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# Computer Network Design in Vocational School Using Network Simulator

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## ABSTRACT

The development of computer network technology is currently increasing rapidly along with the community's need for services that utilize computer networks. A computer network is a relationship between 2 or more computers connected by wired or wireless transmission media. This study aims to As for the purpose of this research is to analyze and design a computer network at SMK Negeri 1 Tabuk Utara. The research model uses the Network Development Life Cycle (NDLC) with six stages, namely analysis, design, simulation prototype, implementation, monitoring and management. However, only the first to third stages were carried out. After being developed through several stages, the results of this study show that by analyzing and designing network designs using Cisco packet tracer, SMK Negeri 1 Tabuk Utara already has 2 design models to be used directly in this design accompanied by material estimation and work on the computer network.

***Keywords***: *Analysis and Design of Computer Networks, Network Development Life Cycle, Cisco Packet Trace*

## INTRODUCTION

The development of computer network technology is currently increasing rapidly along with the needs of the community, especially educational institutions. This plays a very important role in the use of the internet in managing information so that work becomes more effective, namely services that utilize computer networks. A computer network is a relationship between 2 or more computers connected by wired or wireless transmission media . Two computer units are said to be connected if both of them can exchange data or information, share a resource they own, and also use software or hardware connected to the same network.

Small area computer networks, such as campus, school, building or home computer networks. In general, what is called a computer network is a group of computers that are interconnected with each other using communication protocols through communication media so that they can share information and access the internet from both computers and smartphones. Extensive computer networks create easy access to information that is very fast, even realtime. For to meet the needs of an agency or school, a fairly extensive computer network design is needed, namely that every room in the school must have a computer network or internet access.

The use of autonomous computers is no longer compatible because more and more jobs require the ability to share resources and access the internet. The development of this technology has reached the realm of education, especially in the school environment. Currently, many schools require the learning process to use computer technology that is connected to the internet, for example teachers giving assignments to students or assigning assignments via accounts such as email. As a medium of information for students and teachers when looking for teaching materials and learning materials, or media of information to parents or the community regarding school development.

Network technology is used as a communication tool via the internet, for example 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 is built in it first. To make a good network technology, it must be designed carefully and according to needs. The development of a computer network will improve the quality of learning and management of school administration, so that the teaching and learning process can be carried out properly. School is a place where the internet is needed by teachers and students.

SMK Negeri 1 North Tabuk is one of the vocational high schools that does not yet have the computer network needed to increase the effectiveness of learning and teaching and learning processes, especially in TKJ productive subjects. When doing research on computer facilities at this school, there were 14 PCs in the laboratory room, 1 laptop in the principal's room and 1 laptop in the teacher's room. Because there is no computer network yet when doing practice in the TKJ subject, students only use a virtual network application, namely Cisco packet tracer. Therefore, by making an analysis and design of computer networks for schools, it is hoped that it can help students and teachers in the teaching and learning process when the computer network design is implemented later.

In designing a computer network, it is necessary to have an analysis first, the analysis can be in the form of analyzing the old network system in which there is a problem analysis, needs analysis, device analysis, and topology analysis so that data can be found which will later be used as a reference in designing a computer system in accordance with standards for user needs, in this case which will later be implemented at SMK Negeri 1 North Tabukan.

# METHOD

## *Time and Location of Research*

This research was carried out in January and February 2021 and is located at SMK Negeri 1 Tabukan Utara

## *System Development Methodology*

In this study the system development method used by researchers is the Network Development Life Cycle (NDLC) model development method, where implementation and monitoring stages are not implemented specifically. NDLC is the key behind the computer network design process. NDLC is a model that defines the development process cycle or computer network system. The word Cycle is a descriptive keyword of the network system development life cycle which describes explicitly all processes and stages of continuous network system development Goldman (2001).

The steps or stages in the NDLC are as follows:

1. *Analysis*

In the early stages, a needs analysis, problem analysis, user wish analysis and an analysis of the existing network topology are carried out. The method at this stage is:

- Interview
- Field direct survey
- Examine every data obtained from previous data.

2. *Design*

This design phase (data obtained previously) will create a design drawing of the interconnection network topology to be built.

3. *Simulation Prototype*

This is intended to see the initial performance of the network to be built

4. *Implementation*

Implementation will implement everything that has been planned and designed beforehand.

5. *Implementation*

Implementation will implement everything that has been planned and designed beforehand.

6. *Management*

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

## Course of Research

1. Step I of Research The research begins with an introduction to school conditions, surveys and interviews, data collection from surveys and interviews, research preparation at the analysis stage, design stage, simulation and design stage, discussion and conclusion stage.

2. Step II Research etc

Research preparation stage: Submission of titles and preparation, submission

a. proposal, research permit and proposal presentation
b. Implementation phase: Data collection and data analysis
c. Report preparation stage

## RESULTS AND DISCUSSION

### Situation Analysis

SMK N 1 North Tabuk is one of the vocational schools located in the Sangihe Archipelago Regency, precisely at JL. Raya Peta-Naha, Naha 1, Kec. North Taboo. From the results of the initial interview with the school principal, it was found that at SMK N 1 North Tabukan there is 1 Computer Lab. In the Lab there are 14 Personal Computers and are already using the LAN network. The LAN network used in the Lab is only used for practical purposes for students majoring in Computer and Network Engineering (TKJ) and has not been fully used for data sharing.

Analysis of User Needs In this study, the distribution of users was also carried out so that communication lines were not concentrated on one path and bandwidth users were evenly distributed to each user.

The following is the distribution of users:

Structural: Pathways for school principals, vice principals and their assistants who entered into the structure at SMK Negeri 1 North Tabukan. Teachers and Staff: Intended for the path of teachers and staff in the environment State Vocational School 1 North Tabukan. Students: Pathways for students of SMK Negeri 1 North Tabukan

### Analysis of Network Needs

Computer network is a very important requirement in the implementation of education at SMK Negeri 1 Tabukan Utara. To support institutions, computer networks need to be well designed to ensure that resources can be used optimally and the vision and mission can be achieved as expected. Computer networks are a must considering the complexity of the problems faced in the administrative system and the teaching and learning process.

### Feasibility Analysis

SMK Negeri 1 Tabuk Utara has teachers and staff who have experience in the field of computers, including in the field of computer networks.

1. *Topology Analysis*

Based on the results of the analysis of the condition of the school, it was obtained data that the area of the school was not too large and was on a network scale that was not too large so that the concept of a computer network was chosen using the Star topology by looking at several considerations:

Schools that have several computer units in one room and the use of switches will manage network traffic. For network or bandwidth sharing, it will be channeled through the switch from router. Centralized network control, and if 1 network path has a problem, it doesn't interfere with other

paths. Star topology is easy in the installation process, it's just that it will use media more transmission. Star topology is suitable for implementation on small-scale networks such as for school.

*2. Analysis of Network Devices*

Analysis of Network Devices using hardware. See table 1 and table 2.

**Table 1.** Hardware used

| Name HW | Specifications | Information |
|---|---|---|
| 14 Computers Axio Mimo All-in-one PC SUS | Intel inside G645(2.9 GHz), *RAM 2 GB D31333 DIMM, 32 bit OS, HDD 500 GB, VGA intel HD Graphic 2000, Size Monitor 21.5 Dengan LED 1920 X 1080 With Camera Resolution 1.3 Megapixel.* | Used for practicum TKJ students |
| UPS | | Stabilize the flow of electricity and save electricity |

**Table 2.** Software used

| Name SW | Information |
|---|---|
| *Windows 32 bit* operating system | Used on school computer *PCs* |
| *Mozzila firefox* | As a search engine *software* / for *internet browsing purposes* |
| *Google Chrome* | As a search engine *software* / for *internet browsing purposes.* |
| *Microsoft office* | Used as a word manager application, numbers, presentations, and others |

*Network Design*

Based on the network design drawings in Figure 1 and Figure 2, it can be explained that for the provision of internet services / ISP (Internet Service Provider) the school uses Telkom Speedy with direct internet via an ADSL modem. Based on the numbering on the picture, it can be explained as follows:

Modem installed in the operator's room.

The router functions as a firewall router as well as in bandwidth management.

PC server in the distribution of IP Address. The main switches are located in the operator room, servers and computer labs, the network will be designated for operator rooms, computer labs and access points for classrooms. Switch two is located in an office room whose network is intended for office rooms and principals. And Accesspoint for the teacher's room and the surrounding classrooms. See figure 1 and figure 2.

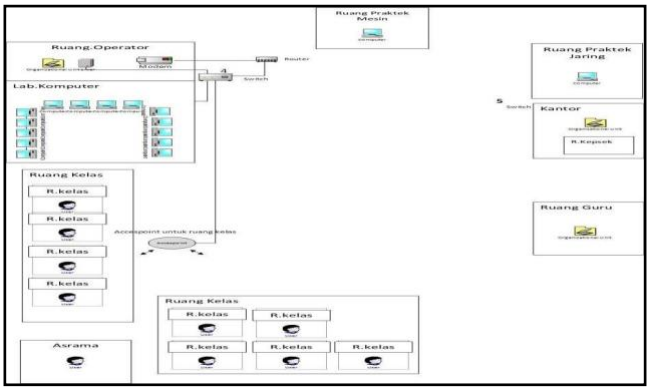


**Figure 1.** Network Design 1 SMK Negeri 1 North Tabukan

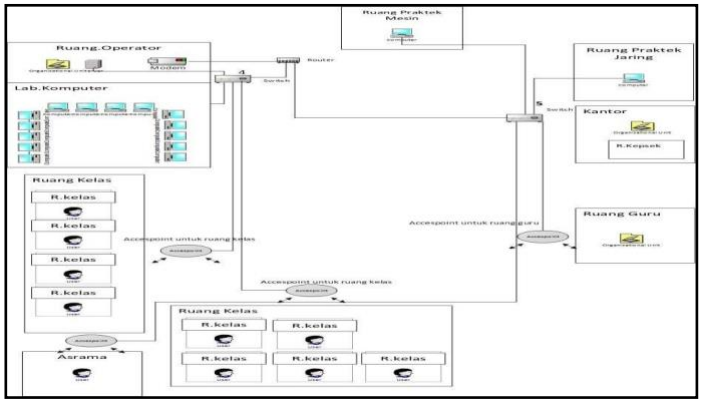


**Figure 2.** Network Design 2 SMK Negeri 1 North Tabukan

## Network Prototypes

*Network Simulation 1*

In the simulation prototyping stage, software is used as a network simulation site, namely the Cisco Packet Tracer application. The purpose of using this application is as a simulation so that trials

can be carried out without using the current network performance, because the system of this network simulation is separate from the existing network. The simulation of the designed network can be seen in Figure 3.

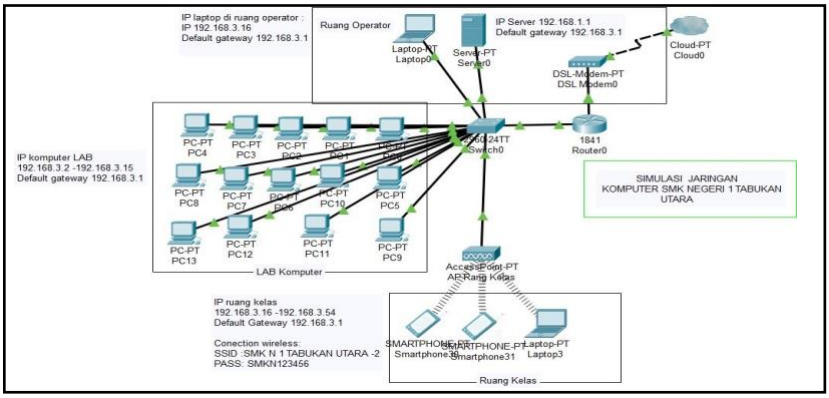


**Figure 3.** Network Simulation 1

In this topology the modem only functions as a bridge. So that the public IP address goes directly to the router via fastethernet port 0/1 and Ethernet port 1/0. With default gateway 192.168.3.1. The router does not provide IP automatically because the IP address used is statick mode for users who connect to the AP (access point).

*1. Distance between devices*

The position of PC server, modem and router, are close to each other connected by
UTP cable with dimensions: PC server to router = 30 cm, modem to router = 15cm

*2. Distance between router and switch = 5 cm c)*

Distance between Classroom. AP to router 10 M d) Indoor AP installed in classroom with UTP cable with POE feature.

*Network simulation 2*

The simulation of the designed network can be seen in Figure 4.

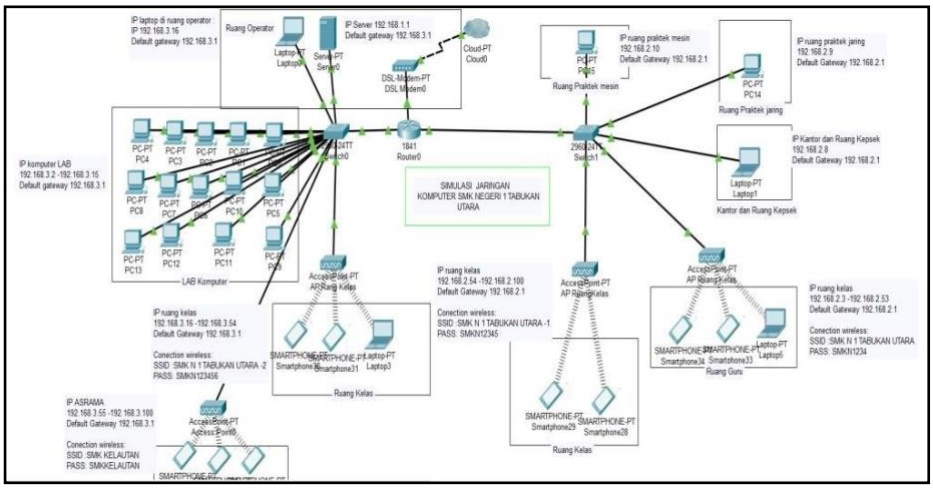


**Figure 4.** Network Simulation 2

Distance between

a. The position of PC server, modem and router, are close to each other connected by UTPcable with dimensions: PC server to router = 30 cm, modem to router = 15 cm
b. The distance between the router and the switch = 5 cm
c. The distance between the AP in the classroom and the router = 10 M
d. The distance between the AP in the dormitory and the switch = 50 M
e. The distance between the router and the switch in the principal's room and office = 50
f. The distance between AP teacher room to switch = 50 M
g. Distance between classroom AP to switch = 60 M Indoor
h. APs are installed in classrooms, dormitories and teacher rooms with UTP cables with POE features

## Discussion

In this study the authors used the Network Development Life Cycle (NDLC) system development method, which was divided into six stages, namely the analysis stage, the design stage, the prototype simulation stage, the implementation stage, the monitoring stage and the management stage. However, this research is only limited to the simulation prototype stage. The design of computer networks is carried out using a special network simulator application for designing computer networks.

The computer network at SMK Negeri 1 North Tabuk is designed based on the school plan. After being designed and simulated, the minimum standards for computer networks at SMK Negeri 1 Tabuk Utara are obtained, namely having 14 computers, having at least 1 access point, using at least 1 modem, having a router, having a PC server, having transmission media, being able to connect to Wifi, has an operating system (OS), uses the TCP/IP protocol, has a division of IP addresses.

The designed computer network is simulated using a network simulator application, namely Cisco Packet Tracer Version 7.2.1. After the network is arranged accordingly with the network design that has been designed beforehand, then check the connection whether the network is already connected by using the PING command. After the PING command is successful, the network design at SMK Negeri 2 Tabukan Utara can be implemented.

## CONCLUSION

From this study it can be concluded that the results of this study are the analysis and design of computer networks at SMK Negeri 1 Tabuk Utara using Cisco Packet Tracer software. The minimum standard for computer networks at SMK Negeri 1 Tabuk Utara is having 14 computers, having at least 1 access point, using at least 1 modem, having a router, having a PC server, having transmission media, being able to connect to Wifi, having an operating system ( OS), the use of the TCP / IP protocol, the distribution of IP addresses. From these minimum standards, two computer network models were designed according to the needs of the school.

## REFERENCES

Arta Ginanjar, H. (2016). Analysis and Design of Mikrotik-Based Hotspot Server

Batmetan, J. R. (2022). Model Enterprise Architecture for Information Technology Services in Universities. International Journal of Information Technology and Education, 1(4), 18-34.

Doni, FR (2016). Computer Network with Mikrotik Router. Simnasiptek 2016, 1(1), 88-93.

Esabella, S. (2016). Design of Computer Network Infrastructure to Support the

Implementation of Information Systems at the University of Technology,

Sumbawa. MATRIC: Journal of Management, Informatics Engineering and Computer Engineering, 16(1), 44-55.

Goldman, James E. & Rawles, P. T (2001) Applied Data Comunication A Bussines Oriented Aproach, 3th Edition. John Wiley & Sons, Inc.

Indria, N., & Widjajarto, A. (2017). Designing a Wireless Network as a Redundancy Link in Telkom Bandung Health Foundation (yakes) Infrastructure Using the Network Development Life Cycle (NDLC) Methodology. eProceedings of Engineering, 4(2).

Kawuka, GR, Togas, P., & Djamen, A. (2018). Local Area Network Design at State Vocational School 1 Sinonsayang. Engineering Education Journal-E2J, 6(2).

Kilis, B. M., Mamonto, J., Legesan, H., & Sagai, Z. (2022). Usability Evaluation of The Android Operating System Using Use Questionnaire. International Journal of Information Technology and Education, 1(2), 16-23.

Pambudi, MG (2017). Analysis and Design of Computer Network Security Against

Brute Force Attacks Using ISO/IEC 27001 Standards With the NDLC Method at Diskominfo Bandung Regency Government.

Pelealu, RRAA, Wonggo, D., & Kembuan, O. (2020). Design and

Implementation of 1 Year State Vocational School Computer Networks. Jointer-Journal of Informatics Engineering, 1(01), 5-11.

Prasetyo, BA (2019). Design of a Mikrotik-Based Wireless Local Area Network

Network at SD Negeri 02 Jatisobo (Doctoral dissertation, Duta Bangsa University, Surakarta).

Rainer, R. K., & Cegielski, C. G. 2011. Introduction to Information System : Enabling and Transforming Business. (3rd Edition). USA : John Wiley & Sons.

Saputro, DT (2019). Learn MikroTik OS-Based Computer Networks.

Suharto, A. (2020). Analysis and Design of VLAN-Based Network Systems with the NDLC Method at Boedi Luhur Vocational School. In ESIT (Vol. 15, No. 2, pp. 42-48).

Sujadi, H., & Mutaqin, A. (2017). Design and Build a Metropolitan Area Network (MAN) Computer Network Architecture Using the Network Development Life Cycle (NDLC) Method (Case Study: Majalengka University). J ENSITEC, 4(01).

Sumardi, S., & Zaen, MTA (2018). Designing a Mikrotik Router OS-Based Computer Network at SMAN 4 Praya. Journal of Informatics and Electronic Engineering, 1(1), 50-56.

Supriadi, D., Fahmi, H., & Imtihan, K. (2018). Analysis and Design of Wireless Local Area Network (WLAN) Network Infrastructure at the Central Lombok District Industry and Trade Service. Journal of Informatics and Electronic Engineering, 1(2), 1-6.

Kelvin, E., Liow, HD, & Djamen, AC (2019). Analysis and Design of Computer

Networks in the Minahasa District Communication and Information Service. Engineering Education Journal-E2J, 6(1).

Tristono, T., & Nurhumam, SD (2013). Design and Build Computer and Internet Networks in Schools. Agri, 14(1), 42-47.

Tulloh, DM, Duskarnaen, MF, & Ajie, H. (2020). Analysis of Internet Access Network Using Mikrotik Router OS at SMK TUNAS HARAPAN With Optimization of Load Balancing Using QoS (Quality of Service) Parameters. PINTER: Journal of Informatics and Computer Engineering Education, 4(1), 39.