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Performance and quality measurement of internet network services at Muhammadiyah University of Surakarta's Faculty of Health Sciences with QOS parameter

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ABSTRACT

In this fully digital age, a lot of individuals require an internet connection. A reliable network must be able to handle this need. Therefore, a stable network needs to establish and maintained correctly. A reliable internet connection is required at Muhammadiyah University of Surakarta's Faculty of Health Sciences to enhance student and lecturer activities in the educational process. This study will analyze the University of Muhammadiyah Surakarta's Faculty of Health Sciences internet network quality. Using Quality of Service (QOS) methods, the study estimated the quality performance of the existing network. The test measures the throughput, jitter, delay, and packet loss parameters using Wireshark. The result revealed that the Faculty of Health Sciences at the University of Muhammadiyah Surakarta had a very good internet network, with a throughput value of 403.487 kbit/s and an index of 4 indicates an Outstanding category, a packet loss value of 6.2% with an index of 3 indicating a good category, a delay value of 16.691 ms with an index of 4 indicates an Outstanding category, and the last is the jitter value of 0.04913 ms with an index of 3 indicating an Outstanding category. Overall, the QoS value of internet network services at the Faculty of Health Sciences, University of Muhammadiyah Surakarta, is 3,5 or 87.5% in the satisfactory category.

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1. Introduction

The development of information technology today is so fast and makes it easy for humans to overcome the problems they face. The development of information technology is currently advancing with the emergence of new technology that we often call internet technology [1]. The Internet is a broad network system that connects computers around the world. Internet services allow anyone to have access and be connected. Internet builds new prospects in communicating without limits [2]. The rapid development of the Internet requires qualified Quality of service (QoS) services. Quality of Service (QoS) is the ability of a network to provide good service by providing bandwidth, overcoming jitter and delay [3]. The quality of service (QoS) parameter describes how rapidly, and reliably different types of data are delivered in communications. QoS refers to the ability of a network to provide better service to a given network traffic through different technologies [4]. Quality of Service is designed to help end users be more productive by ensuring that users get reliable performance [5]. QoS offers the ability to define the attributes of the network services provided, both qualitatively and quantitatively [6].

In the field of education, the internet is used to support every learning activity. One of them is education at the tertiary level. In supporting lecture activities, universities usually provide an internet network for students and lecturers. In fulfilling the need for internet access, we have seen a lot of various technologies that have been raised to support human convenience in getting qualified internet access anywhere and anytime [7]. However, some problems are often encountered in internet network protocols, namely network damage caused by many things that cause problems with network protocols so that network quality does not work normally and sometimes network damage occurs [8]. The occurrence of problems or poor network connections can disrupt the process of teaching and learning activities [9]. One of them is at the Faculty of Health Sciences, University of Muhammadiyah Surakarta (FIK-UMS). FIK-UMS has 4 Departments namely Physiotherapy, Nursing, Nutrition, and Public Health as well as 7 study programs. FIK-UMS provides internet network facilities for students and lecturers. The connectivity of every user in the internet network is very necessary so that lectures and administration activities can run smoothly, besides that good network quality can support the productivity of students, lecturers, and all teaching staff. This study was conducted to evaluate the effectiveness of internet network services, including Quality of Service (QoS) parameters such as throughput, packet loss, delay/latency, and jitter.

2. Method

The materials required, the tools used, and the method for doing the research was all part of the research methodology used in this study. The internet network of Muhammadiyah University of Surakarta's Faculty of Health Sciences serves as the research material. To gather the necessary parameter values and calculate the Quality-of-Service value, we require the software Wireshark. An Asus m409 laptop with an AMD Ryzen 3 3200U processor served as the study's device. The following flow chart illustrates the research flow process:

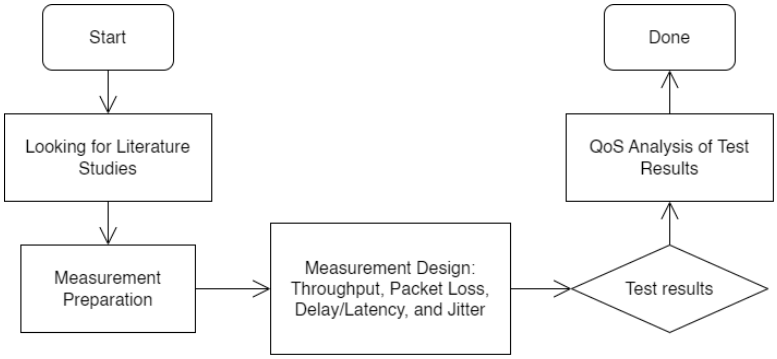


Figure 1. Research flow

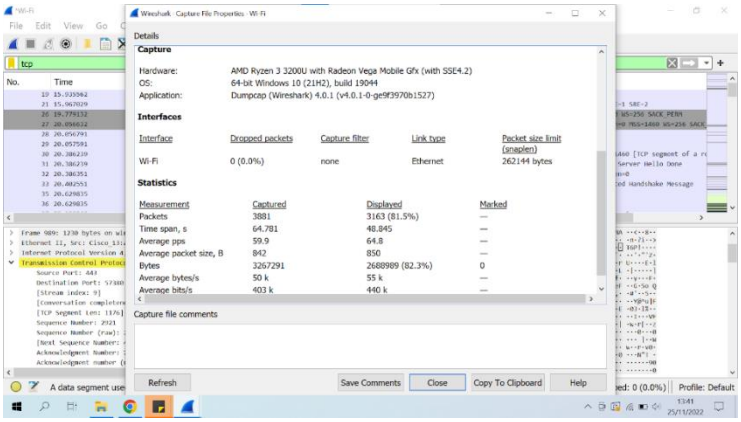
To get started, this research explores the literature for research regarding service quality (QoS). The next step is to measure and gather information on the QoS characteristics of throughput, packet loss, delay/latency, and jitter.

The Wireshark tool is used by the author to keep track of QoS parameters. A free and open-source packet analyzer is called Wireshark. Wireshark is capable of monitoring packets on the network types supported by pcap [10]. These tools are frequently used in network troubleshooting, software development, and communication method formation. Network packets are captured using pcap by the cross-platform Wireshark tool.

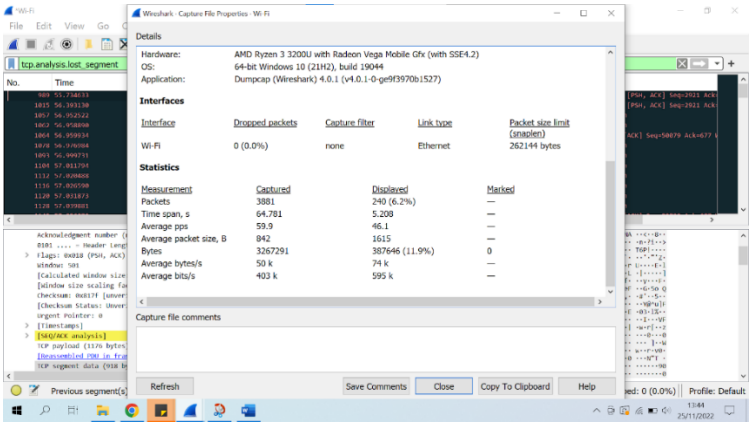
3. Results and Discussion

3.1.Network monitoring results at FIK UMS

Image of packet loss monitoring results can be seen in Figure 2.



(a)



(b)

Figure 2. Image of packet loss monitoring results (a) all capture data and packet loss (b)

This study uses network data from FIK-UMS. Network data can be seen in Table 1.

Table 1. Monitoring data results

No	Time 1	Time 2	Delay
1	0	0,408173	0,408173
2	0,408173	0,714418	0,306245
3	0,714418	1,53623	0,821812
4	1,53623	3,375643	1,839413
5	3,375643	3,694299	0,318656
6	3,694299	5,318586	1,624287
7	5,318586	5,731067	0,412481
8	5,731067	6,137019	0,405952
9	6,137019	8,695411	2,558392
10	8,695411	9,005103	0,309692
11	9,005103	9,619113	0,61401
12	9,619113	9,621891	0,002778
13	9,621891	9,822801	0,20091
14	9,822801	10,642094	0,819293

15	10,642094	10,642094	0
16	10,642094	10,953416	0,311322
17	10,953416	11,87026	0,916244
18	11,87026	15,935562	4,065302
19	15,935562	15,961687	0,026125
20	15,961687	15,967029	0,005342
21	15,967029	18,931741	2,964712
22	18,931741	19,646579	0,714838
23	19,646579	19,767916	0,121337
24	19,767916	19,77788	0,009964
25	19,77788	19,779132	0,001252

The following table is network data at FIK-UMS that the authors took between 13.00 - 14.00 WIB on Friday, 25th November 2022. With the Wireshark application, the author can monitor the network passing at FIK UMS. Within 64 seconds 3,881 data packets are passed by.

3.2.Throughput analysis

The efficient data transfer speed, or throughput, is described in bits per second (bps). The overall number of packets that arrived and are tracked throughout a certain time, divided by that period, is the throughput. Throughput categories can be seen in Table 2.

Table 2. Throughput category

Category	Throughput(bps)	Index
Outstanding	100	4
Good	75	3
Not Bad	50	2
Bad	<25	1

Throughput analysis and calculations are explained as follows:

$$Throughput = \frac{data\ packet\ received}{observation\ time} \quad (1)$$

Data packet received = 3267291

Observation time = 64.781

$$Throughput = \frac{data\ packet\ received}{observation\ time} = \frac{3267291}{64,781} = 50435,95 \text{ bytes/s}$$

= 50435,95 x 8

= 403487,6 bits/s(x1000)

= 403,4876 kbits/s

Throughput = 403,4876 kbits/s (Throughput > 100) according to calculation results, showing it in the very good category with a score of 4.

3.3.Packet loss analysis

The term "Packet Loss" refers to a condition that indicates the total number of packets that may be lost due to network congestion and collisions.

Table 3. Packet loss category table

Category	Packet Loss	Index
Outstanding	0	4
Good	3	3
Not Bad	15	2
Bad	25	1

Analysis and calculation of packet loss are explained as follows:

$$Packet\ loss = \frac{data\ packet\ sent - data\ packet\ received}{data\ packet\ sent} \times 100\% \quad (2)$$

Data packet sent = 3881

Data packet received = 3641

Packet loss $= \frac{data\ packet\ sent - data\ packet\ received}{data\ packet\ sent} x100\%$

$= \frac{3881-3641}{3881} x100\%$

= 6,2 %

According to calculations for packet loss, it has a great result with a score of 3, which is 6.2%.

3.4.Delay Analysis

The amount of time needed for data to transfer from one location to another is called delay (latency). Distance, physical media, traffic, and lengthy processing times can all cause delays.

Table 4. Delay category table

Category	Delay (ms)	Index
Outstanding	<150	4
Good	150-300	3
Not Bad	300-450	2
Bad	>450	1

Analysis and calculation of delay are explained as follows:

$$Delay\ average = \frac{Total\ delay}{data\ packet\ received} \quad (3)$$

Delay = Time 2 - Time 1 (4)

Total Delays = 64.780795 s

$$\text{Delay average} = \frac{total\ delay}{data\ packet\ average} = \frac{64{,}780795}{3881}$$

= 0,016691 s x 1000

= 16,691

From the results of the calculation of the delay, it shows the number 16.691 ms which means it has an outstanding performance with an index of 4.

3.2. Jitter Analysis

Arrival or Jitter different types of packets Jitter is a condition caused by differences in packet delay, data process time, and packet regroup time towards the end of the jitter travel. Jitter, also known as delay variation or latency, refers to the degree of delay fluctuation in data transmission through a network.

Table 5. Jitter category table

Category	Jitter (ms)	Index
Outstanding	0	4
Good	0 – 75	3
Not Bad	75 – 125	2
Bad	>125	1

Throughput analysis and calculations are explained as follows:

$$Jitter\ average = \frac{total\ delay\ variation}{data\ packet\ received} \quad (5)$$

Jitter = Delay 1 - Delay 2 (6)

Total delay variation = 0.190684 s

Jitter average $= \frac{total\ delay\ variation}{data\ packet\ received} = \frac{0{,}190684}{3881}$

= 0,00004913 s x 1000

= 0,04913 ms

It is clear from the result obtained that it performs well because its index is 3 and it is within the range from 0 to 75 ms.

4. Conclusion

The results of the research conducted can be seen in Table 6.

Table 6. Result

QoS Parameters	Average value	Index	Category
Throughput	403,4876 kbps	4	Outstanding
Packet loss	6,2 %	3	Good
Delay	16,691 ms	4	Outstanding
Jitter	0,04913 ms	3	Good
Average value		3,5	Fulfilling

From the results of network performance analysis throughput, packet loss, delay, and jitter at the Faculty of Health Sciences, University of Muhammadiyah Surakarta, it can be concluded that the total average throughput when compared with the TIPHON standard are in the "Outstanding" category because the total average throughput gets a percentage of more than 100%. The average total packet loss result is 6.2%, when compared to the TIPHON standard it is in the "Good" category. The average total delay result is 16.691 ms, when compared to the TIPHON standard it is in the "Outstanding" category. Then finally, the result of the jitter measurement is 0.04913 ms, according to the TIPHON standard, it is included in the " Good" category. Based on the average QoS parameter value of the FIK UMS internet network, it has an average index of 3.5. These results indicate that the network is of top quality.

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