Computer Networks Project Report

Project title: **Bank Network System**

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TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This project presents a high-fidelity simulation of a modern enterprise banking network. The architecture is built upon the Cisco Three-Layer Hierarchical Model to ensure high availability, modularity, and rapid troubleshooting. The design incorporates end-to-end VLAN segmentation for 12 departments across four floors, a centralized server farm for critical services (DHCP, DNS, HTTP), and a redundant core with NAT/PAT implementation for secure external communication. A critical component of this infrastructure is the integrated ATM network, which is logically isolated to ensure financial transaction integrity and compliance with global banking security standards.

2. INTRODUCTION

In the contemporary financial landscape, the network is the lifeblood of banking operations. This project simulates a "Bank Headquarters" environment where data confidentiality, availability, and integrity are the primary design drivers. The transition from a flat network to a segmented, multi-tiered architecture allows for granular control over data flow, ensuring that a security breach in a public-facing area does not compromise the core banking database. This documentation provides a technical roadmap for the deployment of this enterprise-grade system.

3. PROBLEM STATEMENT

Legacy or poorly designed banking networks frequently suffer from:

- **Broadcast Storms:** Large flat networks experience excessive broadcast traffic, leading to significant latency in transaction processing.
- **Security Vulnerabilities:** Lack of logical isolation allows guest users or unauthorized staff to potentially reach sensitive servers.
- **Manual IP Management:** Human error in manual addressing causes IP conflicts, resulting in unpredictable downtime for critical terminals.
- **Inflexible Scaling:** Difficulty in adding new departments or floors without disrupting existing network operations.

4. PROJECT OBJECTIVES

4.1 Functional Objectives

- **Advanced Segmentation:** Create 12 unique Virtual LANs (VLANs) to isolate departmental traffic and reduce attack surfaces.
- **Automated Lifecycle Management:** Deploy a centralized DHCP server to automate IP distribution and management.

- **Inter-VLAN Routing:** Implement high-speed Layer 3 switching to facilitate controlled communication between authorized segments.
- **Edge Security:** Configure NAT/PAT on the edge routers to mask the internal IP structure from external reconnaissance.

4.2 Non-Functional Objectives

- **High Availability:** Eliminate single points of failure through redundant physical and logical links.
- **Traffic Optimization:** Use subnetting and VLANs to optimize bandwidth for real-time banking applications.

5. ORGANIZATIONAL OVERVIEW & NETWORK LAYOUT

The network is physically mapped to a four-story structure, with logical divisions following the functional departments of the bank.
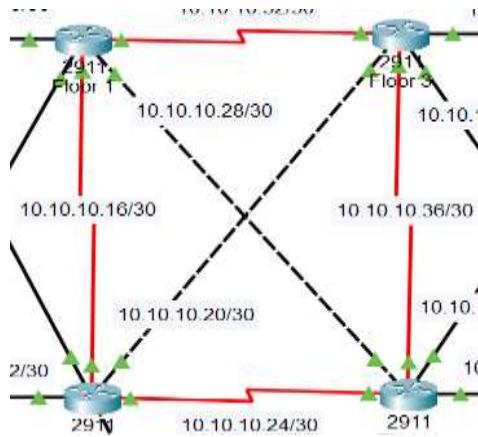
Floor	VLAN ID	Department	Functional Role
First Floor	10	Management	Executive decision-making and sensitive data access.
	20	Research	Data analysis and market trend monitoring.
	30	Human Resources	Employee records and recruitment management.
Second Floor	40	Marketing	Promotional campaigns and external communication.

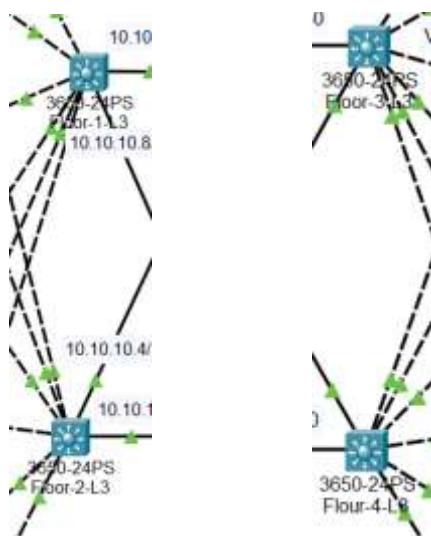|	50	Accounting	Ledger management and internal audits.
	60	Finance	Investment management and high-value transactions.
Third Floor	70	Logistics	Supply chain and physical asset tracking.
	80	Customer Care	Public service and ATM network management.
	90	Guest Area	Restricted internet access for visitors.
Fourth Floor	100	Administration	General operations and clerical support.
	110	ICT	Network maintenance and technical support.
	120	Server Room	Centralized hosting for all bank services.

6. NETWORK DESIGN METHODOLOGY

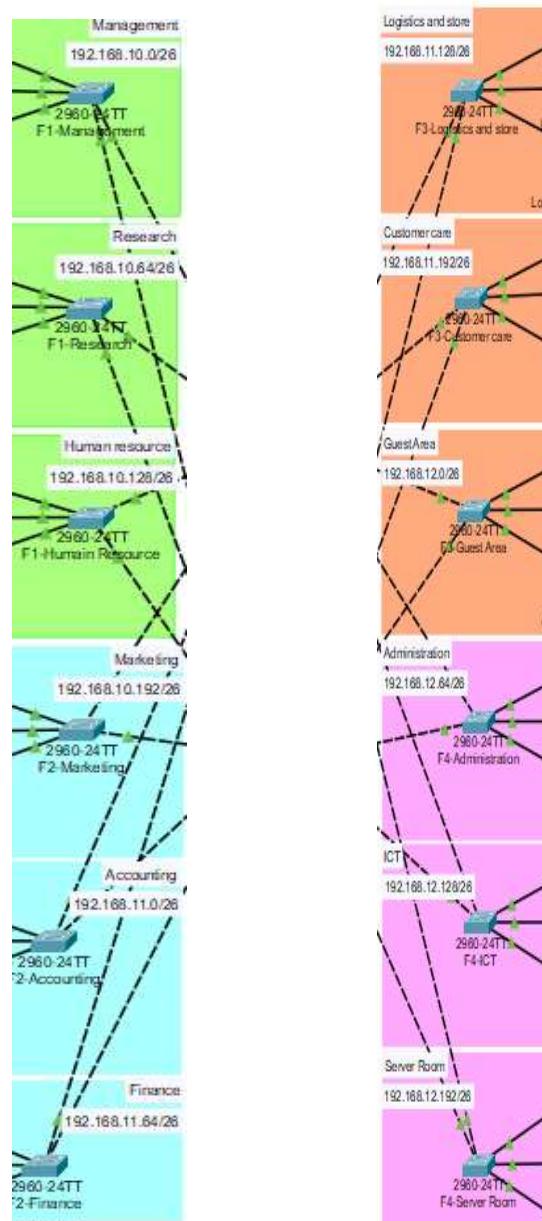## 6.1 The Cisco Three-Layer Hierarchical Model

- **Core Layer (The Highway):** Consists of high-end 2911 Routers. This layer is responsible for fast and reliable transport of data between the internal network and the ISP. It handles the NAT translations and external security policies.

- **Distribution Layer (The Brain):** Utilizes 3650 Multilayer Switches. This layer performs the Inter-VLAN routing, applies Access Control Lists (ACLs), and serves as the gateway for the access switches.
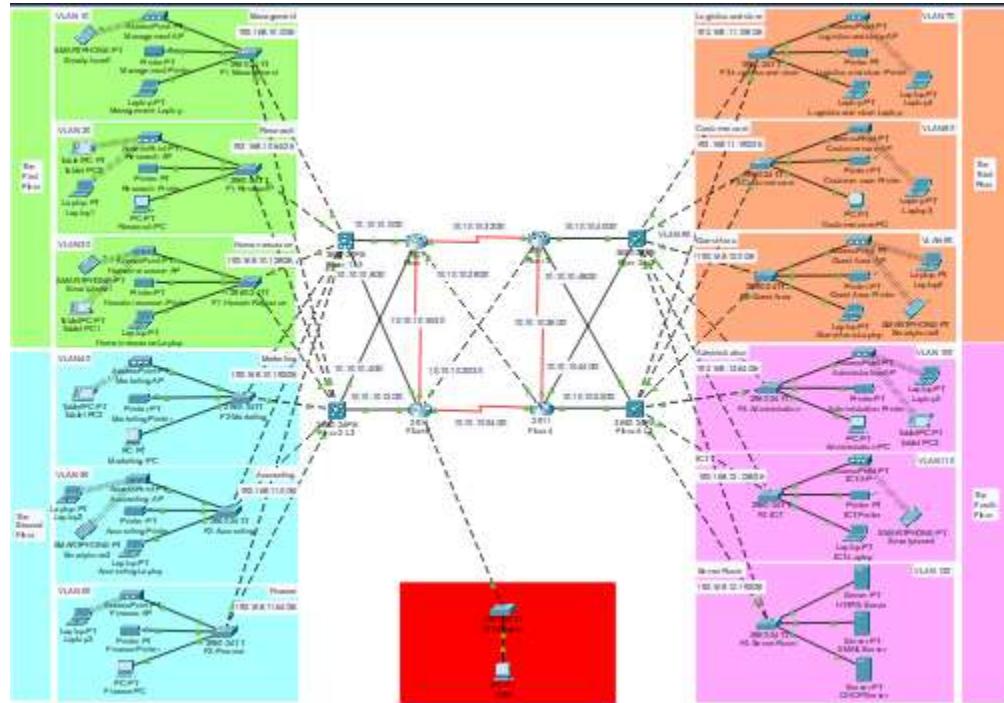
- **Access Layer (The Entry):** Consists of 2960 Access Switches. This layer provides the physical ports for end-devices, including PCs, Printers, and ATMs. It implements Port Security to prevent unauthorized physical connections.

7. LOGICAL NETWORK DESIGN: THE ROLE OF VLANs

The core of this design is the **VLAN architecture**. By logically separating the departments, we create "islands" of connectivity. For example, traffic from the **Guest Area (VLAN 90)** is physically blocked from ever reaching the **Server Room (VLAN 120)** at the hardware level unless specifically permitted by a routing policy. This follows the principle of "Least Privilege" in cybersecurity.
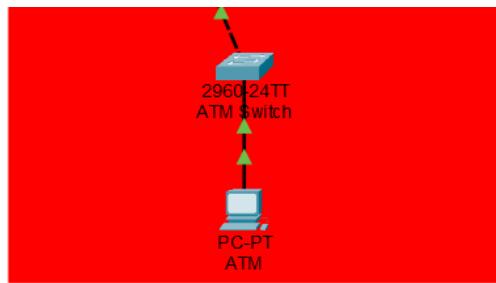

8. IP ADDRESSING & VLSM STRATEGY

To ensure maximum address efficiency, **Variable Length Subnet Masking (VLSM)** was employed. Each department is allocated a /26 subnet, providing 62 usable IP addresses. This prevents address wastage while allowing for future departmental growth.

Example Subnetting Table:

- **VLAN 10:** 192.168.10.0/26 (Range: .1 to .62)
- **VLAN 20:** 192.168.10.64/26 (Range: .65 to .126)
- **VLAN 120:** 192.168.12.192/26 (Range: .193 to .254)

9. ATM INTEGRATION AND SECURITY PROTOCOLS

The **ATM (Automated Teller Machine)** is a critical endpoint. In this project, the ATM is integrated into the **Customer Care (VLAN 80)** segment but treated as a specialized node.
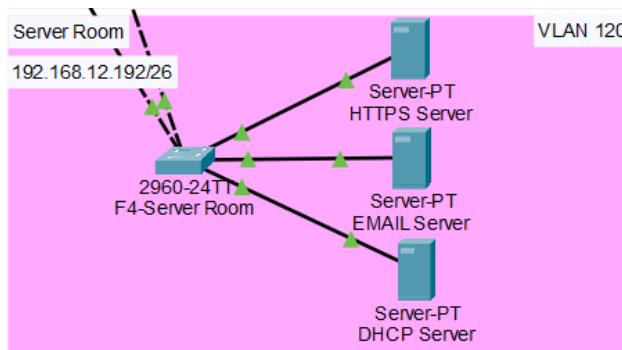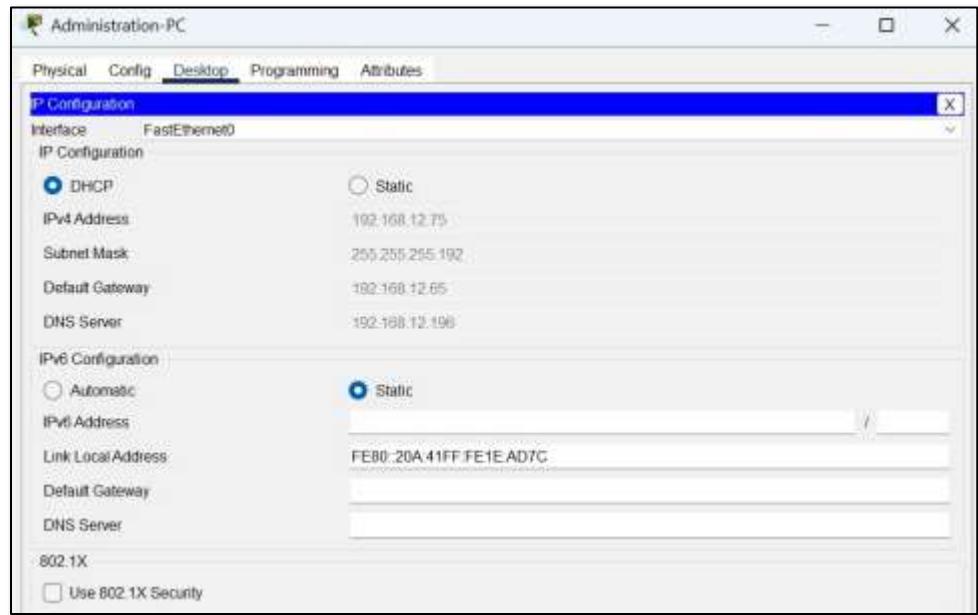

9.1 ATM Communication Flow

1. The ATM initiates a transaction request using a static IP to ensure permanent visibility.
2. The request is routed through the Layer 3 Distribution switch directly to the **HTTPS/Database Server** in the Server Room.
3. **Port Security** is enabled on the switch port connected to the ATM, locking the port to the ATM's specific MAC address. If a rogue device is plugged in, the port immediately shuts down.

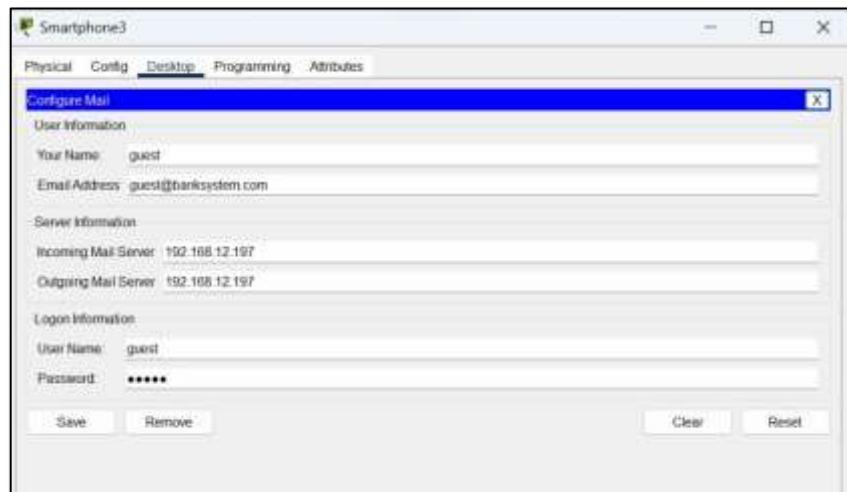# 10. SERVER ROOM AND CENTRALIZED SERVICES

The **Server Room (VLAN 120)** hosts the critical logic of the bank:

- **DHCP Server:** Configured with multiple "Scopes," it automatically detects which VLAN a request is coming from and assigns an IP from the correct pool.
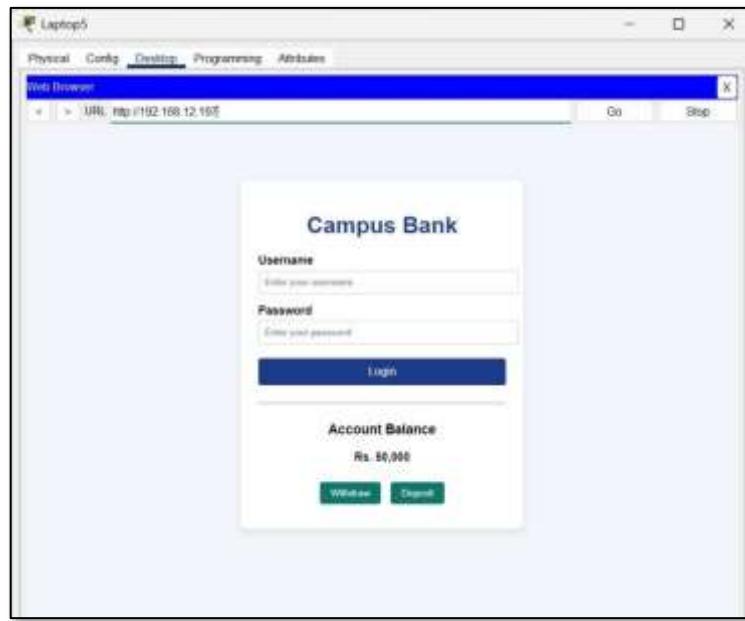
● **Email Server:** Handles encrypted SMTP/POP3 traffic for internal bank memos.

● **HTTP Server:** Serves as the internal portal for employee timesheets and banking software.

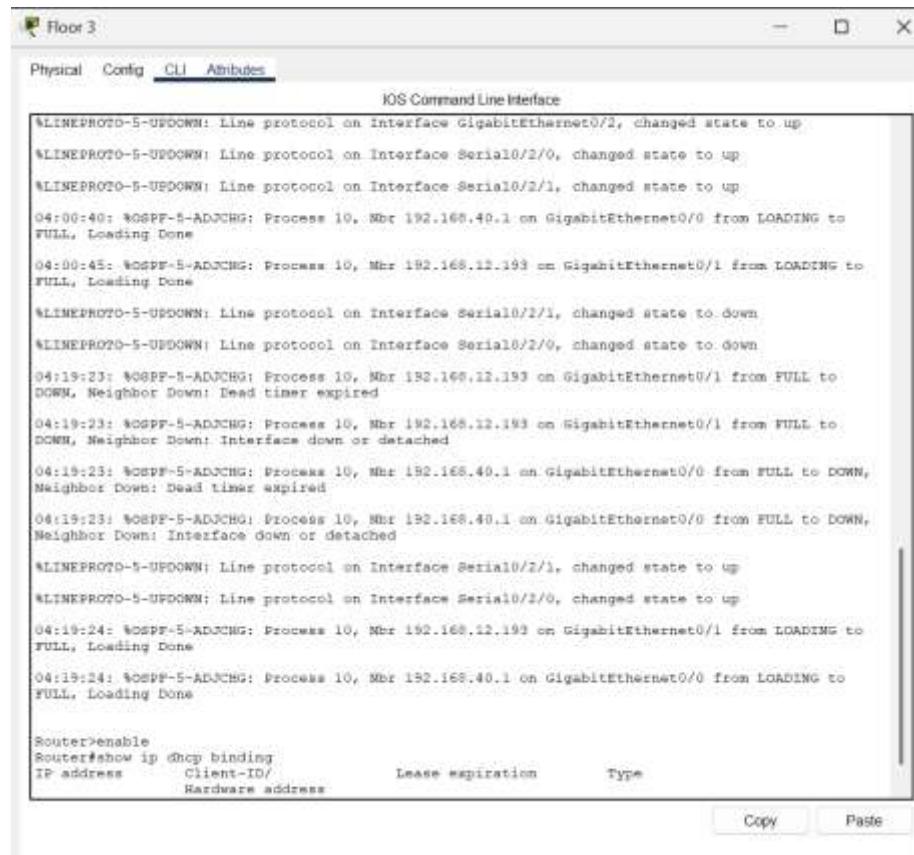# 11. EDGE SECURITY: NAT AND PAT

To protect the bank's internal structure, **NAT Overload (Port Address Translation)** is implemented on the 2911 Routers.

● **Internal Privacy:** Thousands of internal devices appear as a single Public IP address to the outside world.
● **One-Way Traffic:** External entities cannot initiate a connection to a bank PC; the connection must be started from the inside, providing a natural firewall.

12. TESTING, VERIFICATION, AND PERFORMANCE

The following validation steps were completed to ensure system stability:

1. **DORA Process Check:** Verified that a new PC on Floor 3 successfully completes the DHCP DORA process and receives an IP.

2. **Redundancy Failover:** Disconnected a primary link between routers; **Spanning Tree Protocol (STP)** successfully recalculated the path in seconds, maintaining connectivity.

3. Port Security: To verify that an unauthorized device cannot be plugged into a bank teller's or ATM's wall jack.

ATM Switch — IOS Command Line Interface

```
*    1 26    WS-C2960-24TT-L    15.0(2)SE4        C2960-LANBASEK9-M

Cisco IOS Software, C2960 Software (C2960-LANBASEK9-M), Version 15.0(2)SE4, RELEASE SOFTWARE
(fc1)
Technical Support: http://www.cisco.com/techsupport
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Compiled Wed 26-Jun-13 02:49 by mnguyen


Press RETURN to get started!

%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

%LINK-5-CHANGED: Interface FastEthernet0/2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to up


Switch>en
Switch#show ip nat translations
                  ^
% Invalid input detected at '^' marker.

Switch#show port-security interface <interface_id>
                                    ^
% Invalid input detected at '^' marker.

Switch#show port-security interface
% Incomplete command.
Switch#show port-security address
                Secure Mac Address Table
----------------------------------------------------------------------
Vlan   Mac Address     Type                      Ports   Remaining Age
                                                         (mins)
----   -----------     ----                      -----   -------------

----------------------------------------------------------------------
Total Addresses in System (excluding one mac per port)  : 0
Max Addresses limit in System (excluding one mac per port) : 1024
Switch#
```

13. CONCLUSION AND FUTURE SCOPE

The banking network is a scalable, professional-grade solution. It balances ease of use (via DHCP) with extreme security (via VLANs and NAT). Future enhancements will include **IPv6 implementation** and **VPN site-to-site tunnels** to connect this headquarters to smaller rural branches.

THE END