Design and Simulation of a College LAN Infrastructure Using Cisco Packet Tracer

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***Abstract*—This is a detailed design and simulation of a secure, scalable, and resilient Local Area Network (LAN) infrastructure for a college campus using Cisco Packet Tracer. The pri mary objective is to replace the existing aging network, enhance security, and simplify data sharing across various departments and reduce downtime as well as improve man ageability. The proposed network architecture is to connect different departments such as Infor mation Technology, Computer Science, Office, Exam Cell, TPO, and Principal's Office through VLAN segmentation to isolate traffic and provide security. The setup includes IP-based switches with SNMP support for network management and dynamic routing protocols such as RIP for advanced Layer 3 functions. Cisco Catalyst switches and routers, wireless access points, and servers (DNS, FTP, Web) are utilized to provide fast and seamless connectivity. A cost-effective IP addressing scheme was implemented em ploying classful and classless inter-domain routing. Network verification was performed to facilitate communication among VLANs and the operation of hosted services like web and FTP servers. The Unified Computing System (UCS) and Mobility Services Engine (MSE) solutions were integrated to enable virtualization, energy efficiency, and wireless scalability. Security measures comprise segmentation, firewall installation, and remote access set tings. The combination of wired and wireless networks is expandable both in the future and currently, and the network is, therefore, ideal for dynamic academic and administra tive requirements. Briefly, it is a fault-tolerant and high-performance network backbone designed for optimized use in educational institutions. It provides centralized, secure, and efficient management with adherence to the needs of a modern educational institution**

***Index Terms*—LAN, VLAN, Cisco Packet Tracer, RIP, IP addressing, College Network Design**

I. Introduction

TThe increasing demand for connectivity and data sharing within educational institutions calls for reliable network infrastructure. The existing setup at the college lacked scalability, remote access, and security. This project focuses on developing an upgraded LAN design connecting various departments such as IT, Computer Science, Exam Cell, TPO, and Administration using Cisco equipment and simulation tools.

A. LAN Design Principles

A well-designed Local Area Network (LAN) should prioritize scalability, fault tolerance, security, and performance. The hierarchical model is a commonly used architecture consisting of three layers: access, distribution, and core. This design enables better network management and troubleshooting. Redundancy is introduced using multiple paths and link aggregation, while security is achieved using VLANs, access control lists (ACLs), and firewalls.

II. Objectives

The project aims to:

- Replace outdated infrastructure with a secure, scalable LAN.
- Provide high-speed internet with ¿5 Mbps throughput.
- Enable remote access and centralized management.
- Improve fault tolerance and performance monitoring.

III. Existing Infrastructure

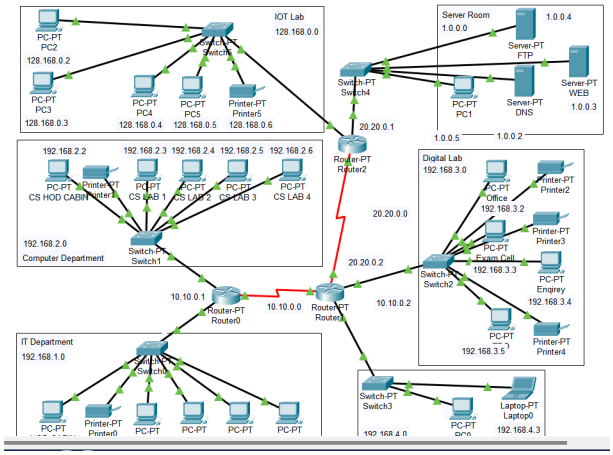
The previous network used static IPs, lacked VLAN segmentation, and had no centralized monitoring or firewall systems. Devices were grouped on a flat network, resulting in security issues and inefficiencies.

IV. Proposed Network Design

The new architecture uses Cisco Catalyst 6509 and 4500 series switches, integrated with Cisco UCS, RIP routing, and VLANs to isolate traffic by department. Devices include:

- Cisco Business Switches
- Cisco RV042G Routers
- Cisco Aironet 1140 Access Points

- Unified Computing System (UCS) for virtualization



B. Virtual LANs (VLANs)

VLANs logically segment a single physical network into multiple broadcast domains. This improves security, reduces broadcast traffic, and enhances performance. Each VLAN is identified by a unique VLAN ID and can be configured to separate departments like IT, Admin, and TPO. Inter-VLAN communication is enabled using Layer 3 routing. In our design, VLANs provide network isolation for each academic department.

TABLE I
NETWORK DEVICES USED

Device	Quantity
Cisco Catalyst 6509 Switch	2
Cisco RV042G Router	3
Cisco Aironet 1140 AP	5
DNS/FTP/Web Servers	3

V. IP ADDRESSING AND ROUTING

A structured IP addressing scheme was implemented using private subnets for different departments:

- IT Dept: 192.168.1.0/24
- Computer Dept: 192.168.2.0/24
- Admin, TPO, etc.: 192.168.3.0/24

Routing is handled using RIP protocol with a hop-count metric

A. IP Addressing and Subnetting

Subnetting is the process of dividing a large IP network into smaller segments. This improves address utilization and enhances security. Private IP ranges such as 192.168.x.x were used in this project, with subnet masks of /24 to provide 254 usable addresses per department. This allocation ensures structured IP planning and future scalability.

VI. TESTING AND RESULTS

Simulations in Cisco Packet Tracer verified:

- Inter-VLAN routing from HOD cabins to Internet Lab
- Functional web hosting and FTP server access
- Secure file and DNS service configurations

E. Cisco Packet Tracer as a Simulation Tool

Cisco Packet Tracer is a visual simulation tool that helps in modeling and testing network topologies. It provides a drag-and-drop interface for configuring routers, switches, and hosts. Packet Tracer allows testing protocols like RIP, DHCP, and DNS without real hardware, making it ideal for academic prototyping and verification.

VII. SUMMARY

The newly proposed LAN architecture successfully enhances the network capabilities of the college. It provides a unified, secure, and scalable communication environment with reduced costs and improved performance.

VIII. FUTURE WORK

To further enhance the network, future work may include:

- Integration with cloud services for offsite backup.
- Deployment of intrusion detection systems (IDS).
- Real-time monitoring using NetFlow or SNMPv3.

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