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Performance Analysis of an Email Communication System using SMTP and POP3 Protocols in Cisco Packet Tracer

Dr. Hemavathi[1], Priyanka B C[2], Krupa R[3], Sanjana B A[4]

[1]Department of Electronics and Communication Engineering, B.M.S. College of Engineering, Bengaluru, India

[2,3,4]PG-DC students, Department of Electronics and Communication Engineering, B.M.S. College of Engineering, Bengaluru, India

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Abstract - Electronic mail (Email) is one of the most widely used communication services in modern computer networks, providing an efficient and reliable means of exchanging digital information. This paper presents the design and implementation of an email communication system using Cisco Packet Tracer by configuring an email server based on the Simple Mail Transfer Protocol (SMTP) and Post Office Protocol Version 3 (POP3). The proposed network architecture consists of a server, router, switch, and two client computers connected within a Local Area Network (LAN). The email server is configured with user accounts, domain information, and SMTP and POP3 services, while the client systems are configured with the appropriate email credentials and server settings. The functionality of the proposed system is validated through successful email transmission and reception between the configured client computers. The implementation demonstrates the practical application of client–server architecture, standard email protocols, and network service configuration in a simulated environment. The proposed system provides an effective platform for understanding email communication mechanisms and network administration concepts, making it suitable for educational laboratories and introductory networking courses.

Key Words: Cisco Packet Tracer, Client–Server Architecture, Email Communication, Local Area Network (LAN), POP3, SMTP.

1.INTRODUCTION

Electronic mail (Email) has become one of the most widely used communication services in modern computer networks because it enables fast, reliable, and cost-effective exchange of digital information. It is extensively used in educational institutions, business organizations, government offices, and enterprise environments for sharing messages, documents, images, and other digital content. Email communication follows a client–server architecture, where the email server manages user accounts, stores messages, and facilitates communication between users. Standard communication protocols such as the Simple Mail Transfer Protocol (SMTP) and Post Office Protocol Version 3 (POP3) play a vital role in ensuring reliable email transmission and retrieval.

Cisco Packet Tracer is a widely used network simulation tool developed by Cisco Systems that enables users to design, configure, and evaluate computer networks in a virtual environment. It provides a practical platform for learning networking concepts without the need for physical hardware. The software supports the configuration of routers, switches, servers, and end-user devices, making it suitable for implementing various network services, including email communication.

In this work, an email communication system is designed and implemented using Cisco Packet Tracer by configuring an email server with SMTP and POP3 services. The proposed network consists of a server, router, switch, and two client computers connected within a Local Area Network (LAN). User accounts are created on the email server, and client systems are configured with appropriate email credentials to enable message exchange. The successful transmission and reception of emails validate the correctness of the network configuration and demonstrate the practical implementation of client–server communication using standard email protocols.

The proposed implementation provides an effective educational model for understanding email server configuration, network services, and communication protocols. It also serves as a foundation for learning enterprise email systems and network administration in academic laboratories and training environments.

2. Literature Survey

Electronic mail (Email) has become one of the most important communication services in computer networks, enabling fast and reliable exchange of information between users. The architecture of email communication is primarily based on the client–server model, where dedicated mail servers manage message storage, transmission, and retrieval using standardized communication protocols. Several studies have highlighted the importance of efficient email server configuration and protocol implementation in ensuring secure and reliable communication.

Tanenbaum and Wetherall emphasized that the Simple Mail Transfer Protocol (SMTP) is the standard protocol for transmitting email messages between clients and mail servers, while Post Office Protocol Version 3 (POP3) enables users to retrieve messages stored on the server. These protocols form the foundation of modern email communication systems and provide interoperability across different network environments.

Forouzan discussed the significance of client–server architecture in computer networks and explained how application-layer protocols facilitate reliable communication between users. The study demonstrated that proper server configuration, user authentication, and protocol management are essential for efficient email services and secure message delivery.

Kurose and Ross described the working principles of application-layer protocols and highlighted the role of SMTP and POP3 in supporting electronic mail services. Their work explains how email clients communicate with mail servers to send, receive, and manage messages while maintaining reliable data transfer over Internet Protocol (IP) networks.

Cisco Systems introduced Cisco Packet Tracer as a network simulation platform that enables students and professionals to design, configure, and evaluate network infrastructures without requiring physical networking hardware. The software supports the implementation of routers, switches, servers, and client devices, making it an effective educational tool for understanding networking concepts and protocol behavior. The present work utilizes Cisco Packet Tracer to configure an email server and validate email communication through SMTP and POP3 protocols in a simulated Local Area Network (LAN).

The literature indicates that simulation-based learning provides an effective approach for understanding network services and client–server communication. Based on these studies, the proposed work focuses on implementing an email communication system using Cisco Packet Tracer to demonstrate the practical configuration of an email server, user authentication, and successful email transmission and reception within a LAN environment.

3. Proposed Methodology

A. System Architecture

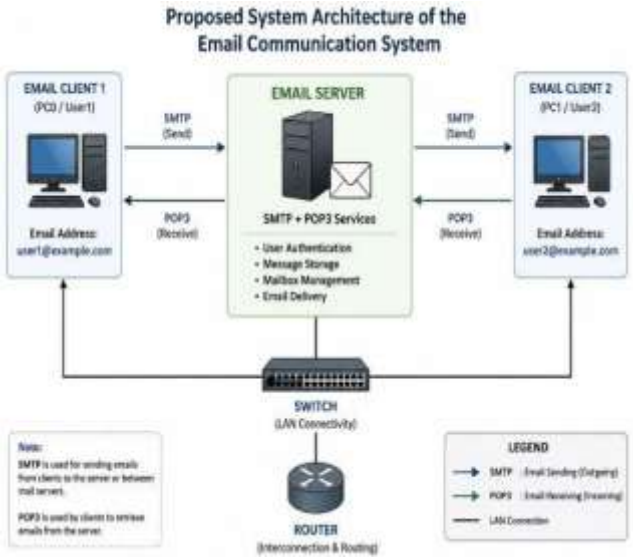


Fig -1: Proposed System Architecture of the Email Communication System

The proposed email communication system is designed using Cisco Packet Tracer based on a client–server architecture. The network consists of one email server, one router, one switch, and two client computers connected within a Local Area Network (LAN). The email server is configured to provide SMTP and POP3 services for email transmission and retrieval. The router enables communication between network devices, while the switch connects all devices within the LAN. The client computers are configured with individual email accounts to facilitate exchange messages through the mail server.

B. Email Server Configuration

The email server is configured with a static Internet Protocol (IP) address to ensure stable communication within the network. The Simple Mail Transfer Protocol (SMTP) service is enabled to support the transmission of outgoing email messages, while the Post Office Protocol Version 3 (POP3) service is configured to retrieve incoming emails. User accounts are created

with unique usernames and passwords to authenticate users before granting access to the email service. The configured server performs message processing, mailbox management, and email delivery between registered clients, thereby acting as the central component of the proposed communication system.

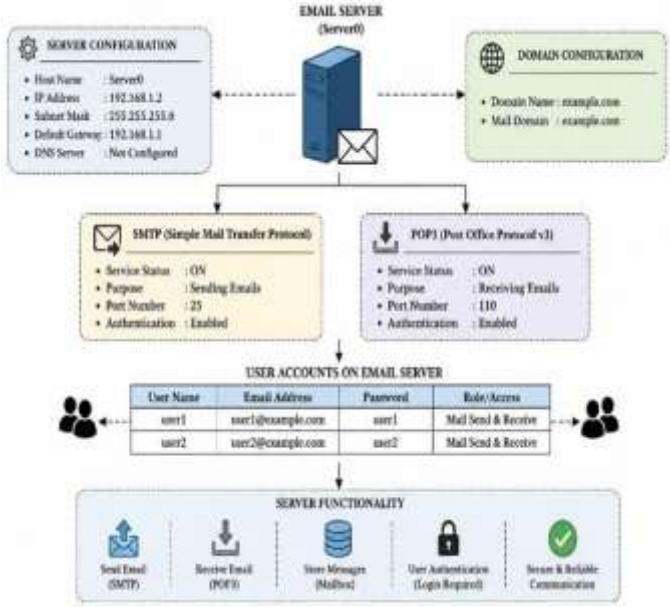


Fig -2: Email Server Configuration

C. Email Client Configuration

Two client computers are configured as email users within the proposed network. Each client is assigned an individual email address, username, and password corresponding to the user accounts created on the email server. The IP address of the configured server is specified as both the incoming (POP3) and outgoing (SMTP) mail server. After successful authentication, the clients can compose, send, receive, and manage email messages through the centralized email server. The client configuration validates the interaction between end-user systems and the mail server in a client–server environment.

D. Email Communication Process

The communication process begins when a sender composes an email using the configured client application. The email message is transmitted to the mail server using the SMTP protocol, where it is authenticated and stored in the recipient's mailbox. The recipient subsequently retrieves the message using the POP3 protocol by establishing a connection with the mail server. Successful transmission and reception of email messages confirm the correct implementation of the communication protocols and validate the functionality of the proposed email communication system within the simulated Local Area Network.

E. Communication Workflow

The methodology follows a systematic workflow consisting of network initialization, email server configuration, client authentication, message transmission, message retrieval, and communication verification. Initially, the network devices are configured and interconnected in Cisco Packet Tracer. The email server is then configured by enabling SMTP and POP3 services and creating user accounts. Subsequently, client systems are configured using the corresponding email credentials. Finally, email communication is validated through successful transmission and reception of messages between authenticated users. This workflow demonstrates the practical implementation of email communication protocols and client–server networking concepts.

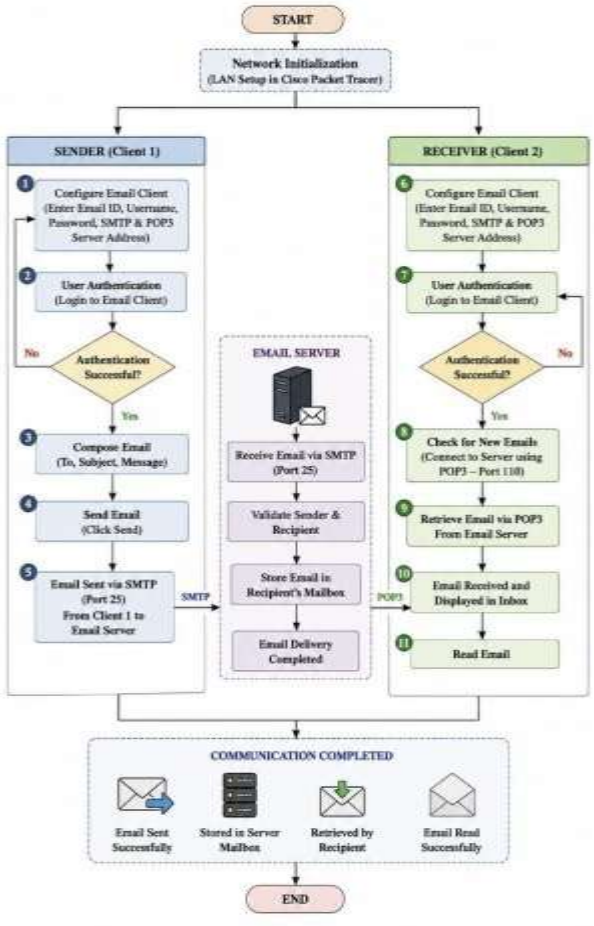


Fig -3: Communication Workflow

4. Proposed Methodology

The proposed email communication system was successfully implemented and validated using Cisco Packet Tracer. The email server was configured with a static Internet Protocol (IP) address, and both the Simple Mail Transfer Protocol (SMTP) and Post Office Protocol Version 3 (POP3) services were enabled to support email transmission and retrieval. User accounts were created with unique usernames and passwords, allowing authenticated users to access the email service and exchange messages within the Local Area Network (LAN).

The client computers were configured using the corresponding email addresses, usernames, passwords, and mail server information. After successful authentication, both clients established communication with the centralized email server and were able to compose, send, receive, and manage email messages without configuration errors. The implemented client–server architecture ensured reliable communication between authenticated users and demonstrated the correct interaction between the email clients and the configured mail server.

The functionality of the proposed system was verified by transmitting emails from one client computer to another through the configured email server. The message was successfully delivered using the SMTP protocol, processed and stored by the mail server, and subsequently retrieved by the receiving client using the POP3 protocol. The successful exchange of email messages confirmed the correctness of the server configuration and validated the implementation of the standard email communication protocols in the simulated network environment.

The experimental results demonstrate that the proposed email communication system provides reliable message transmission and retrieval within a client–server network. The implementation effectively supports user authentication, mailbox management, and protocol-based communication while providing a practical platform for learning network services. Furthermore, the use of Cisco Packet Tracer enables the simulation of real-world email communication without requiring physical networking hardware, making the proposed system suitable for networking laboratories, educational environments, and introductory research on email server configuration. The proposed implementation can be further enhanced by integrating secure email protocols, encrypted communication mechanisms, and advanced authentication techniques to improve security and support enterprise-level email services.

5. CONCLUSIONS

The proposed email communication system was successfully designed and implemented using Cisco Packet Tracer based on a client–server architecture. The email server was configured by enabling the Simple Mail Transfer Protocol (SMTP) and Post Office Protocol Version 3 (POP3) services to facilitate reliable email transmission and retrieval. The client computers were configured with valid user credentials and server information, enabling authenticated communication within the Local Area Network (LAN). Experimental validation confirmed the successful exchange of email messages between the configured clients,

demonstrating the correct operation of the implemented protocols and network services. The proposed system provides an effective platform for understanding email server configuration, client–server communication, and application-layer protocols in a simulated networking environment. Furthermore, the implementation serves as a practical educational model for networking laboratories and can be extended in future work by incorporating advanced security mechanisms, encrypted email communication, and enterprise-level mail management features.

REFERENCES

1. J. F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach, 8th ed. Hoboken, NJ, USA: Pearson, 2021.
2. A. S. Tanenbaum and D. J. Wetherall, Computer Networks, 6th ed. Hoboken, NJ, USA: Pearson, 2021.
3. B. A. Forouzan and F. Mosharraf, Data Communications and Networking, 6th ed. New York, NY, USA: McGraw-Hill Education, 2022.
4. W. Stallings, Data and Computer Communications, 11th ed. Hoboken, NJ, USA: Pearson, 2023.
5. D. E. Comer, Computer Networks and Internets, 7th ed. Hoboken, NJ, USA: Pearson, 2022.
6. Cisco Networking Academy, Introduction to Networks (ITN) Companion Guide. Cisco Press, 2020.
7. Cisco Systems, Cisco Packet Tracer User Guide. Cisco Systems, 2023.
8. Cisco Networking Academy, Getting Started with Cisco Packet Tracer. Cisco Networking Academy, 2024.

9. Cisco Systems, Cisco Packet Tracer – Network Simulation Software Documentation. Cisco Systems, 2024.
10. R. Perlman, Interconnections: Bridges, Routers, Switches, and Internetworking Protocols, 2nd ed. Addison-Wesley Professional, 2021.
11. K. R. Fall and W. R. Stevens, TCP/IP Illustrated, Volume 1: The Protocols, 2nd ed. Addison-Wesley Professional, 2012.
12. Cisco Press, Networking Essentials Companion Guide v3: Cisco Certified Support Technician (CCST) Networking 100-150, 2nd ed., Cisco Press, 2024.
13. Cisco Networking Academy, Networking Essentials Course. Cisco Networking Academy, 2024.
14. M. K. E. Bin Sulaiman, "Teaching Creativity Using a Realistic Multi-User Operation: Packet Tracer," 2020. ArXiv.
15. G. Chen and R. Wanner, "Secure Email Transmission Protocols—A New Architecture Design," 2022, ArXiv.
16. Cisco Press, IT Essentials, 5th ed., Cisco Press.
17. Cisco Press, Introduction to Networks Course Booklet
18. O. S. AlJamal et al., "Design and Simulation of a Network Infrastructure for a Multi-Branch Organization Using Cisco Packet Tracer," in Proc. 25th Int. Arab Conf. Information Technology (ACIT), 2024.