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Green Information Technology Infrastructure Design in Jasdam II Sriwijaya Palembang

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Abstract

In the increasingly developing digital era, the need for reliable and environmentally friendly network infrastructure is very important. Jasdam II Sriwijaya Palembang faces challenges in delivering information quickly and efficiently through wireless networks that are currently experiencing problems, such as less than optimal topology selection, inappropriate device placement, and non-centralized infrastructure design. These conditions not only hinder communication between regions, but also have the potential to increase inefficient energy consumption and have a negative impact on the environment. This study proposes a design for infrastructure improvement by integrating Green Information Technology (Green IT) principles through the application of the Network Development Life Cycle (NDLC) method. The proposed design not only aims to improve network performance and reliability, but also to optimize energy use by implementing energy-efficient devices, efficient topology arrangements, and carbon emission reduction strategies. Through prototyping simulations, evaluation of network performance and energy efficiency is carried out to ensure that the resulting design is able to support operational needs while maintaining environmental sustainability.

Keywords: *Infrastructure, NDLC, Green Information Technology.*

1. Introduction

The problems found by Jasdam II Sriwijaya Palembang require good infrastructure facilities to support the process of data mobilization and communication. The main office, soccer field area, & training hall are the targets of this study because there are problems in terms of topology selection, backup technology and errors in selecting the location of the device so that there is information that should arrive on time but is still delayed or even not delivered & the design of the infrastructure itself is still not centralized which means that if there is a problem at the main network location, the 3 points have no internet connection at all and the delivery of information is increasingly hampered, therefore the maintenance team must go directly to the field to make repairs.

From the existing problems, it is necessary to design Green information technology infrastructure [1],[2] in Jasdam II Sriwijaya Palembang. This infrastructure design is made using the NDLC (Network Development Life Cycle) method.[3] NDLC is a structured methodology used to develop, implement, and maintain computer networks. NDLC provides step-by-step guidance to ensure that networks are built, implemented [4], and managed efficiently and effectively. This study also uses a model used to build network infrastructure to be simpler, more reliable, measurable, easy to understand and environmentally friendly with a Green Information Technology approach [5], [6], [7]. So that it is hoped that the research that has been done can produce good network quality and reduce the impact on the environment [8].

2. Literature Review

Green information technology is the answer to the problem of reducing carbon emissions that will affect the environment. A new strategy to reduce IT system energy usage and electricity waste is called "green information technology. There are 4 approaches taken in the Green IT concept, namely. [9]

1. Green Use Minimizes electricity consumption on computer devices in an environmentally friendly way.
2. Green Disposal recycles unused electronic devices.
3. Green Design Designing energy-efficient computers, servers, and other digital devices.
4. Green Manufacturing Minimizes waste during the computer manufacturing process and reduces the impact on the environment.

The above explanation of the ideas and implementation of the movement known as “Green Computing/Green Information Technology,” also known as “Green Design, Green Use, Green Strategy and Policy, and Green Disposal,” will lead to more economical and efficient use of electrical energy and reduce environmental damage.

3. Research Methods

The NDLC method is a systematic framework that guides the process of network development and evaluation from the planning stage to post-implementation management. The application of NDLC in this study not only aims to build an optimal network, but also ensures that each stage is thoroughly evaluated before proceeding to the next phase. The NDLC method is based on previous development procedures such as data distribution analysis, application development life cycle, and business strategy planning.[10]

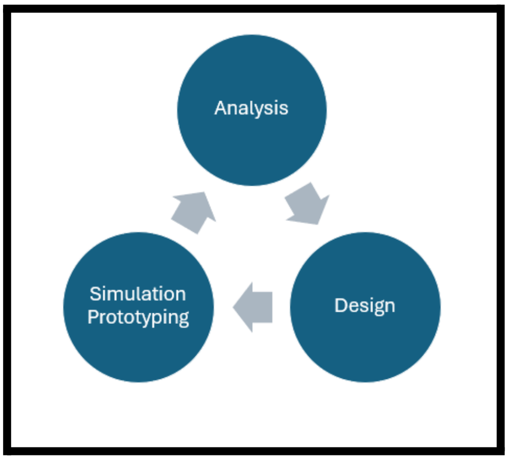

Fig. 1: Network Development Life Cycle Method

Analiysis, The analysis of the current wireless network infrastructure condition includes measuring signal performance through field surveys to create coverage maps, identifying physical obstacles and interference, and evaluating the specifications and technologies of the devices used. The study also highlights the importance of energy efficiency and reducing environmental impact by integrating Green IT principles, such as the use of energy-efficient devices and more centralized topology planning, to ensure optimal signal distribution at all strategic points, both indoors and outdoors.

Identification of Needs and Problems: This initial stage involves data collection through field observations, and literature studies. The data collected includes the current condition of the network infrastructure, problem areas such as areas with weak signals, and user needs. The location of the area points includes some in the Main Building, Football Grandstand Building & Training Hall Building.

Table 1: Computer Specifications

No	Cpu	Socket	Motherboard	Ram	Gpu	Psu	Monitor
1.	Intel, core i3-2100	LGA1155	ATX	4Gb DDR4, SSD 256 & HDD 5400 RPM 3.5		166 WATTS	LG
2.	Intel, core i3-2100	LGA1155	ATX	4Gb DDR4, SSD 256 & HDD 5400 RPM 3.5		166 WATTS	LG
3.	Intel, core i3-2100	LGA1155	ATX	4Gb DDR4, SSD 256 & HDD 5400 RPM 3.5		166 WATTS	LG
4.	Intel, core i3-2100	LGA1155	ATX	4Gb DDR4, SSD 256 & HDD 5400 RPM 3.5		168 WATTS	LG
5.	Intel, core i3-2100	LGA1155	ATX	4Gb DDR4, SSD 256 & HDD 5400 RPM 3.5		168 WATTS	LG
6.	Intel, core i5-6600	LGA1151	ATX	8Gb DDR4, SSD 512& HDD 7200 RPM 3.5	GTX 650 Ti	278WATTS	LG
7.	Intel, core i5-6600	LGA1151	ATX	8Gb DDR4, SSD 512& HDD 7200 RPM 3.5	GTX 650 Ti	278 WATTS	LG

No	Cpu	Socket	Motherboard	Ram	Gpu	Psu	Monitor
8.	Intel, core i3-12100	LGA1700	ATX	8Gb DDR4, SSD 256& HDD 5400 RPM 3.5	AMD Radeon RX 6400	216 WATTS	LG

Table 1 contains a list of computer specifications used in the network infrastructure at Jasdam II Sriwijaya. These specifications include the type of processor, motherboard, RAM capacity, storage, GPU, power consumption (watts), and monitor used. This data is important to understand the power requirements and performance of the system used in network operations.

Table 2 Electricity Usage

Daya PC (Watt)	Jumlah PC	Lama Pemakaian per Hari (Jam)	Konsumsi per PC per Hari (kWh)	Total Konsumsi per Hari (kWh)	Biaya per Hari (Rp)
166	5	8	1,328	6,64	9.588,16
278	2	8	2,224	4,448	6.422,91
216	1	8	1,728	1,728	
					2.495,23
Total	8	8	-	12,816	18.506,30

Table 2 contains a list of computer specifications used in the network infrastructure at Jasdam II Sriwijaya. These specifications include the type of processor, motherboard, RAM capacity, storage, GPU, power consumption (watts), and monitor used. This data is important to understand the power requirements and performance of the system used in operations.

Electricity Usage, The designed network requires computer devices and networks that operate optimally with efficient power consumption. Based on the electricity usage table (Table 3.1.2), the power consumption of the computers used is quite high, with a total daily consumption reaching 12,816 kWh. This large electricity usage has an impact on high operational costs and is less environmentally friendly. Therefore, optimization steps are needed, such as:

1. Utilization of renewable energy: Using solar panels to supply power to network devices, especially access points placed outdoors.
2. Use of energy-saving devices: Use routers and switches with power-saving features.
3. Operation time management: Schedule device uptime based on operational needs to avoid energy waste.

By implementing the Green Information Technology (Green IT) concept, it is hoped that electricity use can be more efficient and environmentally friendly.

Network Topology, The network topology used in this design is designed to be able to cover all required areas with optimal performance. Here are three main points that are the focus of the design::

1. Main Building: This is the main network center that connects all communication and administration devices at Jasdam II Sriwijaya.
2. Football Tribune: This point requires a network to support communication during training and physical exams.
3. Training GOR: Used to upload health test results and communication during training activities.

The topology used is Hybrid Topology, which combines wired and wireless networks. The backbone network uses UTP cables for connection stability, while the access network uses Wi-Fi for user flexibility.

1. Environmental Analysis and Green IT Aspects: In addition to technical aspects, the analysis also includes an evaluation of energy usage and potential environmental impacts. This data is essential for integrating Green IT principles from the start, such as identifying points of excessive electricity usage and inefficient devices.
2. Documentation and Data Validation: The analysis results are collected and documented systematically, thus becoming the basis for the design phase. Data validation is conducted through discussions with related parties (for example, the maintenance team and management of Jasdam II) to ensure that all needs have been identified.

Network Topology Design, Based on data from the analysis stage, a network topology design was created that includes the placement of devices (routers, access points, cables, and supporting devices) at each strategic point (Main Building, Football Field, and Training GOR).

1. Integration of Green IT Standards and Principles: In the design phase, device selection and placement strategies are designed to support energy efficiency. For example, determining the right signal coverage radius to avoid excessive use, and selecting devices with energy-saving certification.
2. Initial Diagramming and Prototyping: Topology diagrams and physical layouts of the network are created with the help of software such as Microsoft Visio. These diagrams depict data flows, connectivity points, and relationships between devices that support further analysis.

4. Results and Discussion

Detailed submission guidelines can be found on the journal web pages. All authors are responsible for understanding these guidelines be-fore submitting their

4.1. Design Planning

This design can change the current network design as a whole or just do this wireless is to optimize the current wireless network. For wireless network design Described by including the use of current wireless network devices and some changes in the routing process in the new network topology. This wireless network topology design is described using Microsoft Visio. Jasdam II Sriwijaya plan which has a length of 557m and a width of 286 m. the following display.

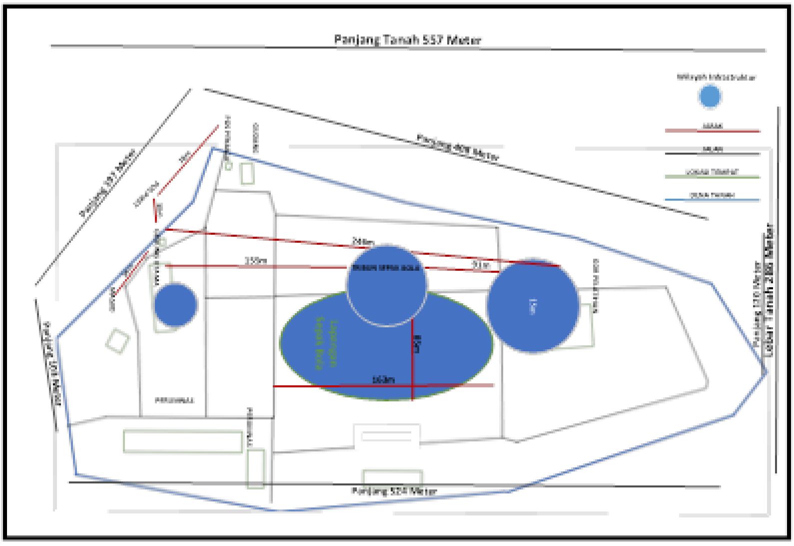

Fig. 2: Overall plan of Jasdam II Sriwijaya infrastructure

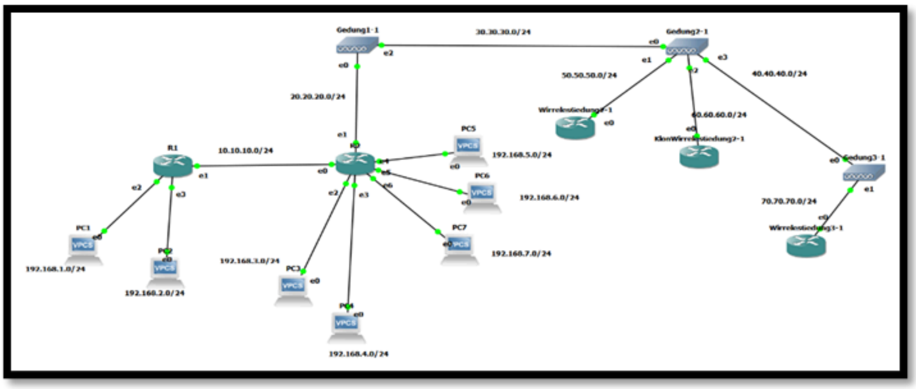

Fig. 3: Overall Topology

4.2. Simulation Result Stage

Network test simulation Distance 100m-150m

No Barriers

Fig. 4: Ping test

There is a Barrier

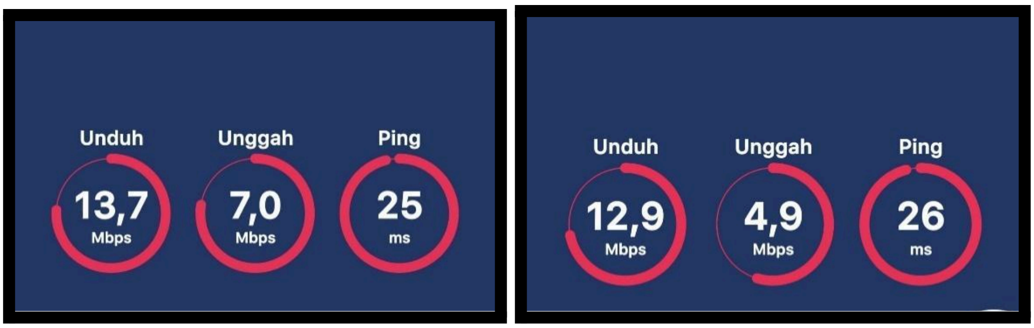

Fig. 5: Ping test

Network Simulation Conclusion

After conducting testing at the simulation stage, several conclusions were obtained, namely:

1. The difference in distance of 100 & 150 meters affects the ping produced by wireless media although the comparison is not far. Where the further the distance, the greater the ping produced or it takes more time to wait for the target device's response.
2. The most visible difference is produced when the device is positioned in the presence and absence of obstacles. At the same distance the device tested with no obstacles shows better results than the one with obstacles. The obstacles are trees or surrounding buildings.
3. The comparison of the results shows that the previous network infrastructure had significant shortcomings, where some rooms and buildings did not get adequate network coverage and high power consumption due to the absence of solar power utilization, which caused electricity costs to increase. With the implementation of the latest infrastructure design, these problems are overcome through more even network distribution and increased energy efficiency with the integration of renewable energy sources, thus not only improving network performance, but also optimizing operational costs and supporting environmental sustainabilit.

4.3. Selected Device

Table 3: Access Point Antenna Specifications

Product Code	EAP110-Outdoor
Interface	1× Fast Ethernet (RJ-45) Port (Support Passive PoE)
Button	Reset

Power Supply	24V Passive PoE (+4,5pins; -7,8pins. PoE Adapter Included)
Power Consumption	3.12 W
Wireless Client Capacity	100+
Wireless Standards	IEEE 802.11n/g/b
Frequency	2.4 GHz
Signal Rate	• 11n: Up to 300 Mbps (dynamic) • 11g: Up to 54 Mbps (dynamic) • 11b: Up to 11 Mbps (dynamic)
Transmit Power	• CE: ≤20 dBm (EIRP) • FCC: ≤22 dBm
Wireless Security	• Captive Portal Authentication • Access Control • Wireless Mac Address Filtering • Wireless Isolation Between Clients • SSID to VLAN Mapping • Rogue AP Detection • 802.1X Support • 64/128/152-bit WEP / WPA / WPA2-Enterprise, WPA-PSK / WPA2-PSK
Wireless Functions	• Multiple SSIDs（Up to 8 SSIDs） • Enable/Disable Wireless Radio • Automatic Channel Assignment • Transmit Power Control（Adjust Transmit Power on dBm） • QoS(WMM) • Load Balance • Rate Limit • Reboot Schedule • Wireless Schedule • Wireless Statistics based on SSID/AP/Client

Table 4: Utp Cable Specifications

Cable LAN	UTP Cat 5e
Connector	RJ45 Cat 5e

Table 5: Router Specifications

Product Code	*C54 AC1200*
LAN Port	4
Wifi Type	IEEE 802.11ac/n/a 5 GHz IEEE 802.11n/b/g 2.4 GHz
Wifi Standards	IEEE 802.11ac/n/a 5 GHz IEEE 802.11n/b/g 2.4 GHz
Wifi Speeds	5 GHz: 867 Mbps (802.11ac) 2.4 GHz: 300 Mbps (802.11n)
Wireless Security	SPI Firewall Access Control IP & MAC Binding Application Layer Gateway
Ethernet Ports	1× 10/100 Mbps WAN Port 4× 10/100 Mbps LAN Ports
Power	9 V ⎓ 0.85 A

Table 6: Solar Component Specifications

Component	Specification	Quantity/Unit	Price (Estimate)	Information
Solar Panels	Monocrystalline type, Output: 100W-150W; high efficiency, long life	1 unit	Rp500.000 -Rp2.000.000	The main energy source in the solar system
Charge Controller	MPPT; Input: 12V/24V; Output: 20A; Protects battery from overcharging	1 unit	Rp400.000 -Rp800.000	Regulates the flow of electricity from the panel to the battery to prevent damage.
Inverters	Pure sine wave inverter; Output power: 500W-1000W; Converts DC to AC	1 unit	Rp500.000 - Rp1.500.000	Converting direct current (DC) from the solar system to alternating current (AC) required by the network devices
Connecting Cable	Category 6; Supports speeds up to 10 Gbps; High insulation quality and resistance to electromagnetic interference	1 roll (305 meter)	Rp250.000 - Rp400.000 per roll	Cable to connect charge controller or inverter to router, supports stable data connection
Lithium-ion battery	Home Battery Lithium; Capacity: 100Ah;	2 unit	-	Power reserve to ensure operational continuity during cloudy weather or at night

Table 4 provides a complete overview of the components of a solar system for network infrastructure, from solar panels, charge controllers, inverters, connecting cables, to lithium-ion batteries. Each component plays an important role in ensuring the system works optimally and efficiently, while supporting the principles of Green IT by reducing operational costs and dependence on conventional electricity. This information is very useful in designing and implementing a reliable and sustainable system.

5. Conclusion

Research that has been conducted in the process of creating a wireless network design plan on Jasdam II using the Network Development Life Cycle method with a Green Information Technology approach can be concluded as follows:

1. The proposed device is suitable and can be used well, when the simulation runs smoothly there are no obstacles.
2. The proposed equipment prices have been reduced to affordable prices and can be easily obtained in offline or online stores.
3. The application of Green IT principles in designing wireless network infrastructure at JASDAM II Sriwijaya has succeeded in increasing energy efficiency without sacrificing network performance. The design that prioritizes the selection of energy-efficient devices and strategic placement of access points results in significant savings in electricity consumption.
4. The application of the Green Information Technology (Green IT) concept in the use of solar power has the potential to significantly reduce electricity consumption. From the analysis results, it is known that the electricity consumption of computer devices reaches a total of 12,816 kWh per day, which has an impact on quite large operational costs.

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