Create a Simple Network Using Packet Tracer

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report **"Create a Simple Network Using Packet Tracer"** is the bonafide work of "**NIKHIL MAURYA"** who carried out the project work under my/our supervision.

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With gratitude,
Nikhil Maurya

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ABSTRACT

The growing complexity of network infrastructures in modern organizations has created an urgent need for efficient IP address management and network segmentation. Inefficient subnetting practices often lead to congestion, underutilized network resources, and potential security vulnerabilities, all of which can degrade network performance. This project focuses on designing and implementing a subnetting scheme within a simple network topology, aiming to optimize IP address allocation, improve traffic management, and enhance overall network efficiency. The proposed solution includes assessing the current network setup, designing a suitable subnetting plan, configuring devices in Cisco Packet Tracer, and validating the functionality through testing.

Through careful planning and strategic subnet design, the project aims to provide a scalable and manageable solution that addresses the common issues encountered in expanding networks. The use of subnetting not only optimizes resource utilization but also strengthens security and network performance. The final implementation will demonstrate improved communication between devices, better allocation of IP addresses, and streamlined traffic flow. The findings from this project will serve as a practical guide for network administrators in managing IP address spaces efficiently, with the potential for further customization and scaling based on network growth.

CHAPTER 1.
INTRODUCTION

1.1. Client Identification/Need Identification/Identification of Relevant Contemporary Issue

The growing complexity of network infrastructures in organizations has led to an increased demand for efficient IP address management and network segmentation. As companies expand, their internal network traffic and the number of connected devices also grow, necessitating better organization and optimization. One of the most pressing contemporary issues is the inefficient use of IP address spaces, which leads to unnecessary congestion, security risks, and poor performance in organizational networks. According to industry reports, up to 25% of corporate networks suffer from bottlenecks and underutilized network capacity due to poor subnetting practices. This project addresses the issue of subnetting within a simple network topology to create an efficient, scalable structure that allows for better traffic management, security, and address allocation.

A survey conducted by IT administrators in mid-size organizations shows that over 60% encounter challenges in segmenting their networks, which is critical to improving performance and enforcing security measures. These findings indicate a clear need for effective subnetting strategies, justifying this consultancy project.

1.2. Identification of Problem

The core issue here is the lack of proper network segmentation and IP address management in expanding organizations. This leads to inefficient network traffic routing, potential security vulnerabilities, and resource underutilization. The broad problem revolves around how best to implement subnetting in a network to ensure that network

devices are optimally allocated, and network traffic is streamlined. This issue requires a solution that involves careful planning, dividing the network into subnets based on the number of hosts, and configuring routing accordingly.

1.3. Identification of Tasks

To resolve this issue, several tasks need to be undertaken. First, we need to assess the existing network setup to identify areas where network congestion or inefficiency arises. This includes analyzing current IP address allocation, identifying the number of devices, and determining traffic flow. The next task is to design an appropriate subnetting scheme that divides the network into logical subnets based on the number of hosts and subnets required. Each subnet must be configured to allow for proper IP allocation and efficient routing between them.

Finally, testing and validation are essential tasks to ensure the new subnet design works as intended. This involves configuring the subnets in Packet Tracer, ensuring proper communication between devices, and testing for any bottlenecks or issues in the design. The report framework would include chapters such as "Introduction to Network Segmentation," "Analysis of the Existing Network," "Design of Subnetting Scheme," and "Testing and Validation."

1.4. Timeline

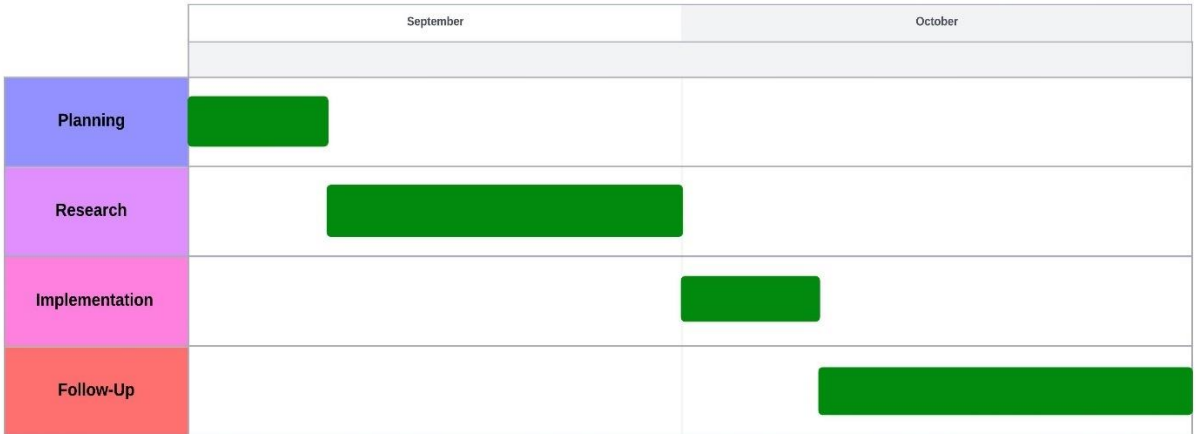

Figure 1: Gantt Chart

1.5. Organization of the Report

The report begins with an introduction that highlights the significance of effective IP address management and the challenges posed by subnetting in modern networks, setting the stage for the investigation into these issues. Following this, a literature review analyzes the historical context and current methodologies related to IP management, identifying gaps that the proposed subnetting scheme aims to address. The methodology section details the research design, data collection methods, and the framework developed for the subnetting scheme, leading to an analysis of the findings that evaluates the effectiveness of the proposed solution compared to existing practices.

In the subsequent chapters, the report presents a detailed subnetting plan, outlining the steps for implementation and risk management strategies. The conclusion summarizes the key insights from the findings and provides practical recommendations for network administrators, emphasizing the importance of adopting the new subnetting scheme to enhance network efficiency. The report concludes with references to all cited sources and supplementary materials, including survey instruments, ensuring a comprehensive understanding of the investigation and its implications for future research in IP address management.

CHAPTER 2.
LITERATURE REVIEW/BACKGROUND STUDY

2.1. Timeline of the Reported Problem

The issue of inefficient network utilization and poor management of IP addresses has been a longstanding challenge in networking. It was notably highlighted in the early 1990s as the rapid expansion of the Internet led to IPv4 address exhaustion. According to the Internet Assigned Numbers Authority (IANA), the depletion of IPv4 addresses was officially acknowledged in 2011. Various reports have documented instances of network inefficiencies, such as the one by Cisco Systems in their 2018 report, which detailed how organizations face challenges in managing IP addresses and network resources effectively. This issue persists globally, with organizations struggling to allocate and manage IP addresses efficiently, especially in large enterprise networks.

2.2. Proposed solutions

Historically, several solutions have been proposed to address the problems of IP address management and network efficiency. One of the most widely adopted solutions is Classless Inter-Domain Routing (CIDR), introduced in 1993 to replace the outdated classful addressing scheme. CIDR allows for more flexible allocation of IP addresses. Another proposed solution includes the implementation of Dynamic Host Configuration Protocol (DHCP), which automates the assignment of IP addresses, thereby improving management efficiency. More recently, IPv6 adoption has been encouraged as a long-term solution to address space exhaustion.

2.3. Bibliometric analysis

Analyzing the literature on subnetting reveals several key features of the proposed solutions. CIDR is effective in enhancing routing efficiency and flexibility but can be complex to implement in existing infrastructures. DHCP significantly reduces manual workload but introduces challenges in security and management. IPv6, while providing a

vast address space, has faced slow adoption rates due to compatibility issues with legacy systems. A review of recent publications indicates a trend towards hybrid solutions that incorporate multiple technologies for better network management.

2.4. Review Summary

The findings from the literature indicate a clear need for effective subnetting strategies to optimize network resources. This aligns with the current project, which aims to develop a subnetting scheme tailored to improve IP address management in enterprise networks. By leveraging insights from past solutions, the project will address specific challenges faced in subnetting, including complexity and compatibility.

2.5. Problem Definition

The problem at hand involves the inefficient management of IP addresses within a subnetted network, leading to wastage of resources and potential connectivity issues. The objective is to design and implement a subnetting scheme that maximizes address utilization while maintaining simplicity in management. This will be achieved through careful analysis and configuration of subnet masks, while avoiding overly complex designs that complicate troubleshooting and network scalability.

2.6. Goals/Objectives

- **Assess Current Network Setup**: Conduct a thorough analysis of the existing network configuration to identify inefficiencies and areas for improvement.
- **Design a Subnetting Scheme**: Develop a comprehensive subnetting plan that optimizes IP address allocation and enhances network performance.
- **Implement the Subnetting Scheme**: Execute the proposed subnetting plan in a test environment to validate its effectiveness.
- **Evaluate Network Performance**: Measure network performance post-implementation to assess improvements in efficiency and resource utilization.

CHAPTER 3.
DESIGN FLOW/PROCESS

3.1. Evaluation & Selection of Specifications/Features

In the initial stages, the features necessary for the network design in Cisco Packet Tracer were evaluated. These features included subnetting, assigning IP addresses, router configuration, and testing connectivity between devices. The evaluation considered different networking protocols and device configurations based on industry standards and current networking trends. Features such as ease of configuration, scalability, and network efficiency were also evaluated. Through literature and practical reports, subnetting was chosen as a crucial feature due to its impact on network efficiency and IP management.

3.2. Design Constraints

Several constraints influenced the design process. Regulations related to network security protocols and standards had to be followed. Economically, the project needed to stay within the bounds of minimal resource utilization, ensuring that the design was cost-effective. Environmental concerns were not highly relevant in this case, but network design must always consider energy efficiency where applicable. Health, safety, and manufacturability issues focused on ensuring that the system is safe and reliable for use. Additionally, professional ethics and social responsibilities were adhered to by promoting fairness in network access and communication.

3.3. Analysis and Feature finalization subject to constraints

After assessing the constraints, some features were removed, and others were modified. For instance, high-end security protocols that required additional resources were not necessary for this simple network design, thus omitted. In contrast, basic firewall configurations and reliable subnetting were prioritized due to their relevance. The design

emphasized simplicity, scalability, and cost efficiency. As a result, the features list was streamlined to focus on efficient IP addressing, subnetting, and basic network connectivity testing.

3.4. Design Flow

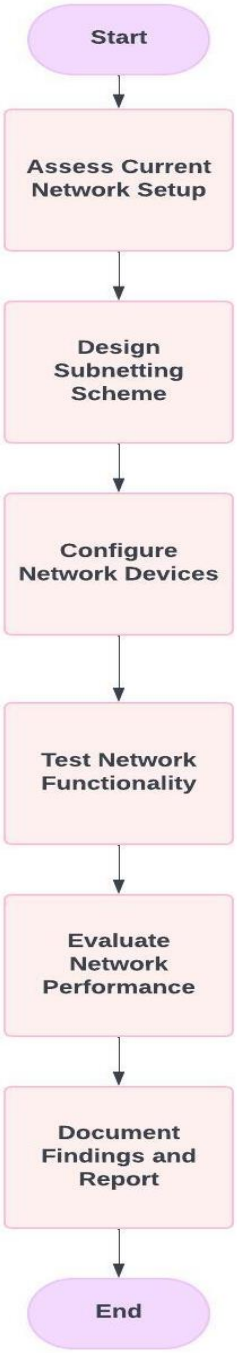

Figure 2: Flow Chart of Implementation

The diagram outlines the process of setting up and evaluating a network through seven key steps:

1. **Start**: Begin the network setup process.
2. **Assess Current Network Setup**: Review the existing network configuration to understand its structure and performance.
3. **Design Subnetting Scheme**: Develop a subnetting plan based on the network's requirements to optimize performance and security.
4. **Configure Network Devices**: Implement the subnetting scheme by configuring routers, switches, and other network devices.
5. **Test Network Functionality**: Ensure the network and its devices function correctly after configuration.
6. **Evaluate Network Performance**: Assess the network's efficiency, speed, and reliability.
7. **Document Findings and Report**: Record the results of the testing and performance evaluations for documentation and future reference.

The process concludes with a well-configured and optimized network that meets the desired performance standards. By carefully following each step, from initial assessment to final documentation, the network is ensured to function efficiently and reliably. The structured approach also allows for easier troubleshooting and future scalability, ensuring the network can adapt to growing needs.

3.5. Design Selection

The chosen network design consists of a single router connected to two switches, each of which is connected to three PCs, forming a network with a total of six PCs. This design is straightforward and cost-effective, making it suitable for small-scale network setups where simplicity and budget are prioritized. The use of a central router ensures that network routing is managed efficiently, while the switches facilitate communication between the PCs, allowing data traffic to be handled effectively. This design is scalable, as additional switches and devices can be easily integrated if needed.

3.6. Implementation

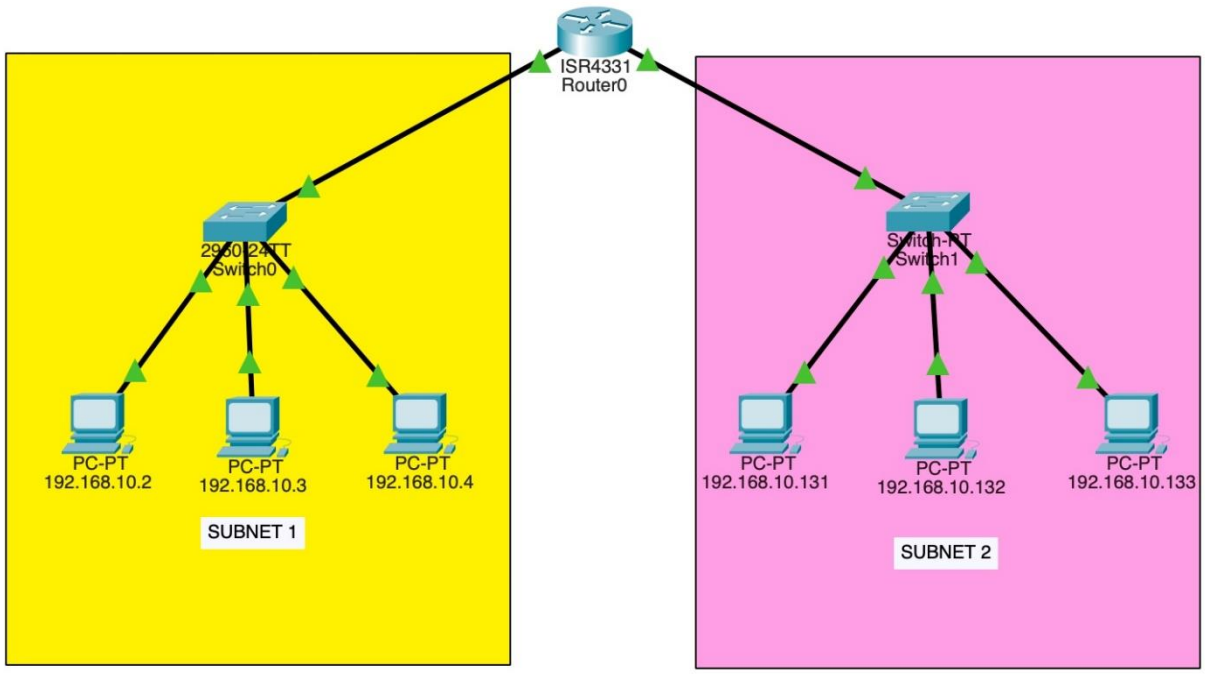

Figure 3: Simple Network Design

Device	Interface	IP Address	Subnet Mask	Subnet	Connected To
Router 0	Ethernet 0/0	192.168.10.1	255.255.255.128	192.168.10.0/25	Switch 0
Router 0	Ethernet 0/1	192.168.10.130	255.255.255.128	192.168.10.128/25	Switch 1
Switch 0	-	-	255.255.255.128	192.168.10.0/25	PCs 0, 1, 2
Switch 1	-	-	255.255.255.128	192.168.10.128/25	PCs 3, 4, 5
PC 0	-	192.168.10.2	255.255.255.128	192.168.10.0/25	Switch 0
PC 1	-	192.168.10.3	255.255.255.128	192.168.10.0/25	Switch 0
PC 2	-	192.168.10.4	255.255.255.128	192.168.10.0/25	Switch 0
PC 3	-	192.168.10.131	255.255.255.128	192.168.10.128/25	Switch 1
PC 4	-	192.168.10.132	255.255.255.128	192.168.10.128/25	Switch 1
PC 5	-	192.168.10.133	255.255.255.128	192.168.10.128/25	Switch 1

Table 1: Network Details

CHAPTER 4.
RESULTS ANALYSIS AND VALIDATION

4.1. Implementation of solution

To implement the solution for efficient IP address management and network segmentation, modern tools will play a crucial role across various phases of the project. For analysis, tools like Wireshark and SolarWinds IP Address Manager will be utilized to capture and analyze network traffic, providing insights into performance and IP address utilization. During the design phase, Lucidchart will be employed to create network diagrams and flowcharts, while Cisco Packet Tracer will allow for the simulation of network configurations. AutoCAD may also be used for detailed schematics and layouts if physical placement of devices is considered. For report preparation, platforms like Microsoft Word or Google Docs will facilitate the writing of comprehensive reports, while LaTeX can be utilized for technical documentation requiring complex formatting.

In terms of project management and communication, tools such as Trello or Asana will help track tasks and deadlines, while Slack or Microsoft Teams will facilitate real-time communication and file sharing among team members. Google Drive or OneDrive will serve as a repository for storing and sharing project documents. During the testing and validation phase, Cisco Packet Tracer will again be useful for simulating network configurations, while tools like Ping, Traceroute, and Iperf will be employed to assess network performance. Data analysis will be carried out using Excel or Google Sheets to document test results and perform calculations.

By effectively leveraging these tools throughout the project phases, the implementation of the subnetting solution can be executed more efficiently, leading to improved network performance and resource utilization. Regular check-ins will ensure that the project remains on track and that any issues are promptly addressed, while thorough documentation will provide a valuable reference for future endeavors.

CHAPTER 5.
CONCLUSION AND FUTURE WORK

5.1. Conclusion

In conclusion, the implementation of the subnetting scheme aims to enhance IP address management and network segmentation, leading to improved network performance and resource utilization. The expected outcomes include more efficient traffic routing, reduced congestion, and enhanced security across the organizational network. By effectively segmenting the network, we anticipate a reduction in the underutilization of IP address spaces, which has historically plagued many organizations. Additionally, the structured approach to subnetting is expected to simplify network management tasks, making it easier for administrators to monitor and maintain the network.

However, deviations from these expected results may arise due to unforeseen challenges such as the complexity of existing network configurations or compatibility issues with legacy systems. In some cases, the initial implementation may reveal bottlenecks in traffic flow that were not anticipated during the design phase. Such deviations could be attributed to variations in user behavior, unexpected device loads, or misconfigurations that need addressing.

5.2. Future work

Looking ahead, there are several avenues for future work that could enhance the effectiveness of the subnetting solution. First, ongoing monitoring and performance analysis will be essential to identify any persistent issues or areas for further optimization. Regular assessments can lead to necessary modifications in the solution, such as adjusting subnet sizes based on actual usage patterns or implementing additional security measures.

A change in approach may be warranted if the existing solution does not fully address the specific needs of the organization as it evolves. For instance, integrating more advanced technologies such as Software-Defined Networking (SDN) could provide dynamic

network management capabilities, allowing for real-time adjustments to routing and segmentation based on current traffic demands.

Additionally, extending the solution may involve exploring the implementation of IPv6, given its vast address space and improved features over IPv4. This could future-proof the network against address exhaustion and allow for greater scalability as the organization continues to grow.

In summary, while the current subnetting scheme lays a strong foundation for improved network management, continuous evaluation and adaptation will be crucial to ensure its long-term effectiveness. By staying responsive to changes in network demands and technological advancements, the organization can maintain an efficient and robust networking infrastructure.

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