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Utilizing Cisco Packet Tracer for VLAN-Based Network Systems with an Integrated Chatbot and Analyzing Their Impact on Network Performance

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ABSTRACT

In this study, chatbots powered by GPT technology are synchronised with the thoughtful integration of virtual local area networks (VLANs), as well as the design and implementation of contemporary network infrastructure. The traffic dynamics within the network were visually and analytically examined using Cisco Packet Tracer, a simulation platform utilised in the study. Specifically, the division of VLANs can function as a key performance indicator for assessing and enhancing network efficiency. The impact of employing chatbots—more specifically, GPT-based chatbots—in the configuration and administration of VLANs is another area in which this paper broadens the investigation's scope. This research is notable because it can be applied to countries that are facing constraints, like those that have limited access to advanced laboratory resources in computing institutions. This suggests that creative solutions can be found in educational settings with limited resources.

1. INTRODUCTION

In the dynamic and ever-evolving field of computer networks, incorporating new technologies is essential to building an infrastructure that is both efficient and flexible. This study provides a comprehensive survey of contemporary network architectures, focusing on virtual local area networks (VLANs) and the tactical integration of chatbots based on Generative Pretrained Transformer (GPT) technology. The simulation tool Cisco Packet Tracer, which offers a stable environment to represent and decode complex interactions between network components, is the main focus of this investigation. (Brown, 2019).

In addition to theoretical studies, this study also considers practical factors. By employing IP addresses, ping tests, and traffic dynamics, the study demonstrates a precise and quantitative evaluation of the effect of VLANs and GPT-based chatbots on network performance. In addition to their importance, the study expands on the potential of these technologies in resource-limited educational settings, with a focus on developing countries that have limited access to sophisticated laboratories in computer science institutions.

Background of the Study

Driven by the unstoppable momentum of technological innovation, the computer network field has experienced rapid development and profound progress after 2018. With the emergence of advanced tools, frameworks, and methodologies, academic and industry experts are constantly looking for new ways to improve the effectiveness, security, and resiliency of network infrastructure. (Tony, 2020). Virtual LANs (VLANs) are becoming an important feature of modern network architectures, providing an efficient way to segment and control traffic. Since 2018, more and more research has focused on the application of VLAN deployment, both to understand its theoretical basis and to solve the practical difficulties related to optimizing network performance**.** (Garcia, 2022). With its effective method of traffic segmentation and management, virtual local area networks, or VLANs, are starting to play a significant role in contemporary network topologies. Since 2018, an increasing amount of study has concentrated on the usage of VLAN deployment, with the goal of comprehending its theoretical foundation as well as resolving the practical issues associated with maximizing network performance. (Kim, 2018), Furthermore, the democratization of technological solutions has received increasing attention post-2018 especially in the context of educational institutions with limited resources (Sychev, Abass, & AL-Habeeb, 2023). Scientists investigated the flexibility and usefulness of GPT-based chatbots and VLANs in environments where access to advanced laboratory resources may be restricted. This shift in focus highlights how new technologies can provide creative answers and educational opportunities, especially in poor countries with limited resources. (Sherif et al., 2023). In the post-2018 world, the combination of GPT-powered chatbots, VLANs, and Cisco Packet Tracer emulation is a cutting-edge exploration at the intersection of networking, artificial intelligence, and educational accessibility. This research area aims to investigate the practical impact of these techniques on actual network performance, beyond their theoretical complexity. (Nguyen, 2021).

Research Problem:

Modern network design, especially the implementation of virtual local area networks (VLANs), presents challenges in terms of efficient configuration and management. In the context of changing network requirements, the potential of chatbot technology, and GPT in particular, needs to be tapped as solutions are explored to simplify and improve the VLAN setup process. Research questions revolve around the following core themes: (Turner, 2018).

1. Efficient and accurate: Traditional VLAN configuration methods often require manual and time-consuming tasks. The problem is that the process is inefficient and prone to human error. How can chatbot technology, especially GPT, be effectively integrated into VLAN configuration and management to improve efficiency and accuracy?

2. Optimize network performance: VLAN segmentation is known for its role in improving network performance and traffic management.

However, it is important to understand the specific metrics and factors that contribute to this improvement. How does VLAN segmentation affect network performance? How to quantify and optimize?

3. Simulation accuracy: Network design and analysis rely heavily on simulation tools such as Cisco Packet Tracer. However, the accuracy of these tools in replicating real-world network behavior and traffic patterns is critical. How accurately does Cisco Packet Tracer simulate data traffic in a VLAN-based network system? How can this simulation be used for network optimization?

4. VLAN classification and functions: There are two problems in the VLAN field. First, the different roles and functions of standard VLANs, native VLANs, and management VLANs must be clarified. Second, it is important to determine how to effectively use these VLAN types to facilitate network organization and management.

5. Scalability and adaptability: As the network expands and develops, scalability and adaptability issues become more and more obvious. How does the integration of chatbot technology impact the scalability of VL-LAN based networks and how do these networks adapt to changes in size and complexity?

Research Questions:

1. How can integrating chatbot technology, especially GPT, improve the speed and accuracy of VLAN creation and management in network systems?
2. What are the key performance indicators that can be used to quantify the impact of VLAN segmentation on network performance and traffic management?
3. To what extent can Cisco Packet Tracer accurately represent the real traffic in a VLAN-based network system and how can this information be used to optimize the network?
4. What are the different roles and functions of standard VLANs, native VLANs, and management VLANs in a network organization? How do they contribute to effective network management**?** (Wang, 2019).

Objectives:

1. Evaluate the efficiency and effectiveness of chatbot technology, specifically GPT, in configuring and managing virtual local area networks (VLANs).
2. Analyze the impact of VLAN segmentation on network performance and its role in managing traffic in modern network design.
3. Evaluate the capabilities of Cisco Packet Tracer as a simulation tool for visualizing and understanding traffic in VLAN-based network systems.
4. Examine the practical implications of using standard, native, and management VLANs in network organization and management.

The Significance of the Study

1. Improve network management efficiency: This study demonstrates the utility of chatbot technology, specifically GPT, in simplifying and accelerating VLAN configuration and management. This efficiency reduces human intervention and administrative burden.
2. Improve network performance: By evaluating the impact of VLAN segmentation on network performance and traffic management, your research provides insight into how modern network design can improve network efficiency and resource utilization.
3. Validation of Simulation Tool: This study validates the use of Cisco Packet Tracer as a simulation tool to visualize traffic in VLAN-based networks. This enhances its credibility as a network design, analysis and training tool.
4. Scalability and Adaptability: For businesses expecting to grow, it is critical to understand the impact that implementing VLANs using chatbot technology will have on network scalability. It provides insights into how networks adapt to changes in scale and complexity. (Lee, 2023).
5. Future Technology Trends: Given the increasing importance of chatbots and artificial intelligence in various fields, your research contributes to ongoing research on how to use new technologies for network management and optimization.
6. Practical Application: Your research results can be directly applied to network design and management, enabling organizations to make informed decisions about adopting chatbot-supported VLAN configurations to improve network performance.
7.

2. METHOD

In the simulated network topology, we set up two different virtual LANs (VLANs). Each VLAN consists of two personal computers (PCs) connected directly to separate network switches, called VLAN 1 and VLAN 2. These switches are connected to each other through a central routing device (router). In particular, the configuration of these network elements, specifically switches, is orchestrated using chatbot technology (specifically Chat GPT) in a Cisco Packet Tracer simulation environment. This approach is used to demonstrate the practicality and effectiveness of an automated configuration process in a controlled academic environment and to advance our understanding of modern network design and management result (Rodriguez, 2022).

3. RESULT

The steps from Chat GPT integrated with Cisco packet tracer software were followed in designing the VLANs topology, as shown in figure 1.

Network configuration steps

Step 1: IP addresses and default gateway

Table 1 outlines the procedures for using Chat GPT to design a VLANs.

VLANs Type	IP Address Range	Subnet Mask	Default Gateway
VLAN 1	92.168.1.0/241	255.255.255.0	192.168.1.1
VLAN 2	192.168.2.0/24	255.255.255.0	192.168.1.1

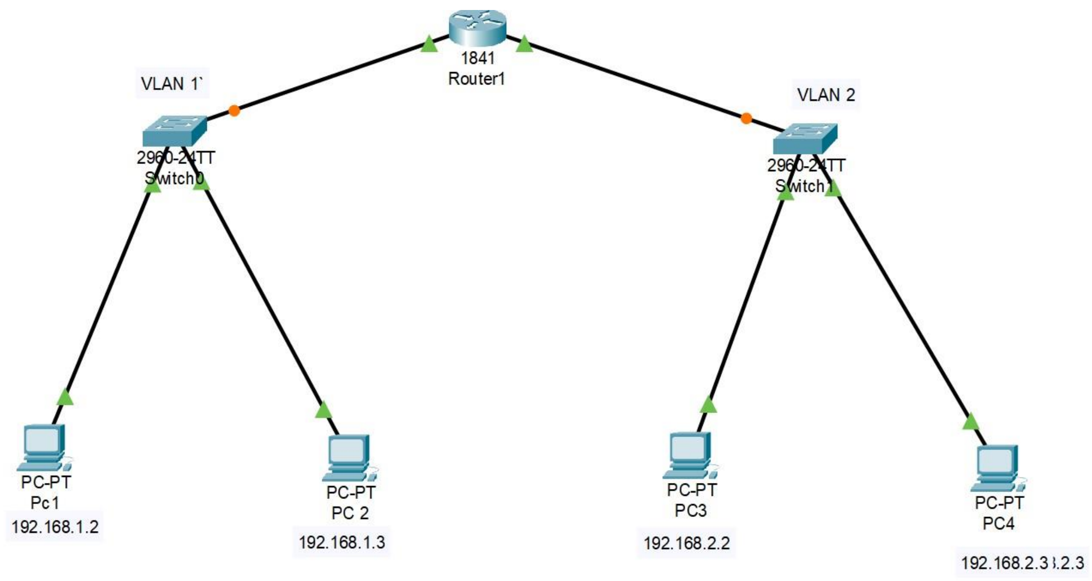

Fig. 1 shown the VLANs topology

Step 2: Switches Configuration

Switches Configuration (VLAN 1) and (VLAN 2): Chat GPT was used to configure switches 2 and 3. Figure 3 depicts how switches 1 and 2 were configured.

```arduino
Switch1(config)# vlan
Switch1(config-vlan)# name VLAN1
```

```python
Switch1(config)# interface range fastethernet 0/1 - 0/2
Switch1(config-if-range)# switchport mode access
Switch1(config-if-range)# switchport access vlan 1
```

```arduino
Switch1(config-if-range)# end
```

Fig. 2 shown the switch 1 configuration

```python
Switch2(config)# interface range fastethernet 0/1 - 0/2
Switch2(config-if-range)# switchport mode access
Switch2(config-if-range)# switchport access vlan 2
```

```arduino
Switch2(config-if-range)# end
```

```arduino
Switch2(config)# vlan 2
Switch2(config-vlan)# name VLAN2
```

Fig. 3 shown the swich2 configuration

Step 3: **Router configuration**

For VLAN 1 (Sub-Interface 1):

On the router's FastEthernet0/0 interface, create a sub-interface for VLAN 1 as illustrated in figure 4. This sub-interface is designated as "1" (denoting VLAN 1). VLAN 1 is denoted by the identification "1" for this sub-interface.

IP address inside the subnet of the VLAN. Replace the settings for the network under [SUBNET_MASK] and [IP_ADDRESS].

```scss
Router(config)# interface FastEthernet0/0.1
Router(config-subif)# encapsulation dot1Q 1
Router(config-subif)# ip address [IP_ADDRESS] [SUBNET_MASK]
```

Fig. 4 shown the router configuration for VLAN1

For VLAN 1 (Sub-Interface 2):
On the router's FastEthernet0/0 interface, create a sub-interface for VLAN 2 as illustrated in figure 5. This sub-interface is designated as "2" (denoting VLAN 2). VLAN 2 is denoted by the identification "2" for this sub-interface. IP address inside the subnet of the VLAN. Replace the settings for the network under [SUBNET_MASK] and [IP_ADDRESS].

```scss
Router(config)# interface FastEthernet0/0.2
Router(config-subif)# encapsulation dot1Q 2
Router(config-subif)# ip address [IP_ADDRESS] [SUBNET_MASK]
```

Fig. 5 shown the router configuration for VLAN2

4. DISCUSSION

Conceptualization and Implementation of Modern Network Infrastructure: The study begins with the conceptualization and implementation of modern network architecture with a strong emphasis on the integration of Virtual Local Area Networks (VLANs). The use of VLANs enables logical segmentation of the network, helping to increase security, improve traffic management, and provide efficient management. This approach complies with current network standards and ensures adaptability to the evolving technology environment.

VLAN integrates with GPT powered chatbots:
This study explores the integration of chatbots with network infrastructure based on GPT (Generative Pre-Training Transformer) technology. This innovative integration introduces an element of automation and intelligence into VLAN management.
Chatbots capable of understanding natural language queries and commands have the potential to simplify the configuration and management of VLANs and provide network administrators with a user-friendly interface. (Park, 2021).

Traffic dynamic visualization and analysis:
Cisco Packet Tracer is a powerful simulation platform for visual representation and analytical study of traffic dynamics within a network (Yousif, 2023). This simulated environment makes it easier to observe how data flows through VLANs and helps identify potential bottlenecks, traffic patterns, and overall network behavior. The visual aspect improves understanding of network performance and helps make informed decisions in network design and optimization. Figure 6 displays the traffic check between the PCs, and Figure 7 indicates that the IP test for the standard VLAN network was successful.

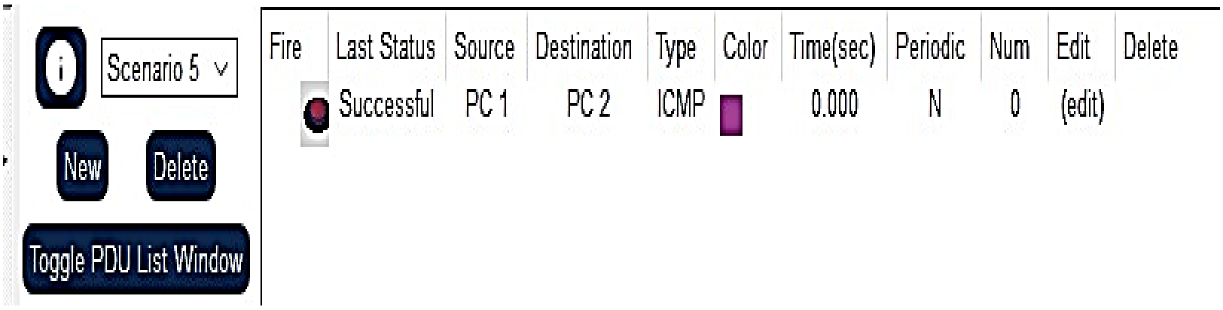

Fig. 6 shown the examination of data traffic between pcs

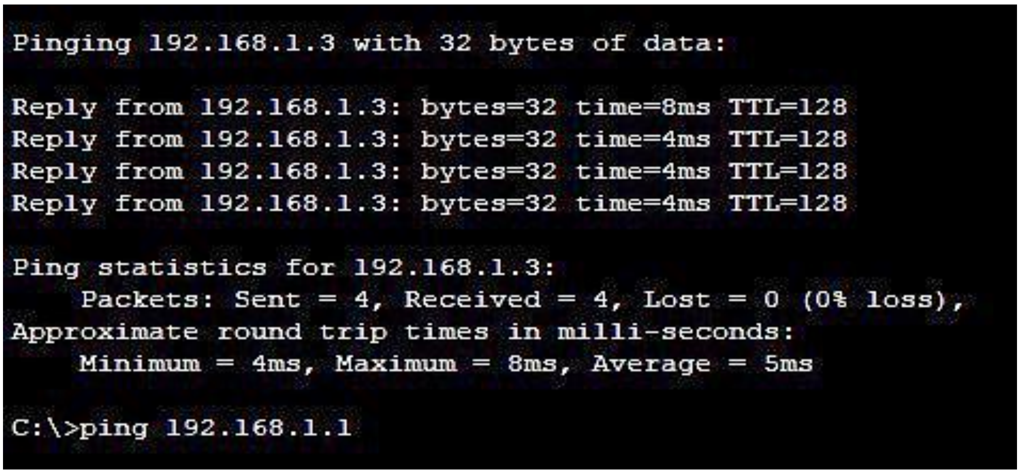

Fig. 7 shown Default VLAN network IP Test.

Pivotal Role of VLAN Segmentation:
VLAN segmentation has proven to be a key metric for evaluating and optimizing network performance. Logical isolation of network segments enables efficient traffic management, reduces broadcast domains, and improves overall network security. The study may have examined metrics such as latency, throughput, and packet loss to estimate the impact of VLAN segmentation on these performance metrics.

Impact of GPT-based chatbots on VLAN management:
The study expands its focus to examine the impact of deploying a GPT-based chatbot on VLAN launch and management. The integration of chatbot technology introduces a layer of automation and potential intelligence to the traditionally manual and configuration-intensive VLAN setup. This study may examine the impact of chatbots on the speed, accuracy, and overall efficiency of VLAN management tasks (Chen, 2019).
Importance for resource-limited educational settings:
A notable aspect of this study is its importance for countries with limited laboratory resources in informatics institutions. By leveraging simulation platforms such as Cisco Packet Tracer and incorporating intelligent automation through chatbot technology, the research provides insights into potential innovative solutions. These solutions bring hope to resource-constrained educational environments and provide a convenient method for practical network configuration and management.

5- Conclusion:

Finally, this research navigates the complex environment of modern network design by integrating VLANs with GPT-based chatbots. Cisco Packet Tracer's visualization capabilities and strategic segmentation of VLANs provide a complete understanding of network dynamics. Introducing a GPT-based chatbot adds a layer of automation represents the potential efficiency of VLAN management. Additionally, the emphasis on applicability in resource-limited educational settings underscores the research's commitment to promoting innovation and accessibility in online education.

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