Jurnal Komputer, Informasi dan Teknologi Vol: 4, No 2, 2024, Page: 1-8

Analysis and Classification Of Wireless LAN Network Service Quality Using The Naive Bayes Algorithm In The Department Of Informatics and Computer Engineering, Faculty Of Engineering, State University Of Makassar

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DOI: https://doi.org/10.53697/jkomitek.v4i2.1841
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Received: 08-05-2024
Accepted: 16-06-2024
Published: 29-07-2024

Abstract: *This study aims to determine the Quality of Service outcomes and the classification results of the Naive Bayes Algorithm on the Wireless LAN network quality in the Department of Informatics Engineering and Computer Faculty of Engineering at Makassar State University. This study uses the Action Research method with a quantitative approach. It conducts 54 tests using Wireshark in two different sessions to be compared for each time conducted during the research. The results of the research indicate that the status of the Wireless LAN network in the Department of Informatics Engineering and Computer Faculty of Engineering at Makassar State University falls into the "Good" category with the highest value of 59.26% , with an algorithm accuracy of 65.43%. Both testing sessions, morning session from 08:30 to 09:00 and afternoon session from 13:30 to 14:00, are categorized as "Good" according to the TIPHON standardization category as well as based on the Naive Bayes Algorithm classification results. Based on the research findings, it is recommended that the measurement of network service quality can utilize software other than Wireshark and increase the amount of test data to improve the accuracy of the Naive Bayes algorithm.*

Keywords: *Analysis, Quality of Service, Naive Bayes, Wireless LAN, TIPHON*

Introduction

In the current era of globalization, the internet has become a necessity for people to find information, communicate with each other, access educational media, and much more. The increasing number of internet users has placed a responsibility on internet service providers to ensure that network performance remains optimal for proper functionality. According to research by APJII, the number of internet users in Indonesia reached 215.63 million people in 2022-2023, marking a 2.67% increase from the previous period, which recorded 210.03 million users. This significant growth reflects the increasingly widespread role of the internet in supporting communicative interactions amidst global dynamics. It is crucial to monitor the network to ensure the internet functions properly. When data traffic on the network exceeds the bandwidth capacity, such as when many people are using the network simultaneously, the smooth operation of the internet network will be affected.

Interruptions or pauses in internet web services will undoubtedly affect the convenience of services for users.

Therefore, it is necessary to anticipate data traffic overloads on the network to ensure error-free network operations. It is vital to evaluate the current network using Quality of Service (QoS) to maintain smooth data traffic on the internet network. This can be used as a measure of how well the network is performing using the Quality of Service (QoS) approach. The QoS method will yield results in the form of values for each parameter measured in the research. These values will be useful in drawing conclusions about the quality of network services. They will also serve as a basis for classifying the status of network service quality using the Naive Bayes Algorithm, which can make decisions using the provided dataset (Sabloak et al., 2018). The application of the QoS method and the Naive Bayes Algorithm in this research is expected to analyze and classify the quality of WLAN network services in the Department of Informatics and Computer Engineering, Faculty of Engineering, State University of Makassar.

Methodology

1. **Type of Research**
   The type of research used is Action Research with a quantitative approach. The research procedure involves diagnosing the main problem, which forms the basis of the study by identifying factors that cause the QoS value to decrease. The first step is to conduct observations by determining the data collection points. After identifying the data collection points, the next step is to measure QoS parameters, namely delay, packet loss, and throughput, using the Wireshark network tool analyzer.
2. **Literature Review**
   The author conducted discussions with specialists relevant to the research, including advisors and lecturers specializing in network concentration. The author also searched for journals or theories related to network analysis and the Naive Bayes theory used in the study.
3. **Data Collection**
   In the data collection method, the author conducted direct measurements at three locations (1st Floor, 2nd Floor, and 3rd Floor) in the Department of Informatics and Computer Engineering, Faculty of Engineering, State University of Makassar, over three days at two different times.
4. **Data Analysis**
   The data analysis technique used is descriptive analysis. The data obtained will be presented in table form. Data analysis is a critical stage in research that involves organizing and structuring the data to identify patterns, categories, and foundational information. This process formally aims to discover themes and formulate hypotheses based on the data contributions (Nurrobi et al., 2020). The data analysis process in this research is grouped based on the QoS parameters studied: delay, packet loss, and throughput. The QoS method is applied in measuring the quality of network services. In addition, to support accuracy and classify the quality of network services, the Bayes theorem in the Naive Bayes algorithm is used.

Result and Discussion

1. **Delay Measurement**

   The delay calculation is done using the Python programming language. To calculate it, you can upload the pcap file from Wireshark. The average delay obtained is as follows:

   = (11.93 ms + 24.37 ms + 5.04 ms + 8.57 ms +
     4.21 ms + 7.12 ms) / 6

   = 10.20 ms

   Based on the tests conducted, the total average delay is 10.20 ms.

2. **Packet Loss Measurement**

   The packet loss calculation is also done using the Python programming language. From the tests conducted, the packet loss values obtained are as follows:

   = (0.81% + 1.26% + 0.18% + 0.42% + 0.24% + 0.28%) / 6

   = 0.53%

3. **Throughput Measurement**

   The throughput calculation is done using the Python programming language. From the tests conducted, the average throughput obtained is as follows:

   = (656.29 Mbps + 734.62 Mbps + 1889.09 Mbps + 974.82 Mbps + 4236.76 Mbps + 1194.61 Mbps) / 6

   = 1613.37 Mbps

4. **Quality of Service Calculation**

   After calculating the three QoS parameters, the QoS value obtained is as follows:

Table 1. QoS Values

PARAMETER	RATING INDEX
Delay	2.4
Packet Loss	4
Throughput	3.96
Rata-Rata	3.4

Based on the assessment of service quality parameters for the network service, three main aspects evaluated are throughput, delay, and packet loss, each with an index value reflecting the service caliber. The data shows that the throughput index value of 2.4 indicates a moderate quality classification, delay with an index value of 4 signifies very commendable service quality, and packet loss also demonstrates a highly satisfactory classification with an index value of 3.96. Collectively, the average index of 3.4 suggests that the network service quality falls within a good classification, although there is a clear disparity in quality among the parameters, with delay emerging as the most superior, while throughput shows moderate performance.

5. **Naive Bayes**

   The classification procedure is conducted using the Naive Bayes algorithm, which utilizes the data collected from previous calculations. Naive Bayes classifies the network status based on the conditions similar to the test results above. The detailed calculations are as follows:

A. Morning Session

1. For the Probability of Very Satisfactory (H = 3.8 - 4)
   \(p(H = 3.80 - 4.00) \times p(H = 3.80 - 4.00 | D < 150 \, ms) \times p(H = 3.80 - 4.00 | P = 0\% - 3\%) \times p(H = 3.80 - 4.00 | T >188 \, kbps) \)
   = (0.037) × (0.037) × (0.071) × (0.71)
   = 0.00
2. For the Probability of Satisfactory (H = 3.00 - 3.79)
   \(p(H = 3.00 - 3.79) \times p(H = 3.00 - 3.79 | D < 150 \, ms) \times p(H = 3.00 - 3.79 | P = 0\% - 3\%) \times p(H = 3.00 - 3.79 | T > 188 \, kbps) \)
   = (0.592) × (0.592) × (0.857) × (0.786)
   = 0.236
3. For the Probability of Moderate (H = 2.00 - 2.99)
   \(p(H = 2.00 - 2.99) \times p(H = 2.00 - 2.99 | D < 150 \, ms) \times p(H = 2.00 - 2.99 | P = 0\% - 3\%) \times p(H = 2.00 - 2.99 | T > 188 \, kbps) \)
   = (0.370) × (0.370) × (0.071) × (0.143)
   = 0.001
4. For the Probability of Poor (H = 1.00 - 1.99)
   \(p(H = 1.00 - 1.99) \times p(H = 1.00 - 1.99 | D < 150 \, ms) \times p(H = 1.00 - 1.99 | P = 0\% - 3\%) \times p(H = 1.00 - 1.99 | T > 188 \, kbps) \)
   = (0) × (0) × (0) × (0)
   = 0
5. Classification Result
   \(\text{ArgMax} \, p(\text{Very Good}) \, p(\text{Good}) \, p(\text{Moderate}) \, p(\text{Poor}) \)
   = (0.00) × (0.236) × (0.001) × (0)
   = 0.236

This section should explore the significance of the results of the study. A combined Results and Discussion section is also appropriate. This section allows you to offer your interpretation and explain the meaning of your results. Emphasize any theoretical or practical consequences of the results.

The Discussion section should be a reasoned and justifiable commentary on the importance of your findings. This section states why the problem is important; what larger issues and what propositions are confirmed or disconfirmed by the extrapolation of these findings to such overarching issues.

Here is the translation in English:

B. Afternoon Session

1. For the Probability of Very Satisfactory (H = 3.8 - 4)

\(p(H = 3.80 - 4.00) \times p(H = 3.80 - 4.00 | D < 150 \, ms) \times p(H = 3.80 - 4.00 | P = 0\% - 3\%) \times p(H = 3.80 - 4.00 | T > 188 \, kbps) \)
= (0) × (0) × (0) × (0)
= 0

2. For the Probability of Satisfactory (H = 3.00 - 3.79)
   \(p(H = 3.00 - 3.79) \times p(H = 3.00 - 3.79 | D < 150 \, ms) \times p(H = 3.00 - 3.79 | P = 0\% - 3\%) \times p(H = 3.00 - 3.79 | T > 188 \, kbps) \)
   = (0.592) × (0.640) × (0.938) × (0.786)
   = 0.279
3. For the Probability of Moderate (H = 2.00 - 2.99)
   \(p(H = 2.00 - 2.99) \times p(H = 2.00 - 2.99 | D < 150 \, ms) \times p(H = 2.00 - 2.99 | P = 0\% - 3\%) \times p(H = 2.00 - 2.99 | T > 188 \, kbps) \)
   = (0.407) × (0.360) × (0.063) × (0.214)
   = 0.002
4. For the Probability of Poor (H = 1.00 - 1.99)
   \(p(H = 1.00 - 1.99) \times p(H = 1.00 - 1.99 | D < 150 \, ms) \times p(H = 1.00 - 1.99 | P = 0\% - 3\%) \times p(H = 1.00 - 1.99 | T > 188 \, kbps) \)
   = (0) × (0) × (0) × (0)
   = 0
5. Classification Result
   \(\text{ArgMax} \, p(\text{Very Good}) \, p(\text{Good}) \, p(\text{Moderate}) \, p(\text{Poor}) \)
   = (0) × (0.279) × (0.002) × (0)
   = 0.279

The classification result using the Naive Bayes method for classifying the state of the internet network from 08:30 to 09:00 falls into the "Good" category with the highest probability value of 0.236, according to the Naive Bayes Algorithm. From 13:30 to 14:00, the network state is in the "Good" category with a probability value of 0.279. The following table shows the calculation results using the Naive Bayes Algorithm:

Table 2. WLAN Network Classification Results

Testing Time	Network Classificatior WLAN			
	Very Good	Good	Modarate	Bad
08.30 – 09.00	0	0.236	0.001	0
13.30 – 14.00	0	0.279	0.002	0

6. Test Results

After calculating the three measured parameters, the test results are as follows:

Table 3. Test Results

Testing time	Testing Date	Classification			
		Very Good	Good	Moderate	Bad
08.30 – 09.00	Monday	0 time	2 time	7 time	0 time
	Tuesday	0 time	8 time	1 time	0 time
	Wednesday	1 time	6 time	2 time	0 time
13.30 – 14.00	Monday	0 time	4 time	5 time	0 time
	Tuesday	0 time	6 time	3 time	0 time
	Wednesday	0 time	6 time	3 time	0 time

Table 4. Accuracy of Naïve Bayes Algorithm

Testing Date	Probability Value (%)
Monday, October 16, 2023	66.67%
Tuesday, October 17, 2023	66.67%
Wednesday, October 18, 2023	62.96%

Conclusion

Based on the analysis and research conducted, the following conclusions can be drawn: (1) According to TIPHON standards, the throughput parameter index is 2.4, categorized as "Moderate." The delay parameter has a value of 4, which falls into the "Very Good" category. The packet loss parameter has a value of 3.96, also categorized as "Very Good." The average index of the three parameters is 3.4, which overall classifies the LAN network in the Department of Computer Science and Engineering as "Good."**. (2) According to the classification results of the Naive Bayes Algorithm, the Wireless LAN network in the Department of Computer Science and Engineering falls into the "Good" category with a highest value of 59.26%. The Naive Bayes Algorithm can classify the status of the Wireless LAN network based on QoS parameters—delay, packet loss, and throughput—with an accuracy level of 65.43% from a total of 54 tests. Based on the QoS parameter measurements, it can be seen that the network quality using the HTB queue method is more optimal. This is because bandwidth is distributed according to the rules applied in bandwidth management, preventing users from competing for bandwidth.

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