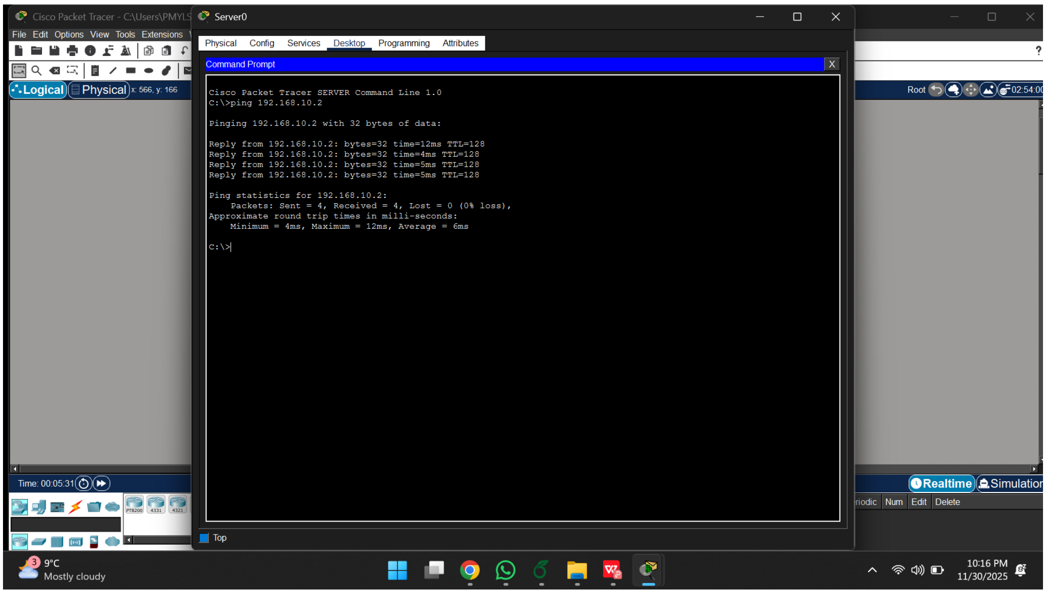
6.2 Connectivity Analysis (Ping Test)

The critical test is verifying if the **Webs Department** can communicate with the **Data Center Server**.

Test Parameters:

- **Source:** Web PC0 (192.168.20.2)
- **Target:** Server0 (192.168.10.2)

Result: The ping was successful with **0% packet loss**. This confirms that the Multilayer Switch is correctly routing traffic between VLAN 20 (Web) and VLAN 10 (Data Center), and the EtherChannel link is functioning.



Successful Ping from Web PC to Data Center Server.

7. Conclusion

7.1 Summary

The "Data Center Simulation" project successfully demonstrated the design principles of a modern enterprise network. By moving away from a flat network topology and adopting a **Hierarchical, VLAN-based architecture**, we achieved:

- **Enhanced Security:** Departments are isolated; traffic is controlled.
- **Optimized Performance:** Broadcast traffic is contained within VLANs.
- **High Availability:** The EtherChannel implementation ensures that the connection to the Data Center Servers is both fast and redundant.

The simulation in Cisco Packet Tracer proved that the logical design is sound, routing protocols are functioning correctly, and the network is ready for deployment.