

# Analysis of Internet Network Quality of Service (QoS) at Yamaha Central Office Palembang using Wireshark

Zella Alfharizi<sup>1\*</sup>, Apriansyah<sup>2</sup>, Karnadi<sup>3</sup>

<sup>1,2,3</sup>Information Technology Study Program, Faculty of Engineering, Muhammadiyah University of Palembang, Indonesia  
[gandhi05far@gmail.com](mailto:gandhi05far@gmail.com)<sup>1\*</sup>, [Apriansyah@um-palembang.ac.id](mailto:Apriansyah@um-palembang.ac.id)<sup>2</sup>, [karnadi@um-palembang.ac.id](mailto:karnadi@um-palembang.ac.id)<sup>3</sup>

## Abstract

The rapid growth of internet usage in office environments demands reliable and consistent network performance to support daily operational activities. However, unstable network quality may lead to communication delays, data transmission errors, and decreased work productivity. Therefore, the research problem addressed in this study is the lack of objective evaluation regarding the actual Quality of Service (QoS) performance of office internet networks. This study aims to analyze and evaluate the Quality of Service of the internet network at the Yamaha Central Office Palembang by measuring key QoS parameters, including throughput, packet loss, delay, and jitter. The objective is to determine whether the existing network performance meets acceptable service quality standards for office operations. A quantitative descriptive method was employed in this research. Data were collected through direct observation and real-time packet capturing using Wireshark during active network usage within a specific measurement period. The captured network traffic data were then processed and analyzed quantitatively based on standard QoS measurement criteria. The results show that the network achieved a throughput of 2416 kbit/s, packet loss of 0.0%, an average delay of 3.53 ms, and jitter of 3.22 ms. These values indicate that the internet network performance at the Yamaha Central Office Palembang is classified as very good and complies with acceptable QoS standards. The contribution of this study lies in providing an empirical evaluation of office network performance using real traffic data and offering practical insights that can be utilized as a reference for network monitoring, performance optimization, and future QoS-related studies in similar office environments.

**Keywords:** Internet Network, Quality of Service, Network Performance, Office Network

## 1. Introduction

The rapid expansion of internet usage in modern office environments has increased the demand for stable, reliable, and high-performance network services [1]. Internet connectivity plays a crucial role in supporting administrative processes, data exchange, and real-time communication [2]. When network performance is inadequate, issues such as increased delay, packet loss, and unstable connections may occur, which can negatively impact productivity and disrupt operational activities[3].

Quality of Service (QoS) has been widely adopted as an effective approach for evaluating network performance by measuring key parameters such as throughput, packet loss, delay, and jitter [4]. These parameters provide a comprehensive representation of network behavior in terms of transmission speed, reliability, responsiveness, and stability [5]. QoS analysis enables network administrators to identify performance bottlenecks and to determine whether the existing network infrastructure meets acceptable service quality standards[6].

Despite the availability of internet services, variations in network performance are still commonly observed in office environments due to factors such as traffic congestion, hardware limitations, and network configuration issues[7]. However, fluctuations in service quality may affect the efficiency of these activities, indicating the need for a systematic and objective evaluation of network performance [8]. A systematic and objective evaluation of network performance is therefore necessary to maintain service reliability and operational efficiency[9].

This study aims to analyze the Quality of Service of the internet network at the Yamaha Central Office Palembang using Wireshark, a network packet analyzer capable of capturing and analyzing real-time network traffic[10]. By employing Wireshark, this research provides detailed measurement of QoS parameters, allowing a clear assessment of network reliability, stability, and responsiveness[11]. The results of this study are expected not only to provide an objective evaluation of current network performance but also to serve as a reference for network monitoring, optimization strategies, and comparative analysis in similar office environments[12].

One relevant study conducted a comparative evaluation of wireless internet services provided by Indihome and First Media, focusing on QoS degradation caused by network congestion, user density, and environmental obstacles such as building structures [13]. The findings revealed that both services experienced performance limitations, particularly in terms of throughput and delay. Although the measured delay values were still categorized as very good, Indihome demonstrated superior overall performance, as reflected by a higher QoS index compared to First Media. This study highlights the impact of external and infrastructural factors on wireless network quality.

Another study analyzed the Quality of Service of a Fiber to the Home (FTTH) network at PT. XYZ by capturing real-time traffic using Wireshark [14]. The research identified performance degradation during peak usage periods but reported that overall QoS values across multiple service set identifiers (SSIDs) remained within the excellent category. However, the study primarily focused on measurement results and did not explore solutions related to physical network infrastructure limitations. Despite this, the findings demonstrate that FTTH-based networks are capable of delivering consistently high QoS under controlled conditions.

A further investigation assessed the internet network performance at the King Bukopin Head Office, where network instability was occasionally observed due to protocol-related factors and traffic variations [15]. Using Wireshark for packet monitoring, the study reported very good QoS values, including zero packet loss, low delay, and minimal jitter. These results indicate that even in complex corporate environments, stable and reliable network performance can be achieved through proper network management and monitoring.

These previous studies provide a foundation for evaluating network QoS in office environments and demonstrate that real-time packet analysis using tools like Wireshark is effective for assessing throughput, packet loss, delay, and jitter, which are critical for ensuring reliable and stable network performance.

The comparison of these three models is justified by their respective strengths and weaknesses, as summarized in Table 1.

**Table 1:** Comparison of Previous Studies

Model	Strengths	Weaknesses	Typical Use Case
Comparative Analysis of Wireless Internet QoS on ISP Services Indihome & First Media	Highlights ISP differences; throughput 65 kbps (Indihome), 42.5 kbps (First Media); QoS index 2 vs 1.67	Limited observation; TeamViewer may not capture full traffic	Comparing ISP performance in office/residential settings
Analysis of FTTH Internet Service Quality at PT. XYZ Using Wireshark	Accurate real-time QoS; throughput 20 Mbps; packet loss, delay, jitter rated excellent	No solution for physical network issues; limited number of SSIDs	Evaluating FTTH customer network performance
QoS Analysis at King Bukopin Head Office Using Wireshark	Stable network; throughput 345 kbps; packet loss 0%; delay 1.124 ms; jitter 8.165 ms	Focused on a single office; limited generalization	Corporate office network monitoring and reliability assessment

## 2. Methods

This study adopted a quantitative research approach with an evaluative design to assess the Quality of Service (QoS) of the internet network at the Yamaha Central Office Palembang[16]. The evaluation focused on analyzing real network performance under normal operational conditions without interrupting ongoing office activities. Quantitative measurement was selected to ensure that the assessment results were objective, measurable, and reproducible [17].

Network performance evaluation was conducted through direct observation and packet-level traffic monitoring. Data collection was performed on an active network environment to represent actual usage patterns during daily operational hours [18]. Wireshark was utilized as a packet capture and analysis tool to record network traffic in real time[19]. The captured packets were then processed to extract relevant information required for QoS performance evaluation[20].

### 2.1. Research Framework

The research framework was designed as a flowchart to illustrate the systematic stages of the network analysis process, from initial preparation to final evaluation. The framework ensures that each stage of the research is executed in a structured and replicable manner[21]. The research framework in this study focuses on evaluating internet network performance through Quality of Service (QoS) parameters. The evaluation process begins with identifying the existing network topology and internet usage environment at the Yamaha Central Office Palembang. Network traffic data are then captured during active operational hours using Wireshark.

The collected packet data are processed to obtain key QoS metrics, including throughput, packet loss, delay, and jitter. Finally, the measurement results are analyzed and interpreted based on standardized QoS performance criteria to determine the overall quality of the network.[22] [23]. The results were then analyzed and discussed to evaluate the effectiveness of the applied method. The overall research workflow is illustrated in Figure 1.

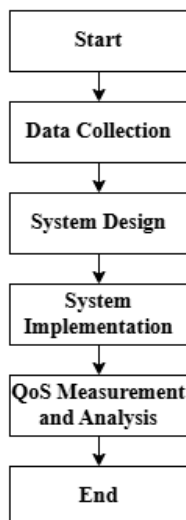


Fig. 1: Research Flowchart

## 2.2. Research Procedure

The research was conducted systematically to ensure reliable and accurate assessment of network performance at the Yamaha Central Office Palembang. The methodology was designed to follow a stepwise procedure, combining both theoretical review and practical measurement. The research stages are described as follows:

1. Review of literature related to QoS concepts and network performance measurement.
2. Identification of network topology and internet usage conditions.
3. Packet capture and traffic monitoring using Wireshark on an active network.
4. Processing of captured data to calculate QoS parameters.
5. Evaluation of network performance based on QoS quality standards.

This stepwise procedure ensures that data collection is systematic, comprehensive, and consistent with best practices for network performance evaluation

## 2.3. Research Model

Quality of Service parameters were employed to represent network performance characteristics comprehensively. The parameters selected in this study included throughput, packet loss, delay, and jitter, as these metrics reflect network speed, reliability, responsiveness, and stability. Each parameter was measured quantitatively and evaluated based on its respective performance objectives, as presented in Table 2.

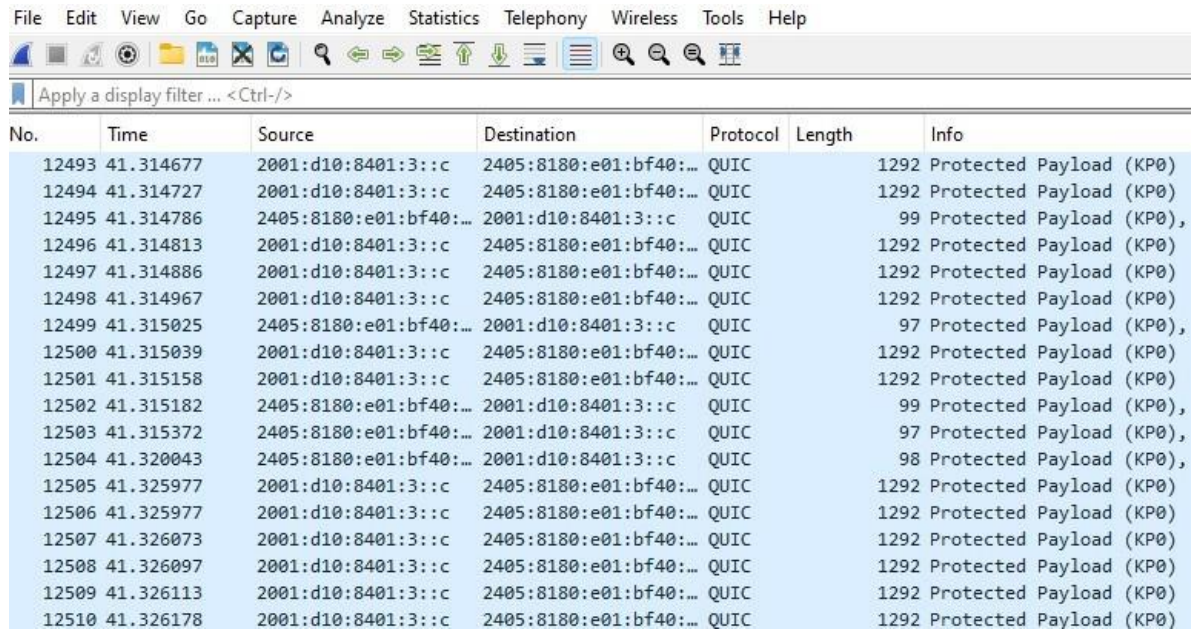
Table 2: Quality of Service (QoS) Parameters

No	QoS Parameter	Definition	Unit	Measurement Objective
1	Throughput	The average rate of successful data transmission over the network during a specific time interval.	Mbps	To measure the effective data transfer speed of the network.
2	Packet Loss	The percentage of data packets that fail to reach the destination during transmission.	%	To evaluate network reliability and transmission accuracy.
3	Delay	The average time required for a data packet to travel from the source to the destination.	ms	To assess network responsiveness and latency performance.
4	Jitter	The variation in packet delay over time during data transmission.	ms	To measure transmission stability, especially for real-time services.

## 3. Results and Discussion

### 3.1. Existing Network System Overview

The internet network performance at the Yamaha Central Office Palembang was evaluated using Wireshark, a widely recognized network traffic monitoring and analysis tool. Packet capture was conducted during operational hours to capture real-time network activity and provide a realistic assessment of the network's behavior under normal office conditions. Conducting measurements during active operational hours is critical because it reflects typical network usage patterns, including fluctuations in traffic caused by multiple users accessing various services simultaneously. The packet capturing process conducted using Wireshark is illustrated in Figure 2, which shows real-time network traffic during normal office operations



No.	Time	Source	Destination	Protocol	Length	Info
12493	41.314677	2001:d10:8401:3::c	2405:8180:e01:bf40:...	QUIC	1292	Protected Payload (KP0)
12494	41.314727	2001:d10:8401:3::c	2405:8180:e01:bf40:...	QUIC	1292	Protected Payload (KP0)
12495	41.314786	2405:8180:e01:bf40:...	2001:d10:8401:3::c	QUIC	99	Protected Payload (KP0),
12496	41.314813	2001:d10:8401:3::c	2405:8180:e01:bf40:...	QUIC	1292	Protected Payload (KP0)
12497	41.314886	2001:d10:8401:3::c	2405:8180:e01:bf40:...	QUIC	1292	Protected Payload (KP0)
12498	41.314967	2001:d10:8401:3::c	2405:8180:e01:bf40:...	QUIC	1292	Protected Payload (KP0)
12499	41.315025	2405:8180:e01:bf40:...	2001:d10:8401:3::c	QUIC	97	Protected Payload (KP0),
12500	41.315039	2001:d10:8401:3::c	2405:8180:e01:bf40:...	QUIC	1292	Protected Payload (KP0)
12501	41.315158	2001:d10:8401:3::c	2405:8180:e01:bf40:...	QUIC	1292	Protected Payload (KP0)
12502	41.315182	2405:8180:e01:bf40:...	2001:d10:8401:3::c	QUIC	99	Protected Payload (KP0),
12503	41.315372	2405:8180:e01:bf40:...	2001:d10:8401:3::c	QUIC	97	Protected Payload (KP0),
12504	41.320043	2405:8180:e01:bf40:...	2001:d10:8401:3::c	QUIC	98	Protected Payload (KP0),
12505	41.325977	2001:d10:8401:3::c	2405:8180:e01:bf40:...	QUIC	1292	Protected Payload (KP0)
12506	41.325977	2001:d10:8401:3::c	2405:8180:e01:bf40:...	QUIC	1292	Protected Payload (KP0)
12507	41.326073	2001:d10:8401:3::c	2405:8180:e01:bf40:...	QUIC	1292	Protected Payload (KP0)
12508	41.326097	2001:d10:8401:3::c	2405:8180:e01:bf40:...	QUIC	1292	Protected Payload (KP0)
12509	41.326113	2001:d10:8401:3::c	2405:8180:e01:bf40:...	QUIC	1292	Protected Payload (KP0)
12510	41.326178	2001:d10:8401:3::c	2405:8180:e01:bf40:...	QUIC	1292	Protected Payload (KP0)

Fig. 2: Packet Capture Display Using Wireshark

Figure 2 illustrates the packet capture process using Wireshark during active office network operations. The figure displays key information such as source and destination addresses, protocol types, packet lengths, and timestamps, which are essential for analyzing real-time network traffic behavior

### 3.2. Network Monitoring Results

The network monitoring process was conducted over a 41-second interval, resulting in a total of 8,964 captured packets, which indicates a high level of network activity. Monitoring such a relatively short yet intensive time period provides sufficient insight into network performance during typical office operations while minimizing the impact on ongoing tasks.

The captured packets included a variety of protocols such as TCP, UDP, and ICMP, which reflect diverse types of network communication ranging from web browsing and email exchanges to file transfers and internal server communications. The results demonstrate that the network is capable of handling multiple concurrent communications with minimal disruption, as the majority of packets were successfully transmitted and received without error. The detailed network monitoring results, including packet transmission time and delay values, are presented in Table 3.

Table 3: Network Monitoring Results

No	Time	Time 1	Time 2	Delay
19	1,565271	1,565271	1,594399	0,029128
20	1,594399	1,594399	1,594563	0,000164
21	1,594563	1,594563	1,595712	0,001149
22	1,595712	1,595712	1,623150	0,027438
23	1,623150	1,623150	1,625230	0,002080
24	1,625230	1,625230	1,625230	0
25	1,625230	1,625230	1,625368	0,000138
26	1,625368	1,625368	1,625724	0,000356
27	1,625724	1,625724	1,625748	0,0000245
28	1,625748	1,625748	1,626046	0,000298
29	1,626046	1,626046	1,626123	0,000077
30	1,626123	1,626123	1,626376	0,000253
31	1,626376	1,626376	1,626431	0,000055
32	1,626431	1,626431	1,632176	0,005745
33	1,632176	1,632176	1,868968	0,236792
34	1,868968	1,868968	2,022597	0,153629
35	2,022597	2,022597	2,022597	0
36	2,022597	2,022597	2,022597	0
37	2,022597	2,022597	2,022761	0,000164
38	2,022761	2,022761	2,023089	0,000328
39	2,023089	2,023089	2,038913	0,015824

Table 3 presents detailed packet transmission timestamps along with calculated delay values. This table is used to identify latency variations between consecutive packets and to evaluate the consistency of packet delivery during the monitoring period.

### 3.3. Throughput Analysis

Throughput represents the effective data transmission rate of the network, measured in bits per second (bps). From the captured dataset, a total of 12,480,891 bytes were transmitted over 41.326 seconds, resulting in an average throughput of 2,416 kbps. This value indicates that the network provides sufficient bandwidth to support daily office operations, including data-intensive activities such as video conferencing, cloud-based file access, and real-time communication applications. Measuring throughput is essential because it reflects the network’s capacity to handle simultaneous data flows efficiently.

Higher throughput correlates with faster data transfer rates, reduced waiting times for users, and overall improved productivity. The throughput measurement parameters, including packet count, time span, and total transmitted bytes, are summarized in Table 4.

**Table 4:** Bytes Transferred and Time Span Measurement

Measurement	Captured
Packets	12,510
Time Span (s)	41.326
Average Packets per Second (pps)	302.7
Average Packet Size (Bytes)	998
Total Bytes	12,480,891

As shown in Table 4, the calculated throughput of 2,416 kbps indicates that the network is capable of supporting daily office data transmission requirements.

### 3.4. Packet Loss Analysis

Packet loss occurs when data packets fail to reach their intended destination, which can negatively impact application performance and user experience. In this study, 12,510 packets were sent, and 12,504 packets were successfully received, resulting in a 0% packet loss rate, effectively indicating that the network is highly reliable.

Low packet loss is particularly important for applications requiring high data integrity, such as VoIP calls, video conferencing, and real-time data synchronization. By maintaining minimal packet loss, the network ensures that users experience smooth and uninterrupted service, which is a critical indicator of Quality of Service. The packet loss statistics obtained from the captured network traffic are presented in Table 5.

**Table 5:** Sent and Received Packet Statistics

Measurement	Captured	Displayed
Packets	12,510	6 (0.0%)
Time Span (s)	41.326	11.378
Average Packets per Second (pps)	302.7	0.5
Average Packet Size (Bytes)	998	1116
Bytes	12,480,891	6,695 (0.1%)
Average Bytes per Second	302 k	588
Average Bits per Second	2,416 k	4,707

The table provides both captured and displayed packet counts, average packet size, and transmission rates, giving a comprehensive view of network reliability. The negligible packet loss observed reflects robust network hardware and effective traffic management protocols.

### 3.5. Delay Analysis

Network delay, or latency, measures the time required for a data packet to travel from the source to the destination. In the current analysis, the total measured delay was 31.631664 seconds, with an average delay of 3.53 ms, which is well below the ITU-T recommended maximum of 150 ms for interactive and real-time services. Low latency ensures that applications respond quickly, enhancing user experience, particularly for time-sensitive operations like online transactions and collaborative tools. The detailed delay measurement results for individual packet transmissions are shown in Table 6.

**Table 6:** Delay Measurement Results

Time 1 (s)	Time 2 (s)	Delay (s)
15.046009	17.774844	2.728835
17.774844	17.816069	0.041225
17.816069	25.535157	7.719088
25.535157	25.486218	0.151061
25.486218	26.354195	0.867977
26.354195	26.614136	0.259941
26.614136	33.196858	6.582722
33.196858	33.196935	7.7E-05

The table provides detailed per-packet delay calculations, allowing for the identification of potential spikes or inconsistencies in transmission times. Maintaining low average delay highlights the network’s efficiency in routing data promptly and minimizing bottlenecks. The findings confirm that the implemented network configuration effectively supports rapid packet delivery, contributing positively to overall QoS performance.

### 3.6. Jitter Analysis

Jitter refers to the variation in packet delay and reflects network stability. The average jitter value measured in this study was 3.22 ms, indicating highly consistent packet delivery. Low jitter is essential for real-time applications such as VoIP, video conferencing, and online streaming, where variations in packet timing can cause disruptions, audio/video lag, or quality degradation. The jitter measurement results, including variations between consecutive packet delays, are presented in Table 7.

**Table 7:** Jitter Measurement Results

No	Jitter Value 1 (s)	Jitter Value 2 (s)	Difference (s)
1	2.687610	-7.477863	-10.165473
2	-7.477863	7.368027	14.845890
3	7.368027	-0.716916	-8.084943
4	-0.716916	0.608036	1.324952
5	0.608036	-6.322781	-6.930817
6	-6.322781	6.582645	12.905426
7	6.582645	0.0000705	-6.582568

In summary, Table 7 demonstrates that the Yamaha Central Office Palembang network achieves stable and predictable performance, which is critical for maintaining high Quality of Service (QoS) standards, particularly for latency-sensitive applications. A summary of the total and average jitter values is presented in Table 8.

**Table 8:** Jitter Summary

Parameter	Value
Total Jitter (s)	-0.028887
Average Jitter (s)	$-3.22256 \times 10^{-6}$

Table 8 indicates that the average jitter value is very small, confirming stable and consistent packet delivery. The minimal jitter observed reinforces the conclusion that the network provides stable and predictable performance, ensuring a reliable operational environment for all users.

## 4. Conclusion

This study successfully evaluated the Quality of Service (QoS) performance of the internet network at the Yamaha Central Office Palembang using Wireshark as a network analysis tool. As stated in the Introduction, the objective of this research was to assess network performance based on key QoS parameters, including throughput, packet loss, delay, and jitter. The results and discussion confirm that this objective has been achieved.

The measurement results indicate that the network demonstrates good overall performance. The obtained throughput value of approximately 2416 kbps shows that the network is capable of supporting office operational activities effectively. In addition, the packet loss value of 0% reflects excellent network reliability and data transmission stability. The average delay of 3.53 ms and jitter of 3.22 ms are both significantly below the threshold values recommended by ITU-T and TIPHON standards, indicating very good responsiveness and minimal delay variation.

Based on the analysis results, it can be concluded that the internet network at the Yamaha Central Office Palembang meets international QoS standards and is suitable for supporting both data-intensive and time-sensitive applications. Furthermore, this study demonstrates that Wireshark is an effective and practical tool for monitoring and evaluating network performance in an office environment.

For future work, further research can be conducted by implementing network optimization techniques, such as bandwidth management or traffic shaping methods, to compare QoS performance before and after optimization. Additionally, QoS measurements over longer observation periods and under varying traffic conditions could provide a more comprehensive understanding of network behavior. The application of automated monitoring systems and integration with other network analysis tools also presents promising opportunities for enhancing network performance evaluation in future studies.

## Acknowledgement

The authors would like to express their sincere gratitude to the Faculty of Engineering, Muhammadiyah University of Palembang, for the academic support and facilities provided during the completion of this study. Appreciation is also extended to colleagues and reviewers who provided constructive feedback and valuable insights that helped improve the quality of this manuscript. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

## References

- [1] M. A. P. Bahinting *et al.*, "Stronger than the Internet Connectivity: A Phenomenology," *Psychol. Educ. A Multidiscip. J.*, pp. 1–19, 2022, doi: 10.5281/zenodo.6791820.
- [2] A. Uzoka, E. Cadet, P. U. Ojukwu, T. V. Group, and N. Carolina, "The role of telecommunications in enabling Internet of Things (IoT) connectivity and applications," *Compr. Res. Rev. Sci. Technol.*, pp. 055–073, 2024.
- [3] K. Zambouri *et al.*, "A Comprehensive Survey of Wireless Technologies, Applications, and Open Issues," *IEEE Commun. Surv. Tutorials*, vol. 27, no. 4, pp. 2129–2155, 2025, doi: 10.1109/COMST.2024.3486618.
- [4] T. Mazhar *et al.*, "Quality of Service (QoS) Performance Analysis in a Traffic Engineering Model for Next-Generation Wireless Sensor Networks,"

- Symmetry (Basel)*, vol. 15, no. 2, p. 513, 2023.
- [5] Í. Ö. DUMAN and U. ELİYYİ, "Performance Metrics and Monitoring Tools for Sustainable Network Management," *Bilişim Teknol. Derg.*, vol. 14, no. 1, pp. 37–51, 2021, doi: 10.17671/gazibtd.780504.
- [6] K. Mbeke, T. Osee, V. Nkemeni, and M. E. Sone, "Quality of Experience Management in Mobile Networks : Techniques , Constraints , and Emerging Trends for Value-Added Services," *Comput. Networks Commun.*, vol. 3, no. 2, pp. 21–58, 2025.
- [7] M. Qi and J. Wang, "Using the Internet of Things E-Government Platform to Optimize the Administrative Management Mode," *Wirel. Commun. Mob. Comput.*, vol. 2021, p. 11, 2021, doi: 10.1155/2021/2224957.
- [8] J. Zang, P. Jiao, S. Liu, X. Zhang, G. Song, and L. Yu, "Identifying Traffic Congestion Patterns of Urban Road Network Based on Traffic Performance Index," *sustainability*, vol. 15, no. 2, p. 948, 2023.
- [9] M. B. Khanyi, S. N. Xaba, N. A. Mlotshwa, B. Thango, and L. Matshaka, "A Roadmap to Systematic Review : Evaluating the Role of Data Networks and Application Programming Interfaces in Enhancing Operational Efficiency in Small and Medium Enterprises," *sustainability*, vol. 16, no. 23, p. 10192, 2024.
- [10] H. Kim, H. Lee, and H. T. Lim, "Performance of Packet Analysis between Observer and WireShark," *Int. Conf. Adv. Commun. Technol.*, pp. 268–271, 2020.
- [11] S. K. Mohamad and A. H. Kahleel, "Optimizing Network Reliability in Dynamic or Rapidly-Changing Topologies," *Babylonian J. Math.*, vol. 2023, pp. 98–103, 2023.
- [12] R. Alghamdi *et al.*, "Intelligent Surfaces for 6G Wireless Networks : A Survey of Optimization and Performance Analysis Techniques," *IEEE access*, vol. 8, pp. 202795–202818, 2020, doi: 10.1109/ACCESS.2020.3031959.
- [13] P. R. Utami, "Comparative Analysis of Wireless Internet Network Quality of Service on Internet Service Provider (ISP) Services: Indihome and First Media," *J. Ilm. Teknol. dan Rekayasa*, pp. 125–137, 2020.
- [14] D. A. Rachman, Y. Muhyidin, and M. A. Sunandar, "ANALYSIS QUALITY OF SERVICE OF INTERNET NETWORK FIBER TO THE HOME SERVICE PT . XYZ," *JITET (Jurnal Inform. dan Tek. Elektro Ter.*, vol. 11, no. 3, pp. 997–1006, 2023.
- [15] M. Hasbi and N. R. Saputra, "QoS Analysis of Internet Network at King Bukopin Head Office Using Wireshark," *Just IT J. Sist. Informasi, Teknol. Informasi, dan Komput.*, vol. 12, no. 1, pp. 17–23, 2021.
- [16] W. M. H. Azamuddin, R. Hassan, A. H. M. Aman, M. K. Hasan, and A. S. Al-Khaleefa, "Quality of Service ( QoS ) Management for Local Area Network ( LAN ) Using Traffic Policy Technique to," *Computers*, vol. 9, no. 2, p. 39, 2020.
- [17] D. Hale, G. Chrysikopoulos, A. Kondyli, and A. Ghiasi, "Evaluation of data-driven performance measures for comparing and ranking traffic bottlenecks," *IET Intell. Transp. Syst.*, vol. 15, no. 4, pp. 504–513, 2021, doi: 10.1049/itr2.12040.
- [18] H. Noorazar, A. Srivastava, and S. Pannala, "Data-driven operation of the resilient electric grid : A case of COVID-19," *J. Eng.*, no. June, pp. 665–684, 2021, doi: 10.1049/tje2.12065.
- [19] B. Dodiya and U. K. Singh, "Malicious Traffic analysis using Wireshark by collection of Indicators of Compromise," *Int. J. Comput. Appl.*, vol. 183, no. 53, pp. 1–6, 2022.
- [20] S. S. Sefati, B. Arasteh, S. Halunga, and O. Fratu, *A comprehensive survey of cybersecurity techniques based on quality of service ( QoS ) on the Internet of Things ( IoT )*, vol. 28, no. 12. Springer US, 2025. doi: 10.1007/s10586-025-05449-z.
- [21] P. Cash, J. Daalhuizen, and P. Hekkert, "Evaluating the efficacy and effectiveness of design methods: A systematic review and assessment framework," *Des. Stud.*, vol. 88, p. 101204, 2023, doi: 10.1016/j.destud.2023.101204.
- [22] T. P. Latchoumi, A. V. Vasanth, and B. Bhavya, "QoS parameters for Comparison and Performance Evaluation of Reactive protocols," *Int. Conf. Comput. Intell. Smart Power Syst. Sustain. Energy (CISPSSSE). IEEE*, 2020.
- [23] Nurcahyo, A. Christian, L. Firgia, and Y. Mustaqim, "Implementation and Analysis of the Hierarchical Token Bucket Method in Network Bandwidth Management (Case Study: Rectorate Network of the Shanti Bhuana Institute)," *J. Inf. Technol.*, pp. 41–49, 2021.