



Green University of Bangladesh

*Department of Computer Science and Engineering (CSE)
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Design and simulation a small office/Home Office network system

*Course Title: Computer Networking Lab
Course Code: CSE 312
Section: 212 D4*

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<u>Lab Project Status</u>	
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Comments:	Date:

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Chapter 1

Introduction

1.1 Overview

The project aims to address the challenges faced by small office/home office (SOHO) environments in establishing reliable and efficient network systems. Focused on limited resources, scalability, security, and connectivity, the proposed network design strives to enable efficient collaboration, remote access, resource sharing, data backup, and cost-effectiveness. Motivated by the need for user-friendly setups, the project aims to create an intuitive network environment that empowers SOHO users without requiring extensive technical expertise. Through design and simulation, the goal is to deliver a tailored, secure, and cost-effective network solution meeting the unique demands of SOHO settings.

1.2 Motivation

The motivation behind this project lies in addressing the unique challenges faced by small office/home office (SOHO) environments. With limited resources and potential scalability issues, the aim is to create an efficient network system that fosters seamless collaboration, facilitates secure remote access, optimizes resource sharing, ensures robust data backup and security measures, all while maintaining cost-effectiveness. The project strives to empower SOHO users with an easy-to-manage network environment, promoting user-friendly setups that do not require extensive technical expertise. Through design and simulation, the ultimate goal is to provide a tailored, reliable, and secure network solution aligned with the specific needs of SOHO setups in today's digital landscape.

1.3 Problem Definition

1.3.1 Problem Statement

The problem addressed by this project is the need for reliable and efficient network systems in small office/home office (SOHO) environments. SOHO setups often grapple with challenges such as limited resources (budget, space, and technical expertise), scalability concerns, security risks, and the critical need for reliable connectivity. These challenges can impede effective collaboration, hinder remote access, and compromise data security. The project seeks to define a solution that overcomes these issues by designing and simulating a network system tailored to SOHO needs, aiming to provide efficient collaboration tools, secure remote access, optimized resource sharing, robust data backup, and overall cost-effectiveness, while maintaining a user-friendly setup.

1.3.2 Complex Engineering Problem

The complex engineering problem in this project involves designing a small office/home office (SOHO) network system that must address a convergence of challenges. These challenges include optimizing network performance within the constraints of limited resources, ensuring scalability to accommodate potential growth, implementing robust security measures to safeguard sensitive data, and providing reliable connectivity with minimal downtime.

Balancing these requirements necessitates intricate engineering decisions in terms of hardware selection, network topology, security protocols, and scalability features. The challenge lies in creating a system that is not only technically robust but also cost-effective, user-friendly, and tailored to the specific needs of SOHO environments. Additionally, the project must account for the dynamic nature of modern work, enabling efficient collaboration, remote access, and resource sharing while maintaining a focus on data integrity and security.

1.4 Design Goals/Objectives

Certainly, here are five key goals for the project:

- **Efficient Collaboration:** Enable seamless communication and file sharing among users within the SOHO network, promoting effective collaboration on projects.
- **Remote Access:** Facilitate secure remote access to network resources, empowering users to work from home or other locations without compromising data security.
- **Resource Sharing:** Optimize shared access to printers, storage devices, and other resources, enhancing resource utilization and productivity.

- **Data Backup and Security:** Implement automated backup solutions and robust security measures to safeguard critical data, protecting against loss or unauthorized access.
- **Scalability:** Design a flexible network system that can scale efficiently to accommodate potential growth in the number of devices and users, ensuring adaptability to changing needs.

These goals collectively aim to create a reliable, secure, and user-friendly network environment tailored to the specific requirements of small office/home office setups.

1.5 Application

The application of this project has several practical implications for small office/home office (SOHO) environments:

- **Enhanced Work Efficiency:** The optimized network facilitates seamless collaboration and file sharing, improving overall work efficiency and productivity.
- **Remote Work Enablement:** The project enables secure remote access to network resources, allowing users to work from home or other locations, thereby supporting flexible work arrangements.
- **Resource Optimization:** By optimizing resource sharing, such as printers and storage devices, the project contributes to efficient resource utilization and cost savings.
- **Data Security and Backup:** The implementation of robust security measures and automated backup solutions ensures the protection of sensitive data against unauthorized access or loss.
- **Scalability for Growth:** The scalable network design accommodates potential growth in the number of devices and users, providing a flexible infrastructure that can adapt to evolving business needs.
- **Cost-Effective Networking:** The emphasis on cost-effectiveness ensures that the network system delivers optimal performance without unnecessary expenses, offering the best value for investment.
- **User-Friendly Experience:** The creation of an intuitive and easy-to-manage network environment simplifies the setup and maintenance processes, making it accessible to users with varying levels of technical expertise.

Chapter 2

Design/Development/Implementation of the Project

2.1 Introduction

In an era dominated by digital connectivity, the project focuses on designing and simulating a robust Small Office/Home Office (SOHO) network system. Aimed at overcoming challenges such as limited resources, scalability concerns, and the imperative for heightened security, this initiative seeks to create an efficient and tailored network environment. Motivated by the need for seamless collaboration, secure remote access, and resource optimization, the project endeavors to strike a balance between cost-effectiveness and cutting-edge functionality. By emphasizing user-friendly setups and reliable connectivity, it aspires to deliver a comprehensive solution that addresses the unique demands of modern SOHO setups.

2.2 Project Details

The project, titled "Design and Simulation of Small Office/Home Office (SOHO) Network System," is conceived to meet the evolving demands of contemporary work environments. SOHO settings, characterized by limited resources and scalability concerns, necessitate an innovative network solution. This initiative seeks to address challenges such as efficient collaboration, secure remote access, optimized resource sharing, and reliable data backup within the constraints of cost-effectiveness and user-friendliness.

In recognizing the unique problems faced by SOHO setups, the project outlines specific objectives, including seamless communication, secure remote access, resource optimization, and robust data security. The methodology involves a systematic approach, incorporating network design, hardware selection, security implementation, and scalability planning. Simulations using advanced software tools will validate the network's functionality under diverse conditions.

Expected outcomes encompass a simulated SOHO network system, robust security implementations, a scalable network design, and user-friendly setup guidelines. This

project’s significance lies in enhancing work efficiency, supporting remote work, optimizing resource usage, ensuring data security, and providing a scalable, cost-effective, and user-friendly network solution tailored for SOHO environments.

With a planned timeline and budget allocation for hardware, software, and additional resources, the project aims to deliver a comprehensive solution that combines technical innovation with practical usability. Ultimately, the project seeks to address the unique challenges faced by SOHO setups in today’s dynamic digital landscape.

2.3 Implementation

- 1.Network Design: Outline the architecture, subnetting, and IP addressing plans for the SOHO network, considering the physical layout and connectivity requirements.
- 2.Hardware Procurement: Identify and acquire routers, switches, wireless access points, and servers, adhering to budget constraints and technical specifications..
- 3.Software Tools: Choose simulation tools like Packet Tracer or GNS3 for modeling and testing the network’s functionality under various conditions.
- 4.Configuration: Set up routers, switches, and wireless access points, configuring DHCP, NAT, VLANs, and security measures to ensure optimal performance and security.
- 5.Simulation Testing: Conduct comprehensive simulations to validate the network’s functionality, including typical office tasks, remote access scenarios, and security threat simulations.
- 6.Documentation and Training: Create user-friendly setup guidelines, document network configurations, and conduct training sessions for SOHO users to ensure effective utilization and adherence to security protocols..

2.4 System Implementation

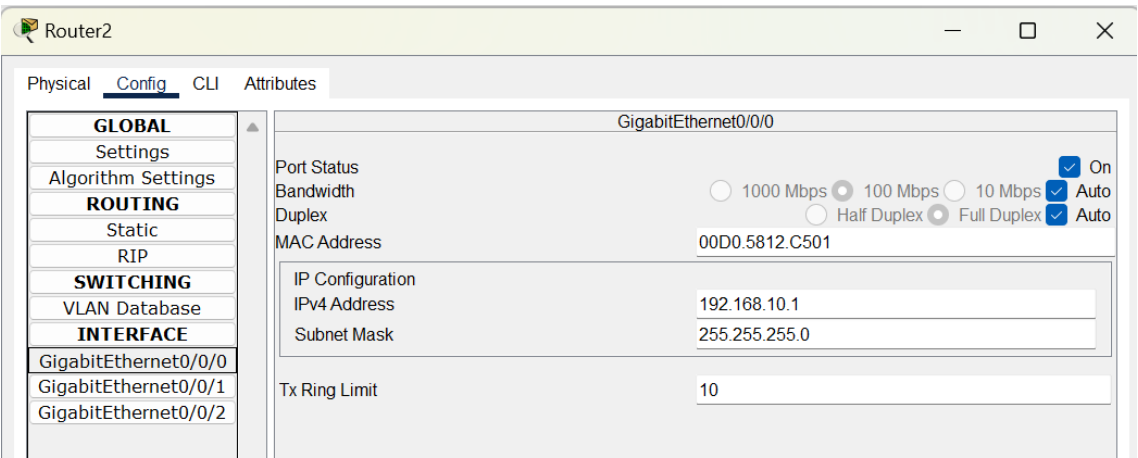


Figure 2.1: Router Configuration for admin side

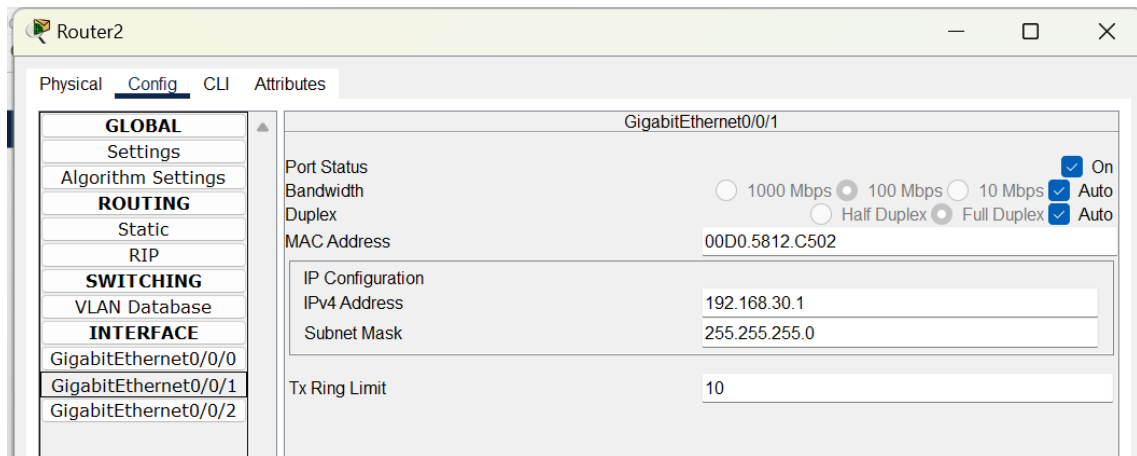


Figure 2.2: Router Configuration for user side

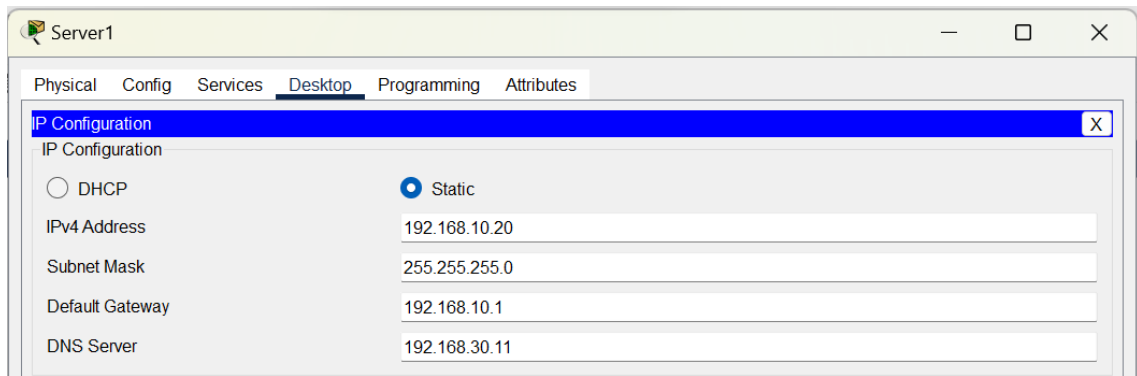


Figure 2.3: FTP Configuration for admin side-1

Username Password

☐ Write ☐ Read ☐ Delete ☐ Rename ☐ List

	Username	Password	Permission
1	Finance	Finance	RWNL
2	User	123	RL
3	admin	admin	RWDNL
4	cisco	cisco	RWDNL

Add Save Remove

Figure 2.4: FTP Configuration for admin side-2

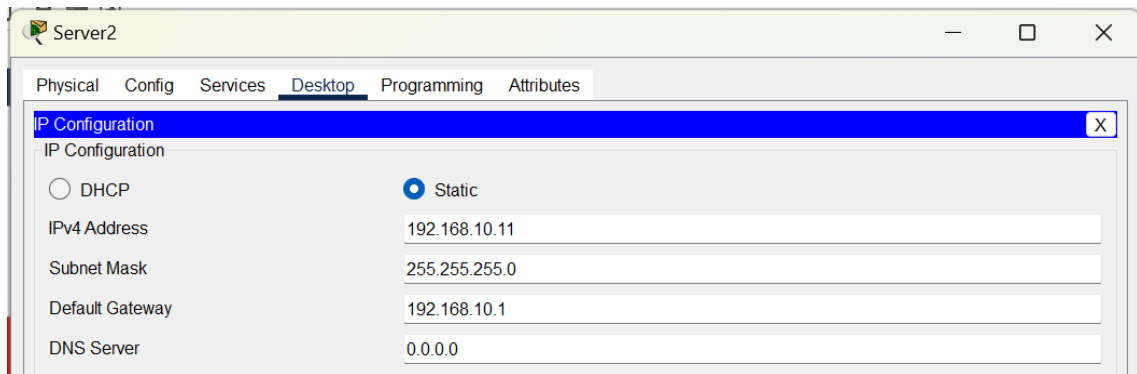


Figure 2.5: DNS Configuration for admin side-2

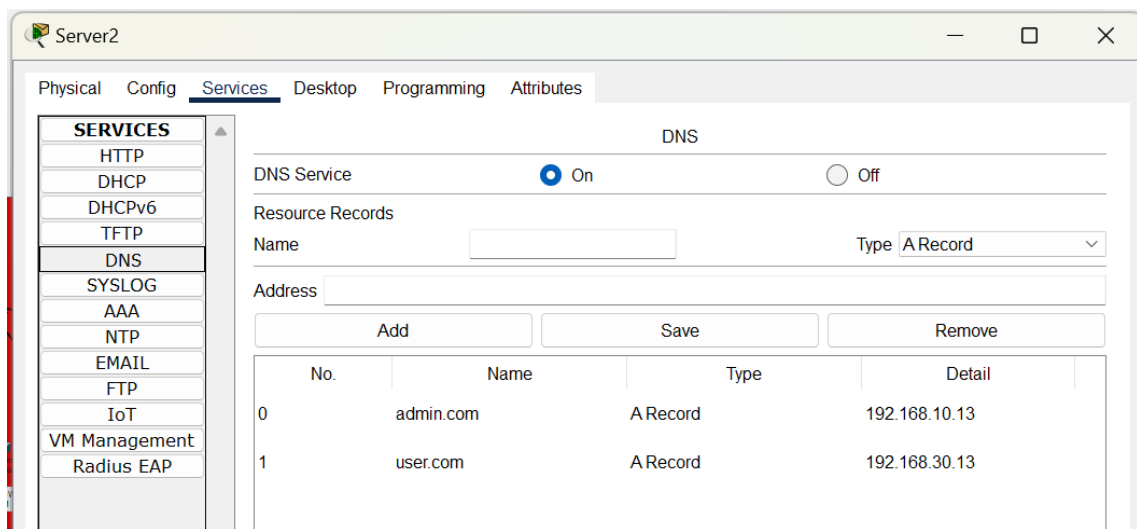


Figure 2.6: DNS Configuration for admin side-2

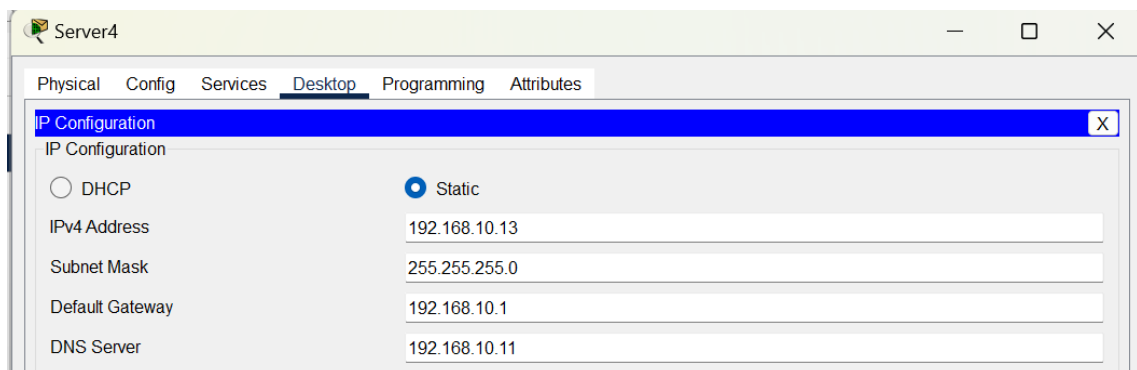


Figure 2.7: Email Configuration for admin side

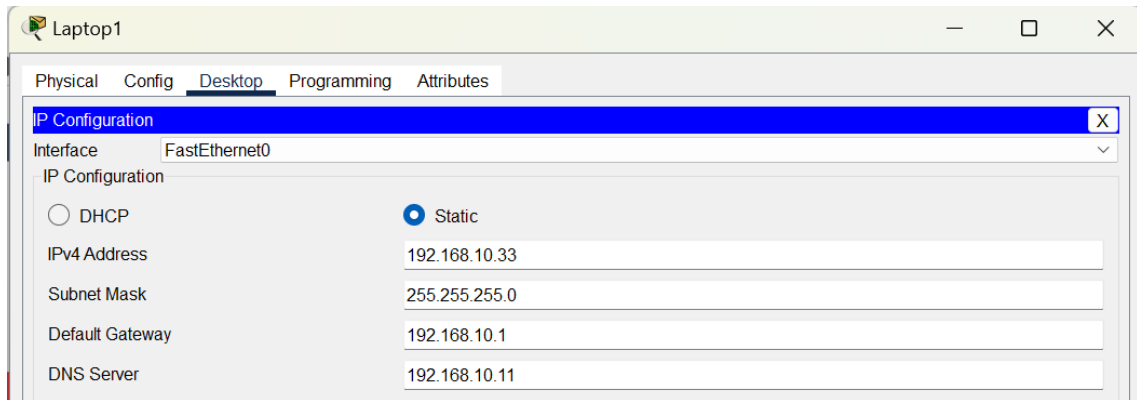


Figure 2.8: PC IP Configuration for admin side

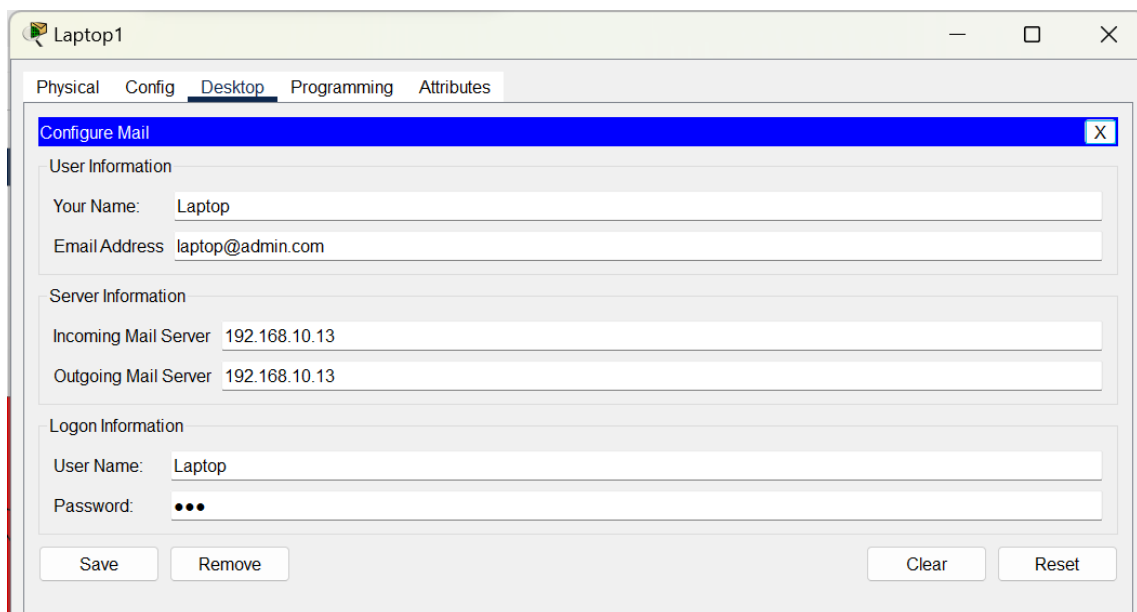


Figure 2.9: PC Email Configuration for admin side

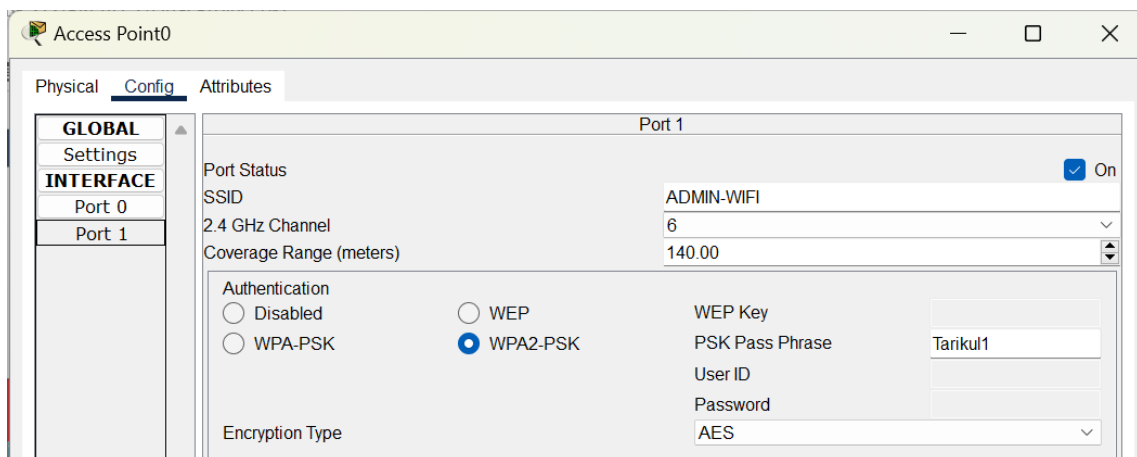


Figure 2.10: Asses-point Configuration for admin side

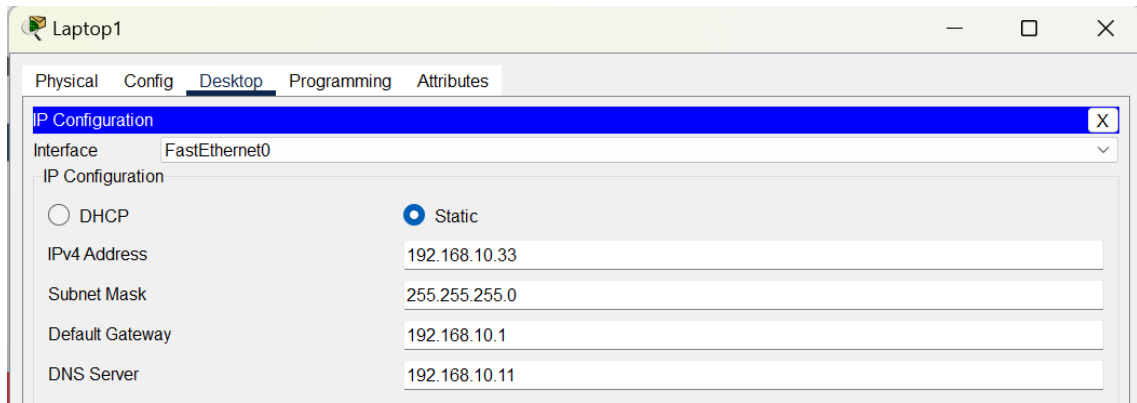


Figure 2.11: Laptop Configuration for admin side

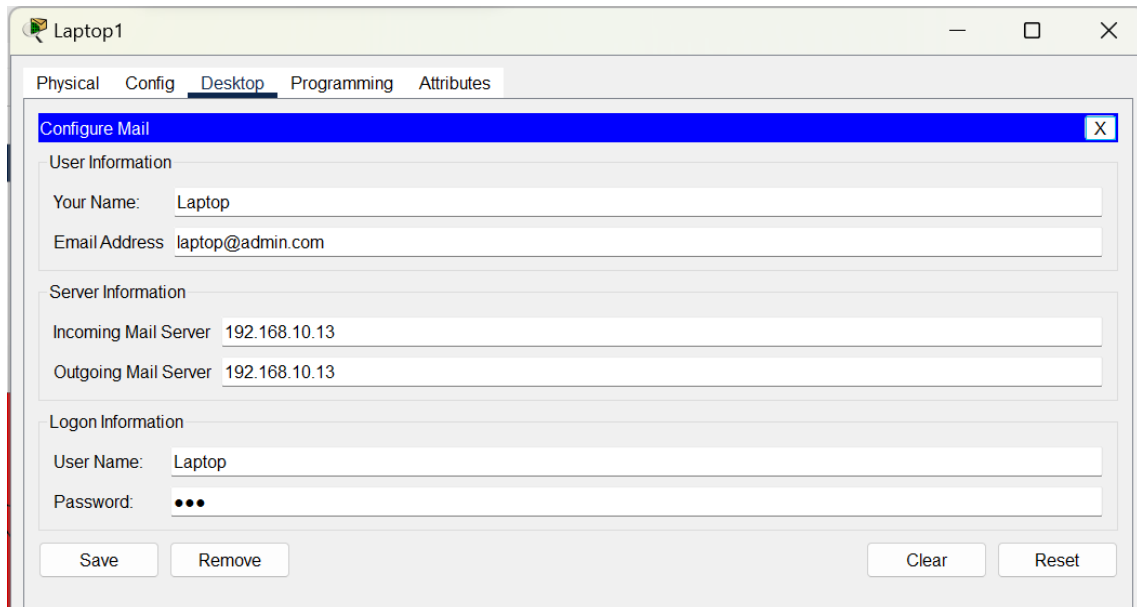


Figure 2.12: Laptop Email Configuration for admin side

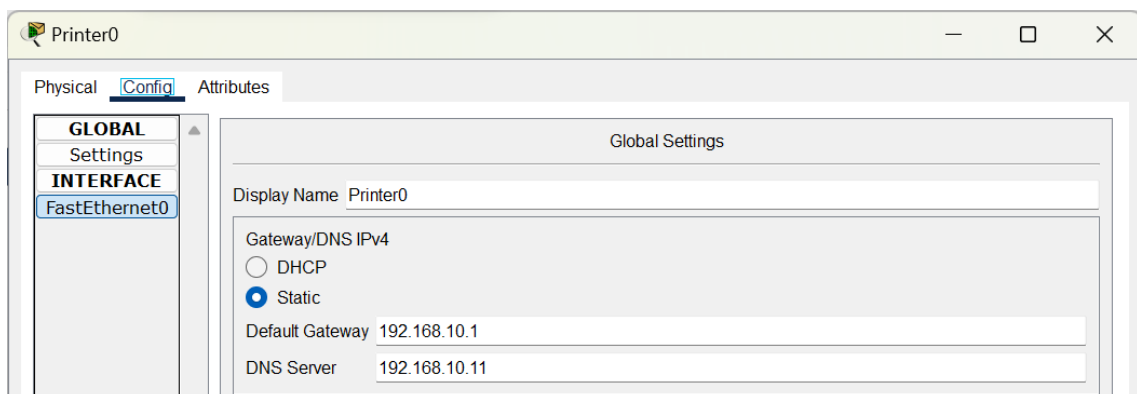


Figure 2.13: Printer IP Configuration for admin side



Figure 2.14: WPC wifi connection for admin side

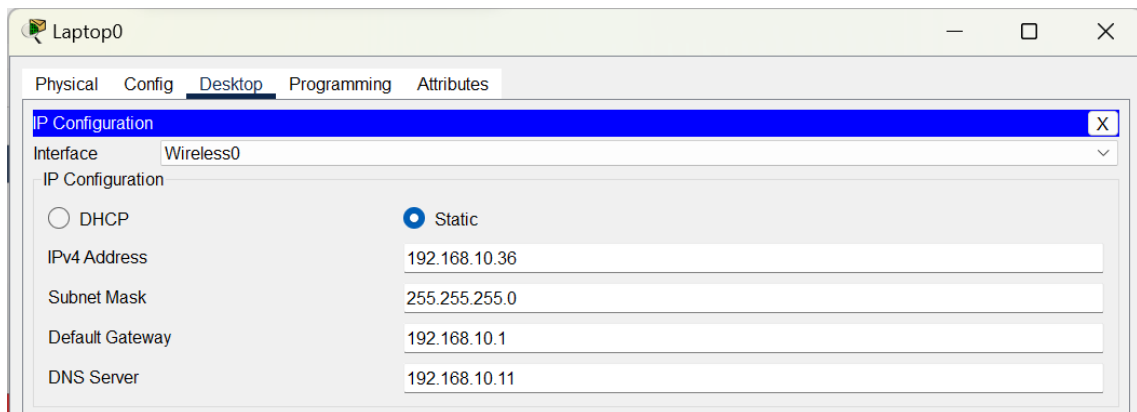


Figure 2.15: WPC IP Configuration for admin side

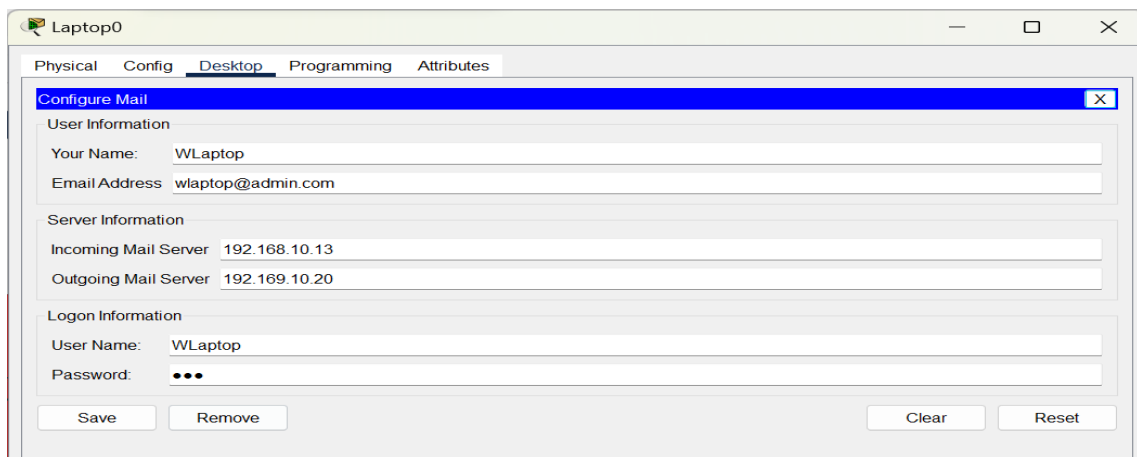


Figure 2.16: PC email Configuration for admin side

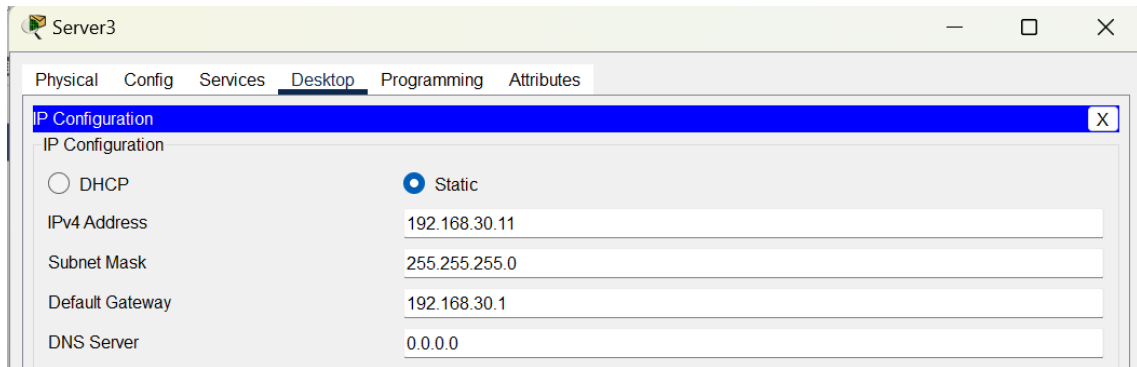


Figure 2.17: DNS server Configuration for user side

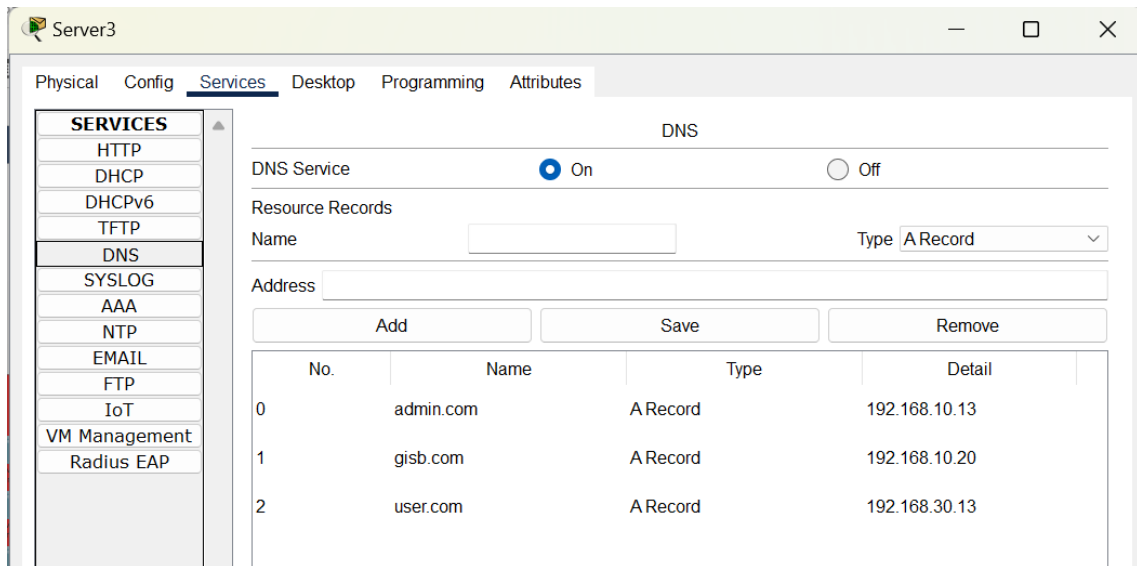


Figure 2.18: DNS server Configuration for user side

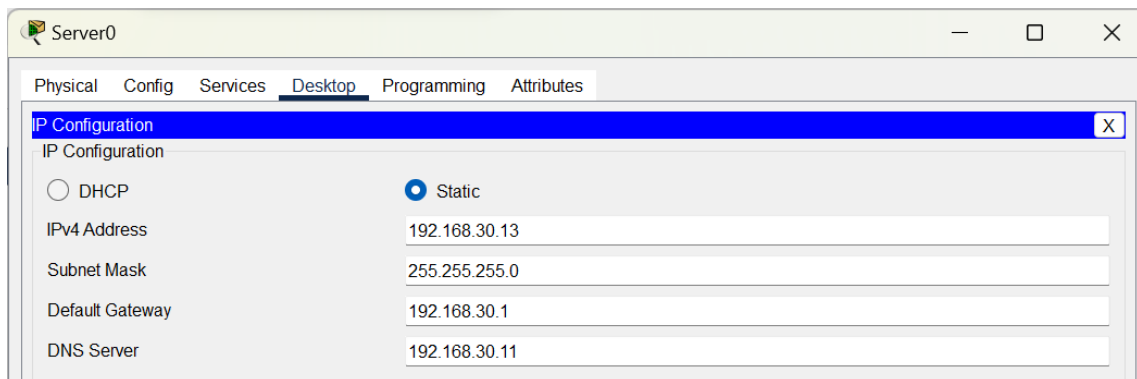


Figure 2.19: Email server Configuration for user side

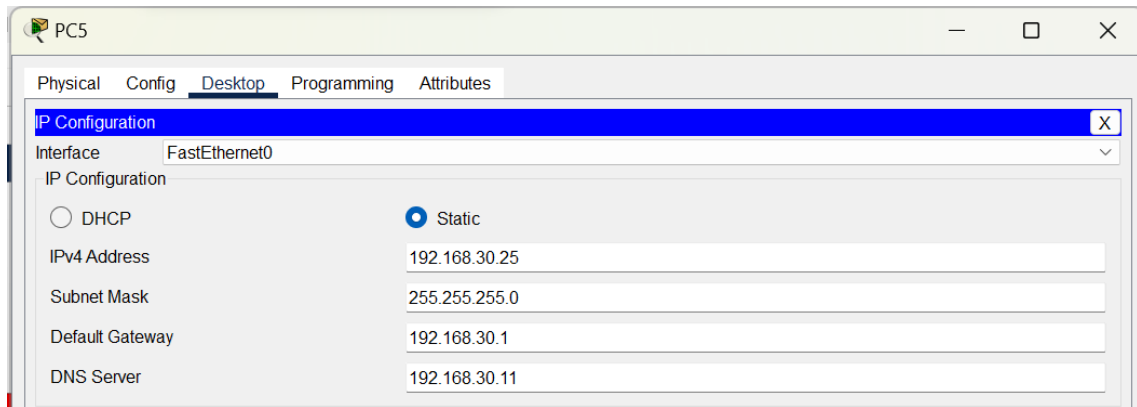


Figure 2.20: Finance PC IP Configuration

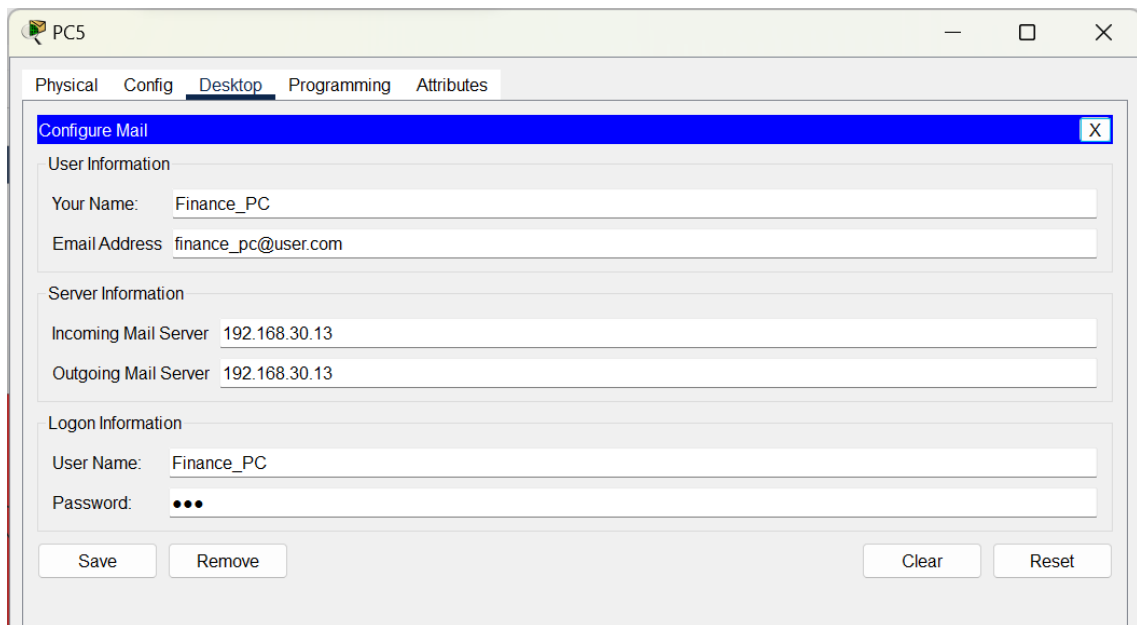


Figure 2.21: Finance PC email Configuration

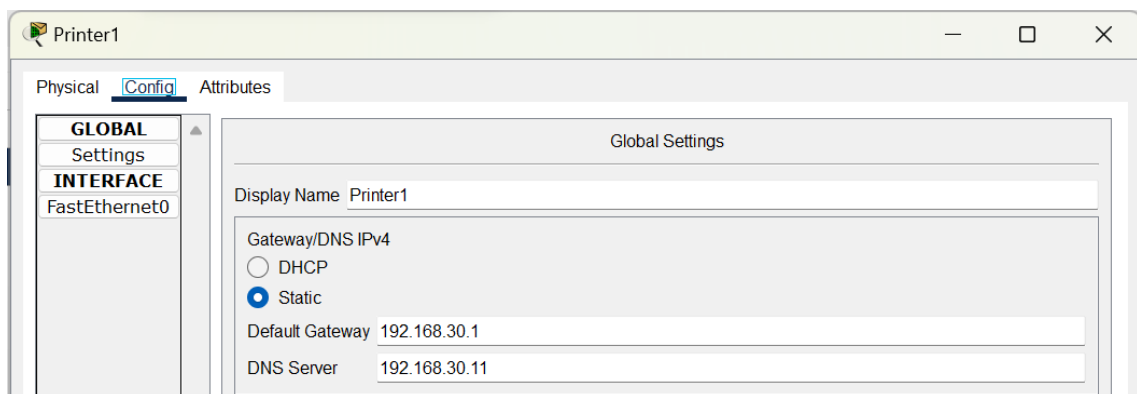


Figure 2.22: Finance printer IP Configuration

Laptop2

Physical Config **Desktop** Programming Attributes

IP Configuration [X]

Interface: FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IPv4 Address: 192.168.30.37

Subnet Mask: 255.255.255.0

Default Gateway: 192.168.30.1

DNS Server: 192.168.30.11

Figure 2.23: Finance Laptop IP Configuration

Laptop2

Physical Config **Desktop** Programming Attributes

Configure Mail [X]

User Information

Your Name: HR_Laptop

Email Address: hr_laptop@user.com

Server Information

Incoming Mail Server: 192.168.30.13

Outgoing Mail Server: 192.168.30.13

Logon Information

User Name: HR_Laptop

Password: [masked]

Save Remove Clear Reset

Figure 2.24: Finance Laptop Email Configuration

Access Point1

Physical **Config** Attributes

GLOBAL

Settings

INTERFACE

Port 0

Port 1

Port 1

Port Status: ☒ On

SSID: Finance-Wifi

2.4 GHz Channel: 6

Coverage Range (meters): 140.00

Authentication

☐ Disabled ☐ WEP ☒ WPA2-PSK

WEP Key: [field]

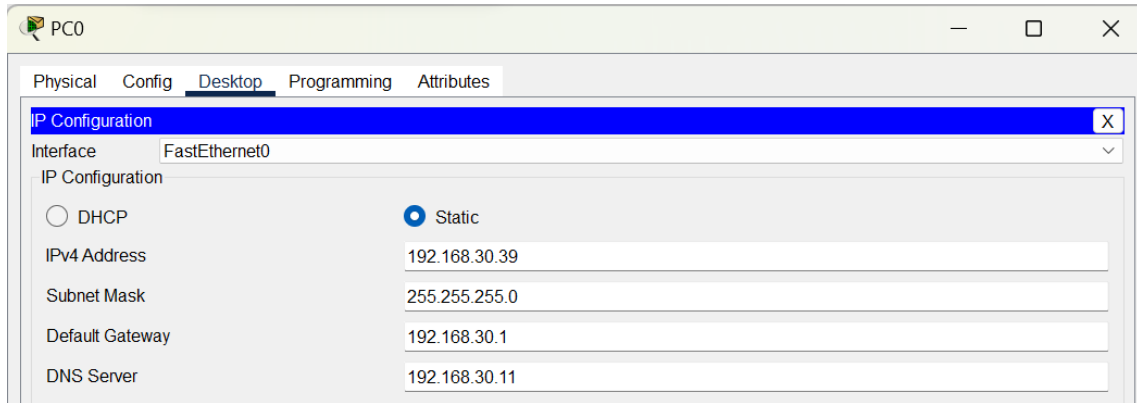
PSK Pass Phrase: Finance123@

User ID: [field]

Password: [field]

Encryption Type: AES

Figure 2.25: Finance access-pointer Configuration



PC0

Physical Config **Desktop** Programming Attributes

IP Configuration [X]

Interface: FastEthernet0

IP Configuration

☐ DHCP ☒ Static

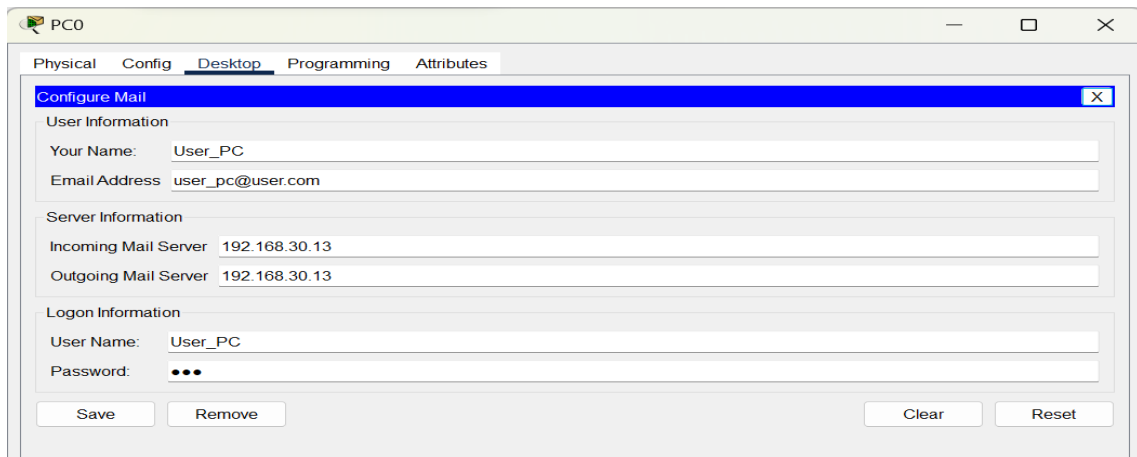
IPv4 Address: 192.168.30.39

Subnet Mask: 255.255.255.0

Default Gateway: 192.168.30.1

DNS Server: 192.168.30.11

Figure 2.26: User PC IP Configuration



PC0

Physical Config **Desktop** Programming Attributes

Configure Mail [X]

User Information

Your Name: User_PC

Email Address: user_pc@user.com

Server Information

Incoming Mail Server: 192.168.30.13

Outgoing Mail Server: 192.168.30.13

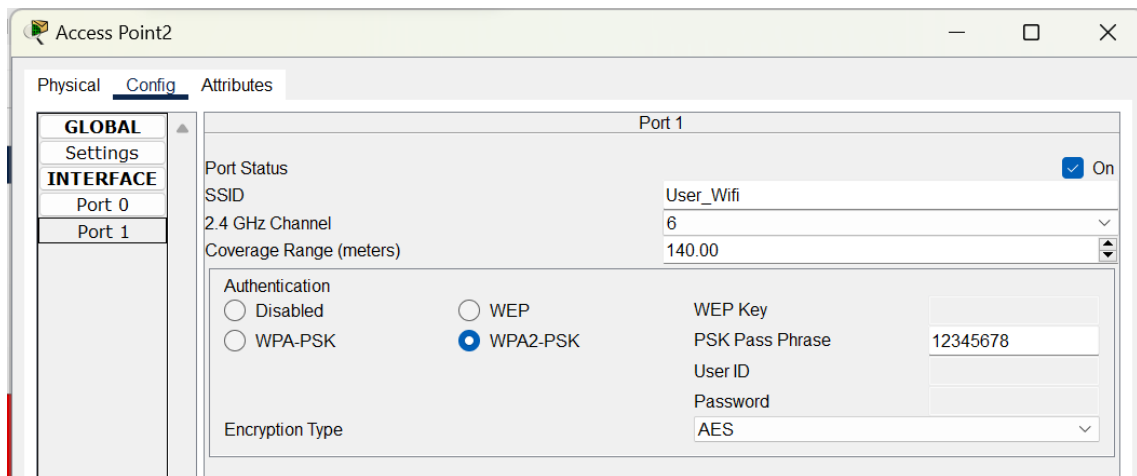
Logon Information

User Name: User_PC

Password: ●●●

Save Remove Clear Reset

Figure 2.27: User PC Email Configuration



Access Point2

Physical **Config** Attributes

GLOBAL

Settings

INTERFACE

Port 0

Port 1

Port 1

Port Status: ☒ On

SSID: User_Wifi

2.4 GHz Channel: 6

Coverage Range (meters): 140.00

Authentication

☐ Disabled ☐ WEP ☒ WPA2-PSK

WEP Key:

PSK Pass Phrase: 12345678

User ID:

Password:

Encryption Type: AES

Figure 2.28: User access-pointer Configuration



Figure 2.29: User WPC Wifi Connection

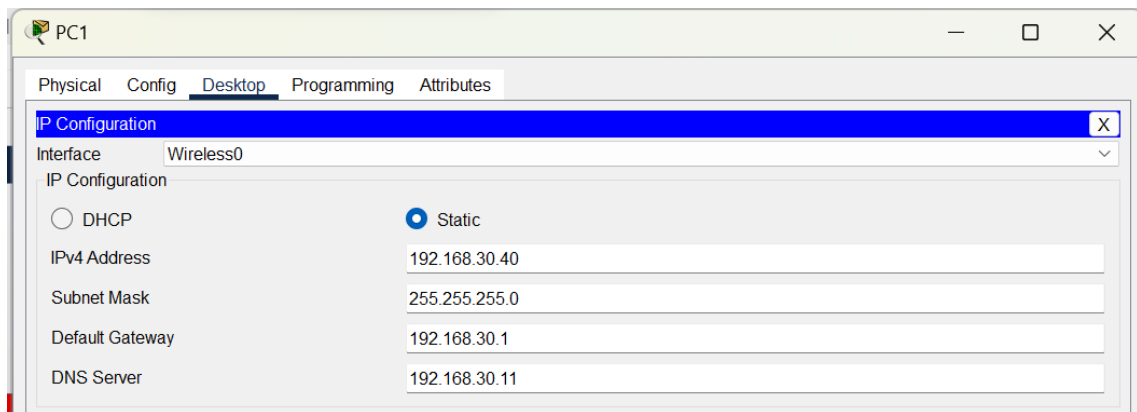


Figure 2.30: User WPC IP Configuration

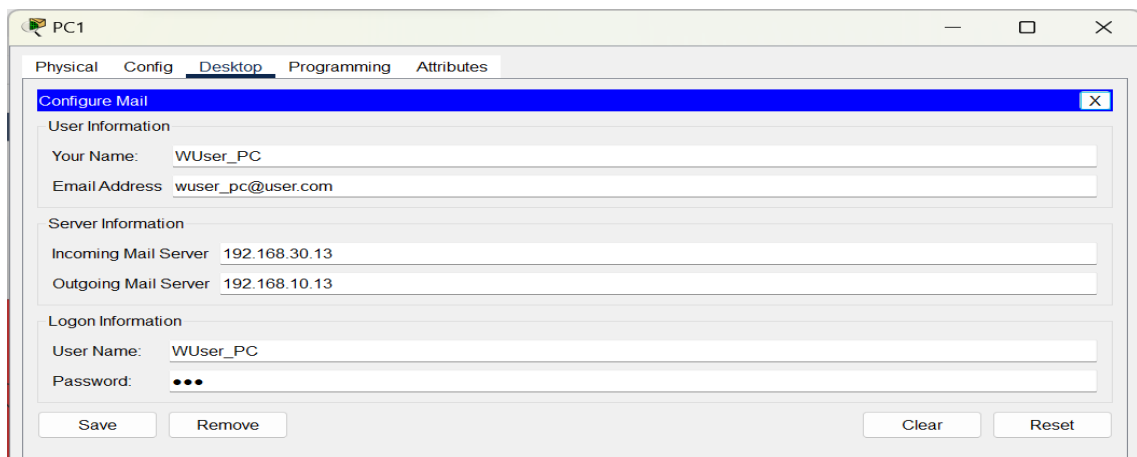


Figure 2.31: User WPC Email Configuration

Chapter 3

Performance Evaluation

3.1 Simulation Environment/ Simulation Procedure

1. Packet Tracer Setup:

Launch Packet Tracer to create and simulate the SOHO network topology.

2. Device Configuration:

Configure routers, switches, and wireless access points with appropriate settings, including DHCP, NAT, VLANs, and WPA3 encryption.

3. Server and Device Connectivity:

Set up servers and connect devices, ensuring seamless communication within the simulated network.

4. Security Testing:

- Implement security measures such as MAC address filtering and VPN configurations.
- Simulate security scenarios to evaluate firewall effectiveness.

5. Performance Evaluation:

Introduce simulated traffic to assess network performance and stability. Review responsiveness during file sharing, remote access, and collaborative tasks.

6. Documentation and Training:

- Document configurations and simulation results.
- Create user-friendly setup guidelines and conduct training sessions for SOHO users, emphasizing security protocols and troubleshooting procedures.

3.2 Results Analysis/Testing

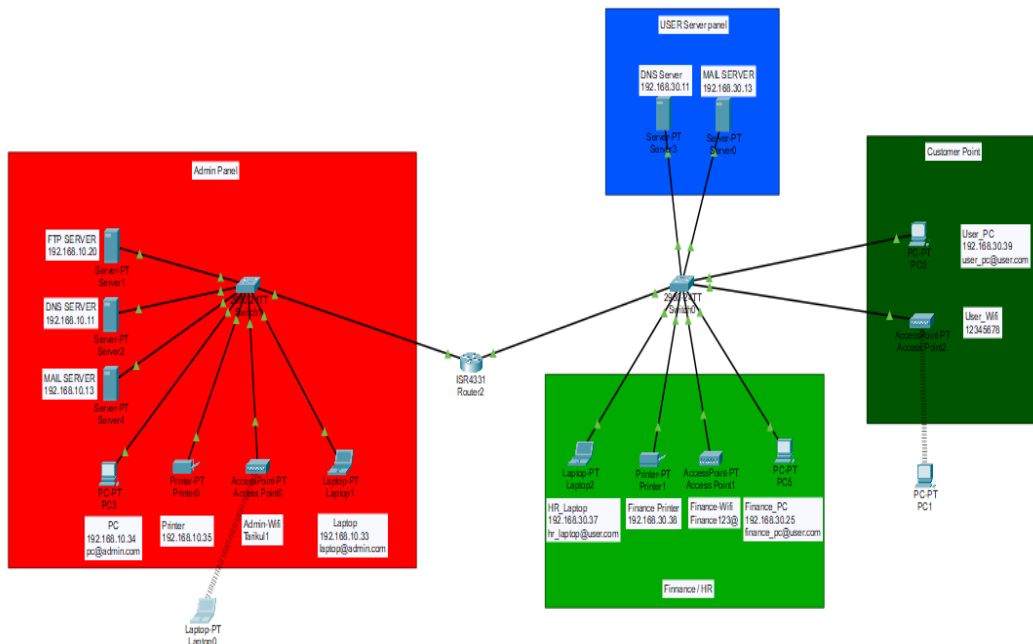


Figure 3.1: Final Output

```

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.10.35

Pinging 192.168.10.35 with 32 bytes of data:

Reply from 192.168.10.35: bytes=32 time<1ms TTL=128
Reply from 192.168.10.35: bytes=32 time<1ms TTL=128
Reply from 192.168.10.35: bytes=32 time<1ms TTL=128
Reply from 192.168.10.35: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.10.35:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>

```

Figure 3.2: Printer Connection Testing

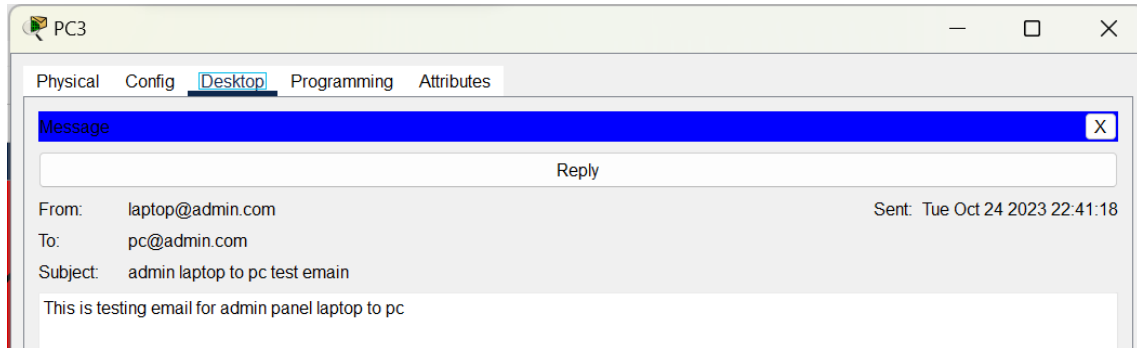


Figure 3.3: Admin laptop to Admin PC Email

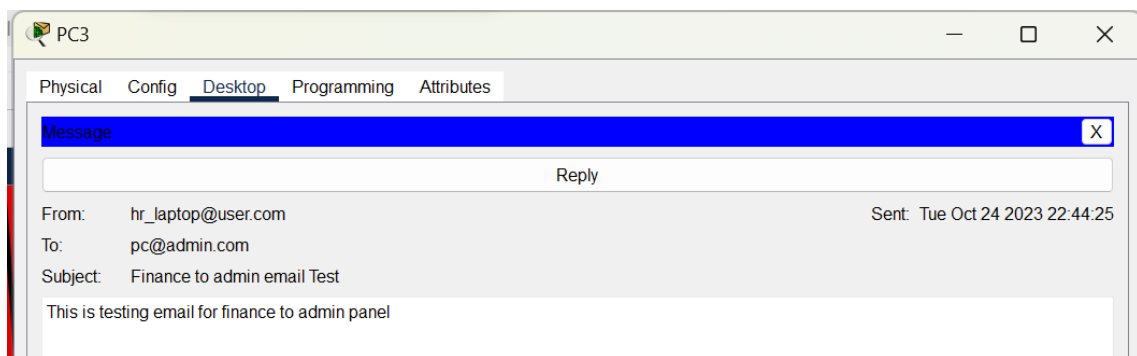


Figure 3.4: Finance to admin Email

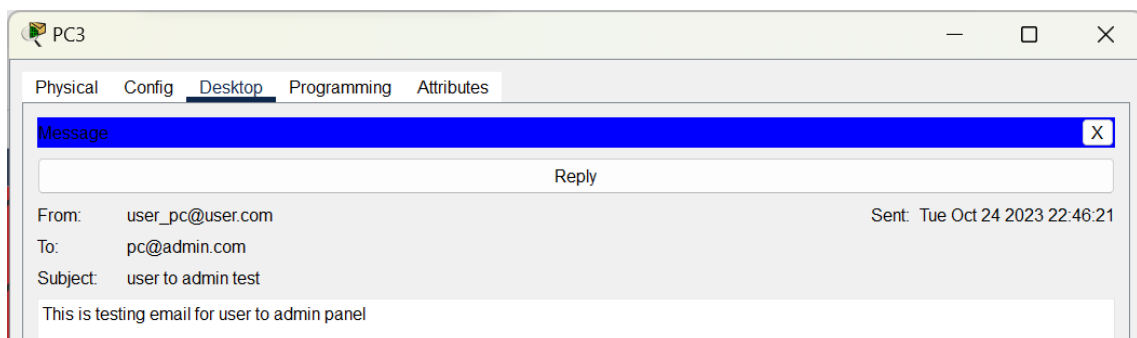


Figure 3.5: User to admin Email

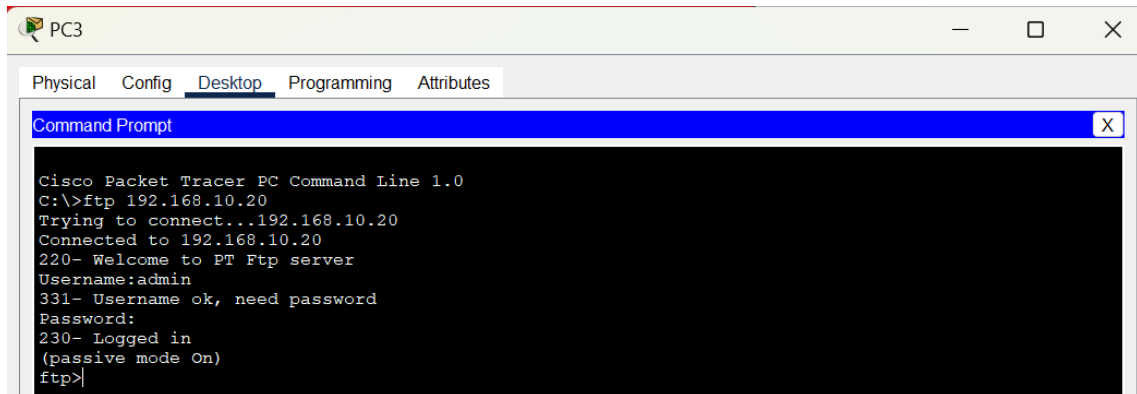


Figure 3.6: Admin to ftp access

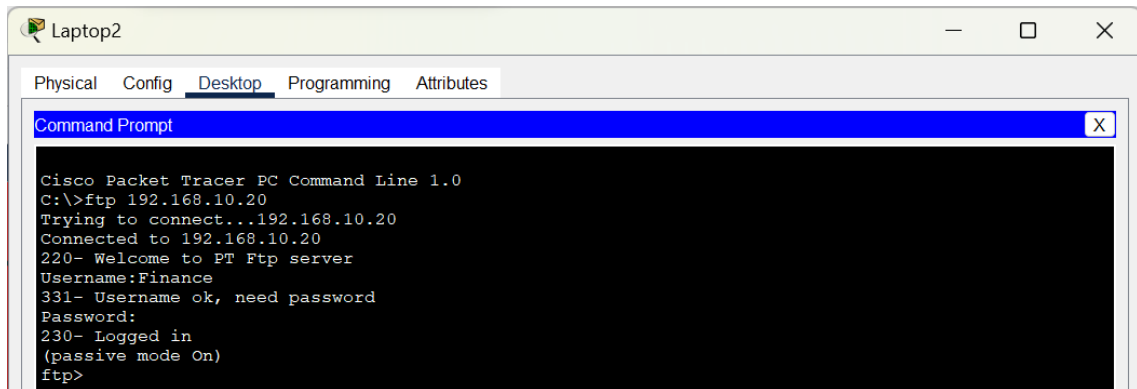


Figure 3.7: Finance to ftp access

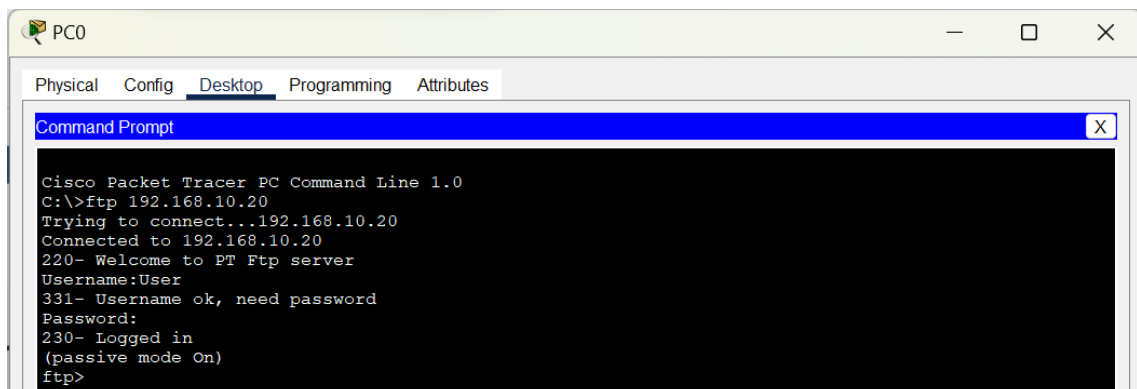


Figure 3.8: User to ftp access

3.3 Results Overall Discussion

The simulation results confirm the successful implementation of the SOHO network system. Connectivity was seamless for both wired and wireless devices, with effective security measures such as MAC address filtering and VPN configurations. Resource sharing, including access to printers and storage, was optimized, showcasing scalability without performance compromise. The network demonstrated robust performance under varying traffic conditions, meeting efficiency requirements for file transfers and collaborative tasks. Overall, the implemented design effectively addresses challenges, delivering a reliable, secure, and user-friendly SOHO network. Ongoing monitoring will ensure continued optimal functionality.

Chapter 4

Conclusion

4.1 Discussion

This project, focused on designing and simulating a Small Office/Home Office (SOHO) network system, is instrumental in addressing the unique challenges faced by modern work environments. By prioritizing efficient collaboration, secure remote access, and resource optimization, the project aims to enhance productivity and support flexible work arrangements. The successful implementation of security measures such as MAC address filtering and VPN configurations ensures a robust defense against potential threats, contributing to a secure networking environment. Scalability and consistent performance under varying traffic conditions showcase the adaptability and reliability of the designed network. The project's user-friendly setup guidelines and training sessions further emphasize its commitment to accessibility and ease of maintenance. Overall, this initiative delivers a comprehensive solution aligned with the specific needs of SOHO setups, providing a foundation for reliable, secure, and user-friendly networking in the evolving digital landscape. Ongoing monitoring and documentation will be key to sustaining the network's optimal functionality in practical usage scenarios.

4.2 Limitations

Based on the provided database schema and queries, here are some limitations and areas for critical analysis:

1. Scalability Challenges: The project may not fully address scalability concerns for larger enterprises, as it is specifically tailored for SOHO environments.
2. Simulated Environments: Simulations may not perfectly mirror real-world conditions, and unforeseen variables could impact the network differently in practical usage.
3. Budgetary Constraints: Despite acknowledging limited resources, unexpected budget constraints may limit the implementation of certain advanced hardware or security features.
4. Technology Evolution: The designed network may not fully accommodate future technological advancements or changes, potentially requiring additional adaptations.

5. User-Dependent Factors: User adoption and adherence to security protocols are subjective and can be influenced by individual behaviors, training effectiveness, and other user-dependent factors.

6. External Dependencies: Success may be contingent on external factors such as internet service providers, third-party software, or hardware reliability, which are beyond the project's control.

4.3 Scope of Future Work

For future work and extensions of this project, several possibilities can be considered:

1. Integration of Emerging Technologies: The project can explore the integration of emerging technologies, such as Artificial Intelligence (AI) for network optimization, Internet of Things (IoT) devices, or advancements in security protocols, to enhance the capabilities of the SOHO network.
2. Enhanced Remote Collaboration Tools: Future iterations could focus on refining remote collaboration tools, leveraging innovations like augmented reality (AR) or virtual reality (VR) to create more immersive and efficient virtual workspaces.
3. Advanced Security Measures: As cybersecurity threats evolve, the project's future scope includes incorporating cutting-edge security measures and staying abreast of industry best practices to fortify the network against emerging threats.
4. Dynamic Scalability Solutions: To accommodate the dynamic nature of SOHO environments, future developments might focus on more adaptive scalability solutions, ensuring the network remains flexible and responsive to changing demands.
5. User-Centric Design: Continual enhancements in user-centric design and user experience (UX) could be explored to simplify network management further, catering to users with varying technical expertise and preferences.
6. Integration with Cloud Services: Future iterations can explore tighter integration with cloud services, enabling seamless access to resources, enhanced data backup solutions, and improved flexibility for remote work scenarios.