COMPARATIVE ANALYSIS OF THE DUAL STACK METHOD AND TUNNELING ON WEBINAR SERVICES IN BBKPM BANDUNG

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ABSTRACT

The Bandung Center for Community Lung Health (BBKPM) requires cheap and easy communication to be able to communicate between the head office and other offices in different cities and provinces. Therefore, the Bandung Center for Community Lung Health (BBKPM) uses a Webinar service.
Ipv4 supplies that have been used up for use and Webinar services are currently still experiencing various obstacles including delays during conversations both video and audio. Based on the above problems, it is necessary to overcome this optimization by using the IP protocol to version 6 migration method, namely Dual Stack and Tunneling, by comparing the Delay, Packet Loss, and Throughput of existing conditions with the application of the Dual Stack and Tunneling method.
By using the Dual Stack and Tunneling method in the Webinar testing the QoS value obtained is better than the existing value. This proves the value of QoS is categorized well according to Tiphon standards. Test results show that the Tunneling method is better than Dual Stack based on QoS test results..

Keywords : *Tunneling, Webinar, QoS, Delay, BBKPM.*

1. PRELIMINARY

The role of the Center for Community Lung Health (BBKPM) Bandung is very important because it has a role as a center for eradicating Tuberculosis and other lung diseases [1]. Based on the Decree of the Minister of Health No.1352 / MENKES / PER / IX / 2005 concerning the Organization and Work Procedure of the Bandung Lung Disease Treatment Unit the function of the Center for Community Lung Health (BKPM) was improved [2].

BBKPM Bandung is one of the government-owned public health facilities in Bandung, West Java. BBKPM Bandung has an integrated system between BBKPM West Java, especially in the City of Garut and Cianjur. By using computer network technology that is interconnected through internet networks found in all areas, one of them is BBKPM Bandung utilizing Webinar services. Webinar or video conference is a face-to-face communication service that allows for seminars, meetings or meetings without face-to-face meetings [3]. This operational digitization supports the acceleration of information exchange and the acceleration of decision making.

Based on interviews with IT staff, it was found that the meeting room network used in operational use using Ipv4 revealed that there was a problem with the high transfer time with received throughput only around 40-50%, delays that tended to be around 300-350 ms and the last load data traffic on the Ipv4 network is increasing, because this Webinar must interact in realtime which requires stability and smooth delivery and data connections in realtime.

Based on a press release of the Ministry of Communication and Information numbered 219 / PIH / KOMINFO / 11/2009 entitled "Ipv6 Workshop: Threat of Scarcity of Ipv4 and Efforts to Realize" Next Generation Internet "through Ipv6 to Provide Access to Information to the General Public" and numbered No.8 / PIH / KOMINFO / 1/2014 concerning "RPM Public Tests on the IPv6 Implementation Roadmap Policy" explains in detail the urgency in preparing for the implementation of Ipv6 and the many advantages of Ipv6. There are several mechanisms for migrating IP protocol protocols from IPv4 to IPv6 and vice versa such as Dual stack, Tunneling, and Teredo [3]. Dual stack method which has the characteristics of bridging communication between IPv4 and IPv6 networks by stacking multiple IP addresses on IPv4 and IPv6 [4] and the Tunneling process which has the characteristics of Ipv4 encapsulation that will be used as Ipv6 as an identity for connected computers [5]. The comparative analysis process uses the QoS (Quality of Services) results using parameters of

transfer time, throughput, packet loss and delay so that the optimal method between dual stack and tunneling results is obtained to produce recommended method choices that are standardized for TIPHON (Telecommunications and Internet Protocol Harmonization) Over Network) [6]. So this research is entitled "Comparative Analysis of the Dual Stack and Tunneling Method in Webinar Services at BBKPM Bandung".

1.1 Formulation of the problem

From the above background, it can be concluded that there are several issues, including:

1. Implement the use of IPv6 address migration protocol in BBKPM starting from the migration method used.
2. The average result of received throughput is around 40-50% and the delay is around 300-350 ms.
3. Determine which method is more optimal for IP protocol migration.

1.2 Research purposes

From the above background, it can be concluded that there are several issues, including:

1. Implement the use of IPv6 address migration protocol in BBKPM starting from the migration method used.
2. The average result of received throughput is around 40-50% and the delay is around 300-350 ms.
3. Determine which method is more optimal for IP protocol migration.

1.4 Limitation Problems

Based on the formulation of the problem, the authors limit the problem in analyzing the suitability of resource requirements for the development and improvement of network infrastructure and IPv4 and IPv6 protocols at BBKPM Bandung, including:

a. The use of IPv4 and IPv6 migration mechanisms uses the dual stack and tunneling methods.
b. Webinar or video conference service for QoS testing from the migration process of the IPv4 to IPv6 protocol.
c. It uses a simulation of migrating the Ipv4 protocol to Ipv6 and vice versa virtually with the VM Ware application.
d. Use of the Windows Server 2008 server operating system.
e. Use of the Star network topology.
f. A central server that is connected directly to the JalaWave ISP which has a bandwidth of 10 Mbps.
g. Network analysis is limited to only one building.
h. Network testing is limited to 1 room.
i. The implementation of Ipv6 technology with the Dual Stack and Tunneling methods is only done at BBKPM Bandung.
j. Use the Wireshark application to monitor network and data traffic.

1.5 Computer Network.

A computer network is a collection of computer network hardware devices that can be connected by the same technology and can exchange information and resources [4]. Connections can use copper wire media, optical fiber, microwaves, infrared light or use satellite communications [4].

To create a computer network, switches and routers use various protocols and algorithms to exchange information and to bring data to the desired endpoint. Each endpoint (sometimes called a host) in the network has a unique identifier, often an IP address or Media Access Control address that is used to indicate the source or destination of transmission [4].

1.6 TCP/IP

TCP and IP is one of the standard protocols designed to carry out data communication in the internet network. TCP / IP consists of a set of protocols responsible for certain tasks in data communication [4]. With this principle the protocol tasks are clear and simple, making it easy to implement all hardware and software on the network and also easy to do the troubleshooting and maintenance process.

Of the various protocols that exist in TCP & IP, the IP protocol is the core of the TCP & IP protocol. All data coming from layers above IP must be passed, processed by the IP protocol and then sent as an IP address packet to the destination. There are currently two versions of the IPv4 protocol (32 bits) and IPv6 (128 bits). Unreliable means that the IP protocol does not guarantee that datagrams sent must arrive at their destination [4]. The IP protocol only does its best to bring the datagram to its destination. Connectionless means that in sending packets to the destination there is no prior agreement (handshake). Datagram delivery service means a data packet that is sent independent of other data packages [4].

1.7 IP Address

Internet Protocol Address or often abbreviated as IP is a series of binary numbers between 32 bits and 128 bits that are used as identification addresses for each host computer in the Internet network. Sending data in a TCP / IP network based on the IP address of the sending and receiving computers. IP address has two parts, namely the network address (network address) and the address of the local computer (host address) in a network.

The network address is used by routers to find the network where a local computer is located, while the local computer address is used to identify a computer on the local network. The length of this number is 32 bits (for IPv4 or IP version 4), and 128 bits (for IPv6 or IP version 6)

1.8 *IPv4*

The addressing model in IPv4 uses a 32-bit base binary number. But to make it easier to write, each 8 bit binary is represented by one segment of octet numbers (base number 8), so that each address will have four segments from 0.0.0.0 to 255.255.255.255 for example 202.152.254.254 so the total address is 232. IPv4 Address divided into several types, namely as follows:

a) Unicast address, is an IPv4 address that is determined for a network interface that is connected to an IP Internetwork. Unicast addresses are used in point-to-point or one-to-one communication.

b) Broadcast Address, is an IPv4 address that is designed to be processed by each IP node in the same network segment. A broadcast address is used in one-to-everyone communication.

c) Multicast Address, is an IPv4 address that is designed to be processed by one or several nodes in the same or different network segments. Multicast addresses are used in one-to-many communication.

1.9 *IPv6*

IPv6 or IPng (Internet Protocol Next Generation) is designed as an improvement and refinement of IPv4. IPv6 is designed to work well on high performance networks, IoT and also efficient for networks that use a small bandwidth such as a wireless connection. IPv6 also provides a platform for new functions on the internet that will be needed in the future [14]. IPv6 is designed as an improvement and refinement of IPv4, and is not an extreme change from IPv4. Just like IPv4, IPv6 also allows the DHCP Server as an automatic address manager.

In IPv6, 128-bit addresses will be divided into 8 16-bit blocks, which can be converted into 4-digit hexadecimal numbers. Each block of hexadecimal numbers will be separated by a colon (:).

The following are examples of IPv6 addresses in the form of binary numbers:

0010000111011010000000001101001100000000000000000101111001110110000001010101010000000001111111111111111000101000100111000101110 10

Then, each block of 16 bits must be converted or converted into hexadecimal numbers and each hexadecimal number is separated by using a colon. The results of the conversion are as follows:

21DA: 00D3: 0000: 2F3B: 02AA: 00FF: FE28: 9C5A

The IPv6 addressing convention also allows for a simpler address simplification, namely by removing a large number of characters 0, on an address with many numbers of 0s. If an IPv6 address used in the colon-hexadecimal format notation contains several 16-bit blocks with the number 0, then the address can be simplified by using a colon (: :).

1.10 IP Protocol Transition Mechanism

Transition mechanism is generally defined as a set of techniques or methods that can be implemented and implemented by IPv6 nodes to be compatible and communicate with IPv4 nodes that already exist. Following are some of the mechanisms developed for the transition from IPv4 to IPv6:

1. Tunneling.
2. Dual Stack.

1.11 Tunneling Method Transition

IPv4 and IPv6 are two different protocols. Therefore, hosts with IPv4 addresses cannot communicate directly with IPv6 hosts. Tunneling method is a method that can be used to overcome these problems. Tunneling is a mechanism for the encapsulation of a network protocol into different delivery protocols, so that in practice, IPv6 packets can be passed on IPv4 networks, and vice versa [3]. This mechanism is generally achieved through Manuals or entry-based parameter tools, existing services such as DNS or DHCP, or by paying attention to the use of embedment information to IP addresses or implementing IPv6 anycast addresses.

1.12 Dual Stack Method Transition

Dual stack is a method of transition from IPv4 to IPv6, in which IPv4 and IPv6 support is provided, so in this method it will send and receive data packets in IPv4 and IPv6 formats, and can run concurrently in a device in all layer protocols without interfere with each other and be influenced by each other [3]. The dual stack method is implemented at the network layer for IPv4 and IPv6. Before transferring packets to the next layer, the network layer will choose the path to be used based on information from the data link layer [5]. Large enterprise networks that decide to transit IPv6 can implement the dual-stack method as a basic strategy, which involves configuring devices to be able to utilize IPv4 and IPv6 at the same time on core routers, perimeter routers, firewalls, servers, and desktop access routers.

1.13 *Quality Of Service*

Quality of Service (QoS) is a description or measurement of the overall performance of a service, such as telephone or computer networks or cloud computing services, especially performance by network users [17]. To measure service quality quantitatively, several related aspects of network services are often considered, such as error rate, bit rate, throughput, transmission delay, availability, jitter. This study will use the parameters of

throughput, packet loss and delay as QoS test parameters for the Tunneling and Dual Stack methods.
The following is an explanation of the QoS test parameters:
1. Throughput
Throughput is the rate (rate) of effective data transfer, which is measured in bps. Throughput calculates the total number of packet arrivals observed at the destination during a certain time interval divided by the duration of the time interval [6]. Throughput calculation equation:

$$Throughput = \frac{\text{Paket data diterima}}{\text{Lama pengamatan}}$$

Gambar 1 Throughput Calculation.

1. Delay
Delay is the time it takes for data to travel the distance from origin to destination. Delay can be affected by distance, physical media, and also long processing time [6].

$$Delay = \frac{\text{Total } delay}{\text{Total paket yang diterima}}$$

Gambar 2 Delay Calculation.

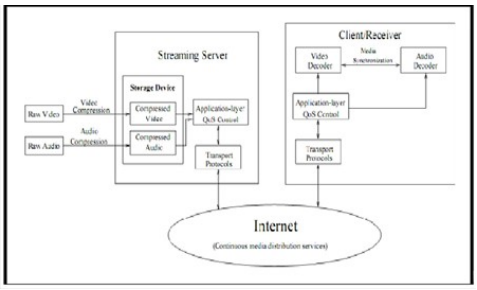
2. Packet Loss
Packet loss is the number of packets lost in the process of sending data packets from one node to another. The calculation is done by reducing the number of packages sent by the number of packages received by the user [5].
Packet loss is a failure in transmitting data packets to achieve its goals [6]. The packet's failure to reach its destination can be caused by several possibilities such as a connection being blocked.

$$Packet\ Loss = (\text{Paket yang hilang} / \text{Paket yang dikirim}) * 100\%$$

Gambar 3 Packet Loss Calculation.

1.14 Webinar

The basic idea of a webinar or video conference is to divide a video packet into several parts, transmit the data packet in realtime, then the receiver can decode and play the video package snippet without having to wait for the whole file to be sent to the host or receiver [5] The video conference has several processes that must be considered, namely, the compression process, Quality of Service (QoS), continuous media distribution services, streaming servers, synchronization mechanisms, and protocols for streaming media.

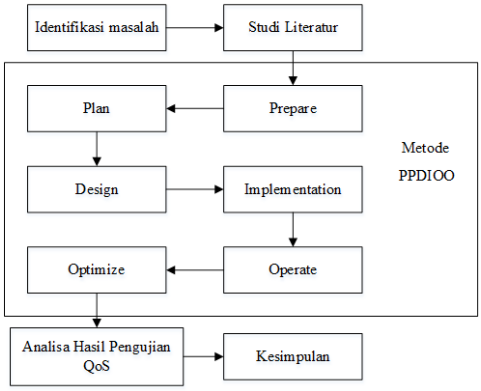


Gambar 4 Systematic Webinar

2. RESEARCH CONTENTS

2.1 Problem analysis

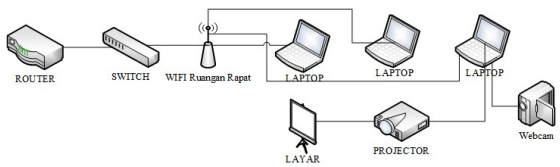
This analysis is an action to find out more about the object to be studied and prepare for the required implementation and comparative analysis. This chapter will describe the process of analysis of preparation, planning and design for the subsequent implementation of the Dual Stack and Tunneling method as a method of migrating IP protocol protocols in BBKPM, Bandung. Before planning is carried out, first an analysis of the ongoing system at BBKPM will be used as the basis for the planning phase to be carried out by designing the implementation of the system to be made. The entire discussion of system analysis will then be used in the process of implementation, operate, and optimize.



Gambar 5 Research Phase

2.2 Analysis of the Prepare Phase

At this stage it will contain an ongoing system analysis, network infrastructure data contained in BBKPM, Bandung City with all network systems that will have an impact on Webinar services and planning data on the analysis and recommendations to be implemented.

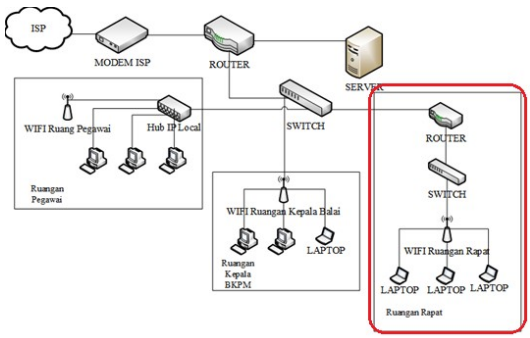


Gambar 6 BBKPM webinar room network scheme

The scope of work of BBKPM Bandung is divided into several sections including:
1. BKPM Garut
2. BKPM Cianjur

2.3 Planning Phase Analysis

System planning is an analysis process that will describe how a system to meet the needs of the analysis phase. The stages carried out in the design of this system discusses the purpose of system design, IP protocol protocol migration design that is applied to the computer network topology in BBKPM Bandung.



Gambar 7 Limitation of Method Implementation.

Based on the topology used in BBKPM in Bandung City using the Star topology, the planning of implementation will focus on configuring the access point in the meeting room of BBKPM in Bandung. The mechanism that is carried out will be in the form of a configuration of the buildup of IP addresses contained in the meeting room access point.

2.4 Design Phase Analysis

In the analysis of the measurement of Quality of service (QoS) webinar services, testing is conducted covering network measurements that are currently running. Measurements were taken to determine the quality of the webinar or video conference service. Furthermore, the system development will be carried out by applying the Dual Stack and Tunneling method in migrating IP addresses which is useful for optimizing the quality of the webinar or video conference service. Then the results will be compared with the current system. This design phase will focus on simulating and designing the implementation of the method that will be used as a guide in the analysis of the implementation and analysis of QoS test results.

Gambar 8 Simulation topology for the implementation of the Tunneling and Dual Stack methods.

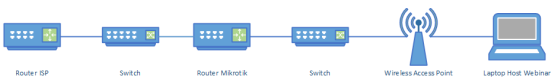
1. **Simulation of Dual Stack Implementation.**

The dual-stack method uses two IPv4 and IPv6 stacked for concurrent operation, which allows devices to run on both concurrent protocols. Configuring IPv4 on the Mikrotik Router. At this stage there are several processes from configuration to testing as follows:

a. Providing the router address.
   Providing the router address is done by requesting an IP address request to the ISP service in order to get internet service access.
b. Making a DHCP configuration
   The results of receiving IP address requests to the ISP will then be automatically addressed through the DHCP router which will be configured in accordance with the conditions in BBKPM Bandung.
c. Selection of the routing protocol path.
   Determination of the routing path in order to see the configuration used is in accordance with previously planned
d. Selection of the test IP address
   Testing is done by double stacking IPv4 and IPv6 IP addresses together.
e. Observation of Implementation
   After holding this implementation, observations are made in the form of QoS test results using parameters throughput, delay and packet loss.
f. Observation of Testing Anomalies
   At this stage, anomalous observations that appear during the test are carried out and pay attention to the test results based on different time and test results. So it can be concluded how the test results and what parameters will be the deciding recommendation of the test results

2. Simulation of Tunneling Method

At this stage IPv4 and IPv6 are two different protocols. Therefore, hosts with IPv4 addresses cannot communicate directly with IPv6 hosts. Tunneling method is a method that can be used to overcome these problems.



Gambar 9 Simulation topology for the implementation of the Tunneling and Dual Stack methods.

At this stage there are several processes from configuration to testing as follows:

a Providing the router address.
Providing the router address is done by requesting an IP address request to the ISP service in order to get internet service access.

b Making the Static IP Tunnel configuration
Furthermore, addressing will be done statically or manually through the Tunnel router interface that will be configured in accordance with the conditions in BBKPM Bandung.

c Selection of the routing protocol path.
Determination of the routing path in order to see the configuration used is in accordance with previously planned

d Selection of the test IP address
The test is carried out by performing the data encapsulation process from IPv4 to IPv6 and vice versa.

e Observation of Implementation
After holding this implementation, observations are made in the form of QoS test results using parameters throughput, delay and packet loss.

f Observation of Testing Anomalies
At this stage, anomalous observations that appear during the test are carried out and pay attention to the test results based on different time and test results. So it can be concluded how the test results and what parameters will be the deciding recommendation of the test results

3. Analysis of Data Priority Settings

At this stage, the device will be configured to have priority data packets that are passed by the webinar service and bandwidth usage will also be regulated which will affect the test results and analysis results of the use of the two methods.

The use of 5 Mbps bandwidth allows services to run smoothly. With consideration of the distribution of bandwidth with BPJS services and SIM Hospital owned by BBKPM Bandung in serving patients who come for treatment and use these services.

2.5 Analysis of Implementation and Testing

After the prepare, plan, and design phases, the implementation, Operate and Optimize phases will then be carried out which will provide an analysis of the implementation of the Dual Stack and Tunneling methods tested based on the Quality of Services test parameters. The aim is to find out the comparison of the results of testing methods that have been implemented and carried out testing to determine the results of the comparison between the Dual Stack and Tunneling methods.

The implementation phase in each of the Dual Stack and Tunneling methods will be focused on the configuration inside the Mikrotik Router in the BBKPM building in Bandung. In this phase, the basic configuration needed to implement the two methods will be carried out.

Implementation of the method will focus on analyzing how to implement and how to work from the method along with the analysis of the method.

Tabel 1 QoS Test Results from the implementation of the Tunneling method and existing conditions.

Pengukuran	*Delay*		*Packet Loss*		*Throughput*	
	Eksisting	*Tunneling*	Eksisting	*Tunneling*	Eksisting	*Tunneling*
1	217 ms	154 ms	5.65 %	2.48 %	2.58 Mbps	3.08 Mbps
2	219 ms	145 ms	5.68 %	2.21 %	2.61 Mbps	3.24 Mbps
3	214 ms	144 ms	5.13 %	2.31 %	2.97 Mbps	3.01 Mbps
4	217 ms	150 ms	5.45 %	1.94 %	2.11 Mbps	2.95 Mbps
5	219 ms	146 ms	5.74 %	2.29 %	2.28 Mbps	3.02 Mbps

Even though this increase did not significantly indicate a high improvement, it could give better results than the conditions before the implementation of the Tunneling method.

The Dual Stack method based on the test results shows an improvement in terms of performance and quality of the Webinar service which improves from the existing conditions before the implementation and testing method.

Tabel 2 QoS Test Results from the implementation of the Dual Stack method and existing conditions.

Pengukuran	*Delay*		*Packet Loss*		*Throughput*	
	Eksisting	*Dual Stack*	Eksisting	*Dual Stack*	Eksisting	*Dual Stack*
1	217 ms	180 ms	5.65 %	2.43 %	2.58 Mbps	2.87 Mbps
2	219 ms	171 ms	5.68 %	2.23 %	2.61 Mbps	3.02 Mbps
3	214 ms	161 ms	5.13 %	2.17 %	2.97 Mbps	2.93 Mbps
4	217 ms	170 ms	5.45 %	1.92 %	2.11 Mbps	3.01 Mbps
5	219 ms	164 ms	5.74 %	2.26 %	2.28 Mbps	3.08 Mbps

Even though this increase did not significantly indicate a high improvement, it could give better results than the conditions before the Dual Stack method was implemented.

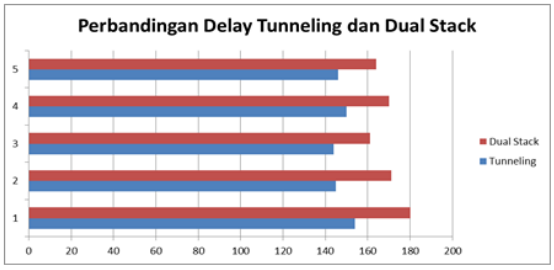
Based on the results of the existing conditions QoS test results before the implementation of the two methods showed poor performance according to the TIPHON standard.

Tabel 3 QoS Test Results from the implementation of the Dual Stack method and the Tunneling method.

Pengukuran	*Delay*		*Packet Loss*		*Throughput*	
	Tunneling	*Dual Stack*	*Tunneling*	*Dual Stack*	*Tunneling*	*Dual Stack*
1	154 ms	180 ms	2.48 %	2.43 %	3.08 Mbps	2.87 Mbps
2	145 ms	171 ms	2.21 %	2.23 %	3.24 Mbps	3.02 Mbps
3	144 ms	161 ms	2.31 %	2.17 %	3.01 Mbps	2.93 Mbps
4	150 ms	170 ms	1.94 %	1.92 %	2.95 Mbps	3.01 Mbps
5	146 ms	164 ms	2.29 %	2.26 %	3.02 Mbps	3.08 Mbps

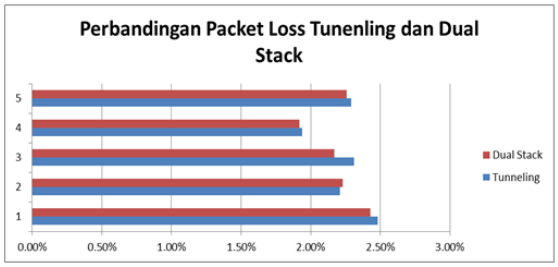
The delay on the Dual stack tends to be still greater when compared to Tunneling, this proves

that Webinar services using 5 Mbps bandwidth and tunneling methods are better.



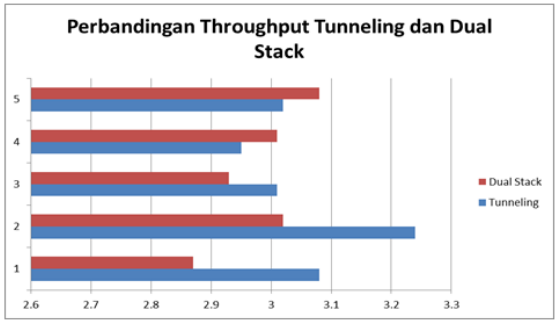
Gambar 10 Comparison Delay Between Method.

In the packet loss comparison both show the results of improvement of existing conditions before implementing the IP address migration method. This shows that the optimize or optimization phase using the Dual stack migration method and Tunneling gives good results based on the TIPHON standardization.



Gambar 11 Comparison Packet Loss Between Method.

There is an anomaly where changes in throughput using dual stack in the first test show very different results from tunneling which is already much better than dual stack. But in the end the throughput generated by the dual stack in the 5th test shows that the test results are better than tunneling.



Gambar 12 Comparison Throughput Between Method.

The results were obtained because the address recognition process took a long time to do by the system to the Dual stack method. After the system can recognize the address, there is a significant increase in the test results using the Dual stack method.

With the results of these tests the results obtained in the form of significant improvements were obtained in the implementation using the Tunneling method. When compared with the Dual Stack method, the quality of QoS produced shows less change than the Tunneling method. The test results will be used in the implementation using the IP address protocol migration method in accordance with the TIPHON standard.

The test results show the Tunneling method is better when compared to the Dual Stack method using 5 Mbps bandwidth that is set according to the allocation given to use the Webinar service through the GoToWebinar application which is carried out in the 4th floor meeting room of the BBKPM building in Bandung.

3. COVERING

In this section, explain the conclusions that contain the results obtained after analysis, design, and implementation of the design that was built and suggestions that will provide important notes and possible improvements that need to be done.

3.1 Conclusions

Based on the results obtained in the writing of this thesis, then conclusions can be drawn as follows:

1. By using the Dual Stack and Tunneling method in the video conference service at the Center for Community Lung Health (BBKPM) Bandung. measurement, the delay value obtained does not exceed 170 ms which is between Very Good and Good. This proves the value of QoS using the Tunneling method is Good according to the Tiphon standard.
2. By using the Dual Stack and Tunneling method in the testing webinar, the delay value obtained is better than the existing value. This proves the value of QoS is categorized Good by Tiphon standards.
3. Applying Dual Stack and Tunneling webinar quality can run well based on the results of tests conducted.

3.2 Suggentions

Based on the conclusions that have been described, it is expected that in the future the suggestions put forward in order to be input in the deficiencies for the next development are as follows:

1. The use of large bandwidth allocations can overcome delay and throughput.
2. In webinar services, delay, jitter, and packet loss must be considered because these factors greatly affect the quality of the webinar service.
3. The use of BPJS services and RS SIM which is often a major problem because of the use of a large enough bandwidth and requires a

fast process of attention because it has a very large effect on other services.

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