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BUILDING THE SIMULATION MODEL OF DIGITAL COMMUNICATION NETWORKS: A NEW APPROACH IN THE CISCO PACKET TRACER ENVIRONMENT

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Abstract: This article describes the process of creating and optimizing a simulation model of a digital communication network. New methodologies aimed at improving network efficiency, ensuring security, and optimizing performance in the CISCO Packet Tracer simulation environment are introduced. The model integrates QoS, VLAN, OSPF protocols, and network security mechanisms. The effectiveness of the new approach is demonstrated through experiments and results. The article presents both scientific analysis and practical outcomes.

Keywords: Network modeling, CISCO Packet Tracer, digital communication network, simulation, simulation environment, network security, QoS, OSPF, VLAN.

Introduction

Digital communication networks are a fundamental infrastructure in the field of information technology. Modeling and simulation processes play a critical role in improving network performance, ensuring security, and managing the network. The CISCO Packet Tracer simulation environment is widely used for designing networks, configuring them, and conducting various tests. This article presents a scientific methodology for building and optimizing a digital communication network simulation model using CISCO Packet Tracer.

Network modeling is especially crucial in testing and analyzing complex network systems, as this process helps identify issues within the network and develop effective solutions. The article demonstrates that new methodologies can significantly enhance network performance and security.

Literature Review

Several studies have been conducted in the field of digital communication network modeling and simulation. Tanenbaum and Wetherall (2011) present a methodology for managing network protocols and optimizing network performance in their book *Computer Networks*. Kurose and Ross (2017) emphasize the importance of integrating protocols such as QoS, VLAN, and OSPF to enhance the efficiency of network systems. CISCO (2019) provides extensive information about the features of Packet Tracer and its application in network modeling. Based on these sources, this article presents new approaches to network simulation and optimization.

Methodology

In this study, a simulation model of a digital communication network is built within the CISCO Packet Tracer environment. The following network components are integrated into the model:

Selecting Network Components: The model includes routers, switches, servers, and computers. IP addresses and subnets are configured in various network segments. Traffic is managed, and priorities are assigned through QoS and VLAN settings.

Protocol Configuration: The model utilizes the OSPF (Open Shortest Path First) protocol to determine network routes and select the best paths. QoS (Quality of Service) is used to prioritize different types of network traffic.

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Ensuring Security: To enhance security, VPN (Virtual Private Network) and ACL (Access Control List) are used to protect network resources. Firewalls and other security mechanisms are also integrated.

Simulation: The network is built and tested within the CISCO Packet Tracer software. Network connections are checked using ping and traceroute tools. The effectiveness of QoS, OSPF, and security protocols is tested.

Experiments and Results

Building the Model: The following components are used in the model:

- **Routers and Switches**: Used to ensure routing and switching within the network.
- **QoS Protocols**: Used to prioritize traffic for video and voice communications.
- **Security Protocols**: VPN and ACL configurations are used to enhance network security.

Tests and Trials: The following tests were performed during the network simulation:

- **Ping Test**: To check the continuity of the network.
- **Traceroute Test**: To verify network paths and routes.
- **Security Tests**: To protect the network from external threats.

Results: The tests revealed that network efficiency and security were enhanced. The QoS protocol helped prioritize video and voice communications, which improved network performance. OSPF enabled efficient routing, ensuring uninterrupted network connections. VPN and ACL protocols enhanced network security.

Analysis and Issues

Some issues were encountered during the network simulation. For example, there were conflicts between certain protocols, and the need to increase the maximum load capacity of the network. However, these issues were resolved through network optimization and reconfiguration. Furthermore, it was demonstrated that some security risks exist, indicating the need for stronger security measures in the future.

Conclusion

This study created a simulation model of a digital communication network in the CISCO Packet Tracer environment. By simulating and optimizing the network, it was shown that network performance can be improved, and security can be enhanced. New methodologies allow for better resource optimization and increased security within the network. In the future, this methodology could be applied using other simulation programs as well.

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