Natural Sciences Engineering & Technology Journal (NASET Journal)

Journal Homepage: https://nasetjournal.com/index.php/nasetjournal

Overview of Computer Networks for Data Transmission at Pondok Kopi Islamic Hospital, Jakarta, Indonesia

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ARTICLE INFO

Keywords:
Axence netTools 5
Monitoring
Quality of service
TIPHON

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All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/nasetjournal.v3i2.41

A B S T R A C T

Network quality monitoring can provide services in the provision of computer network performance in the provision of data transmission according to the level of aspects related to the performance of network infrastructure systems and the number of clients operating for each computer. During the day, at certain hours, many subscribers use the network when the connection is blocked, and the graphics on the screen reach their highest levels. By monitoring computer network installation graphics, Axence netTools software needs to know bandwidth management to overcome network congestion by analyzing the QoS (quality of service) of computer network data transmission. The purpose of this study is to provide quality of service presentation material on LAN infrastructure performance using the TIPHON standard to measure LAN performance and analyze the factors that influence the results of quality of service measurements and obtain packet loss, delay, jitter based on class classification and average bandwidth value, according to TIPHON. The research method used is observation, interviews, literature study, monitoring, and qualitative descriptive research methods. The results showed that the percentage value of quality of service based on the TIPHON standardization was 66.66%. This result was classified as "unsatisfactory" because the average packet loss was 40%. The average percentage of delay is 115ms, and the average percentage of jitter is 7.5ms. The factors that affect the QoS index results are the distance of computer network transmission facilities and the need to monitor computer networks when adding and maximizing bandwidth according to TIPHON standards.

1. Introduction

The development of the telecommunication world is very rapid in this modern era, with demands for fast and efficient services. Likewise, data communication ranges from connections between two computers to computer networks. Computer network technology has penetrated various fields and aspects of life. We see it in terms of users of computer networks as well as in terms of authorities, groups, and individuals. Information network technology is a very important container for managing and producing timely and accurate information. Electronic media is needed as a tool. Technological progress is not a guarantee of completeness of information but rather a well-built system capable of accommodating or managing all the information needed to support all telecommunication information systems.[1-3]

Telecommunications is the development of data transmission technology for sending data via telephone lines so that computer network

infrastructure becomes faster and more efficient. The same is true for data communications, from connections between two computers to a computer network. A computer network is a service that enables the simultaneous operation of data and software, enabling information systems to communicate quickly and efficiently, simply, accurately, securely, integrated, and precisely. One form of service system implementation is the use of information technology using a computerized information system as part of the development of communication data transmission technology in the use of computer information technology. Pondok Kopi Islamic Hospital Jakarta uses a computer network infrastructure for telecommunications, a computer network is needed for communication between rooms and the hospital building. Due to the operation of the network infrastructure system and the number of clients which launch daily, until the client uses the network at the same time at a certain time, causing connection difficulties and reaching the highest surveillance card level. One way to find and monitor images is to use the Axence netTools 5 software. Axence netTools 5 uses a local area network (LAN) to connect one computer to another. Besides that, Axence netTools emphasizes the process of monitoring and measuring network quality parameters of IT network infrastructure in terms of data access speed.[4-7]

Network quality analysis can be carried out by measuring service quality, namely the technology used by computer networks to provide optimal and fair services to computer network users. QoS enables hosts/servers to handle various traffic congestion problems on computer networks. The measurement parameters analyzed were bandwidth, packet loss, throughput, and jitter, compared to the TIPHON standard (telecommunication and internet protocol harmonization over network), which is a network quality measurement method and seeks to determine the characteristics and nature of the service.[8,9]

In the medical record unit and network administration, the problem formulation was found in the local area network computer network and data transmission jams at the Pondok Kopi Islamic Hospital Jakarta. The frequent occurrence of problems on computer networks on each client that distributes data transmission causes the frequent occurrence of packet loss on a computer network, on any client, or the server, and complicates the distribution of data to the server. The formulation of the problem that can be concluded from the findings of researchers may occur due to weather factors, equipment hardware, software, as well as limitations in providing internet connection on bandwidth.[10,11] This study aimed to conduct a review of computer networks for data transmission at Pondok Kopi Islamic Hospital, Jakarta, Indonesia.

2. Methods

The location of the research was Pondok Kopi Islamic Hospital Jakarta, which is located at Jl. Pondok Kopi II, Pd. Kopi, Duren Sawit District, East Jakarta, Special Capital Region of Jakarta 13460, and the time for carrying out research observations were carried out from December 1st, 2021, to March 2022. The research method describes the research object based on actual data or facts obtained from direct observation and interviews obtained to understand user factors about network computer data transmission at Pondok Kopi Islamic Hospital Jakarta. Data collection techniques and tools are: observations are made by collecting data about the network topology structure and the installation of supporting network elements, interviews with administrators about the specifications of network installations, librarians collect data based on theories related to service quality in the study and download of work monitoring data thanks to companion applications Axence netTools 5 installed on the author's laptop with IP address access rights granted by the land manager. Analysis of the QoS monitoring process using the Axence netTools 5 application. Diagnosing, namely by identifying problems related to the purpose of data collection and problem boundaries with researchers. Action planning, namely the implementation of network quality performance in terms of network speed graphic quality using the Axence netTools 5

application. Action taking, namely measuring network quality based on field data in the form of network topology installed in the study area, testing network quality using the Axence netTools 5 an application, and analysis of service quality data in the form of packet loss, delay and jitter on the TIPHON standard. Evaluating, namely the evaluation of the data in the form of packet loss, delay, and bandwidth based on monitoring results quality of service.

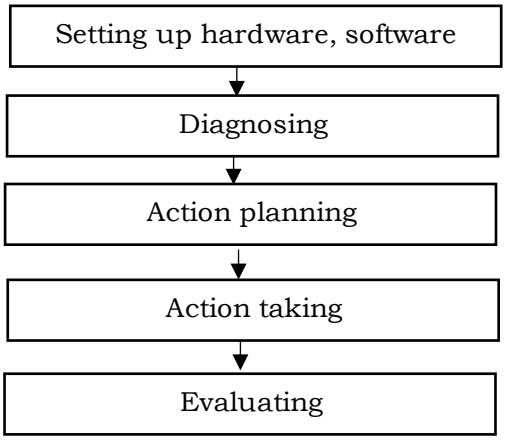

Figure 1. Research process flowchart.

3. Results and Discussion

Network infrastructure design of Pondok Kopi Islamic Hospital Jakarta

The design of the computer network infrastructure at Pondok Kopi Islamic Hospital Jakarta is described in the concept of a VLAN (virtual local area network) cable. Main computer network infrastructure design implemented at Pondok Kopi Islamic Hospital Jakarta.

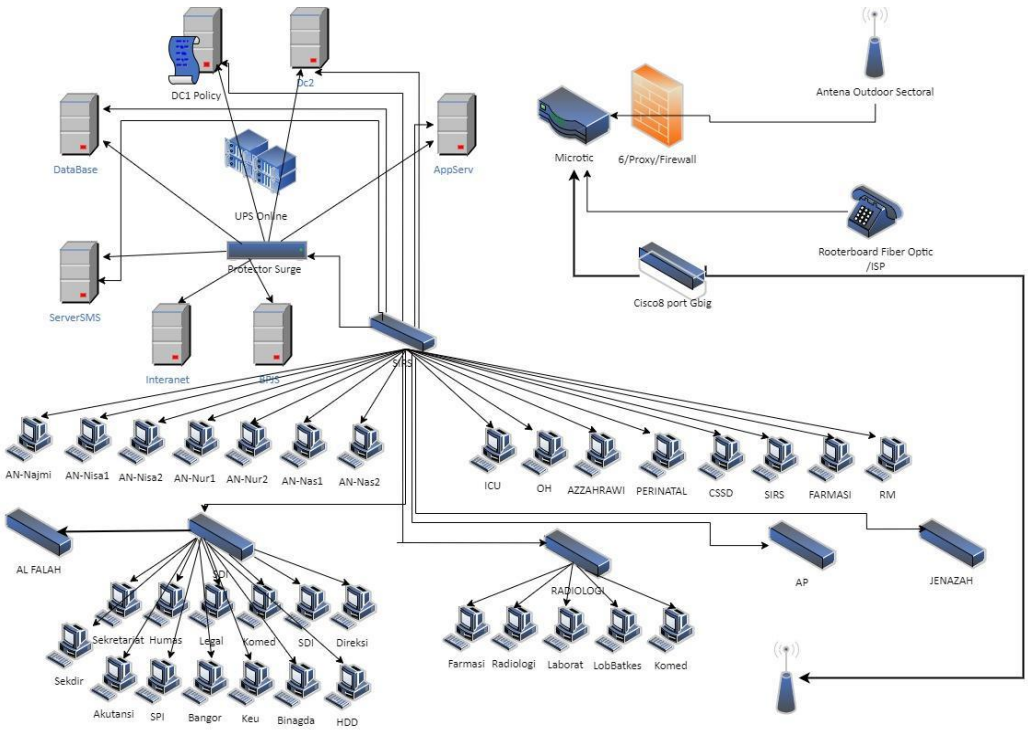

Figure 2. Computer network infrastructure design implemented at RSIJPK.

Based on the description above, it can be explained that the topology of the IT network infrastructure implemented at Pondok Kopi Islamic Hospital Jakarta is a star topology using 1 router and 9 switches as network interfaces. Computer network infrastructure connected to 280 client PCs. The use of star topology computer network infrastructure has the advantage of this topology in that new nodes can be easily added if one of the problematic nodes does not interfere with other nodes and facilitates computer network maintenance. Based on the results of interviews with the IT section of Pondok Kopi Islamic Hospital Jakarta, it is known that the bandwidth management method used at Pondok Kopi Islamic Hospital Jakarta is PCQ (per connection queue) and queue tree, where the PCQ method is sharing the bandwidth of users who join the network. So that each user gets the same network speed, and the queue tree function limits bandwidth usage according to IP addresses as in computer network infrastructure. The results obtained are a total bandwidth allocation of 150 Mbit/s and WIFI of 26 Mbit/s for user access.

LAN network monitoring results at Pondok Kopi Islamic Hospital Jakarta (RSIJPK) QoS parameters.

The scheme explained that for data retrieval, the laptop that will be used has Axence netTools 5 installed. Next, the laptop will be connected to the RSIJP local network cable access point and then proceed with monitoring by sending the ping command to the target IP address (10.12. 12.35) and (10.12.12.167) use Axence netTools 5 software to record bandwidth, delay, packet loss, and jitter data.

Bandwidth

Table 1 shows data that can be known. The average value bandwidth the highest occurred on Wednesday, November 9th, 2022 in the time range 09.00-13.00, namely 14,613,221 bps, while the average value bandwidth the lowest occurred on Thursday, November 10th, 2022 in the time range 09.00-13.00, namely 196,810 bps. The average value bandwidth in total is 3,091,817 bps or 386,477,125 kbps.

Table 1. Bandwidth values at the RSIJPK access point.

No	Date and time	Time (WIB)	Bandwidth (bps)		
			Min	Max	Average
1	Wednesday/November 9th, 2022	09.00 – 13.00	1.615.432	21.667.768	14.613.221
2	Thursday/November 10th, 2022	09.00 – 13.00	18.848	6.111.768	196.810
3	Wednesday/November 16th, 2022	09.00 – 13.00	39.744	6.151.776	212.932
4	Wednesday/November 23rd, 2022	09.00 – 13.00	41.104	6.632.528	205.355
5	Thursday/November 24th, 2022	09.00 – 13.00	41.088	5.987.624	230.765
Average					3.091.817

Packet loss

According to TIPHON, packet loss goes into the deep category very good in percentage. The loss is 0%, good if 3%, moderate if 15%, and bad if 25%. Table 2 shows that the percentage of packet loss at the RSIJPK access point included in the category bad is in the range of 41% -60% on all days and goes into category bad on Wednesday, November 23rd, 2022. The lowest percentage of packet loss occurred on Wednesday, November 9th, 2022, in the time range 09.00-13.00, namely 2%. Whereas percentage the highest packet loss occurred on Wednesday, November 23rd, 2022, which was 60%. After calculating the overall average, presentation packet loss at the RSIJPK access point is 40%, so it is included in the bad category.

Table 2. Packet loss values at the RSIJPK access point according to TIPHON.

No	Date and time	Time (WIB)	Packet loss			Category
			Sent	Lost	Lost (%)	
1	Wednesday/November 9th, 2022	09.00 – 13.00	9362	145	2	Very good
2	Thursday/November 10th, 2022	09.00 – 13.00	8568	3486	41	Bad
3	Wednesday/November 16th, 2022	09.00 – 13.00	9045	4832	53	Bad
4	Wednesday/November 23rd, 2022	09.00 – 13.00	6297	3786	60	Bad
5	Thursday/November 24th, 2022	09.00 – 13.00	5056	2330	46	Bad
Average					40	Bad

Delay

According to TIPHON, the delay is included in the category very good if a large delay is < 150 ms, good if the delay is between 150 ms to 300 ms if it is a delay of 300 ms up to 450 ms, and bad if the delay is> 450 ms. Table 3 shows that the average delay at the RSIJPK access point is included in very good category i.e., less than 150 ms on all days. The lowest average delay occurs on Wednesday, November 9th, 2022, in the time range 09.00-13.00, which is 1 ms. While on average delay, the highest occurred on Wednesday, November 23rd, 2022, which was 151 ms. After calculating the overall average, the average delay at the RSIJP access point is 115 ms, so it is included in very good category.

Table 3. Delay value at the RSIJPK access point according to TIPHON.

No	Date and time	Time (WIB)	Delay (ms)			Category
			Max	Min	Average	
1	Wednesday/9th November 2022	09.00 – 13.00	656	0	1	Very good
2	Thursday/November 10th, 2022	09.00 – 13.00	399	1	136	Very good
3	Wednesday/November 16th, 2022	09.00 – 13.00	900	1	148	Very good
4	Wednesday/November 23rd, 2022	09.00 – 13.00	988	1	151	Good
5	Thursday/November 24th, 2022	09.00 – 13.00	399	1	141	Very good
Average					**115**	Very good

Jitter

According to TIPHON, jitter is included in the category very good if the jitter is 0 ms, good if 0 ms up to 75 ms, moderate if 75ms to 125 ms, and bad if 125 ms up to 225 ms. Table 4 shows that the jitter at the RSIJPK Access Point is included in the category good, namely between 0 ms to 75 ms all day. The lowest jitter occurred on Thursday, November 24th, 2022, in the time range 09.00 – 09.05, which was 1.79 ms. Meanwhile, the highest jitter occurred on Thursday, November 10th, 2022, in the time range 12.55 – 13.00, which was 20.47 ms. After calculating the overall average, the jitter at the RSIJPK access point is 7.53 ms, so it is included in the good category.

Table 4. Category jitter on the RSIJPK access point based on TIPHON.

No	Date and time	Time (WIB)	Jitter (ms)	Category
1	Wednesday/9th, November 2022	09.00 – 09.05	3,46	Good
		12.55 – 13.00	13,27	Good
2	Thursday/November 10th, 2022	09.00 – 09.05	2,72	Good
		12.55 – 13.00	20,47	Good
3	Wednesday/November 16th, 2022	09.00 – 09.05	4,05	Good
		12.55 – 13.00	9,05	Good
4	Wednesday/November 23rd, 2022	09.00 – 09.05	3,51	Good
		12.55 – 13.00	5,37	Good
5	Thursday/November 24th, 2022	09.00 – 09.05	1,79	Good
		12.55 – 13.00	11,67	Good
Average			7,53	Good

Quality of service LAN RSIJPK network

From the data above, the results of the analysis are packet loss in the category bad, delay in the category very good, and jitter in the category Good. Analysis results later analyzed back to the TIPHON standard-based QoS parameter index table. The index for the packet loss parameter is 1 while the delay parameter is 4 and the jitter parameter is 3 so that it is obtained percentage as a result of Quality of Service with use formula as follows:

$$\frac{The\ number\ of\ QoS\ indexes\ obtained}{The\ maximum\ number\ of\ QoS\ indexes}\ X\ 100\%$$

$$\frac{8}{12}\ X\ 100\% = 66{,}66\%$$

Thus, the results of the Quality of Service of the LAN network at the Pondok Kopi Islamic Hospital Jakarta are included in the Unsatisfactory category. Based on the calculation of quality of service indicators, it is necessary to increase QoS on the LAN network at the Pondok Kopi Islamic Hospital Jakarta, which is categorized as satisfactory, requiring minimum bandwidth for each client:

$$\frac{386.477{,}125}{66{,}66}\ X\ \frac{x}{75} = 434.830{,}248\ \text{Kbps}$$

With these results, then the allocated bandwidth is required in fulfilling client*s* of 434,830.248*Kbps.*

From the measurement results of the analysis above, it is clear that the QoS value is influenced by several factors consisting of throughput, delay, packet loss, and jitter in the network, which result in a decrease in the QoS value, namely: Due to the longer distance through the transmission medium, in this case, the optical fiber. Each transmission medium has different attenuation depending on the type and material. The strength of the transmitted signal can be weakened due to the long distances at each node. An undetectable signal exists between the transmission of the sender and receiver when measuring QoS parameters with the application Axence netTools 5.[12-15]

4. Conclusion

The QoS level compared to the TIPHON standard is included in the unsatisfactory category with a value of 66.6%. If the QoS level is to be increased, a 75% level is needed, and the minimum bandwidth required is 434.83 kbps. The average value of total packet loss compared to TIPHON is in a bad category, with an average total packet loss of 40% higher than an average packet loss of 25%. The results of the overall average delay compared to the TIPHON standard are included in the very good category, with the overall average delay reaching a percentage of 115 ms. The average total jitter compared to the TIPHON standard is in a good category, with an average total packet loss of 7.5 ms. The factor that affects the measurement results is the distance of the transmission media from the wired network and the WLAN network.

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