

Performance Analysis of a Wireless LAN Using QoS and QoE Parameters at Batara Guru Belopa Regional General Hospital

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ARTICLE INFORMATION	ABSTRACT
Received : 03 – 10 – 2024 Revised : 02 – 10 – 2025 Published : 29 – 10 – 2025	This study aims to assess network performance on the first floor of Batara Guru Regional General Hospital and to determine whether the network meets users' internet needs. The Quality of Service (QoS) analysis of the hospital's Wireless LAN shows that throughput is of moderate quality during peak hours with an average of 518 kbps, and very good during off-peak hours with an average of 2,794 kbps. Packet loss is good at peak hours (4.1%) and very good off-peak (0.35%). For delay, network quality is very good in both peak and off-peak periods, averaging 60.7 ms and 75.05 ms, respectively. Jitter is good in both peak and off-peak periods, averaging 60.8 ms and 73.8 ms, respectively. The Quality of Experience (QoE) analysis of the hospital's wireless network falls within the normal category, with an overall mean score of 3.55: Quality of Effectiveness 3.63 (normal), Quality of Efficiency 3.79 (normal), Usability 3.69 (normal), Expectations 3.26 (normal), and Context 3.41 (normal). In summary, the network at Batara Guru Regional General Hospital meets TIPHON and MOS standards and is categorized as good/satisfactory.
Keywords: Hospital QOS QOE Wireshark WLAN	

I. Introduction

Batara Guru Regional General Hospital currently operates a Wireless LAN with several access points deployed—particularly in the Finance, Administration, and Edelweiss units. The hospital's network has an aggregate bandwidth of 300 Mbps provisioned from three ISPs: IndiHome 200 Mbps, Astinet 50 Mbps, and Icon Plus 50 Mbps. The number of user accesses is unrestricted, enabling staff to connect to the SIMRS (Hospital Management Information System) and Ministry of Health (KEMENKES) applications over the internet. However, around 10:30 WITA, traffic typically spikes, disrupting data transactions. This necessitates a preliminary analysis to identify the causes of network congestion.

Several studies have examined wireless network analysis. At SMP Negeri 6 Palopo, an analysis of WLAN performance found that network instability stemmed from ineffective bandwidth management; allocating bandwidth as unlimited led to contention for stable internet access, especially when many users connected to the same access point simultaneously [1]. The IEEE 802.11 b/g/n (national WLAN standard) divides operating frequencies into two bands: 2.4 GHz with a maximum bandwidth of 72 Mbps, and 5 GHz with a maximum bandwidth of 100 Mbps [2]. As wireless usage grows, data-communication congestion has become a prominent issue [3]. Wireless LAN performance problems—particularly those affecting Quality of Service (QoS)—are often caused by low throughput, transmission delay, and packet loss, which can significantly impact networked applications [4]. In performance terms, wireless networks have inherent disadvantages compared to wired networks [5].

Given these gaps, further analysis of the Batara Guru Hospital network is warranted. Accordingly, this study is titled: "Performance Analysis of a Wireless LAN Using QoS and QoE Parameters at Batara Guru Regional General Hospital."

II. Method

A. Wireless Local Area Network (WLAN)

A WLAN is a data-communication system that can be adapted to organizational needs and used as an extension or replacement for a wired LAN. Radio-frequency (RF) technology is employed to transmit data

over the air, reducing reliance on physical cabling. This enables a combination of data connectivity and user mobility within the WLAN [12].

B. Quality of Service (QoS) Parameters

Quality of Service (QoS) refers to techniques for assessing the quality of an internet/network connection. In a given network, QoS is evaluated based on the speed and timeliness of data delivery across different types of communication [13].

Table 1. QoS Percentage and Ratings (TIPHON)

Score	Percentage	Index
3.8–4	95–100	Very Satisfactory
3–3.79	75–94.75	Satisfactory
2–2.99	50–74.75	Unsatisfactory
1–1.99	25–49.75	Poor

Several parameters are commonly used to evaluate QoS—namely Throughput, Delay (Latency), Jitter (packet-arrival variation), and Packet Loss [14].

1) Throughput

Throughput adalah efisiensi transfer data, diukur dalam bps (bit per detik), yang mencerminkan jumlah keseluruhan paket yang berhasil tiba di tujuan dalam interval waktu tertentu, dibagi oleh durasi interval waktu tersebut [15].

Table 2. Throughput Parameter

Category	Throughput	Index
Very Good	>1200	4
Good	700 – 1200	3
Fair	388- 700	2
Poor	<388	1

Throughput calculation formula:

$$\text{Throughput} = \frac{\text{Packet Received}}{\text{Data Transmission time}}$$

2) Delay

Delay is the time required for a packet to traverse from the sender to the intended receiver (end-to-end latency) [16].

Table 3. Delay Parameter (TIPHON)

Category	Delay	Index
Very Good	< 150 ms	4
Good	150 s/d 300 ms	3
Fair	d 450 ms	2
Poor	> 450 ms	1

TIPHON

Average delay formula:

$$\text{Avg Delay} = \frac{\text{Total delay}}{\text{Total packet received}}$$

3) Jitter

Jitter is the variation in inter-packet delay on IP networks. Its magnitude depends heavily on traffic variability and load; higher traffic increases the likelihood of congestion, which in turn raises jitter values and degrades Quality of Service (QoS) [17].

Table 4. Jitter Parameter

Category	Jitter	Index
Very Good	0 ms	4
Good	0 s/d 75 ms	3
Fair	75 s/d 125 ms	2
Poor	125 s/d 225 ms	1

Jitter calculation:

$$Jitter = \frac{\text{Total delay variation}}{\text{Total packet received}}, \text{ with } \textit{delay variation} = \textit{delay} - \textit{delay}$$

4) Packet Loss

Packet loss is the proportion of packets that fail to reach the destination after transmission. Causes commonly include collisions and congestion within the network [18].

Table 5. Packet Loss Parameter

Category	Packet Loss	Index
Very Good	0%	4
Good	3%	3
Fair	15%	2
Poor	25%	1

Packet loss formula:

$$\textit{Packet Loss} = \frac{\textit{Packets sent} - \textit{Packets received}}{\textit{Packets sent}} \times 100\%$$

C. Quality of Experience (QoE) Parameters

Quality of Experience (QoE) denotes the user's perceived level of satisfaction when using a given service or application. Factors such as speed, reliability, latency, audio/video quality, interface responsiveness, and other user-experience aspects influence QoE [19]. Human perception is commonly measured using the Mean Opinion Score (MOS), which reflects ratings from a test panel. Questionnaires are constructed based on the QoE parameters defined for each application [20]. In this study, questionnaires were administered to staff and employees, with 20 respondents in total. Following the Absolute Category Rating (ACR) scale, scores fall into five categories: 5 = excellent, 4 = very good, 3 = good, 2 = fair, and 1 = poor [21].

Table 6. Mean Opinion Score (MOS)

MOS	Quality	Perception
5	Excellent	Imperceptible
4	Good	Perceptible
3	Fair	Slightly Annoying
2	Poor	Annoying
1	Bad	Very Annoying

Average score computation

$$\bar{X} = \frac{x_1 + x_2 + x_3 + \dots + x_n}{n}$$

Example questionnaire items commonly used in QoE surveys [22]:

- Is the wireless network performance at Campus 1, AKPRIND Yogyakarta, stable?
- Does the wireless network service at Campus 1, IST AKPRIND Yogyakarta, operate without interruptions?
- Does the wireless network at Campus 1, AKPRIND Yogyakarta, provide per-account access for students?
- Does the wireless network operate at all times?
- Does the wireless network allow users freedom in using Wi-Fi?

D. Research Stages

1) Site Selection

Identify the location or area to be used as the research site.

2) Problem Identification

A critical planning step to focus the research objectives and establish relevance.

3) Data Collection

Gather the information or evidence required to answer the research questions or test hypotheses.

4) Analysis Using QoS & QoE Parameters

During implementation, compute QoS metrics and administer the QoE questionnaire to hospital staff to assess current network quality for future improvements. The assessment uses QoE parameters and QoS formulas based on TIPHON standards (packet loss, delay, throughput, and jitter).

5) Final Outcome

Upon completing these stages, derive conclusions based on data collected via QoS and QoE parameters. These results support efforts to improve network performance at Batara Guru Regional General Hospital.

This research is experimental in nature, employing network-testing software aligned with QoS and QoE standards to measure network access speed..

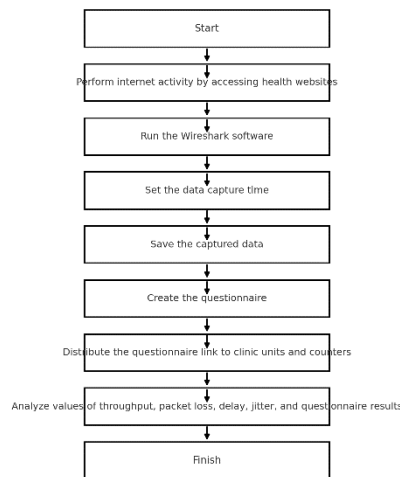


Figure 1. Research Scenario

Based on Figure 1, the workflow is as follows: perform typical internet activities by accessing health-related websites; run Wireshark; set the capture duration to define how long data will be collected; save the capture results; design a questionnaire and distribute the link to outpatient units and service counters; finally, analyze throughput, packet loss, delay, jitter, and the Mean Opinion Score (MOS).

III. Results and Discussion

Measurements were conducted over two weeks. Each week, data were collected on Monday and Thursday using Wireshark as the capture tool. Data collection comprised two sessions per day, with each capture lasting 1 minute. The peak-hour session ran from 09:00–12:00, and the off-peak session from 13:00–03:00. The results are as follows.

Table 6. Throughput Measurements During Peak Hours

Day/Date	Time	Packet				
		Number of Bytes	Time Span	Kbps	Index	Category
Monday / 01 – 07 – 2024	09.00 – 12.00	767159	59.713	102 kbps	1	Poor
Thursday / 04 – 07 – 2024	09.00 – 12.00	90184	58.207	12 kbps	1	Poor

Day/Date	Time	Packet				
		Number of Bytes	Time Span	Kbps	Index	Category
Monday / 08 – 07 – 2024	09.00 – 12.00	2038096	59.915	272 kbps	1	Poor
Thursday / 11 – 07 – 2024	09.00 – 12.00	12345555	58.447	1689 kbps	3	Good
Average Throughput				518 kbps	2	Fair

Throughput measurements on 01, 04, 08, and 11 July 2024 during 09:00–12:00 (with 60-second captures) yielded an average peak-hour throughput of 518 kbps, categorized as fair.

Table 7. Throughput Measurements During Off-Peak Hours

Day/Date	Time	Packet				
		Number of Bytes	Time Span	Kbps	Index	Category
Monday / 01 – 07 – 2024	13.00 – 15.00	422673	58.472	57 kbps	1	Poor
Thursday / 04 – 07 – 2024	13.00 – 15.00	63667	57.709	8.825 kbps	4	Very Good
Monday / 08 – 07 – 2024	13.00 – 15.00	6391139	58.178	878 kbps	3	Good
Thursday / 11 – 07 – 2024	13.00 – 15.00	10493536	59.169	1.418 kbps	4	Very Good
Average Throughput				2.794 kbps	4	Very Good

Based on the throughput measurements taken on 01, 04, 08, and 11 July 2024 during 13:00–15:00 with 60-second captures, the average off-peak throughput was 2,794 kbps, classified as very good.

Table 8. Packet Loss Measurements During Peak Hours

Day/Date	Time	Packet				Index	Category
		Packets sent	Packets received	Loss			
Monday / 01 – 07 – 2024	09.00 – 12.00	1311	1275	2,7%	4	Very Good	
Thursday / 04 – 07 – 2024	09.00 – 12.00	356	349	1,9%	4	Very Good	
Monday / 08 – 07 – 2024	09.00 – 12.00	2442	2207	9,6%	3	Good	
Thursday / 11 – 07 – 2024	09.00 – 12.00	26249	25609	2,4%	4	Very Good	
Average Packet Loss				4,1%	3	Good	

The packet loss measurements taken on 01, 04, 08, and 11 July 2024 during 09:00–12:00 with 60-second captures indicate that the average peak-hour packet loss reached 4.1%, categorized as good.

Table 9. Packet Loss Measurements During Off-Peak Hours

Day/Date	Time	Packet				Index	Category
		Packets sent	Packets received	Loss			
Monday / 01 – 07 – 2024	13.00 – 15.00	726	726	0%	4	Very Good	
Thursday / 04 – 07 – 2024	13.00 – 15.00	276	276	0%	4	Very Good	

Day/Date	Time	Packet				
		Packets sent	Packets received	Loss	Index	Category
Monday / 08 – 07 – 2024	13.00 – 15.00	10123	10089	0,33%	4	Very Good
Thursday / 11 – 07 – 2024	13.00 – 15.00	11728	11725	0,02%	4	Very Good
Average Packet Loss				0,35%	4	Very Good

The packet loss measurements taken on 01, 04, 08, and 11 July 2024 during 13:00–15:00 with 60-second captures show that the average off-peak packet loss was 0.35%, classified as very good..

Table 10. Delay Measurements During Peak Hours

Day/Date	Time	Packet				
		Packet received	Total Delay	Average	Index	Category
Monday / 01 – 07 – 2024	09.00 – 12.00	1275	59,713279	46,8 ms	4	Very Good
Thursday / 04 – 07 – 2024	09.00 – 12.00	349	58,206716	166,7 ms	3	Good
Monday / 08 – 07 – 2024	09.00 – 12.00	2207	59,914834	27,1 ms	4	Very Good
Thursday / 11 – 07 – 2024	09.00 – 12.00	25609	58,447164	2,2 ms	4	Very Good
Average Delay				60,7 ms	4	Very Good

The delay measurements taken on 01, 04, 08, and 11 July 2024 during 09:00–12:00 with 60-second captures indicate that the average peak-hour delay reached 60.7 ms, classified as very good.

Table 11. Delay Measurements During Off-Peak Hours

Day/Date	Time	Packet				
		Packet received	Total Delay	Average	Index	Category
Monday / 01 – 07 – 2024	13.00 – 15.00	726	58,471664	80,5ms	4	Very Good
Thursday / 04 – 07 – 2024	13.00 – 15.00	276	57,708875	209,0 ms	3	Good
Monday / 08 – 07 – 2024	13.00 – 15.00	10089	58,177587	5,7 ms	4	Very Good
Thursday / 11 – 07 – 2024	13.00 – 15.00	11725	59,169194	5,0 ms	4	Very Good
Average Delay				75,05 ms	4	Very Good

The delay measurements taken on 01, 04, 08, and 11 July 2024 during 13:00–15:00 with 60-second captures show that the average off-peak delay was 75.05 ms, classified as very good.

Table 12. Jitter Measurements During Peak Hours

Day/Date	Time	Packet				
		Packet received	Total Jitter	Average	Index	Category
Monday / 01 – 07 – 2024	09.00 – 12.00	1275	59,792693	46,8ms	3	Good
Thursday / 04 – 07 –	09.00 – 12.00	349	58,24956	166,9ms	1	Poor

Day/Date	Time	Packet			Index	Category
		Packet received	Total Jitter	Average		
2024						
Monday / 08 – 07 – 2024	09.00 – 12.00	2207	60,386038	27,3 ms	3	Good
Thursday / 11 – 07 – 2024	09.00 – 12.00	25609	58,35609	2,2 ms	3	Good
Average Jitter				60,8 ms	3	Good

The jitter measurements taken on 01, 04, 08, and 11 July 2024 during 09:00–12:00 with 60-second captures indicate that the average peak-hour jitter reached 60.8 ms, categorized as good.

Table 13. Jitter Measurements During Off-Peak Hours

Day/Date	Time	Packet			Index	Category
		Packet received	Total Jitter	Average		
Monday / 01 – 07 – 2024	13.00 – 15.00	726	56,88591	78,3 ms	3	Good
Thursday / 04 – 07 – 2024	13.00 – 15.00	276	56,865083	206,0ms	1	Poor
Monday / 08 – 07 – 2024	13.00 – 15.00	10089	60,583576	6,0 ms	3	Poor
Thursday / 11 – 07 – 2024	13.00 – 15.00	11725	59,089368	5,0 ms	3	Good
Average Jitter				73,8 ms	3	Good

The jitter measurements taken on 01, 04, 08, and 11 July 2024 during 13:00–15:00 with 60-second captures show that the average off-peak jitter was 73.8 ms, also categorized as good.

Table 14. QoE Data Collection Results

Aspect	Question (translated)	SS (5)	S (4)	CS (3)	TS (2)	STS (1)	Mean	MOS	Desc
Quality of Effectiveness	The wireless network at RSUD Batara Guru has stable performance.	7	9	9	1	0	3.84		
	The wireless network at RSUD Batara Guru never gets disconnected while in use.	4	8	10	4	0	3.46		
	The wireless network at RSUD Batara Guru never fails when sending files.	3	9	10	4	0	3.42	3,63	Normal
	Data sent via Gmail never suffers damage or loss.	6	11	6	3	0	3.76		
	Downloading/uploading files on a Gmail account is very fast.	4	12	8	2	0	3.69		
Quality of Efficiency	The wireless network speed for searching on Google is very good.	6	10	9	1	0	3.8		
	The wireless network has authentication login (security) before use.	8	11	6	0	1	3.96	3,79	Normal
	The wireless network is reliable / has high	5	9	11	1	0	3.69		

Aspect	Question (translated)	SS (5)	S (4)	CS (3)	TS (2)	STS (1)	Mean	MOS	Desc
Usability	capability for fast access.								
	The wireless network is safe to use.	6	10	8	1	1	3.73		
	The wireless network operates at all times.	8	12	3	2	1	3.92	3,69	Normal
Expectations	The wireless network is easy to access.	5	10	4	6	1	3.46		
	The wireless network meets user needs.	4	11	7	3	1	3.53	3,26	Normal
Context	The wireless network gives users freedom in using Wi-Fi.	3	7	5	9	2	3.26		
	The wireless network can be accessed indoors and outdoors.	3	9	6	8	0	3.26	3,41	Normal
	The wireless network can be accessed on multiple devices.	5	9	8	4	0	3.57	3,55	Normal

Table 14 presents the MOS results for each QoE aspect under study. The Quality of Effectiveness aspect obtained an MOS of 3.63 (normal); Quality of Efficiency scored 3.79 (normal); Usability scored 3.69 (normal); Expectations scored 3.26 (normal); and Context scored 3.41 (normal). The MOS values were derived by first multiplying the response counts by their respective scoring weights, summing the products, and dividing by the number of respondents to obtain an item mean. The aspect-level MOS was then computed by averaging the item means within each aspect. Finally, the overall MOS was obtained by averaging the MOS values across all aspects.

IV. Conclusion

Based on the study conducted at RSUD Batara Guru Belopa, the Quality of Service (QoS) analysis of the hospital's Wireless LAN indicates that throughput is moderate during peak hours (average 518 kbps) and very good during off-peak hours (average 2,794 kbps). Packet loss is good during peak hours (4.1%) and very good off-peak (0.35%). For delay, network quality is very good in both periods, averaging 60.7 ms (peak) and 75.05 ms (off-peak). Jitter is good in both periods, averaging 60.8 ms (peak) and 73.8 ms (off-peak).

The Quality of Experience (QoE) analysis places the network in the normal category with an overall mean MOS of 3.55: Quality of Effectiveness = 3.63 (normal), Quality of Efficiency = 3.79 (normal), Usability = 3.69 (normal), Expectations = 3.26 (normal), and Context = 3.41 (normal).

In summary, considering both QoS and QoE parameters, the network at RSUD Batara Guru meets TIPHON and MOS standards and falls within the good/satisfactory category. These findings can serve as evidence for RSUD Batara Guru to further improve network quality in terms of both technical performance and user experience.

Recommendations. Future work should consider using more advanced measurement tools to produce richer results, expanding the study scope, and increasing the number of test sessions to obtain more accurate data and strengthen subsequent research.

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