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Design and Implementation of Computer Networks Cokroaminoto Vocational School, Kotamobagu

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ABSTRACT

SMK Cokroaminoto Kotamobagu is one of the Educational Institutions that aims to develop the potential of the nation's children so that they can compete at the world level. To meet these objectives Educational Institutions need to be equipped with adequate computer networks. This study aims to manage the computer network system in SMK Cokroaminoto Kotamobagu so that it can be optimally utilized by teachers and students. The research method used in this study is the Network Development Life Cycle (NDLC). Steps being taken are: Analysis, Design, Prototype Simulation, Implementation, Observation, and Arrangement. There has been an increase in network quality after this study. Such as the delay value on the TKJ LAB SSID decreased by 47%, the value of packet lost by 67%, the difference in the value of downloads rose by 1.17 Mbps, the difference in the value of uploads rose by 0.99 Mbps and the delay the value of the SSID SMK 1 year decreased by 47%, the value of the packet lost was 33%, the difference in the value of downloads rose 0.74 Mbps, the difference in the value of uploads rose 1.75 Mbps.

Keywords: design, network, NDLC

INTRODUCTION

In the field of education, network technology is used as a communication tool via the internet, such as as a medium for a teacher to give assignments to students, school information

media to the community and other functions. To support the functioning of the internet in a school, network technology must be built in it first. To make a good network technology, it must be designed carefully and according to needs. Technology can be a connecting medium to improve the level of education. Not only in the relationship between teachers and students, but also can make teachers and students have access to the outside world, so they are able to find more learning materials. In addition, schools can also create schools that are more technologically and informationally systemized in order to facilitate access for teachers and schools, as well as students and schools.

The definition of a computer network is an operating system consisting of several computers and other network devices that work together to achieve a common goal. Another understanding of a computer network is also directly related to the delivery of messages that can be done through several points or nodes that are connected to each other, with or without cables. This network is commonly used by computers and telephones to convey messages through several existing systems on the computer or telephone itself. Types of computer networks based on topology is Bus Topology (This bus topology is a simpler topology when compared to other topologies, but if a cable is disconnected, it will break the bus network and interfere with other computers or clients), Star topology (Like a star, this topology shape is the same as a star because it has a core node in the middle that is connected to other nodes. Each type of computer network certainly has advantages, just like this star topology). Ring Topology is network topology is able to connect several computers in a circuit whose shape is circular like a ring. However, this topology has a drawback, namely that if there is one cable that is disconnected it will make the computer network fail to operate and affect others. Tree Topology, This tree topology is able to connect several star topology networks that are connected to a bus topology network. In this topology there are usually several types of networks at a higher level to a lower level. This tree topology makes data centralized according to its level so as to make data management easier. Types of computer networks based on their functions is Peer-To-Peer (In this type of network, every computer that is connected to the network can communicate directly with other computers without an intermediary. Each connected computer can also share some facilities such as printers, hard disks, and drives). Client-Server, In this network there are computers that act as servers, meaning that it provides facilities for computers that are members of the network, known as clients. Type of computer network by area is PAN (Personal Area Network), This computer network only includes personal computers with various devices around them such as keyboards, mice, headphones, etc. This network is usually used to connect your personal device or connect to the internet network. LAN (Local Area Network), LAN is a computer network that is used to cover a small area only. For example, covering the area of an office building, school, campus, or in the house. MAN (Metropolitan Area Network), This computer network certainly provides services with a wider area coverage of up to 10 to 50 KM. This network is also capable of providing high speed when transferring data within a certain city. WAN (Wide Area Network), WAN of course covers a wider area compared to LAN or MAN. This WAN can connect several regions and even reach other countries. This network requires a router. WAN is used to connect local networks in an area with other local networks in other areas. Computer network protocols are rules that exist in a computer network that must be obeyed by the sending and receiving parties in order to communicate with each other and exchange information even though they have different systems. The function of computer network protocols in general is to connect senders and recipients in communicating and exchanging information so that they

can run accurately and smoothly. There are several types of computer network protocols that can be applied to hardware, software, or a combination of both.

SMK Cokroaminoto Kotamobagu is currently using wifi for internet connection. The wifi is only in Computer Lab 1 and Computer Lab 2, while other rooms also need it unreachable internet connection. Like the teacher's room, the teacher needs an internet network to find more interesting teaching materials and also a library room that really needs an internet network so that students and teachers can add insight via the internet, not just relying on the books in the library. This research aims to develop a computer network that can answer the needs of SMK Cokroaminoto Kotamobagu.

METHOD

Research Time and Place

This research was conducted from September 2019 to November 2019 and the place of this research was at SMK COKROAMINOTO KOTAMOBAGU.

Types of Research

The type of research used in this research is the Network Development Life Cycle (NDLC). See figure 1.

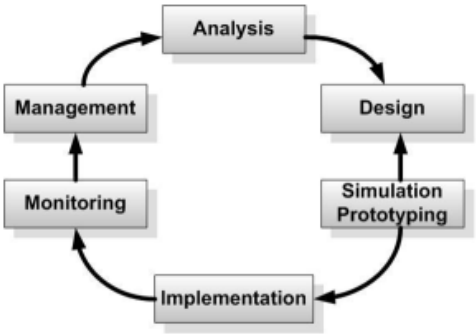

Figure 1. NDLC Method steps

1. Analysis

In this initial stage, a needs analysis is carried out, an analysis of problems that arise, an analysis of user desires, and an analysis of the current topology / network. The method commonly used at this stage includes conducting interviews with the authorities in implementing computer networks in schools. In addition to conducting interviews, an analysis of the basic theory needed to build an optimal computer system in schools was also carried out, according to the needs and limitations of the agency.

2. Design

At this design stage, a network topology design drawing will be made, it is hoped that this image will provide an overview of existing needs. The usual designs are in the form of topological structure designs, data access designs, cabling layout designs, and so on which will provide a clear picture of the project to be built.

3. Simulation Prototype

The next stage is making a prototype of the system to be built, as a simulation of the implementation of the production system, thus the author can know the general description of the communication process, connectivity and working mechanisms of the interconnection of all elements of the system to be built. The author built a prototype of this system on virtual environment, by using a virtual machine, as a replication of the system to be run, because a virtual machine allows a program that has been dedicated to a system.

4. Implementation

At this stage it will take longer than the previous stage. In implementation the researcher will apply everything that has been planned and designed beforehand. Implementation is a very decisive stage of the success/failure of the project to be built.

5. Monitoring

After the implementation of the monitoring phase is an important stage so that computer and communication networks can run according to the wishes and initial goals of the user in the early stages of analysis, it is necessary to carry out monitoring activities. Monitoring can be in the form of making observations on;

a. Hardware infrastructure: by observing the condition of the reliability of the system that has been built (reliability = performance + availability + security),
b. Pay attention to the course of data packets on the network (timing, latency, peak time, throughput)
c. The method used to monitor the "health" of networks and communications in general is centralized or distributed. The most frequently used approach is the Network Management approach, with this approach many devices, both local and dispersed, can be monitored as a whole.

6. Management

The management or regulation stage, one of which is of particular concern is the issue of policy, policies need to be made to make / manage so that the system that has been built and runs well can last a long time and the element of reliability is maintained. The policy will depend on the management level policy and the company's business strategy. IT as much as possible should be able to support or alignment with the company's business strategy.

Research Tools and Materials

The equipment or devices used in this study are divided into two types, namely hardware (hardware) and software (software).

1. Hardware

Hardware, we using in this research see in table 1,2,3 and 4.

Table 1. Computer Lab Hardware 1

No	Device Name	Specification	Information	Amount
1	PCs (Lenovo)	Processor Intel(R) Core(TM) i3-3210 CPU @ 3.20GHz, 2GB RAM, 64-bit, Windows 10 Pro	As a client pc in computer lab 1	20
2	Modem MDM3100 IP Satellite Modem	Has 4 Lan Ports, 1 ISP port, and supports IPv4 and IPv6	As an internet source from the PSN Provider	1

			(Pacific Satellite Nusantara)	

Table 2. Computer Lab Hardware 2

No	Device Name	Specification	Information	Amount
1	PCs (Lenovo)	Processor Intel(R) Core(TM) i3-3210 CPU @ 3.20GHz, 2GB RAM, 64-bit, Windows 10 Pro	As a PC client in computer lab 2	25
2	Modem Nokia G-240W-F	Has 4 Ethernet ports and a wireless connection that supports a 2.4 GHz frequency	As an internet source from the IndiHome Provider	1

Table 3. Teacher Room Hardware and Administration

No	Name	Specification	Information	Amount
1	PC (Lenovo)	AMD A6-9200 Radeon R4, 5 COMPUTE CORE 2C+3G 2.00 GHz , 4GB RAM, 64-bit, Windows 8.1 Pro	PC in Teacher's Room and administration	2
2	HP Laptops	Intel Core i3-7020U AMD Radeon 520 Graphics, Processor speed 2.3GHz, 4GB RAM, Windows 10 Pro	Laptop in teacher and administration room	2
3	Acer Laptops	Intel Core i7-8265U Quad Core @1.6 GHz (6M cache, up to @3.9 GHz), 4 GB RAM, Windows 10 Home	Laptop in teacher and administration room	1

Table 4. Library Room Hardware

No	Device Name	Specification	Information	Amount
1	Lenovo PCs	Processor Intel(R) Core(TM) i3-3210 CPU @ 3.20GHz, 2GB RAM, 64-bit, Windows 10 Pro	PC used in the library	1
2	Acer Notebooks	Windows 8 64-bit - AMD Dual-Core Processor A4-1250 - 2GB DDR3 Memory	Laptop used in library	2

	+ 2GB DDR3 Memory - 500GB HDD – SD

2. Software (software)

software, we using in this research see in table 5.

Table 5. software list

No	Device Name	Information
1	OS Windows 10 Pro	Used as OS on all computers in the lab, computers in the library, computers in the teacher's room, and laptops
2	OS Windows 8.1 Pro	Used as OS on one of the computers in the teacher's room
3	Mozilla Firefox	Used as an application for browsing
4	Google Chrome	Used as an application for browsing
5	Microsoft Office	Used as an application to process data
6	Speedtest (ookta)	Used as an application to measure network speed

RESULTS AND DISCUSSION

Analysis

At this stage the identification process was carried out at SMK Cokroaminoto Kotamobagu. This identification process describes the initial conditions where the school already has internet access using services from *PSN* (Pacific Satellite Nusantara), the modem used is the MDM3100 IP Satellite Modem, with a bandwidth capacity of only 3 *Mbps* but its use is not yet optimal and the topology applied at Cokroaminoto Vocational High School Kotamobagu.

The following is a display of the network topology design at SMK Cokroaminoto Kotamobagu before this research was carried out, see figure 2.

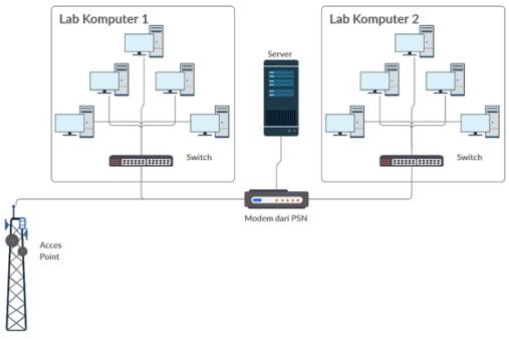

Figure 2. the old network design

In Figure 2, the old network design at SMK Cokroaminoto Kotamobagu only exists in Computer Lab 1, Computer Lab 2 and uses 1 access point whose users include teachers, administrative staff and students at SMK Cokroaminoto Kotamobagu.

We also tested the quality or speed of the network using the SPEEDTEST application. The following is a list of the test table 6.

Table 6. Network speed test result at ISP PSN

Done on 11-10-2019					
SSID	Parameter				
	Delays (ms)	Downloads (Mbps)	Uploads (Mbps)	Packet (%)	Lost
LAB TKJ	722 ms	1.55Mbps	1.50Mbps	0.3%	
SMKCokroKTG	668 ms	0.54Mbps	0.14Mbps	0.3%	

Based on Table 6, it can be seen that the parameter results obtained on the SSID LAB TKJ before implementation were carried out, namely, the *delay value was* 722 ms, the *download value was* 1.55 Mbps, the *upload value was* 1.50 Mbps, and the *packet lost value was* 0.3%. while the SSID SMKCokroKTG namely, the *delay value is* 668 ms, the *download value is* 0.54 Mbps, the *upload value is* 0.14 Mbps, and the *packet lost value is* 0.3%. This measurement is measured using the *SPEEDTEST android application* .

Design

At this stage the researcher designed the topology according to the rooms at SMK Cokroaminoto Kotamobagu, because of the school plan infrastructure which can be seen in Figure 4. The following shows the new network design at SMK Cokroaminoto Kotamobagu. Based on the identification of the analysis, the authors designed a computer network for SMK Cokroaminoto Kotamobagu according to the data obtained in the previous stage. In Figure 4.4 The new network design, the researcher suggests to the school to add internet services using a

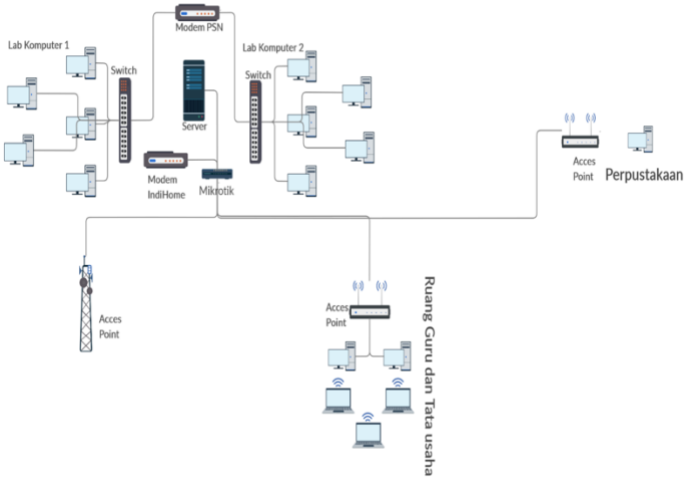

Figure 1. The new network designs

Provider from Telkom IndyHome with a bandwidth capacity of 20 Mbps so that the internet network at SMK Cokroaminoto Kotamobagu does not only exist in the computer lab area but can reach all rooms. other areas such as teachers' rooms, administration and even students at Cokroaminoto Kotamobagu Vocational School can use the internet network properly. In designing the computer network design for Cokroaminoto Kotamobagu Vocational School the researchers also made a computer network design design within the Cokroaminoto Kotamobagu Vocational School floor plan, as follows:

The following is an explanation of computer network design:

1. At number 1 is the Modem from PSN (*Pacific Satellite Nusantara*) connected to number 5 switch as an IP divider to the PC in Computer Lab 1.
2. From number 1 to number 6 the switch acts as an IP divider to the PC in Computer Lab 2.
3. From number 1 to number 6 Switch which is a switch in Computer Lab 2.
4. At number 2 is a Modem from Telkom Indyhome connected to number 4 proxy.
5. From number 4 to number 3 Server.
6. From number 4 to number 7 Access point which is an outdoor access point.
7. From number 4 to number 8 Access Point which is an access point for teachers and administrative staff.
8. From number 4 to number 9 Access point which is an access point for students and teachers who are in the library area.

Network Management

At this stage is the stage of implementing all the things that have been planned in accordance with the network design and analysis that has been done previously. At this stage the authors perform the subnetting process including determining the number of subnets, determining the number of hosts, determining the broadcast address, determining the network id address, and IP range that can be used and configuring the network components of SMK Cokroaminoto Kotamobagu. See table 7.

Table 7. Bandwidth Management

SSID	Max Limit Upload Target	Download Target
VOCATIONAL SCHOOL-TEACHER	5 Mbps	5 Mbps
SMKCOKROKTG-PERPUS	5 Mbps	5 Mbps
SMKCokroKTG	5 Mbps	5Mbps
speedy@7ef0	5Mbps	5Mbps

Bandwidth settings are done with the Mikrotik Router device. With Simple Queue, we can divide and manage the amount of bandwidth that can be received by clients. So that data traffic on our network can run according to expectations and desires. The modem from PSN (*Pacific Satellite Archipelago*) is connected to every switch in Computer Lab 1 and Computer Lab 2 and then distributed to every existing computer. So, the configuration stage of the modem from the ISP PSN (*Pacific Satellite Archipelago*) is only focused on the lab, the author also configures the IP address on each computer in Computer Lab 1 and Computer Lab 2

Monitoring

In this stage the author conducts quality tests or monitoring so that computer networks and

Done on 17-10-2019				
	Parameter			
SSID	Delay (ms)	Downloads (Mbps)	Uploads (Mbps)	Packet Lost (%)
speedy@7ef0	2 ms	25.7 Mbps	5.77 Mbps	0.0%
VOCATIONAL SCHOOL-TEACHER	63 ms	9.88 Mbps	2.16 Mbps	0.0%
SMKCOKRO KTG-PERPUS	62 ms	9.76 Mbps	2.20 Mbps	0.0%

communications can run according to the initial wishes and goals. At this stage the author made observations using the *SPEEDTEST android application*, the results are as follows table 8.

Table 8. Measurement Results At Isp Psn (After)

Done on 17-10-2019				
	Parameter			
SSID	**Delays (ms)**	**Downloads (Mbps)**	**Uploads (Mbps)**	**Packet Lost (%)**
LAB TKJ	385 ms	2.72Mbps	2.49Mbps	0.1 %
SMKCokroKTG	458 ms	1.28Mbps	1.89Mbps	0.2%

Based on table 8, it can be seen that the parameter results obtained on the SSID LAB TKJ after implementation are, the *delay value is* 385 ms, the *download value is* 2.72 Mbps, the *upload value is* 2.49 Mbps, and the *packet lost value is* 0.1%. while the SSID of SMKCokroKTG is, the *delay value is* 443 ms, the *download value is* 1.28 Mbps, the *upload value is* 1.89 Mbps, and the *packet lost value is* 0.2%. This measurement is measured using the *SPEEDTEST android application* .

Table 9. Parameter Results Obtained At Isp Telkom Indyhome

Based on Table 9, it can be seen that the parameter results obtained at ISP Telkom Indyhome with SSID speedy@7ef0 are, the *delay value is* 2 ms, the *download value is* 25.7 Mbps, the *upload value is* 5.77 Mbps, and the *packet lost value is* 0.0%. on the SSID SMKCOKROKTG-GURU, the *delay value is* 63 ms, the *download value is* 9.88 Mbps, the *upload value is* 2.16 Mbps, and the *packet lost value is* 0.0%. While on the SSID SMKCOKROKTG-PERPUS, the *delay value is* 62 ms, the *download value is* 9.76 Mbps, the *upload value is* 2.20 Mbps, and the *packet lost value is* 0.0%. This measurement is measured using the *SPEEDTEST android application* .

DISCUSSION

a. Improvement comparison

Below is a comparison before conducting this research and after conducting this research. This comparison is focused on pre-existing internet networks, namely internet networks that use providers from *PSN* (Pacific Satellite Nusantara). Here 's the explanation in table 10.

Table 10. Comparison of speed measurements

Before				
SSID	**Parameter** **Delays (ms)**	**Downloads (Mbps)**	**Uploads (Mbps)**	**Packet Lost (%)**
LAB TKJ	722 ms	1.55Mbps	1.50Mbps	0.3%
SMKCokroKTG	668 ms	0.54 Mbps	0.14 Mbps	0.3%
After				
SSID	Parameter Delay (ms)	Downloads (Mbps)	Uploads (Mbps)	Packet Lost (%)
TKJ LAB	385 ms	2.72 Mbps	2.49 Mbps	0.1%
SMKCokroKTG	458 ms	1.28 Mbps	1.89 Mbps	0.2%

Based on Table 10, it can be seen that the parameter results obtained in SSID LAB TKJ the previous *delay value* is 722 ms, the *delay value* after is 385 ms, the previous *download value is* 1.55 Mbps, the *download value* after 2.72 Mbps, the *upload value* before 1, 50 Mbps, *upload value* after 2.49 Mbps, *packet lost value* before 0.3 %, and *packet lost value* after 0.1 % . While the SSID of SMKCokroKTG is, the previous *delay value* is 668 ms, the *delay value* after is 458 ms, the previous *download value is* 0.54 Mbps, the *download value is* after 1.28 Mbps, the *upload value is* before 0.14 Mbps, the *upload value is* after 1, 89 Mbps, the value of *packet lost* before 0.3%, and the value of *packet lost* after 0.2% . This measurement is measured using the *SPEEDTEST android application*. See table 11.

Table 11. Comparison Percentage

SSID	**Comparison**

	Delay Decrease Percentage (%)	Download Speed Increase (%)	Upload Speed Increase (%)	Percentage of Packet Lost Drop (%)
KJ LAB	7%	5%	6%	7%
MKCokroKTG	1%	37%	250%	3%

Based on Table 11, it can be seen that the comparisons obtained at SSID LAB TKJ the *delay value* decreased by 47%, the download value *increased* by 75%, the *upload value* increased 66% and the *packet lost value* decreased by 31%. While the SSID SMKCokroKTGvalue *delay* decreased by 47%, download value *increased* by 137%, *upload value* increased by 1250% and *packet lost value* decreased by 33%.

b. Influencing factors

Some of the factors that affect the performance of the internet network are as follows:

1. Number of Users (users)
   The number of users accessing the internet at SMK Cokroaminoto Kotamobagu is quite a lot so that it can affect the speed of internet access. Activities that are usually carried out such as downloading files on the internet or watching Youtube can cause slow network performance.
2. bandwidth
   The amount of bandwidth can also affect the speed of internet access. The greater the bandwidth used, the faster the access speed on the internet.
3. Electricity
   The last problem is that the electricity at the school is unstable, in Figure 4.5 The network design on the floor plan, it can be seen that around the library area there are several rooms where the internet network is not reachable, due to unstable electric currents.

CONCLUSION

Based on the results of research and discussion in the design of computer networks at SMK Cokroaminoto Kotamobagu, it can be concluded that: 1. Access to the computer network at SMK Cokroaminoto Kotamobagu is currently accessible to most of the rooms in the school and is more optimal than before. 2. There was an increase in network quality after this research was conducted. For example, the delay value on SSID LAB TKJ decreased by 47%, the packet lost value by 67%, the difference in download values increased by 1.17 Mbps, the difference in upload values increased by 0.99 Mbps and the delay value on SSID SMKCokroKTG decreased by 47%, the value packet lost 33%, difference in download value increased 0.74 Mbps, difference in upload value increased 1.75 Mbps. 3. After doing this research, the school or operator can manage users or users and use excessive bandwidth.

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