SIBAU NETWORK INTEGRATION MODEL

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Abstract **- In today's interconnected world, networks are vital for supporting education by enabling efficient knowledge sharing. Educational institutions require secure and reliable communication systems to ensure uninterrupted data flow. To address these needs, I developed the SIBAU Network Integration Model, which connects the Sukkur IBA University Main Campus and Khairpur Campus. The system utilizes VLANs and interconnected networks, designed and tested in Cisco Packet Tracer. This report highlights the security protocols and configurations implemented to ensure privacy, data integrity, and seamless inter-campus communication.**

Index Terms - HTTP Server, Cisco Packet Tracer, VLANs

1. INTRODUCTION

The network has become an essential tool for students, researchers, and educators. In educational environments, networks play a key role in enabling the sharing of information and promoting collaboration, making them indispensable for the dissemination of knowledge. However, with the rapid expansion of web technologies and online services, networks face increased risks from various threats and attacks, ranging from physical damage to cyber-attacks. Such threats can compromise the integrity of the network and jeopardize sensitive data.

Network security is critical in safeguarding against these vulnerabilities and ensuring the reliability of communication infrastructure. To address these challenges, I have developed the **SIBAU Network Integration Model**, which includes multiple VLANs and employs strong security protocols to guarantee secure access. This network is designed to prevent unauthorized access, ensuring the protection of both data privacy and integrity.

This report outlines the technologies and methods utilized in creating the **SIBAU Network Integration Model**, including the security measures applied to the network topology and the protocols ensuring its safe operation. It covers topics such as IP addressing, VLAN configuration, and security setups, culminating in a secure and integrated campus network model.

2. METHODOLGY

For this project, **Cisco Packet Tracer (CPT)** was used as the primary tool for designing and simulating the **SIBAU Network Integration Model**. CPT is a powerful simulation platform developed by Cisco Systems, widely used in network education for practical learning. It offers a realistic environment to design, configure, and troubleshoot networks, making it ideal for this project.

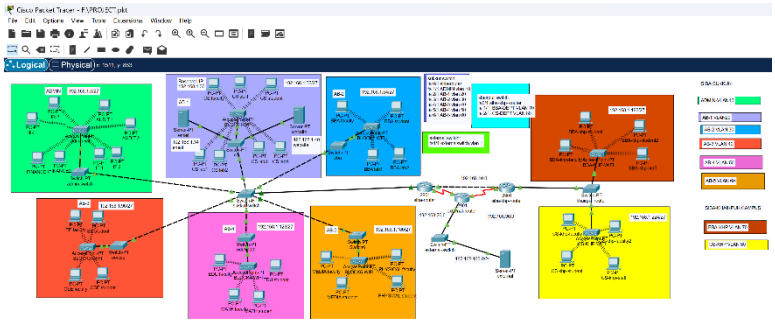
Additionally, CPT supports various security protocols, such as Spanning Tree Protocol (STP), which helps resolve network loop issues, especially in complex topologies with multiple interconnected switches. This feature was utilized to ensure both stability and security within the network.

2.1. Implementation

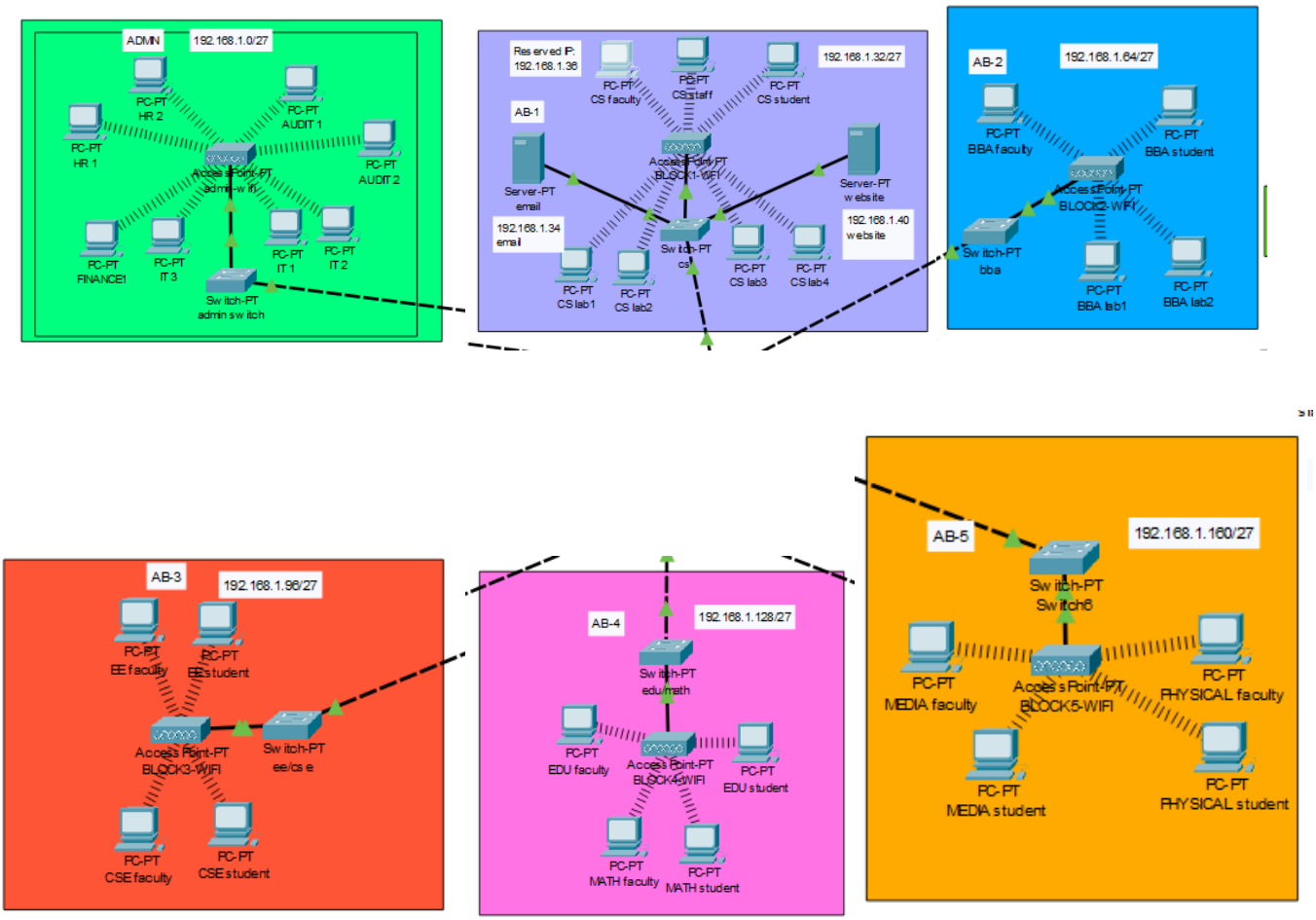
To build the **SIBAU Network Integration Model**, both wired and wireless devices were connected using diverse communication media. Key configurations, including VLANs, DHCP, and RIP, ensured efficient network management and seamless inter-campus connectivity. Security measures were applied to critical devices to safeguard the network from threats, ensuring a stable and secure infrastructure

2.2. SIBAU NIM topology

The SIBAU Network Integration Model topology includes multiple buildings across the Sukkur and Khairpur campuses, such as Academic Blocks, Admin Block, Business Block, Library, and more. Each block is equipped with devices like switches, computers, servers, and wireless routers. These devices are locally connected to switches, which are then linked to routers for inter-campus connectivit, as shown in toplology diagram.



Sukkur Campus:



Khairpur Campus:

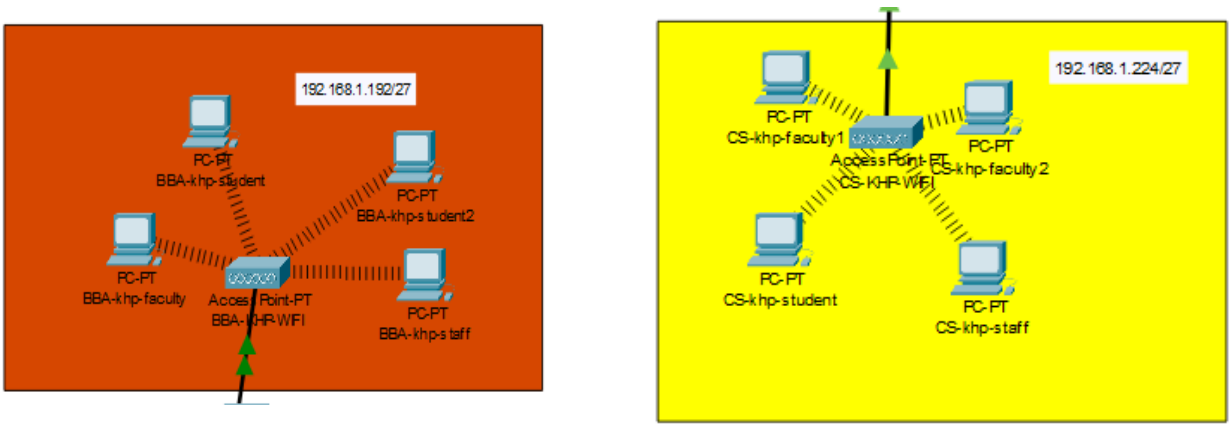


Figure 1. Topology of network integration model

2.3. Required resources

To illustrate various connectivity scenarios within the SIBAU network integration model, the following resources were employed:

- Multiple switches (e.g., admin switch, server switch, sub-switch, etc.)
- Routers (e.g., 2301, 2302, 2303)
- Servers (e.g., Server-1, Server-2, Server-3, Server-4)
- PCs for different departments and roles (e.g., ADMIN, HR, FINANCE, CS Faculty, CS Student, etc.)
- Various cables (Ethernet, Serial DTE, Copper Straight-Through, Copper Crossover)

3. IP ADRESSES

The SIBAU Network Integration Model utilizes an efficient IP addressing scheme to ensure seamless communication and security. Each department and building is assigned a unique subnet: Admin Block (192.168.1.0/27), Academic Block 1 (CS department, labs, servers: 192.168.1.32/27), Academic Block 2 (Business: 192.168.1.64/27), Academic Block 3 (Engineering: 192.168.1.96/27), Academic Block 4 (Education & Mathematics: 192.168.1.128/27), and Academic Block 5 (Media & Physical Sciences: 192.168.1.160/27).

The Khairpur Campus is segmented into 192.168.1.192/27 for BBA and CS departments and 192.168.1.224/27 for faculty. Core and external networks use 192.168.10.0/24 and 192.168.20.0/24, respectively.

Dynamic IP allocation is managed through a DHCP server to simplify device connectivity within each subnet. The integration of VLAN segmentation across the network further enhances security, ensures efficient resource utilization, and maintains robust network performance.

```
siba-router(config)#ip dhcp excluded-address 192.168.1.1
192.168.0.50

siba-router (config)#ip dhcp pool admin

siba-router (dhcp-config)#network 192.168.1.0
255.255.255.224

siba-router (dhcp-config)#default-router 192.168.1.1

siba-router (dhcp-config)#dns-server 192.168.1.40
siba-router(config)#router rip

siba-router(config-router)#version 2

siba-router(config-router)#network 192.168.1.0

siba-router(config-router)#network 192.168.20.0
```

Figure 2. Router configuration to provide DHCP

3.1. Connectivity

The **SIBAU Network Integration Model** ensures efficient and secure connectivity across both Sukkur and Khairpur campuses. Each building is equipped with switches that connect devices like PCs, laptops, and printers. These switches are connected to routers, which manage communication between buildings and campuses. VLANs are used to segment the network for each department, such as Admin, Academic Blocks, and IT, ensuring efficient data management and security.

Routers within the Sukkur Campus use RIP v2 for dynamic routing between VLANs and buildings. The Sukkur and Khairpur campuses are connected via a secure WAN link, allowing seamless inter-campus communication. Access Control Lists (ACLs) are implemented to control traffic flow, giving HR full access to all departments while restricting certain access, such as the Finance department's protection from academic VLANs.

Wireless access points are installed in each block to provide mobile connectivity to devices, ensuring accessibility and flexibility across the network. This setup guarantees secure, efficient, and reliable communication within the university's network. Figures 3 and 4.

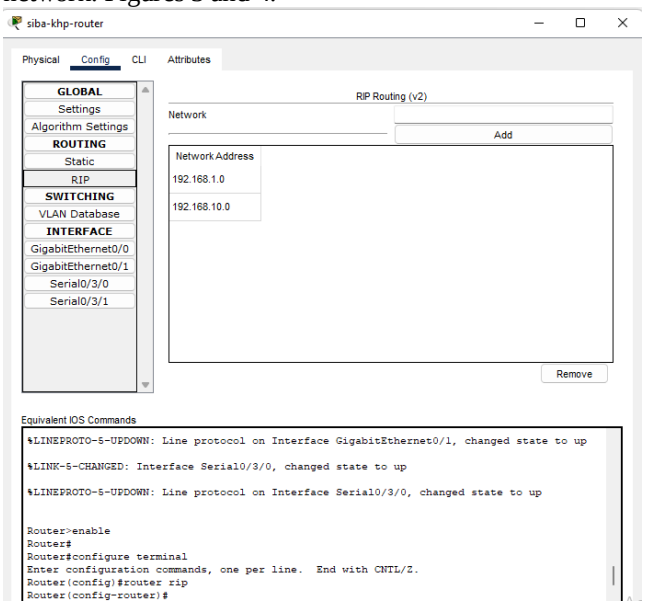


Figure 3. Routing information protocol (RIP)

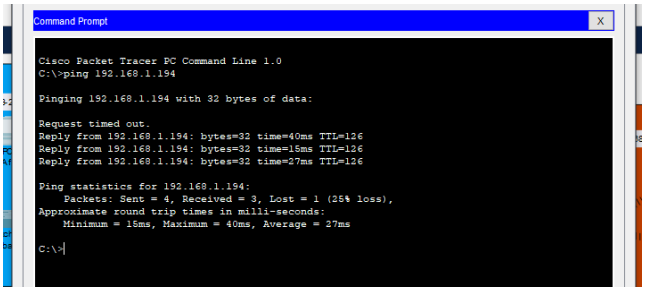


Figure 4. Connectivity between devices

4. Network Segmentation and Routing

Network segmentation and routing are essential components of the **SIBAU Network Integration Model**, designed to enhance security, performance, and manageability. The network is divided into VLANs to segregate traffic based on departments and user roles, optimizing resource usage and minimizing broadcast domains.

VLAN Configuration:

- **ADMIN-VLAN:** Reserved for administrative operations and management tasks.
- **Academic Staff VLANs (AS1-AS5):** Separate VLANs created for different academic staff groups

to meet their unique network requirements.

- **CS-Faculty VLAN:** Allocated to computer science faculty, ensuring low latency and high bandwidth for academic needs.
- **CS-Student VLAN:** Designed for computer science students, providing secure access to necessary resources while maintaining performance.

Inter-VLAN routing is managed by routers configured with efficient protocols like OSPF or EIGRP, ensuring smooth data flow and low latency. Access Control Lists (ACLs) on both routers and switches enforce strict traffic control, allowing only authorized communication between VLANs and further enhancing the network's security.

4.1. Network security

Network security is a cornerstone of the SIBAU Network Integration Model, with measures like firewalls, encryption, and ACLs safeguarding against threats. Firewalls filter unauthorized traffic, while encryption secures data during transmission. ACLs control access to sensitive areas, such as restricting academic access to the Finance Department.

VLAN segmentation further enhances security by isolating network sections, reducing the spread of potential attacks. Regular updates and patches keep devices protected from vulnerabilities, while continuous monitoring and audits ensure the network remains secure and reliable for the institution's needs.

5. Conclusion

The SIBAU Network Integration Model successfully demonstrates the application of networking concepts to create a robust and interconnected system for Sukkur IBA University's Main Campus and Khairpur Campus. Through the implementation of VLANs, DHCP, and RIP, the project ensures efficient communication, secure data transfer, and seamless inter-departmental access. The use of Cisco Packet Tracer enabled the design and simulation of a realistic network topology, highlighting the importance of proper configuration and protocol selection in maintaining stability and security.

6. REFERENCES

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