PERANCANGAN JARINGAN ETHERNET LINK DENGAN MENGGUNAKAN TEKNOLOGI AUTO FAILOVER DAN LOAD BALANCING DALAM OPTIMALISASI THROUGHPUT

TUGAS AKHIR

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Menyetujui,

(Ir. Emil R. Kaburuan, Ph.D., IPM.)
Dosen Pembimbing

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(Wawan Gunawan, S.Kom, MT)	(Ir. Emil R. Kaburuan, Ph.D., IPM.)
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KATA PENGANTAR

Puji dan syukur penulis panjatkan kehadirat Allah SWT, karena berkat rahmat dan karunia-Nyalah penulis dapat menyelesaikan skripsi yang berjudul "Perancangan Jaringan Ethernet Link Dengan Menggunakan Teknologi *Auto Failover* Dan *Load balancing* Dalam Optimalisasi *Throughput*".

Pada kesempatan yang baik ini, izinkanlah penulis menyampaikan ucapan terima kasih yang sebesar-besarnya kepada semua pihak yang telah memberikan bantuan, dukungan, serta sumbangan pikiran dari berbagai pihak. Oleh karena itu dalam kesempatan ini penulis ingin memberikan ucapan terima kasih kepada :

1. Ir. Emil R. Kaburuan, Ph.D., IPM. selaku Ka. Prodi Teknik Informatika sekaligus Dosen Pembimbing tugas akhir yang telah memberikan pengarahan selama masa perkuliahan dan bimbingan terkait materi laporan tugas akhir kepada penulis.
2. Wawan Gunawan, S.Kom, MT selaku koordinator tugas akhir yang telah memberikan arahan teknis untuk pengumpulan tugas akhir.
3. Orang tua dan rekan - rekan perkuliahan yang telah memberikan dukungan serta doa selama proses penyusunan laporan tugas akhir.

Penulis menyadari bahwa tidak tertutup kemungkinan didalamnya terdapat kekurangan baik bentuk, isi, maupun teknik penyajiannya. Dengan segala kerendahan hati penulis memohon maaf atas segala kekurangan dan keterbatasan. Akhir kata, semoga skripsi ini dapat bermanfaat bagi penulis khususnya dan bagi para pembaca pada umumnya.

Jakarta, 07 Juli 2022

Muhammad Rifqi Nur Hadi

DAFTAR ISI

NASKAH JURNAL

ETHERNET LINK NETWORK DESIGN USING *AUTO FAILOVER* AND *LOAD BALANCING* TECHNOLOGY IN *THROUGHPUT* OPTIMIZATION

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ABSTRACT

The era of information technology is currently developing rapidly, so people need a stable internet connection and able to support data and information exchange activities quickly. To support these needs, the network must be supported with backup links to minimize downtime and also so that *High Availability* networks can be maintained. When there are many requests from network users, network devices will be burdened because they have to do a lot of service processes for requests from these users. this causes the connection to be slow and the connection to be lost if the network device cannot serve all the requests. The solution is to divide the traffic load that comes to network devices. The *Load balancing* method can be used in dividing the traffic load that enters the network through several available network links so that it is not centered on one ISP (Internet Service Provider). The purpose of this study is to increase the *Throughput* value so that traffic can run optimally. So that it can maintain network stability with the *Load balancing* method and reduce the occurrence of downtime due to one ISP (Internet Service Provider) experiencing network problems by applying the *Autofailover* technology method. The results showed an increase in the *Throughput* value after using the *load balancing* method, The measurement of the *Throughput* value based on the TIPHON index has an average value of "4 (excellent)". By maximizing the *Throughput* value, it is expected to increase the upload speed and download speed of an ethernet link network. Furthermore, by applying the *Autofailover* method as a backup link when one connection is problematic or experiencing downtime, the backup link will *Auto*matically run to support all network traffic.

Keywords: *Network , Load balancing, Internet Service Provider, Failover, Throughput*

1. INTRODUCTION

The rapid development of internet technology is currently influenced by the increasing number of human needs and the expansion of human knowledge with digital information technology. So that technology users will always look for up to date information. In 2021, the number of internet users in Indonesia has increased by 11 percent from the previous year, from 175.4 million to 202.6 million users. However, the current increase in the number of internet network users is not supported by a comparable increase in the quality of the internet network. with a fast internet network can help in various businesses and speed up communication. Based on data from the Indonesian Consumers Foundation (YLKI) in 2021, there were 32 percent of complaints about sudden internet connection drops, which resulted in communication being cut off and disrupted several businesses using the internet network. In addition, one of the problems that usually occurs in the community is the problem of bandwidth obtained, because a lot or less bandwidth will affect access for users, be it for browsing, streaming, downloading and uploading. If client get a little bandwidth, the connection will be slow, so users feel dissatisfied with internet usage.

To overcome this problem, we need a network method that can prevent network disconnection and increase the stability of a network when there are many requests from users. Several previous studies have provided an overview of the *load balancing* system which is one way that can be used to share the traffic load from the client on several internet connections, it can be used as a backup/*failover* when one of the internet connections is interrupted. Researchers are interested in implementing and combining these two things into one and making it simpler so that it can be easily applied by network users to overcome the problems mentioned above. One of the shortcomings in previous research [9] is that it only uses one of the two methods that we present, namely the *failover*

method with two Internet service provider (ISP) connections, so that one ISP only works when the main ISP is disconnected and makes it not work. effective. In another study [15], they only applied *load balancing* technology. When all ports are downtimed, the entire domain is inaccessible because there is no *failover* system on their containers.

Load balance is a process and technology that distributes traffic between multiple servers using network-based devices [1]. This device (*load balancing* server) holds or captures traffic destined for an address and then redirects that traffic to many servers. The load balance process is transparent to users who make requests to the load balancer server. The *Failover* method will back up the main connection and change the connection from the main connection to the backup connection will run *Auto*matically so it is very useful if you are experiencing problems with disconnection at the Main ISP (Internet Service Provider) [8].

2. METHOD ANALYSIS AND TOPOLOGY DESIGN

In this paper, the author uses the PPDIOO (Prepare, Plan, Design, Implement, Operate, and Optimize) method. PPDIOO is a network design and development method developed by Cisco. This method consists of several stages of network development including, Prepare (preparation), Plan (Planning), Design, Implementation, Operate (Operation) and Optimize (Optimization).

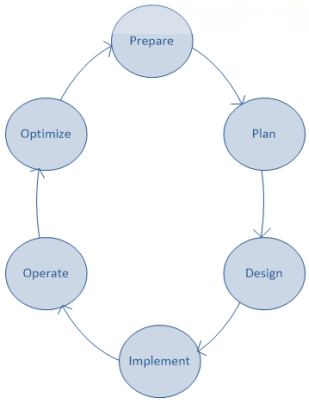

Figure 1: PPDIOO Method

2.1 Preparation

Preparation is stage to determine device requirements, develop network strategies, and propose network architecture concepts. In this stage, the preparation and data collection of the application (software) or hardware that will be used is carried out. The following is a table of some of the devices used in this study.

Table 1: device requirement

No	Device Name	Type	Information
1	Laptop	Hardware	Intel(R) Core(TM) i5-3437U, CPU @ 1.90GHz (with SSE4.2), 4GB Ram
2	Mikrotik Router	Hardware	Type RB941-2^{nD}
3	ZTE F609 router	Hardware	ISP A (CBN)
4	Fiberhome router	Hardware	ISP B (TELKOM)
5	Winbox v6.48.2	Software	Mikrotik RB941-2nD Router Operating System
6	Wireshark v3.6.2-0	Software	Application for *Throughput* Testing
7	Opera Mini	Software	Web Browser Application
8	Windows 10	Software	Laptop Operating System

2.2 Planning

Planning is the stage of network design based on the objectives, facilities, and network requirements. This is useful for describing the characteristics of a network, which aims to assess the network. The following is a research planning flowchart.

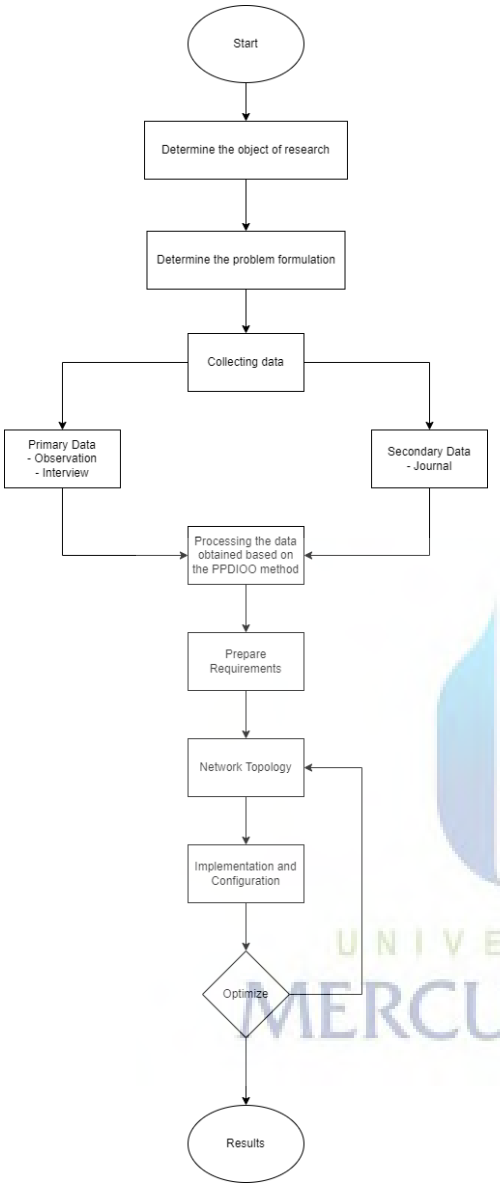

Figure 2: Research Planning Flowchart

2.3 Design

At this design stage is to create a network topology based on the technical requirements and plans that have been made. The design and description of the network architectural topology must be comprehensive and detailed in order to explain the series of network systems that will be implemented. In the picture below is the existing topology used by PT. Fiberstar POP Meruya which is located at Ruko Permata Regency Jl. H. Kelik No.D/32, West Jakarta City, Special Capital Region of Jakarta.

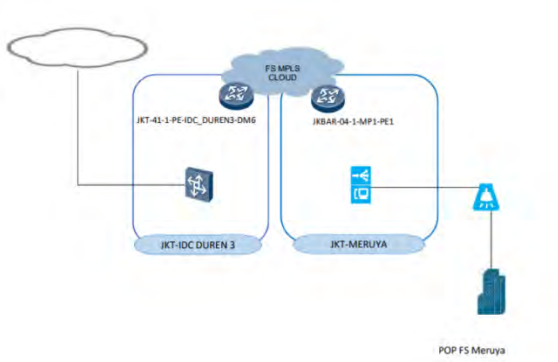

Figure 3: Existing Topology

One of the problems with the existing topology is that it has not been equipped with a *failover* method. So that when the main network connection is experiencing problems such as Fiber Optic Cut, all activities that use internet access will be disrupted. therefore, we made changes to the topology by adding *failover* technology and backup connections.

2.4 Implementation

At this stage, the installation and configuration of the network architecture topology that has been described will be carried out.Implementation at this stage is to describe the implementation in the field, set-up and configuration used from the network design that has been made.

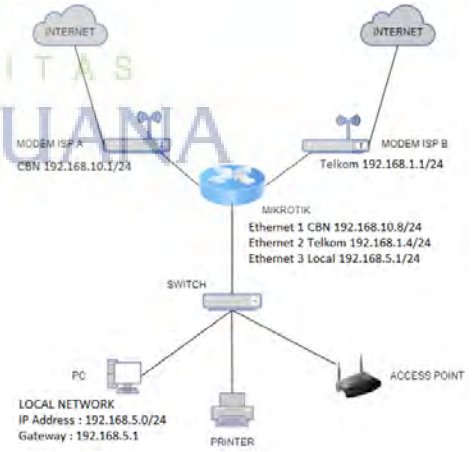

Figure 4: Proposed New Topology

Proposed New Topology at figure 4 can be described as a topology that uses *failover* technology for backup links if one port or cable is problematic or experiencing downtime and *Load balancing* which combines two links into one virtual link so that we will get a greater *Throughput* bandwidth. LinkThe backup that has been configured with *failover* will replace the disconnected link and when the link is back to normal, the connection path that is

used again becomes the main link, so that the connection on the network will always be connected.

2.5 Operation

Perform testing experiments for configurations on *failover* and *load balancing* that have been carried out. Tests are carried out on router devices by looking at the *Throughput* that can be obtained. As well as *failover* testing by turning off one network as a simulation if there is a downtime at one ISP, then the backup ISP will *Auto*matically replace the down ISP link.

2.6 Optimization

At this stage it is possible to modify the network design and configuration if there are many network problems that arise to improve performance, to get maximum results, and maintain network stability.

3. DATASET

In this paper, we use two types of data, primary data and secondary data which serves as a comparison to the previous literature. Premier data is data obtained directly from research subjects using measurement tools or data retrieval tools directly on the subject as a source of information (Azwar, 2007). In this study, researchers made observations on the speed of internet access (download and upload) through the website *https://speedtest.net*. At the time of observation on March 22, 2022, at 07.57 Indonesian Time (GMT +7), it was found that Telkom's ISP internet speed limit decreased. The speedtest results show a download speed of 0.65 Mbps and an upload speed of 0.25 Mbps.

Table 2: Speedtest Observations

Date	Download Speed (Mbps)	Upload Speed (Mbps)	Status
March 16, 2022	10.43	3.52	Normal
March 21, 2022	10.55	3.48	Normal
March 22, 2022	0.65	0.25	Down

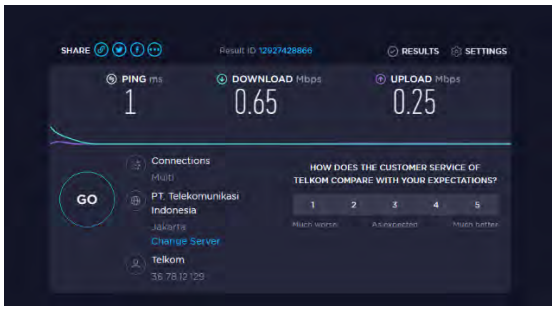

Figure 5: The Speedtest Results

This decrease in internet bandwidth speed occurs due to interference with the fiber optic cable network which causes the received power value at the Optical Network Terminal (ONT) to be -33.01 dBm, lower than the IEEE 802.8 standard that has sbeen set, with a maximum value of -28 dBm. Due to the decrease in bandwidth, so the *Throughput* value obtained by the client becomes small.

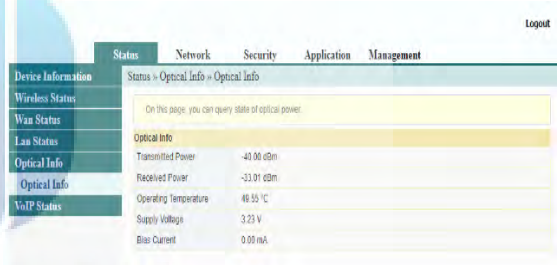

Figure 6: ONT Attenuation Value

Throughput is the effective data transfer rate, measured in bps. *Throughput* is a measure in real time of how fast data is sent on the network. *Throughput* can be calculated by the following equation :

Throughput = Total number of bits / Total observation time (1)

The following are *Throughput* standards according to TIPHON :

Table 3: TIPHON Throughput Standard

Throughput Category	*Throughput*	Index
Bad	0 - 338 kbps	0
Poor	338 – 700 kbps	1
Fair	700 – 1200 kbps	2
Good	1200 kbps – 2.1 Mbps	3
Excellent	> 2.1 Mbps	4

4. SOURCE CODE AND CONFIGURATION

Source code describes the application used for multiple configurations in designing *load balancing* and *failover* methods.

4.1 Winbox

Winbox is a software for configuring a GUI-based Mikrotik Router. Winbox can be used on devices running Windows, Linux, and MACOS (OSX) using Wine. In this study, the source code is used to configure *Load balancing* and *failover* on the Mikrotik RouterRB941-2nD by using the Winbox Application,The source code or configuration used in this study includes the following commands.

a. Ethernet interfaces configuration on the Mikrotik Router via the winbox application. Configuration consists of Ethernet 1 CBN Provider, Ethernet 2 TELKOM Provider, and Ethernet 3 LOCAL CONNECTION.

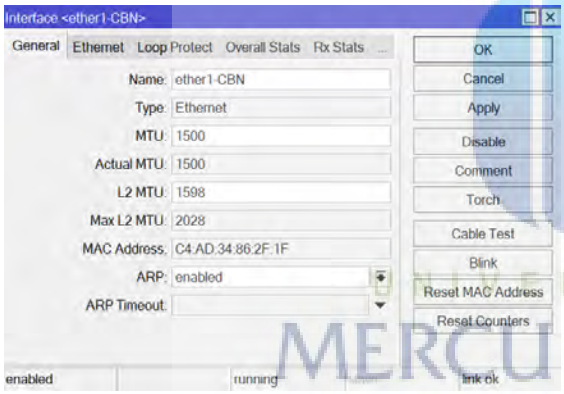

Figure 7: Ethernet 1 Interface Configuration

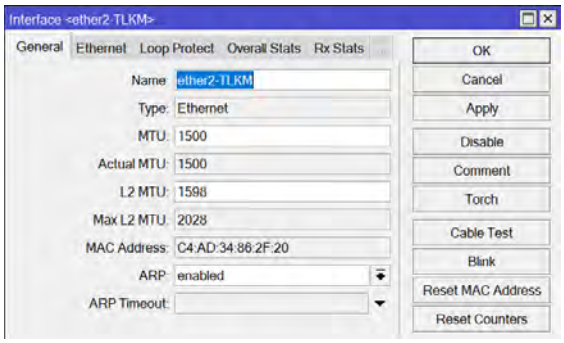

Figure 8: Ethernet 2 Interface Configuration

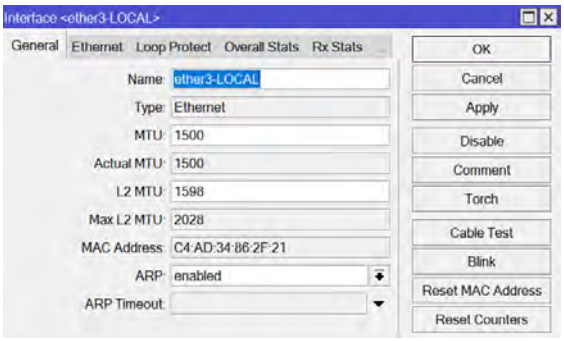

Figure 9: Ethernet 3 Interface Configuration

b. Add IP Address for the three interfaces and IP Gateway on each interface.

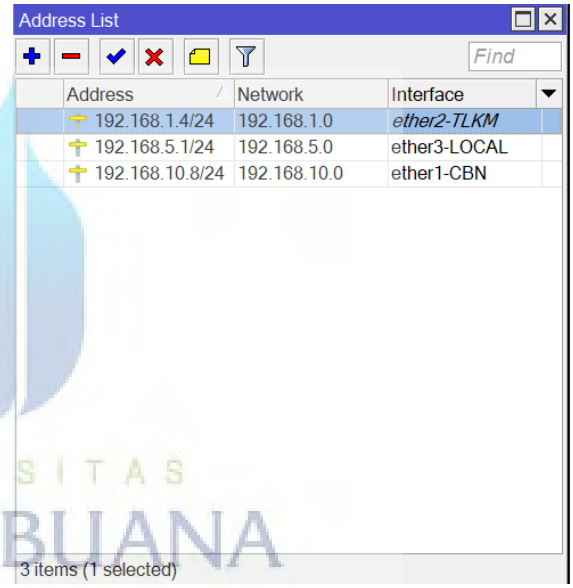

Figure 10: IP Address List

4.2 Load balancing Configuration

After configuring the IP address on the Mikrotik, the next step is to implement *load balancing* on the Mikrotik Router. The use of the *Load balancing* method aims to make the link more optimal by dividing the traffic load on the two connection lines in a balanced way so that it can avoid overload on one link.

a. Configuring Network Address Translation (NAT) Firewall

In configuring *Load balancing*, it is necessary to change the local IP address or private IP address to Public IP, this is because the local IP address or private IP address is not allowed to enter the WAN network or the internet. For that, the "srcnat" configuration is carried out with the "masquerade" action of both ISPs to hide the local IP address or private IP address and replace it with the public IP address installed on the router.

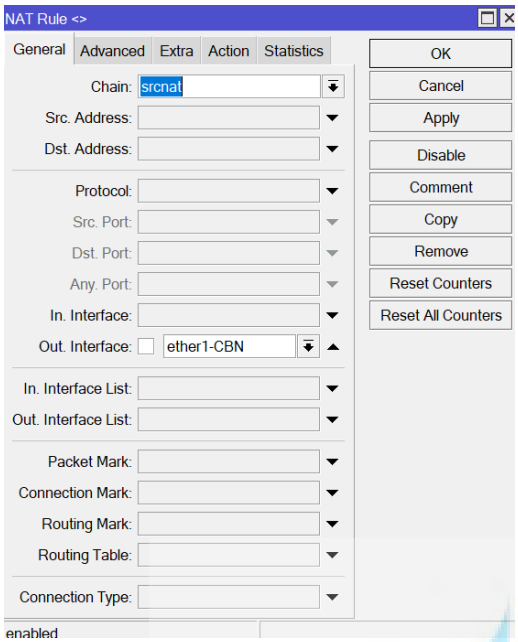

Figure 11: Ethernet 1 Network Address Translation Configuration

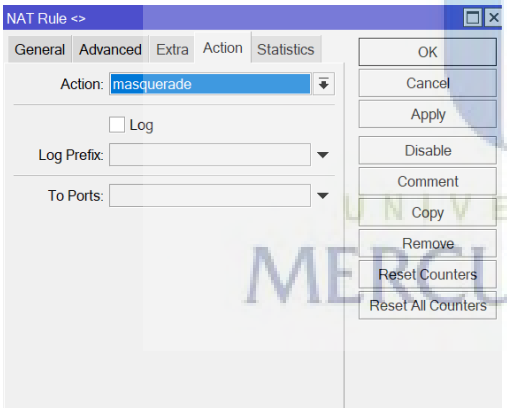

Figure 12: Ethernet 1 Network Address Translation Masquerade Action

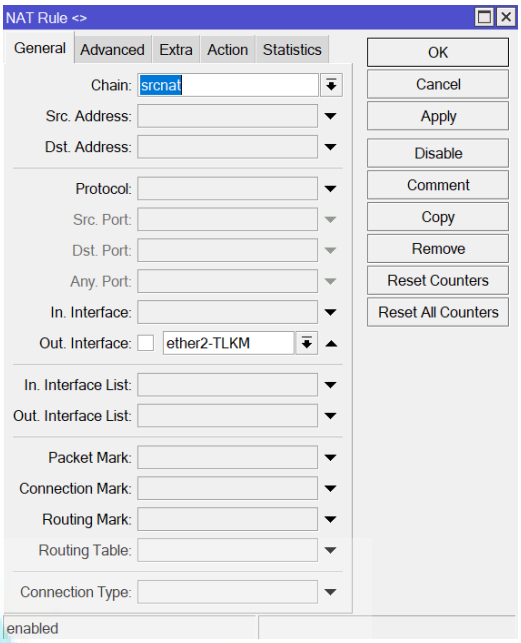

Figure 13: Ethernet 2 Network Address Translation Configuration

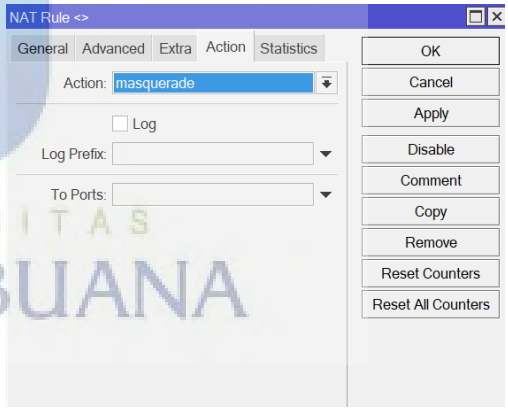

Figure 14: Ethernet 2 Network Address Translation Masquerade Action

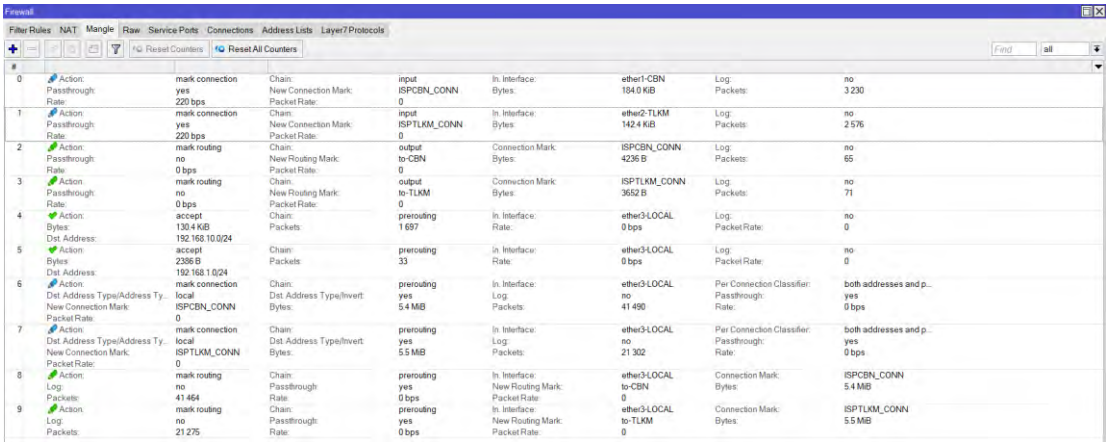

Figure 15: Mangle Settings

b. Mangle Settings

Mangle is a tool that serves to perform the marking function of data packets to be performed bandwidth management or routing. (Mikrotik, 2005). Mangle on Mikrotik Firewall can be used to mark data packets. The marking can be used for other features such as Filter, Routing, NAT, or Queue. In its implementation, the mangle can be used to perform load balance, the router that performs the load balance is usually the main router which is also used to perform bandwidth management.

Load balance is a technique to distribute the traffic load on two or more connection lines in a balanced way so that traffic can run optimally and there is no overload on any of the connection lines. One of the Load balance techniques is PCC (Per Connection Classifier). By using the PCC feature, we can group connection traffic that passes through or enters the router into several groups. The router will remember the gateway path that was passed at the beginning of the connection traffic so that the next packet that is still connected will be passed on the same path as before.

In some previous literature, the PCC load balance is shown to be distributed only on 1 LAN network. In this paper, we will distribute 2 Wan connections into 2 WANs (as shown in Figure 4). Of the several rules below, the first thing to do is to provide an accept action on local traffic so that local traffic is not marked as a connection to the internet network. Then give a signal to traffic from ISP 1 (CBN) then the traffic will be returned back through ISP1 as well as if there is traffic from ISP2 (TELKOM). Next is the PCC load balance method.

And the next Mangle is to mark the traffic so that routing can be done.

Figure 15 shows the mangle configuration is used to mark data packets so that they are easy to manage so that the IP Address configuration and connection paths or links are not confused.

4.3 Failover Configuration

By having multiple gateways for a destination, we can perform a backup path mechanism commonly known as *Failover*. *Failover* is one of the techniques that can be used on Mikrotik, this technique works if one of the links experiences downtime, the backup link will replace it *Automatically* (Towidjojo, 2016). By using the winbox application, *failover* can be done by setting the value on distance.

a. Distance Settings

Distance serves to determine the routing path that will be a priority or be a backup link. By default the distance value on MikroTik is 0 (Zero) - 8 (Eight). So, the smaller the value on the distance, the more prioritized the link will be. To configure *failover*, we must first determine which link will be the priority and become the backup link.

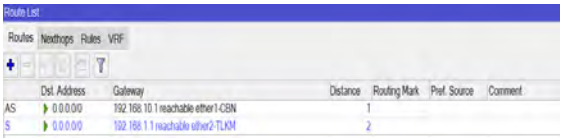

Figure 16: Distance Settings

From the picture above, it can be seen that the CBN ISP has a distance value of "1" because the CBN ISP is the main link used, while the Telkom ISP has a distance value of "2" as a backup link.

b. Check Gateway Parameters

The Check Gateway parameter works is by sending an ARP Request or Test Ping for 10 seconds to the Gateway ISP. This aims to ensure that the ISP is still connected to the internet network , if for 10 seconds the Gateway ISP does not respond it will be considered a "Gateway Time-Out" and if there are 3 gateway time-outs in succession, then the ISP is called "Unreachable".

In Figure 17, the main ethernet 1 connection is being disabled, causing the CBN ISP connected to ethernet 1 to be unreachable. When an Unreachable occurs on this main link, *failover* will *Auto*matically move the connection path to the backup link.

5. EXPERIMENT STAGE OF *FAILOVER* AND *LOAD BALANCING* METHOD FOR OPTIMIZING *THROUGHPUT* VALUE

This stage is a testing process on *Load balancing* and *failover* configurations that are carried out using Winbox and Wireshark applications. In this paper, the authors carried out several experimental stages as follows.

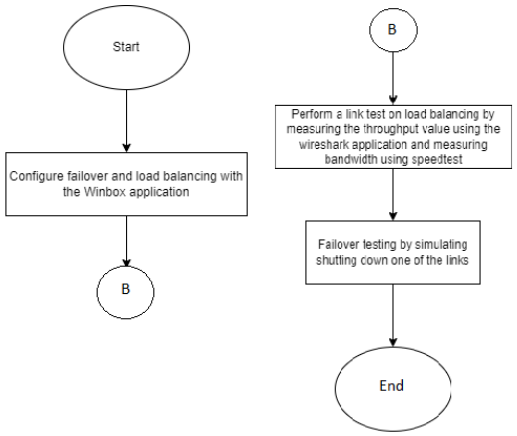

Figure 18: Flowchart of Experimental Stages

Before configuring the Mikrotik with *load balancing* and *failover* methods, the Ethernet 1 interface from the Mikrotik was combined to Ethernet ONT ISP CBN, Ethernet 2 to Ethernet ONT ISP Telkom, and Ethernet 3 to the Local Network.

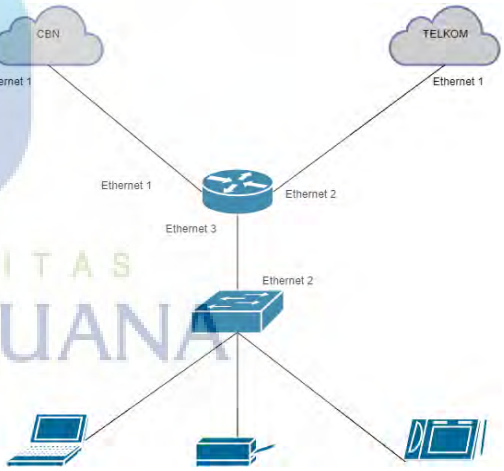

Figure 19: Ethernet Links Configuration

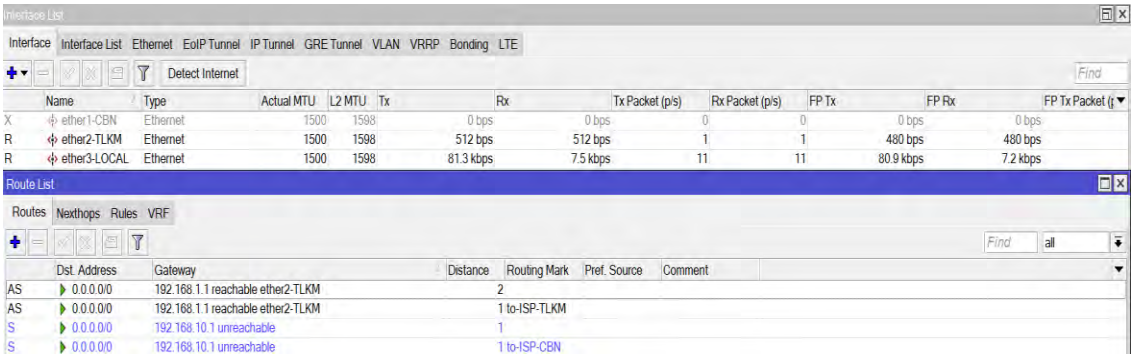

Figure 17: Interface List and Route List

Load balancing configuration by adding IP addresses, DNS settings, NAT firewall settings with actions masquerade ,and Mangle configuration. In making these settings, carefulness is needed so as not to make the wrong configuration. Next, *Failover* configuration is performed using the distance and check gateway parameters. The distance parameter is used to select the main link connection path and the backup link connection path. While the check gateway parameter is used to ensure the main link connection is in good condition or not. If the link is down then the link will be unreachable.

a. *Load balancing* Test

After configuring *load balancing* and *failover*, the next step is to test the link *load balancing* using the Wireshark application to monitor the *Throughput* value of the link. Testing is carried out with the following conditions:

1. The first attempt is to download a file of 124 mb.
2. The second experiment was conducted by testing the bandwidth speed through the speedtest.net page.
3. The third attempt is to stream 4K resolution video.

b. *Failover* Test

In the *Failover* test, it is carried out using a scenario of shutting down one of the ISPs. To ensure that this method is successful, use the traceroute command to see which connection path is being used when one of the ISPs is experiencing downtime.

6. RESULT OF ALL EXPERIMENTS

6.1 Load balancing Test Results

The results obtained from each test of the *load balancing* method are as follows :

a. First Test Result

In the first test, the activity of downloading a file of 124 mb was carried out using the CBN ISP and Telkom ISP which had not done *load balancing*. Figure 20 shows CBN ISP has a *Throughput* value of 9.95 Mbps while Telkom's ISP has a *Throughput* value of 9.58 Mbps (Figure 21).

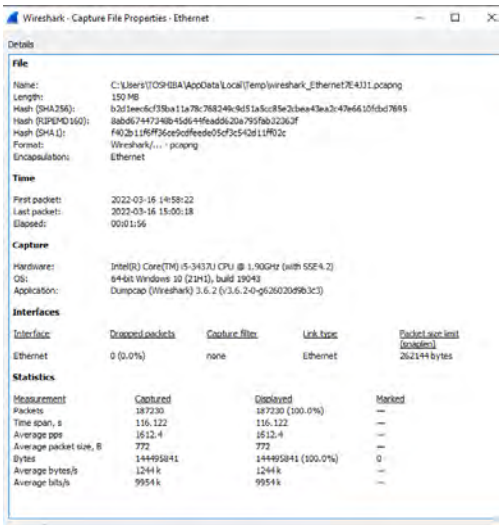

Figure 20: First Test Results CBN Throughput

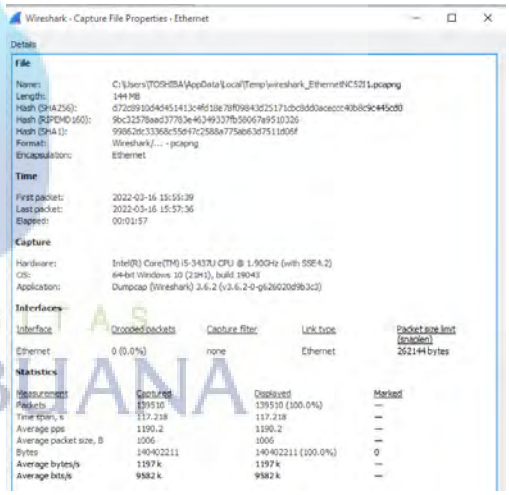

Figure 21: First Test Results TELKOM Throughput

Then, after merging the links from the two ISPs using the *load balancing* method, in figure 22 we got an increase in the total *Throughput* value to 10 Mbps.

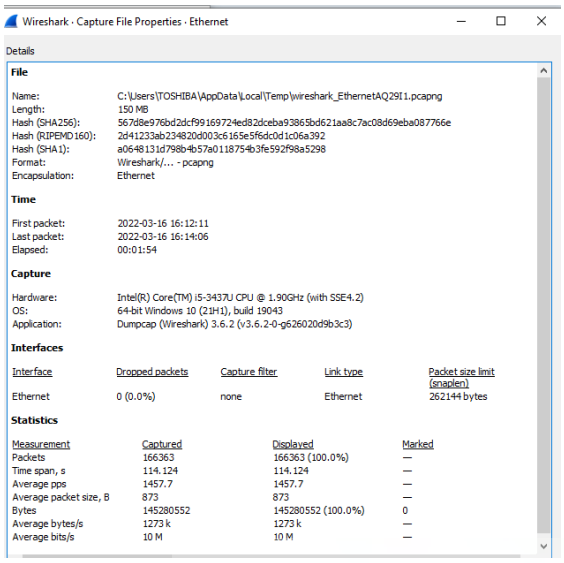

Figure 22: First Test Results Load balancing Throughput

b. Second Test Result

The second test was carried out by testing the bandwidth speed through the Ookla Speedtest https://www.speedtest.net page. The test results can be seen in Table 4.

Based on data from Table 4, the bandwidth speed that uses the *load balancing* method is higher than the speed of the ISP that does not use the *load balancing* method.

c. Third Test Result

The third test is to stream 4K resolution video for 4 minutes. The CBN ISP has a *Throughput* value of 1.1 Mbps (Figure 23) while the Telkom ISP has a *Throughput* value of only 723 Kbps (Figure 24). However, when the two ISPs are combined with the *load balancing* method, the *Throughput* value increases significantly by 5.42 Mbps (Figure 25).

From the *load balancing* test results that have been carried out, the *load balancing* method is proven to increase the *Throughput* value and bandwidth access speed. All the test results of the *load balancing* method can be seen in Table 5.

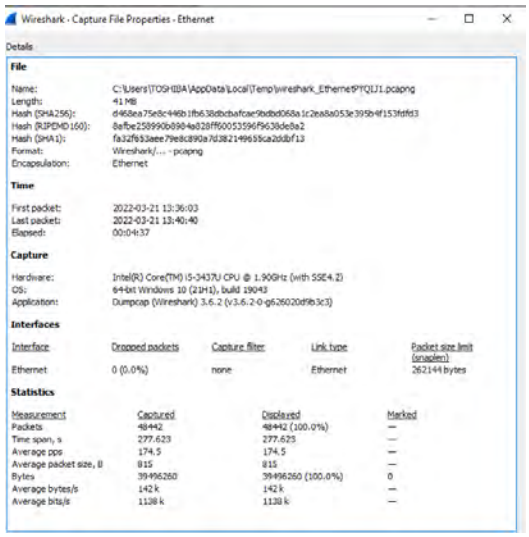

Figure 23: Third Test Results CBN Throughput

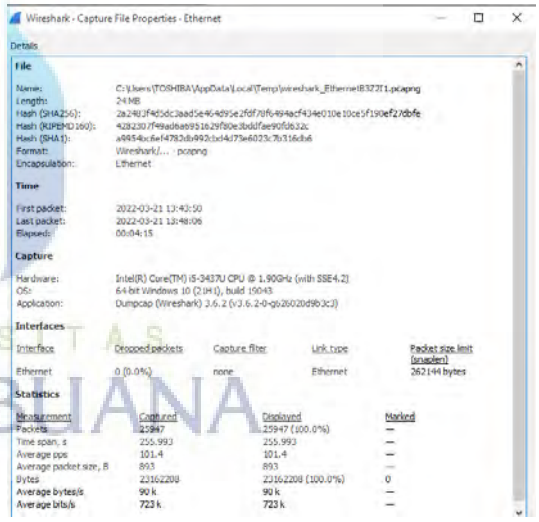

Figure 24: Third Test Results TELKOM Throughput

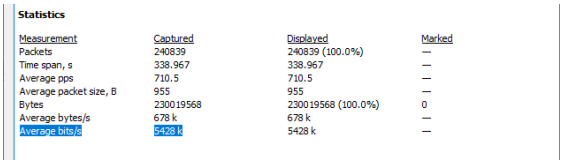

Figure 25: Third Test Results Load balancing Throughput

Table 4: Second Result Test

ISP/Method	*Ping* (ms)	Download Speed (Mbps)	Upload Speed (Mbps)	*Throughput* (Mbps)
CBN ISP	3	9.85	9.55	7.63
TELKOM ISP	1	10.57	3.12	5.51
LOAD BALANCING	17	19.92	12.33	13

Table 5:All of Load balancing Test Result

No	Test Type	ISP/Method	*Throughput* (Mbps)	*Throughput* Category	Index *Throughput*
1	Download	CBN	9.95	Excellent	4
		TELKOM	9.58	Excellent	4
		Load balancing	10	Excellent	4
2	Speedtest	CBN	7.63	Excellent	4
		TELKOM	5.51	Excellent	4
		Load balancing	13	Excellent	4
3	Streaming	CBN	1.1	Fair	2
		TELKOM	0.72	Fair	2
		Load balancing	5.42	Excellent	4

From all *load balancing* experiments that have been carried out, (data can be seen from Table 5) The *load balancing* method has increased the value of *Throughput*. This is in accordance with the statement that the use of *load balancing* can take advantage of the existing bandwidth and increase *Throughput*, compared to not using the *load balancing* method [1]. With *Load balancing* technology, benefits can be obtained such as guaranteeing service reliability, availability and scalability of a network [4] so that benefits can be obtained such as ensuring a stable internet. This experiment also proves that an ethernet network that applies the *load balancing* method will balance the traffic load on the two connection lines, so that traffic can run optimally [10]. This happens because *load balancing* will divide the load based on the source, destination address and port address. All internet requests from users will go to the Router that has been configured with the PCC method, so that the Router will manage outgoing requests from users via ISP line 1 or ISP line 2 to be able to enter the internet connection.

6.2 Failover Test Results

In the *failover* test, it is done by trying a scenario to disable the main link on ethernet 1 as shown in the figure 26.

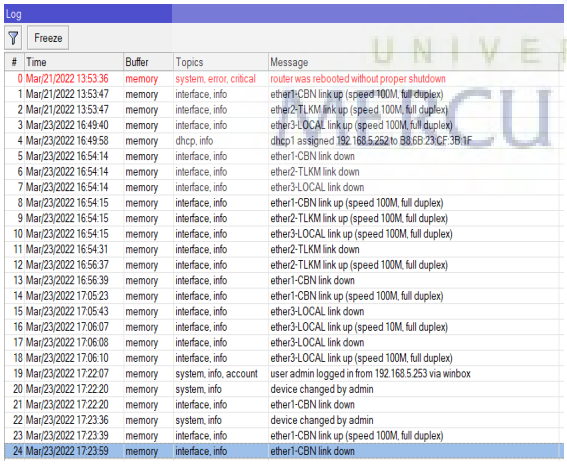

Figure 26: Ethernet 1 CBN Down

Since the CBN ether-1 link (IP Gateway: 192.168.10.1) is experiencing downtime, the status on the route list will change to "unreachable" as shown in the figure 27.

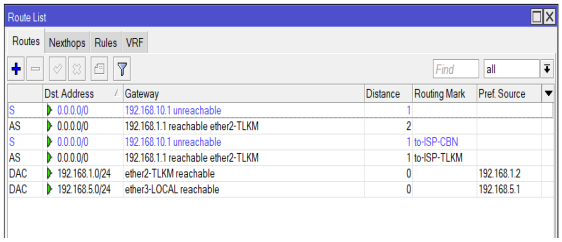

Figure 27: Route List Status

That is, the system check gateway parameters work well. Then do a traceroute to make sure the uplink comes from the backup link. From the traceroute results, the *failover* method worked well. This is because the route that the packet takes to reach the destination of Google DNS 8.8.8.8 is from a backup link, namely ISP Telkom with IP Address 192.168.1.1.

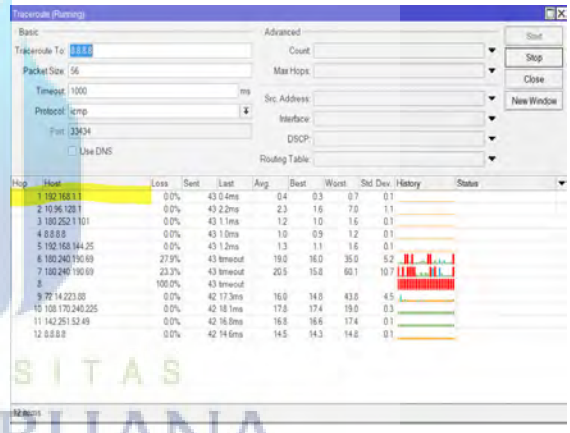

Figure 28: Traceroute Result

The results of the *Auto failover* test show that the prevention system if the network is disconnected has been successful. *Failover* as a form of method where this function is very useful if you are experiencing problems with disconnected connections at the Main Internet Service Provider [8]. This method is very effective because this method will *Auto*matically change the main network connection to the backup network if the main network is disconnected or is in trouble. When the Primary ISP returns to normal, the Primary ISP immediately replaces its role. Figure 28 shows the final network test. Testing if the Primary ISP is experiencing interference, it can be seen that the backup ISP with IP 192.168.1.1 immediately provides its role as a backup ISP. And from the connection test, it looks like it only takes a moment to change the ISP.

7. CONCLUSION

This study focuses on the implementation of *load balancing* in optimizing the results of existing *Throughput* values in an ethernet link network and the use of *failover* as a network backup method when a disturbance occurs. Content that has a tendency to design topological structures by combining *load balancing* and *failover* methods in an ethernet link network design. The design is used as a form of completeness to make the network *High Availability*. *High Availability* is a network concept that can minimize failure or downtime and aims to ensure the level of operational performance of the network so that it can serve users well.

Based on the research results, it can be concluded that the network topology that uses *failover* and *load balancing* methods is a network that can guarantee *High Availability*. This is because the use of the *failover* method can help the network to prevent network failures caused by long downtime. as well as *load balancing* methods that can make the network architecture faster to distribute traffic on the network. So as to make network traffic can run optimally and can avoid overload on one connection line. When the two methods are combined, the possibility of network failure will be very small.

The *load balancing* method is also very good in increasing the *Throughput* value. This is based on all the tests that have been carried out, the *Throughput* value has increased. The *Throughput* value affects the data transfer speed, the higher the *Throughput* value, the faster the data will be sent or received. This method is also proven to increase bandwidth by combining two different connections. Basically, the bandwidth of each ISP does not increase, but with *load balancing* that uses a multi-connection system, the network gets higher bandwidth than before. The *load balancing* method is very effective in video streaming activities, based on testing this method increases the *Throughput* value to 5.42 Mbps from previously only 1.1 Mbps (CBN ISP) and 0.72 Mbps (TELKOM ISP).

The use of *failover* in the network topology is also very important to overcome and prevent offline occurrence on a network. With the increasing number of internet users, the quality of service must also be improved. one way is to reduce downtime on a network. *failover* can serve as a backup if one of the links is interrupted, so that there is no internet access failure.

Based on this research, the combination of both *load balancing* and *Autofailover* methods has succeeded in optimizing so that there is an increase in the *Throughput* value, meaning that it has succeeded in achieving its goal of providing significant changes in network speed and stability. So users don't have to worry about data transfer speed and downtime issues.

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KERTAS KERJA

Ringkasan

Kertas kerja ini merupakan material kelengkapan artikel jurnal dengan judul Perancangan Jaringan Ethernet Link Dengan Menggunakan Teknologi *Auto Failover* Dan *Load balancing* Dalam Optimalisasi *Throughput* yang berisi semua material hasil penelitan Tugas Akhir yang tidak dimuat atau disertakan di artikel jurnal. Dalam kertas kerja ini akan dijelaskan mengenai literature review, dataset yang digunakan, serta langkah-langkah perancangan, tahapan implementasi dan hasil pengujian penelitian.

Latar Belakang

Era teknologi informasi pada saat ini sedang berkembang dengan pesat, sehingga masyarakat membutuhkan koneksi internet yang stabil dan mampu mendukung kegiatan pertukaran data serta informasi secara cepat. Untuk mendukung kebutuhan tersebut, jaringan harus didukung dengan *backup link* untuk meminimalisir terjadinya *downtime* dan juga agar jaringan *High Availability* dapat terjaga dan terpelihara.

Perkembangan teknologi internet yang pesat saat ini dipengaruhi oleh semakin banyaknya kebutuhan manusia atau pengguna teknologi akan informasi yang selalu *up to date* dan membutuhkan komunikasi yang lancar. Pada tahun 2021, jumlah pengguna internet di Indonesia meningkat 11 persen dari tahun sebelumnya, yaitu dari 175,4 juta menjadi 202,6 juta pengguna. Namun, peningkatan jumlah pengguna jaringan internet saat ini tidak didukung oleh peningkatan mutu jaringan internet yang sebanding, dengan adanya jaringan internet cepat dapat membantu dalam berbagai bisnis dan mempercepat dalam berkomunikasi. Berdasarkan data Yayasan Lembaga Konsumen Indonesia (YLKI) di tahun 2021, terdapat 32 persen aduan mengenai terjadinya putus koneksi internet secara tiba – tiba, yang mengakibatkan komunikasi menjadi terputus dan membuat beberapa bisnis yang menggunakan jaringan internet menjadi terganggu. Selain itu, salah satu permasalahan yang biasanya kerap terjadi di masyarakat adalah masalah bandwidth yang diperoleh, karena banyak atau sedikitnya *bandwidth* akan mempengaruhi

akses bagi pengguna, baik itu untuk *browsing*, *streaming, download* dan *upload*. Jika mendapatkan bandwidth sedikit maka koneksi akan menjadi lambat, sehingga pengguna merasa tidak puas dalam penggunaan internet.

Untuk mengatasi masalah tersebut, dapat digunakan metode *Load balancing* dalam membagi beban trafik yang masuk ke dalam jaringan melalui beberapa link network yang tersedia sehingga tidak terpusat pada satu ISP *(Internet Service Provider)* dan juga metode *Autofailover* sebagai *backup link* ketika salah satu koneksi bermasalah atau mengalami *downtime,* maka *link backup* akan otomatis berjalan untuk menopang semua traffic jaringan.

load balance merupakan sebuah proses dan teknologi yang menyalurkan lalu lintas (*traffic*) diantara beberapa server menggunakan perangkat berbasis jaringan. (Tony Bourke, 2001). Perangkat ini (*load balancing server*) menahan atau menangkap traffic yang bertujuan kepada sebuah alamat kemudian me-*redirect traffic* tersebut kepada banyak *server*. Proses *load balance* ini bersifat transparan terhadap pengguna yang melakukan request ke server *load balancer*.

Metode *Failover* akan mem-*backup* koneksi utama dan melakukan pergantian koneksi dari koneksi utama ke koneksi cadangan akan berjalan secara otomatis sehingga sangat bermanfaat apabila sedang mengalami kendala terputus koneksi pada ISP (*Internet Service Provider*) Utama. (Mohammad Badrul & Akmaludin, 2019).