

# PERFORMANCE COMPARISON ANALYSIS MICHMON AND USERMANGERS ON MICROTIC

## ABSTRACT:

The current condition is that the Village Bumdes in Sepakat does network management using the hotspot feature found on Mikrotik. This hotspot feature has Authentication, Authorization and Accounting functions(AAA) with the license used on MikroTik, which is a level 4 license which means it has a maximum active user limit of 50 users. The purpose of this research is to find out a better performance comparison between Mikhmon and Usermanager and also provide an alternative solution which is better in Mikrotik management between Mikhmon and Usermanager. The data collection methods used are observation, interviews, and literature studies and use the Quality Of Service (QoS) analysis method. The results of the research that has been carried out are in order to provide an alternative solution which is better in managing mikrotik between Mikhmon and Usermanager.

*Keywords: Analysis, Network, Mikhmon, Usermanager, QoS.*

## 1. INTRODUCTION

The development of communication technology is a necessity in supporting human activities. A person can easily communicate and gain knowledge, education, and employment. This is due to the existence of a wide-scale network or *Interconnected Network*(Internet) which serves to connect one electronic media to another quickly and precisely. The speed of internet services is influenced by the availability of adequate network infrastructure, the network infrastructure is built as a whole to connect the capital city, province, district to remote villages.

Sepakat Village is one of the villages in Plampang District, Sumbawa Regency, West Nusa Tenggara Province. This Sepakat Village has a signal strength that can be quite weak, therefore the community in Sepakat Village still lacks access to internet services so that the information obtained by the community is not fast enough, considering that in this era of globalization the internet has become a basic need for every community to communicate and exchange information.

In this case, the Village Government prepares an alternative to support the fulfillment of internet access for rural communities by building a hotspot which we usually know as Wireless Fidelity (WIFI) which is built at the Village Bumdes.

The current condition is that the Village Bumdes in Sepakat does network management using the hotspot feature found on Mikrotik. This hotspot feature has Authentication, Authorization and Accounting functions(AAA) with the license used on MikroTik, which is a level 4 license, which means it has a maximum active user limit of 200 users.

The problem that currently exists is that the Mikrotik in the Village Bumdes of Sepakat is Mikrotik with the RB941-2nD series, which is a Mikrotik that does not support the use of Usermanager for management, so an alternative solution is needed for the management of Mikrotik in the Village Bumdes of Sepakat.

*Mikrotik Hotspot Monitor*(Mikhmon) is a web-based application (Mikrotik API PHP Class) to assist in managing Mikrotik hotspots. Especially Mikrotik which does not support

Usermanager. Mikhmon is not a Radius Server, so it doesn't have to be active all the time. Mikhmon can be activated when needed or as needed (Laksamadi, 2018).

Based on the description of the problems above, it is necessary to conduct a study to compare the performance of Mikrotik which is being used in the Village Bumdes of Sepakat with the performance of Mikrotik which the researcher proposes to do, in order to determine the performance of Mikrotik as well as to provide solutions to the above problems. Therefore, the author raised the title "Comparative Analysis of Mikhmon and Usermanager Performance on Mikrotik".

## **2. LITERATURE REVIEW**

### **2.1 Review Library**

Research conducted by Kusuma et al (2020) with the title of developing a web filtering firewall using Mikrotik and Usermanager with Mikhmon at SMK Negeri 3 Jayapura using the Network Development Life Cycle (NDLC) method. The result of this research is to develop a new web filtering firewall using Mikrotik [1].

Research conducted by Nanang (2020) with the title Comparative Analysis of Freeradius and Usermanager Performance on Mikrotik using the Network Development Life Cycle (NDLC) method, the result of this study is to compare the performance of two server applications on Mikrotik [2]

Research conducted by Asep Syaputra et al (2020) with the title Utilizing Mikrotik for Hotspot Networks with a Voucher System in Ujan Mas Village, Pagar Alam City by using the Prepare, Plan, Design, Implement, Operate, Optimize (PPDIOO) method, where research from Asep carried out the development internet network with a hotspot voucher generating system by managing mikrotik [3]

Research conducted by Eko Purwanto (2015) entitled Implementation of a Hotspot Network Using a Learning Supporting Mikrotik Router where in this study the methods used include Analysis, Design, Implementation, and Evaluation and in Eko's research, the development and implementation of a hotspot network using a mikrotik hotspot [4].

Research conducted by Standy Oei (2014) entitled Design of a Hotspot Network at the University of Nusantara Manado Campus Using a Mikrotik Router in Standy's research, includes the Library Study method, Needs Analysis, Network Architecture Design, Implementation, and Testing. By utilizing the existing hotspot network, the authentication function has been implemented, as well as the bandwidth sharing function based on user profiles created. The router application using the resulting proxy can meet system needs, especially in filtering applications according to user needs [5].

### **2.2 Basic theory**

#### **2.2.1 Analysis**

according to Edi & Bethani (2009) defines that analysis is a method used to find out how to describe data, data relationships, data semantics and data boundaries that exist in an information system [6].

#### **2.2.2 Ratio**

According to Sjachran (2009) Comparison is a method of study or investigation by making comparisons between two objects of study or more to increase and deepen knowledge about the object under study [7].

### 2.2.3 Computer network

According to Herman (2018) defines that a computer network is a group of computers (more than one) that are connected to one another using certain media so that it is possible between the computers to interact, exchange data and share common equipment such as printers, scanners, etc [8].

### 2.2.4 Michmon

According to Laksamadi (2018), he explained that *Mikrotik Hotspot Monitor*(Mikhmon) is a web-based application (Mikrotik API PHP Class) to assist in managing Mikrotik hotspots. Especially Mikrotik which does not support Usermanager. Mikhmon is not a Radius Server, so it doesn't have to be active all the time. Mikhmon can be activated when needed or as needed [9].

### 2.2.5 UserManager

According to Fajar (2008) defines User Manager as a web interface with web-based menus that are used to manage hotspot users. The user manager on Mikrotik here functions as AAA management, where previously the Mikrotik function was activated [10].

### 2.2.6 Hot spot

According to Jubile (2012), hotspots are: a variant of communication and information technology that works with local area network (WLAN) hotspot networks and circuits [11].

### 2.2.7 Mikrotik

According to Doni (2014) defines that Mikrotik is a one of the default operating systems of Linux. Mikrotik itself is widely used in internet cafes and has been widely developed because it is very good and easy to configure and install [12].

### 2.2.8 Quality Of Service (QoS) Method

According to Rika Wulandari (2016) *Quality Of Service*(QoS) is a method of measuring how well a network is and is an attempt to define the characteristics and properties of a service. QoS is used to measure a set of performance attributes that have been specified and associated with a service [13].

1. The QoS Monitoring component consists of Application Monitoring, QoS Monitoring, Monitor, and Object Monitoring
  - a. *Monitoring Application*  
is an interface for network administrators. This component functions to retrieve interface information from the target to be analyzed.
  - b. *QoS Monitoring*  
Provides a QoS monitoring mechanism by providing flow information recording the QoS parameter values of packet data traffic.
  - c. *Monitor*  
In charge of collecting and recording data packet traffic information. The monitor performs real-time flow measurement of data packets.
  - d. *Monitored Objects*  
Is information such as attributes and activities that are monitored in the network. In the context of QoS monitoring, the information is data packet flows that are monitored

in real time. The type of data packet flow can be known from the source and destination addresses in the IP layers, the port used, such as UDP or TCP, and the parameters in the RTP packet.

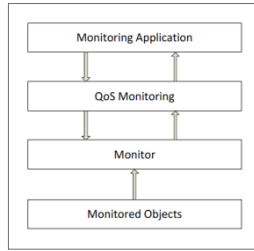


Figure 1. Cycle Quality Of Service(QoS)

2. The Quality Of Service (QOS) parameter consists of several parameters, namely as follows.

a. *throughput*

*throughput* is the actual bandwidth, measured in certain units of time and under certain network conditions used for file transfers of a certain size. The calculation of the Throughput category can be seen in Table I.

Table I Throughput Category

Kategori Throughput	Throughput (bps)	Indeks
Sangat Bagus	100	4
Bagus	75	3
Sedang	50	2
Jelek	< 25	1

(source TIPHON)

$$throughput = \frac{\text{Number of Bytes}}{\text{Time Span}}$$

b. *Jitter*

*Jitter* is a variation of the arrival time of data packets. In digital communication where data is sent in the form of packets that allow the delivery to be carried out simultaneously but the packets do not necessarily arrive simultaneously because they go through different paths. The Jitter measurement standards can be seen in table II.

Table II Jitter Category

Kategori Jitter	Jitter (ms)	Indeks
Sangat Bagus	0 ms	4
Bagus	0 ms s/d 75 ms	3
Sedang	75 ms s/d 125 ms	2
Jelek	125 ms s/d 225 ms	1

(source TIPHON)

$$\frac{Jitter}{\text{Total Package}} = \text{Total Variation Delay}$$

c. *Packet Loss*

is a packet that is lost in the network, in digital communication a packet will be set to the maximum number of hops that can be passed. For example, the maximum default in windows is 128 hops, when the packet sent passes more than 128 hops, the packet will not arrive at the destination address. The packet that is lost is what is called packet loss. The Packet Loss category can be seen in table III.

Table III Jitter Category

Kategori Degradasi	Packet Loss (%)	Indeks
Sangat Bagus	0	4
Bagus	2	3
Sedang	15	2
Jelek	25	1

(source TIPHON)

$$\text{Packet loss} = (\text{Packet Sent} - \text{Packet Received}) / \text{Packet Sent} \times 100$$

d. *delay*

*Delay (Latency)* is the time it takes the data to travel the distance from origin to destination. Delay can be affected by distance, physical media, congestion or also long processing times. The delay category can be seen in table IV.

Table IV Jitter Category

Kategori Latensi	Besar Delay (ms)	Indeks
Sangat Bagus	< 150 ms	4
Bagus	150 ms s/d 300 ms	3
Sedang	300 ms s/d 450 ms	2
Jelek	> 450 ms	1

(source TIPHON)

$$\text{Delay} = \frac{\text{Time 1}}{\text{time 2}}$$

### 3. RESEARCH METHODS

#### 3.1 Research methods

In conducting research at the Village Bumdes, agree with the title Analysis of the Performance Comparison of Mikhmon and UserManager on Mikrotik. The stages in this research can be seen in Figure II below.

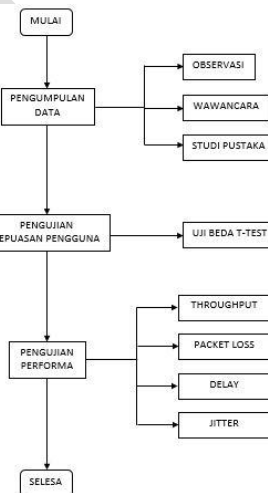


Figure 2. Flow of Research Stages

##### 3.1.1 Method of collecting data

1. Observation at this stage the researchers conducted a site survey to collect data. This survey was conducted to find network data and data related to the problem to be discussed.
2. Interview at this stage the researcher conducted interviews with the bundle management to obtain information about the problems faced.
3. Literature Studies at this stage researchers study concepts, techniques, and information from various sources such as the internet, books, journals, and other scientific articles related to computer networks.

### 3.1.2 Satisfaction Test

At this stage the authors tested the satisfaction of the Usermanger users and also the users of Mikhmon which was done by giving a questionnaire to the user and the data obtained in the form of the questionnaire results were processed through SPSS and a T-Test was carried out.

### 3.1.3 Network Analysis Method

The network analysis method used by the author in this study is to use QoS parameters, namely Throughput, Packet loss, Delay, and Jitter which are measurement parameters of the Quality of Service (QoS) method, which can be seen in the following explanation:

1. *throughput* is the stage where the writer takes the data, the total number of successful packet arrivals that the writer observes during a certain time interval. The data taken is the effective data transfer rate, which is measured in bps (bits per second).

$$\text{throughput} = \frac{\text{Number of Bytes}}{\text{Time Span}}$$

2. *Packet loss* At this stage the writer takes a parameter value that describes a condition that shows the total number of lost packets.

$$\text{Packet loss} = \frac{(\text{Packet Sent} - \text{Packet Received})}{\text{Package Sent} \times 100}$$

3. *Delay / Latency* At this stage, the writer takes the time data needed by the data to cover the distance from origin to destination

$$\text{Delay} = \frac{\text{Time 1}}{\text{time 2}}$$

4. *Jitter* At this stage the authors take values from variations in queue length, in data processing time, and also in packet reassembly time at the end of the jitter journey.

$$\text{Jitter} = \frac{\text{Total Variation Delay}}{\text{Total Package}}$$

## 3.2 Identification of Needs

### 3.2.1 Hardware Requirements (Hardware)

Based on the minimum client specifications and supporting devices such as laptops and routers.

### 3.2.2 Software Requirements (Software)

Is a minimum specification requirement in the construction of computer networks such as operating systems, browsers, and controller applications.

### 3.2.3 User Needs

User needs here play an important role, such as admins who manage and monitor computer network performance and optimization of network use which is measured based on user convenience in conducting data transactions and exchanging information.

## 3.3 Analysis

### 3.1.1 Problem analysis

Based on the results of field observations by means of interviews and researcher observations with the Head of the Bumdes management in Sepakat Village, that the problem is that alternative solutions are needed to accommodate active users who are increasing every time, and divide the access speed of users in an even manner, and by utilizing the MikroTik routerboard and hotspot feature to perform network management.

### 3.1.2 Problem Solving Strategy

After the writer conducted the interview the writer gave the following suggestions:

1. Comparing the performance of Mikhmon and Usermanager networks using the QoS method parameters.
2. Perform performance testing by utilizing users who are connected to the same network to determine the stability of Mikhmon and Usermanager.

## 4. RESULTS AND DISCUSSION

Quality Of Service (QoS) Network Analysis method that has been carried out up to the monitored stage and in this study, the results are divided into the results of the discussion on Monitoring Application, QoS Monitoring, Monitor, and conducting network testing of 3 clients to serve as samples.

### 4.1 Data Collection Results

Of the three methods that the author uses in data collection, it can be described from the data that was successfully collected during the study within a period of 3 months. The following are the results of these data:

#### 4.1.1 Observation

After the author made observations at the Village Bumdes in Sepakat, the relevant management was willing to provide information related to the network to be analyzed, the information provided was in the form of displaying several users on Mikrotik, the Mikrotik type used was the RB941-2nD series, and the number of active users was 200, as follows is the user view given from the observation stage that has been done. The results of the observations can be seen in Figure 3.

Username	Till time	Total time left	Actual profile
2aq	Unlimited	Unlimited	PPP
h77	Unlimited	Unlimited	PPP
zsh	Unlimited	Unlimited	PPP
fj	Unlimited	Unlimited	PPP
zdi	Unlimited	Unlimited	PPP
n9x	Unlimited	Unlimited	PPP
sxa	Unlimited	Unlimited	PPP
9ik	Unlimited	Unlimited	PPP
y5k	Unlimited	Unlimited	PPP

Figure 3. User Display on Mikrotik

#### 4.1.2 Interview

At the interview stage, it was carried out by giving direct questions to the management of the Bumdes of Sepakat Village. The results of the interview process that were carried out that the management of the Bumdes in Sepakat Village supported the conduct of network research in the Bumdes in Sepakat Village. The results of the interviews can be seen as follows:

1. So far the number of people who can connect is only a few and if someone wants to connect then they have to wait until one of the users finishes using wifi.
2. For a period of time for each user is free depending on the extent to which the user requires an internet connection.
3. So far, no development has been carried out because the bumdes itself does not know the right way to develop the Bumdes wifi.

#### 4.2 T-Test Differential Test

The results of the T-Test Different Exam by testing the hypothesis that is to compare satisfaction in using Usermanager with Mikhmon can be seen in table V.

Table V Hypothesis Testing

No.	Inikator	Mean	
		User Manager	Mikhmon
1.	Tampilan	2.8	3.6
2.	Kecepatan	2.6	4.2
3.	Kepuasan	3.1	4.2
4.	Kualitas	3.1	3.7
5.	Penggunaan	2.9	4.0

From the calculations on the T-Test difference test, it can be seen that there are differences between UserManager and Mikhmon. This shows that the display indicators (2,800 < 3,600), Speed (2,600 < 4,200), Satisfaction (3,100 < 4,200), Quality (3,100 < 3,700), Usage (2,900 < 4,000). This difference can be caused because the speed and quality that is owned by Mikhmon is much better than the speed and quality that is owned by the UserManager.

Table VI Calculated Value

	t	Sig	Mean Difference
MIKHMON	15.318	0,00	19.650
UserManager	12.841	0,00	14.350

From the calculations on the T-test, the calculated value of Mikhmon is greater than that of UserManager with a value of (15.318 > 12.841) with a significance value of 0.00. So there is a significant difference between Mikhmon and UserManager. This difference can be obtained because Mikhmon has advantages such as performance, a better display and easy to use compared to UserManager.

### 4.3 Needs Analysis

At this stage of analysis there are 2 results of needs analysis that the author uses in conducting research, among others, as follows:

#### 4.3.1 Hardware Requirements Analysis

The hardware requirements in this study can be seen in table VII.

Table VII Hardware Requirements

No	Perangkat Keras	Spesifikasi
1.	Laptop	a. Processor Intel Baytrail M Dual – Core 2840 up to 2.58 GHz b. RAM 2 GB c. VGA Intel HD d. HDD 500 Gb
2.	Mikrotik Routerboard	a. RB941-2nD b. Data Storage/NAND 16 MB c. RAM 32 MB d. Switch Chip 1 e. Lan Port 4 f. Router OS Level 4
3.	Kabel Lan	a. RJ-45

#### 4.3.2 Software Requirements Analysis

The software requirements in this study can be seen in table VIII.

Table VIII Software Requirements

No	Prangkat Lunak	Versi
1.	Windows	7 (32 Bit)
2.	Google Chrome	92.0
3.	Winbox	3.28
4.	Mikshmon	4.6
5.	Wireshark	3.4.7

### 4.4 QoS . Parameter Measurement

#### 4.4.1 Mikshmon QoS Parameter Measurement

The picture below shows the Mikshmon data traffic process starting from the ISP and then Mikrotik manages using Mikshmon and the signal is spread by access points.

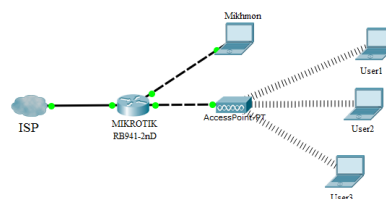


Figure 4 Mikshmon's Data Traffic Process

The results of the parameter measurements from Mikhmon which include measurements of Throughput, Packet Loss, Delay, and Jitter can be seen in the following tables:

#### 1. *throughput*

The results of Mikhmon's throughput parameter measurement for each stage of measuring the number of clients can be seen in table IX.

Table IX Throughput Parameter Measurement

No	Pengukuran	Rata-rata Throughput (kb/s)
1	1 client	441
2	2 client	3295
3	3 client	1957

#### 2. *Loss Packages*

The results of the measurement of Mikhmon's packet loss parameters for each stage of measuring the number of clients can be seen in table X.

Table X Measurement of Packet Loss Parameters

No	Pengukuran	Rata-rata Packet Loss (%)
1	1 client	0%
2	2 client	0%
3	3 client	0,037%

#### 3. *delay*

The results of measuring the Delay Mikhmon parameter for each stage of measuring the number of clients can be seen in table XI.

Table XI Delay Parameter Measurement

No	Pengukuran	Rata-rata Delay (ms)
1	1 client	1,536
2	2 client	2,355
3	3 client	3,856

#### 4. *Jitter*

The results of measuring the Jitter Mikhmon parameter for each stage of measuring the number of clients can be seen in table XII.

Table XII Jitter Parameter Measurement

No	Pengukuran	Rata-rata Jitter (ms)
1	1 client	3,46
2	2 client	6,72
3	3 client	6,599

#### 4.4.2 UserManager QoS Parameter Measurement

The picture below shows the Usermanager data traffic process starting from the ISP and then Mikrotik manages it using the Usermanager and the signal is spread by the access point.

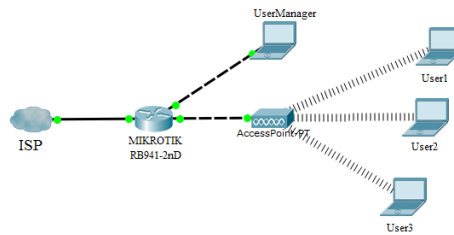


Figure 5 Usermanger Data Traffic Process

For the parameter measurement results from the Usermaner which include measurements of Throughput, Packet Loss, Delay, and Jitter, it can be seen in the following tables:

### 1. throughput

The measurement results of Usermanager throughput parameters for each measurement stage with the number of clients can be seen in table XIII.

Table XIII Throughput Parameter Measurement

No	Pengukuran	Rata-rata Throughput (kb/s)
1	1 client	1222
2	2 client	2718
3	3 client	9329

### 2. Packet Loss

The results of measuring the Usermanager packet loss parameters for each stage of measuring the number of clients can be seen in table XIV.

Table XIV Measurement of Packet Los Parameters

No	Pengukuran	Rata-rata Packet Loss (%)
1	1 client	0%
2	2 client	0%
3	3 client	2.123%

### 3. delay

The results of measuring the Delay Usermanager parameter for each stage of measuring the number of clients can be seen in table XV.

Table XV Delay Parameter Measurement

No	Pengukuran	Rata-rata Delay (ms)
1	1 client	2,747
2	2 client	6,122
3	3 client	6,599

#### 4. Jitter

The results of measuring the Jitter Mikhmon parameter for each stage of measuring the number of clients can be seen in table XVI.

Table XVI Jitter Parameter Measurement

No	Pengukuran	Rata-rata Jitter (ms)
1	1 client	3,46
2	2 client	6,72
3	3 client	6,599

The tables above show the results of measuring QoS parameters from Mikhmon and also Usermanager which includes measurements of Throughput, Packet Loss, Delay, and Jitter.

#### 4.5 Comparison of QoS . Parameter Measurement Results

At this stage, the results of parameter measurements from mikhmon and usermanager have been tested in the previous stage which has been discussed above, the following is a comparison table:

At this stage, the results of the parameters from Mikhmon and Usermanager that have been tested in the previous stage which have been discussed above are the following comparison table:

Table XVII Mikhmon and Usermanager QoS Parameter Recapitalization Table when streaming youtube

No	Pengukuran	Parameter QoS Mikhmon				Parameter QoS Usermanager			
		Throught	Packet Loss	Delay	Jitter	Throught	Packet Loss	Delay	Jitter
1	Parameter 1 Client	441	0%	1,536	1,563	1222	0%	2,747	3,46
2	Parameter 2 Client	32,95	0%	2,355	8,21	2718	0%	6,122	6,72
3	Parameter 3 Client	1957	0,037%	3,856	9,16	9329	2,123%	6,599	6,599

The recapitalization of the measurement results can be seen in table XVII of the QOS value index, namely:

1. *Throughput*: the throughput measurement results for Mikhmon is the highest in 1 client with a value of 441 while for UserManager in 1 client with 1222, this shows the result that Mikhmon's throughput is better than UserManager.
2. *Packet loss*: the result of packet loss measurement for Mikhmon is 0% according to the TIPHON standard if the average packet loss is 0% then it is included in the "Very Good" category. Meanwhile, UserManager is 2 according to the TIPHON standard, if the average packet loss is 2%, it falls into the "Good" category, it can be concluded that the value of the Los Mikhmon packet is better than the UserManager.
3. *Delay/latency*: the result of delay/latency measurement for 3 Mikhmon clients is 3,856 while for 3 UserManager clients it is 6,599 which means that the delay from Mikhmon is smaller than UserManager which shows that Mikhmon's delay is better than UserManar.
4. *Jitter*: the results of the jitter measurement for 3 Mikhmon clients are 9.16 ms according to the TIPHON standard if the average jitter is 9 ms then it falls into the "Good" category. and for 3 UserManeger clients it is 6,599 ms according to the TIPHON standard if the average jitter is 6 ms then it is in the "Good" category. From the results of the jitter, Mikhmon and UsserManager are of the same value, but the jitter of UsserManager is better than Mikhmon.

## 5. CONCLUSION

### 5.1 Conclusion

From the results of the analysis that has been carried out previously using the Quality Of Service (QoS) method and the T-Test Differential Test, the authors can conclude that the comparison analysis of Mikhmon and Usermanager at Mikrotik (a case study of Bumdes Desa Sepakat) has been completed and the results show that the performance of mikhmon is better than usermanager. And Mikhmon which is easier to use than Usermanager. So the author recommends Mikhmon as a tool for user management on Mikrotik. So the research conducted by the author can contribute to help and provide solutions to the problems that exist in the Bumdes of Sepakat Village.

### 5.2 Suggestion

From the results of the performance comparison analysis between Mikhmon and Usermanager on the Mikrotik that the author has worked on, the authors provide suggestions for further research in order to be able to develop networks to obtain better performance, including:

1. For further research, it is recommended to replace Mikrotik by using Microbits that have higher specifications than MikroTik.
2. Network infrastructure can be developed by expanding the frequency

### **COMPETING INTERESTS DISCLAIMER:**

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

## REFERENCES

- [1] Budiansyah, Nanang. (2020). Comparative Analysis of Freeradius and Usermanager Performance at Mikrotik, Sumbawa.
- [2] Eddie, Doro. (2009). Data Analysis Using Erd And Data Warehouse Conceptual Model. Journal of Informatics, 5(1), 71-85.
- [3] Firmansyah, Anang. 2020. Introduction to E-Marketing. Qiara Media : East Java.
- [4] Komaruddin. (2001). Analysis of Networked News Broadcasting Program 1 Rri Samarinda in Delivering News from Border Areas, Communication Sciences Ejournal, 2015,3(2) : 278 – 292.

- [5] Kristanto, Andi. 2003. Computer Networks. Graha Ilmu : Yogyakarta.
- [6] Kudratullah & Yudi Mulyanto. (2019). Infrastructure Analysis and Development Computer Networks in Supporting the Implementation of Digital Schools. Jinteks, 1(1), 58-67.
- [7] Kurnia, Deni. (2018). Comparative Analysis of Performance Between Mikrotik Os And Routers Myhotspot application in managing a network, a case study in high school Cijangkar, Journal of Technology. Vol 7 No.4 Pg. 253.
- [8] Kusuma, Budhi. (2020). Web Filtering Firewall Development Using Mikrotik And Usermanager With Mikhmon At Smk Negeri 3 Jayapura.
- [9] Kurniawan, Agus. (2014). Network Forensics With Wireshark. Andi Publisher. Jakarta.
- [10] Mikrotik. (2004). Winbox General Information, Quoted From [Http://Mikrotik.Co.Id/Testdocs/Ros/2.9/Guide/Winbox.Php](http://Mikrotik.Co.Id/Testdocs/Ros/2.9/Guide/Winbox.Php). On March 24, 2021.
- [11] Rahmah, HedianaN. (2020). Work Effectiveness of Civil Servants (PNS) and Regional Contract Workers (Tk2d) Department of Population and Civil Registration of East Kutai Regency: Journal of Government Science (Govsci). 1(1) : 1-11.
- [12] Standi Oei. (2014). Design and Build a Hotspot Network on the Manado Nusantara University Campus Using Mikrotik.
- [13] William, Frado. (2016). Analysis and Design of Usermanager On Mikrotik Router With Credit Voucher Purchase System.
- [14] Wulandari, Rika. (2016). Analysis of Quality Of Service (Qos) on the Internet Network (Case Study: Upt Loka Mining Engineering Test Jampang Kulon – Lipi). Judgment. 2 (2) : 162 – 172.
- [15] Yuliandoko, Herman. 2018. Wire And Wireless Computer Networks And Its Applications. cv. Budi Utama : Yogyakarta.