

Quality of Service Analysis on Udayana University Wireless Network

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Abstract: The use of Internet in this globalization era is really needed to support easier data and information exchange. The quality of the connection or has to be considered too, a good Internet connection is must for a smooth data and information exchange. This paper explains about the quality of Internet network or known as QoS (Quality of Service) on Udayana University the parameters used are throughput, delay, jitter and packet loss. Measurements at the access point in every 13 Faculty and Pasca Sarjana at Sudirman Campus, Nias Campus and Bukit Campus in the morning, afternoon and evening. From the results of the measurements, the performance of wireless network service on Udayana University is belongs to the very good, which has a average value of delay < 150 ms, an average jitter of 0 ms and an average packet loss of 0% categorized according to TIPHON version standardization is very good.

Keywords: QoS (Quality of Service); Throughput; Delay; Jitter; Packet Loss.

1. INTRODUCTION

Internet is making data and information exchange easier today. Internet is a network with wide and enormous range that connect to each other with computer network that in turn connect human and electronic devices all around the world by telephone line, optic cable, coaxial cable, satellite, or electromagnetic waves to replace cable, Internet gives way for data (text, image, sound, video, and other form) sharing for it users. Data sharing is enabled by using a standard protocol called Transmission Control Protocol and Internet Protocol or TCP/IP. Onno W. Purbo defines that internet is a media that is used to make communication process more efficiently by using various application like Web, VoIP, E-mail [1].

The more people that use wireless network technology then more public places that provide internet services called hotspot, especially on campus. By the use of hotspot enable using internet without cable, this makes data exchanges easier for students, lectures, and employees.

The majority of internet users at Udayana University did not know whether the quality provided is quite good or not especially to studens, lectures, and employees during lecture or the otherwise. Users convenience is affected by the quality of service provided. QoS (Quality of Service) is a method to measure how good the network is and to define the characteristic and nature of a service [2]. QoS can be used to measure a set of performance attribute that have been specified and associated with a service, so that to bring a better internet service. According to Zeithaml quality of service is the degree of differences between consumers expectation or desire and perceptions [3].

Analysis of QoS (Quality of Service) on wireless network can be measured by a parameter of throughput, delay, jitter, and packet loss [4]. After the measurement, it can be seen what factor that affect the quality of internet service provided. The

goal of this research is to determine the degree of quality of network service that is provided to become information material for management of USDI (Unit Sumber Daya Informasi) Udayana University to bolster ICT (Information Communication Technology) based education services.

2. LITERATURE REVIEW

The research that had been done previously by Timur Dali Purwanto and Widya Cholil on 2013 titled “Analisa Kinerja Wireless Radius Server pada Perangkat Access Point 802.11g (Studi Kasus di Universitas Bina Darma)”. From the results of the research and QoS analysis of the hotspot network on Bina Darma University it can be concluded that QoS is affected by wall thickness factor and adjacent signal interference from other components that cause the decrease of signal quality being received [5].

Another research had been done by Roman Lara-Cueva, Diego Benitez, Claudia Fernandez dan Carlos Morales titled “Performance Analysis of Wireless Network Modes in Conformance with IEEE 802.11b and WDS”. The main goal of this research is to compare Ad-Hoc, IEEE 802.11b and WDS network in open space. The result obtained is WDS networks have higher efficiency therefore, better performance in long distance communication than Ad-Hoc and IEEE 802.11b networks [6].

The research done by Rika Wulandari titled “Analisis QoS (Quality of service) pada Jaringan Internet (Studi Kasus: UPT Loka Uji Teknik Penambangan Jampang Kulon - Lipi)”. The average measurement results of throughput, delay, jitter and packet loss for each buildings on morning between 07.30 AM - 12.00 AM, afternoon 01.00 PM - 04.00 PM, evening on 06.00 PM - 10.00 PM is classified as very good according to TIPHON standardization [7].

The research done by Vikram Mehta and Dr. Neena Gupta titled “Performance Analysis of QoS Parameters of WiMAX

Networks”. QoS research using delay, jitter, packet delivery ratio, packet loss ratio dan throughput parameter. Packet delivery ratio calculation result is when mobile node increases then packet delivery ratio also increases, Packet loss ratio measurement result is when mobile node increases then packet delivery ratio will decreases, and throughput calculation result is when mobile node increases then throughput also increases [8].

3. RESEARCH METHODOLOGY

The research was done based on data gotten from measurement result of throughput, delay, jitter and packet loss in the morning, afternoon, and evening on Jimbaran Hill Campus, Sudirman Campus, and Nias Campus. The measurement process stages of quality of service are illustrated in the flowchart which can be seen in Figure 3.1.

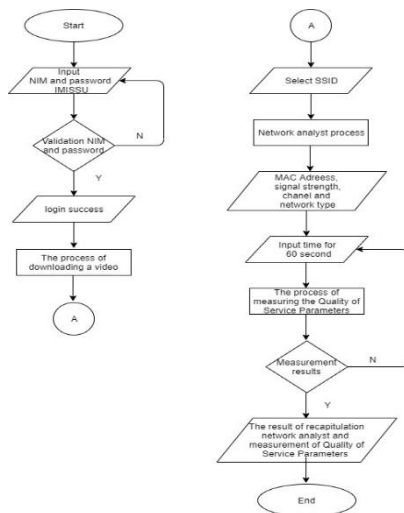


Figure. 1 Flowchart of Quality of Service measurement

Figure 1 is flowchart design of quality of service measurement, when device is connected to the network then it will be directed to the login page which uses NIM and GIS (the password is IMISSU) which in case fail then will be forced to reinput NIM and password IMISSU again. After a successful login, start downloading the file first and then continue with network observation process using the tool called insider by selecting the SSID which the device connected to. The network observation process will display a network information interface which include MAC address, signal strength, channel, and network type. After that in the process of measuring the quality of service parameters will be using wireshark tool by inputting the duration of 60 second to measure throughput, delay, and jitter also packet loss. In case of failure, then restart by inputting 60 seconds duration until successful result and then continue with recapitulation of network observation result and quality of service parameter measurement.

3.1 Quality of Service Parameter Calculation Process

Quality of service parameter calculation is being done after all the need data has been collected, the data is collected from the measurement using wireshark tool. As for quality of service parameter include.

Throughput value calculation is obtained from the measurement results that have been done using wireshark. Throughput can be calculated using equation (1).

$$\text{Throughput} = \frac{\sum \text{Data Delivered}}{\text{Length of Measurement}} \quad (1)$$

Delay value is obtained from the measurement results that have been done using wireshark. Delay can be calculated using equation (2).

$$\text{Delay Average} = \frac{\sum \text{Delay}}{\sum \text{Data Packet}} \quad (2)$$

Jitter value is obtained from the measurement results that have been done using wireshark. Jitter can be calculated using equation (3).

$$\text{Jitter} = \frac{\sum \text{Delay Variation}}{(\sum \text{Data Packet} - 1)} \quad (3)$$

Packet loss value is obtained from the measurement results that have been done using wireshark. Packet loss can be calculated using equation (4).

$$\text{Packet Loss} = \frac{\sum \text{Data Delivered} - \sum \text{Data Arrival}}{\sum \text{Data Delivered}} * 100\% \quad (4)$$

4. CONCEPTS AND THEORIES

Literature review contains supporting theories in the research that will be conducted. The theories including Quality of Service and its Parameters will be discussed as follows.

4.1 Quality of Service

QoS (Quality of service) is a metode to discern and measure how well a network is and aim to define the characteristic and nature of a service. QoS is closely related to multimedia data, multimedia services and real time multimedia, and so as to provide better Internet services [2]. According to Zeithaml quality of service is the degree of differences between consumers expectation or desire and perceptions [3].

4.2 Quality of Service Parameters

The quality of service measurement of Udayana Universty wireless network, using QoS method (Quality of Service) and as for the technical quantities parameters of QoS to measure the quality of a service, are [4].

4.2.1 Throughput

Throughput is the average speed of data packets (bit) effective over a certain observation interval (second). The value of throughput is measured in bps (bits per second) [2].

4.2.2 Delay

Delay is the delay time of a packet caused by transmission process from one point to its destination point. Delay is defined as the length of time it takes for the data packet to arrive at the destination represented in second units [2]. The value of the delay calculation results that have been obtained, then determine the results of the delay calculation is classified in which category according to the TIPHON standardization version.

Table 1. TIPHON Delay Standardization Version

| Degradation Category | Delay Magnitude | Index |
|----------------------|-----------------|-------|
| Very Good | < 150 ms | 4 |
| Good | 151 - 300 ms | 3 |
| Average | 301 - 450 ms | 2 |
| Bad | > 451 ms | 1 |

4.2.3 Jitter

Jitter is a variation of delay, in which there is a difference in delay in the delay in packets sent by the data packet stream represented in units of seconds [2]. The value of the jitter calculation results that have been obtained, then determine the results of the jitter calculation is classified in which category according to the TIPHON standardization version.

Table 2. TIPHON Jitter Standardization Version

| Degradation Category | Jitter Magnitude | Index |
|----------------------|------------------|-------|
| Very Good | 0 ms | 4 |
| Good | 1- 75 ms | 3 |
| Average | 76 – 125 ms | 2 |
| Bad | 126 – 225 ms | 1 |

4.2.4 Packet Loss

Packet loss is the number of packets lost on a computer network during data packets transmission caused by collisions, overload traffic, and errors caused by endless TTL (Time to Live) packets [2]. The value of the packet loss calculation results that have been obtained, then determine the results of the packet loss calculation is classified in which category according to the TIPHON standardization version.

Table 3. TIPHON Packet Loss Standardization Version

| Degradation Category | Packet Loss | Index |
|----------------------|-------------|-------|
| Very Good | 0% | 4 |
| Good | 3% | 3 |
| Average | 15% | 2 |
| Bad | 25% | 1 |

5. RESULT AND DISCUSSION

Result and discussion were obtained from sample result of quality of service measurement at one access point for three days time in the morning, afternoon, and evening in 13 faculties and Sudirman Post Graduate Campus, Nias Campus, and Jimbaran Hill Campus. From the result sample obtained, one faculty was selected for further research by adding observation period to 5 day in the morning, afternoon, and evening at Faculty of Social and Political Sciences and the Faculty of Economics and Business at Sudirman Campus.

5.1 Quality of Service Parameter Recapitulation

Throughput, delay, jitter dan packet loss measurement results at the Faculty of Social and Political Sciences at Sudirman Campus can be seen in Table 4.

Table 4. QoS Parameter Recapitulation of Faculty of Social and Political Sciences at Sudirman Campus

| SSID | Period | Throughput | Delay | Jitter | Packet loss |
|------------------------------------|-----------|------------|-------|--------|-------------|
| Monday, 2 September 2019 | | | | | |
| imissu@berbudaya | Morning | 2453 Kbps | 3 ms | 0 ms | 0% |
| | Afternoon | 1350 Kbps | 4 ms | 0 ms | 0% |
| | Evening | 6686 Kbps | 1 ms | 0 ms | 0% |
| imissu@mandiri | Morning | 4148 Kbps | 2 ms | 0 ms | 0% |
| | Afternoon | 2942 Kbps | 3 ms | 0ms | 0% |
| | Evening | 15523 Kbps | 1 ms | 0 ms | 0% |
| imissu@unggul | Morning | 3858 Kbps | 2 ms | 0 ms | 0% |
| | Afternoon | 2622 Kbps | 3 ms | 0 ms | 0% |
| | Evening | 11296 Kbps | 1 ms | 0 ms | 0% |
| Tuesday, 3 September 2019 | | | | | |
| imissu@berbudaya | Morning | 4815 Kbps | 2 ms | 0 ms | 0% |
| | Afternoon | 2495 Kbps | 3 ms | 0 ms | 0% |
| | Evening | 9634 Kbps | 1 ms | 0 ms | 0% |
| imissu@mandiri | Morning | 10618 Kbps | 1 ms | 0 ms | 0% |
| | Afternoon | 4149 Kbps | 2 ms | 0ms | 0% |
| | Evening | 8286 Kbps | 1 ms | 0 ms | 0% |
| imissu@unggul | Morning | 15079 Kbps | 1 ms | 0 ms | 0% |
| | Afternoon | 5121 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 10797 Kbps | 1 ms | 0 ms | 0% |
| Wednesday, 4 September 2019 | | | | | |
| imissu@berbudaya | Morning | 4983 Kbps | 2 ms | 0 ms | 0% |
| | Afternoon | 2972 Kbps | 3 ms | 0 ms | 0% |
| | Evening | 5503 Kbps | 1 ms | 0 ms | 0% |
| imissu@mandiri | Morning | 6641 Kbps | 1 ms | 0 ms | 0% |
| | Afternoon | 5005 Kbps | 1 ms | 0ms | 0% |
| | Evening | 12543 Kbps | 1 ms | 0 ms | 0% |
| imissu@unggul | Morning | 6755 Kbps | 1 ms | 0 ms | 0% |
| | Afternoon | 5103 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 11890 Kbps | 1 ms | 0 ms | 0% |

| Thursday, 5 September 2019 | | | | | |
|----------------------------|-----------|------------|------|------|----|
| imissu@berbudaya | Morning | 3968 Kbps | 2 ms | 0 ms | 0% |
| | Afternoon | 2941 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 6082 Kbps | 1 ms | 0 ms | 0% |
| imissu@mandiri | Morning | 6691 Kbps | 1 ms | 0 ms | 0% |
| | Afternoon | 5939 Kbps | 1 ms | 0ms | 0% |
| | Evening | 12399 Kbps | 1 ms | 0 ms | 0% |
| imissu@unggul | Morning | 6745 Kbps | 1 ms | 0 ms | 0% |
| | Afternoon | 5580 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 12423 Kbps | 1 ms | 0 ms | 0% |
| Friday, 6 September 2019 | | | | | |
| imissu@berbudaya | Morning | 4285 Kbps | 2 ms | 0 ms | 0% |
| | Afternoon | 3547 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 8811 Kbps | 1 ms | 0 ms | 0% |
| imissu@mandiri | Morning | 5855 Kbps | 1 ms | 0 ms | 0% |
| | Afternoon | 4584 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 14975 Kbps | 1 ms | 0 ms | 0% |
| imissu@unggul | Morning | 7095 Kbps | 1 ms | 0 ms | 0% |
| | Afternoon | 4744 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 14309 Kbps | 1 ms | 0 ms | 0% |

Based on the table of QoS parameter measurement result above the highest throughput is on SSID imissu@mandiri with value of 15.523 Kbps while lowest throughput is on SSID imissu@berbudaya with value of 1.350 Kbps. Delay measurement result is < 150 ms. Packet loss and jitter measurement result on each SSID is 0% and 0 ms.

Throughput, delay, jitter dan packet loss measurement results at the Faculty of Economics and Business at Sudirman Campus can be seen in Table 5.

Table 5. QoS Parameter Recapitulation of Faculty of Economics and Business at Sudirman Campus

| SSID | Period | Throughput | Delay | Jitter | Packet loss |
|--------------------------|-----------|------------|-------|--------|-------------|
| Monday, 9 September 2019 | | | | | |
| imissu@berbudaya | Morning | 3117 Kbps | 3 ms | 0 ms | 0% |
| | Afternoon | 4315 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 8608 Kbps | 1 ms | 0 ms | 0% |

| imissu@mandiri | Morning | 4567 Kbps | 2 ms | 0 ms | 0% |
|------------------------------|-----------|------------|------|------|----|
| | Afternoon | 3983 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 3597 Kbps | 2 ms | 0 ms | 0% |
| imissu@unggul | Morning | 3769 Kbps | 2 ms | 0 ms | 0% |
| | Afternoon | 2774 Kbps | 3 ms | 0 ms | 0% |
| | Evening | 4198 Kbps | 2 ms | 0 ms | 0% |
| Tuesday, 10 September 2019 | | | | | |
| imissu@berbudaya | Morning | 4372 Kbps | 2 ms | 0 ms | 0% |
| | Afternoon | 3830 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 6279 Kbps | 1 ms | 0 ms | 0% |
| imissu@mandiri | Morning | 5774 Kbps | 2 ms | 0 ms | 0% |
| | Afternoon | 3867 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 9220 Kbps | 1 ms | 0 ms | 0% |
| imissu@unggul | Morning | 6769 Kbps | 1 ms | 0 ms | 0% |
| | Afternoon | 6320 Kbps | 1 ms | 0 ms | 0% |
| | Evening | 6171 Kbps | 1 ms | 0 ms | 0% |
| Wednesday, 11 September 2019 | | | | | |
| imissu@berbudaya | Morning | 4659 Kbps | 2 ms | 0 ms | 0% |
| | Afternoon | 3397 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 12372 Kbps | 1 ms | 0 ms | 0% |
| imissu@mandiri | Morning | 5569 Kbps | 2 ms | 0 ms | 0% |
| | Afternoon | 3682 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 11370 Kbps | 0 ms | 0 ms | 0% |
| imissu@unggul | Morning | 5119 Kbps | 2 ms | 0 ms | 0% |
| | Afternoon | 4229 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 11482 Kbps | 1 ms | 0 ms | 0% |
| Thursday, 12 September 2019 | | | | | |
| imissu@berbudaya | Morning | 5922 Kbps | 1ms | 0 ms | 0% |
| | Afternoon | 4137 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 10555 Kbps | 1 ms | 0 ms | 0% |
| imissu@mandiri | Morning | 8083 Kbps | 1ms | 0 ms | 0% |
| | Afternoon | 4655 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 10585 Kbps | 1 ms | 0 ms | 0% |

| | | | | | |
|----------------------------------|-----------|------------|------|------|----|
| imissu@unggul | Morning | 8080 Kbps | 1ms | 0 ms | 0% |
| | Afternoon | 4668 Kbps | 2 ms | 0 ms | 0% |
| | Evening | 11614 Kbps | 1 ms | 0 ms | 0% |
| Friday, 13 September 2019 | | | | | |
| imissu@berbudaya | Pagi | 4625 Kbps | 2 ms | 0 ms | 0% |
| | Siang | 3903 Kbps | 2 ms | 0 ms | 0% |
| | Sore | 12406 Kbps | 1 ms | 0 ms | 0% |
| imissu@mandiri | Pagi | 7.106 Kbps | 1 ms | 0 ms | 0% |
| | Siang | 5882 Kbps | 1 ms | 0 ms | 0% |
| | Sore | 7424 Kbps | 1 ms | 0 ms | 0% |
| imissu@unggul | Pagi | 7260 Kbps | 1 ms | 0 ms | 0% |
| | Siang | 5101 Kbps | 2 ms | 0 ms | 0% |
| | Sore | 10129 Kbps | 1 ms | 0 ms | 0% |

Based on the table of QoS parameter measurement result above the highest throughput is on SSID imissu@berbudaya with value of 12.406 Kbps while lowest throughput is on SSID imissu@unggul with value of 2.774 Kbps. Delay measurement result is < 150 ms. Packet loss and jitter measurement result on each SSID is 0% and 0 ms. Based on the table of QoS parameter measurement result above the highest throughput is on SSID imissu@berbudaya with value of 12.406 Kbps while lowest throughput is on SSID imissu@unggul with value of 2.774 Kbps. Delay measurement result is < 150 ms. Packet loss and jitter measurement result on each SSID is 0% and 0 ms.

5.2 QoS Data Processing

The index result of quality of service with parameters of throughput, delay, jitter and packet loss based on TIPHON version as standard in the Faculty of Social and Political Sciences at Sudirman Campus can be seen in Table 6.

Table 6. QoS Index of Faculty of Social and Political Sciences at Sudirman Campus Based on TIPHON standard

| Period | Parameter | Average | Index | Category |
|-------------------------|-------------|-----------|-------|-----------|
| imissu@berbudaya | | | | |
| Morning | Throughput | 4037 Kbps | - | - |
| | Delay | 2.2 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |
| Afternoon | Throughput | 2661 Kbps | - | - |
| | Delay | 2.8 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |
| Evening | Throughput | 7343 Kbps | - | - |
| | Delay | 1 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |

| imissu@mandiri | | | | |
|-----------------------|-------------|-------------|---|-----------|
| Morning | Throughput | 6791 Kbps | - | - |
| | Delay | 1.2 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |
| Afternoon | Throughput | 4524 Kbps | - | - |
| | Delay | 1.8 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |
| Evening | Throughput | 12745 Kbps | - | - |
| | Delay | 1 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |
| imissu@unggul | | | | |
| Morning | Throughput | 7906 Kbps | - | - |
| | Delay | 1.2 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |
| Afternoon | Throughput | 4634 Kbps | - | - |
| | Delay | 2.2 ms | 4 | Very Good |
| | Jitter | 0,001400 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |
| Evening | Throughput | 12143 Kbps | - | - |
| | Delay | 1 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet loss | 0% | 4 | Very Good |

Based on the table above, analysis of quality of service data processing with SSID imissu@berbudaya in the morning, afternoon, and evening belong to very good category based on TIPHON standardization version, SSID imissu@mandiri in the morning, afternoon, and evening belong to very good category based on TIPHON standardization version, and SSID imissu@unggul in the morning, afternoon, and evening belong to very good category based on TIPHON standardization version.

The index result of quality of service with parameters of throughput, delay, jitter and packet loss based on TIPHON version as standard in the Faculty of Economics and Business at Sudirman Campus can be seen in Table 7.

Table 7. QoS Index of Faculty of Economics and Business at Sudirman Campus Based on TIPHON standard

| Period | Parameter | Average | Index | Category |
|-------------------------|-------------|------------|-------|-----------|
| imissu@berbudaya | | | | |
| Morning | Throughput | 4798 Kbps | - | - |
| | Delay | 2 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |
| Afternoon | Throughput | 3917 Kbps | - | - |
| | Delay | 2 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |
| Evening | Throughput | 10044 Kbps | - | - |
| | Delay | 1 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |

| imissu@mandiri | | | | |
|-----------------------|-------------|-----------|---|-----------|
| Morning | Throughput | 6220 Kbps | - | - |
| | Delay | 1.6 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |
| Afternoon | Throughput | 4414 Kbps | - | - |
| | Delay | 1.8 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |
| Evening | Throughput | 8439 Kbps | - | - |
| | Delay | 1 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |
| imissu@unggul | | | | |
| Morning | Throughput | 6199 Kbps | - | - |
| | Delay | 1.4 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |
| Afternoon | Throughput | 4618 Kbps | - | - |
| | Delay | 2 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |
| Evening | Throughput | 8719 Kbps | - | - |
| | Delay | 1 ms | 4 | Very Good |
| | Jitter | 0 ms | 4 | Very Good |
| | Packet Loss | 0% | 4 | Very Good |

Based on the table above, analysis of quality of service data processing with SSID imissu@berbudaya in the morning, afternoon, and evening belong to very good category based on TIPHON standardization version, SSID imissu@mandiri in the morning, afternoon, and evening belong to very good category based on TIPHON standardization version, and SSID imissu@unggul in the morning, afternoon, and evening belong to very good category based on TIPHON standardization version.

6. CONCLUSION

Quality of service data with parameters of throughput, delay, jitter, and packet loss in imissu@berbudaya, imissu@mandiri, and imissu@unggul at Udayana University have very good quality based on TIPHON standard with average of < 150 ms delay value, 0 ms jitter, and 0% packet loss.

REFERENCES

- [1] Purbo, O.W., et al., *Buku Pintar Internet TCP/IP*. Jakarta: PT Elex Media Komputindo, 1998.
- [2] Putu, A.E.P.J.B.I., *Handbook Jaringan Komputer Teori dan Praktik Berbasis Open Source*. 2014.
- [3] Parasuraman, A., V.A. Zeithaml, and L.L. Berry, *Servqual: A multiple-item scale for measuring consumer perc.* Journal of retailing, 1988. **64**(1): p. 12.
- [4] *Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON), General aspects of Quality of Service (QoS)*. 1999, TR Patent 101329V2.
- [5] Purwanto, T.D. and W. Cholil, *Analisa Kinerja Wireless Radius Server Pada Perangkat Access Point 802.11 g (Studi Kasus di Universitas Bina Darma)*. Semantik 2013, 2013. **3**(1): p. 371-376.

- [6] Lara-Cueva, R., et al. *Performance Analysis of Wireless Network Modes in Conformance with IEEE 802.11 b and WDS*. in *Computer Aided System Engineering (APCASE), 2015 Asia-Pacific Conference on*. 2015. IEEE.
- [7] Wulandari, R., *Analisis QoS (Quality of Service) Pada Jaringan Internet (Studi Kasus: UPT Loka Uji Teknik Penambangan Jampang Kulon-LIPI)*. Jurnal Teknik Informatika dan Sistem Informasi, 2016. **2**(2).
- [8] Mehta, V. and D.N. Gupta, *Performance analysis of qos parameters for wimax networks*. International Journal of Engineering and Innovative Technology (IJEIT) Volume, 2012. **1**: p. 105-110.