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QOS Analysis of Internet Networks Faculty of Engineering Islamic University Kuantan Singingi Using Wireshark 4.0.3

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ABSTRACT

Internet is needed in every field. One of them is the government sector, industry sector, health sector and education sector. Kuantan Singingi Islamic University uses internet facilities to support facilities and infrastructure in teaching and learning activities. The aim of this research is to analyze the existing QOS of the internet network at the Faculty of Engineering at Kuantan Singingi University using parameters (throughput, delay, packet loss and jitter). The type of research used in this research is quantitative research [1]. The quantitative research method was chosen with the aim of analyzing based on numerical data the quality of the wireless network in the Faculty of Engineering Building at Kuantan Singingi Islamic University using the help of the Wireshark 4.0.3 application to see the quality and performance of internet services based on computer network parameters [2]. From the measurement results (QOS), the Throughput results were 69 Kbps in the "Good" category with an index value of 3. Packet Loss 0.1% in the "Very Good" category with an index value of 4. Delay 361 ms in the "Medium" category with an index value of 2 Jitter 360 ms in the "Poor" category. Thus, it can be concluded that according to the QOS TIPHON internet network standards at the Faculty of Engineering, Kuantan Singingi Islamic University, the results were 2.5 in the "Medium" category [3]. By increasing the bandwidth capacity, the internet access speed at the Faculty of Engineering will increase and become very good according to QOS TIPHON standards.

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1. Introduction

The Internet is a global communications system that connects computers and networks throughout the world [4][5]. Currently, the internet network has developed very rapidly, the internet has become the most widely

used source of information for people to find the information they need. One way of obtaining information is the internet network where this technology is a major concern for human technology [6].
Internet is needed in every field. One of them is the government sector, industry sector, health sector and education sector. Kuantan Singingi Islamic University uses internet facilities to support facilities and infrastructure in learning and teaching activities [7]. Therefore, it is very important for the University, especially the Faculty of Engineering, to provide good quality network services so that the teaching and learning process is not hampered [8].
The Faculty of Engineering utilizes internet network facilities to make it easier for both students and lecturers in teaching and learning activities [9]. The occurrence of problems or poor connections can disrupt the teaching and learning process at the Faculty of Engineering [10]. Lecturers usually send material via social media that uses the internet network and also use learning videos obtained on the internet [11]. For this reason, a Quality of Service monitoring system must be implemented in the network system to support good network performance in providing services to satisfy users [12].
At the Faculty of Engineering, users who access the internet only know that the network is good if internet access is at good speed and bad when network access is slow in the process of data retrieval and data transmission. Internet users do not yet know whether the quality of their internet service is good or not, and have not implemented QOS or measured network quality using QOS parameters [13]. Quality of Service is the ability to provide performance from a computer network in providing services to applications within the computer network so as to determine the level of satisfaction of users who use the network [14]. The bandwidth capacity used also affects the speed of accessing the existing network. When many users connect simultaneously, traffic becomes congested [15].
Therefore, the researcher carried out an analysis of the quality of service at the Faculty of Engineering, which will be the researcher's main priority in analyzing the quality of the services provided. For this reason, it is necessary to analyze and test the quality of existing services to be able to control the network so that it remains at a good Quality of Service level [16]. One of the causes of slow internet connections can be identified by measuring service quality parameters such as throughput, packet loss, delay and jitter [17].

2. Research Method

The type of research used in this research is quantitative research. Quantitative research methods were chosen with the aim of analyzing based on numerical data the quality of the wireless network in the Engineering Faculty Building at Kuantan Singingi Islamic University using the help of the Wireshark 4.0.3 application to see the quality and performance of internet services based on computer network parameters [18][19].

The location used as the research site is the Faculty of Engineering Building at Kuantan Singingi Islamic University which is located at Jl. Gatot Subroto KM. 7 Pineapple Garden, Jake Village, Central Kuantan District, Kuantan Singingi Regency[20][14].

The following is an image of a research flow diagram that is expected to achieve good final results:

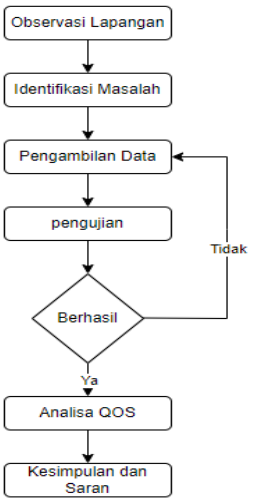

Figure 1. Research Flow Diagram

The researchers' data collection techniques used in this research are as follows:

1. Observation Method

The observation method is the initial stage in research where the researcher visits the research location by conducting research and direct inspection of the problems taken by the researcher. Direct observations are made at the Faculty of Engineering Building at Kuantan Singingi Islamic University by observing the computer equipment used and the number of devices used in the room. and proper placement[21].

2. Interview

Interviews were carried out using a direct dialogue and question and answer process with the campus. The questions asked in the interview included the network system currently running in the Faculty of Engineering Building. At this stage, interviews were conducted with the Head of the Laboratory to obtain data and information regarding the computer network system in the Faculty of Engineering [22].

3. Literature Study

Data collection was carried out by searching for references relevant to the research to be conducted in the campus library, online journals, books, theses and previous research. Literature study was carried out by looking at material related to the research the author conducted [23].

1.1 Implemention

The discussion of Quality of Service research in the Faculty of Engineering Building at Kuantan Singingi Islamic University is as follows :

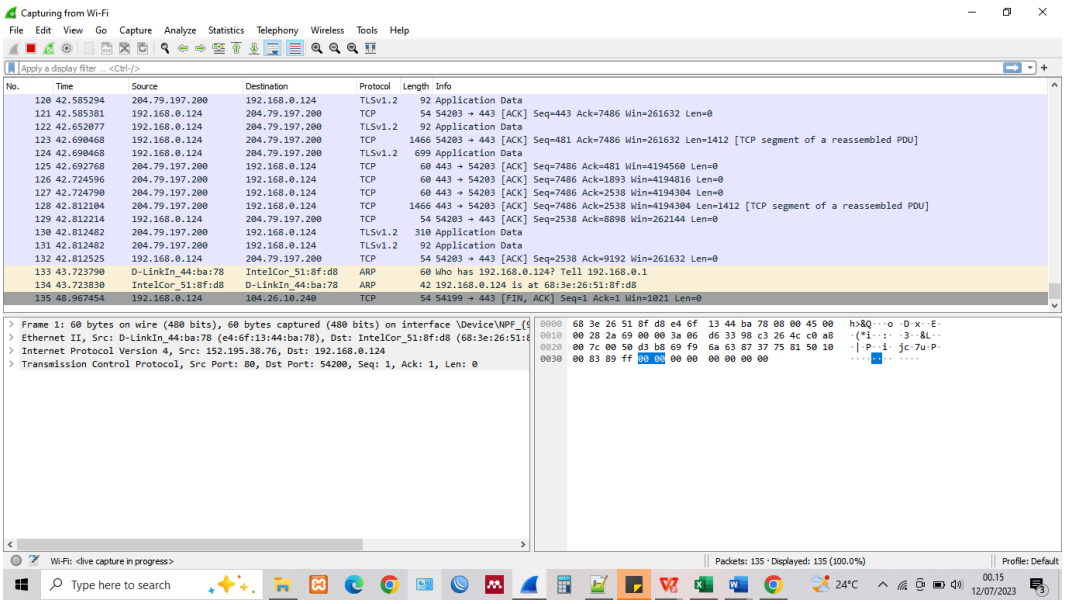

Figure 2. Wireshark Application View

Wireshark is software used to analyze data packets on a network, which is also called a network packet analyzer with the function of capturing every packet that passes through the network and is also used to display all data packet information in detail [24].

Based on the results of QOS (Quality Of Service) data collection at the Faculty of Engineering Building, Kuantan Singingi Islamic University on Monday 12 June 2023 which was carried out for 30 minutes on seven different wifi, the following measurement results were obtained:

a. Throughput

The results of throughput measurements during teaching and learning hours on the seven wifi are as follows:

1. LabFT 5G (09.52-10.22)

The results of measuring throughput on LabFT 5G wifi (09.52-10.22) showed that the number of bytes = 66108095 and time span = 1799.128.Throughput $= \frac{66108095 \times 8}{1799,128} = 293956,16$ bits/s x 1000

= 294 kbits/s

Is in index "4" and category "very good"

2. HUAWEI-2.4G-F85w (10.25-10.55)

The results of measuring throughput on the HUAWEI-2.4G-F85w wifi (09.52-10.22) showed that the number of bytes = 582724 and time span = 1785,469.

$$\text{Throughput} = \frac{582724 \times 8}{1785,469} = 2610.96 \text{ bits/s} \times 1000$$

= 3 kbits/s

Is in index "1" and category "bad"

3. DEKANAT FT (11.25-11.55)

The results of measuring throughput on DEKANAT FT wifi (09.52-10.22) showed that the number of bytes = 2528360 and the time span = 1775,430.

$$\text{Throughput} = \frac{2528360 \times 8}{1775,430} = 11392.664 \text{ bits/s} \times 1000$$

= 11 kbits/s

Is in index "1" and category "bad"

4. HUAWEI-5G-5TTx (13.20-13.50)

The results of measuring throughput on the HUAWEI-5G-5TTx wifi (13.20-13.50) showed that the number of bytes = 35810030 and time span = 1782.583.

$$\text{Throughput} = \frac{35810030 \times 8}{1782,583} = 160710.744 \text{ bits/s} \times 1000$$

= 161 kbits/s

Is in index "4" and category "very good"

5. Teknik Informatika Area (14.00-14.30)

The results of measuring throughput on the Teknik Informatika wifi area (14.00-14.30) showed that the number of bytes = 1555074 and the time span = 1779.008.

$$\text{Throughput} = \frac{1555074 \times 8}{1779,008} = 6992.992 \text{ bits/s} \times 1000$$

= 7 kbits/s

Is in index "1" and category "bad"

6. RUANG DOSEN (15.00-15.30)

The results of measuring throughput on the RUANG DOSEN wifi (15.00-15.30) showed that the number of bytes = 715174 and the time span = 1802.746.

$$\text{Throughput} = \frac{715174 \times 8}{1802,746} = 3173.704 \text{ bits/s} \times 1000$$

= 3 kbits/s

Is in index "1" and category "bad"

7. Gedung Teknik (15.35-16.05)

The results of throughput measurements on the Gedung Teknik wifi (15.35-16.05) showed that the number of bytes = 594661 and the time span = 1802.967.

$$\text{Throughput} = \frac{594661 \times 8}{1802,967} = 2638.584 \text{ bits/s} \times 1000$$

= 3 kbits/s

Is in index "1" and category "bad"

a. Packet Loss

The results of Packet Loss measurements during teaching and learning hours on the seven wifi are as follows:

1. LabFT 5G (09.52-10.22)

The Packet Loss measurement results on LabFT 5G wifi (09.52-10.22) showed that Packets Sent = 24193 and Packets Received = 24193-39 = 24154.

Packet Loss = {(24193 - 24154) / 24193} x 100
= 0.2 %

Is in index "4" and category "very good"

2. HUAWEI-2.4G-F85w (10.25-10.55)

The Packet Loss measurement results on HUAWEI-2.4G-F85w wifi (09.52-10.22) showed that Packets Sent = 3911 and Packets Received = 3911-4 = 3907.

Packet Loss = {(3911 - 3907) / 3911} x 100
= 0.1 %

Is in index "4" and category "very good"

3. DEKANAT FT (11.25-11.55)

As for the Packet Loss measurement results on DEKANAT FT wifi (11.25-11.55), it was found that Packets Sent = 8292 and Packets Received = 8292-5 = 8287.

Packet Loss = {(8292 - 8287) / 8292} x 100
= 0.1 %

Is in index "4" and category "very good"

4. HUAWEI-5G-5TTx (13.20-13.50)

The Packet Loss measurement results on the HUAWEI-5G-5TTx wifi (13.20-13.50) showed that Packets Sent = 16601 and Packets Received = 16601-3 = 16598.

Packet Loss = {(16601 - 16598) / 16601} x 100
= 0 %

5. Teknik Informatika Area (14.00-14.30)

As for the Packet Loss measurement results on the Teknik Informatika Area wifi (14.00-14.30), it was found that Packets Sent = 6671 and Packets Received = 6671-0 = 6671.

Packet Loss = {(6671 - 6671) / 6671} x 100
= 0 %

Is in index "4" and category "very good"

6. RUANG DOSEN (15.00-15.30)

As for the Packet Loss measurement results on the RUANG DOSEN wifi (15.00-15.30), it was found that Packets Sent = 5500 and Packets Received = 5500-2 = 5498.

Packet Loss = {(5500 - 5498) / 5500 } x 100
= 0 %

Is in index "4" and category "very good"

7. Gedung Teknik (15.35-16.05)

The results of Packet Loss measurements on the Engineering Building wifi (15.35-16.05) showed that Packets Sent = 4415 and Packets Received = 4415-5 = 4410.

Packet Loss = {(4415 - 4410) / 4415 } x 100
= 0.1 %

Is in index "4" and category "very good"

b. Delay

The results of Delay measurements during teaching and learning hours on the seven wifi are as follows :

1. LabFT 5G (09.52-10.22)

The Delay measurement results on LabFT 5G wifi (09.52-10.22) showed that Total Delay = 17991.28 and Data Sent = 24193.

Delay = (17991.28 / 24193) x 1000
= 744 ms
Is in index "1" and category "bad"

2. HUAWEI-2.4G-F85w (10.25-10.55)
The Delay measurement results on the HUAWEI-2.4G-F85w wifi (10.25-10.55) showed that Total Delay = 1785.46 and Data Sent = 3911.
Delay = (1785.46 / 3911) x 1000
= 457 ms
Is in index "1" and category "bad"

3. DEKANAT FT (11.25-11.55)
The Delay measurement results on DEKANAT FT wifi (11.25-11.55) showed that Total Delay = 1775.43 and Data Sent = 8292.
Delay = (1775.43 / 8292) x 1000
= 214 ms
Is in index "3" and category "good"

4. HUAWEI-5G-5TTx (13.20-13.50)
The Delay measurement results on the HUAWEI-5G-5TTx wifi (13.20-13.50) showed that Total Delay = 1782.58 and Data Sent = 16601.
Delay = (1782.58 / 16601) x 1000
= 107 ms
Is in index "4" and category "very good"

5. Teknik Informatika Area (14.00-14.30)
The results of Delay measurements on the Teknik Informatika WiFi Area (14.00-14.30) showed that Total Delay = 1779.00 and Data Sent = 6671.
Delay = (1779.00 / 6671) x 1000
= 267 ms
Is in index "3" and category "good"

6. RUANG DOSEN (15.00-15.30)

The results of Delay measurements on the RUANG DOSEN WiFi (15.00-15.30) showed that Total Delay = 1802.74 and Data Sent = 5500.
Delay = (1802.74 / 5500) x 1000
= 328 ms
Is in index "2" and category "medium".

7. Gedung Teknik (15.35-16.05)
The results of Delay measurements on the Gedung Teknik wifi (15.35-16.05) showed that Total Delay = 1802.96 and Data Sent = 4415.
Delay = (1802.96 / 4415) x 1000
= 408 ms
Is in index "2" and category "medium"

c. Jitter

The results of Jitter measurements during teaching and learning hours on the seven wifi are as follows :

1. LabFT 5G (09.52-10.22)
The Jitter measurement results on LabFT 5G wifi (09.52-10.22) showed that Total Jitter = 17989.45 and Data Sent = 24193.

Jitter = (17989.45 / 24193) x 1000
= 744 ms

Is in index "1" and category "bad"

2. HUAWEI-2.4G-F85w (10.25-10.55)

The Jitter measurement results on the HUAWEI-2.4G-F85w wifi (10.25-10.55) showed that Total Jitter = 1785.84 and Data Sent = 3911.

Jitter = (1785.84 / 3911) x 1000
= 457 ms

Is in index "1" and category "bad"

3. DEKANAT FT (11.25-11.55)

The Jitter measurement results on DEKANAT FT wifi (11.25-11.55) showed that Total Jitter = 1775.21 and Data Sent = 8292.

Jitter = (1775.21 / 8292) x 1000
= 214 ms

Is in index "1" and category "bad"

4. HUAWEI-5G-5TTx (13.20-13.50)

The Jitter measurement results on the HUAWEI-5G-5TTx wifi (13.20-13.50) showed that Total Jitter = 1781.53 and Data Sent = 16601.

Jitter = (1781.53 / 16601) x 1000
= 107 ms

Is in index "1" and category "bad"

5. Teknik Informatika Area (14.00-14.30)

The Jitter measurement results on the Informatics Engineering WiFi area (14.00-14.30) showed that Total Jitter = 1778.41 and Data Sent = 6671.

Jitter = (1778.41 / 6671) x 1000
= 267 ms

Is in index "1" and category "bad"

6. RUANG DOSEN (15.00-15.30)

The Jitter measurement results on the RUANG DOSEN WiFi (15.00-15.30) showed that Total Jitter = 1775.22 and Data Sent = 5500.

Jitter = (1775.22 / 5500) x 1000
= 323 ms

Is in index "1" and category "bad"

7. Gedung Teknik (15.35-16.05)

The Jitter measurement results on the Gedung Teknik wifi (15.35-16.05) showed that Total Jitter = 1801.02 and Data Sent = 4415.

Jitter = (1801.02 / 4415) x 1000
= 408 ms

Is in index "1" and category "bad"

Based on the results of research discussions that were carried out at the Faculty of Engineering Building at Kuantan Singingi Islamic University, data for each parameter was obtained as follows:

1. Throughput

From the results of the research that has been carried out, it can be seen that the results of throughput measurements according to the TIPHON standard are in the "Good" category with an average value of 69 Kbps.

2. Packet Loss
From the results of the research that has been carried out, it can be seen that the results of Packet Loss measurements according to TIPHON standards are in the "Very Good" category with an average value of 0.1%.
3. Delay
From the results of the research that has been carried out, it can be seen that the results of Delay measurements according to the TIPHON standard are in the "Medium" category with an average value of 361 ms.
4. Jitter

Based on the results of the research that has been carried out, it can be seen that the results of jitter measurements according to the TIPHON standard are in the "Bad" category with an average value of 360 ms [25].

From the Quality of Service (QOS) measurement results, the Throughput results were 69 Kbps in the "Good" category with an index value of 3. Packet Loss 0.1% in the "Very Good" category with an index value of 4. Delay 361 ms in the "Medium" category with index value 2. Jitter 360 ms in the "Bad" category with an index value of 1. As in the following table:

Table 1. Quality Of Service Index

No	*Quality Of Service*	Explanation	
		Indeks	**Category**
1.	*Throughput*	3	Good
2.	*Packet Loss*	4	Very good
3.	*Delay*	2	Currently
4.	*Jitter*	1	Bad
Average QOS Index		**2,5**	**Currently**

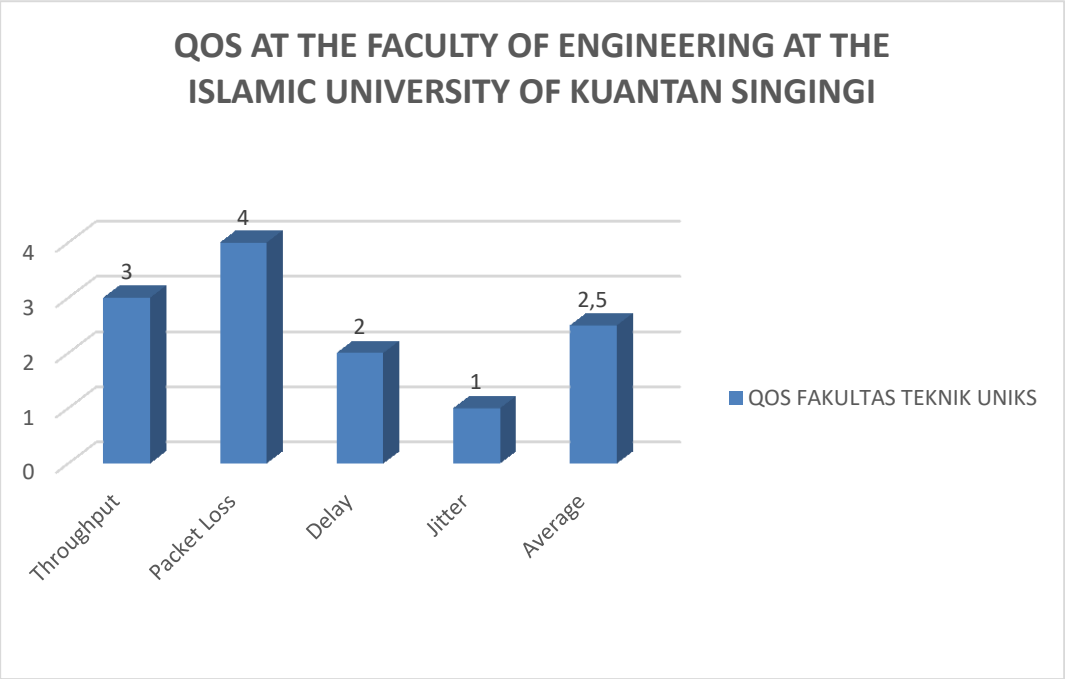

Figure 2. Quality Of Service Index Graph

Based on TIPHON standardization, the value category is "very good" if the QoS value is 3.8 - 4, "good" if the QoS value is 3 - 3.79, "Medium" if the QoS value is 2 - 2.99 and "bad" if the QoS value is 1 – 1.99. Meanwhile, from Table 5.6, the Quality of Service index according to the TIPHON standard shows a result of 2.5 in the "Medium" category, at the Faculty of Engineering, Kuantan Singingi Islamic University.

Conclusions

1. Based on the results of the research and discussion of the Quality of Service analysis of the internet network at the Faculty of Engineering Building, it was concluded that:
2. 1. By analyzing the Quality of Service (QOS) measurements using the Wireshark 4.0.3 application, the Throughput results were 69 Kbps in the "Good" category with an index value of 3. Packet Loss 0.1% in the "Very Good" category with an index value of 4. Delay 361 ms in the "Medium" category with an index value of 2. Jitter 360 ms in the "Poor" category with an index value of 1.
3. 2. Thus, it can be concluded that according to the QOS TIPHON internet network standards at the Faculty of Engineering, Kuantan Singingi Islamic University, a result of 2.5 was obtained in the "Medium" category.
4. 3. Increasing bandwidth capacity will increase the speed of internet access in the Faculty of Engineering and will become very good according to QOS TIPHON standards.

Based on the conclusions of the discussion, the researcher provides suggestions regarding the need for further evaluation of the internet network at the engineering faculty of Kuantan Singingi Islamic University in order to improve the quality of the existing internet network to be very good with QOS standards as follows:

1. Building a network server to organize and manage the network at the Faculty of Engineering, such as dividing, organizing and prioritizing bandwidth as well as filtering or limiting sites and applications that use a lot of bandwidth.
2. 5. Researchers who wish to continue this research are advised to use different methods or tools or create an application that can monitor the network in real time.
3. 6. Arrange bandwidth distribution to each room in the Faculty of Engineering. Labor1 20 mb, Labor2 20 mb, TU (administration) room 10 mb, labor head room 35 mb, head of study room 35 mb and divide 1 mb per user across 40 computers Labor 1 and 2. Labor

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Reference

[1] G. Y. Noviantoro, “Analisa Perbandingan Antar Kualitas Jaringan VPN IP Security Dan ZRTP Pada Voice Over Internet Protocol,” *J. Teknol. Pint.*, 2022, [Online]. Available: http://teknologipintar.org/index.php/teknologipintar/article/view/119

[2] G. G. Setiaji, “Analisa Perbandingan Quality of Service Protokol VPN antara Protokol SSTP Dan Open VPN Berbasis Router Mikrotik,” *Indones. J. Comput. Sci.*, 2022, [Online]. Available: http://ijcs.net/ijcs/index.php/ijcs/article/view/3034

[3] H. Abrianto and A. D. Sidik, "Analisa Performansi Layanan Wlan (Wireless Local Area Network) dengan Metode QOS (Quality of Service) Studi Kasus PT X.," *J. Cahaya Mandalika ISSN ...*, 2023, [Online]. Available: https://ojs.cahayamandalika.com/index.php/jcm/article/view/3277

[4] V. Y. P. Ardhana and M. D. Mulyodiputro, "Analisis Quality of Service (QoS) Jaringan Internet Universitas Menggunakan Metode Hierarchical Token Bucket (HTB)," *J. Informatics ...*, 2023, [Online]. Available: http://www.hostjournals.com/jimat/article/view/257

[5] A. Wibawanto, "Penggunaan Internet dalam Perpustakaan," *Pustakaloka*, vol. 10, no. 2, p. 191, 2018, doi: 10.21154/pustakaloka.v10i2.1472.

[6] I. Fibriani, A. Bayu, and P. Ciptaning, "Analisa Sistem Monitoring Greenhouse Berbasis Internet of Things (IoT) pada Jaringan 4G LTE," *SinarFe7*, 2020, [Online]. Available: https://journal.fortei7.org/index.php/sinarFe7/article/view/295

[7] R. K. Pamungkas, "Analisis Sistem Informasi Manajemen Rumah Sakit Pada Instalasi Rawat Jalan Di Rsud Puri Husada Tembilahan Tahun 2020," *J. Olahraga dan Kesehat. ...*, 2022, [Online]. Available: http://journals.badnurmedisa.org/index.php/orkes/article/view/5

[8] N. Nurmiati, L. Surimi, and S. Subardin, "Analisis Kinerja Load Balancing Terhadap Jaringan Internet Menggunakan Metode Equal Cost Multi Path (ECMP)," *Digit. Transform. ...*, 2022, [Online]. Available: https://jurnal.itscience.org/index.php/digitech/article/view/1779

[9] M. S. Rafinaldo, I. Iskandar, N. S. Harahap, and ..., "Analisis Kualitas Jaringan Internet pada SMK Menggunakan Metode Quality of Service," *KLIK Kaji. Ilm. ...*, 2023, [Online]. Available: http://djournals.com/klik/article/view/903

[10] D. A. Rachman, Y. Muhyidin, and ..., "Analysis Quality Of Service Of Internet Network Fiber To The Home Service Pt. Xyz Using Wireshark," *J. Inform. dan ...*, 2023, [Online]. Available: http://journal.eng.unila.ac.id/index.php/jitet/article/view/3436

[11] M. R. Kamil, F. Arzalega, and ..., "Analisis Kualitas Layanan Jaringan Internet Wifi PT. XYZ Dengan Metode QoS (Quality of Service)," *J. Bid. ...*, 2023, [Online]. Available: https://ejournal.kreatifcemerlang.id/index.php/jbpi/article/view/107

[12] A. Ananda, F. W. Ginting, K. Putri, and ..., "ANALISIS KUALITAS LAYANAN JARINGAN INTERNET WIRELESS LAN PADA LAYANAN INDIHOME," *J. Ilm. ...*, 2023, [Online]. Available: https://geloraciptanusantara.org/jurnal/index.php/jimik/article/view/111

[13] A. Noviriandini, H. Hermanto, D. A. Ambarsari, and ..., "Analisis Management Bandwidth Dan Firewall Dengan Router Mikrotik Pada Pt. Bca Multifinance," *J. Tek. dan ...*, 2022, [Online]. Available: http://journal.admi.or.id/index.php/JTS/article/view/466

[14] J. Nur, L. M. Fajar Israwan, and M. Saputra, "Analisis Quality of Service Jaringan Internet Pada Universitas Dayanu Ikhsanuddin Analysis of Quality of Internet Network Service At Dayanu Ikhsanuddin University," *J. Inform.*, vol. 11, no. 2, pp. 2–10, 2022.

[15] Veeny Saputri and Herry Mulyono, "ANALISIS DAN PERANCANGAN SISTEM INFORMASIMANAJEMEN PELAPORAN DATA HASIL PANENBERBASIS WEB PADA DINAS PERTANIAN TANAMANPANGAN PROVINSI JAMBI," *J. Manaj. Sist. Inf.*, vol. 4, no. 2, 2019.

[16] M. S. Anwar, "Analisis QoS (Quality of Service) Manajemen Bandwidth menggunakan Metode Kombinasi Simple Queue dan PCQ (Per Connection Queue) pada Fakultas Teknik …," *sudo J. Tek. Inform.*, 2022, [Online]. Available: https://jurnal.ilmubersama.com/index.php/sudo/article/view/24

[17] R. Purnomo and P. R. Arisandi, "Analisis QoS Dengan Virtual Tenant Network Pada Software Define Networking," *J. Teknol. Inform. dan ...*, 2019, [Online]. Available: https://journalthamrin.com/index.php/jtik/article/view/173

[18] I. Rahmadhan, K. Khairil, and A. Al Akbar, "Qos Analysis In The Application Of HTB At Computer Laboratory Of Engineering Faculty Of Universitas Muhammadiyah Bengkulu," *J. Media Comput. ...*, 2024, [Online]. Available: https://jurnal.unived.ac.id/index.php/jmcs/article/view/6595

[19] M. Hasbi and N. R. Saputra, "Analisis Quality of Service (Qos) Jaringan Internet Kantor Pusat King Bukopin Dengan Menggunakan Wireshark," *Just IT J. Sist. Informasi, Teknol. ...*, 2022, [Online]. Available: https://jurnal.umj.ac.id/index.php/just-it/article/view/13596

[20] S. Amin, A. C. Rumaikewi, and A. Adahati, "Monitoring dan Analisis Quality Of Service (QOS) Jaringan Internet dengan Metode Drive Test pada Kantor Bandar Udara Rendani," *J. Syntax Admiration*, 2020, [Online]. Available: https://www.academia.edu/download/88019386/392.pdf

[21] A. Armanto and N. K. Daulay, "Analisis Quality of Service (Qos) Pada Jaringan Internet Di Universitas Bina Insan Lubuklinggau Menggunakan Metode Hierarchical Token Bucket (Htb)," *J.*

Digit. Teknol. ..., 2020, [Online]. Available: https://jurnal.um-palembang.ac.id/digital/article/view/2471

[22] A. S. Wati and P. Maharani, "Analisis Quality of Service (QoS) pada jaringan internet Fakultas Ilmu Komputer Universitas Sjakhyakirti," *J. Eng. Technol. ...*, 2023, [Online]. Available: https://www.ejournal-rmg.org/index.php/JETI/article/view/113

[23] S. Sukri and I. P. Sari, "Analisa Peningkatan Kualitas Jaringan Dengan Penerapan Metode Antrian Hirarchical Token Bucket," *Semin. Nas. Sains dan Teknol. ...*, 2018, [Online]. Available: http://prosiding.seminar-id.com/index.php/sensasi/article/view/56

[24] N. A. K. Rianto, H. Salsabila, and ..., "Analysis of quality of service (QoS) Wi-Fi Network in UNNES digital center building using wireshark," *J. Student ...*, 2023, [Online]. Available: https://www.shmpublisher.com/index.php/josre/article/view/108

[25] R. Kango, N. Jamal, and M. I. Abas, "Analysis of End-to-End Delay Video Conferencing Services on a Mobile Ad Hoc Network," *J. INFORMATICS ...*, 2023, [Online]. Available: https://ojs.uma.ac.id/index.php/jite/article/view/8231