Analysis of Internet Quality on Fiber Optical Networks in Kampung Kali Ulu Using the Quality of Service Method

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Abstract: **Kali Ulu Village has a LAN internet network service that uses fiber optic cables as a connecting medium between computer networks. Quality of service (QoS) is a way of measuring how good or bad a network service is. The parameters (QoS) are delay, throughput, packet loss and bandwidth according to THIPON standards. In residents' houses 1 - 4 in Kali Ulu Village, the available bandwidth is 100 Mbps and the capacity per house is 10 Mbps. Therefore, measurements are really needed to see how good the service quality is in Kali Ulu village between houses using the Axence Nettol application to find out the results of delay, throughput, packet loss values and accessing http://www.speedtest. net/ to measure bandwidth. The results of the measurements (QoS) on the fiber optic network in Kali Ulu village, can first be seen from the results of the bandwidth measurements, the average download speed is "102.31Mbps" and the average upload speed is "101.23 Mbps", the average value delay is "146ms" which means included very good category because < 150 ms, the average packet loss value is "0%" which is included in the Very Good category because <3% and the average throughput value is "2.0 Mbps" which means it is included in the Very Good category because > 1.2 Mbps.**

Keywords: **Quality of Service (QoS), Bandwidth, Delay, Throughput, Packet Loss.**

1. Introduction

In everyday life in the modern era, we cannot be separated from the internet network, starting from the world of business, education, government, etc. The emergence of internet networks is in line with the rapid development of telecommunications technology. The internet is applied as a communication tool or to facilitate the flow of information easy for every user. The internet is connected by a variety of electronic, wireless and optical network technologies.

In Kali Ulu village itself, the LAN internet network service uses fiber optic cables as a connecting medium between computer networks to support operational facilities and infrastructure. You need to know that fiber optic cables have the same function as other computer network cables, but what differentiates this type of cable is that it is made of glass or very smooth plastic, and is used as a transmission medium because it can transmit light signals from one location to another. others at high speed.

Quality of Service (QoS) or Quality of Service is an evaluation method used to ensure network capabilities, such as network applications, hosts, or routers to supply effective and more planned network services that meet service needs. QoS is a network related to the speed and ability to provide various types of data in a communication, which allows network administrators to prioritize certain traffic. The QoS parameters consist of bandwidth, delay, throughput, packet loss which functions to determine the quality of internet network services according to the QoS presentation by using the application axence nettolls and speed test. The aim of this research is to support network performance, to determine bandwidth capacity, and to determine network quality for each parameter.

2. Library Survey

A. Analysis

Analysis is an attempt to uncover a problem or focus of study into parts (decomposition) so that the structure/order of the form of something being described is clearly visible and therefore the meaning can be more clearly understood or the problem can be more transparently understood [1].

B. Internet

Internet is an abbreviation of Interconnected Networking which can be interpreted in Indonesian as a series of computers connected in several networks [2].

C. Quality of Service (Quality of Service)

Table 1
Percentage and Value of QoS

Mark	Percentage (%)	Index
3, 8 – 4	95 – 100	Very satisfactory
3 – 3,79	75 - 94,75	Satisfying
2 – 2,99	50 – 74,75	Less Satisfactory
1 – 1,99	25 – 49,75	Signs

Quality of Service (QoS) is a measurement discussing how good the network is and is an attempt to define the characteristics and properties of a service. QoS is used to manage a set of performance attributes that have been specified and associated with a service. QoS refers to the network's ability to provide good service to certain network traffic through

different technologies [3].

D. *Parameter Quality of Service (QoS)*

The following are several characteristics for measuring service quality in a network internet [4]:

1) Throughput

Throughput namely the speed (rate) of effective data transfer, which is measured in bps (bit per second). Throughput is the total number of successful packet presences observed at the destination while a certain time interval is divided by the duration of that time interval. Category Throughput shown in table 2.

Table 2
Categories Throughput

Categories Throughput	Throughput (bps)
Very good	>1.200 Kbps
Good	700 – 1.200 Kbps
Currently	338 – 700 Kbps
Signs	0 – 338 Kbps.

Source: TIPHON

Calculation equation Throughput:

$$Throughput = \frac{Data\ packet\ received}{Long\ observation}$$

2) Packet loss

Packet loss is a parameter that describes a condition that indicates the total number of packet losses that can occur due to collision and congestion on the network. Index and categories packet loss shown in table 3 [5].

Table 3
Categories packet loss

Degre dation Category	Packet Loss (%)
Very good	0
Good	3
Currently	15
Signs	25

Calculation equation,

$$Packet\ Loss = \frac{Data\ packet\ received}{Sent\ data\ packets} \times 100$$

3) Delay

Delay is the time required for data to travel the distance from origin to destination. Delay can be influenced by distance, physical media, congestion or long processing times. In table 4, the categories of delay and big delay [6].

Table 4
Categories Delay

Category Delay	Large Delay (ms)
Very good	< 150ms
Good	150ms s/d 300ms
Bad	300ms s/d 450ms
Very Bad	>450ms

Source: TIPHON

Calculation equation,

$$Delay = Total\ packets\ received - Average\ delay$$

4) Bandwidth

Bandwidth The bandwidth used for data transmission or network speed that different applications require bandwidth different.

E. *Optical Fiber*

Optical fiber is a LAN cable made from glass and plastic tubes that is capable of transmitting light, which is then converted into sound, speech or information. These cables use light pulses to carry and transmit data from point to point. Fiber optic cables are capable of transmitting data and signals over more bandwidth and at faster speeds than traditional copper or aluminum cable lines. It can be used in various data transmission applications [2].

3. Research Methodology

A. *LAN Network Identification*

First, let's get to know what is called or what is meant by a LAN network, which is the first thing that must be discussed before starting to analyze the quality of internet services at Kali Ulu village. (SAP), Local Area Network is a computer network whose network only covers a small area, such as a campus computer network, building, office, home, school or smaller, where there are a number of computer units client and 1 PC unit as server. In general, LAN is used to connect each other client nor client the server to share with each other file as well as a means for exchanging information on PC units connected to the internet network (LAN). Functions of the computer client is like a connecting medium for accessing data or files on a PC server, meanwhile the computer server to serve computer needs client that is, like information.

B. *Topology Design*

Based on observations and collection of data obtained directly from the homes of residents 1-4 in Kali Ulu village

Fig. 1. Topology of the Kali Ulu village network
Source: Kp. Kali Ulu (2023)

C. *Research Variables*

In this research, measurements Quality of service (QoS) in LAN networks there are four main variables, namely:

1) Understand bandwidth available

It's getting bigger bandwidth that is available, the larger the data package you get each time, the better the internet access speed you use and the most important thing to pay attention to

is the number of other users who use the network.

2) Understand the big delay

The bigger the number delay displayed by the application Axence NetTools on the monitor screen in one of the networks, the worse the quality of the network. Vice versa, if the value of the number recorded is smaller, make sure the quality of the network better. So what causes the slow delivery of a data packet is numbers delay the big one.

3) Understand the amount packet loss

The smaller the value displayed in the application Axence NetTools the better the quality of the internet network, and vice versa, the greater the value, the worse it is network quality. So, value packet loss The larger it is, the data packets obtained can be lost or reduced.

4) Understand Throughput

Throughput the same as the explanation of understanding in bandwidth that is, it gets bigger bandwidth available, the larger the data packets received every second. Throughput is the actual bandwidth measured at a certain time on a specific internet route when downloading. What's different throughput with bandwidth is throughput concluded at the actual speed that occurs when transferring data while bandwidth concluded at the maximum speed possible when transferring data.

D. Analyzing QoS LAN network

The following are the steps used by researchers to analyze the LAN network in residents' homes in Kali Ulu village by following the research method. action research and here are the steps:

1) Initial Stage (Diagnosing)

Carrying out the diagnosis, in this initial stage the researcher understands the problem of identifying the standard problems required, so that the main basis for this research is analyzing the LAN network scheme, as in this step then the researcher looks at the first data, namely bandwidth, The initial data I got in Kali Ulu Village is bandwidth available in KP Kali Ulu is 100mbps and capacity bandwidth the floor is 10 Mbps.

2) The second stage (Action Planning)

In the last step the researcher begins a plan to carry out measurements where the researcher will design an action plan such as starting to measure bandwidth, delay, throughput and packet loss. measurement of accessing parameters website speed test by Ookla to measure bandwidth and use the application Axence nettools for measurement delay, throughput and packet loss.
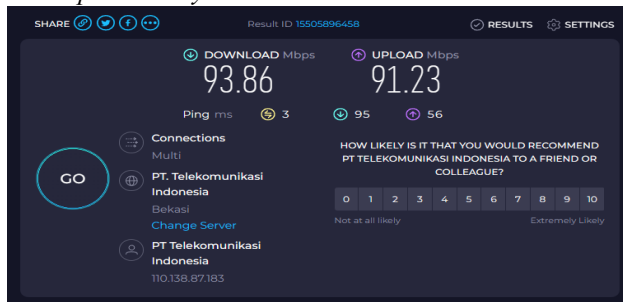
1. Speed test by Ookla
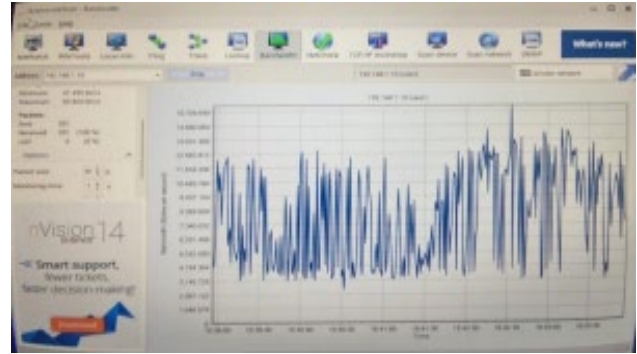

Fig. 2. Speed test by Ookla
Source: https://www.speedtest.net/

2. Axence nettools

Fig. 3. NetTools Windows Layout
Source: http://www.axencesoftware.com

3) Third stage (Action Taking)

In this third step, researchers will carry out an action plan and test the network Local Area Network (LAN) in Kali Ulu village. This test was carried out in four residents' homes. So, the monitoring system model is used to evaluate parameters QoS related to the fiber optic LAN network in Kali Ulu village, namely monitoring application.

4. Results and Discussion

Method system monitoring QoS (Quality of Service) which is used for measuring accessing parameters website speed test by Ookla to measure bandwidth and use the application Axence nettools for measurement delay, throughput and packet loss on the internet network in the homes of residents 1 – 4 in Kali Ulu village. In this section, we will explain the process of action plans that have been created or compiled. Definition of QoS parameter measurements using the application Axence NetTools namely by sending a packet and overloading it with a certain packet size to the IP address (IP network 192.168.1.10) in Kali Ulu village, for each device and wait for a response from node sender (source) to node recipient (destination) in the IP layers of the network scheme to be measured. Then take information on the values of QoS parameters (Quality of Service) from data packet traffic and collect and print data packet traffic information will then be sent for monitoring application.

Measuring QoS parameters using the application axence NetTools and access website on the internet speed test by Ookla, carried out over 4 days starting from 12 November 2023 to 16 November 2023, divided into 2 measurement times, namely morning measurements at 08.00 – 12.00 WIB and afternoon measurements, 14.00 – 18.00 WIB. Measurements were carried out in four residents' houses which were carried out in 1 (one) day for 1 house. Measurements were made using 1 laptop and 1 a LAN cable in every house.

A. Discussion of QoS Measurement Results

The results obtained from the application of QoS parameter measurements are bandwidth, delay, throughput and packet loss as explained above, where the measurement procedure uses website speedtest.net and apps Axence NetTools done in every house. Below are the measurement results:

1) Bandwidth

Results obtained from measurements Bandwidth with speed test from houses 1 - 4 are the following results:

The table above explains the highest download speed, namely 102.31Mbps and the highest upload speed is 101.23 Mbps. Meanwhile, the lowest download speed is 4.45 Mbps and the lowest upload speed is 4.60 Mbps.

Fig. 4. Measurement results bandwidth with speedtest.net

From the picture above it shows that the ping speed is 3ms, speed download is 93.71 Mbps and upload speed is 90.58 Mbps.

B. Delay

Delay is the time required for data to reach the distance from origin to destination.

From the description of the results in the table above based on the TIPHON table values, the delay category, in house 1 (Akbar) in the morning and afternoon hours is categorized as very good, house 2 (Izan) in the morning is categorized as good and in the afternoon it is categorized as very good, At home (Sandi), the morning & afternoon hours are the same as at Akbar's house, everything is very good and finally at home 2 (Ari) in the morning it is in the good category and in the afternoon it is categorized as moderate. The following is the manual calculation formula for the equation in delay.

Total packets received – average delay

For example: 64 - 6: 58 (including categorized as very good)

Fig. 5. Measurement results delay with Axence Nettools

Application Axenxe NetTools is what is used to calculate delay from measurement to IP server above shows the results lost 0, avg, min 0, max 4 which means the image above is included in the very good delay value category.

C. Packet Loss

Packet loss is the number of packets lost during the transmission process which is measured in percent.

From the table above, based on the TIPHON version table values, then category Packet Loss All houses 1 - 4 are categorized as very good. The following is the manual calculation formula for the equation Packet Loss:

$$Packet\ Loss = \frac{Data\ packet\ received}{Sent\ data\ packets} \times 100$$

For example,

$$Packet\ Loss = \frac{0}{148} \times 100 = 0\%$$

Researchers use applications Axenxe NetTools to count Packet Loss from measurement to IP server above shows the results sent 148, lost 0, %lost 0 which is included in the very

Table 5
Bandwidth House 1- 4

No.	Location	IP	Jam	Ping	Download	Upload
1	Akbar	192.168.1.10	10.20 WIB	3ms	93.71 Mbps	90.58 Mbps
			18.00 WIB	2ms	102.31 Mbps	101.23 Mbps
2	to be	192.168.1.5	08.40 WIB	5ms	10.24 Mbps	10.54 Mbps
			14.19 WIB	7ms	7.74 Mbps	10.45 Mbps
3	Nardi	192.168.1.11	09.09 WIB	5ms	5.91 Mbps	5.74 Mbps
			17.22 WIB	7ms	4.45Mbps	5.60 Mbps
4	Armin	192.168.1.6	11.41 WIB	6ms	4.67 Mbps	4.65 Mbps
			16.02 WIB	8ms	5.34 Mbps	5.40 Mbps

Table 6
Delay between houses 1 – 4

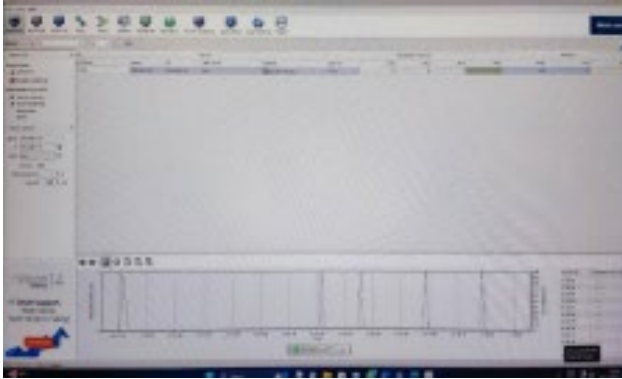| Host | | Jam | Response Time | | | | |
O	Location		Last	Avg	Min	Max	Siphon
1	House 1 Akbar	10.20 WIB	0	0	0	1	Very good
		15.33 WIB	0	0	0	2	Very good
2	House 2 Izan	08.40 WIB	0	0	1	3	Very good
		14.19 WIB	0	0	2	3	Very good
3	House 3 Nardi	09.09 WIB	0	0	1	3	Very good
		17.22 WIB	0	0	2	4	Very good
4	House 4 Ilham	11.41 WIB	0	0	3	4	Very good
		16.02 WIB	0	0	3	3	Very good

good group from the figure below.

Fig. 6. Measurement results packet loss with Axence NetTools

D. Throughput

Throughput described by sending or charging a certain number of packets from a company workstation source to servers. Variable The reception time and how many packets are received during that time are two important measurements. Result of Throughput expressed in units of bits per second (bit/s). Based on value throughput with the THIPON version as standardized for value Throughput.

From the table above, based on the TIPHON version table values, it becomes a category Throughput in houses 1, 2, 3 and 4, it is categorized as very good. The following is the manual calculation formula for the equation Throughput:

$$Throughput = \frac{Data\ packet\ received}{Long\ observation}$$

$$For\ example, = \frac{2.8}{137} \times 100$$

The Fig. 7 produces results minimum throughput in bit/s form it is 136 200, in Kbps form it is 136 Kbps and in Mbps form it is 0.13 Mbps. Results maximum throughput in the form

of bit/s is 5.729.232 bit/s, in the form of Kbps is 5.729 Kbps, and in the form of Mbps is 5.7 Mbps and the following results Average (on average) in bit/s form it is 2,515,076 bit/s, in Kbps form it is 2,515 Kbps and in Mbps form it is 2.5 Mbps. That is the measurement of application assistance Axence NetTool that researchers use.
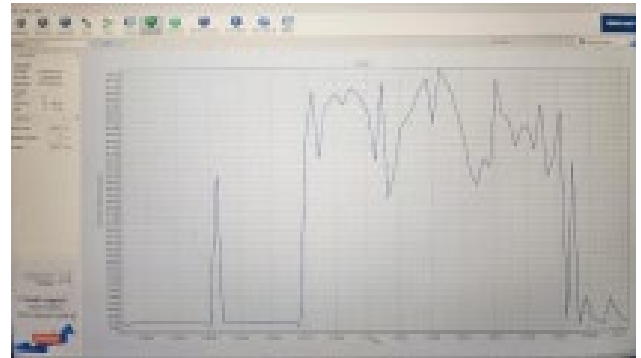

Fig. 7. Measurement results throughput with Axence NetTools

5. Conclusion

Observation and analysis measurement results Quality of Service (QoS) on the fiber optic internet network in Kali Ulu Village, especially in the homes of residents 1 – 4, conclusions can be drawn, namely:

1. The bandwidth capacity at home is 100 Mbps and capacity bandwidth each house is 20mbps where bandwidth in houses 1 – 4 have been managed regularly for each user which aims to support network performance.
2. Big or small bandwidth existing or available ones greatly influence the QoS performance of an internet network. After knowing the capacity bandwidth, the following are the results of observing access speed client on measurement bandwidth in houses 1 – 4, the average download speed is 102.31 Mbps and the average upload speed is 101.23 Mbps.
3. Parameter delay which is based on THIPON version,

Table 7
Packet Loss Houses 1 - 4

No.	Location	IP	Jam	Packet Loss			THIPON
				Sent	Loss	% Loss	
1	House 1	192.168.1.10	18.00 WIB	133	0	0	Very good
			08.40 WIB	124	0	0	Very good
2	House 2	192.168.1.5	14.19 WIB	136	0	0	Very good
			09.09 WIB	141	0	0	Very good
3	House 3	192.168.1.11	17.22 WIB	121	1	1	Very good
			11.41 WIB	148	0	0	Very good
4	House 4	192.168.1.6	16.02 WIB	158	0	0	Very good
			18.00 WIB	141	0	0	Very good

Table 8
Throughput Houses 1 - 4

No.	Location	IP	Jam	Minimum	Maximum	Rate-rate
1	House 1	192.168.1.10	18.00 WIB	22 119 416 bit/s	45 120 788bit/s	40 341 296 bit/s
			08.40 WIB	26 192 336 bit/s	29 112 253 bit/s	42.337.895bit/s
2	House 2	192.168.1.5	14.19 WIB	701 776bit/s	6 790 800bit/s	4 699 931bit/s
			09.09 WIB	944 776bit/s	5 592 272bit/s	4 991 982bit/s
3	House 3	192.168.1.11	17.22 WIB	2 104.144 bit/s	4.955.112 bit/s	4.716.424 bit/s
			11.41 WIB	3 040.168 bit/s	5.475.184 bit/s	3.045.403 bit/s
4	House 4	192.168.1.6	16.02 WIB	750.200 bit/s	4.481.864 bit/s	3.493.830 bit/s
			18.00 WIB	956.472 bit/s	4.991.808 bit/s	2.728.503 bit/s

that measurement delay in houses 1 – 4 in Kali Ulu village, shows the average value delay is 146ms which means it is in the very good category.

4. On parameters QoS that is packet loss which is based on THIPON version, that measurement packet loss in houses 1 – 4 in Kampung Kali Ulu, shows the average value packet loss is 0% included in the Very Good category.

5. In QoS parameters, namely throughput which according to the THIPON version, that measurement Throughput in the Kali Ulu village, houses 1 – 4, show the average value Throughput is 2.0 Mbps which means it is included in the Very Good category because it is >1.2 Mbps.

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