|Jurnal Jaringan Komputer dan Keamanan |JJKK|Vol. 5| No. 2|June|Year 2024|
This is an Open Access article, published by Institute of Information Technology and Social Science (IITSS), Indonesia

Analysis and Design of an Enterprise Campus Area on the Hierarchical Network Infrastructure of STIK Bina Husada Palembang Based on the Cisco Enterprise Model

Wahfiyudin Alkahfi[1*], Edi Surya Negara[2], Zaid Amin[3]

Abstract

The utilization of internet-based computer networks has become a fundamental necessity for supporting human activities in the modern era. This is particularly evident in various institutional activities, especially in academic settings such as colleges and schools, which heavily rely on internet network services. However, employing a large network segment with numerous hosts leads to excessive broadcast packet traffic. This issue is further compounded when the network is a flat network that lacks functional grouping for services and devices. To address these challenges, a network migration is necessary: shifting the existing Flat Local Area Network (LAN) to a hierarchical model based on the Cisco Enterprise Model, specifically employing the Enterprise Campus Area approach. This hierarchical design divides the LAN into several network layers, establishing more efficient Broadcast Domains and dedicated service functions, resulting in a system that is more modular and well-managed. The network was designed using the Top-Down method. The resulting design blueprint for the computer network system at STIK Bina Husada Palembang is intended to serve as a reference for future network planning and development.

Keywords

Computer Network Benefits, LAN Network, Top-Down Method.

Article History
Received 21 March 2024
Accepted 25 June 2024

How to Cite
Alkahfi, W., & Negara, E.S. & Amin, Z, (2024). Analysis and Design of an Enterprise Campus Area on the Hierarchical Network Infrastructure of STIK Bina Husada Palembang Based on the Cisco Enterprise Model. ***Jurnal Jaringan Komputer dan Keamanan,*** *5*(2), 40-50.

[1*] Science Technolgy Faculty, Universitas Bina Darma, Indonesia,
Corresponding email: 171420032@student.binadarma.ac.id,
[2 3] Science Technolgy Faculty, Universitas Bina Darma, Indonesia

Introduction

Sekolah Tinggi Ilmu Kesehatan (STIK) Bina Husada Palembang is a higher education institution that focuses on delivering health science education and professional training. As an academic institution with a wide range of administrative and learning activities, the need for reliable information and communication technology (ICT) infrastructure has become increasingly essential. Daily operations—such as academic data processing, digital learning, communication between departments, and information retrieval—rely heavily on stable computer networks and internet connectivity. The institution provides internet access to students, faculty, and administrative staff through an integrated interconnection network that serves as the backbone of campus digital services.

Along with the growing number of internet users and the expansion of academic and administrative activities, STIK Bina Husada faces significant challenges in maintaining stable and well-managed network performance. The increasing demand for information access often leads to inconsistent network behavior and user access issues. Moreover, instances of improper network usage or policy violations have begun to appear, demonstrating the need for improved network control and monitoring mechanisms. As highlighted in previous studies, user growth without adequate infrastructure adjustments can result in declining service quality and increased operational inefficiency.

Currently, the campus network infrastructure consists of more than 100 client PCs distributed across various buildings and classrooms. However, the existing design operates within a large broadcast domain and lacks structured segmentation. This configuration causes inefficient traffic handling, frequent broadcast storms, and difficulty isolating network problems. A network of this scale requires systematic management to ensure optimal performance, especially considering that STIK Bina Husada's buildings are physically separate and interconnected through campus-wide wiring.

To address these challenges, a scalable and efficient network architecture is needed—one that can support the institution's operational requirements while preventing congestion and ensuring long-term reliability. Hierarchical network design, a widely adopted approach in enterprise networking, offers a model capable of organizing the network into manageable layers, thus reducing complexity and improving performance. The hierarchical model also strengthens network security and enhances troubleshooting efficiency by allowing segmentation and distribution of network roles.

In this study, the Cisco Enterprise Architecture Model, specifically the Enterprise Campus Area Design, is proposed as the foundation for redesigning the computer network at STIK Bina Husada Palembang. This architecture divides the network into distinct functional layers—core, distribution, and access—allowing for improved traffic flow, enhanced scalability, and consistent policy enforcement throughout the campus. By leveraging Cisco's structured design principles, the redesigned network is expected to accommodate future growth while maintaining high levels of performance and security.

To validate the proposed design, the study employs Cisco Packet Tracer as a simulation platform. Packet Tracer enables visualization, testing, and evaluation of the hierarchical topology before real-world implementation. Through simulation, various scenarios can be analyzed, including device configurations, routing behavior, redundancy management, and inter-building connectivity. This approach ensures that the proposed design is not only theoretically sound but also practically feasible for deployment within STIK Bina Husada Palembang. The ultimate goal is to produce a reliable, efficient, and scalable network blueprint that supports the institution's ongoing digital transformation and academic advancement.

Research Methodology

Research Methods

The data collection methods employed in this study included:

1. Observation: The author conducted direct field observations to acquire explicit data pertinent to the research.
2. Interview: Interviews were performed with the IT Administrator at STIK Bina Husada Palembang to gather information related to the research topic.
3. Literature Review: The author compiled research-related data and information from textbooks, journals, and other reading materials to be used as a reference or guideline.

System Development Method

The system development methodology used in this research is the Top-Down Design approach. According to Oppenheimer (2011), the top-down method is a computer network system development approach that is fundamentally user-needs-oriented. This approach aims to achieve user requirements and objectives more efficiently and effectively. Top-Down Network Design is an essential discipline that integrates elements of systems analysis and engineering to model network requirements and implementation.

The primary objective of employing this methodology and topology is to partition a project into sub-sections to facilitate easier replacement and maintenance. The Top-Down Network Design process is segmented into four distinct steps:

1. Problem Analysis: This phase involves interviewing users to comprehend the underlying business processes and establish clear goals for the new system.
2. Logical Network Design: The Network Analyst creates the logical topology for the new network system.
3. Physical Network Design: The Network Analyst selects the appropriate technologies and hardware components for implementation.
4. Testing, Optimization, and Network Design Documentation: The final step in Top-Down Network Design is the implementation of the designed network.

Results

Logical Network Design

A logical network focuses exclusively on logical connectivity and does not consider physical support elements, such as the length of the cables used. A critical step in logical network design is selecting the appropriate topology, as the topology determines the physical relationships between network devices. The network topology chosen for the STIK Bina Husada Palembang computer network is the Star topology. The logical network provides a conceptual illustration of the final network architecture.

During a direct inspection of the existing computer network at STIK Bina Husada Palembang and subsequent interviews with the IT department, the author inquired about the computer network infrastructure devices used in each respective section. The figure below (Figure 1. Logical Network Design) illustrates the new logical network design developed by the author for the STIK Bina Husada Palembang network infrastructure.

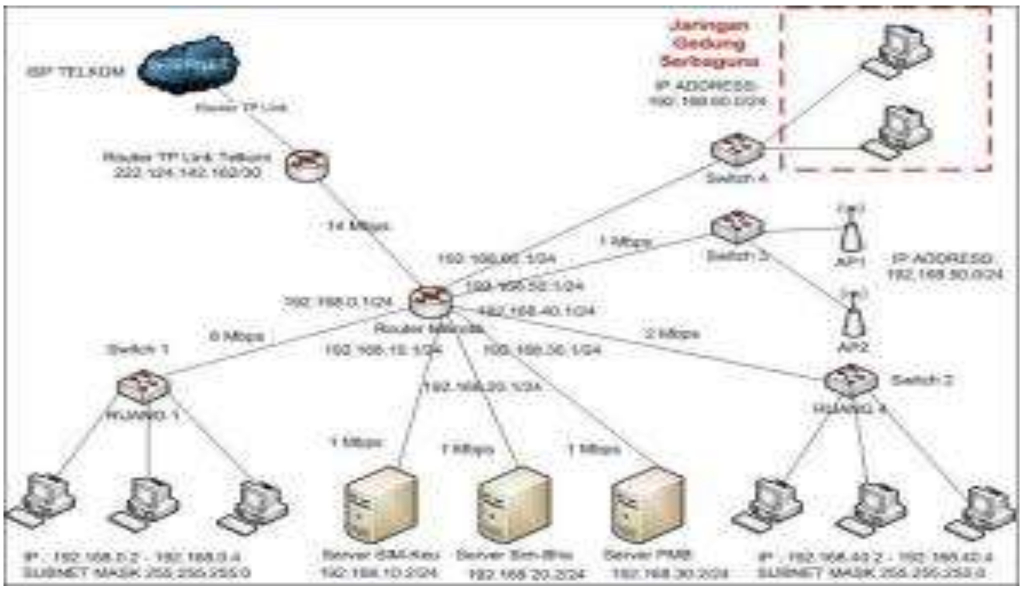

Figure 1. Logical Network Design

In this stage, the author performed several steps to design the logical computer network for STIK Bina Husada Palembang.

IP Address Design and Naming

First, the author designed the IP Address scheme and naming convention for each device in the new STIK Bina Husada Palembang computer network. The planned IP Address design to be used during the testing phase is presented in Table 1.

Table 1. IP Address Design

DEVICE	INTERFACE	IP ADDRESS	SUBNET MASK	DEFAULT GATEWAY
Router TP Link Telkom	Fa0/1	222.124.142.163	255.255.255.0	-
Router TP Link Telkom	Fa0/0	192.168.100.1	255.255.255.0	222.124.142.163
Router Mikrotik	Gig/0/0	192.168.100.2	255.255.255.0	222.124.142.163
Router Mikrotik	Gig/1/0	192.168.0.1	255.255.255.0	192.18.100.2
Router Mikrotik	Gig/4/0	192.168.10.1	255.255.255.0	192.18.100.2
Router Mikrotik	Gig/5/0	192.168.20.1	255.255.255.0	192.18.100.2
Router Mikrotik	Gig/6/0	192.168.30.1	255.255.255.0	192.18.100.2
Router Mikrotik	Gig/7/0	192.168.40.1	255.255.255.0	192.18.100.2
Router Mikrotik	Gig/8/0	192.168.50.1	255.255.255.0	192.18.100.2
Router Mikrotik	Gig/9/0	192.168.60.1	255.255.255.0	192.18.100.2
Wireless AP 1	Fa0/2	192.168.50.2	255.255.255.0	192.168.50.1
Wireless AP 2	Fa0/3	192.168.50.3	255.255.255.0	192.168.50.1
OFFICE				
PC 0	Fa0	192.168.0.2	255.255.255.0	192.18.0.1
PC 1	Fa0	192.168.0.3	255.255.255.0	192.18.0.1
PC 2	Fa0	192.168.0.4	255.255.255.0	192.18.0.1
Server SIM-Keu				
Server SIM-Keu	Fa0	192.168.10.2	255.255.255.0	192.18.10.1
Server SIM-Bha				
Server SIM-Bha	Fa0	192.168.20.2	255.255.255.0	192.18.20.1
Server PMB				
Server PMB	Fa0/1	192.168.30.2	255.255.255.0	192.18.30.1
Bagian Umum				
PC 3	Fa0	192.168.40.2	255.255.255.0	192.18.40.1
PC 4	Fa0	192.168.40.3	255.255.255.0	192.18.40.1
PC 5	Fa0	192.168.40.4	255.255.255.0	192.18.40.1
Bagian Gedung Serba Guna				
PC 6	Fa0	192.168.60.2	255.255.255.0	192.18.60.1
PC 7	Fa0	192.168.60.3	255.255.255.0	192.18.60.1

Configuration was performed for each segment by assigning IP Addresses to the Servers, PCs, laptops, and smartphones, ensuring that all components connected via cable or wireless could easily communicate with one another. The configuration for assigning the IP Address to the TP Link Telkom Router is shown, as it serves as the gateway directly connected to the Internet.

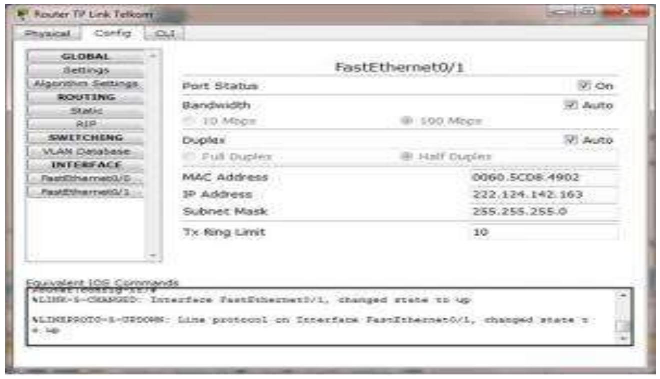

Figure 2. Assigning IP addresses to TP Link Telkom Routers

Figure 2 shows the IP address assignment for the TP Link Telkom Router, where IP address 222.124.142.163/24 is entered, with the default gateway pointing to the Telkom Provider.

Figure 3. Assigning the IP address to the TP Link Router Interface fa0/0

Figure 3 illustrates the IP address assignment for the TP Link Router's Fa0/0 interface with the IP address 192.168.100.1/24.

Figure 4. Assigning the Mikrotik Router IP address to the Gig0/0 interface

Next, the author performed the configuration on the Mikrotik Router's Gig0/0 interface. Figure 4 shows the Mikrotik Router configuration by entering the IP address 192.168.100.2/24.

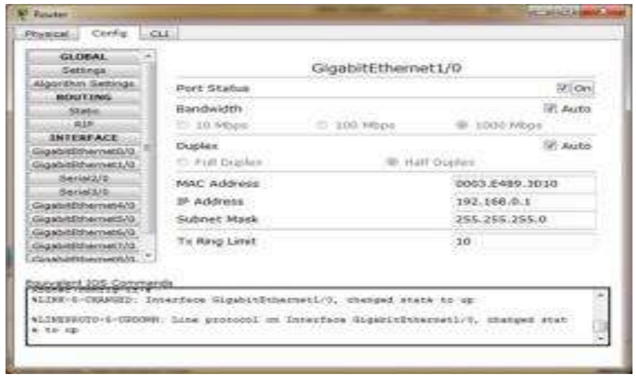

Figure 5. Assigning the Mikrotik Router IP address to the Gig1/0 interface

Subsequently, the author performed the configuration on the Mikrotik Router's Gig1/0 interface. Figure 5 shows the Mikrotik Router configuration by entering the IP address 192.168.0.1/24.

Figure 6. Assigning the Mikrotik Router IP address to the Gig4/0 interface

The configuration for the Mikrotik Router's Gig4/0 interface was then performed , as shown in Figure 6.

Web Server Design on the SIM-PMB Server

Following the IP configuration steps for all device interfaces, the author configured the PMB Server (New Student Admissions Server) to provide Web Server functionality and HTML coding. This configuration is designed to display the STIK Bina Husada website to all PCs, laptops, and smartphones using the domain name www.stikbinahusada.com and the IP address 192.168.30.2/24. The configuration steps are shown in Figure 7.

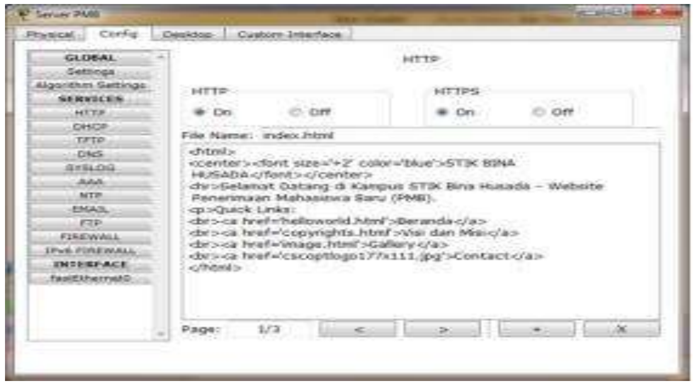

Figure 7. Assigning an IP address to the PMB Server (Web Server)

After configuring the Web Server and the HTML coding, the next step is to set up the DNS Server configuration to map the IP address 192.168.30.2 to the domain name www.stikbinahusada.com. The configuration steps are shown in Figure 8.

Figure 8 Assigning an IP address to the PMB Server (Web Server)

Design of OSPF Routing Protocol Configuration with Bandwidth Allocation According to the Designed Topology

After configuring the DNS Server, the next step is to implement the OSPF (Open Shortest Path First) routing protocol configuration on the STIK Bina Husada computer network. Following the OSPF configuration, the subsequent step is to implement the OSPF bandwidth configuration according to the design plan for the STIK Bina Husada computer network.

STIK Bina Husada Network Topology Design

In this stage, the author recommends a new computer network topology for the STIK Bina Husada network, based on the planning conducted in the preceding phases. The designed topology is shown in Figure 9. New STIK Bina Husada Network Topology Design.

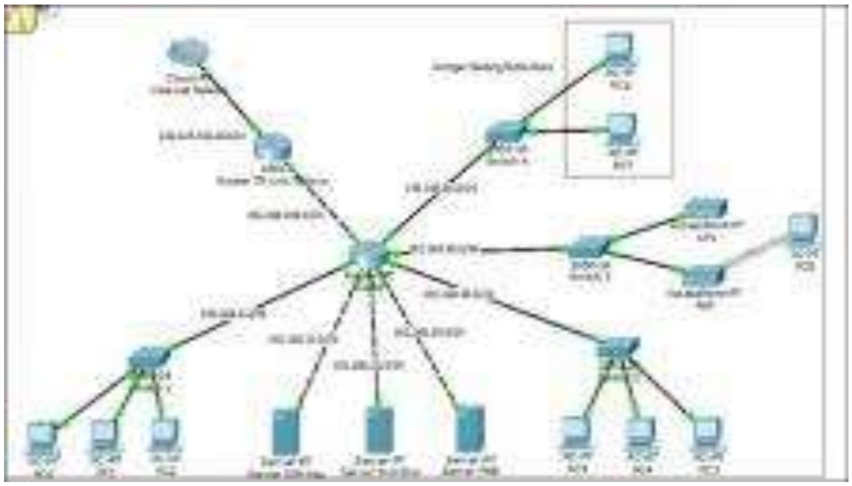

Figure 9. New STIK Bina Husada Network Topology Design

Testing

After creating the new STIK Bina Husada network design, the final phase of this research involves testing the network design using Cisco Packet Tracer for network simulation.

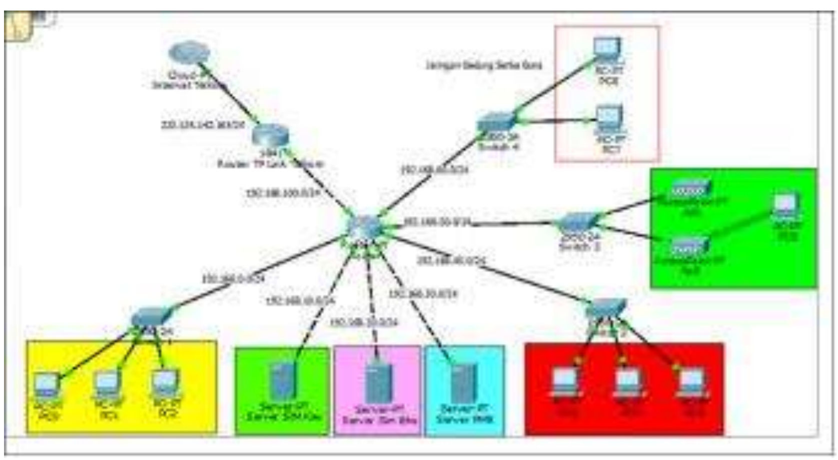

Figure 10. Testing Simulation Design

Figure 10 illustrates the simulation design of the STIK Bina Husada network topology, which aims to simulate the LAN (Local Area Network). In the topology, the author placed 7 client segments: PC0-PC2, Server Room, PC3-PC5, Wi-Fi Access Point, and Multipurpose Room.

Conclusion and Recommendations

As the conclusion of this thesis, the author draws several conclusions based on the discussion presented in the previous chapters:

1. The analysis of the STIK Bina Husada Palembang computer network infrastructure identified various types of network devices and topologies, existing constraints, and a plan for developing the routing protocols for the current infrastructure.
2. A suitable computer network infrastructure design for the STIK Bina Husada Palembang system was successfully developed.

References

Ariantoro, T. R. (2017). Implementation of the Top-Down Design Method in Computer Networks at STIK Bina Husada. JUTIM (Journal of Informatics Engineering Musirawas), 2(1).

Aslah, T. Y., Wowor, H. F., & others. (2017). Design of 3D Animation for Cultural Tourism Object: Watu Pinawetengan Museum. Journal of Informatics Engineering, 11(1).

Basuni, S., & Kusmindari, D. C. (2020). Decision-Making Analysis for Purchasing Daihatsu Vehicles Using the Analytical Hierarchy Process. Bina Darma Conference on Engineering Science.

Buchari, M. Z., Sentinuwo, S. R., & Lantang, O. A. (2015). Development of 3D Animation Video for Vehicle Testing Mechanism at the Department of Transportation, Culture, Tourism, Communication, and Information. Journal of Informatics Engineering, 6(1).

Cisco. (2014, May 9). Cisco Press. Retrieved March 01, 2021, from Cisco Press

Christianto, A. (2012). Analysis and Design of VLAN (Virtual Local Area Network) at LPPT-UGM. Amikom School of Informatics and Computer Management, Yogyakarta.

Garc, D. J., & Guitart, V. E. (2019). Economic Valuation of Ecosystem Services Using the Analytic Hierarchy Process and Analytic Network Process: A Comparative Analysis in Albufera Natural Park, Valencia (Spain). International Journal of Design & Nature and Ecodynamics.

Irwansyah. (2019). Implementation of OSPF (Open Shortest Path First) Dynamic Routing on Frame Relay Network Mapping. Matrik Scientific Journal, Bina Darma University.

Khan, A. U. (2020). Analytical Hierarchy Process (AHP) and Analytic Network Process Methods and Their Applications: A Twenty-Year Review (2000–2019). International Journal of the Analytic Hierarchy Process.

Lin, F., Lin, S. W., & Lu, W. M. (2018). Sustainability Assessment of Taiwan's Semiconductor Industry: A Hybrid Model Combining AHP and Two-Stage Additive Network DEA. MDPI Sustainability Journal.

Prihartini, & Fatoni. (2019). Structural Analysis and Network Development at the Department of Energy and Mineral Resources, South Sumatra. Vocational Research Results Seminar (SEMHAVOK).

Rasmila, Saksono, P. H., Mukti, A. R., & Diana. (2020). Application of Token Bucket Queueing Technique in Internet Bandwidth Management. Vocational Research Results Seminar (SEMHAVOK).

Riady, A., & Mukthi, A. R. (2021). Bandwidth Management Implementation Using Hierarchical Token Bucket at PT. Bukit Energi Servis Terpadu. Journal of Information System and Informatics Development.

Sevinc, A., Giir, S., & Eren, T. (2020). Analysis of SMEs' Challenges in Industry 4.0 Applications Using AHP and ANP Methods. MDPI Processes Journal.

Shin, J., You, I., & Seo, J. T. (2020). Investment Priority Analysis of ICS Information Security Resources in Smart Mobile IoT Networks Using the Analytic Hierarchy Process. Hindawi Journal.