Intranet Network Optimization Using VLAN at Vocational High School Gedangan

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Abstract

Purpose: This study aims to optimize the intranet network at Vocational High School Gedangan by using Virtual Local Area Network (VLAN). The main goal is to enhance network performance and security, especially in environments with numerous users, where LAN structures face management and security challenges.

Method: The research employs a qualitative descriptive method, utilizing observations and interviews with the school's IT staff to understand how VLAN is implemented and its advantages. The data collected is used to analyze how VLAN can improve network efficiency and flexibility.

Practical Applications: By segmenting the network with VLAN, the school can better manage user access and isolate different departments or student groups. This helps prevent network congestion and reduces potential security threats, contributing to a more reliable and secure system for daily operations and learning processes.

Conclusion: VLAN implementation at Vocational High School Gedangan significantly optimizes the network's performance and security, creating a more efficient and safer environment for both administration and educational activities.

Introduction

An institution, organization, or other entity requires a communication network to carry out activities, interact, share information, and perform other tasks. An intranet (international connected network) is a system designed to connect various parts of the world, often through a local area network (LAN) that uses standard communication protocols and internet-like facilities, effectively functioning like a localized internet. Typically, an intranet also has internet access, enabling the exchange of information and data with other intranet networks (internetworking) via basic internet infrastructure (Hestomo & Gunawan, 2011).

In this context, interaction between computer users via a network becomes an important need. One form of computer network implementation used is LAN. LAN is a type of network that has limited coverage in a local area or distance (Putu et al., 2019), where hardware and software are used together to communicate in a limited area. LANs are generally built for office purposes, educational institutions, or for departments within a company.

Although the use of LAN provides advantages in sharing resources, sometimes some problems arise related to its use. These problems include a lack of effective management, inadequate security configurations (Rahmat et al., 2022), as well as problems in communication and data transmission within the network, especially if the number of connected users is large enough. This can cause a decrease in network speed, especially as performance related to data communications within the network increases.

Implementing LAN (Local Area Network) management (Yugianus et al., 2021) can be done by using a Virtual Local Area Network (VLAN) to manage and divide the network into separate segments. Network segmentation using VLANs is carried out by grouping the network into several virtual network groups and providing logical addressing with subnetting to regulate the number of hosts in one network. This is done by utilizing switches that can be managed as key components of the LAN network. Apart from that, the use of VLANs can also increase network flexibility (Noviani, 2020)

Thus, network administrators can more easily control and secure access, as well as optimize the overall performance of the network. This aligns with the views expressed in the journal by (Hartono et al., 2023), which highlight how VLAN technology supports better network segmentation and management, improving not only performance but also security. By logically separating networks, administrators can isolate critical areas, monitor traffic, and respond more effectively to any issues that may arise, thereby reducing downtime and enhancing operational efficiency.

Including in the educational context at Vocational High School Gedangan to support the efficiency of teaching and learning activities and smooth school operations, the implementation of VLAN in the school environment is very important because it provides network management capabilities based on functional and administrative needs. Vocational High School Gedangan can utilize VLAN to separate the network into several network segments, such as student, teacher, administrative staff and network device segments.

The implementation of VLAN at SMKN 1 Gedangan is not just a technical step, but also has a significant impact on the school's operational efficiency and student learning experience. By separating network traffic, schools can increase data security, reduce network congestion (Fathul, 2020), and increase flexibility in adapting to future network needs. However, implementing VLANs is not simple and requires careful planning and a deep understanding of school network needs.

Based on the description above, research was conducted at the Gedangan 1 State Vocational High School regarding intranet network optimization using VLAN, the benefits of its implementation, effective implementation strategies, and the challenges faced during the implementation process. Therefore, this research is entitled "Intranet Network Optimization Using VLAN at Vocational High School Gedangan".

Method

This research applies a qualitative descriptive approach. Qualitative research is a research method that involves an evaluation process to produce descriptive data in the form of written or spoken words that describe people's views and observed behavior. In this approach, researchers interpret and explain data obtained from interviews, observations and documentation to obtain a detailed and clear understanding of the problem under study. (Aziza, 2017). This research method aims to investigate intranet network optimization using a Virtual Local Area Network (VLAN) to monitor online users and connected devices, as well as to expand the network and increase the efficiency of using IP addresses at the Vocational High School Gedangan, Malang Regency. The data collection methods used were observation and interviews. The observation method is one of the techniques used in research to collect data by observing activities directly, while the interview method is an essential technique for obtaining in-depth data from the perspective of subjects relevant to the research topic by conducting direct interaction between researchers and respondents. This method provides a comprehensive framework for conducting research on optimizing intranet networks using VLAN, with the hope of providing valuable insights for future network development.

Result

a. Network Address Translation (NAT)

Network Address Translation (NAT) is a firewall feature on the Mikrotik router which functions to translate the source IP address of data packets. This feature changes the sender's IP address of a data packet to allow communication between the local network (private) and the internet network (public). In other words, NAT on the Mikrotik router functions as a gateway that connects and manages data traffic between the internal and external networks, ensuring that devices on the private network can access and communicate with the public network (Salim et al., 2023).

b. DHCP Server

Dynamic Host Control Protocol (DHCP) is an internet protocol whose job is to distribute TCP/IP information directly to connected computers and uses the TCP/IP protocol. DHCP evolved from Bootstrap Protocol (BOOTP) and offers the advantage of automatic allocation of various network addresses connected to each other. DHCP has two main functions. First, DHCP functions as a persistent store of network parameters for clients, storing key-values which are unique identifiers for each client computer and contain configuration parameters. This unique identifier is in the form of an IP subnet number. The second function of DHCP is as an IP address allocator for clients, either temporarily or permanently. The DHCP mechanism prevents the reallocation of previously assigned addresses, avoiding sending the same address every time a client requests an address from the DHCP Server. Therefore, DHCP will not send the same IP address to more than one device on the network at the same time, even if the device is restarted many times (Medianto, 2020).

c. VLAN

The working principles of LAN (Local Area Network) networks (Ar-Rasyid et al., 2024) is that all devices in one LAN are in one broadcast domain. In this broadcast domain, if one device sends a broadcast frame, all other devices on the LAN will receive a copy of the frame. Without a VLAN, the switch considers all its ports to be in one broadcast domain, so that all computers connected to the switch are on the same LAN. However, with VLAN technology, switches can group some ports into one broadcast domain and other ports into different broadcast domains, creating multiple broadcast domains. According to (Riyantana et al., 2024) each broadcast domain created by this switch is called a Virtual LAN (VLAN) or Virtual Local Area Network (VLAN)

1. Access Port

A port on a switch that has been configured to have a single VLAN only can pass through it is called an Access Port.

2. VLAN Trunking

VLAN Trunk is a point-to-point connection between one or more interfaces of an Ethernet network device such as a router or switch (Revansa et al., 2022). When using multiple VLAN in a network that has multiple switches connected to each other, the switches must implement VLAN trunking on the segments that connect one switch to another switch. VLAN trunking involves a process called VLAN tagging, where a switch sending data to another switch will add headers to the frame before sending it over the trunk. This additional header contains a VLAN identifier (VLAN ID), which allows the sending switch to tag sent frames with a specific VLAN ID. In this way, the receiving switch can know that the frame it receives is intended for a specific VLAN.

3. Default VLAN

The default VLAN (such as VLAN 1 on Cisco devices) is the default VLAN where all ports on the switch are automatically part of this VLAN. This causes all ports on the switch to receive the same broadcast domain, making a switch with this configuration act as a normal unmanageable switch. The default VLAN has all the characteristics of other VLAN, but it is not possible to rename it or delete it (Nukman et al., 2023)

The benefits of implementing a Virtual Local Area Network (VLAN) include:

● Improve computer network performance by filtering unnecessary packets/data.
● Provides flexibility in computer network design, allowing members to move locations without needing to replace hardware, just by configuring the software.
● Changing VLAN does not require additional installation costs.
● Improve network security by managing user access to applications based on access lists (Revansa Elimanafe, Yohanes Suban Belutowe, and Petrus Katemba 2022).

Here are the steps in Optimizing an Intranet Network Using VLAN:

1. Open the Winbox application on a laptop or PC connected to the internet then log in to the network system by entering the user and password.

Figure 1. Login Page
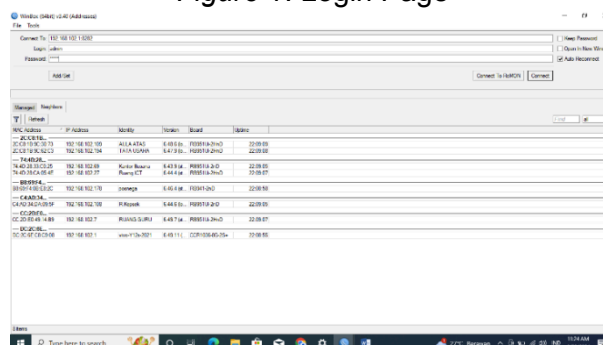
2. Open the IP menu, select DHCP Client from the server to obtain the IP configuration automatically.
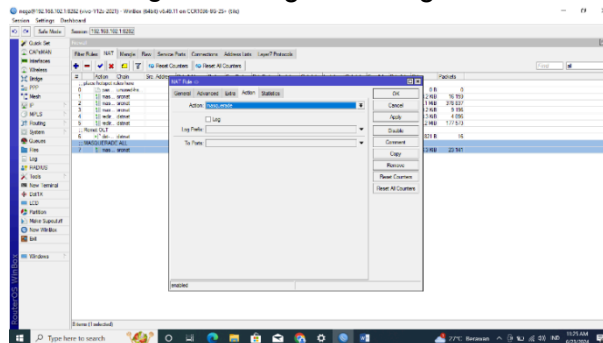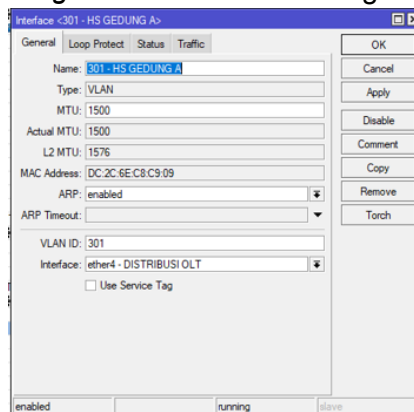
Figure 2. DHCP Client Page
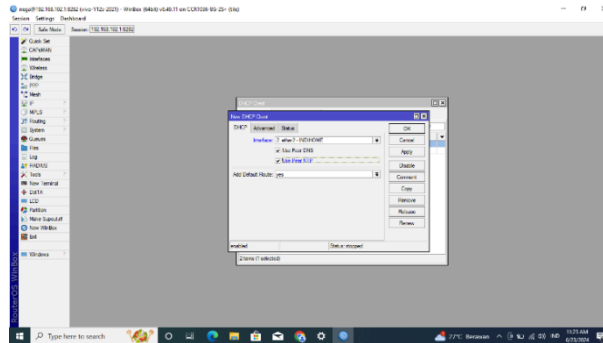
3. Open the IP menu, select Firewall then NAT on Chain = SCRNAT and Action = Masquerade to manage network traffic.

Figure 3. Page Creating NAT

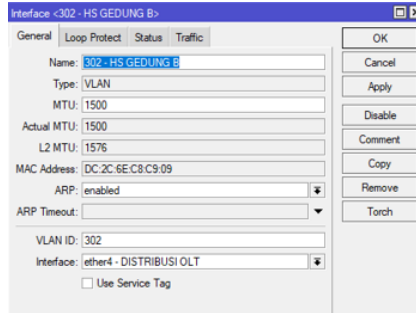4. Create VLAN ID 301 for Router A on Ethernet interface 2 as internet distribution or network.

Figure 4. VLAN ID Building A

5. Create VLAN ID 302 for router B on the Ethernet 2 interface as internet distribution or network.
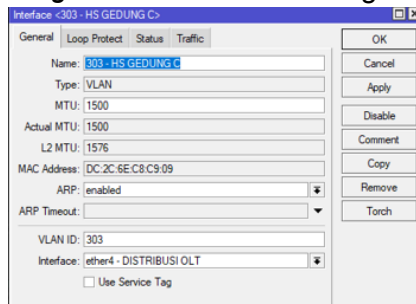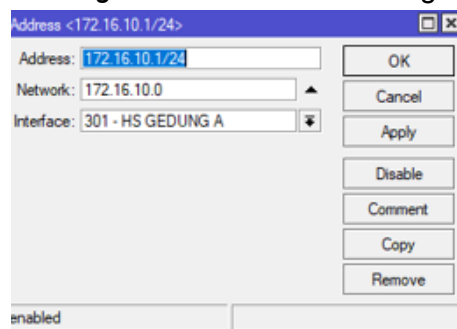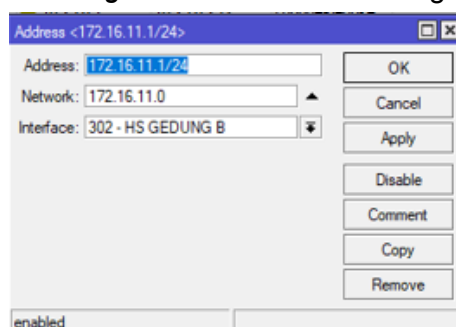
Figure 5. VLAN ID Building B

6. Create VLAN ID 303 for router C on the Ethernet 2 interface as internet distribution or network.

Figure 6. VLAN ID Building C

7. Create an IP Addres VLAN ID 301 : 182.16.10.1/24

Figure 7. IP Addres Building A

8. Create an Addres VLAN ID 302 : 182.16.11.1/24

Figure 8. IP Addres Building B

9. Create an Addres VLAN ID 303 : 182.16.12.1/24

Figure 9. IP Addres Building C
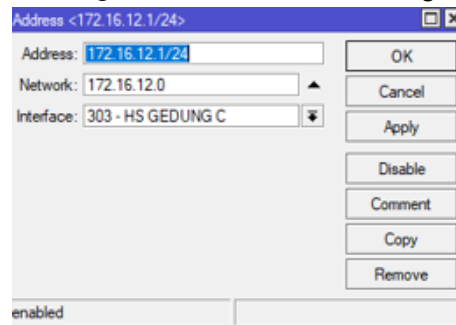
10. Create a DHCP server from the IP Address of building A which is already running on VLAN.

*Figure 10*. DHCP Server from IP Addres Building A
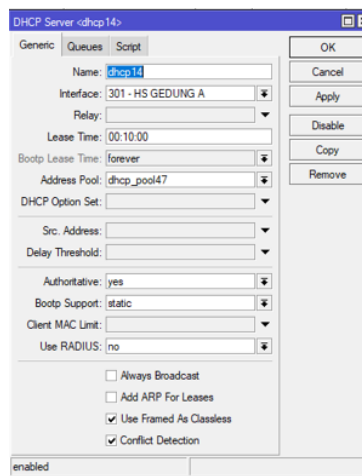
11. Create a DHCP server from the IP Address of building B which is already running on VLAN.

Figure 11. DHCP Server from IP Addres Building B
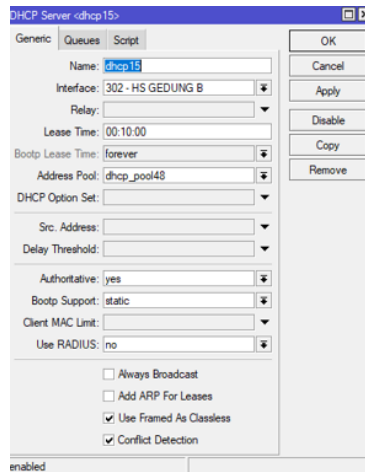
12. Create a DHCP server from the IP Address of building B which is already running on VLAN

Figure 12. DHCP Server from IP Addres Building C
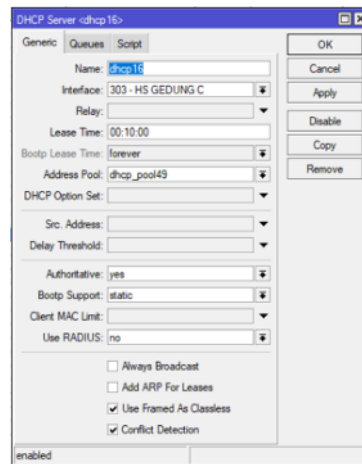
13. Open Google Chrome then type 192.168.90.2:8482 then enter your username and password.

Figure 13. Page OLT HSGQ
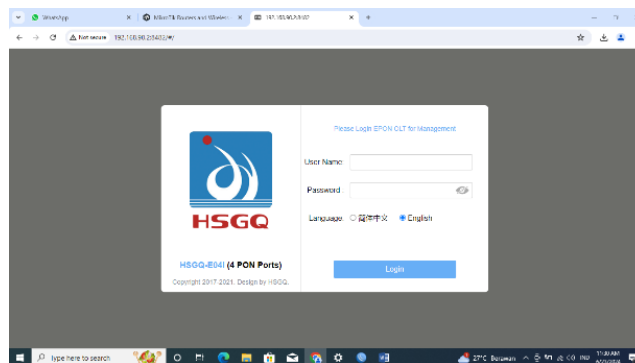
14. Create VLAN ID 301 on the VLAN page then tagged PON 1 – PON 4 and GE01.

Figure 14. VLAN ID 301

15. Create VLAN ID 302 on the VLAN page then tagged PON 1 – PON 4 and GE01.

Figure 15. VLAN ID 302

16. Create VLAN ID 303 on the VLAN page then tagged PON 1 – PON 4 and GE01.

Figure 16. VLAN ID 303

17. Login to the RouterBoard class by entering your username and password.

Figure 17. Page Login to Winbox
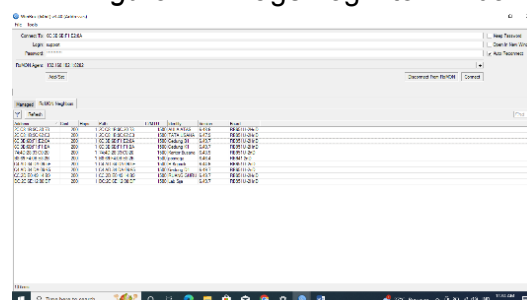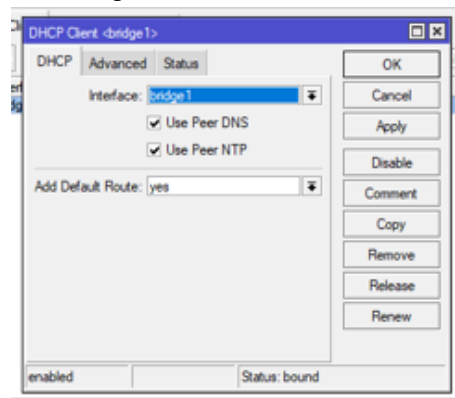
18. Setting bridge configurations to combine several networks into one.
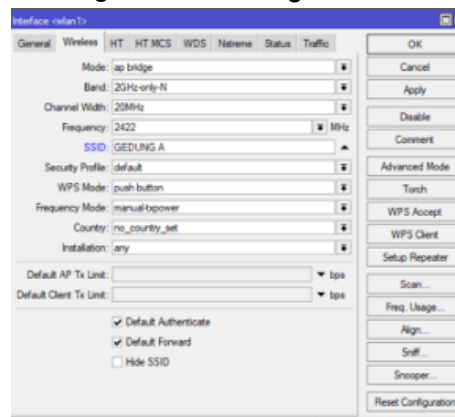
Figure 18. Configuration Bridge
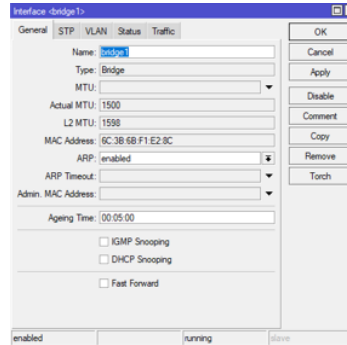
19. Configure DHCP client requests to the router server.

Figure 19. DHCP Client

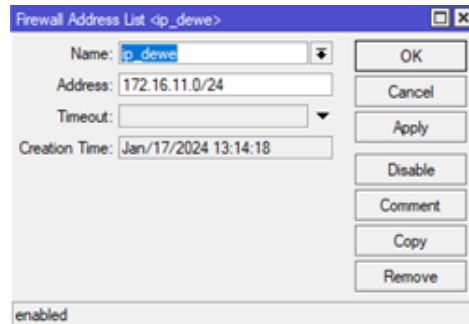20. Configure wireless access points to distribute the network wirelessly.
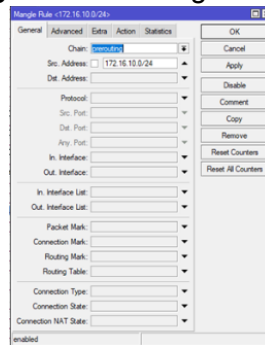
Figure 20. Configuration Wireless

21. Addresslist settings to register IP addresses for routing to mangle to route network traffic.
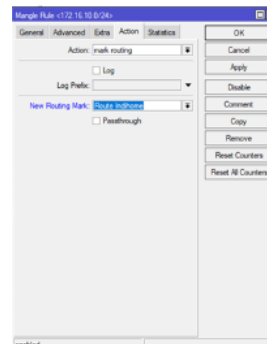
Figure 21. Setting Adress

22. Mangle firewall settings to manage and optimize data flow in the network

Figure 22. Setting Firewall

23. Add an internet connection via IP Address settings

Figure 23. Added Internet Line

Discussion

Optimizing intranet networks requires the deployment of a Virtual Local Area Network (VLAN), particularly in establishments such as Vocational High School Gedangan. VLAN improves performance and security by segmenting the network into smaller parts, separating traffic, cutting down on pointless data packet transfer, and guaranteeing resource efficiency. By facilitating smooth communication between private and public networks and automating IP address distribution, features like Network Address Translation (NAT) and Dynamic Host Control Protocol (DHCP) further simplify network administration. Additionally, this segmentation offers network design flexibility, making it simple to adjust to changing needs

without having to pay large additional expenses. Implementing a VLAN in a school environment guarantees efficient operations, facilitates the teaching-learning process, and makes managing different network segments—such as administrative personnel, instructors, and students—simpler.

However, effective administration and planning are essential to the adoption of VLANs. To optimize the advantages, difficulties including comprehending network needs, setting up VLAN trunks, and fixing security flaws must be properly handled. Network managers may now efficiently manage many VLANs across a single infrastructure thanks to the emergence of technologies like VLAN trunking and tagging, which enhance inter-switch communication. Furthermore, effective network traffic management inside their respective domains is ensured by the use of access ports and default VLANs. This study shows that Vocational High School Gedangan can better handle future network needs by deploying VLAN, which not only maximizes current network resources but also creates a foundation for scalability.

Conclusion

Network management becomes very important when the number of network users exceeds 1000 users plus network devices spread across various classes is very important to manage the network optimally. This management includes selecting good network devices, connecting from a stable provider, managing IP and bandwidth distribution according to needs and using VLANs as a final strategy. Bandwidth management is a tool that can be used to manage and optimize various types of networks by implementing Quality of Services (QoS) services to determine types of network traffic. The use of VLANs can increase efficiency network management, Virtual Local Area Network (VLAN) can make network settings centralized and structured, making it easier to manage and monitor all activities that occur in the network.

Before using VLANs, the main challenge faced by network administrators was monitoring the number of active users on a device while the maximum capacity of the device was not always known. This can lead to overloading the device with users and excessive bandwidth, which in turn slows down the internet connection. With VLANs, network administrators can easily identify the number of users connected to each device so that if the bandwidth and number of users approach the maximum limit, redistribution can be carried out to other devices or VLANs to maintain optimal network performance and network administrators can also divide network traffic based on function. without the need to make changes to the physical structure of the existing network.

Acknowledgements

Reference

Ar-Rasyid, Harun, Satrio Broto, and Windy Artika. 2024. "Optimasi Infrastruktur Jaringan Vlan Trunking Protocol Menggunakan Simulasi Packet Tracer Pada Pt. Rukun Sejahtera Teknik." *Jeis: Jurnal Elektro Dan Informatika Swadharma* 4(1): 39–46. doi: 10.56486/jeis.vol4no1.422.

Aziza, Nur. 2017. "Jenis Dan Pendekatan Penelitian Penelitian." *Metode Penelitian Kualitatif* (17): 45–54.

Fathul. 2020. "Implementasi Paessler Router Traffic Grapher Untuk Monitoring Jaringan Di

Pt Implementasi Paessler Router Traffic." 2(1–61): 1–2.

Ferdian Bagas Cahyono, Wiwin Sulistyo. 2023. "View of Analisa Perbadingan QoS Menggunakan Metode Simple Queue Dan Metode Queue Tree Pada Hierechical Network Design Di Sekolah Dasar Negeri 2 Kelet.Pdf."

Hestomo, Ciptoning, and Irwan P Gunawan. *Optimalisasi Jaringan PT Berau Coal*.

Maulana, *, Ali Waliyadin, Maulana Ali Waliyadin, Hendra Supendar, and Riza Fahlapi. 2023. "Implementasi Jaringan Internet Dengan Teknologi Gpon Menggunakan Vlan Pada Pt Quantum Tera Network." 1(4): 10–21. https://doi.org/10.59841/saber.v1i4.320.

Medianto. 2020. "Analisis Keamanan Jaringan Local Area Network Yang Menggunakan DHCP Server Berbasis Cisco Dengan Metode Penetration Testing." : 100–124.

Noviani, Yulia Dwi. 2020. "Analisis Pengembangan Virtual Local Area Network (VLAN) Di SMK Asy-Syarifiy Pandanwangi-Lumajang." 02: 61–66.

Nukman, Nukman, Muhammad Khulaimi, and Muhamad Taqiudin. 2023. "Pelatihan Jaringan VLAN Menggunakan Mikrotik Di SMK Darussholihin NW Kalijaga." *Jompa Abdi: Jurnal Pengabdian Masyarakat* 2(2): 157–63. doi:10.57218/jompaabdi.v2i2.671.

Putu, I, Agus Eka Pratama, Putu Adhika Dharmesta, and Teknologi Informasi. 2019. "Implementasi Wireshark Dalam Melakukan Pemantauan Protocol Jaringan (Studi Kasus : Intranet Jurusan Teknologi Informasi Universitas Udayana)." *Jurnal Mantik Penusa* 3(1): 94.

Rahmat, Rahmat, Rita Wiji Wahyuningrum, Edi Haerullah, and Sodikin Sodikin. 2022. "Analisis Monitoring Sistem Jaringan Komputer Menggunakan Aplikasi Spiceworks." *PROSISKO: Jurnal Pengembangan Riset dan Observasi Sistem Komputer* 9(1): 44–52. doi:10.30656/prosisko.v9i1.4671.

Revansa, Yohanes Suban Belutowe, and Petrus Katemba. 2022. "Perancangan Jaringan Virtual Local Area Network (Vlan) Untuk Menunjang Transaksi Data Antar Jaringan." *Jurnal Teknologi Informasi* 6(1): 102–11.

Riyantana, I Komang Wahyu Shefi, Pande Putu Gede Putra Pertama, I Made Sudarsana. 2024. "View of Optimalisasi Jaringan Internet Berbasis Mikrotik Dengan Metode VLAN Di Kelurahan Kapal Mengwi Badung.Pdf."

Salim, Agus, Galih Surono, Enggar Bagoes Pabelan, Achmad Raizaldi, and Kata Kunci. 2023. "Penerapan Load Balancing Metode Per Connection Classifier Berbasis Router Mikrotik Di PT . Asuransi Jiwa Nasional." : 33–42.

Yugianus, Pausta, Yasir Arafat, and Tri Bowo Atmojo. 2021. "Optimalisasi Infrastruktur Local Area Network Dalam Upaya Mendukung Proses Pembelajaran Berbasis E-Learning." *Jurnal ELIT* 2(1): 33–42. doi:10.31573/elit.v2i1.196.