DEVELOPMENT OF MONITORING SYSTEM AND NETWORK OPTIMIZATION IN SMAN 2 BANJAR

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ABSTRACT

The purpose of this study was to optimasi internet connection throughput load on the clock time teaching and learning in SMAN 2 Banjar by using Mikrotik routers and use a proxy server, storage Moving Traffic Network log data on the server computer and internet access options settings on a computer network SMAN 2 Banjar. In this study, load optimization throughput by scheduling access the website to the internet at the time of teaching and learning activities as well as using a proxy server as a cache of Internet content. The process of scheduling access the website to the internet to do in Mikrotik using the feature service Layer 7 Protocol with intermediaries Mikrotik API on a system that will dibanguan, Salain the role of proxy server as cache also plays internet content store log data in the database as a Network Traffic website frequently accessed information. By doing logging Network Traffic on the database then future checks can cause termonitoring throughput load and make arrangements to the Internet by accessing the website traffic termonitoring the dashboard application network monitoring systems. Of the system that has been built using the obtained test results were successful in reducing the burden of QoS parameters of throughput, monitoring Internet traffic, and perform scheduling arrangements accessing the website. By doing logging Network Traffic on the database then future checks can cause termonitoring throughput load and make arrangements to the Internet by accessing the website traffic termonitoring the dashboard application network monitoring systems. Of the system that has been built using the obtained test results were successful in reducing the burden of QoS parameters of throughput, monitoring Internet traffic, and perform scheduling arrangements accessing the website. By doing logging Network Traffic on the database then future checks can cause termonitoring throughput load and make arrangements to the Internet by accessing the website traffic termonitoring the dashboard application network monitoring systems. Of the system that has been built using the obtained test results were successful in reducing the burden of QoS parameters of throughput, monitoring Internet traffic, and perform scheduling arrangements accessing the website.

Keywords :monitoring, optimization, network, proxy, Mikrotik API, proxy server, QoS.

1. INTRODUCTION

SMAN 2 Banjar is a public school located in Banjar, West Java province. SMAN 2 Banjar has class science majors (Natural Sciences), IPS (Social Sciences), and the language is divided into several levels among grade 10 classes for Class X, Class 10 for class XI and class 9 to class XII. In the second semester of academic year 2018/2019 had a total of 983 student learners and education personnel 65 people. From the report data 2011 - 2018 admission of students each school year on average receives about 350 students.

Based on interviews with Vikri Setiawan, Kom., As a responsible computer infrastructure at SMAN 2 Banjar and the results of internet usage log data were recorded using the devices Mikrotik router Routerboard RB750Gr3 and data stored on the server in the period January to March 2019 that in a computer network is now running show activity as much as 60% of internet usage at SMAN 2 Banjar to access social media sites Intagram, facebook, and twitter dijam 8 am to 11 noon, at that time it shall be used for teaching and learning activities that are not in accordance with the press release KOMINFO No. 208 / HM / KOMINFO / 08/2018 on 30 August 2018,

Another problem that is obtained when it will be done for the logging of Internet usage in SMAN 2 Banjar only able to accommodate data in a scale which is smaller maximum size of 1 MB (Mega Byte) and can only be recorded within 10 minutes it made it difficult to collect the data prior to the interest of the report exploiting the use of internet facilities.

In addition, at this time SMAN 2 Banjar using one ISP (Internet Service Provider), which has a speed of 100 Mbps with FUP (Fair Usage Policy) 2000 GB (Gigabyte) of each month, which is divided into several needs, the first to the needs of students obtain bandwidth 10 Mbps, the second to the needs of employees of educational personnel gain bandwidth of 30 Mbps on and the rest is not manageable used for server data synchronization school and computer lab, according to log data on internet usage activity found to download entertainment files such as video and music to 200 GB per day. This will accelerate the reduction of FUP, when usage exceeds 2000 GB FUP then the speed of bandwidth down 50% to 50 Mbps this will cause a slow internet connection.

Of the problems that occur it is necessary to solve existing problems. Solution a use of technology to solve the case of the above is by way of the implementation of the use of proxy servers (cache proxy server) can help optimize Internet access were mainly used to store the website files that have been accessed by the client who can then display the files of webstie whenever the same request and internet services with limited bandwidth both in terms of speed and in terms of cost[1] and paper engineering block access to browse using Mikrotik router device that supports the time schedule [2]besides dituhukannya system that can make measurements over time shows movement toward or away from the goal. Monitoring will provide information on the status and trends that the measurement and evaluation of completed yansg repeated from time to time, monitoring is generally done for a specific purpose, to check on the process[3] ,

2. THEORETICAL BASIS

2.1. Computer network

Computer network (computer network) is a computer model of a single serving computing tasks are replaced with a set of computers in large numbers of separate but interconnected in their duties. Computer networks can be defined as the set of interconnection (interconected) a number of autonomous computers. In computer networks connected to each other can be said when the two can exchange information with the media exchange intermediary that variant (wire, fiber optic, microwave, satellite, etc.)[4],

2.2. Monitoring system

According to Renda Towidjojo a network monitoring network monitoring activity include the number of users connected, any user who authenticate, also includes any user who is connected but has not authentication should also be able to bypass (that do not require user authentication) [5],
Then sisitem monitoring can be interpreted as a monitor user activity on a computer network to maintain the integrity of the connection jariangan access rights to each user.

2.3. Computer Network Optimization

Network optimization technology is used to improve network performance for specific environments. It is considered as an important component of an effective management information systems. Network optimization plays an important role because information technology is growing at an exponential rate with business users generate large volumes of data and thus consume network bandwidth greater If network optimization is right there, sustained growth can add to the strain on the network architecture of the environment or organizations concerned.

2.4. PPDIOO Network Lifecycle

PPDIOO is networking dikembang development lifecycle by CISCO SYSTEMS INC a company focus mengembangankan computer networking devices in the world. With PPDIOO can assess whether the network still meet the needs and evaluate[6],

2.5. QoS parameters

QoS parameters that affect network performance measurement Internet is packet loss, delay (latency), jitter, and throughput.

a. Throughput

Throughput is the actual bandwidth measured in a certain time and under certain network conditions that are used to transfer files of a certain size. System throughput is the amount of data sent to the speed of all terminals in a network[7],

Table 1 Standards for Throughput

	Throughput (bps)	**Category**	**Index**
standard Throughput	100 bps	Very good	4
	75 bps	Nice	3
	50 bps	moderate	2
	<25 bps	Bad	1

Throughput calculation:

$$\text{Throughput} = \frac{\text{package received}}{\text{duration of observation}}$$

b. Packet Loss

End to end packet loss is one of the QoS performance metrics of the most significant because it will affect many applications such as VoIP. Performance dropped drastically if the packet loss exceeds a certain limit, and will become unusable if the packet loss is very large[21], Standard values using a standard packet loss TIPHON recommendations can be seen in Table 1.1.

Table 2 Standards for Parameter Packet Loss TIPHON

Standard	**Packet Loss (%)**	**Category**	**Index**
packet Loss	0 s / d 0.5%	Very good	3
	0.5 s / d 1.5%	Nice	2
	> 1.5%	Bad	1

Packet loss calculation:

$$\text{Packet loss} = \frac{(\text{data packet sent} - \text{Data packet received}) \times 100\%}{\text{data packet sent}}$$

c. Delay (Latency)

One major factor in the transmission of voice QoS is the delay perceived by the user. To allow normal conversation over the network, this delay should be kept almost constant and below the specified limits. If the delay of end to end too high, interactive communication is difficult or impossible[21], Standard delay value can be seen in Table 1.2.

Table 3 Delay parameters based TIPHON (Letency)

	Packet Loss (ms)	Category	Index
Standard Packet Delay (Letency)	0 s / d 150 ms	Very good	3
	150 s / d 400 ms	Nice	2
	> 400 ms	Bad	1

Delay calculation:

$$\text{Deyal rata-rata} = \frac{\text{total delay}}{\text{total package received}}$$

d. Jitter

Jitter is generally caused by congestion in the IP network. Congestion can occur either on the router interface or network operator if the circuit is not set correctly[21], Standard delay value can be seen in 1.3.

Table 4 Jitter parameters based TIPHON

	Jitter (ms)	Category	Index
standard Jitter	0 s / d 20 ms	Very good	3
	20 s / d 50 ms	Nice	2
	> 50 ms	Bad	1

Jitter calculation:

$$\text{Jitter} = \frac{\text{total delay variation (iv)}}{\text{total package received}}$$

the total delay variation is obtained from :

total delay variation = delay - average delay

2.6. PHP

PHP is a programming language that can be used for general purposes, equal are like other programming languages: C, C ++, Pascal, Python, Perl, Ruby, and so on. However, PHP is more popularly used for building web applications. In the process of making web pages, PHP does not require a long kodeyang such as Perl and Python (for example) for the PHP code can be inserted into the HTML code[8],

2.7. Squid Proxy

Squid is a caching proxy for the Web supporting HTTP, HTTPS, FTP, and more. It reduces bandwidth and improves response time by storing and reusing frequently requested web pages. Squid has extensive access controls and makes a great server accelerator. It runs on most operating systems are available, including Windows and is licensed under the GNU GPL[9],

2.8. Mikrotik API (Application Programming Interface)

Application Programming Interface (API) allows users to create specific software solutions for communicating with RouterOS to gather information, customize and manage the router configuration. Word is part of a sentence that is encoded in a certain way - a long and encoded data[10],

3. ISI RESEARCH

3.1. Analysis Plan Room

To support the analysis of the topology that will be proposed the plan analyzes the room is needed, the following is a plan of SMAN 2 Banjar taken in 2019:

Picture 1 Plan school SMAN 2 Banjar

3.2. Scheme Analysis Network

Based on the observation that in doing, the following is a network topology that is running in the school SMAN 2 Banjar:

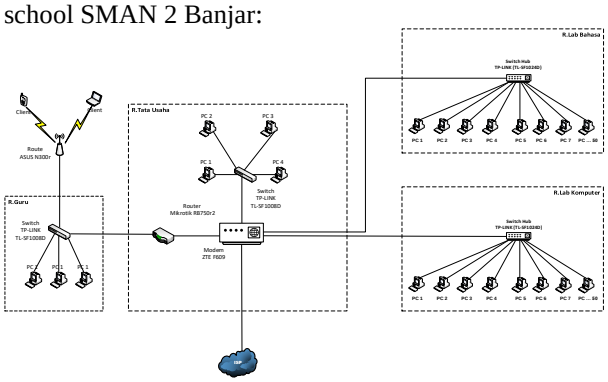

Figure 2 The network topology running at SMAN 2 Banjar

In Figure 3.3 topology running currently no centralized proxy router position seingga data activity log data is not recorded all the activities, which are

only now just tercata wifi network for both students and educators.

3.3. Network Quality Analysis

Before the network optimization is carried out using a computer network quality measurement parameters of QoS (Quality of Service). Testing communication with a network server for 30 seconds using Iperf3 application. Collecting data on each - each conducted every room connected computer networks. of the measurement results QoS parameters consist of bandwidth, throughput, delay and packet loss TIPHON default values that can be evaluated and analyzed with the following explanation:

a. Measurement Throughput

Table 5 Throughput testing results at 07.30 am - 12.00 pm

No.	locations	The average throughput (bps)	Information	
			Index	Category
1	Teacher's room	72.05 bps	3	Nice
2	Administration room	77.11 bps	4	Very good
3	Language Laboratory Space	60.76 bps	3	Nice
4	Space Computer Laboratory	71.05 bps	3	Very good
5	Schoolyard	10.80 bps	1	Bad

Table 6 Throughput Testing Results at 12.00 am - 17.00 pm

No.	locations	The average throughput (bps)	Information	
			Index	Category
1	Teacher's room	70.80 bps	3	Nice
2	Administration room	51.53 bps	3	Nice
3	Language Laboratory Space	60.80 bps	3	Nice
4	Space Computer Laboratory	70.30 bps	3	Nice
5	Schoolyard	60.27 bps	3	Nice

b. Packet Loss

table 7 Results of testing the packet loss at 07.30 am - 12.00 pm

No.	locations	On average Packet Loss (%)	Information	
			Index	Category
1	Teacher's room	0%	3	Very good
2	Administration room	0%	3	Very good
3	Language Laboratory Space	0%	3	Very good
4	Space Computer Laboratory	0%	3	Very good
5	Schoolyard	0%	3	Very good

Table 10 Results of testing the packet loss at 12.00 am - 17.00 pm

No.	locations	On average Packet Loss (%)	Information	
			Index	Category
1	Teacher's room	0%	3	Very good
2	Administration room	0%	3	Very good
3	Language Laboratory Space	0%	3	Very good
4	Space Computer Laboratory	0%	3	Very good
5	Schoolyard	0%	3	Very good

c. Delay (latency)

table 11 The test results delay at 07.30 am - 12.00 pm

No.	locations	On average Delay (ms)	Information	
			Index	Category
1	Teacher's room	10.20 ms	3	Very good
2	Administration room	31.26 ms	3	Very good
3	Language Laboratory Space	23.55 ms	3	Very good
4	Space Computer Laboratory	48.25 ms	3	Very good
5	Schoolyard	65.40 ms	3	Very good

Table 12 The test results delay at 12:00 pm - 17:00 pm

No.	locations	On average Delay (ms)	Information	
			Index	Category
1	Teacher's room	20.20 ms	3	Very good
2	Administration room	41.26 ms	3	Very good
3	Language Laboratory Space	12.63 ms	3	Very good
4	Space Computer Laboratory	25.22 ms	3	Very good
5	Schoolyard	10.80 ms	3	Very good

d. Jitter

table 13 Test result jitterat 07.30 am - 12.00 pm

No.	locations	On average Jiter (ms)	Information	
			Index	Category
1	Teacher's room	11.4 ms	3	Very good
2	Administration room	110.11 ms	1	Bad
3	Language Laboratory Space	28.58 ms	2	Very good
4	Space Computer Laboratory	20.66 ms	2	Very good
5	Schoolyard	33.9 ms	2	Very good

Table 14 Test result jitterat 12.00 am - 17.00 pm

No.	locations	On average Jiter (ms)	Information	
			Index	Category
1	Teacher's room	10.61 ms	2	Nice
2	Administration room	29.78 ms	2	Nice
3	Language Laboratory Space	20.34 ms	2	Nice
4	Space Computer Laboratory	8.41 ms	3	Very good
5	Schoolyard	52.1 ms	1	Bad

3.4. Proposed Analysis Topology

The proposed topology analysis on the development of computer networks to optimize the network in SMAN 2 Banjar. The topology is proposed to build a computer network at SMAN 2 Banjar.

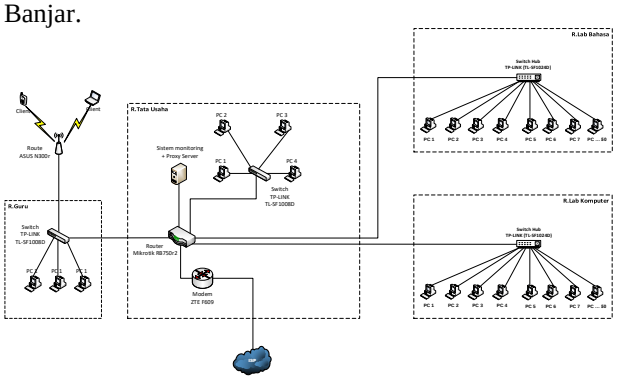

Figure 3 Topology will dibangaun

In gambardiatas there is the addition of the server that serves as a proxy and server monitoring system based websites on the topology that serves as

penyimapanan log data and data while internet content that is frequently accessed by network users or referred to as a cache content that will manage and control the overall data on the network traffic and also acting as a gateway to the internet. This topology works so meminimalisis usage data to the internet and help add kapasis log storage on a network.

3.5. Architectural analysis Monitoring System

Analysis of system architecture is a process to describe the system that will be built as a whole and also the supporting components. Here is an overview of the proposed arsistektur system to be built.

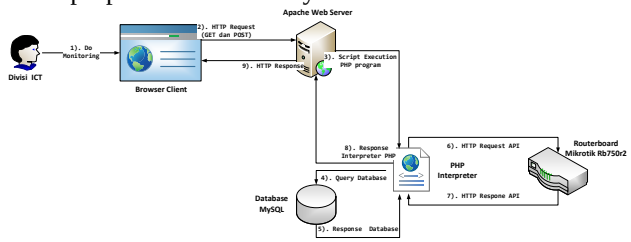

Figure 4 Network Monitoring System Architecture

Here is the explanation of network monitoring system architecture design bedasarkan picture above system:

1. Users who have positions open division ICT-based monitoring system program website using a web browser.
2. Web browsers make requests using the HTTP protocol to the Apache server.
3. Then Server Apache received instructions to execute PHP scripts on the interpreter program.
4. PHP interpreter querying the database for to manage data with a SQL query command.
5. MySQL did show both query response as instructed by the PHP interpreter.
6. PHP interpreter perform instructions Mikrotik API access to your router using the HTTP protocol.
7. Router Mikrotik perform instructions given PHP interpreter then give a response.
8. PHP interpreter returns the response to the Apache server.
9. Apache server to continue rsponse to Kilen via HTTP protocol through a browser.

3.6. Analysis of Communication API Router Mikrotik

On Mikrotik Router devices are services API (Application Programming Interface) that allows software developers to communicate with the Router Mikrotik to give instructions to the process of retrieving the data, store data and perform configuration.

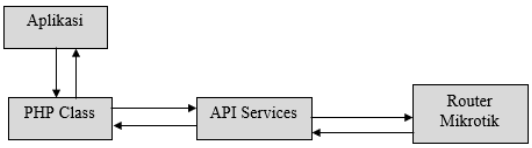

Figure 5 Mikrotik API Process Workflow

In the picture above process there is an intermediary Mikrotik API router PHP class that does printah directly to the device via the HTTP protocol.

3.7. Analysis of Proxy Server

The role of the proxy server on the optimization of the network in SMAN 2 Banjar is as a service to perform regular content storage sites or being called a data cache.

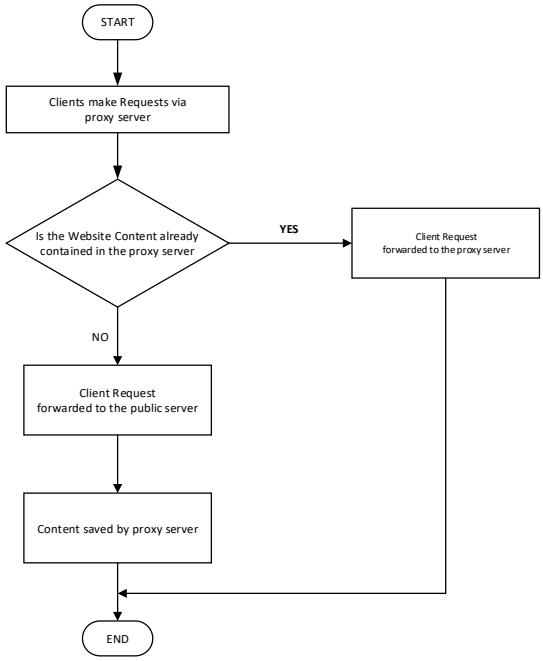

Figure 6 Workflow proxy process server

3.8. On Mikrotik API Implementation Program Code

After doing impmlementasi Mikrotik API configuration then proceed to implemntasi program code, the purpose of the program code implemntasi Mikrotik API is a communication process between the programming language that will be used for monitoring the system membanguan Mikortik router device.

On Mikrotik API for membanguan Implemantasi monitoring system will be built using the PHP programming language in the form of framework laravel assisted version 5.8 package pear2 / net_routeros so that the process of communication with Mikrotik router device in the form of a programming language functionality provided by the package. Here are the stages of program code implentasi:

1. Intalasi package pear2 / net_routeros using the command line composer

```
composer require pear2 / net_routeros
```

2. Dialing class package pear2 / net_routeros laravel each controller that will communicate with the router Mikrotik.

```
...
use PEAR2 \ Net \ RouterOS;
...
```

3. Implemntasi code request register hosts connected to the router Mikrotik

```
$ UTIL = new RouterOS \ Util (
 $ Client = new RouterOS \ Client ($ this->       ip_mikrotik,       $       this->
username_mikrotik,        $       this->
password_mikrotik)
 );

 $ Util-> setMenu ( '/ ip dhcp-server lease');

 foreach ($ util-> getAll () as $ item) {
 $ Data [] = [
 'Address' => $ item-> getProperty ( 'address'),
 'Mac_address' => $ item-> getProperty ( 'mac-address'),
 'Host_name' => $ item-> getProperty ( 'host-name'),
 'Status' => $ item-> getProperty ( 'status'),
 ];
 }

 return view ( 'monitoring_host.index', [ 'data' => $ data]);
```

4. Implemntasi code for melalkukan process using the blocking layer 7 protocol features belonging to Mikrotik.

```
try {
 $ Client = new RouterOS \ Client ($ this->     ip_mikrotik,     $     this->
username_mikrotik,        $       this->
password_mikrotik);
 $ UTIL = new RouterOS \ Util ($ client);

 $ Util-> setMenu ( '/ ip firewall used layer7-protocol');
 $ Id_layer7 = $ util-> add (
 array (
 'Comment' => $ request-> name,
 'Name' => $ request-> url,
 'Regexp' => '((' .str_replace ( '.', ')? \.? (', $ Request-> url). '))'
 )
 );
 $ Penjadwalan-> id_layer7 = $ id_layer7;

 // return var_dump ();
 // time = \ 0s-23h20m, sun, mon, tue, wed, thu, fri, sat
 usleep (500000);
 $ Util-> setMenu ( '/ ip firewall filter');
 $ Id_firewall = $ util-> add (
 array (
 'Chain' => 'forward',
 'Action' => 'drop',
  'Used layer7-protocol' => $ request-> url,
  'Comment' => $ request-> name,
 'Time' => $ request-> start. ': 00 -'. $ Request-> end. ': 00, mon, tue, wed, thu, fri, sat'
 )
 );

 $ Penjadwalan-> id_firewall = $ id_firewall;
 $ Penjadwalan-> save ();
 return back ();
 } Catch (Exception $ e) {
 die ($ e);
 }
```

4. TESTING

4.1. Network Quality Testing

Patrameter quality testing using QoS (Quality of Service) is a test performed on the network using a data collection applications. Tests using the application iperf3 provide an assessment of the quality of the network resulting in a conclusion.

On QoS testing is done when the state of the network connection does blocking Internet addresses that use penjadawalan access from the monitoring system. This test is to determine whether the implementation of network optimization as follows:

a. Measurement Throughput

Table 15 Results of testing the throughput at 07.30 am - 12.00 pm

No.	locations	The average throughput (bps)	Information	
			Index	Category
1	Teacher's room	72.05 bps	3	Nice
2	Administration room	77.11 bps	4	Very good
3	Language Laboratory Space	60.76 bps	3	Nice
4	Space Computer Laboratory	71.05 bps	3	Very good
5	Schoolyard	10.80 bps	1	Ugly

Table 16 Testing Results throughput at 12.00 am - 17.00 pm

No.	locations	The average throughput (bps)	Information	
			Index	Category
1	Teacher's room	70.80 bps	3	Nice

2	Administration room	51.53 bps	3	Nice
3	Language Laboratory Space	60.80 bps	3	Nice
4	Space Computer Laboratory	70.30 bps	3	Nice
5	Schoolyard	60.27 bps	3	Nice

b. Packet Loss

Table 17 Results of testing the packet loss at 07.30 am - 12.00 pm

No.	locations	On average Packet Loss (%)	Information	
			Index	Category
1	Teacher's room	0%	3	Very good
2	Administration room	0%	3	Very good
3	Language Laboratory Space	0%	3	Very good
4	Space Computer Laboratory	0%	3	Very good
5	Schoolyard	0%	3	Very good

Table 18 Results of testing the packet loss at 12.00 am - 17.00 pm

No.	locations	On average Packet Loss (%)	Information	
			Index	Category
1	Teacher's room	0%	3	Very good
2	Administration room	0%	3	Very good
3	Language Laboratory Space	0%	3	Very good
4	Space Computer Laboratory	0%	3	Very good
5	Schoolyard	0%	3	Very good

c. Delay (latency)

Table 19 The test results delay at 07.30 am - 12.00 pm

No.	locations	On average Delay (ms)	Information	
			Index	Category
1	Teacher's room	10.20 ms	3	Nice
2	Administration room	31.26 ms	3	Nice
3	Language Laboratory Space	23.55 ms	3	Nice
4	Space Computer Laboratory	48.25 ms	3	Nice
5	Schoolyard	65.40 ms	3	Nice

Table 20 The test results delay at 12:00 pm - 17:00 pm

No.	locations	On average Delay (ms)	Information	
			Index	Category
1	Teacher's room	20.20 ms	3	Nice
2	Administration room	41.26 ms	3	Nice
3	Language Laboratory Space	12.63 ms	3	Nice
4	Space Computer Laboratory	25.22 ms	3	Nice
5	Schoolyard	10.80 ms	3	Nice

d. jitter

Table 21 Jitter testing results at 07.30 am - 12.00 pm

No.	locations	On average Jiter (ms)	Information	
			Index	Category
1	Teacher's room	11.4 ms	3	Nice
2	Administration room	110.11 ms	1	Bad
3	Language Laboratory Space	28.58 ms	2	Enough
4	Space Computer Laboratory	20.66 ms	2	Enough
5	Schoolyard	33.9 ms	2	Enough

Table 22 Jitter testing results 7 at 12:00 pm - 17:00 pm

No.	locations	On average Jiter (ms)	Information	
			Index	Category
1	Teacher's room	10.61 ms	2	Enough
2	Administration room	29.78 ms	2	Enough
3	Language Laboratory Space	20.34 ms	2	Enough
4	Space Computer Laboratory	8.41 ms	3	Nice
5	Schoolyard	52.1 ms	1	Bad

5. CONCLUSION

Based on the results obtained from the study it can be concluded that the monitoring system has been built to monitor the state of a network that includes monitoring of network hosts, websites frequently accessed on the network and bandwidth use of the internet, the system can assist in determining the scheduling Internet access, using the Layer 7 Protocol as a method of blocking sites is accomplished, internet throughput load optimization by way of blocking a website address efektik enough to do.

As a suggestion for further research to be developed for the recording of a track record of internet access each network user as performance assessment, expected next monitoring system accessible outside the local network.

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