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Computer network design using the simple queue method in maximising network performance in companies

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Abstract: Computer Network Design Using the Simple Queue Method at CV. Ide Maju Berkarya is made to maximise the performance of existing networks in the company. This design is to provide network capacity for users evenly using the Simple Queue method and can monitor the existing network in the company so that there can be no more problems in getting network capacity where previously the capacity that each user got was uneven. This computer network design is based on a case study at CV. Ide Maju Berkarya which lasted for 4 (four) months. The object of activity carried out in the form of direct observation to the field to see the circumstances and situations that occur, how the performance of the existing network at CV. Ide Maju Berkarya. From the conditions that occur in the field, it can be seen that the distribution of nets for each employee is not evenly distributed, there is no network that can monitor the network in the company so that problems often occur when using the internet becomes slow and disconnected. Conclusions and suggestions on the design of this computer network are to be able to improve the performance of existing networks in the company by sharing the capacity of each user evenly when using internet access in the company and can monitor traffic and users connected to the network.

Keywords: Computer network; Monitoring; Simple queue; Network development life cyle

1. Introduction

Science and technology that develops from time to time causes human needs to increase (Reeves & Crippen, 2021; Vladova et al., 2021). To deal with these technological developments, is to develop human resources and improve skills so that they are able to compete in facing the challenges of technological development (Haleem et al., 2022; Indrawati & Kuncoro, 2021; Kang et al., 2019). Communication using internet technology is almost a primary need for everyone today (Ayaz et al., 2019; Selvaraj et al., 2021). Almost everyone in this world needs an internet network for their daily needs. The Wireless Fidelity network or commonly called wifi is very familiar to our ears, because at this time it is very easy for us to find in various places such as in offices, in educational institutions or in the business sector there is a Wireless network (Liao et al., 2017).

The amount of internet needs at CV. Ide Maju Berkarya where currently the internet used by Indihome is 50 Mbps and there are seventeen devices connected to the internet where five computers and seven leptops are on the second floor, two computers and three leptops on the first floor which are all computer and laptop devices. High internet requirements affect the network capacity provided by the internet provide (Poulopoulos & Wallace, 2022). Where for employees who use leptops, they still access the internet using Wireless Fidelity which is uneven because the range of routers on the second floor is far away, making employees on the first floor slow and disconnected in accessing the internet (Hariadi et al., 2019; Indrawati & Kuncoro, 2021). There is no network system to monitor the

company's existing network. So that in checking the network when the network has problems, the information obtained is not optimal so that it cannot be repaired quickly (Liang et al., 2020). The distribution of network capacity that is not equally large for each user results in users having difficulty using the internet facilities that have been provided (Healy et al., 2022), sometimes there are those who access the internet smoothly, there are also some employees who are slow in accessing the internet. This is caused by the absence of maximum or minimum bandwidth restrictions for each user.

The purpose of the computer network is to make it easier to monitor the network in the company, because this computer network has a server that can monitor the computer client network in CV. Ide Maju Berkarya, and also this bandwidth network management can divide the network according to the needs of each division of the company with this management is very useful because it can maximise network performance so that no one is disconnected and slow in accessing the internet. According to (Tao et al., 2021), The Simple Queue method is a fairly simple method of configuring it. In the simple queue method we cannot allocate special bandwidth for ICMP (internet Control Message Protocol) so that if the bandwidth usage on the client is full the ping time will increase and even RTO (Request time out). According to (Prasetya et al., 2023), Network Development Life Cyle (NDLC) is one of the methods used in developing methods in networks. Where NDLC has six (6) stages, namely Analysis, Design, Prototype Simulation, Implementation Monitoring and Management.

2. Methods

In this study the authors used the process at the stages of the Network Development Life Cycle (NDLC) method, which is one of the methods used in the development of methods in the network. Where NDLC has six (6) stages, namely Analysis, Design, Simulation, Prototype, Implementation, Monitoring and Management. This method is a method that is easy to control, flexible and can include developer strategies to be comprehensive where the entire team works as a unit to achieve the same goal. The stages in the development of the Network Development Life Cycle (NDLC) method (Siswanto et al., 2021), shown in Figure 1.

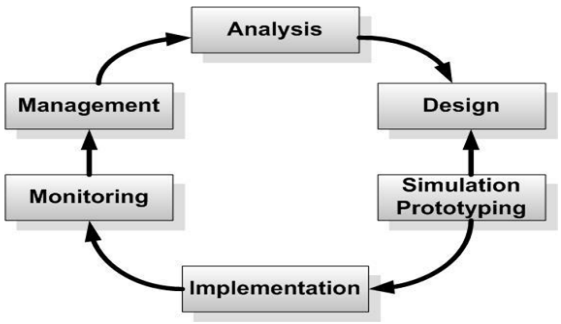


Figure 1. Network Development Life Cyle (NDLC) method

The stages in the development of the Network Development Life Cycle (NDLC) method are as follows:

a. Analysis is the first stage of research including problem analysis, and analysis of existing network topology.
b. Design is the second stage that researchers do, where in this design stage a depiction of the proposed existing network scheme architecture will be made.
c. Simulation Prototyping is the third stage that researchers do, where at this simulation stage will build a prototype system from the data that has been obtained in the previous stage using Cisco packet tracert software as a replica of the system to be run.Implementation of the fourth stage that researchers do, where at this stage the design specifications will be carried out including network configuration installation, hardware network installation (hadware);

d. Monitoring the fifth stage that researchers do, where at this monitoring stage testing of the network infrastructure that has been implemented runs or not;
e. Management is the sixth stage that researchers do, where at this management stage it regulates so that the system can run well and can last a long time.

3. Results and discussion

The author develops network technology that can monitor the existing network at CV. Ide Maju Berkarya and distribute capacity evenly to achieve existing results. According to the author, the company really needs the Network Development Life Cycle (NDLC) method, which is one of the methods used in developing methods in the network. Where NDLC has six (6) stages, namely analysis, design, simulation, prototype, implementation, monitoring and management (Siswanto et al., 2021).

3.1 Analysis

The stage of describing all the needs is used to describe the needs in detail with the aim of producing something new or updated (Kondaveeti et al., 2021). At this stage, the process of identifying the system concept is carried out, as well as defining the needs of a number of elements or components of the system.

3.1.1 Hardware requirements analysis

As for some of the hardware needed in the design of this computer network, we can see from the table 1.

Table 1. Hardware required

No	Hardware	Specifications
1	Server Computers	a. 9th Generation Intel® Core™ i7 processor b. 8 GB DDR4-2666 SDRAM (1 X 8 GB) c. 1 TB 7200 rpm SATA. d. Intel® UHD Graphics 630.
2	Mikrotik Routerboard	a. RB941-2Nd b. 4 port Fast Ethernet. c. Build-in Wireless 2.4Ghz (802.11b/g/n)
3	LAN Cable	a. RJ45 b. 10 Meter
4	*HUB*	a. TL-SG1016D b. port RJ45 Gigabit Auto-Negotiation, Support Auto MDI / MDIX
5	Repeater	a. TL – WA820RE b. 300Mbps USB WI-FI Range Extender
6	Router	a. TD- W9851ND b. 4 LAN Port

3.1.2 Software requirements analysis

There are several software applications that are also needed in building a computer network that we can see from the table 2.

Table 2. Required software

No	Software	Version
1	Windows	Win 10 (64 Bit)
2	Winbox	3.27
4	Telegram	8.8.3
5	TP- Link Tether	3.6.3

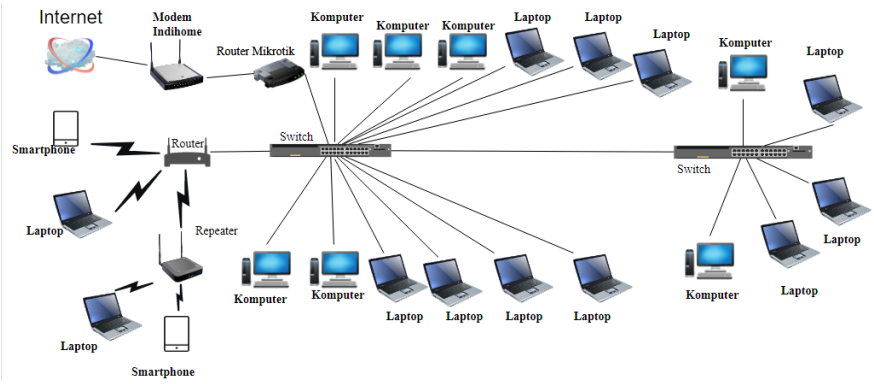
3.2 Design

The design stage is part of the design process of the network infrastructure to connect each client and server computer in CV Ide Maju Berkarya (Huda et al., 2021). Furthermore, the initial stage carried out is to choose the appropriate topology from the room in CV Ide Maju Berkarya. And User IP Adrees Design. We can see from the description below:

3.2.1 Network structure design

The following is part of several network structure drawings that will be applied according to the results of observing the space at CV Ide Maju Berkarya. The following is the design of the overall network structure at this stage is an overview of the overall design of the network being built and can be shown in Figure 2.

Figure 2. Overall network structure



3.2.2 IP Address usage design

At this stage, the IP address design in CV Ide Maju Berkarya is used in the network, and the distribution of this IP address is divided into 2 networks from the router. 1 network is used for Mikrotik Router Internet IP network, 1 network is used for Wifi IP network and LAN IP is used for LAN networks. The network division is shown in Table 3.

Table 3. User IP Address

Interface	Network address	Host range	Broadcast address
Internet	192.168.1.100/24	192.168.1.100 - 192.168.1.254	192.168.1.255
LAN	192.168.10.1/24	192.168.10.2- 192.168.10.254	192.168.10.255

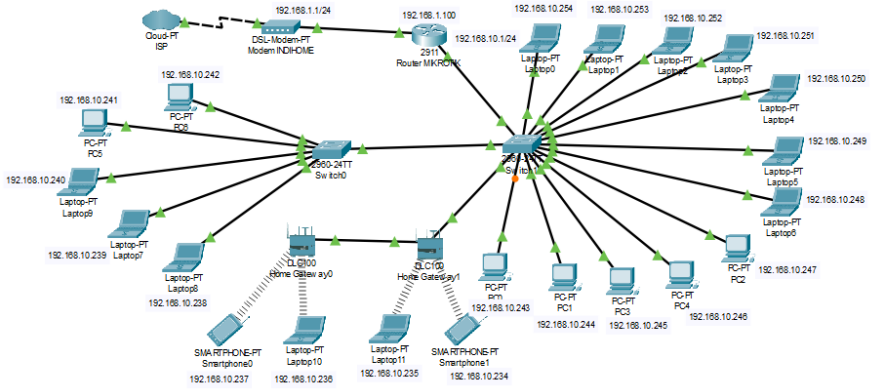
Table 3 can be explained that the Internet interface has an IP address of 192.168.1.100 - 192.168.1.254 and the subnet mask of the modem interface is 255.255.255.0. The IP address 192.168.1.1 will be used for the modem network gateway, will not be used by other clients. Then for the LAN interface, it can be explained that it has an IP address of 192.168.10.2 - 192.168.10.254 and the subnet mask of

the LAN interface is 255.255.255.0 IP address 192.168.10.1 will be used to give its IP address given by DHCP.

3.3 Network simulation

At this stage, the author selects the simulator that will be used in this research, namely using Cisco Packet Tracer Version 7.0, in this simulation process there are features that make it easy to design and build networks that have various real network capabilities in their configuration, so this will make network simulation in accordance with reality and in this case simulation can also make it possible to combine several levels. The network topology design after the application of supporting devices in network construction is shown in Figure 3.

Figure 3. Simulated network after



In Figure 3 shows that the network topology that the researcher wants to build and has implemented additional supporting devices in building the network, where there are proxy routers, switches, and the addition of two access ponit routers and repeaters that are interconnected and work together in the network so that employees at CV Ide Maju Berkarya can feel Internet access and connect to the network during working hours and break hours because the network that has been installed is already accessible and in simulation form ready for implementation.

3.4 Implementation

When implementing the network design using multiple supporting devices, the author installs from device installation to network settings using the Winbox application to configure and provide security on the network via proxy (Fachrurrozi et al., 2023; Owens, 2019; Safaei Pour et al., 2023).

3.4.1 Physical implementation

As for this stage, it can be seen that the installation of proxy devices, switches, routers in CV. Ide Maju Berkarya. which can be seen below in Figure 4.

Figure 4. Physical implementation

3.4.2 Configuration implementation

The stages of configuration implementation at CV. Ide Maju Berkarya there are several stages described below, as well as the results of the configuration.

a. Microtik configuration

Proxy configuration consists of several parts, from logging in to completing the configuration, as explained in each of the following sections:

1) Interface Settings The author makes settings in the Interface menu where in the Interface menu the author only changes the name on each Ether to make it easier for the author when doing other configurations, here the author changes ether1 = Internet and Ether2 = LAN.
2) IP Address Configuration At this stage the author enters Ip Adrees in accordance with the Interface that has been created by the author entering Ip 192.168.1.100/24, the Intefacenya The author chooses the Internet because the Ip is for the internet, and in the network the IP will automatically appear after selecting the applay. Next do the same thing add another IP to the address list, namely the IP for LAN = 192.168.10.1/24. We can see the results in the picture below.
3) Gateway Configuration in this configuration the author enters the Gateway in the routes menu for the IP on this Geteway It must be in accordance with each internet provider used here the author uses indihome So for indihome Gateway IP is 192.168.1.1.
4) 4) Firewal Configuration at the Firewall configuration stage, the writer adds mascurade to the NAT menu. It can be explained that the Mikrotik Router in this scenario is a router that is between the public network (internet) and the Local LAN network. Routers in this position must run Network Address Translation (NAT) which functions to change the IP address on each data packet that comes out of the user device (Private IP Address) to a public IP Address. For out.interface select internet, then select Action then select mascuerade which we can see in the picture below.
5) DNS configuration at this stage is part of mapping hostnames or sites on the internet into IP addresses. Based on the scenario, the DNS Server used is the Google DNS Server with an IP address of 8.8.8.8 which will make the Mikrotik Router a DNS Server as well. So that later the DNS configuration on the user device is simply directed to the Mikrotik Router, and no longer directed to the ISP's DNS Server. This technique can save bandwidth because DNS queries will only be given to the Mikrotik Router.

b. Access point router configuration

Next on the quick start page - Wlan dpda at this stage I only change the SSID and Pre-Sharde key where for SSID = IMB and for Pre-Sharde key = ImbLantai1 then select Next.Next enter the Quick Star complete page on this page the end of the configuration in Quick Star. And to save the results of what has been edited above, select next. That way it is automatically saved. From the several stages above, the configuration of the Access point Router section using the TP-LINK TD-W8951IND router model has been completed.

c. Access point repeater configuration

The repeater configuration consists of several steps using hardware devices, namely Samsung HP and TP-Link Extender model TL-WA820RE. As well as using the Tether application provided by TP-Link which can be downloaded at the play store. Which has several stages that can be explained below. The

first stage turns on the TP-Link Extender model TL-WA820RE. Connect the TP-Link Extender device with a mobile phone using WI-FI. Then select the WI-FI that you want to connect with the TP-Link Extender, namely IMB. Next, enter the WI-FI IMB password then select next. At this stage I only changed the SSID = IMB_LT1 which is to distinguish the WI-FI router on the second floor from the repeater on the first floor.

d. Bandwidth management configuration

Bandwidth management configuration consists of several steps where I use a Mikrotik router and Winbox software and use the Simple Queue method in Bandwidth Management at CV. Ide Maju Berkarya. The first step is to create a parent in the Simple Queue with IP subnet by logging into Mikrotik using winbox and entering the Queue section > Simple Queue > click icon +> Name: TrafficLocal > Destination: 192.168.10.0/24 > Max Limit: 50M / 50M (Target Upload / Target Download). Then select Apply and ok. The next stage is to enter a script on the DHCP server where this script will be used for bandwidth management where each user or device connected to the network will be listed in CV. Ide Maju works will be listed in a simple queue list where the Mac Address, IP of each device, with Max Limit: 45M/45M (Target Upload/Target Download) and Limit at: 25M/25M (Target Upload/Target Download) by using the parent that has been created. By entering IP> DHCP Server> double click on dhcp1> input script. Then select Apply and Ok.

e. Configuration of network monitoring via Telegram

Configuring network monitoring via Telegram at CV.Ide Maju Berkarya consists of several steps where I use winbox and Telegram software. Where the steps are explained below. The first step that must be done is to create a Telegram Bot. open the Telgram application, then search for the @BotFather account then we chat by just clicking on the account, then click Start and type /newbot. Next create a bot name, the /newbot command is used to create a new bot. In this step I created a bot with the name NetworkComputerImb_bot. After the name is verified and there is no duplication of names, the Bot is successfully created. Then information about the HTTP API Token appears, please note it because this token is used in the script later. Furthermore, the author creates a group in telegram where this group functions to send network monitoring traffic in CV. Ide Maju Berkarya by entering the telegram bot that has been created. With the name IMB_Monitoring_Network Group. The next step is to enter the script in the winbox by selecting system> Script> click +> enter the script in the source column. Then choose Apply and ok. Next, create a schedule to run the monitoring script where the script functions to send traffic messages in telegram. For this CV. Ide Maju Berkarya, the author makes 2 schedules. Where the schedule is made to run the script at 10:30 and 15:00. By way of system> Schedule> click +> Name: Monitoring1 > Star Time: 10:30 > Interval: 1d > input the command to run the script on On Event. Then choose Apply and ok. Then do the same thing to create monitring2, system > Schedule > click + > Name: Monitoring2 > Star Time : 15:00 >Interval: 1d > input the command to run the script on On Event. Then choose Apply and ok.

f. WI-FI Portal Login Configuration

At this stage the author creates a login portal for the Wi-FI network in CV. Ide Maju Berkarya. this portal login has several stages. The first stage enters the templet that has been created on the proxy by entering the file menu in the winbox then copying the templet file on the file menu. Then enter IP> Hotspot> Server> Hotspot Setup> HotSpot Interface: LAN then select next. For the next DNS Name input here the author enters the DNS Name: IMB.net then select next. Next, enter the user and password to log in to the network at CV. Ide Maju Berkarya. then choose next. Select Hotspot Server

Profile select Hostpot with DNS Name IMB.net, then in the HTML Directory select the templet file that was copied in the file menu. Then choose Apply and ok.

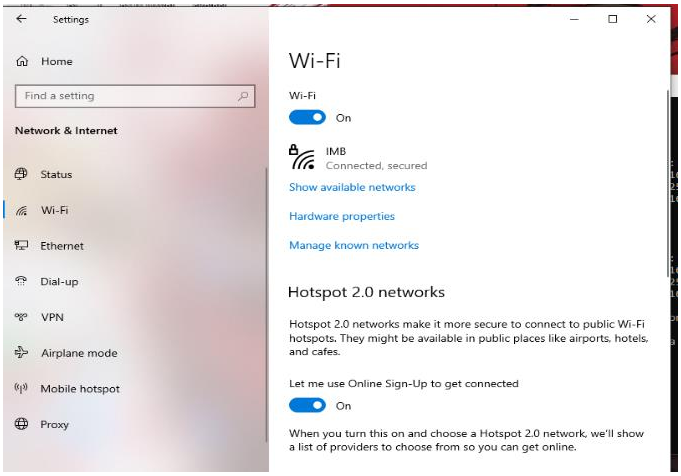
3.4.3 Implementation of configuration results

The implementation of the results of this configuration shows the results of the configuration made at CV. Ide Maju Berkarya which is described below:

a. Router configuration results

In the picture below is the result of configuring the TP- Link Router model TD-W8951ND with the name WI-FI: IMB where this Router Access point can already be used by employees at CV. Ide Maju Berkarya.

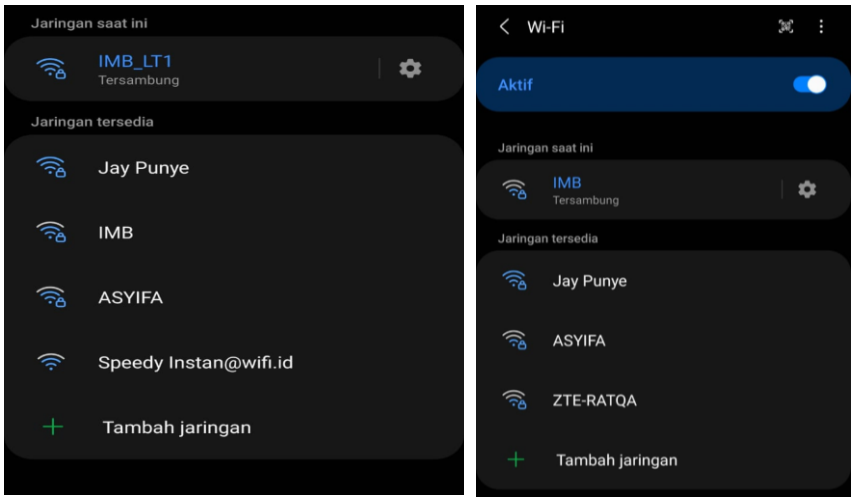
Figure 5. TP-Link Router configuration results



b. TP-Link extender configuration result

The results of the TP-Link Extender configuration can be seen in Figure 5 which shows the results after installing the TP-Link Extender at CV. Ide Maju Berkarya succeeded by displaying the SSID: IMB_LT1 and a Stable WI-FI signal, then you can see in Figure 6 which shows the results before installing the TP-Link Extender at CV. Ide Maju Berkarya only has one WI-fi which when the user uses wifi on the first floor gets a little signal, making the internet connection often slow and disconnected.

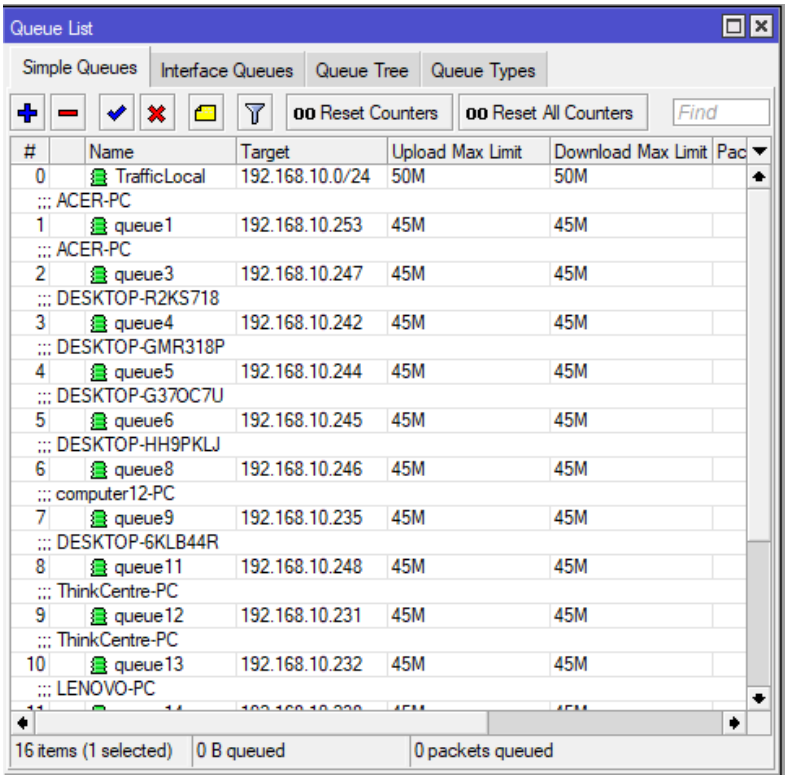
Figure 6. TP-Link extender configuration results



c. Bandwidth management configuration result

The figure below shows the results of the Bandwidth Management configuration where each user who uses the internet network at CV. Ide Maju Berkarya gets a limitation evenly.

Figure 7. (a) Bandwidth management configuration results, (b) Results before bandwidth management, and (c) Results after bandwidth management



(a)

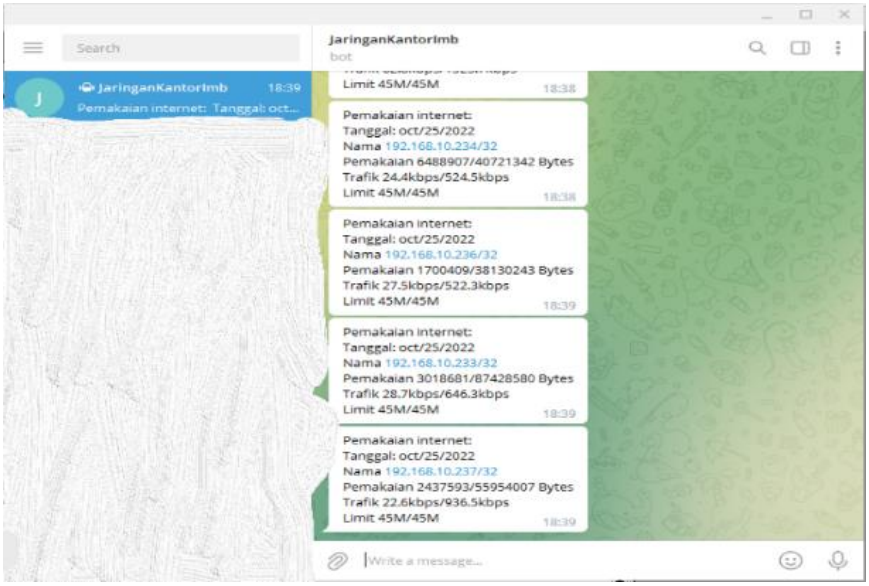
(b)

(c)

d. Configuration results of network monitoring via Telegram

In Figure 8 shows the results of monitoring via Telegram, which is by creating a Telegram bot that is connected to the existing network at Cv. Ide maju Berkaraya using proxy displays the usage traffic of each user in CV. Ide maju Berkarya.

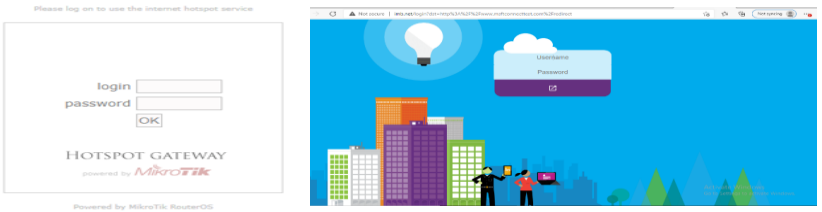
Figure 8. Network monitoring configuration via Telegram



e. WI-FI portal login configuration result

Figure shows the Default Login Page from proxy and a picture showing the results of the WI-FI portal configuration where the Login page has changed.

Figure 9. Default login and portal login pages

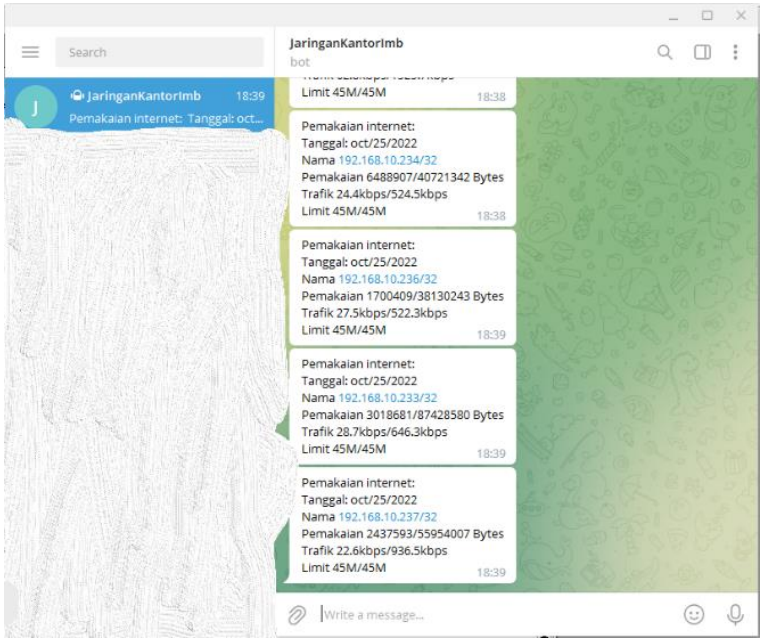


3.5 Monitoring

At the monitoring stage, the process is carried out to monitor the network that was built and this monitoring can see the success of the previous stages, with this because in this monitoring the author and the admin can later find out the errors or successes of the network that have been built at the monitoring results stage. In Figure 10 (a) a network speed test is carried out with speedtest, and in Figure 10 (b) it can be seen the results of monitoring traffic usage via Telegram in CV. Ide Maju Berkarya.

Figure 10. (a) Network speed test with speedtest and (b)

(a)



(b)

3.6 Management

From the 5 stages above, it is certain that the computer network built at CV. Ide Maju Berkaraya has been running well, and has a long period of use. The network that is formed is also very helpful in the work of employees at CV Ide Maju Berkaya. With well-designed bandwidth management to limit upload and download speeds so that the speed of internet access for other activities can be maximised.

4. Conclusion

Based on the results of the discussion of writing in all sections regarding Computer Network Design Using the Simple Queue Method at CV. Ide Maju Berkarya, the authors put forward the following conclusions:

a. In the Design of Computer Networks Using the Simple Queue Method at CV. Ide Maju Berkarya, the author has designed a network that can monitor the network, distribute the capacity of the network that is evenly distributed and add access points on the first floor with results that run well, where previously the network in the company did not have an uneven distribution of network capacity which often resulted in slow and disconnected when using the network.

b. The role of the Network Development Life Cycle (NDLC) method in this research has gone well, so that it can facilitate the implementation of making the system built from scratch until the system is ready for use.

Based on the conclusions that the author has made, the author puts forward several suggestions that can be used as input and consideration by the company CV. Ide Maju Berkarya. These suggestions include:

a. Improving the quality of internet speed in provaider because the needs of every user who uses the network increase with the times.
b. Implementing Web Proxy, where a web proxy is a server computer that acts as another computer to receive or request content from an internet network, with the aim that later users who use the internet. Forward Working Idea access rights are limited, meaning that there are certain websites that cannot be accessed or there are several websites that can be accessed but with certain times and hours.
c. Implementing Firewalls with Network Security using several software, one of which is the Intrusion Detection System (IDS) with the aim of being able to detect suspicious activity in a system or network.
d. Implement Load Balance because Load Balance itself is a technique for dividing the load into several link paths, with the aim that no link gets a bigger load than other links. It is hoped that by dividing the load into several links, there will be a balance in the use of existing links in an Autonomous System (AS).

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Declarations

Author contribution

Abdul Rohmad Basar as research implementer, designing media and collecting data. Novi Hendri Adi as research and article concept designer. Raja Hayri Gunawan as research and article concept designer. Siti Afiat Jalil as proof-reader.

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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical clearance

There are no human subjects in this manuscript and informed consent is not applicable. The research company has agreed to carry out the research and is willing if the results of this research are published.

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