Analysis Of WiFi Network Performance Using FDMI Method

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Abstract. This journal aims to analyze how optimal the performance of WiFi network services, the results can represent the average performance of Internet network services against changes in the value of Quality of Services (QoS) parameters when the highest traffic in the Hotspot Lab IT Laboratory area and Musamus Informatics Engineering Department to support developments in the digitalization era as part of the 4.0 Industrial revolution. Measurement data was got from the results of interviews, observations, and literature studies. Measurement data captured using Wireshark, Fixed Daily Measurement Interval (FDMI) method is the method used in the measurement. The QoS parameters used in the measurement are throughput, delay, and packet loss. Overall, the average value of throughput got is 0.99 MBps. The average value of delay is 124.05 ms is in the very good category according to TIPHON standards. The average value of packet loss is 0.05% with the very good category. The measurement results show that WiFi networks in the Hotspot IT Laboratory area and Musamus Informatics Engineering Department are reliable and meet user needs.

1. Introduction
The era of digitalization in various aspects of life is a form of the Industrial Revolution 4.0 which encourages development and growth in various fields throughout the world, especially in Indonesia [1]. The Industrial Revolution 4.0 also affected the world of education, Musamus University as one of the State Universities in Eastern Indonesia continued to develop itself to improve quality with the aim of adjusting to the digitalization era, both in terms of human resources and infrastructure. Automation innovation that occurs with the creation of super-computers, robotics, and artificial intelligence is part of a course from the Department of Informatics. Of course, the Informatics Engineering department requires optimal support in serving the needs in the digitalization era.

The internet network is one of the important parts that supports the digitalization era, which requires infrastructure support both in the form of hardware and software that supports the use of the internet network in everyday use in the University environment. One service to access the internet provided by the university is to use a wireless network (WiFi) [2]. WiFi is one of the latest technologies standardized by IEEE as 802.11x WLAN [3]. WiFi is one of the transmission media used in sending and receiving signals and data. More and more Internet users have an impact on the increasing access of WiFi users in the Hotspot Lab IT area of the Laboratory and the Informatics Engineering Department of Musamus. For WiFi network services to be more optimal, measurement results are needed that can represent the average performance of Internet network services against changes in the value of Quality of Services (QoS) [4][5][6] parameters when the highest traffic is at the Hotspot Lab Lab IT area and the Musamus Informatics Engineering Department.

The measurement method used in this study is the Fixed Daily Measurement Interval (FDMI) method at the Laboratory Hotspot IT area Laboratory and the Informatics Engineering Department of Musamus so we can know the average performance of WiFi services against changes in the Quality of
Services (QoS) parameter when the highest traffic. The FDMI method will be used continuously on the highest traffic for 2 weeks, starting from June 10, 2019 to June 23, 2019.

2. Methodology

This study uses the Fixed Daily Measurement Interval (FDMI) and Quality of Services (QoS) methods in making measurements.

2.1. Method

Fixed Daily Measurement Interval (FDMI) method can be used in which a predetermined time interval (i.e. a set of consecutive read-out periods) is identified. During this time interval, each day traffic intensity measurements are taken. The peak traffic intensity over the measured read-out periods is recorded for the day. If it is known that peak period loads will likely occur during a particular read-out period during the day, the FDMI method can be reduced to measuring traffic intensity only during the identified busy read-out period and recorded for the day [7][8][9][10].

2.2. QoS Parameter

Quality of Service (QoS) measured in this study uses the following parameters:

2.2.1. Throughput. Throughput is the effective data transfer rate, measured in Bps. The header in the data packet reduces this value. Throughput can be calculated by looking at the number of packages that received to the number of packages that sent. To find throughput values using equations (1):

\[
\text{Throughput} = \frac{\text{total received data}}{\text{data sent time}}
\]  

(1)

2.2.2. Delay. Delay is the time needed for data to travel from distance to destination. Total delay can be calculated using equation (2). Equation (3) is used to calculate the average delay of the total package sent:

\[
\text{Total Delay} = \sum \frac{\text{package time received}}{\text{package time sent}}
\]  

(2)

\[
\text{Average Delay} = \frac{\text{Total delay}}{\text{Total sent data}}
\]

(3)

The delay category from the measurement results can be seen in Table 1.

| Delay Category | Delay time |
|----------------|------------|
| Very Good      | < 150 ms   |
| Good           | 150 ms - 300 ms |
| Average        | 300 ms - 450 ms |
| Bad            | >450 ms    |

2.2.3. Packet Loss. Packet loss is a comparison of all lost IP packets with all IP packets sent between source and destination (packet loss when sent on the network). Equation (4) is used to find packet loss:
The Packet Loss degradation category from the measurement results can be seen in Table 2.

**Table 2. Degradation Category**

| Degradation Category | Packet Loss |
|----------------------|-------------|
| Very Good            | 0 %         |
| Good                 | 3 %         |
| Average              | 15 %        |
| Bad                  | 25 %        |

3. Results and Discussion

WiFi network topology used in the Hotspot IT Lab Laboratory area and the Musamus Informatics Engineering Department can be seen at Figure 1.

Measurements are made from the client-side, carried out for 14 days, starting from June 10, 2019, June 23, 2019. Measurements are made for 1 hour, starting at 12.00 WIT - 13.00 WIT. The selection of testing hours to comply with the FDMI method is based on the results of interviews with the network admin to find out the peak user time of the average user each day. Measurements are made using the Wireshark application.

3.1. Needs:

The quality of the WiFi Hotspot IT network laboratory service area and the Musamus Informatics Engineering Department need to know the average performance of WiFi services against changes in the Quality of Services (QoS) parameter values when the highest traffic is input in network development.
3.2. Result conducted:
Measurements made using Wireshark according to predetermined scenarios provide measurement results which are then calculated with QoS parameters to determine the value of Throughput, Delay and Packet Loss from the WiFi network Hotspot Lab TI area of the Laboratory and Informatics Engineering Department of Musamus.

| Hari Pengukuran | Rata-rata Throughput (MBps) | Delay   | Packet Loss (%) |
|-----------------|----------------------------|---------|-----------------|
| 1               | 1,23                       | 300 ms  | Good            | 0                | Very Good         |
| 2               | 1,21                       | 121,2 ms| Very Good       | 0,4              | Very Good         |
| 3               | 1,17                       | 99,9 ms | Very Good       | 0                | Very Good         |
| 4               | 1,27                       | 115,6 ms| Very Good       | 0,2              | Very Good         |
| 5               | 1,15                       | 128,4 ms| Very Good       | 0                | Very Good         |
| 6               | 0,53                       | 100,6 ms| Very Good       | 0                | Very Good         |
| 7               | 0,38                       | 88,5 ms | Very Good       | 0                | Very Good         |
| 8               | 1,19                       | 145 ms  | Very Good       | 0                | Very Good         |
| 9               | 1,25                       | 116 ms  | Very Good       | 0                | Very Good         |
| 10              | 1,09                       | 105 ms  | Very Good       | 0                | Very Good         |
| 11              | 1,14                       | 111 ms  | Very Good       | 0                | Very Good         |
| 12              | 1,26                       | 129 ms  | Very Good       | 0,1              | Very Good         |
| 13              | 0,61                       | 97 ms   | Very Good       | 0                | Very Good         |
| 14              | 0,43                       | 79,5 ms | Very Good       | 0                | Very Good         |

Table 3. Measurement data with QoS parameters

Figure 2. shows a not-so-significant change in measurements for days 1,2,3,4,5,8,9,10,11 and 12. This is because of measurements made during lecture days. While days 6,7,13 and 14 show the lowest average throughput because measurements are made on lecture holidays. The graph shows the relationship between the number of users and the average throughput or actual bandwidth value used on the measurement day.
The graph shown in Figure 3 presents the measurement results got which have results that are not too volatile. The highest delay got is only on day 1, at 300 ms. Delay itself can be defined as the total delay required by a packet caused by the transmission process to reach its destination. The lowest delay value is on the 14th day with a delay value of 79.5 ms. This happened because at the time of the measurement day the weather was bad which was enough to disrupt sending data, resulting in a reduction in the quality of delivery which was marked by the high value of delay on the measurement on that date. While the lowest delay is got when lectures are on holiday, so the use of the network is not as dense as during lectures. This shows that the number of network users and the signal quality of a network, especially WiFi networks, is strongly influenced by the natural conditions at the testing site.

The results of the packet loss measurements got are in the category very good. There is only 3 times the increase in the value of packet loss, namely on days 2, 4, and 12. Queues of data in the network that increases when sending data cause an increase in the risk of queue data that is not served to the disposal of data because the queue becomes larger resulting in packet loss. The biggest percentage of packet loss occurs on day 2 with a value of 0.4% which is still included in the very good category according to TIPHON standards so it does not affect the quality of the WiFi network as a whole.

4. Conclusion
Based on the analysis of the measurement results of WiFi network performance that has been done, the following conclusions are drawn.
1. Overall the average value of throughput got is 0.99 MBps. The overall average value of delay is 124.05 ms which is included in the very good category according to the TIPHON standard. While the average value of packet loss that is got as a whole is 0.05% with the very good category.
2. Based on the results of measurements that have been made, WiFi networks in the Hotspot Lab TI area and Musamus Informatics Engineering Department are reliable and meet user needs.

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